"Emission & Regeneration" Unified Field Theory

Definition of a space with fundamental particles with longitudinal and transversal angular momenta, and deduction of the linear momenta which generate electrostatic, magnetic, induction and gravitational forces.

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$$\bar{J}^{(s)}_{n_2} = \ \mathrm{sign}(\bar{J}_{e_1}) \ \mathrm{sign}(\bar{J}_{e_2}) \ (\sqrt{J_{e_1}} \ \bar{e}_1 \ \times \ \sqrt{J_{s_2}} \ \bar{s}_2)$$

$$\bar{J}^{(n)}_{n_2} = \ \mathrm{sign}(\bar{J}_{e_1}) \ \mathrm{sign}(\bar{J}_{e_2}) \ (\sqrt{J_{n_1}} \ \bar{n}_1 \ \times \ \sqrt{J_{n_2}} \ \bar{n}_2)$$

$$dE = \frac{m \ c^2}{\sqrt{1 - \frac{v^2}{c^2}}} \ \frac{2 \ c}{\pi \ v} \left| \ \frac{\bar{v}_s}{|\bar{v}_e|} \ \times \ \frac{\bar{v}_r}{|\bar{v}_r|} \ \right| \ W \ \sin\varphi \ d\varphi$$

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Preface

The Standard Model has passed many steps in the evolution to the presently accepted version. The main difference between steps consists in the description of the mechanism about what happens in the space between attracting or repelling subatomic particles. The first primitive description postulated the existence of a substance named ether responsible for the transmission of forces between particles. Then an empty space was postulated and special carrier particles for each type of force were introduced (photons, gluons, W and Z bosons, gravitons) as a **substitute** for the ether.

The proposed approach models subatomic particles such as electrons and positrons as **focal points** in space where continuously fundamental particles are emitted and absorbed. The energy of electrons and positrons is distributed on their fundamental particles and stored as rotations at them, defining longitudinal and transversal angular momenta (fields). Interaction laws between angular momenta of fundamental particles are postulated in that way, that the basic laws of physics (Coulomb, Ampere, Lorentz, Maxwell, Gravitation, etc.) can be mathematically derived. This methodology makes sure, that the approach is in accordance with the basic laws of physics, in other words, with well proven experimental data. Due to the description of a particle extending dynamically over the whole space, the present approach is not forced to introduce an artificial substance (aether) or **substitute** objects (bosons).

All forces are mathematically derived from one vector field generated by the longitudinal and transversal angular momenta of fundamental particles, and not introduced through individual fittings as it is done by our Standard Theory.

Contents

Abbreviations and special nomenclature introduced.

FP	Fundamental particle.
SP	Subatomic particle.
BSP	Basic subatomic particle (electron, positron and constituent of photon).
CSP	Complex subatomic particle (proton, neutron, nuclei of atoms and photon).
LRM	Longitudinal rotational (angular) momentum.
TRM	Transversal rotational (angular) momentum.
$\bar{J}_e$	Longitudinal rotational (angular) momentum (LRM) of emitted fundamental particle.
$\bar{J}_s$	Longitudinal rotational (angular) momentum (LRM) of regenerating fundamental particle.
$\bar{J}_n$	Transversal rotational (angular) momentum (TRM) of regenerating fundamental particle.
$\bar{J}_n^{(s)}$	Transversal angular momentum generated by the **longitudinal** angular momentum of two meeting regenerating fundamental particles.
$\bar{J}^{(n)}$	Angular momentum generated by the **transversal** angular momentum of two meeting regenerating fundamental particles.
$\bar{v}_l$	Low velocity of fundamental particle $\bar{v}_l \approx c$.
$\bar{v}_h$	High velocity of fundamental particle $\bar{v}_h \approx \infty$.
$\bar{v}_e$	Emission velocity of fundamental particle.
$\bar{v}_r$	Velocity of regenerating fundamental particle.
$\bar{v}$	Velocity of basic subatomic particle (BSP).
φ	Emission angle of fundamental particle.
ψ	Regenerating angle of fundamental particle.
α	Angle between emitted and regenerating fundamental particles.
β	Angle between regenerating fundamental particles.
dE_s	Energy stored in the **longitudinal** rotational momentum of regenerating fundamental particle.
dE_n	Energy stored in the **transversal** rotational momentum of regenerating fundamental particle.
E	Relativistic energy of a basic subatomic particle (BSP).
H	Square root of the relativistic energy of a basic subatomic particle.
$d\kappa$	Space distribution function of the relativistic energy E of a BSP and of its square root H.

Part I Postulates and definitions

A space with Fundamental Particles with angular momenta is postulated and their interactions defined in such a way, that linear momenta on Subatomic Paticles are generated.

1 Methodology.

As a mathematical theory, physics should have a pyramidal shape, where few postulates at the top allow the deduction of all known laws from top to bottom. Each law in the theoretical building, expressed as an equation, is deduced from equations that are placed at a higher level. The deduction of laws from equations that are placed at the same level or below is not allowed.

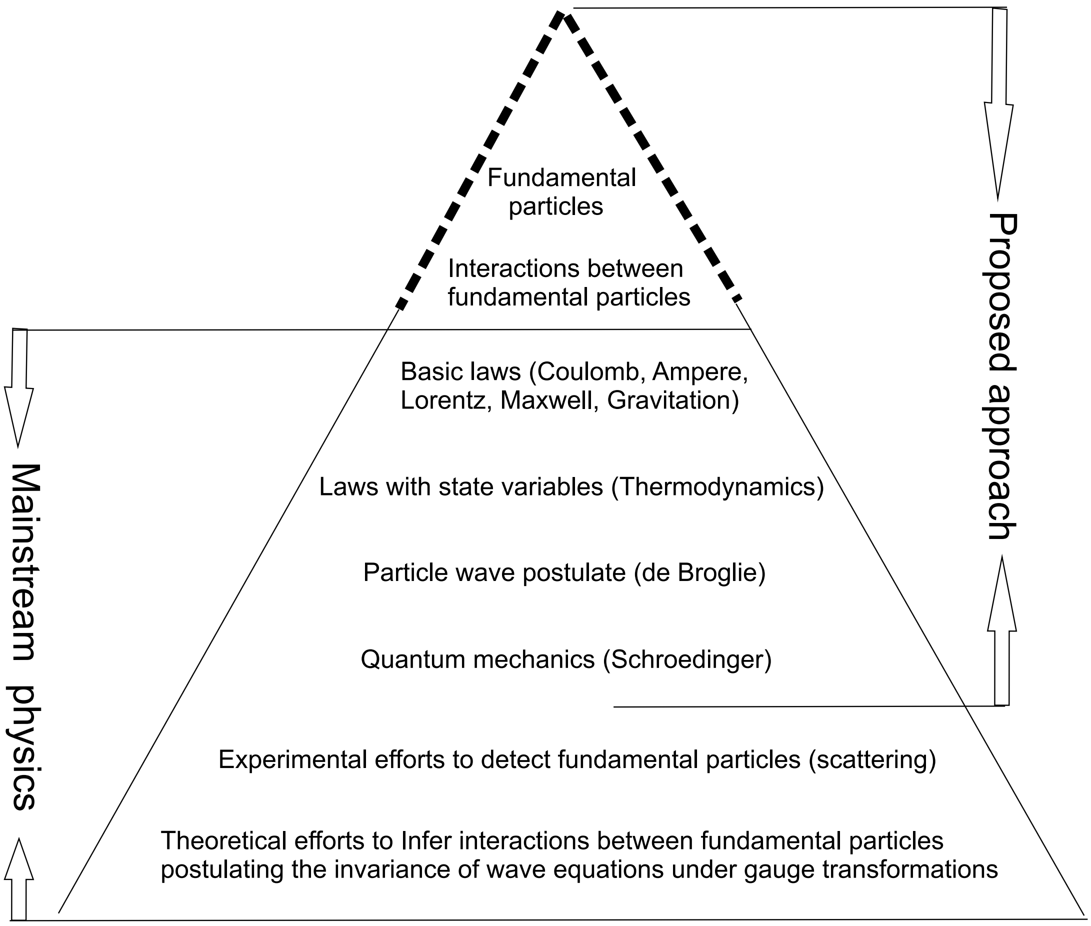


Figure 1: Methodology

Figure 1 shows a schematic comparison between the methodology used in mainstream physics and the proposed approach. The standard theory starts formulating mathematically the basic laws for individual particles, namely, Coulomb, Ampere, Lorentz, Maxwell and Gravitation. At a second level thermodynamic laws are introduced to describe assemblies of particles with state variables. Then the particle's wave is postulated (de Broglie) to explain the analogy between diffraction patterns obtained with electromagnetic rays and rays of particles. The particle's wave allows the definition of differential equations of the wave function to describe mathematically the quantized behavior of particles in nature (Schroedinger). Up to this point of the theory, no explanation is given about the origin of the forces and momenta obtained by measurements between particles. Efforts made to find explanations are:

- of experimental nature, scattering particles in particle accelerators and
- of theoretical nature, trying to infer interactions between fundamental particles postulating the invariance of wave equations under gauge transformations.

The present approach intends to explain what happens in the space between two charged particles or two masses that generates the forces we measure at the particles. The methodology followed starts postulating fundamental particles (FPs) based on the idea, that the energy of a subatomic particle like the electron is not concentrated at a point but distributed in space and, that the energy is stored in fundamental particles that are emitted continuously from a focal point in space and to which regenerating fundamental particles continuously return. FPs store the energy as rotations which are independent of coordinate systems and which define longitudinal and transversal angular momenta. In a second step the interactions between FPs are postulated as interactions between their angular momenta, which mathematically is expressed as scalar and vector products. Finally, the interaction laws between FPs are determined in a recursive process so that the fundamental laws of physics, namely, Coulomb, Ampere, Lorentz, Maxwell and Gravitation can be derived. The methodology makes sure, that the approach is in accordance with experimental data.

2 General theoretical part.

The present theory is based on the following postulates and physical laws:

- Postulates that define a space through the definition of fundamental particles and its characteristics.
- Postulates that define the interactions of fundamental particles.
- Relativistic energy of a moving particle

$$E = \frac{m\,c^2}{\sqrt{1 - \frac{v^2}{c^2}}} \tag{1}$$

- Inertial force

$$F = \frac{dp}{dt} \qquad with \qquad p = \frac{m\,v}{\sqrt{1 - \frac{v^2}{c^2}}} \tag{2}$$

In this section, fundamental particles (FPs) with longitudinal and transversal angular momenta are postulated, filling the whole space.

Basic subatomic particles (BSPs) are defined (electron, positron and neutrino as a constituent of the photon) and laws are postulated that describe the generation of angular momenta when fundamental particles cross.

With the idea, that basic subatomic particles emit and are continuously regenerated by fundamental particles, an equation for the distribution in space of the energy of a BSP is introduced.

The regenerating fundamental particles and the requirements their angular momenta must comply to generate linear momenta are defined.

The energy of a BSP that moves with constant velocity is distributed at the longitudinal and transversal angular momenta of its regenerating fundamental particles.

The vector $d\bar{H}$ is defined.

The probability equation for the crossing in space of emitted and regenerating fundamental particles is defined, and the balance of energy and angular momenta is shown.

The transition of BSPs with $v < c$ to BSPs with light speed is deduced and the photon is introduced as a complex subatomic particle (CSP).

The different forms of polarizations for BSPs are defined.

2.1 Postulates that define a space with fundamental particles (FPs) with longitudinal and transversal rotational momenta.

- **Postulate 1**: A space exists with two types of fundamental particles (FPs) that have strongly differing velocities designated by v_h (high) and v_l (low). The FPs have longitudinal rotational momenta (LRMs) and move in a straight line relative to a given system of coordinates. A right rotation of the LRM in the moving direction of the FP is defined as positive LRM and designated by $\bar{J}_s^+$. A left rotation of the LRM in the moving direction of the FP is defined as negative LRM and designated by $\bar{J}_s^-$.

  Normal (orthogonal) to its moving direction the FP can have transversal rotational momenta (TRM) designated by $\bar{J}_n$. In a neutral space the TRM of the FPs are not oriented in a special direction and their vector sum over time or space neutralize.

- **Postulate 2**: Through each point in the space the two types of FPs flow continuously in and from all directions. When two FPs cross in space, their directions and velocities don't change.

- **Postulate 3**: In the same space there are focal points where the FPs change their velocities and the rotations of their LRM. These focal points are the points where our standard theory assumes that the basic subatomic particles (BSPs), namely the electrons and positrons are located.

  The concept is shown in Fig. 2.

  Fig. 2 shows the emitted FPs with their longitudinal angular momenta $\bar{J}_e$ and the regenerating FPs with their longitudinal and transversal angular momenta $\bar{J}_s$ and $\bar{J}_n$ respectively. The configuration has an axial symmetry around the speed vector $\bar{v}$.

  The transversal angular momenta follow the right screw law in the direction of the speed $\bar{v}$, independent of the charge of the BSP. Our standard theory defines the magnetic field $\bar{H}$ in the right screw direction for positively charged particles and in the left screw direction for negatively charged particles.

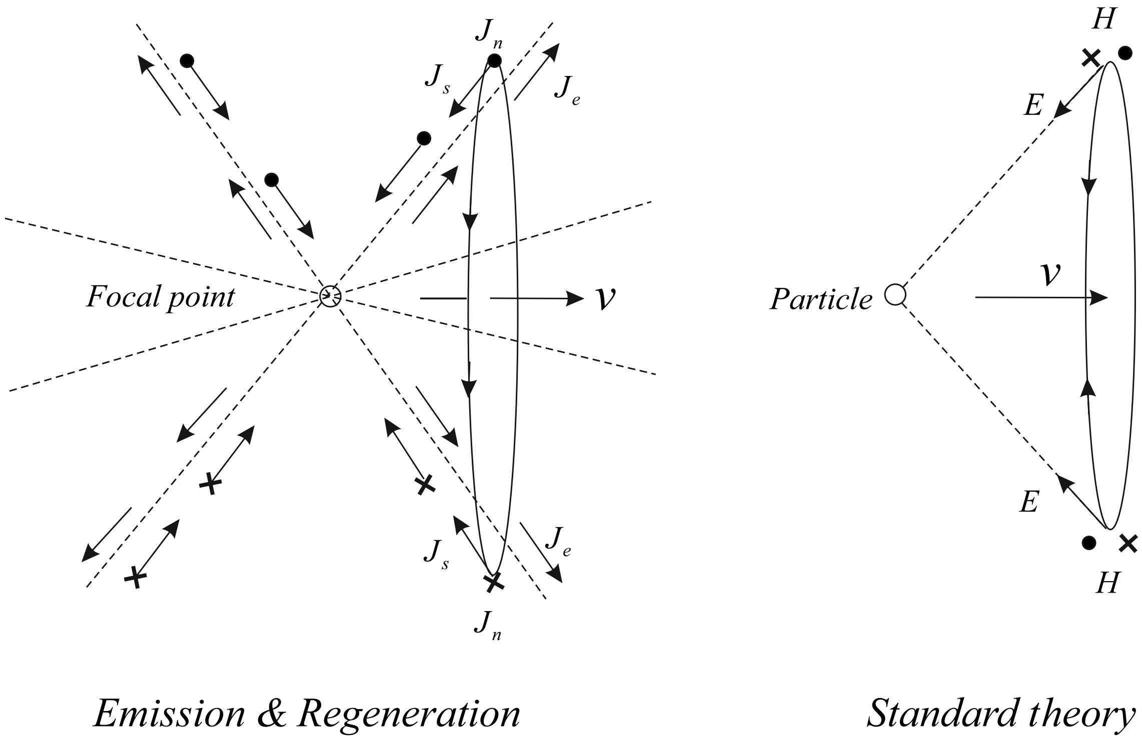


Figure 2: Particle represented as focal point

The BSPs are classified according to the change of the velocity of their FPs at the focal point in accelerating and decelerating BSPs.

The concept is shown in Fig. 3.

1. Accelerating basic subatomic particles radiate fundamental particles (FPs) with high velocity $v_h = v_e$ (e=emission) and are regenerated by FPs with low velocity $v_l = v_r$ (r=regeneration).
2. Decelerating basic subatomic particles radiate fundamental particles (FPs) with low velocity $v_l = v_e$ (e=emission) and are regenerated by FPs with high velocity $v_h = v_r$ (r=regeneration).

The BSPs are also classified according to their longitudunal rotational momenta in positive and negative BSP.

1. Positive basic subatomic particles transform negative LRM $\bar{J}_s^-$ in positive LRM $\bar{J}_s^+$.

   The concept is shown in Fig. 4.

2. Negative basic subatomic particles transform positive LRM $\bar{J}_s^+$ in negative LRM $\bar{J}_s^-$.

   The concept is shown in Fig. 5.

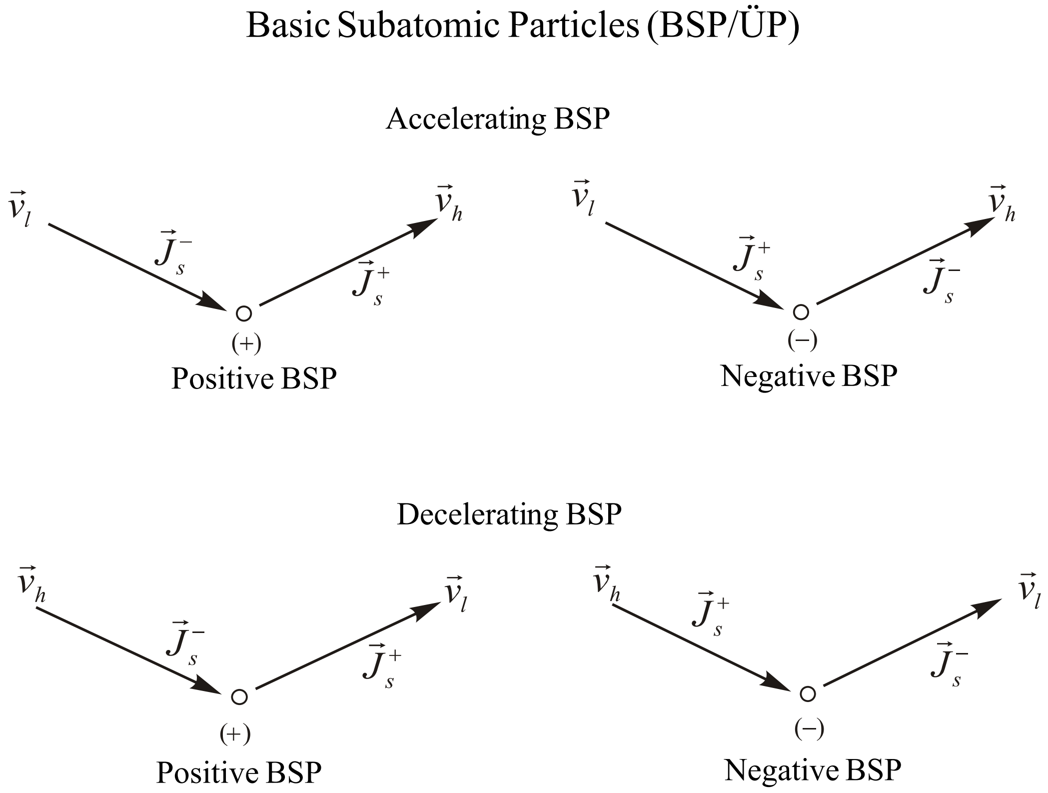


Figure 3: Basic Subatomic Particles

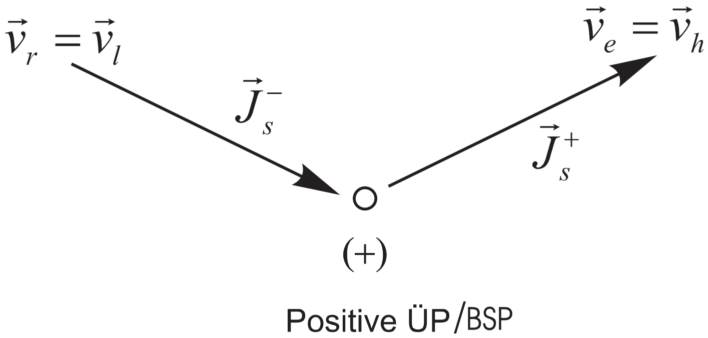


Figure 4: Positive basic subatomic particle (positron)

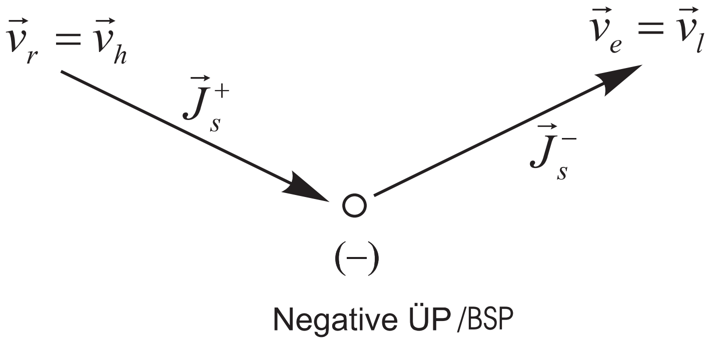


Figure 5: Negative basic subatomic particle (electron)

- **Postulate 4**: The FPs that are radiated by the basic subatomic particles have no transversal rotational momenta $\bar{J}_n$ and they possess well defined radiation velocities relative to a system of coordinates that is fix to the basic subatomic particles.

  1. Accelerating basic subatomic particles emit fundamental particles (FPs) with high velocity $v_e \to \infty$ relative to a system of coordinates that is fix to the basic subatomic particle.
  2. Decelerating basic subatomic particles emit fundamental particles (FPs) with low velocity $v_e = c$ relative to a system of coordinates that is fix to the basic subatomic particles.

2.2 Postulates that define the interactions of fundamental particles.

- **Postulate 5**: The FPs with the longitudinal rotational momenta $\bar{J}_e$ emitted by a BSP generate, when they cross with the regenerating FPs of the same BSP, longitudinal $\bar{J}_s$ and transversal $\bar{J}_n$ rotational momenta on the regenerating FPs. The sense of rotation of the transversal rotational momenta $\bar{J}_n$ is the direction in that the vector $\bar{J}_s$ must move over the smallest angle to coincide with the vector $\bar{J}_e$ of the BSP.

  The FPs emitted by a BSP deliver the energy stored in their LRM $\bar{J}_e$ to the LRM $\bar{J}_s$ and TRM $\bar{J}_n$ of the regenerating FPs. The distribution of the energy between the LRM and the TRM of the regenerating FPs is a function of the angle α between the velocity vectors of the emitted and regenerating FPs.

  The concept is shown on Fig. 6.

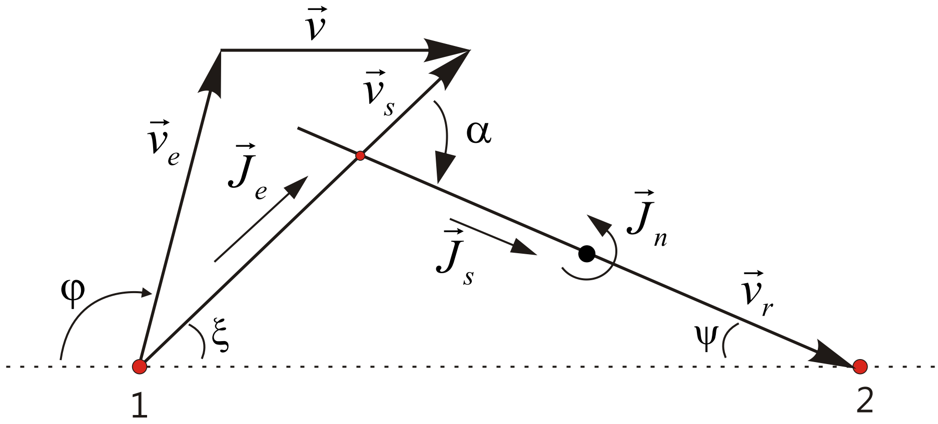


Figure 6: Speed diagram with regenerating longitudinal J_s and transversal J_n rotational momenta for a basic subatomic particle that moves with v

In Fig. 7 the convention for unit vectors of emitted and regenerating fundamental particles is shown.

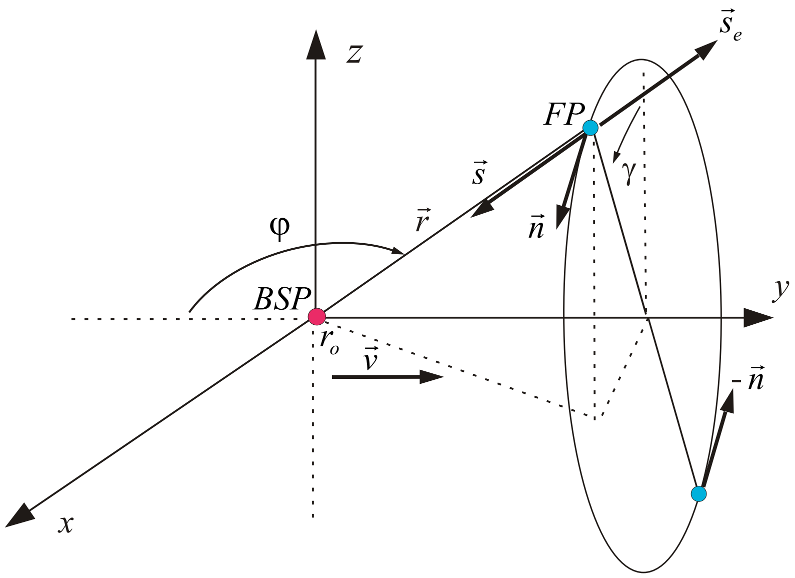


Figure 7: Unit vector $\bar{s}_e$ for an emitted FP and unit vectors $\bar{s}$ and $\bar{n}$ for a regenerating FP of a BSP moving with $v \neq c$

- **Postulate 6**: If two FPs from **different** BSPs cross, their LRM $\bar{J}_s$ generate two opposed TRM $\bar{J}_n^{(s)}$ that are defined by the cross product of the square roots of their original LRM. The sign of the generated TRM is opposed to the product of the signs of their original LRM.

$$\bar{J}_{n_2}^{(s)} = \operatorname{sign}(\bar{J}_{s_1}) \operatorname{sign}(\bar{J}_{s_2}) \left(\sqrt{J_{s_1}}\ \bar{s}_1 \ \times \ \sqrt{J_{s_2}}\ \bar{s}_2\right) \tag{3}$$

For the two generated transversal rotational momenta (TRM) we have that

$$\bar{J}_{n_1}^{(s)} = -\ \bar{J}_{n_2}^{(s)} \tag{4}$$

The concept is shown on Fig. 8.

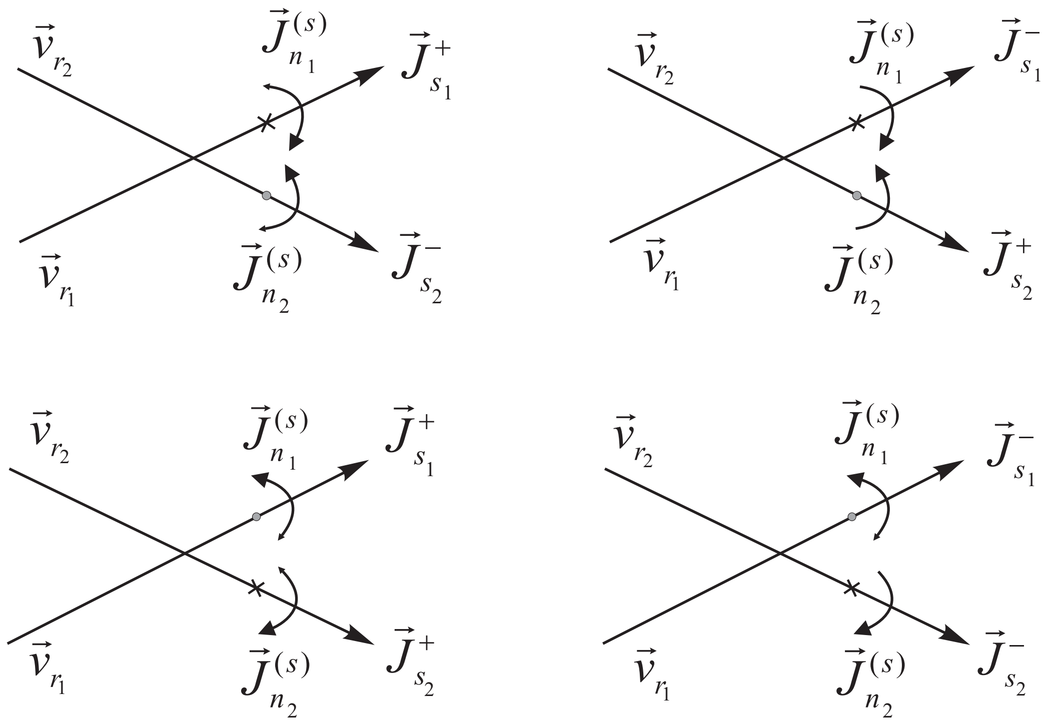


Figure 8: Generation of transversal rotational momenta $J_{n_i}^{(s)}$
out of longitudinal rotational momenta J_{s_i}
of FPs that belong to different BSPs

The vectors $\bar{s}_1$ und $\bar{s}_2$ are unit vectors with the direction of the velocity vectors of the FPs.

The upper (s) means that the rotational momenta were generated by longitudinal rotational momenta.

The sign of the TRM $\bar{J}_n^{(s)}$ is a function of the signs of the LRM of the FPs.

If the LRM of the FPs that cross have different signs, than opposed TRM $\bar{J}_n^{(s)}$ are generated on the FPs that rotate **to** each other if seen against the moving direction of the FPs.

If the LRM of the FPs that cross have the same signs, than opposed TRM $\bar{J}_n^{(s)}$ are generated on the FPs that rotate **from** each other if seen against the moving direction of the FPs.

- **Postulate 7**: If two FPs from **different** BSPs cross, their TRM $\bar{J}_n$ will generate two opposed rotational momenta $\bar{J}^{(n)}$ that are defined by the cross product of the square roots of their original TRM. The sign of the generated rotational momenta is given by the product of the signs of their original LRM. Additionally TRM $\bar{J}_n^{(s)}$ according to postulate 6 are generated.

$$\bar{J}_2^{(n)} = \operatorname{sign}(\bar{J}_{s_1}) \operatorname{sign}(\bar{J}_{s_2}) \left(\sqrt{J_{n_1}}\, \bar{n}_1 \times \sqrt{J_{n_2}}\, \bar{n}_2\right) \tag{5}$$

with

$$\bar{J}_1^{(n)} = -\bar{J}_2^{(n)} \tag{6}$$

The concept is shown on Fig. 9.

The vectors $\bar{n}_1$ und $\bar{n}_2$ are unit vectors orthogonal to the direction of the velocity vectors of the FPs.

The upper (n) means that the rotational momenta were generated by transversal rotational momenta.

The rotation of the rotational momenta $\bar{J}_2^{(n)}$ is opposed to the rotational momenta $\bar{J}_1^{(n)}$ and they can be expressed by their longitudinal and transversal components.

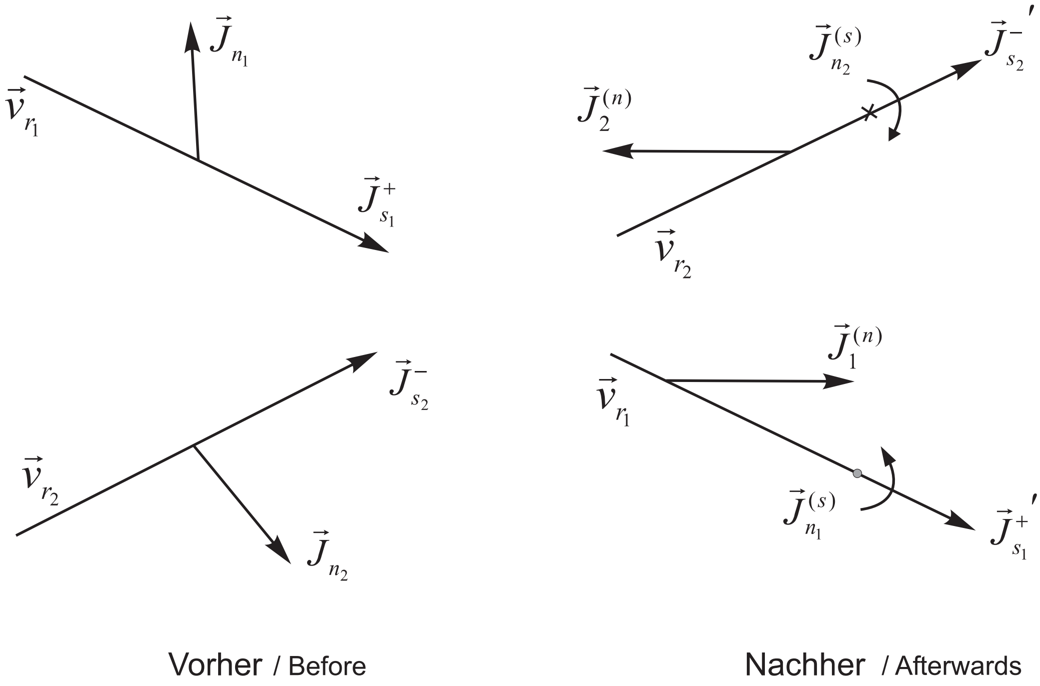


Figure 9: Generation of rotational momenta $J_i^{(n)}$
out of transversal rotational momenta J_{n_i}
of FPs that belong to different BSPs

- **Postulate 8**: If a FP 1 with an angular momentum $\bar{J}_1$ crosses with a FP 2 with a longitudinal angular momentum $\bar{J}_{s_2}$, the orthogonal component of $\bar{J}_1$ to $\bar{J}_{s_2}$ is transferred to the FP 2, if at the same instant between two other FPs 3 and 4 an orthogonal component is transferred which is opposed to the first one.

2.3 Energy distribution of a basic subatomic particle (BSPs) that moves with the velocity $\bar{v}$.

Basic subatomic particles like the electron or the positron, that are at the time $t = 0$ at the point 1 with $x = 0$ and move with the velocity v, disintegrate by radiating fundamental particles of one of the two velocities and are regenerated, at the point 2 with $\bar{x} = \bar{v}\, t$ at the time t, by fundamental particles of the other velocity. The part of the total radiating energy of the basic subatomic particle that is in the conus with the rotational angle φ and the thickness $d\varphi$ is given by the following expression:

$$dE = \frac{m\, c^2}{\sqrt{1-\frac{v^2}{c^2}}}\, \frac{c}{2\, v} \left| \frac{\bar{v}_s}{|\bar{v}_e|} \times \frac{\bar{v}_r}{|\bar{v}_r|} \right| W\, d\varphi \qquad dE = E\, d\kappa \tag{7}$$

with

$$E = \frac{m\, c^2}{\sqrt{1 - \frac{v^2}{c^2}}} \qquad d\kappa = \frac{c}{2\, v} \left| \frac{\bar{v}_s}{|\bar{v}_e|} \times \frac{\bar{v}_r}{|\bar{v}_r|} \right| W\, d\varphi \tag{8}$$

The concept is shown on Fig. 10.

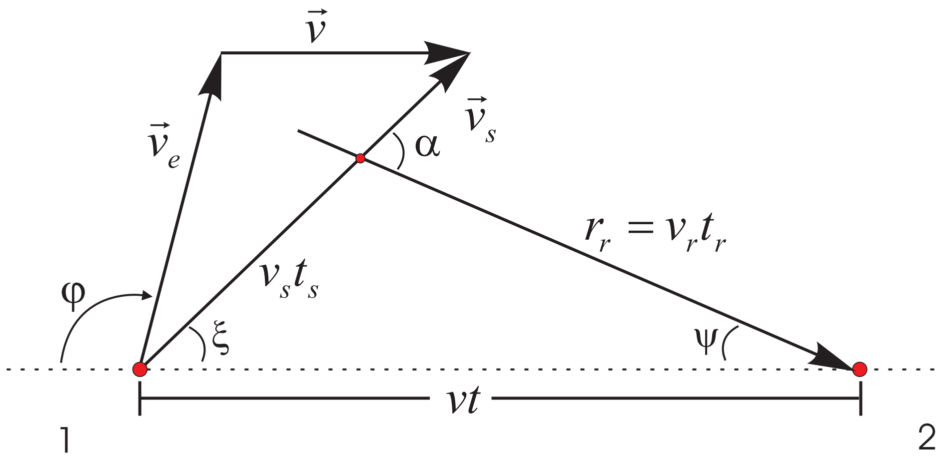


Figure 10: Space diagram with emission $v_s t_s$ and regeneration $v_r t_r$ distances for a basic subatomic particle that moves with v

$d\kappa$ describes the part of the total energy E of a basic subatomic particle that moves with the velocity v contained in the angle $d\varphi$.

v_e is the emission velocity of the fundamental particles relative to a coordinate system that is fix with the basic subatomic particle that moves with v. The velocity v_e is equal to $v_h \to \infty$ for accelerating BSPs and equal to the speed of light c for decelerating BSPs.

v_s is the velocity of the emitted fundamental particles relative to a coordinate system in which the BSP moves with the velocity v.

$$v_s = \sqrt{v_e^2 + v^2 - 2\, v_e\, v\, cos\varphi} \tag{9}$$

v_r is the velocity of the fundamental particles that regenerate the BSP relative to a coordinate system in which the BSP moves with the velocity v. For accelerating BSPs $v_r = c$ is the velocity of light and for decelerating BSPs $v_r \to \infty$.

W represents the probability that emitted fundamental particles cross with regenerating fundamental particles. For a basic subatomic particle that moves with constant velocity v the whole emitted energy must equal the whole regenerating energy to conserve the particle, so that the probability for the whole particle is $W = 1$.

2.4 Deduction of the angle α between the speed vectors $\bar{v}_s$ and $\bar{v}_r$.

Note: This subsection can be skipped in a first approache.

The time t that a BSP needs from point 1 to 2 must be equal to the time the emitted FP needs from the moment of its emission at $t = 0$ to the moment it crosses with the regenerating FP, plus the time the regenerating FP needs then to arrive at $\bar{x} = \bar{v}\, t$.

The concept is shown in Fig. 10 and Fig. 11.

Fig. 11 shows the regeneration of a BSP at point $x = 0$ for two rays that were emitted at vt and vt'.

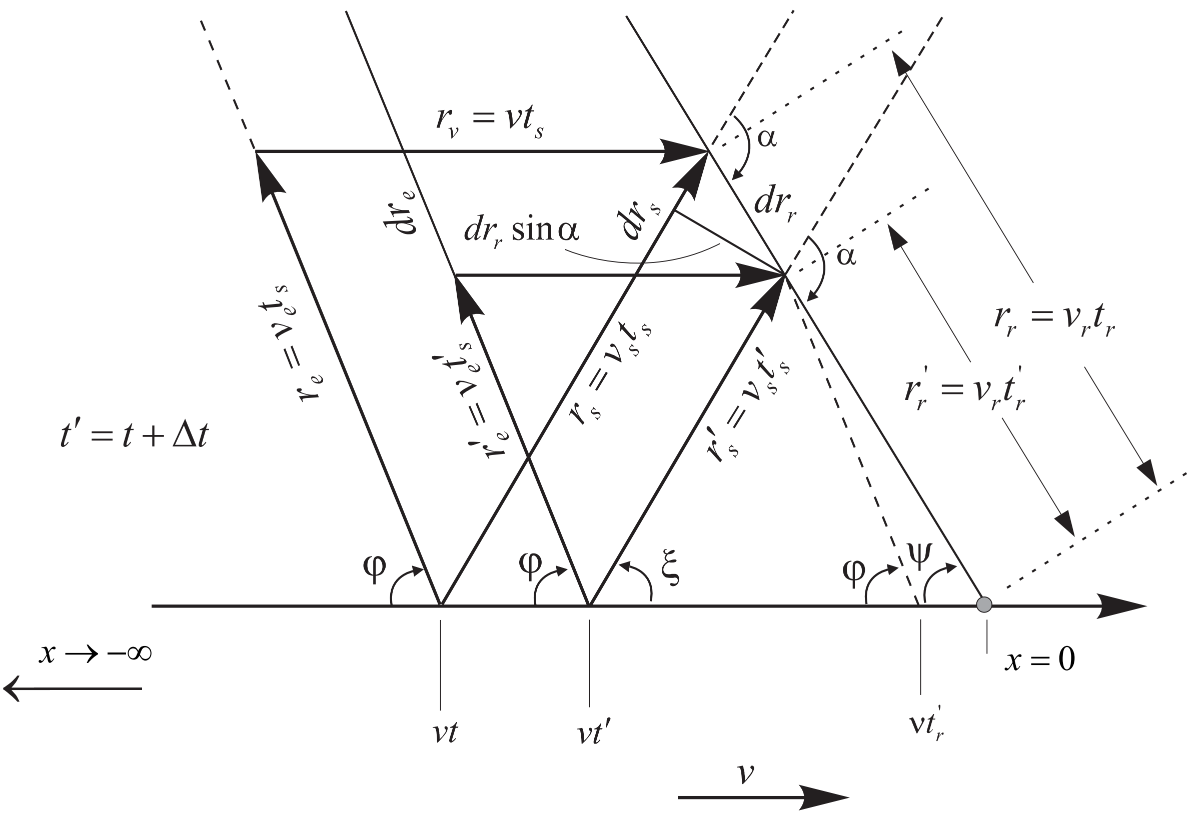


Figure 11: Space diagram showing the regeneration of a BSP

$0 <= \varphi <= \pi$

$\xi = \frac{\varphi}{2} + \arctan\left[\frac{v_e - v}{v_e + v} \cot\frac{\pi - \varphi}{2}\right]$

$v_s^2 = v_e^2 + v^2 - 2\, v_e\, v\, \cos(\pi - \varphi)$

$t_r = t - t_s$

$v_r^2(t-t_s)^2 = v^2t^2 + v_s^2t_s^2 - 2(vt)(v_st_s)\cos\xi$

$(v_r^2 - v_s^2)t_s^2 + (2vv_st\cos\xi - 2tv_r^2)t_s + (v_r^2 - v^2)t^2 = 0$

The solution of the second order equation gives t_s.

$\psi = \frac{\pi}{2} - \frac{\xi}{2} + \arctan\left[\frac{v_st_s - vt}{v_st_s + vt}\cot\frac{\xi}{2}\right]$

$\alpha = \psi + \xi$

The crossing angle α is independent from the selected time t and varies as follows.

$$0 <= \varphi <= \pi \begin{cases} v = 0 & \alpha = \pi \\ 0 <= v <= c & \pi >= \alpha >= \frac{\pi}{2} \end{cases} \tag{10}$$

A BSP is regenerated at the point $x = 0$ by all the rays the same BSP has emitted from $x \to -\infty$ to $x = 0$.

2.5 Determination of a more simple distribution function $d\kappa(\varphi)$.

Note: This subsection can be skipped in a first approache.

The distribution function $d\kappa(\varphi)$ is not adequate for analytic manipulation because of the complicate dependence of $\alpha(\varphi)$. In what follows a more simple expression $d\kappa(\varphi)$ will be introduced.

The equation (7), that defines the distribution of the energy, we can write with $W = 1$ as follows

$$dE = \frac{m\,c^2}{\sqrt{1-\frac{v^2}{c^2}}}\,\frac{c}{2\,v}\,\frac{v_s}{v_e}\,\sin\alpha\,d\varphi \tag{11}$$

Because of

$$\int_{\varphi=0}^{\pi} dE = \frac{m\,c^2}{\sqrt{1-\frac{v^2}{c^2}}} \qquad we\ \ have \qquad \frac{c}{2\,v_e}\int_{\varphi=0}^{\pi}\frac{v_s}{v}\,\sin\alpha\,d\varphi = 1 \tag{12}$$

For $v = 0$ we have that $\int_{\varphi=0}^{\pi} dE = m\,c^2$, and we select from the many possible functions for $\int_{\varphi=0}^{\pi} f(\varphi)\,d\varphi = 1$ the following function, selection that shows to be right in all what follows.

$$\int_{\varphi=0}^{\pi} dE = m\,c^2 = m\,c^2\,\frac{1}{2}\int_{\varphi=0}^{\pi}\sin\varphi\,d\varphi \quad because \quad \frac{1}{2}\int_{\varphi=0}^{\pi}\sin\varphi\,d\varphi = 1 \tag{13}$$

2.5.1 Analysis for BSPs with $v \to 0$.

For $v = 0$ we have also that $v_s = v_e$, valid for BSPs with $v_e = c$ as for BSPs with $v_e \to \infty$, what leads to the conclusion that

$$\lim_{v\to 0} \frac{\sin\alpha}{v} = \frac{1}{c}\ \sin\varphi \tag{14}$$

and for $d\kappa$ we get

$$d\kappa \approx \frac{1}{2}\, W\ \sin\varphi\, d\varphi \qquad v = 0 \tag{15}$$

2.5.2 Analysis for accelerating BSPs with $v_e \to \infty$.

For accelerating BSPs we have to differentiate between $v = 0$ and $v \neq 0$.

For $v = 0$ results that:
If for $v_r = c$ the speed $v_e \to \infty$ then $t_e \to 0$, and for $v = 0$ results that

$$r_r = v_r\, t_r \to r_e = v_e\, t_s \qquad and \qquad dr_r \to dr_e \tag{16}$$

It results then that

$$\psi = \varphi \qquad and \qquad d\psi = d\varphi \tag{17}$$

For $v \neq 0$ results that:

$$r_r = v_r\, t_r \neq r_e = v_e\, t_s \qquad and \qquad dr_r \neq dr_e \tag{18}$$

and that

$$\psi \neq \varphi \qquad and \qquad d\psi \neq d\varphi \tag{19}$$

Now we analyse $d\kappa$ for $v \ll c$ and $v = c - \Delta v$ with $\Delta v \ll c$.
We start with

$$d\kappa = \frac{c}{2\, v}\ \frac{v_s}{v_e}\ \sin\alpha\, W\ d\varphi \tag{20}$$

a) With $v_e \to \infty$ it is $v_s \approx v_e$ and with $v \ll c$ the angle α can be approximated by (see Fig. 12)

$$\alpha \approx \pi - \frac{v}{c}\ \sin\varphi \tag{21}$$

and we have that

$$d\kappa \approx \frac{2\ c}{\pi\ v}\ \ \sin\left[\pi - \frac{v}{c}\ \sin\varphi\right]\ W\ \sin\varphi\ d\varphi \tag{22}$$

Because of

$$\sin\left[\pi - \frac{v}{c}\ \sin\varphi\right] = \sin\left[\ \frac{v}{c}\ \sin\varphi\right] \approx \frac{v}{c}\ \sin\varphi \tag{23}$$

we have that

$$d\kappa \approx \frac{1}{2}\, W\ \sin\varphi\ d\varphi \tag{24}$$

b) If we now take $v = c - \Delta v$ with $\Delta v \ll c$ the angle α can be expressed by (see Fig. 12)

$$\alpha \approx \pi - \varphi \quad for \quad 0 \leq \varphi \leq \pi/2 \qquad and \qquad \alpha \approx \varphi \quad for \quad \pi/2 \leq \varphi \leq \pi \tag{25}$$

we get $\sin\alpha = \sin\varphi$ for $0 \leq \varphi \leq \pi$ and for $d\kappa$

$$d\kappa \approx \frac{1}{2}\, W\ \sin\varphi\ d\varphi \tag{26}$$

Fig. 12 shows the relation between α, φ and the speed v for accelerating BSPs where $v_e \to \infty$ and $v_r = c$.

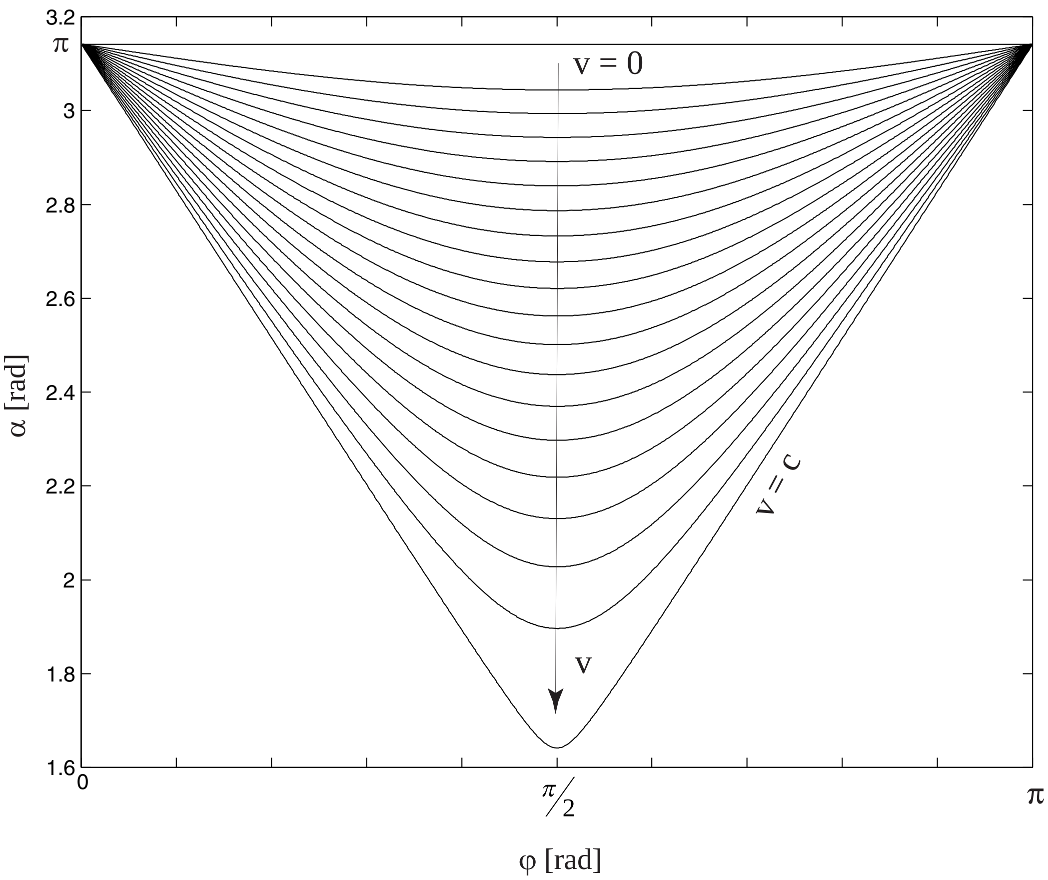


Figure 12: α as a function of φ and v for accelerating BSPs

Fig. 13 shows the relation between ψ, φ and the speed v for accelerating BSPs.

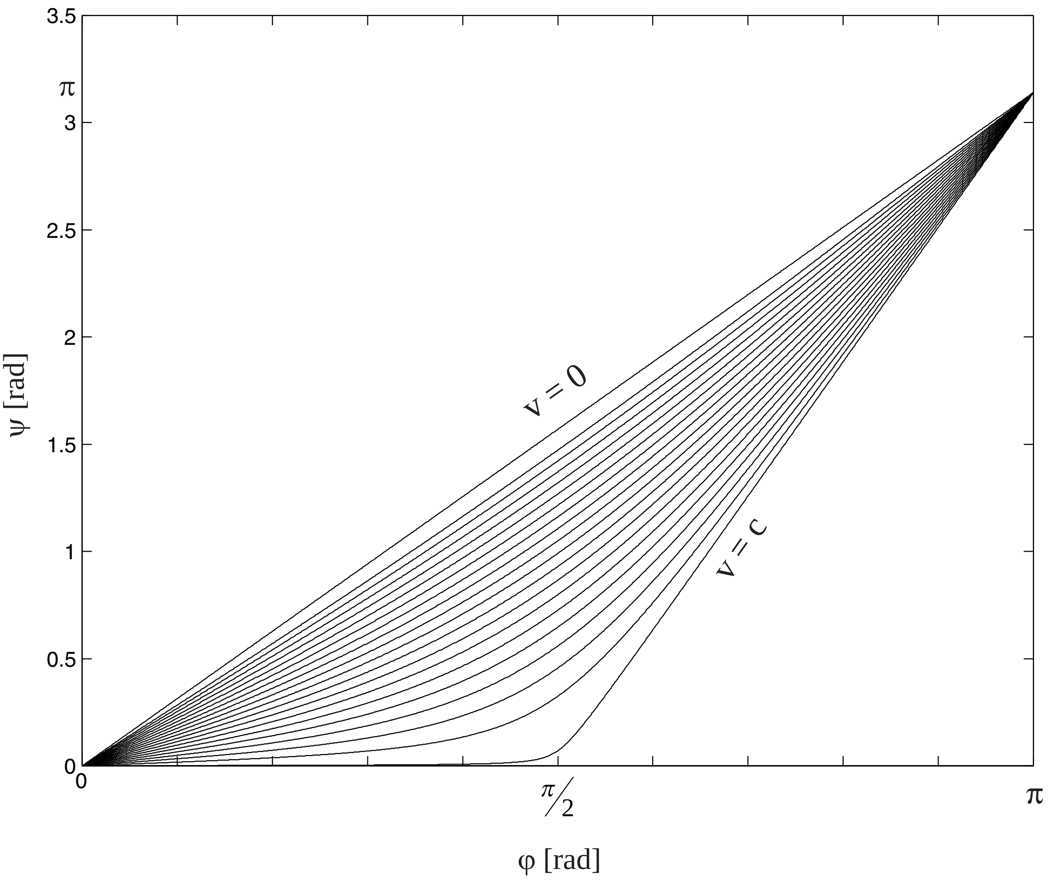


Figure 13: ψ as a function of φ and v for accelerating BSPs

2.5.3 Analysis for decelerating BSPs with $v_r \to \infty$.

If for $v_e = c$ the speed $v_r \to \infty$, then $t_r \to 0$ and

$$r_r = v_r\ t_r \to r_e = v_e\ t_s \qquad and \qquad dr_r \to dr_e \tag{27}$$

We conclude that for decelerating BSPs

$$\psi = \varphi \qquad and \qquad d\psi = d\varphi \tag{28}$$

Now we analyse $d\kappa$ for $v \ll c$ and $v = c - \Delta v$ with $\Delta v \ll c$.
We start with

$$d\kappa = \frac{c}{2\,v}\;\frac{v_s}{v_e}\;\sin\alpha\; W\; d\varphi \tag{29}$$

a) With $v_e = c$ and $v \ll c$ it is $v_s \approx c$ and the angle α can be approximated by (see Fig. 14)

$$\alpha \approx \pi - \frac{v}{c}\;\sin\varphi \tag{30}$$

and we have that

$$d\kappa \approx \frac{c}{2\,v}\;\;\sin\left[\pi - \frac{v}{c}\;\sin\varphi\right]\; W\; d\varphi \tag{31}$$

Because of

$$\sin\left[\pi - \frac{v}{c}\;\sin\varphi\right] = \sin\left[\;\frac{v}{c}\;\sin\varphi\right] \approx \frac{v}{c}\;\sin\varphi \tag{32}$$

we have that

$$d\kappa \approx \frac{1}{2}\; W\;\;\sin\varphi\; d\varphi \tag{33}$$

b) If we now take $v = c - \Delta v$ with $\Delta v \ll c$ the angle α can be expressed by (see Fig. 14)

$$\alpha \approx \frac{1}{2}\;(\pi + \varphi) \qquad\qquad \textit{or} \qquad\qquad \sin\alpha \approx \cos\frac{\varphi}{2} \tag{34}$$

and

$$v_s = \sqrt{v_e^2 + v^2 - 2\;v_e\;v\;\;\cos\varphi} \approx 2\;c\;\;\sin\frac{\varphi}{2} \tag{35}$$

we get

$$d\kappa \approx \frac{1}{2}\; W\;\;\sin\varphi\; d\varphi \tag{36}$$

Conclusion: The function $d\kappa$ has the following important characteristics:

- The equation for $d\kappa$ is the same for the whole speed range $0 \leq v \leq c$ for accelerating and decelerating BSPs.
- The function $d\kappa$ gives the energy distribution in space, which must be the same for all reference systems. This is expressed by the independence of $d\kappa$ from the speed v.
- The function $d\kappa$ has a rotational symmetry around the velocity vector $\bar{v}$.

- The function $d\kappa$ has the following symmetry, which is very important for the demonstrations of the conservation laws

$$d\kappa(\varphi) = d\kappa(\pi - \varphi) \tag{37}$$

Fig. 14 shows the relation between α, φ and the speed v, for decelerating BSPs with $v_e = c$ and $v_r \to \infty$.

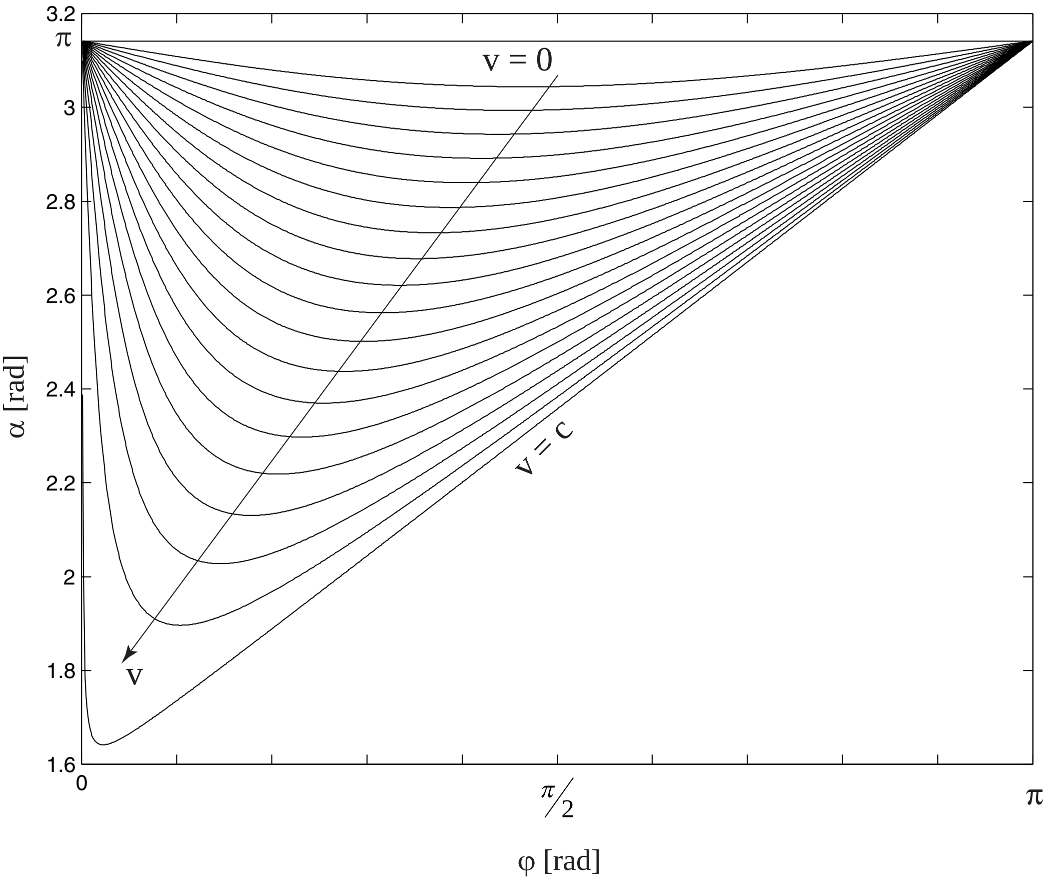


Figure 14: α as a function of φ and v for decelerating BSPs

Fig. 15 shows the relation between ψ, φ and the speed v for decelerating BSPs.

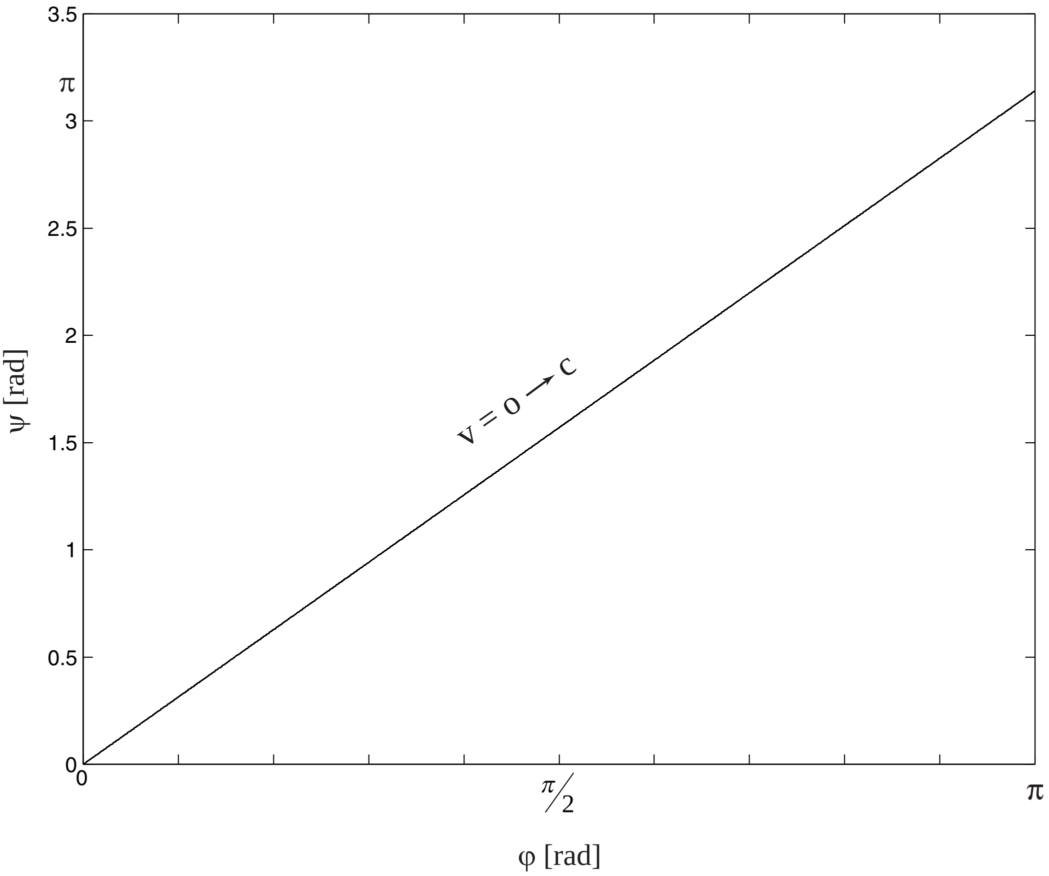


Figure 15: ψ as a function of φ and v for decelerating BSPs

Miscellaneous

If we define

$$\frac{v}{c} = \sin \alpha_m \tag{38}$$

with α_m the minimum of the curve α/φ for a given speed v, we get for **decelerating** BSPs with $v_e = c$ and for **accelerating** BSPs with $v_e \to \infty$, expressions that depend only from angles.

Fig. 16 shows the angle α_m as function of the speed v, angle that is the same for accelerating and decelerating BSPs.

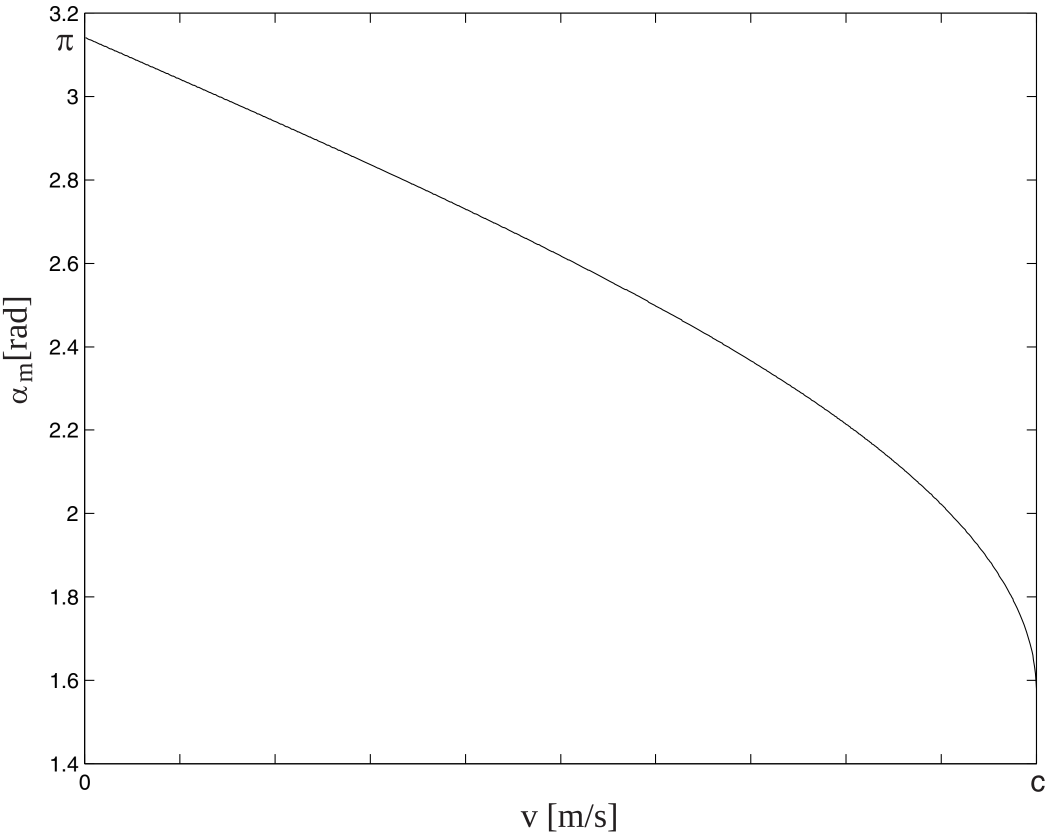


Figure 16: α_m for accelerating and decelerating BSPs

Note: The energy distribution function $d\kappa$ was selected between several possible functions like

$$dE = \frac{m\,c^2}{\sqrt{1-\frac{v^2}{c^2}}}\,\frac{2\,c}{\pi\,v}\left|\frac{\bar{v}_s}{|\bar{v}_e|}\times\frac{\bar{v}_r}{|\bar{v}_r|}\right| W\ \sin\varphi\,d\varphi \qquad dE = E\,d\kappa \tag{39}$$

with

$$d\kappa \approx \frac{2}{\pi}\,W\ \sin^2\varphi\,d\varphi \tag{40}$$

With this distribution the force between two static BSPs expressed as rotor of the field dH_n is zero for $\varphi = 0$ which is not the case for the distribution selected for the present approach (see 17.2).

2.5.4 General observations to the energy distribution of BSPs.

In sec. 2.5 we have introduced the function $d\kappa$ for the energy distribution in space for a BSP.

For an isolated BSP with $v = 0$ the distribution of the energy is point symmetric with no privileged direction and described by

$$d\kappa = \frac{1}{2}\,\frac{r_o}{r_r^2}\,dr_r \tag{41}$$

This is not expressed with

$$d\kappa = \frac{1}{2}\,\frac{r_o}{r_r^2}\,dr_r\;\sin\varphi \tag{42}$$

that is also valid for $v = 0$ and where we have a privileged direction defined by $\varphi = 0$.

We are not interested in isolated particles without interactions. Privileged directions exist always we have more than one BSP and are defined by the connecting directions of the BSPs.

We have also seen that all interactions at $v = 0$ between BSPs are generated by accelerations of the BSPs in the connecting directions.

This explains why the equation

$$d\kappa = \frac{1}{2}\,\frac{r_o}{r_r^2}\,dr_r\;\sin\varphi \tag{43}$$

is also valid for $v = 0$ where the privileged direction is the connecting line to the other BSP.

2.6 Energy of a BSP that moves with constant velocity v.

To obtain the total energy of a basic subatomic particle that moves with constant v, the equation (7) of section 2.3 for dE must be integrated over the whole spacial coordinates. As dE represents the Energy in the angle $d\varphi$ that has a rotational symmetry, the integration goes from $\varphi = 0$ to $\varphi = \pi$.

$$E = \frac{m\,c^2}{\sqrt{1-\frac{v^2}{c^2}}}\;\frac{c}{2\,v}\int_{\varphi=0}^{\varphi=\pi}\left|\;\frac{\bar{v}_s}{|\bar{v}_e|}\;\times\;\frac{\bar{v}_r}{|\bar{v}_r|}\right|\;W\;d\varphi \tag{44}$$

Calculations.

To calculate the energy we assumed as low speed $v_l = c$ and as high speed for the fundamental particles $v_h = 10^{17}\cdot c\;\;\frac{m}{s}$ and used the mass of the electron. The deviation in percent between E_{must} and E_{calc} in the range $0 \le v \le c$ was less than 10^{-6}. The results were the same for accelerating and decelerating BSPs.

Note: With the energy distribution of eq.(39) and a low speed $v_l = c$ and a high speed of $v_h = 10^{17}\cdot c\;\;\frac{m}{s}$, the deviation in percent between E_{must} and E_{calc} in the range $0 \le v \le c$ was less than 10^{-12}.

2.7 Linear momentum $\bar{p}$ of a BSP that moves with constant velocity v.

The linear momentum of a basic subatomic particle that moves with constant velocity v is given by

$$\bar{p} = \int d\bar{p} = \frac{\bar{v}}{c^2} \int dE \tag{45}$$

with

$$d\bar{p} = \frac{m\,\bar{v}}{\sqrt{1-\frac{v^2}{c^2}}} \, \frac{c}{2\,v} \left| \frac{\bar{v}_s}{|\bar{v}_e|} \times \frac{\bar{v}_r}{|\bar{v}_r|} \right| W\, d\varphi \qquad\qquad d\bar{p} = \bar{p}\; d\kappa \tag{46}$$

The equation is composed by the total linear momentum of the BSP and a dimensionless factor that gives the part of the linear momentum corresponding to the angle $d\varphi$.

Calculations

To calculate the linear momentum we assumed as low speed $v_l = c$ and as high speed for the fundamental particles $v_h = 10^{17} \cdot c \;\frac{m}{s}$ and used the mass of the electron. The deviation in percent between p_{must} and p_{calc} in the range $0 \leq v \leq c$ was less than 10^{-6}. The results were the same for accelerating and decelerating BSPs.

2.8 Energies stored in longitudinal rotational momenta $\bar{J}_s$ and transversal rotational momenta $\bar{J}_n$ of regenerating FP.

We start with the total energy of a BSP with constant v.

$$E = \sqrt{E_o^2 \;+\; E_p^2} \tag{47}$$

with

$$E_o = m\,c^2 \qquad\qquad E_p = p\,c \qquad \mathit{and} \qquad p = \frac{m\,v}{\sqrt{1-\frac{v^2}{c^2}}} \tag{48}$$

and through differentiation we get

$$dE = \frac{E_o\,dE_o \;+\; E_p\,dE_p}{\sqrt{E_o^2 \;+\; E_p^2}} \tag{49}$$

We define

$$dE_s = \frac{E_o\, dE_o}{\sqrt{E_o^2 \;+\; E_p^2}} \qquad and \qquad dE_n = \frac{E_p\, dE_p}{\sqrt{E_o^2 \;+\; E_p^2}} \tag{50}$$

and get

$$dE = dE_s \;+\; dE_n \qquad with \qquad dE_o = c^2\, dm \qquad and \qquad dE_p = \frac{c\; v}{\sqrt{1-\frac{v^2}{c^2}}}\, dm \tag{51}$$

Through integration we obtain

$$E = E_s + E_n \qquad with \qquad E_s = \frac{E_o^2}{\sqrt{E_o^2 \;+\; E_p^2}} \qquad and \qquad E_n = \frac{E_p^2}{\sqrt{E_o^2 \;+\; E_p^2}} \tag{52}$$

From

$$dE = \frac{m\; c^2}{\sqrt{1-\frac{v^2}{c^2}}}\; \frac{c}{2\; v}\; \left| \frac{\bar{v}_s}{|\bar{v}_e|} \;\times\; \frac{\bar{v}_r}{|\bar{v}_r|} \right| W\; d\varphi \tag{53}$$

and

$$E = \frac{m\; c^2}{\sqrt{1-\frac{v^2}{c^2}}} = E_s \;+\; E_n \tag{54}$$

results that

$$dE_s = \frac{E_o^2}{\sqrt{E_o^2 \;+\; E_p^2}}\; \frac{c}{2\; v}\; \left| \frac{\bar{v}_s}{|\bar{v}_e|} \;\times\; \frac{\bar{v}_r}{|\bar{v}_r|} \right| W\; d\varphi \qquad\qquad dE_s = E_s\; d\kappa \tag{55}$$

and

$$dE_n = \frac{E_p^2}{\sqrt{E_o^2 \;+\; E_p^2}}\; \frac{c}{2\; v}\; \left| \frac{\bar{v}_s}{|\bar{v}_e|} \;\times\; \frac{\bar{v}_r}{|\bar{v}_r|} \right| W\; d\varphi \qquad\qquad dE_n = E_n\; d\kappa \tag{56}$$

The current densities σ_s and σ_r of the fundamental particles are proportional to their velocities v_s and v_r.

$$\sigma_s = \varrho_s\; v_s \qquad and \qquad \sigma_r = \varrho_r\; v_r \tag{57}$$

The energy of a BSP is stored in the rotational momentum of the emitted and regenerating fundamental particles. The energy of a BSP is continuously transferred from the LRM of the emitted FP to the LRM and TRM of the regenerating FP. The energy flows continuously from FPs with one velocity to FPs with the other velocity (v_h / v_l).

The equation to calculate the energy E_p from E_s and E_n is

$$E_p = \frac{E_o}{E_s} \sqrt{E_s} \sqrt{E_n} \tag{58}$$

2.8.1 Common angular velocity ν_g for all FPs.

If we assume that the longitudinal and transversal angular momenta of the regenerating fundamental particles from an isolated basic subatomic particle have a common angular velocity ν_g we get

$$\Delta E_e = \nu_g \; J_e \qquad \Delta E_s = \nu_g \; J_s \qquad \Delta E_n = \nu_g \; J_n \tag{59}$$

$$E_e = \nu_g \sum_i^{N_e} \; J_{e_i} \qquad E_s = \nu_g \sum_i^{N_s} \; J_{s_i} \qquad E_n = \nu_g \sum_i^{N_n} \; J_{n_i} \tag{60}$$

where N_e, N_s and N_n are the corresponding numbers of ΔE_e, ΔE_s and ΔE_n.

The concept is shown in Fig. 17.

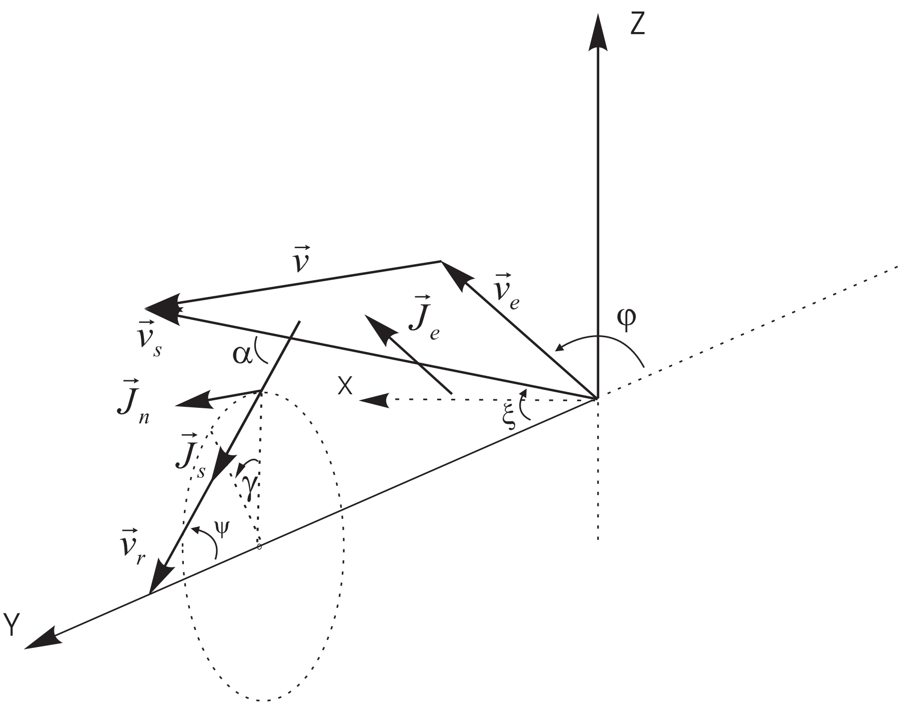


Figure 17: Spacial representation of L-($\bar{J}_s$) and T-($\bar{J}_n$) rotational momentum

If we now define equivalent rotational momenta J, J_o and J_p so that we obtain

$$E = \nu_g\ J \qquad E_o = \nu_g\ J_o \qquad E_p = \nu_g\ J_p \tag{61}$$

and that

$$E = E_e = E_s\ +\ E_n = \sqrt{E_o^2\ +\ E_p^2} = \nu_g \sqrt{J_o^2\ +\ J_p^2} = \nu_g\ J = \nu_g \sum\ J_e \tag{62}$$

then we get

$$J = \sqrt{J_o^2\ +\ J_p^2} \qquad and \qquad J = \sum\ J_e = \sum\ J_s\ +\ \sum\ J_n \tag{63}$$

a relation between the orthogonal rotational momenta J_s and J_n of the regenerating FP and the equivalent rotational momenta J, J_o and J_p of the basic subatomic particle.

If we consider the axial symmetry of the rotational momentum $\bar{J}_n$ we obtain the vector sum

$$\sum\ \bar{J}_n = 0 \tag{64}$$

Also for $v = 0$ the vector sum of $\bar{J}_s$ is

$$\sum\ \bar{J}_s = 0 \tag{65}$$

If all FPs have the same angular momentum J_{FP} we get

$$J = N_e\ J_{FP} = N_s\ J_{FP}\ +\ N_n\ J_{FP} \qquad and \qquad N_e = N_s\ +\ N_n \tag{66}$$

where now N_e is the number of the total emitted FPs, N_s the number of the total regenerating FPs with longitudinal angular momenta and N_n the number of the total regenerating FPs with Transversal angular momenta.

For the energy we have

$$\nu_g\ J = N_e\ J_{FP}\ \nu_g = N_s\ J_{FP}\ \nu_g\ +\ N_n\ J_{FP}\ \nu_g \qquad or \qquad E = E_e = E_s\ +\ E_n \tag{67}$$

where $E_{FP} = J_{FP}\ \nu_g$ is the energy of one FP.

2.8.2 Common angular momentum J_g for all FPs.

If we assume that the longitudinal and transversal angular momenta of the regenerating fundamental particles from an isolated basic subatomic particle are all equal to a common angular momentum J_g we get

$$\Delta E_e = J_g\, \nu_e \qquad \Delta E_s = J_g\, \nu_s \qquad \Delta E_n = \ J_g\, \nu_n \tag{68}$$

and

$$E_e = J_g \sum_i^{N_e} \nu_{e_i} \qquad E_s = J_g \sum_i^{N_s} \nu_{s_i} \qquad E_n = J_g \sum_i^{N_n} \nu_{n_i} \tag{69}$$

where N_e, N_s and N_n are the corresponding numbers of ΔE_e, ΔE_s and ΔE_n.

If we define equivalent angular frequencies ν, ν_o and ν_p so that we obtain

$$E = J_g\, \nu \qquad E_o = J_g\, \nu_o \qquad E_p = J_g\, \nu_p \tag{70}$$

and

$$E = E_e = E_s \ + \ E_n = \sqrt{E_o^2 \ + \ E_p^2} = J_g \ \sqrt{\nu_o^2 \ + \ \nu_p^2} = \nu \ J_g \tag{71}$$

then we get

$$\nu = \sqrt{\nu_o^2 \ + \ \nu_p^2} \qquad and \qquad \nu = \sum_i \nu_{e_i} = \sum_i \nu_{s_i} \ + \ \sum_i \nu_{n_i} \tag{72}$$

a relation between the angular frequencies ν_s and ν_n of the regenerating FP and the equivalent angular frequencies ν, ν_o and ν_p of the basic subatomic particle.

If all FPs have the same angular frequency ν_{FP} we get

$$\nu = N_e\, \nu_{FP} = N_s\, \nu_{FP} \ + \ N_n\, \nu_{FP} \qquad and \qquad N_e = N_s \ + \ N_n \tag{73}$$

where now N_e is the number of the total emitted FPs, N_s the number of the total regenerating FPs with longitudinal angular momenta and N_n the number of the total regenerating FPs with Transversal angular momenta.

For the energy we have

$$\nu \ J_g = N_e\, \nu_{FP} \ J_g = N_s\, \nu_{FP} \ J_g \ + \ N_n\, \nu_{FP} \ J_g \qquad or \qquad E = E_e = E_s \ + \ E_n \tag{74}$$

where $E_{FP} = \nu_{FP}\ J_g$ is the energy of one FP.

2.9 Definition of regenerating fundamental particles.

As *regenerating fundamental particles* of a BSP that moves with constant velocity v in a space that is not influenced by other BSPs, we define those FPs of the space that comply with the following requirements:

1. they are of the opposite type compared with the emitted FPs. This means, that they have from the two possible velocities v_h or v_l the opposite one.
2. they move in the direction in which they meet emitted FPs with the same velocity v_s and under the same angle α from $r_r = \infty$ to $r_r = r_o$, where r_o is the radius of the nucleus of the basic subatomic particle.

The concept is shown on Fig. 18.

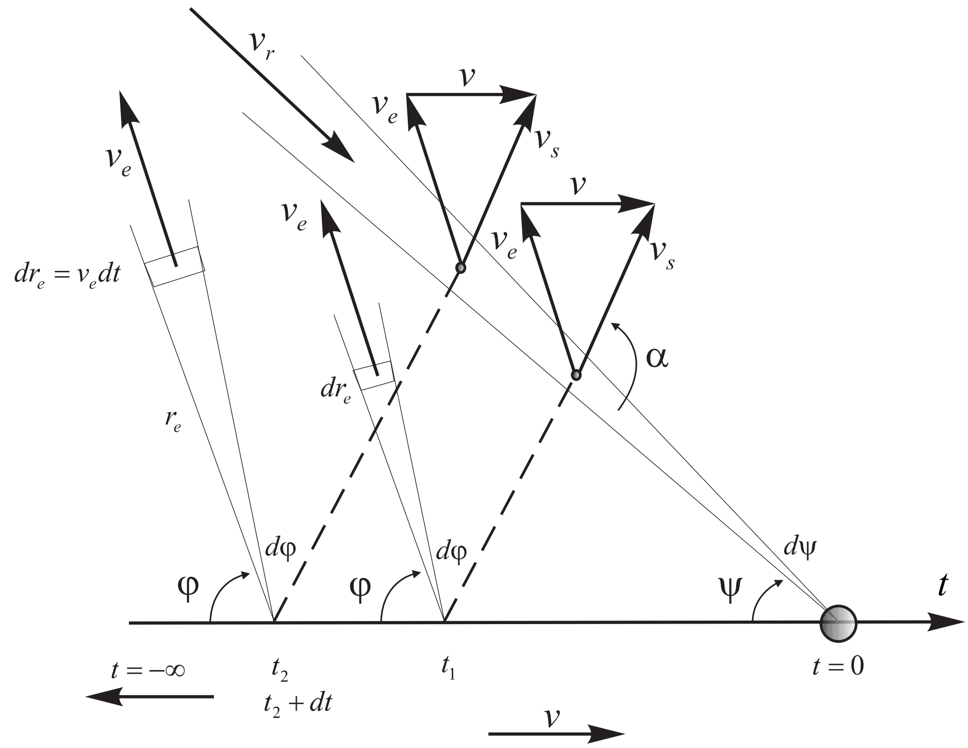


Figure 18: Regeneration of a particle at $t = 0$ due to emissions at $t_2 < 0$ and $t_1 < 0$

The probability to meet in the space fundamental particles that comply with the first requirement is

$$w_o = 1 \tag{75}$$

The emitted FPs that the *regenerating particles* meet at the trajectory to the nucleus of the BSP, were emitted by the same BSP during the time $t = -\infty$ to $t = 0$. The LRMs J_s and TRMs J_n that are generated on the regenerating FPs when they meet with the emitted FPs at the trajectory to the nucleus of the BSP are all identic. These regenerating FPs transport with their rotational momentums the energy that regenerates the basic subatomic particle.

Fundamental particles of the opposite type than the emitted one, that move in other directions, meet on their trajectory emitted FPs that have different velocities v_s and under different angles α. The generated LRMs and TRMs on these trajectories are not identic and don't contribute to the regeneration of the basic subatomic particle.

The exchange of energy between emitted and regenerating FPs is given by the following equation

$$\nu_g J_e = \nu_g J_s + \nu_g J_n \tag{76}$$

with J_e the longitudinal rotational momentum of the emitted FP and ν the common angular velocity.

For $v = 0$ only the FPs of the opposite type than the emitted FPs that move on radial trajectories to the nucleus of the basic subatomic particle, meet permanently emitted FPs with the same velocity $v_s = v_e$ and under the same angle $\alpha = \pi$.

Only on those FPs of the opposite type that move on radial trajectories to the nucleus of the basic subatomic particle, identical regenerating LRMs are produced along their trajectory, while on those FPs that move in other directions different LRMs are produced along their trajectory.

It is important to note, that while the FPs of the other type are equally distributed in the space and the probability to meet them is therefor $w_o = 1$, the regenerating FPs with the LRM J_s and TRM J_n move on radial trajectories to the BSP and the probability to meet them is therefor

$$w_r = \frac{r_o}{r_r^2}\, dr_r \tag{77}$$

2.10 Requirements for the generation of linear momentum $\bar{p}$ on basic subatomic particles (BSPs).

The requirements that must be fulfilled by rotational momentums of fundamental particles to generate linear momentum $\bar{p}$ on a BSP are:

1. The rotational momentums must form pairs with the same amplitude and with parallel but opposed angular velocities.

2. The direction orthogonal (normal) to the plane that contains the opposed angular momentums and that goes through the center of the circle to which the opposed rotational momentums are tangential, must go also through the BSP.

The concept is shown on Fig. 19.

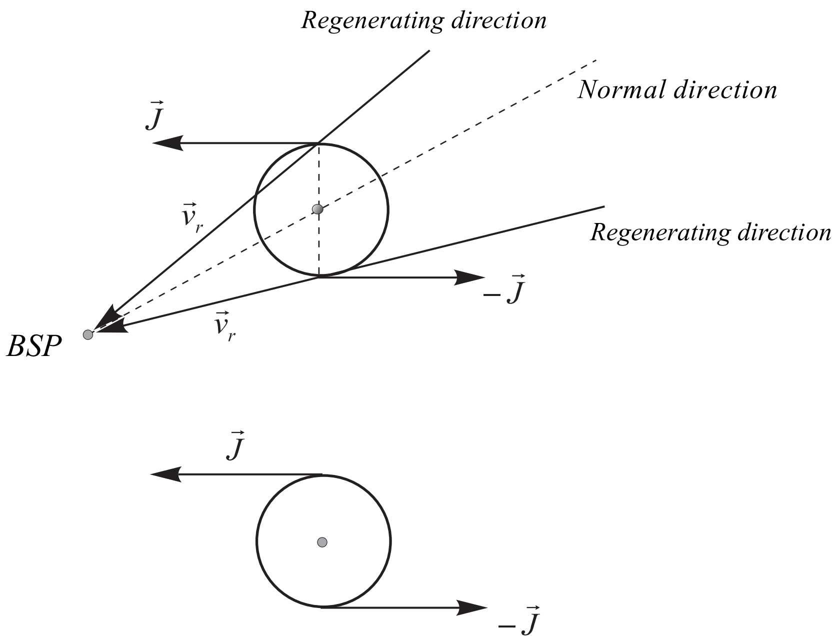


Figure 19: Symmetry requirements for generation of linear momentums

Note: The generation of linear momentum out of a pair of opposed angular momentum is similar to what can be observed when a cyclone and a anticyclone meet.

The pair of opposed transversal rotational momentum from a BSP that moves with constant velocity v, comply with the requirements for the generation of linear momentum p in the direction of the velocity v.

Note: Isolated FPs have only angular momenta, they have no linear momenta. Linear momentum is the product of the energy stored in FPs with opposed angular momentum as previously defined. When FPs meet in space they interact changing the orientation of their angular momenta.

The concept is shown on Fig. 20.

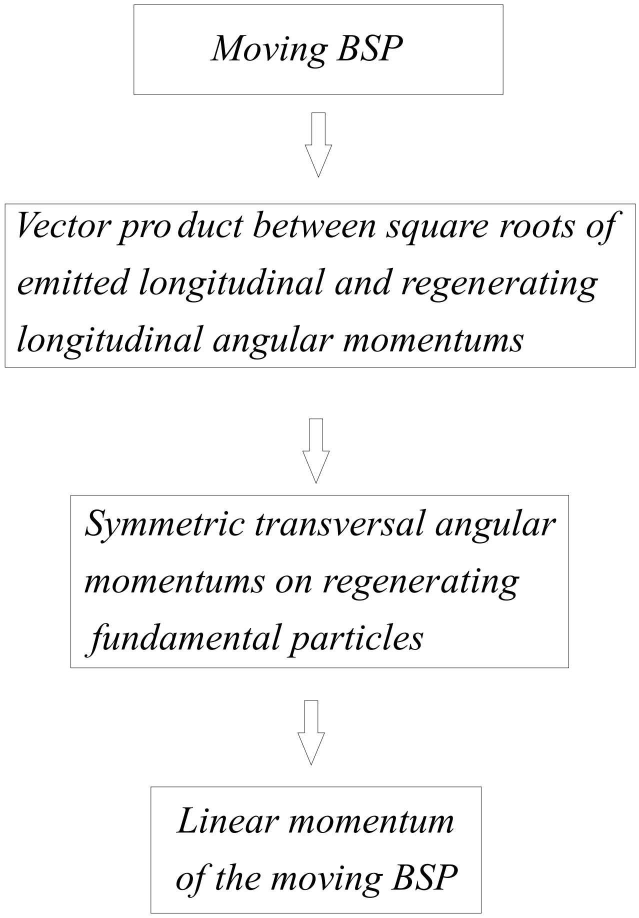


Figure 20: Generation of linear momentum at a moving BSP

2.11 Energy balance and rotational momentum balance between FPs of a BSP that moves with constant v.

2.11.1 Energy conservation

The energy flow between the fundamental particles of a basic subatomic particle must not violate the energy conservation principle.

The total energy of a basic subatomic particle that moves with constant velocity v must remain unchanged. This means that the energy stored in the longitudinal rotational momentum J_e of an emitted FP must be transferred to the rotational momentums of the regenerating FP when they meet and regenerate the BSP. This means that

$$\nu_g J_e = \nu_g J_s + \nu_g J_n \tag{78}$$

The concept is shown on Fig. 21.

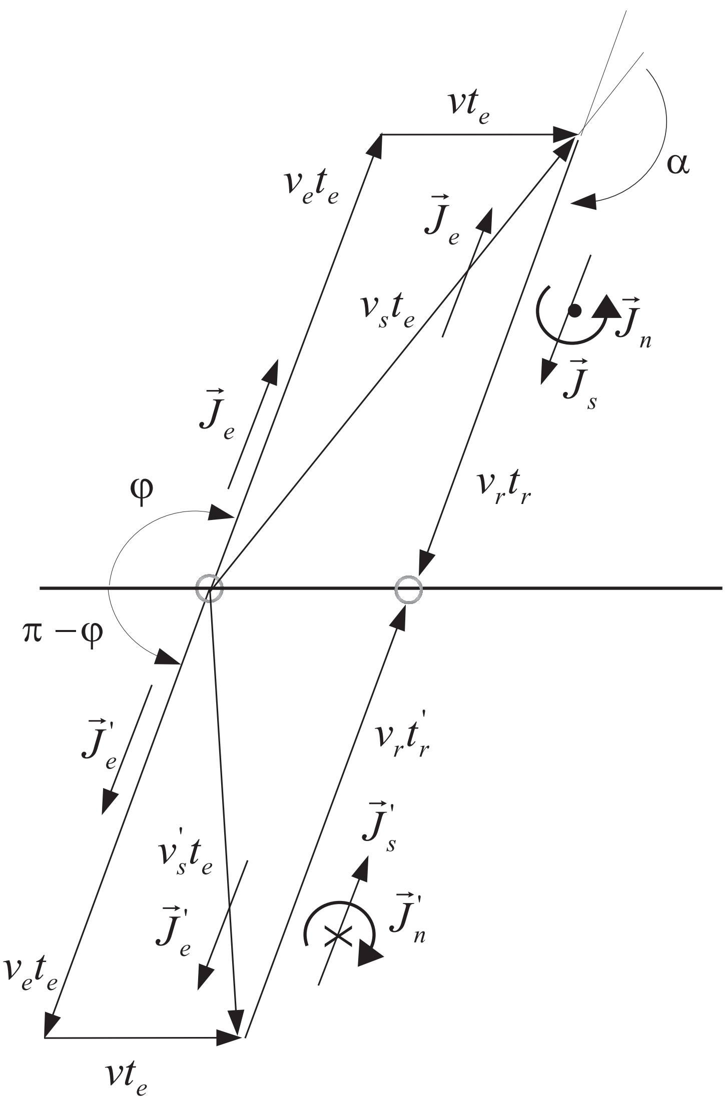


Figure 21: Balance of energy and rotational momentum

2.11.2 Conservation of the rotational momentum.

To demonstrate the conservation of the rotational momentums we assume that all the rotational momentums of the FPs that participate on the flow of energy of a BSP that moves with constant velocity v have the same angular velocity ν_g.

We make use of the function $d\kappa(\varphi) = d\kappa(\pi - \varphi)$ and write

$$dE = \nu_g J_e = E\ d\kappa(\varphi) = E\ d\kappa(\pi - \varphi) = \nu_g J_e^{'} \qquad J_e = J_e^{'} \tag{79}$$

$$dE_s = \nu_g J_s = E_s\ d\kappa(\varphi) = E_s\ d\kappa(\pi - \varphi) = \nu_g J_s^{'} \qquad J_s = J_s^{'} \tag{80}$$

$$dE_n = \nu_g J_n = E_n\ d\kappa(\varphi) = E_n\ d\kappa(\pi - \varphi) = \nu_g J_n^{'} \qquad J_n = J_n^{'} \tag{81}$$

For a plane that contains the axis of the axial-symmetric configuration we have

$$\bar{J}_e = -\bar{J}_e^{\,\prime} \qquad \bar{J}_s = -\bar{J}_s^{\,\prime} \qquad \bar{J}_n = -\bar{J}_n^{\,\prime} \tag{82}$$

The whole process is dynamic where at the same instant opposed rotational momentums are generated and annihilated, so that the sum of all rotational momentums remain equal zero. At the nucleus, opposed $\bar{J}_e$ rotational momentums are generated while at the same instant opposed $\bar{J}_e$ rotational momentums are transformed in opposed $\bar{J}_s$ and $\bar{J}_n$ rotational momentums. At the same instant during the regeneration of the nucleus, opposed $\bar{J}_s$ and $\bar{J}_n$ rotational momentums are annihilated.

Note: There is a strong coupling between the opposed rotational momentums $\bar{J}$, so that they are generated and annihilated at the same instant, independent of the distance between them (entanglement).

2.11.3 Conservation of the linear momentum p.

The linear momentum p is a measurable variable of a BSP, generated by rotational momentums of the regenerating fundamental particles of the BSP when they fulfill the requirements for generation of linear momentum. The conservation of linear momentum has no validity for fundamental particles. They maintain, according to their definition the direction and velocity when they meet with other fundamental particles.

2.12 Basic subatomic particles that move with light speed.

2.12.1 Energy and linear momentum of a basic subatomic particle that moves with light speed.

Up to now we have seen basic subatomic particles that move with velocities smaller than the speed of light.

We start with the energy equation of a basic subatomic particle.

$$dE = \frac{m\,c^2}{\sqrt{1-\frac{v^2}{c^2}}}\,\frac{c}{2\,v}\,\left|\,\frac{\bar{v}_s}{|\bar{v}_e|}\times\frac{\bar{v}_r}{|\bar{v}_r|}\right|\,W\,d\varphi \tag{83}$$

with

$$\frac{m\,c^2}{\sqrt{1-\frac{v^2}{c^2}}} = E_s + E_n \qquad and \qquad W = 1 \tag{84}$$

and

$$E_s = \frac{E_o^2}{\sqrt{E_o^2 + E_p^2}} \qquad and \qquad E_n = \frac{E_p^2}{\sqrt{E_o^2 + E_p^2}} \tag{85}$$

with

$$E_o = m\, c^2 \qquad and \qquad E_p = \frac{m\, v}{\sqrt{1 - \frac{v^2}{c^2}}}\, c \tag{86}$$

and we define that for $v \to c$ and the rest masse $m \to 0$

$$\lim_{\substack{m \to 0 \\ v \to c}} \frac{m}{\sqrt{1 - \frac{v^2}{c^2}}} = m_c \tag{87}$$

with m_c the masse at light velocity.
We obtain, that

$$E_o \to 0 \qquad and \qquad E_p \to m_c\, c^2 \tag{88}$$

and

$$E_s \to 0 \qquad and \qquad E_n \to m_c\, c^2 \tag{89}$$

For $v \to c$ the longitudinal rotational momentum $\bar{J}_s \to 0$ and only the transversal rotational momentum $\bar{J}_n$ remain. The total energy of a basic subatomic particle with light speed is stored in the transversal rotational momentum. Longitudinal rotational momentums don't exist and the particle does not emit FPs and is not regenerated by FPs. The transversal rotational momentums fulfill the requirements for generation of linear momentum in the direction of propagation or opposed to it. Due to the non existence of longitudinal rotational momentums they can simultaneously fulfill the requirements for generation of linear momentum in a direction that is transversal to the propagation direction.

An equivalent representation for the transversal rotational momentums responsible for the linear momentum $p_c^{\|}$ parallel to the propagation direction, is its tangential arrangement on a ring that is in a plane orthogonal to the propagation direction. The concept is shown in Fig. 22.

The vector sum of the transversal rotational momentums along the ring, that we designate with $0^{\|}$ must give zero. So we have that

$$\sum_{0^{\|}} \bar{J}_n = 0 \qquad and \qquad E_c^{\|} = m_c^{\|}\, c^2 = \oint_{\|} dE_n = \sum_{0^{\|}} \nu_u\, J_n \tag{90}$$

The linear momentum is

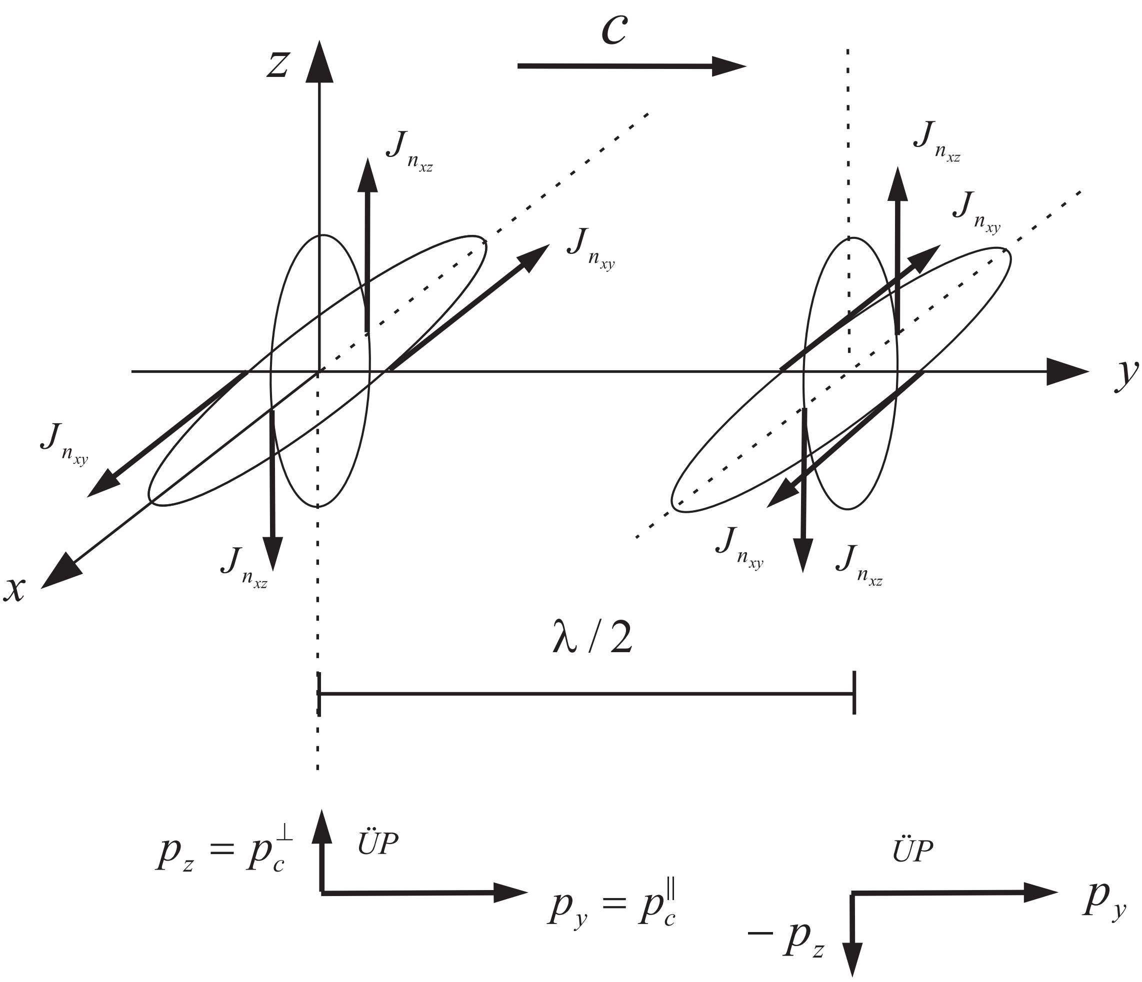


Figure 22: Photon composed of two basic subatomic particles with opposed potential transversal linear momentums p_z

$$p_c^{\parallel} = m_c^{\parallel} \, c = \frac{1}{c} \oint_{\parallel} dE_n \tag{91}$$

An equivalent representation for the transversal rotational momentums responsible for the linear momentum $p_c^{\perp}$ orthogonal to the propagation direction, is its tangential arrangement on a ring that is in a plane that contains the propagation direction.

The vector sum of the transversal rotational momentums along the ring, that we designate with $0^{\perp}$ must give zero. So we have that

$$\sum_{0^{\perp}} \bar{J}_n = 0 \qquad and \qquad E_c^{\perp} = m_c^{\perp} \, c^2 = \oint_{\perp} dE_n = \sum_{0^{\perp}} \nu_u \, J_n \tag{92}$$

The linear momentum is

$$p_c^{\perp} = m_c^{\perp}\, c = \frac{1}{c} \oint_{\perp} dE_n \tag{93}$$

For the total energy and the total linear momentum we have that

$$[\, E_c \,]^2 = [\, E_c^{\|} \,]^2 + [\, E_c^{\perp} \,]^2 \qquad [\, p_c \,]^2 = [\, p_c^{\|} \,]^2 + [\, p_c^{\perp} \,]^2 \tag{94}$$

with

$$[\, m_c \,]^2 = [\, m_c^{\|} \,]^2 + [\, m_c^{\perp} \,]^2 \tag{95}$$

Note. The defined basic subatomic particles that move with light speed don't emit and are not regenerated by fundamental particles. Their existence is independent from the space in which they move. The potential linear momentum they transport can be oriented in moving direction, opposed to the moving direction or orthogonal to the moving direction. They are not photons. Photons will be defined as complex subatomic particles that move with light speed.

2.12.2 Complex subatomic particles that move with light speed.

Complex subatomic particles that move with light Speed (photons) are generated when negative basic subatomic particles (electrons) of an atom change to a lower energy level. The energy difference is stored in the transversal rotational momentum J_n of basic subatomic particles that move with light speed. A complex subatomic particle that moves with light speed consists of at least two basic subatomic particles that move with light speed, separated by a distance of $\frac{\lambda}{2}$ in propagation direction. The two basic subatomic particles differ in their potential transversal linear momentums $p_c^{\perp}$, that are opposed.

The longitudinal linear momentum $p_c^{\|}$ is responsible for the particle character, while the opposed transversal linear momentums at the distance $\frac{\lambda}{2}$ define the wave character of the complex subatomic particle that move with light speed (photon).

The concept is shown on Fig. 22.

2.13 Polarization of basic subatomic particles.

We have seen that the basic subatomic particles emit fundamental particles in all directions and are regenerated by fundamental particles of the opposed type from all directions.

To calculate the total energy or the total linear momentum we have to ingrate over the angle φ from 0 to π, and over the angle γ from 0 to 2 π as shown in Fig. 17. The integration over the angle γ is not necessary with non polarized basic subatomic particles because of the rotational symmetry of these particles.

The polarized basic subatomic particles have an axial symmetry and the integrations over the angle φ or the angle γ are limited to part of the whole intervals, because over the remaining intervals the integrations are zero.

The following polarizations (spins) are possible:

1. Longitudinal polarization, when the integration over the angle γ can be limited to part of the whole interval.

2. Transversal polarization, when the integration over the angle φ can be limited to part of the whole interval.

3. Longitudinal and transversal polarization, when both integrations can be limited to part of the whole intervals.

4. Complex polarization, when the relation between γ and φ is given by a complex function.

2.14 Determination of the probability function W for basic subatomic particles.

The emitted fundamental particles expand with constant velocity in the space around the nucleus of the basic subatomic particle.

The density is therefore invers proportional to the square distance to the nucleus of the basic subatomic particle.

The density of the emitted beam of fundamental particles is because of the radial symmetry given by

$$\rho_e = \frac{r_o}{r_e^2} \tag{96}$$

Fundamental particles of the opposed type are equally distributed in the neutral space and the probability to meet them is

$$w_o = 1 \tag{97}$$

The probability that fundamental particles of the emitted beam meet with fundamental particles of the opposed type in the neutral space in the volume

$$dV = dr_e \; r_e d\varphi \;\; r_e \sin\varphi \; d\gamma \tag{98}$$

and regenerate the basic subatomic particle is

$$w = w_e \; w_o \qquad with \qquad w_e = \frac{r_o}{r_e^2} \; dr_e \tag{99}$$

For a basic subatomic particle that moves with constant speed v in a neutral space the probability W that the emitted fundamental particles meet with fundamental particles of the opposed type is $W = 1$. This results from the consideration that the energy of the emitting basic subatomic particle at $x = 0$ and the energy of the basic subatomic particle that is regenerated at the distance $x = vt$ is the same.

The integration of the probability along the emitted beam is given by

$$W = \int_{r_o}^{\infty} w = \int_{r_o}^{\infty} \frac{r_o}{r_e^2} \; dr_e = 1 \tag{100}$$

A basic subatomic particle that moves with the velocity v is regenerated at $t = 0$ by its emitted fundamental particles from $t = -\infty$ to $t = 0$. The probability that fundamental particles meet in the defined volume dV is expressed as a time function by

$$w = w_e \; w_o = \frac{(v_e \; t_o)}{(v_e \; t_s)^2} \; d(v_e \; t_s) \tag{101}$$

with

$v_e \; t_o = r_o$ Radius of the nucleus of the BSP
$v_e \; t_s = r_e$ Length of the emitted ray
$v_e \; dt_s = dr_e$

Note: $t_s = t_e$ for all BSP.

The concept is shown in Fig. 23;
See also Fig. 18.

We define that inside the radius r_o of the nucleus of the BSP there are no emitted fundamental particles and that the probability to meet them there is zero. The time integration along the emitted beam is

$$W = \int_{-\infty}^{-t_o} \frac{(v_e \; t_o)}{(v_e \; t_s)^2} \; d(v_e \; t_s) = 1 \tag{102}$$

If we introduce the probability function in the equation for the energy

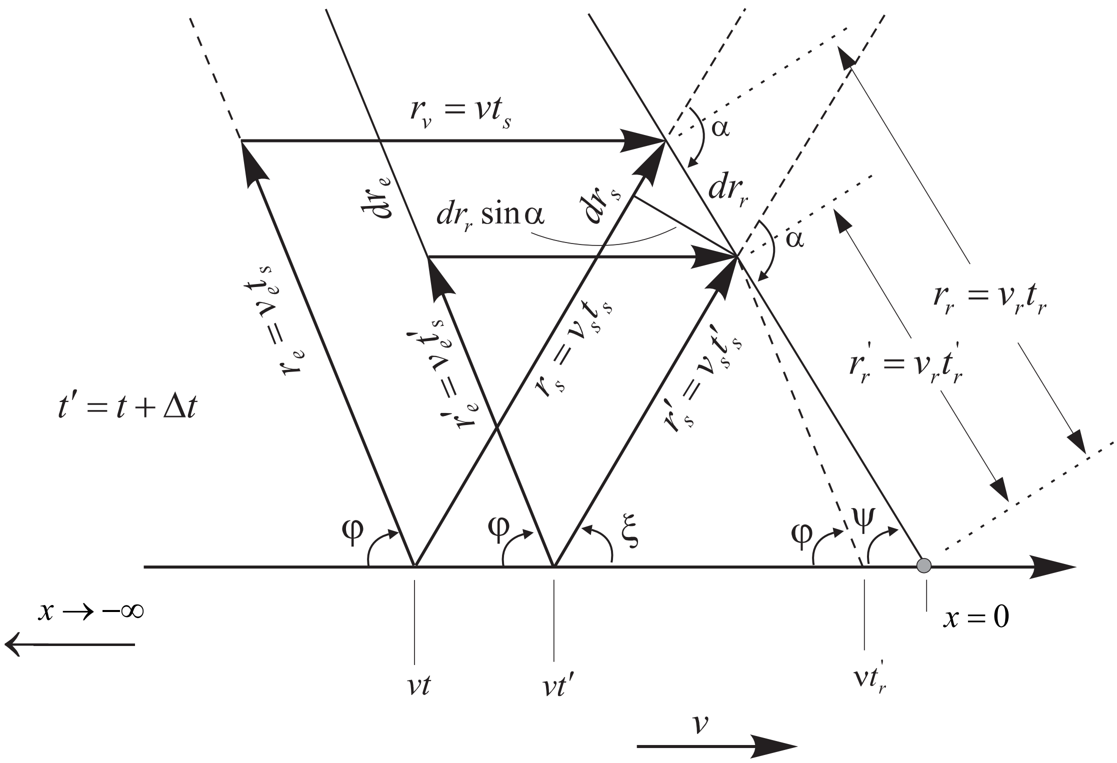


Figure 23: Space diagram showing the regeneration of a particle at $vt = 0$ due to emissions at vt and vt'

$$dE = \frac{m\,c^2}{\sqrt{1-\frac{v^2}{c^2}}}\ \frac{c}{2\,v}\left|\ \frac{\bar{v}_s}{|\bar{v}_e|}\ \times\ \frac{\bar{v}_r}{|\bar{v}_r|}\right|\ W\ d\varphi \tag{103}$$

we get

$$dE = \frac{m\,c^2}{\sqrt{1-\frac{v^2}{c^2}}}\ \frac{c}{2\,v}\left|\ \frac{\bar{v}_s}{|\bar{v}_e|}\ \times\ \frac{\bar{v}_r}{|\bar{v}_r|}\right|\ \int_{r_o}^{\infty}\ \frac{r_o}{r_e^2}\ dr_e\ d\varphi \tag{104}$$

The linear momentum is given by

$$dp = \frac{v}{c^2}\ dE \tag{105}$$

2.15 Specific energy of a basic subatomic particle that moves with constant v.

We start with the expression

$$dE = E\ d\kappa \tag{106}$$

with

$$d\kappa = \frac{c}{2\ v} \left| \frac{\bar{v}_s}{|\bar{v}_e|} \times \frac{\bar{v}_r}{|\bar{v}_r|} \right| \frac{r_o}{r_r^2}\ dr_r\ d\varphi\ \frac{d\gamma}{2\pi} \tag{107}$$

For accelerating and decelerating BSPs we have for $v \ll c$ that $\varphi \approx \psi$ and $r_e \approx r_r$. For differences between accelerating and decelerating BSPs see Fig. 13 and Fig. 15.

We also have that

$$v_s \approx v_e \qquad and \qquad \sin\alpha \approx \frac{v}{c}\ \sin\varphi \tag{108}$$

We get

$$d\kappa \approx \frac{1}{2}\ \frac{r_o}{r_r^2}\ dr_r\ \sin\varphi\ d\varphi\ \frac{d\gamma}{2\pi} \tag{109}$$

With

$$dr_\psi = r_r\ d\varphi \qquad h = r_r\ \sin\varphi \qquad dV = dr_r\ dr_\psi\ h\ d\gamma \tag{110}$$

we get for the specific energy

$$\frac{dE}{dV} = \frac{E}{4\pi}\ \frac{r_o}{r_r^{\,4}} \qquad for \qquad v \ll c \tag{111}$$

The energy density varies only with the distance r_r. There is no influence on the energy density distribution due to the speed v.

2.16 Definition of the magnitudes dH_s and dH_n.

We start with the expressions

$$E = E_s\ +\ E_n \qquad\qquad dE = dE_s\ +\ dE_n \tag{112}$$

with

$$dE_s = E_s\ \frac{c}{2\ v} \left| \frac{\bar{v}_s}{|\bar{v}_e|} \times \frac{\bar{v}_r}{|\bar{v}_r|} \right| w\ d\varphi \qquad\qquad dE_s = E_s\ d\kappa \tag{113}$$

and

$$dE_n = E_n \frac{c}{2\ v} \left| \frac{\bar{v}_s}{|\bar{v}_e|} \times \frac{\bar{v}_r}{|\bar{v}_r|} \right| w\ d\varphi \qquad\qquad dE_n = E_n\ d\kappa \tag{114}$$

with

$$d\kappa = \frac{c}{2\ v} \left| \frac{\bar{v}_s}{|\bar{v}_e|} \times \frac{\bar{v}_r}{|\bar{v}_r|} \right| w\ d\varphi \qquad\qquad dE = E\ d\kappa \tag{115}$$

We define the magnitudes

$$dH_s = H_s\ d\kappa \qquad and \qquad dH_n = H_n\ d\kappa \tag{116}$$

with

$$H_s^2 = E_s = \frac{E_o^2}{\sqrt{E_o^2\ +\ E_p^2}} \qquad and \qquad H_n^2 = E_n = \frac{E_p^2}{\sqrt{E_o^2\ +\ E_p^2}} \tag{117}$$

We define also the variable H so that

$$H^2 = H_s^2\ +\ H_n^2 \qquad\qquad with \qquad\qquad H^2 = E \tag{118}$$

For the longitudinal components at a point in the space we get

$$dE = H^2\ d\kappa = \nu\ J_e \qquad\qquad dH = H\ d\kappa \tag{119}$$

$$dE_s = H_s^2\ d\kappa = \nu\ J_s \qquad\qquad dH_s = H_s\ d\kappa \tag{120}$$

and for the transversal component we get

$$dE_n = H_n^2\ d\kappa = \nu\ J_n \qquad\qquad dH_n = H_n\ d\kappa \tag{121}$$

Note:

$$[\ dH\ ]^2 = \nu\ J_e\ d\kappa = dE\ d\kappa \neq dE \qquad\qquad [\ dH_s\ ]^2 = \nu\ J_s\ d\kappa = dE_s\ d\kappa \neq dE_s \tag{122}$$

$$[\ dH_n\ ]^2 = \nu\ J_n\ d\kappa = dE_n\ d\kappa \neq dE_n \qquad\qquad dH \neq dH_s\ +\ dH_n \tag{123}$$

For a particle moving with $v \ll c$ we have

$$E_s \approx E_o \qquad E_n \approx \frac{p^2}{m} \qquad H_s \approx \sqrt{m}\ c \qquad H_n \approx \frac{p}{\sqrt{m}} \tag{124}$$

and

$$dH_n = H_n\, d\kappa = \frac{p}{\sqrt{m}}\, d\kappa \qquad\qquad p = \sqrt{m} \int_\sigma dH_n \tag{125}$$

with $\int_\sigma$ the spacial integral. From the last expression we see that dH_n is a measure of the linear momentum p of a particle.

If two fundamental particles from two BSPs cross, their longitudinal rotational momentums generate, according to postulate 6, the following transversal rotational momentum.

$$\bar{J}^{(s)}_{n_2} = \operatorname{sign}(\bar{J}_{e_1}) \operatorname{sign}(\bar{J}_{e_2}) \left(\sqrt{J_{e_1}}\, \bar{e}_1 \times \sqrt{J_{s_2}}\, \bar{s}_2\right) \tag{126}$$

If we multiply both sides of the equation with $\sqrt{\nu_{e_1}\, d\kappa_1}$ and $\sqrt{\nu_{s_2}\, d\kappa_2}$ and take the absolute value we get

$$dE^{(s)}_{n_2} = \left| \sqrt{\nu_{e_1}\ J_{e_1}\ d\kappa_1}\, \bar{e}_1 \times \sqrt{\nu_{s_2}\ J_{s_2}\ d\kappa_2}\, \bar{s}_2 \right| \tag{127}$$

or

$$dE^{(s)}_{n_2} = |\, dH_{e_1}\ \bar{e}_1 \times dH_{s_2}\ \bar{s}_2\, | \qquad \textit{with} \qquad dH_{s_i}\ \bar{s}_i = \sqrt{\nu_{s_i}\ J_{s_i}\ d\kappa_i}\, \bar{s}_i \tag{128}$$

If at the same time two other fundamental particles from the same two BSPs generate a transversal rotational momentum $-\bar{J}^{(s)}_{n_2}$, so that the pair complies with the symmetry requirements for generation of linear momentum, we get for the linear momentum on the two BSPs

$$dp = \frac{1}{c}\, dE^{(s)}_p \qquad \textit{with} \qquad dE^{(s)}_p = \left| \int_{r_{r_1}}^{\infty} dH_{e_1}\ \bar{e}_1 \times \int_{r_{r_2}}^{\infty} dH_{s_2}\ \bar{s}_2 \right| \tag{129}$$

If two fundamental particles from two BSPs cross, their transversal rotational momentums generate, according to postulate 7, the following rotational momentum.

$$\bar{J}^{(n)}_2 = \operatorname{sign}(\bar{J}_{e_1}) \operatorname{sign}(\bar{J}_{e_2}) \left(\sqrt{J_{n_1}}\, \bar{n}_1 \times \sqrt{J_{n_2}}\, \bar{n}_2\right) \tag{130}$$

If we multiply both sides of the equation with $\sqrt{\nu_{n_1}\, d\kappa_1}$ and $\sqrt{\nu_{n_2}\, d\kappa_2}$ and take the absolute value we get

$$dE^{(n)}_1 = |\, dH_{n_1}\ \bar{n}_1 \times dH_{n_2}\ \bar{n}_2\, | \qquad \textit{with} \qquad dH_{n_i}\ \bar{n}_i = \sqrt{\nu_{n_i}\ J_{n_i}\ d\kappa_i}\, \bar{n}_i \tag{131}$$

If at the same time two other fundamental particles from the same two BSPs cross, and their transversal rotational momentum generate a rotational momentum $-\bar{J}_2'^{(n)}$, so, that the pair complies with the symmetry requirements for generation of linear momentum, we get for the linear momentum on the two BSPs

$$dp = \frac{1}{c}\, dE_p^{(n)} \qquad with \qquad dE_p^{(n)} = \left| \int_{r_{r_1}}^{\infty} dH_{n_1}\, \bar{n}_1 \times \int_{r_{r_2}}^{\infty} dH_{n_2}\, \bar{n}_2 \right| \tag{132}$$

2.16.1 Relations between fields from standard physics and the dH fields.

The energy densities for the electric and the magnetic fields from standard physics are:

$$\omega_e = \frac{1}{2}\,\mathbf{E}\,\mathbf{D} = \frac{1}{2}\,\epsilon_o\,\mathbf{E}^2 \qquad\qquad \omega_m = \frac{1}{2}\,\mathbf{H}\,\mathbf{B} = \frac{1}{2}\,\mu_o\,\mathbf{H}^2 \tag{133}$$

Note: **Bold** letters are used for the fields from standard physics.

For the fields of the present theory, the corresponding energy densities are:

$$\omega_s = \frac{dE_s}{dV} \qquad \omega_n = \frac{dE_n}{dV} \qquad with \qquad dV = r^2\,dr\,\sin\varphi\,d\varphi\,\frac{d\gamma}{2\pi} \tag{134}$$

With

$$dH_s = \sqrt{dE_s\,d\kappa} \qquad and \qquad dH_n = \sqrt{dE_n\,d\kappa} \tag{135}$$

we get with $\omega_e = \omega_s$ and $\omega_m = \omega_n$

$$dH_s = \sqrt{\frac{1}{2}\,\epsilon_o\,dV\,d\kappa}\;\mathbf{E} \qquad and \qquad dH_n = \sqrt{\frac{1}{2}\,\mu_o\,dV\,d\kappa}\;\mathbf{H} \tag{136}$$

Note: The fields from standard physics generate the forces on charged particles directly while the dH fields from the present approach require pairs of opposed dH components to generate forces (see sec. 2.10).

3 Linear momentum generated out of opposed angular momenta.

3.1 Total linear momentum out of dE_p.

Fig. 24 shows how the linear momentum dp is calculated out of the opposed angular momenta $\bar{J}_n$ and $-\bar{J}_n$ for a single moving subatomic particle (SP). For the single particle it is $dp = 0$ what means that $p = mv$ is constant in time.

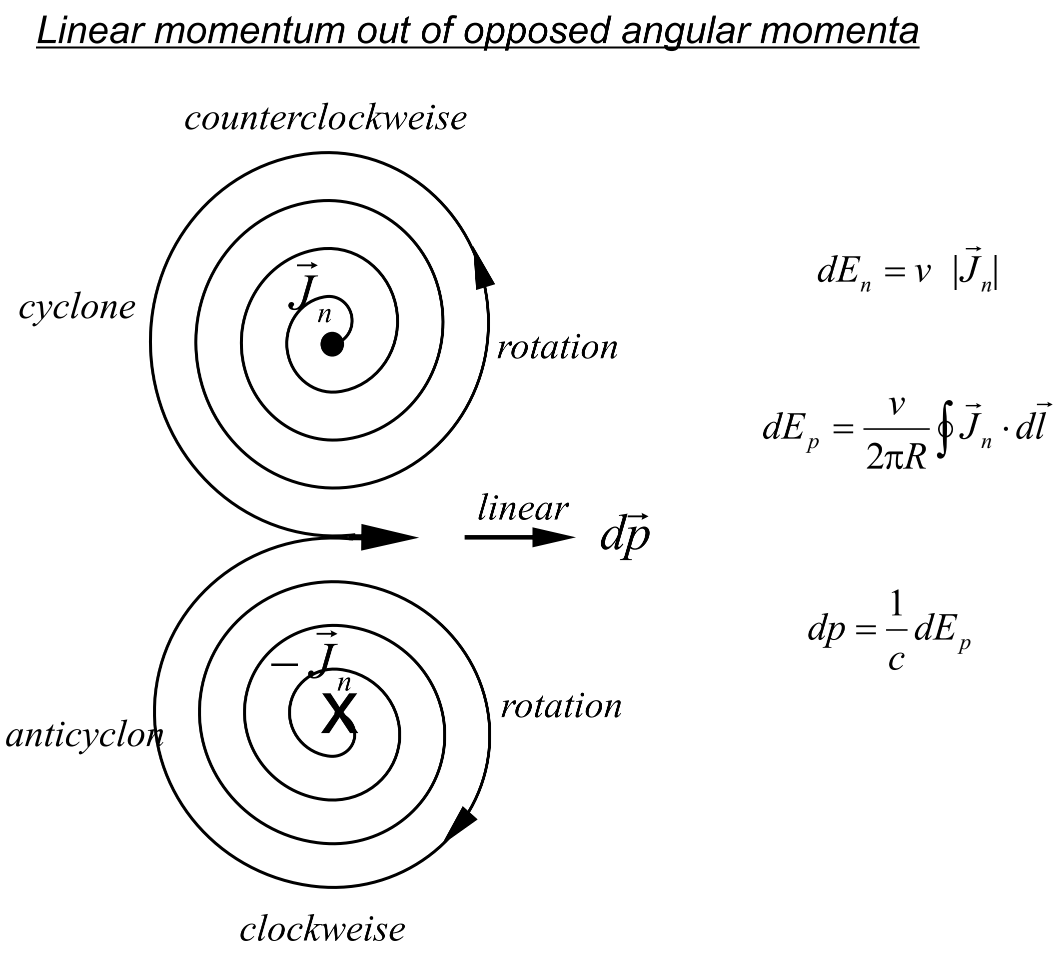


Figure 24: Generation of linear momentum out of opposed angular momenta

Two SPs interact trough the cross or scalar products of the angular momenta of their FPs. For SP "1" and SP "2" we can write in a general form:

$$J \, \bar{e} = \sqrt{dJ_1} \, \bar{e}_1 \; \times \; \sqrt{dJ_2} \, \bar{e}_2 \tag{137}$$

with $dJ_i = J_i \, d\kappa_i$ and $\bar{e}_i$ the unit vector.
We now multiply the equation with the frequency ν to get the energy.

$$dE \, \bar{e} = \sqrt{\nu \ J_1 \, d\kappa_1} \, \bar{e}_1 \; \times \; \sqrt{\nu \ J_2 \, d\kappa_2} \, \bar{e}_2 \tag{138}$$

With $dE_i = \nu \ J_i = E_i \, d\kappa_i$ and $E_i = E_i(v)$ and $d\kappa = d\kappa(r_o, r, \varphi, \gamma)$ we get

$$dE \, \bar{e} = \sqrt{E_1} \, d\kappa_1 \, \bar{e}_1 \; \times \; \sqrt{E_2} \, d\kappa_2 \, \bar{e}_2 \tag{139}$$

and with $dH_i = \sqrt{E_i} \, d\kappa_i$ we get

$$dE\;\bar{e} = dH_1\;\bar{e}_1\;\times\;dH_2\;\bar{e}_2 = d\bar{H}_1 \times d\bar{H}_2 \tag{140}$$

We define that

$$dE_p^{'}\;\bar{e} = \sqrt{E_1}\;\int_{r_o}^{\infty} d\kappa_1\;\bar{e}_1\;\times\;\sqrt{E_2}\;\int_{r_o}^{\infty} d\kappa_2\;\bar{e}_2 = \int_{r_o}^{\infty} \bar{d}H_1\;\times\;\int_{r_o}^{\infty} \bar{d}H_2 \tag{141}$$

and that

$$dE_p = \frac{1}{2\pi R}\oint dE_p^{'}\;\bar{e}\cdot d\bar{l} \qquad dp = \frac{1}{c}dE_p \qquad dF = \frac{dp}{dt} \tag{142}$$

Note: For the Coulomb interaction $\bar{e}_i = \bar{s}_i$. For the Ampere interaction $\bar{e}_i = \bar{n}_i$ and for the inductive interaction $\bar{e}_1 = \bar{n}_1$ and $\bar{e}_2 = \bar{s}_2$ and the cross product has to be changed to the scalar product.

3.2 Elementary linear momentum out of dE_h.

The energy stored in the transversal angular momentum J_n of a BSP moving with v and which corresponds to a volume dV was defined as

$$dE_n = E_n\;d\kappa_n = J_n\;\nu \tag{143}$$

The concept is shawn in Fig.24

We now define N as the number of FPs with the elementary energy $E_{FP} = h\nu_o$, where ν_o is a universal constant frequency, contained in the volume dV with energy dE_n. See sec. 9.2.1 for the definition of $E_{FP} = h\nu_o$.

$$N_n = \frac{dE_n}{E_{FP}} = \frac{E_n\;d\kappa_n}{E_{FP}} \qquad with \qquad E_{FP} = h\;\nu_o \tag{144}$$

The linear momentum of a SP defines a relative movement to a static BSA and is given by

$$dp_{ind}^{(n)} = \frac{1}{c}\;d\bar{H}_n\cdot d\bar{H}_{s_p} \qquad with \qquad dH_i = H_i\;d\kappa_i \tag{145}$$

where $d\bar{H}_n$ is the transversal field of the moving BSP and $d\bar{H}_{s_p}$ is the longitudinal field of the static porbe BSP. With

$$dH_i = \sqrt{E_i}\;d\kappa_i = \sqrt{dE_i\;d\kappa_i} = \sqrt{N_i\;E_{FP}\;d\kappa_i} \tag{146}$$

The product $d\kappa_n\;d\kappa_{sp}$ that results from equation (145) gives the probability that FPs of the two BSPs meet in the volume dV. As to each FP from N_n corresponds one

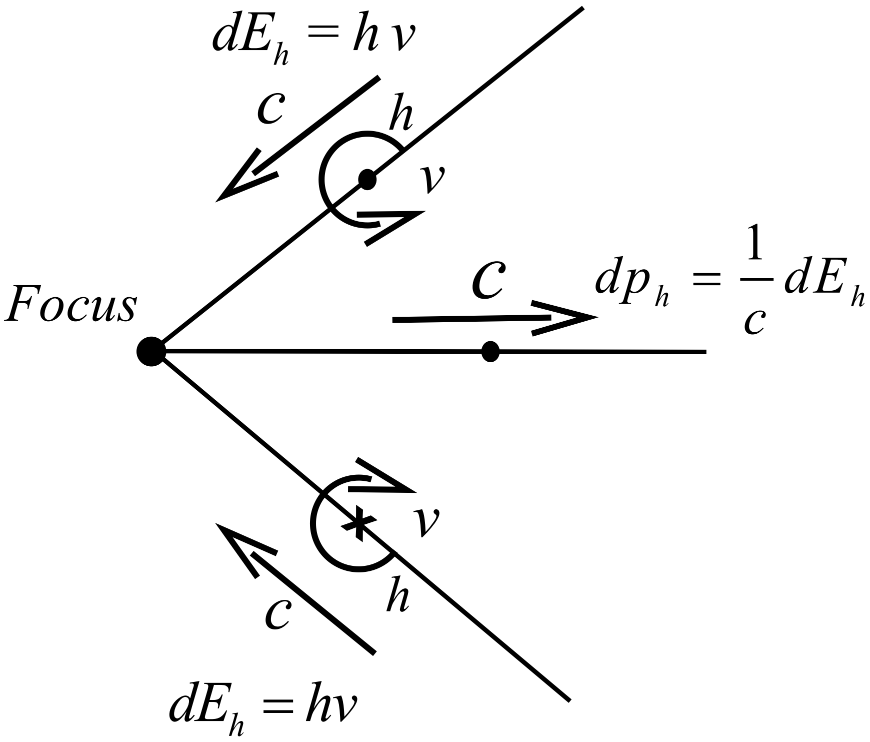


Figure 25: Generation of elementary linear momentum
out of opposed elementary angular momenta h

FP of N_{sp} results that $N_n = N_{sp} = N$ and that the probability $d\kappa_n \, d\kappa_{sp} = 1$. We get that

$$dp_{ind}^{(n)} = \frac{1}{c} \, N \, E_{FP} \tag{147}$$

If we define the elementary linear momentum dp_h as (see Fig. 25)

$$dp_h = \frac{1}{c} \, E_{FP} = \frac{h}{c} \, \nu_o \tag{148}$$

and consider that $N_n = N_{sp} = N$ we get for the total linear momentum

$$dp_{ind}^{(n)} = N \, dp_h \tag{149}$$

For

$$dE_n = E_n \, d\kappa = \frac{E_p^2}{\sqrt{E_o^2 + E_p^2}} \, d\kappa \tag{150}$$

and $E_o^2 << E_p^2$ and $v << c$ we get

$$N = \frac{dE_n}{E_{FP}} = \frac{m \, c \, d\kappa}{E_{FP}} \, v = K \, v \quad with \quad K = \frac{m \, c \, d\kappa}{E_{FP}} = constant \tag{151}$$

From eq. (149) we get

$$dp_{ind}^{(n)} = m\ v\ d\kappa \qquad p_{ind}^{(n)} = m\ v\ \oint_V d\kappa \qquad p_{ind}^{(n)} = m\ v \tag{152}$$

3.3 De Broglie and the Focal Point approach.

The present Focal Point approach defines the wave length of a SP as follows:

$$\lambda = \frac{h\ c}{\sqrt{E_o^2 + E_p^2}} \quad with \quad E_o = m\ c^2 \qquad E_p = p\ c \tag{153}$$

We define the following wavelength:

$$\lambda_o = \frac{h\ c}{E_o} \qquad and \qquad \lambda_p = \frac{h\ c}{E_p} \tag{154}$$

If we replace them in the first equation we get

$$\lambda = \frac{1}{\sqrt{\frac{1}{\lambda_o^2} + \frac{1}{\lambda_p^2}}} \qquad or \qquad \frac{\lambda^2}{\lambda_o^2} + \frac{\lambda^2}{\lambda_p^2} = 1 \tag{155}$$

For the de Broglie wavelength $\lambda_{dB} = \lambda_p$ we get

$$\lambda_{dB} = \lambda_p = \frac{\lambda\ \lambda_o}{\sqrt{\lambda_o^2 - \lambda^2}} \tag{156}$$

Part II Static Interactions

Deduction of the Coulomb, Ampere and Lorentz laws. Quarks are defined as swarms of electrons and positrons.

4 Laws that describe the interactions at static basic subatomic particles.

In this section the linear momentum at two static BSPs that are separated by the distance d is deduced and the quantized momentum time Δt and the potential energy are calculated.

The general form of the Coulomb-law is deduced and the range is shown where it coincides with the classic Coulomb-law.

The induction between two static BSPs is derived and the energy-, angular and linear momenta balance presented.

The energy of the transversal angular momenta of FPs of a straight infinite conductor, and the current flow for a constant mass-current I_m are calculated. Subsequently, the linear momentum on two parallel straight conductors at the distance d and the general form of the Ampere-law are derived. The range is shown where the general Ampere-law coincides with the classic Ampere-law.

After calculation of the quantized momentum time Δt for two straight conductors and comparing it with the quantized momentum time Δt for two static BSPs, the coincidence in the range $d \gg r_o$ is shown, where r_o is the radius of a BSP.

The force (Lorentz) on a BSP that moves with constant speed through a field of oriented transversal angular momenta and the force on a complex SP through the same field is explained.

Finally a classification of particles and fields is presented.

4.1 Linear momentum at two basic subatomic particles.

At an isolated basic subatomic particle with $v = 0$ the angle α between emitted and regenerating fundamental particles is $\alpha = \pi$ and no transversal rotational momentum J_n is generated. If there are two static basic subatomic particles at a distance d, the emitted fundamental particles of one BSP will cross with the regenerating fundamental particles of the other BSP and their longitudinal rotational momentums will generate opposed transversal rotational momentums according to postulate 6. Because of the symmetry shown on Fig. 26, the opposed transversal rotational momentums J_n are generated at different but symmetric rays. These transversal rotational momentums have different magnitudes along a ray of regenerating fundamental particles because of the changing angle β along the ray, but all have the same rotational sense. The concept is shown on Fig. 26.

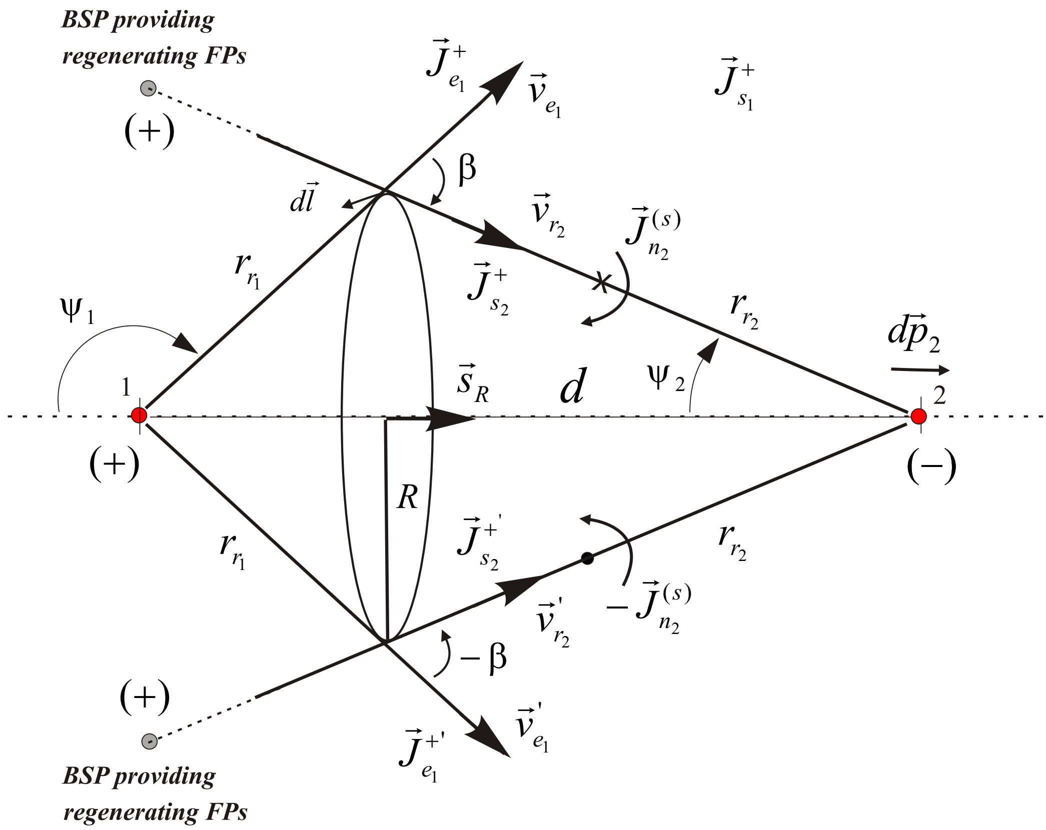


Figure 26: Generation of rotational momentums at regenerating fundamental particles of two static basic subatomic particles at the distance d

The generated opposed transversal rotational momentums $\bar{J}^{(s)}_{n_2}$ at the regenerating rays of BSP 2 comply with the requirements for generation of linear momentum at BSP 2. The direction of the linear momentum coincides with the connection line between the two basic subatomic particles.

According postulate **6** it is

$$\bar{J}^{(s)}_{n_2} = \ \mathrm{sign}(\bar{J}_{e_1})\,\mathrm{sign}(\bar{J}_{e_2})\left(\sqrt{J_{e_1}}\;\bar{e}_1 \;\times\; \sqrt{J_{s_2}}\;\bar{s}_2\right) \tag{157}$$

The sign of the linear momentum is given with

$$\mathrm{sign}(d\bar{p}_2) = -\ \mathrm{sign}(\bar{J}^{(s)}_{n_2}) \tag{158}$$

To calculate the energy $dE^{(s)}_p$ that allows to calculate the linear momentum dp, we start with the energy equation for longitudinal rotational momentum J_s of a BSP that moves with the velocity v.

$$dE_s = \frac{E_o^2}{\sqrt{E_0^2 \; + \; E_p^2}} \, \frac{c}{2\,v} \left| \, \frac{\bar{v}_s}{|\bar{v}_e|} \; \times \; \frac{\bar{v}_r}{|\bar{v}_r|} \right| \, w_e \; d\varphi \tag{159}$$

with

$$w_e = \frac{r_o}{r_e^2} \, dr_e \qquad and \qquad E_o = m \; c^2 \tag{160}$$

For $v = 0$ we have that $v_s = v_e$ and that

$$\lim_{v \to 0} \frac{\sin \alpha}{v} = \frac{1}{c} \; \sin \varphi \tag{161}$$

We obtain

$$dE_s = E_o \, \frac{1}{2} \; w_e \; \sin \varphi \; d\varphi \;\; = \;\; E_o \; d\kappa \tag{162}$$

For $v = 0$ we also have, that

$$r_e = r_r \qquad dr_e = dr_r \qquad \varphi = \psi \qquad d\varphi = d\psi \tag{163}$$

and we can write dE_s as follows

$$dE_s = E_o \, \frac{1}{2} \; w_r \; \sin \psi \; d\psi \;\; = \;\; E_o \; d\kappa \tag{164}$$

Now we write the expression for the variable dH_s

$$dH_s = H_s \, \frac{1}{2} \, \frac{r_o}{r_r^2} \, dr_r \; \sin \psi \; d\psi \qquad with \qquad H_s = \sqrt{E_o} \tag{165}$$

Through the area dA at the distance r_r defined by the differential angles $d\psi$ and $d\gamma$ of the torus with vertex at the BSP

$$dA = r_r \; \sin \psi \; r_r \; d\psi \; d\gamma \tag{166}$$

flows at each moment all the fundamental particles that the regenerating ray has stored from r_r to $r_r = \infty$.

$$\int_{r_r}^{\infty} dH_s \qquad with \; \psi \;\; and \;\; d\psi = constant \tag{167}$$

The same is valid for the fundamental particles stored by the emitting ray and we can write

$$\int_{r_r}^{\infty} dH_e \qquad with \qquad dH_e = H\ d\kappa = \sqrt{E_o}\ d\kappa \tag{168}$$

If we have two basic subatomic particles whose stored fundamental particles meet at the distances r_{r_1} and r_{r_2}, we get for the energy contribution responsible for the linear momentum at BSP 2

$$dE_p^{(s)} = \left| \int_{r_{r_1}}^{\infty} dH_{e_1}\ \bar{s}_1 \times \int_{r_{r_2}}^{\infty} dH_{s_2}\ \bar{s}_2 \right| \tag{169}$$

and the linear momentum is given by

$$dp_2\ \bar{s}_R = \frac{a}{c} \oint_R \left\{ \frac{\bar{dl} \cdot (\bar{s}_1 \times \bar{s}_2)}{2\pi R} \int_{r_1}^{\infty} H_{e_1}\ d\kappa_{r_1} \int_{r_2}^{\infty} H_{s_2}\ d\kappa_{r_2} \right\} \bar{s}_R \tag{170}$$

Note: The dimensionless equalization factor $a = 8.7743 \cdot 10^{-2}$ is introduced at this point to make in sec. 9.1 the product $E_o\ \Delta_o t$ exactly equal the Planck constant h.

The magnitudes dH_{e_1} and dH_{s_2} must refer to the same volume dV in which they meet and in which they generate the transversal rotational momentum. In this special case of symmetry the requirement is fulfilled, because of the coincidence of the two toruses of the BSPs, by the following relation between the two areas.

$$dr_{r_1}\ r_{r_1}\ d\psi_1 = dr_{r_2}\ r_{r_2}\ d\psi_2 \tag{171}$$

The concept is shown in Fig. 27.

The contribution to the linear momentum of the BSP 2 due to the ring-shaped volume dV is

$$dp_2 = \frac{1}{c}\ dE_p^{(s)} \tag{172}$$

We obtain the total linear momentum for the BSP 2 by integrating over the whole space. For the integration over $d\psi_1$ and $d\psi_2$ we must consider the minimum and maximum integration limits defined by the radii of the two BSPs and the distance d. The limits are given by

$$\psi_{min} = \arcsin \frac{r_o}{d} \qquad \psi_{max} = \pi - \psi_{min} \qquad d \geq \sqrt{r_o^2 + r_o^2} \tag{173}$$

$$\psi_{min} = \arccos \frac{d}{2r_o} \qquad \psi_{max} = \pi - \psi_{min} \qquad d < \sqrt{r_o^2 + r_o^2} \tag{174}$$

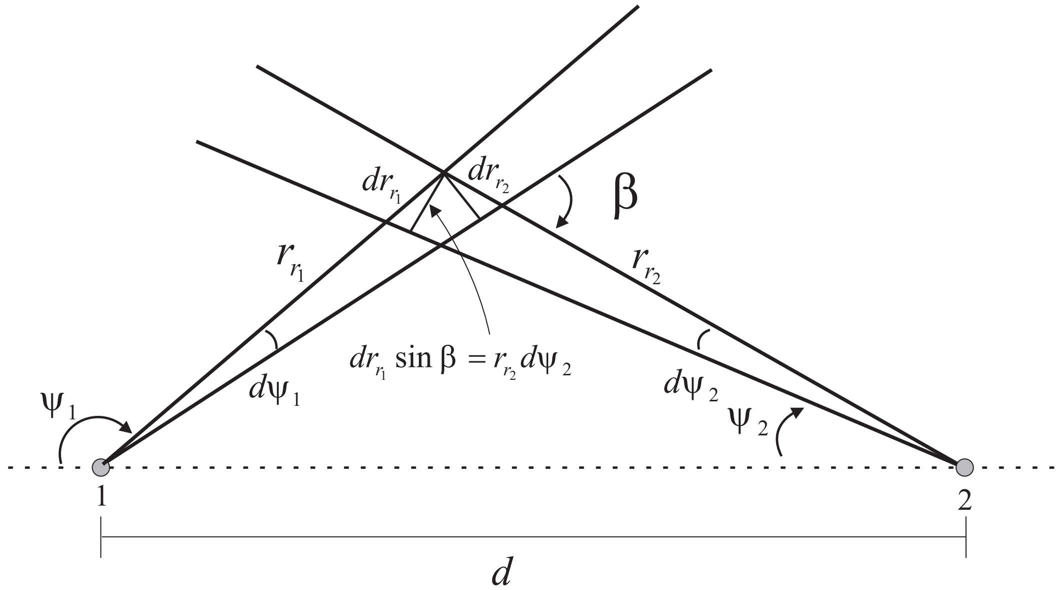


Figure 27: Geometric relations for the calculation of the linear momentum between two static basic subatomic particles at a distance d

$$p_2 = \int_{\psi_{1_{min}}}^{\psi_{1_{max}}} \int_{\psi_{2_{min}}}^{\psi_{2_{max}}} dp_2 \tag{175}$$

The concept is shown in Fig. 28 for the angle φ of the emitted ray.

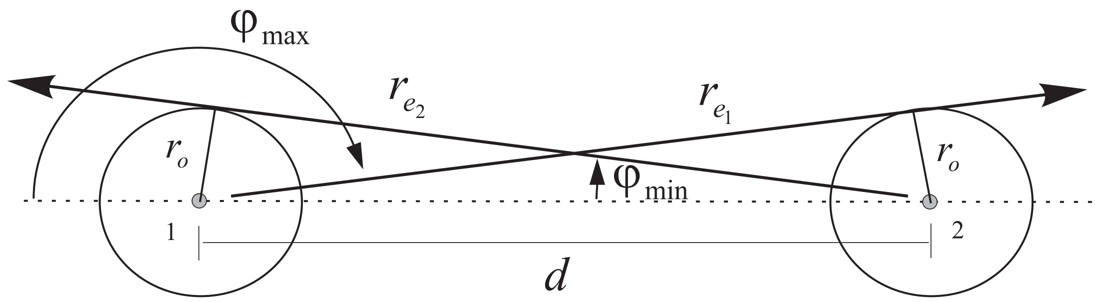


Figure 28: Integration limits for the calculation of the linear momentum between two static basic subatomic particles at the distance d

The force is measured by reversing the distance Δd produced by the linear momentum $\bar{p}_2$ in the time Δt, applying an external force on the BSP. We can therefore write that $d\bar{p}_2 = \bar{p}_2$.

$$d\bar{F}_2 = -\frac{d\bar{p}_2}{dt} = -\frac{\bar{p}_2}{\Delta t} \tag{176}$$

To obtain the total resulting force $\bar{F}$ we have to integrate along all the regenerating rays of BSP 2.

$$\bar{F}_{_2} = \int_\sigma d\bar{F}_{_2} \tag{177}$$

At large distances beyond the maximum linear momentum of Fig. 29, where the force is given by the Coulomb law, the quantized momentum time Δt is calculated by the ratio between the momentum p_2 and the Coulomb force between two charges.

$$\Delta t = \frac{p_2}{F} \qquad with \qquad F = \frac{1}{4\,\pi\,\epsilon_o}\,\frac{Q_1\,Q_2}{d^{\,2}} \tag{178}$$

At short distances before the maximum linear momentum of Fig. 29, we define the quantized momentum time Δt as equal to the quantized momentum time Δt beyond the maximum linear momentum which has the same momentum p_2.

We note that the probability w is a function of the radius of the BSP and, therefore also the momentum p_2 and the time Δt are functions of the radius.

For complex particles that consist of more than one BSP, the force is given by

$$d\bar{F}_2 = -(\Delta n_1.\Delta n_2)\,\frac{\bar{p}_2}{\Delta t} \tag{179}$$

$$d\bar{F}_2 = -(\Delta n_1.\Delta n_2)\,\frac{a}{c\,\Delta t}\,\left|\int_{r_{r_1}}^{\infty} dH_{e_1}\;\bar{s}_1 \times \int_{r_{r_2}}^{\infty} dH_{s_2}\;\bar{s}_2\right| \tag{180}$$

with $\Delta n_i = n_i^+ - n_i^-$ the difference between the number of positive and negative BSPs that form the complex particle i.

For the proton we have $n^+ = 919$ and $n^- = 918$ with a binding Energy of $E_{B_{prot}} = -6.9489 \cdot 10^{-14}\ J = -0.43371\ MeV$. For the neutron we have $n^+ = 919$ and $n^- = 919$ with a binding Energy of $E_{B_{neutr}} = 5.59743 \cdot 10^{-14}\ J = 0.34936\ MeV$.

We define the field generated by the complex particle 1 as

$$dF_F = \frac{d\bar{F}_2}{\Delta n_2} = -\Delta n_1\,\frac{a}{c\,\Delta t}\,\left|\int_{r_{r_1}}^{\infty} dH_{e_1}\;\bar{s}_1 \times \int_{r_{r_2}}^{\infty} dH_{s_2}\;\bar{s}_2\right| \tag{181}$$

with dF_F the force generated by the complex SP Δn_1 on a BSP at point 2.

4.1.1 Calculations

The results are the same for accelerating and decelerating BSPs.

$m_e = 9.1093897 \cdot 10^{-31}\ kg$

$q_e = 1.60217733 \cdot 10^{-19}\ A\ s$
$\epsilon_o = 8.85418781762 \cdot 10^{-12}\ \frac{A\ s}{V\ m}$
$v_e = c$
$v_r = 10^{30}\ \frac{m}{s}$
$r_o = 10^{-16}\ m$
$a = 8.7743 \cdot 10^{-2}$

Note: Because of the axis symmetry of the Coulomb configuration it is possible to describe the problem without the space variable γ. The general form of the distribution function $d\kappa$ is

$$d\kappa = \frac{1}{2}\ \frac{r_o}{r_r^2}\ dr_r\ \sin\varphi\ d\varphi\ \frac{d\gamma}{2\pi} \tag{182}$$

Fig. 29 shows the calculation for the linear momentum p.
For $d = 0$ we have $p = 0$. The linear momentum grows up to his maximum at $d = 2\ r_o$ and then decreases proportional to d^{-2}.

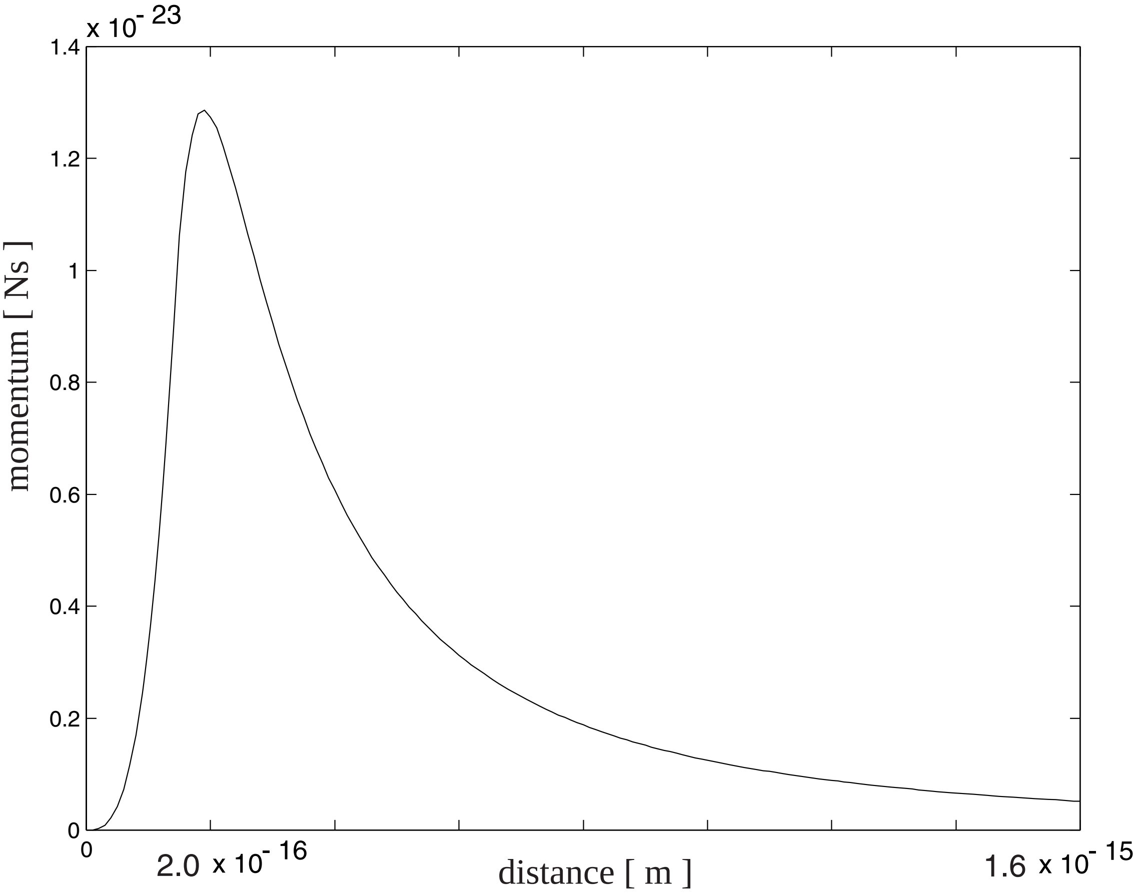


Figure 29: Linear momentum p between two static basic subatomic particles with radius $r_o = 1.0 \cdot 10^{-16} m$

Fig. 30 shows the calculation for the time Δt.
For $d = 2\ r_o$ the time has a minimum an grows then up for $d \to \infty$ to the same value it has for $d = 0$.

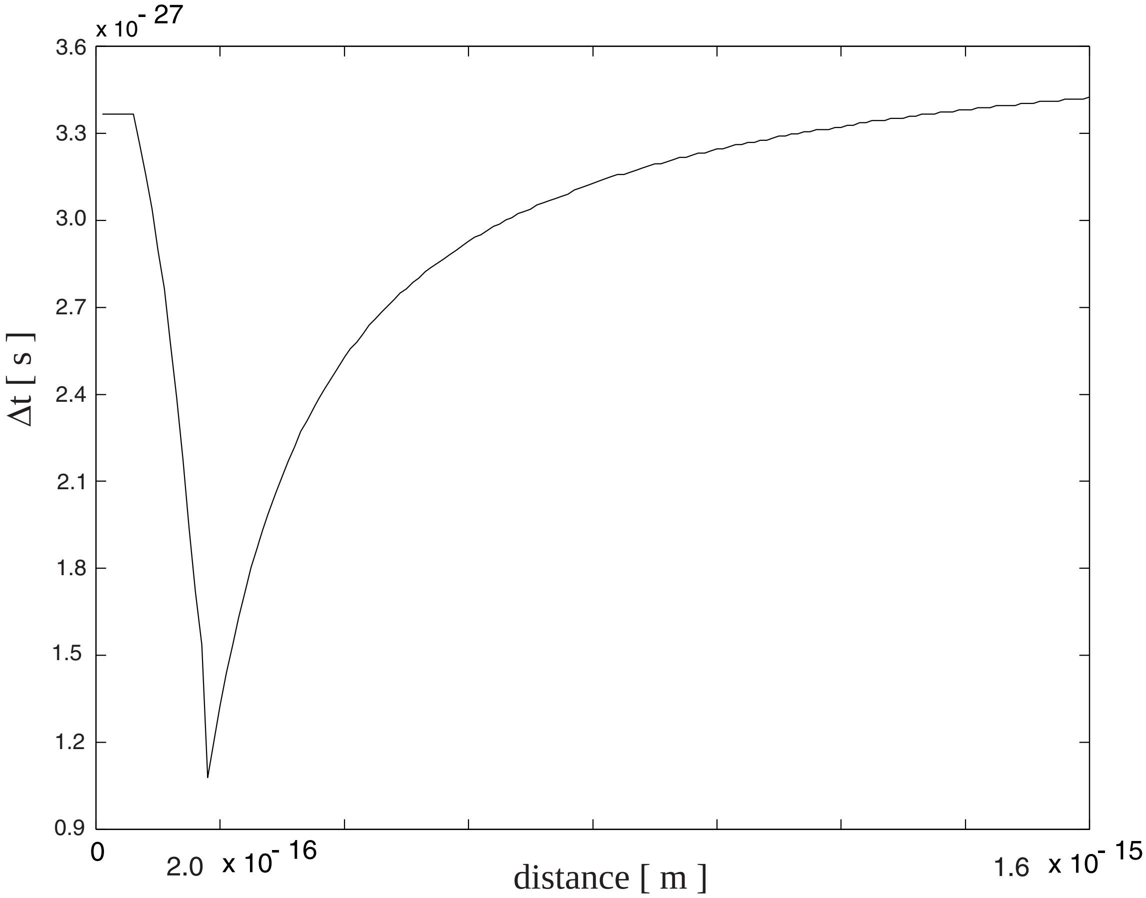


Figure 30: Quantized momentum time Δt between two static basic subatomic particles with radius $r_o = 1.0 \cdot 10^{-16} m$

Fig. 31 shows the calculation for the force F.
For $d = 0$ the force is $F = 0$. The force grows up to his maximum at $d = 2\ r_o$ and then decreases proportional to d^{-2}.

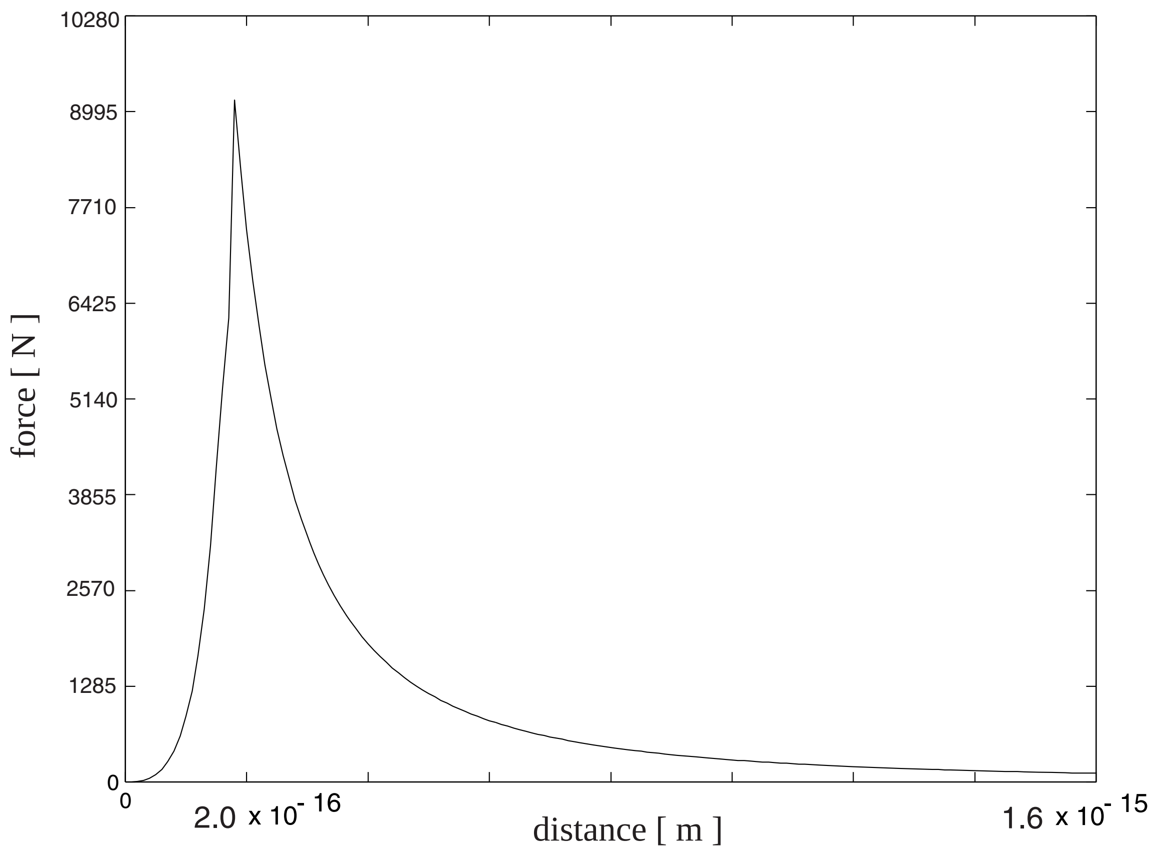


Figure 31: Force F between two static basic subatomic particles with radius $r_o = 1.0 \cdot 10^{-16} m$

Fig. 32 shows the calculation for the potential energy W.
For $d = 0$ the potential energy is $W = 0$. The potential energy then grows for $d \to \infty$ to $W_{pot} = 1.6 \cdot 10^{-12}\ J$

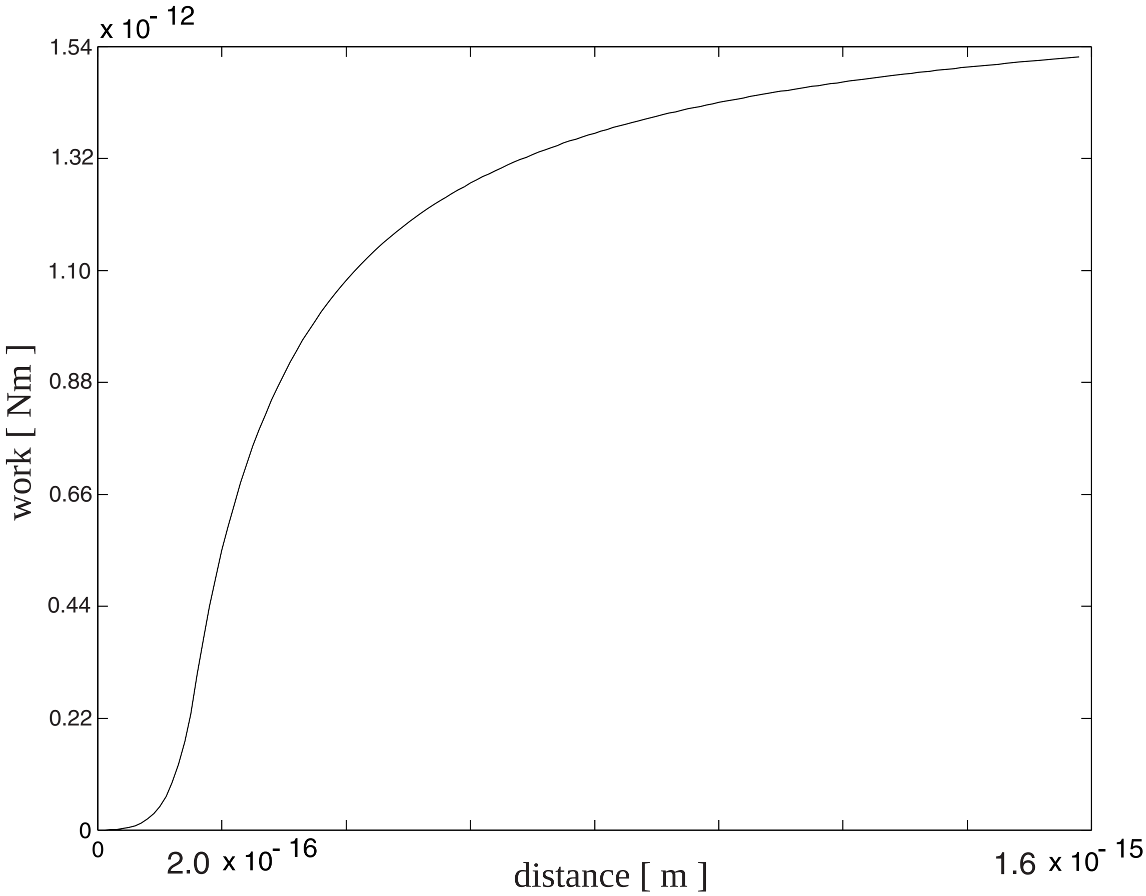


Figure 32: Potential energy between two static basic subatomic particles with radius $r_o = 1.0 \cdot 10^{-16} m$

Summary of calculations.

The time Δt is the same for $d = 0$ and for $d \to \infty$.

$$\Delta t(d = 0) = \Delta t(d \to \infty) \tag{183}$$

The time Δt is a function of the radii r_{o_1} and r_{o_2}.

$$\Delta t = K\ r_{o_1}\ r_{o_2} \qquad with \qquad K = 5.42713 \cdot 10^4\ \frac{sec}{m^2}\ =\ \text{constant for}\ \ d \gg r_o \tag{184}$$

That the force disappears for $d = 0$ means that in the nucleus of an atom the BSPs don't attract nor repel each other.

The energy necessary to separate two BSPs with the proposed radii r_o and with opposed signs from $d = 0$ to $d = \infty$ is

$$W_{pot} = 1.6 \cdot 10^{-12}\ J \approx 1.0 GeV. \tag{185}$$

Note: The ionization potential required to separate an orbital electron from its atom is approx. 5.0 eV. The energy of $W_{pot} \approx 1.0GeV$ shows the difficulty to separate one electron from a neutron, which is composed of equal number of electrons and positrons.

Conclusions.

- As the Coulomb law is only an approximation of the force between two BSPs for distances $d \gg r_o$ we conclude, that the time Δt is constant for all distances from $d = 0$ to $d \to \infty$ as long as the radii remain constant. This conclusion is based on the result that the time Δt is the same for $d = 0$ and $d \to \infty$ (see Fig. 30).

- The new expression for the Coulomb law is proportional to the mass of the electron or positron. The charge of the electron is used to calculate the quantized momentum time Δt. The conservation law of charge is replaced by the conservation law of positive n^+ and negative n^- BSPs that form a complex SP. As the n are integer numbers, the Coulomb force is quantized.

- As the linear momentum is caused by a pair of regenerating fundamental particles with opposed rotational momentums in the time Δt, the frequency the fundamental particles arrive to the nucleus of the BSP is $\frac{1}{\Delta t}$.

4.1.2 Complex particles.

Complex particles are formed by basic subatomic particles with distances between them oscillating around zero. All electrons and positrons that form a stable atomic nucleus are in the region left to the maximum of the curve of Fig. 29, where the attracting or repulsing force grows with the distance. Because of the dynamic polarization of an atomic nucleus produced by the electrons and positrons of the nucleus, all electrons or positrons that leave the nucleus are immediately attracted and remain in the nucleus.

Positive BSPs don't mix with negative BSPs at $d = 0$ because their emitted and regenerating fundamental particles have different rotational momentums and velocities. They can be separated by applying the necessary energy to overcome the maximum linear momentum between them.

We have defined $\Delta n_i = n_i^+ - n_i^-$ as the difference between the number of positive and negative BSPs that form the complex particle i. As examples we have for the proton $n^+ = 919$ and $n^- = 918$ with a binding Energy of $E_{B_{prot}} = -6.9489 \cdot 10^{-14}\ J = -0.43371\ MeV$, and for the neutron $n^+ = 919$ and $n^- = 919$ with a binding Energy of $E_{B_{neutr}} = 5.59743 \cdot 10^{-14}\ J = 0.34936\ MeV$.

4.2 The Coulomb-law for two BSPs.

For the static force between two basic subatomic particles with $v = 0$ and therefor $\psi = \varphi$ we get from the previous section

$$F_2 = \int_\sigma \frac{a}{c\,\Delta t} \left| \int_{r_{r1}}^\infty dH_{e_1}\ \bar{s}_1 \times \int_{r_{r2}}^\infty dH_{s_2}\ \bar{s}_2 \right| \tag{186}$$

with

$$\int_{r_{r_1}}^\infty dH_{e_1} = \frac{1}{2} \sqrt{m_1}\ c\ \frac{r_{o_1}}{r_{r_1}}\ \sin\varphi_1\ d\varphi_1 \qquad |\bar{s}_1 \times \bar{s}_2| = \sin\beta \tag{187}$$

and

$$\int_{r_{r_2}}^\infty dH_{s_2} = \frac{1}{2} \sqrt{m_2}\ c\ \frac{r_{o_2}}{r_{r_2}}\ \sin\varphi_2\ d\varphi_2 \tag{188}$$

If we put the last two expressions in the first equation and concentrate on a dF_2 we get, because of the symmetry

$$dF_2 = \frac{a}{4\,\Delta t} \sqrt{m_1} \sqrt{m_2}\ c\ r_{o_1}\ r_{o_2}\ \frac{\sin\varphi_1\ \sin\varphi_2}{r_{r_1}\ r_{r_2}}\ \sin\beta\ d\varphi_1\ d\varphi_2 \tag{189}$$

or

$$dF_2 = K_F \, \frac{\sin\varphi_1 \, \sin\varphi_2}{r_{r_1} \, r_{r_2}} \, \sin\beta \, d\varphi_1 \, d\varphi_2 \qquad K_F = \frac{a}{4 \, \Delta t} \, \sqrt{m_1} \, \sqrt{m_2} \, c \, r_{o_1} \, r_{o_2} \tag{190}$$

With the following geometric conditions

$$R = r_{r_1} \, \sin\varphi_1 \qquad R = r_2 \, \sin\varphi_2 \qquad - r_{r_1} \, \cos\varphi_1 + r_{r_2} \, \cos\varphi_2 = d \tag{191}$$

we get

$$r_{r_1} \, r_{r_2} = d^{\,2} \, \frac{\sin\varphi_1 \, \sin\varphi_2}{[\, \sin\varphi_1 \, \cos\varphi_2 - \sin\varphi_2 \, \cos\varphi_1 \,]^2} \tag{192}$$

As

$$\sin\varphi_1 \, \cos\varphi_2 - \sin\varphi_2 \, \cos\varphi_1 = \sin(\varphi_1 - \varphi_2) = \sin\beta \tag{193}$$

we obtain for the total force F_2

$$F_2 = \frac{K_F}{d^{\,2}} \int_{\varphi_{1_{min}}}^{\varphi_{1_{max}}} \int_{\varphi_{2_{min}}}^{\varphi_{2_{max}}} |\sin^3(\varphi_1 - \varphi_2)| \, d\varphi_2 \, d\varphi_1 \tag{194}$$

With $\Delta t = K \, r_{o_1} \, r_{o_2}$ and $r_{o_1} = r_{o_2}$ and $m_1 = m_2$ and $a = 8.7743 \cdot 10^{-2}$ we get

$$K_F = \frac{a}{4 \, K} \, m \, c = 1.104516 \cdot 10^{-28} \, \left[\frac{kg \; m^3}{s^2}\right] \quad with \quad K = 5.4274 \cdot 10^4 \, \left[\frac{s}{m^2}\right] \tag{195}$$

$$\varphi_{min} = \arcsin\frac{r_o}{d} \qquad \varphi_{max} = \pi - \varphi_{min} \qquad d \geq \sqrt{r_o^2 + r_o^2} \tag{196}$$

$$\varphi_{min} = \arccos\frac{d}{2 \, r_o} \qquad \varphi_{max} = \pi - \varphi_{min} \qquad d < \sqrt{r_o^2 + r_o^2} \tag{197}$$

Eq.(194) is the **Coulomb-law** expressed in the present approach. We see the inverse proportionality to $d^{\,2}$. The double integral becomes zero for $d \to 0$ because the integration limits approximate each other taking the values $\varphi_{min} = \frac{\pi}{2}$ and $\varphi_{max} = \frac{\pi}{2}$. For $d \gg r_o$ the double integral becomes a constant because the integration limits tend to $\varphi_{min} = 0$ and $\varphi_{max} = \pi$.

The classic Coulomb-law for the electron is

$$F_s = \frac{1}{4\pi \, \epsilon_o} \frac{q_e \cdot q_e}{d^2} = K_F^{'} \, \frac{1}{d^2} \tag{198}$$

with

$$K_F^{'} = \frac{q_e^2}{4\pi\ \epsilon_o} = 2.307078 \cdot 10^{-28} \qquad [N\ m^2] \tag{199}$$

If we make $F_2 = F_s$ we get for the double integral the value $\int\int_{Coulomb} = 2.0887$ which is valid for $d \gg r_o$. The Coulomb equation transforms to

$$F_2 = 2.088768\ \frac{a\ c}{4\ K}\ \frac{\sqrt{m_1}\sqrt{m_2}}{d^{\,2}} = 2.78029601 \cdot 10^{32}\ \frac{m_1\ m_2}{d^{\,2}} \tag{200}$$

The charge of the electron is replaced by the mass of the electron.

For complex particles that are formed by more than one BSP and with $d \gg r_o$ we have

$$F_2 = 2.307078 \cdot 10^{-28}\ \frac{\Delta n_1\ \cdot \Delta n_2}{d^2} \tag{201}$$

The charge Q is replaced by the expression $\Delta n = n^+ - n^-$ which gives the difference between the **constituent** numbers of positive and negative BSPs that form the complex SP. As the n_i are integer numbers, the Coulomb force is quantified.

As examples we have for the proton $n^+ = 919$ and $n^- = 918$ with a binding Energy of $E_{B_{prot}} = -6.9489 \cdot 10^{-14}\ J = -0.43371\ MeV$, and for the neutron $n^+ = 919$ and $n^- = 919$ with a binding Energy of $E_{B_{neutr}} = 5.59743 \cdot 10^{-14}\ J = 0.34936\ MeV$.

In the case of an atomic nucleus $\Delta n = n^+ - n^-$ is equal to the order number Z of the element.

The following Fig.33 shows a schematic representation of the generation of the Coulomb force.

We now express the Coulomb force as a function of the power stored in the longitudinal angular momentum of the two BSPs. We start with eq. (194) that we write as

$$F_2 = \frac{a\ m\ c\ r_o^2}{4\ \Delta t\ d^{\,2}} \int\int_{Coulomb} = \frac{a\ c\ r_o^2\ \sqrt{m}\ \sqrt{m}}{4\ d^{\,2}\ \sqrt{\Delta t}\ \sqrt{\Delta t}} \int\int_{Coulomb} \tag{202}$$

or

$$F_2 = \frac{a\ r_o^2}{4\ c\ d^{\,2}} \sqrt{\frac{E_o}{\Delta t}}\sqrt{\frac{E_o}{\Delta t}} \int\int_{Coulomb} \qquad and\ \ with \quad P_o = \frac{E_o}{\Delta t} = E_o\ \nu_o \tag{203}$$

we get for complex particles

$$F_2 = \frac{a\ r_o^2}{4\ c} \sqrt{P_o}\sqrt{P_o}\ \frac{\Delta n_1\ \cdot \Delta n_2}{d^2} \int\int_{Coulomb} \tag{204}$$

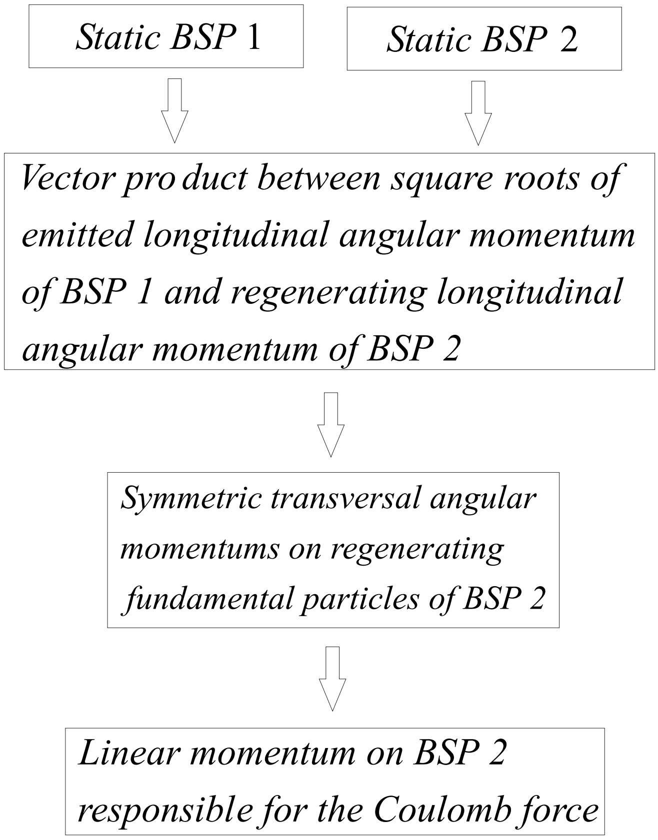


Figure 33: Generation of linear momentum between two static BSP

4.3 Convention for the representation of positron and electron.

Fig. 34 shows the convention used for the electron and positron. The positron emits FPs with high speed $v_e = \infty$ and positive longitudinal angular momentum $\bar{J}_s^+$ $(\infty+)$ and is regenerated by FPs with low speed $v_r = c$ and negative longitudinal angular momentum $\bar{J}_s^-$ $(c-)$. The electron emits FPs with low speed $v_e = c$ and negative longitudinal angular momentum $\bar{J}_s^-$ $(c-)$ and is regenerated by FPs with high speed $v_r = \infty$ and positive longitudinal angular momentum $\bar{J}_s^+$ $(\infty+)$. (see sec. 2.1 postulate 3)

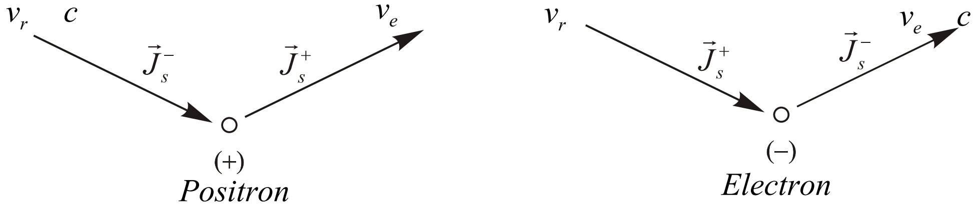


Figure 34: Convention for electron and positron

4.4 Power flow between charged complex SPs.

The energy E_p exchanged between two BSPs is given by

$$E_p = \int_\sigma a \left| \int_{r_{r_1}}^{\infty} dH_{e_1} \, \bar{s}_1 \times \int_{r_{r_2}}^{\infty} dH_{s_2} \, \bar{s}_2 \right| \qquad with \qquad a = 8.7743 \cdot 10^{-2} \tag{205}$$

or

$$E_p = 6.82333 \cdot 10^{-27} \, \frac{E_o}{d^{\,2}} \;\; J \tag{206}$$

and the power P

$$P_1 = \frac{E_p}{\Delta_o t} = c \, F_1 = c \, F_2 = P_2 \qquad with \qquad \Delta_o t = K \, r_o^2 \tag{207}$$

resulting

$$P_1 = 6.82333 \cdot 10^{-27} \, \frac{E_o}{\Delta_o t} \, \frac{1}{d^{\,2}} \;\; J/s \tag{208}$$

The energy $E_p = P_1 \, \Delta_o t$ is exchanged with the frequency

$$\nu_o = \frac{1}{\Delta_o t} = 1.2373 \cdot 10^{20} \;\; s^{-1} \tag{209}$$

The concept is shown at Fig.35

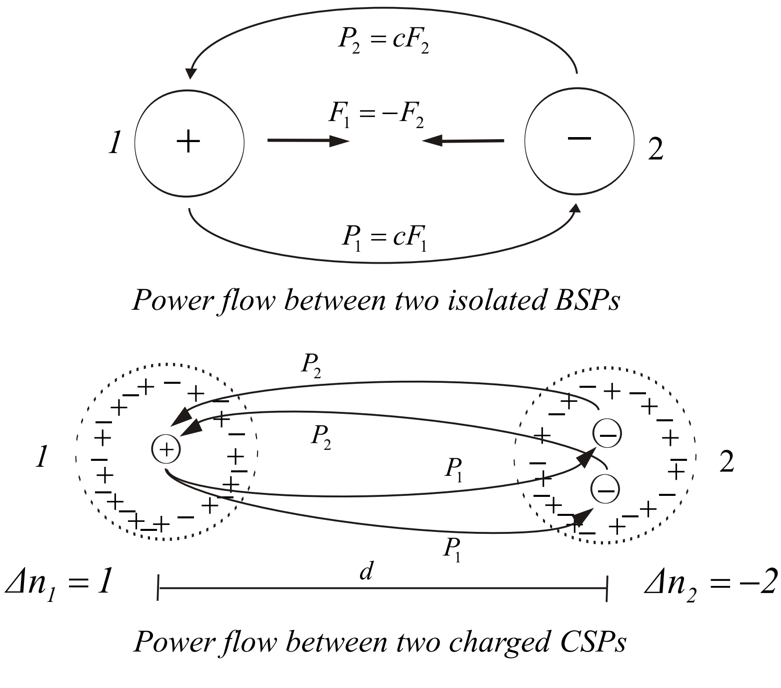


Figure 35: Power flow between charged complex SPs

Note: According eq.(206) the exchange energy $E_p = pc = E_o$ gives the distance $d = 8.26032 \cdot 10^{-14}\ m$, distance that is smaller than $2r_o = 7.71806 \cdot 10^{-13}\ m$ where the curve of Fig.29 has its maximum of $p_{max} = 1.3 \cdot 10^{-23}\ Ns$ and $E_{p_{max}} = 3.9 \cdot 10^{-15}\ J$. For all distances d the exchanged energy $E_p < E_o \approx 21\ E_{p_{max}}$.

In the case of charged complex SPs the power exchanged is

$$P_1 = \Delta n_1\ \Delta n_2\ \frac{E_p}{\Delta_o t} = c\ F_1 = c\ F_2 = P_2 \tag{210}$$

For a given distance d, each BSP of the complex SP "1" emits Δn_2 times the power of two isolated BSPs at the same distance d, and each BSP of the complex SP "2" emits Δn_1 times the power of two isolated BSPs at the same distance d. The power interchange is quantized in power units of two isolated BSPs at the same distance d.

Fig. 36 shows a proton with one level electron. The level electron emits FPs with light speed, what explains the light speed of photons when the level electron changes to a lower energy level.

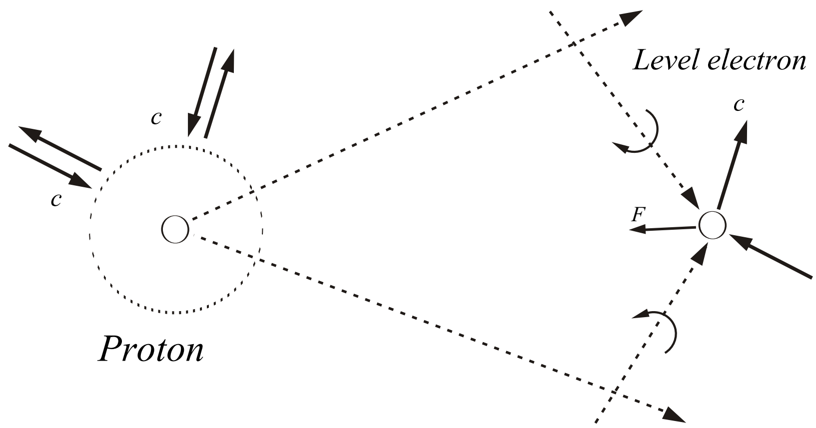


Figure 36: Proton with level electron

4.5 Invariance of the Coulomb force.

Two BSPs that move parallel with the speed v at a distance d between them, are exposed to the following Coulomb force.

$$d\bar{F}_2 = \frac{a}{c\ \Delta t} \left| \int_{r_{r_1}}^{\infty} dH_{e_1}\ \bar{s}_1 \times \int_{r_{r_2}}^{\infty} dH_{s_2}\ \bar{s}_2 \right| \tag{211}$$

where we have for the emitting particle 1

$$dH_{e_1} = H\ d\kappa_{e_1} \qquad where \qquad H^2 = E = \sqrt{E_o^2\ +\ E_p^2} \tag{212}$$

and for the regenerating particle 2

$$dH_{s_2} = H_s \, d\kappa_{s_2} \qquad where \qquad H_s^2 = E_s = \frac{E_o^2}{\sqrt{E_o^2 \, + \, E_p^2}} \tag{213}$$

We now analyze the force for $v \ll c$ and for relativistic speed.

a) For $v \ll c$ we have that

$$H = \sqrt{E_o} \qquad and \qquad H_s = \sqrt{E_o} \tag{214}$$

If we introduce these expressions in (211) we get

$$d\bar{F}_2 = a \, \frac{m_o \, c^2}{c \, \Delta t} \left| \int_{r_{r_1}}^{\infty} d\kappa_{e_1} \, \bar{s}_1 \times \int_{r_{r_2}}^{\infty} d\kappa_{s_2} \, \bar{s}_2 \right| \tag{215}$$

b) For relativistic speed with $E_o^2 \ll E_p^2$ we have that

$$H \approx \sqrt{E_p} \qquad and \qquad H_s \approx \frac{E_o}{\sqrt{E_p}} \tag{216}$$

If we introduce these expressions in (211) we get

$$d\bar{F}_2 = a \, \frac{m_o \, c^2}{c \, \Delta t} \left| \int_{r_{r_1}}^{\infty} d\kappa_{e_1} \, \bar{s}_1 \times \int_{r_{r_2}}^{\infty} d\kappa_{s_2} \, \bar{s}_2 \right| \tag{217}$$

As $d\kappa$ is independent of the speed v and proportional to the particle's radius like Δt, we get the same force for the whole range $0 \leq v \leq c$ of speed. The Coulomb force is invariant for inertial reference systems.

Note: The Lorentz invariance of the charge in today's theory is equivalent to the invariance of the difference between the **constituent** numbers of BSPs with positive $\bar{J}_e^{(+)}$ and negative $\bar{J}_e^{(-)}$ that integrate the complex SP.

4.6 Induced force on a static BSP.

The force between two static basic subatomic particles is basically, if we ignore the proportionality factor a,

$$F_{s_p} = \int_{\sigma} dF_{s_p} \qquad with \qquad dF_{s_p} = \frac{1}{c \, \Delta t} \left| \int_{r_r}^{\infty} dH_e \, \bar{s} \times \int_{r_p}^{\infty} dH_{s_p} \, \bar{s}_p \right| \tag{218}$$

where $\int_{\sigma}$ is the spacial integral around the test particle.

The force on the static test BSP dH_{s_p} has its origin at the pairs of symmetric and opposed transversal angular momentums generated by the longitudinal angular momentum of the fundamental particles of the two static particles, when they cross.

Pairs of symmetric and opposed transversal angular momentums are also generated by a BSP that moves with the speed v.

We now imagine an BSP that is accelerated in the time Δt by the transversal angular momentums J_n of its regenerating fundamental particles from $v = 0$ to $v = k\ c$ with $k < 1$, and then returned by an external force to its original position with $v = 0$ in the time $\Delta t \to \infty$.

We then have

$$\int_{r_r}^{\infty} d\bar{H}_n = \int_{r_r}^{\infty} d\bar{H}_n(v = k\ c) - \int_{r_r}^{\infty} d\bar{H}_n(v = 0) = \Delta \int_{r_r}^{\infty} d\bar{H}_n \tag{219}$$

because

$$\int_{r_r}^{\infty} d\bar{H}_n(v = k\ c) = \int_{r_r}^{\infty} d\bar{H}_n \qquad \textit{and} \qquad \int_{r_r}^{\infty} d\bar{H}_n(v = 0) = 0 \tag{220}$$

We now introduce (219), that gives us pairs of symmetrical opposed transversal angular momentums in eq.(218) in considering, that the vector $d\bar{H}_n$ is constant and tangential along a torus with an axis that goes through the two BSPs. The resulting force is the induced force on the probe BSP by the moving BSP and we call it dF_i.

$$dF_i = \frac{1}{c} \oint \frac{\bar{dl}}{2\pi R} \cdot \left\{ \frac{\Delta}{\Delta t} \int_{r_r}^{\infty} d\bar{H}_n \int_{r_p}^{\infty} dH_{s_p} \right\} \tag{221}$$

Now we generalize the expression to dynamic processes where the vector $d\bar{H}_n$ changes in time and in space and get

$$dF_i = \frac{1}{c} \oint \frac{\bar{dl}}{2\pi R} \cdot \left\{ \frac{d}{dt} \int_{r_r}^{\infty} d\bar{H}_n \int_{r_p}^{\infty} dH_{s_p} \right\} \tag{222}$$

This expression of the force as a function of a closed path integral of a timely changing variable is called **induced force** and is the basis for the description of all dynamic processes that will be analyzed in the section 7 for dynamic laws.

Note: It has still to be determined if an equalization factor is required for the equation of the induced linear momentum to match with experimental data.

4.7 Field divergence of a static complex SP.

We start with the expression of the field for a complex SP that is defined as

$$dF_s = \frac{d\bar{F}_2}{\Delta n_2} = \Delta n_1\ \frac{a}{c}\ \frac{1}{\Delta t} \left| \int_{r_{r_1}}^{\infty} dH_{e_1}\ \bar{s}_1 \times \int_{r_{r_2}}^{\infty} dH_{s_2}\ \bar{s}_2 \right| \tag{223}$$

Through calculations in sec. 4.1.1 we arrived to the following results for $d \gg r_o$:

1. The inverse proportionality of the two vectors $\int dH_{e_1}$ and $\int dH_{s_2}$ to their respective r_{r_1} and r_{r_2} results in an inverse proportionality to the distance $d^{\,2}$ for the force F_2.
2. The proportionality $\Delta t = K r_{o_1}\, r_{o_2}$, with $K = 5.42713 \cdot 10^{\,4}$.

According to eq. (200) the field F_s can be written with $\Delta n_2 = 1$ and $m_1 = m_2$ as

$$F_s = 2.5326 \cdot 10^2\ \Delta n \cdot \frac{m}{d^{\,2}} \tag{224}$$

Now we define the divergence of the field F_s as

$$div F_s = \lim_{V \to 0} \frac{\oint F_s\, dA}{V} \tag{225}$$

With A the area of a sphere with centrum in $\Delta n \cdot m$ and V its volume we get

$$div F_s = 4\pi \cdot 2.5326 \cdot 10^2\ \Delta n\ \frac{m}{V} = 3.1826 \cdot 10^3\ \Delta n\ \rho_m \tag{226}$$

where ρ_m is the masse density of a positive or negative basic subatomic particle.

4.8 Balance of energy, rotational momentum and linear momentum between two static BSPs.

4.8.1 Balance of energy.

The energy νJ_{e_1} stored in an emitted fundamental particle of BSP 1 with $v = 0$ is passed to a regenerating fundamental particle of the same BSP 1 when they meet, so that

$$\nu J_{e_1} = \nu J_{s_1} \tag{227}$$

The concept is shown in Fig. 37.

The energy νJ_{s_1} is then split in longitudinal and transversal components when it meets with regenerating fundamental particles of the other BSP (2) so that

$$\nu J_{s_1} = \nu J_{s_1}^{(s)}\ +\ \nu J_{n_1}^{(s)} \tag{228}$$

The energy emitted by the BSP (1) is returned to the same BSP (1) and we can write

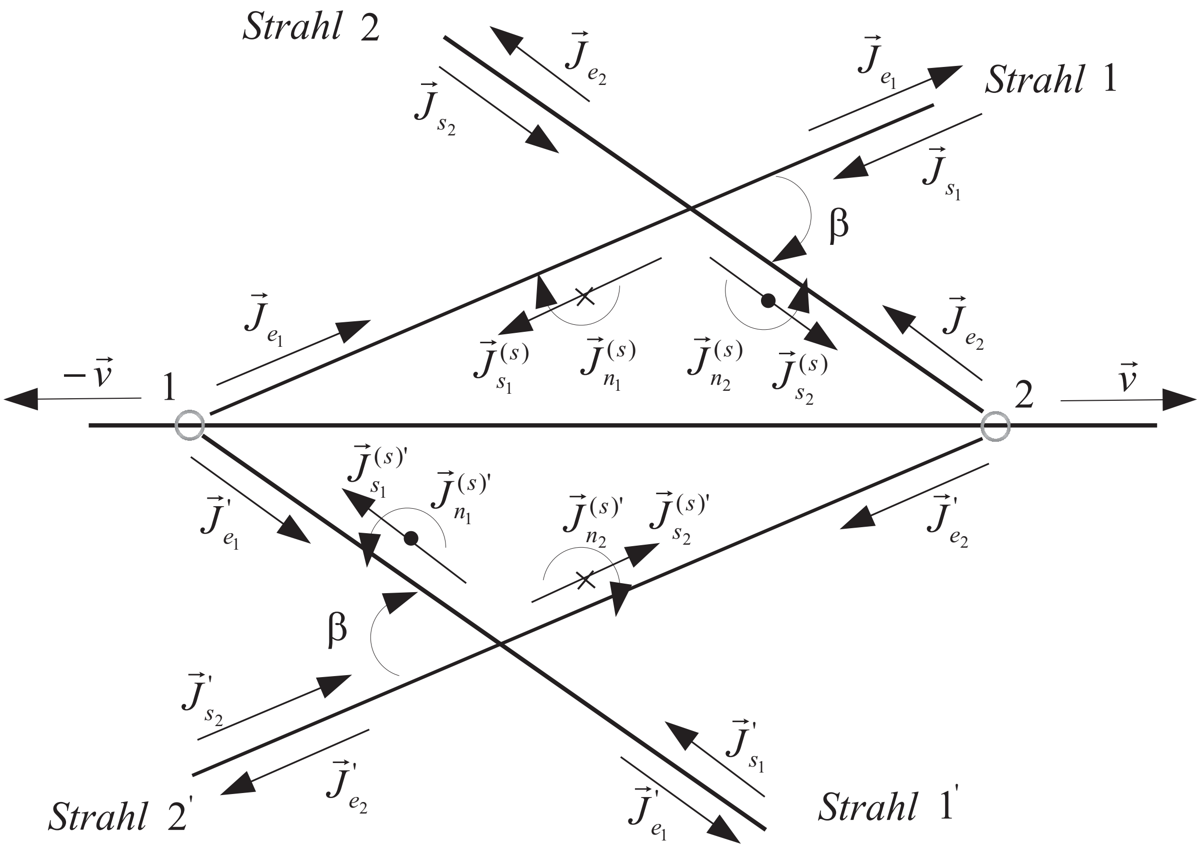


Figure 37: Rotational momentum balance between two static basic subatomic particles

$$\nu J_{e_1} = \nu J^{(s)}_{s_1} \; + \; \nu J^{(s)}_{n_1} \tag{229}$$

The same process is valid for the other BSP (2).

The energy balance can also be explained through an energy interchange between the two static BSPs in, that the energy νJ_{e_1} stored in an emitted fundamental particle of BSP 1 with $v = 0$ is splitted and passed to a regenerating fundamental particle of BSP 2 when they meet, so that

$$\nu J_{e_1} = \nu J^{(s)}_{s_2} \; + \; \nu J^{(s)}_{n_2} \tag{230}$$

Because of symmetry, there is an emitted FP of BSP 2 that meets a regenerating FP of BSP 1 with the same angle β that carries the same energy.

4.8.2 Balance of rotational momentum.

The concept is shown in Fig. 37.

On the drawing we see that on ray $2'$ all the longitudinal rotational momentums are opposed to ray 1. The same applies for the rays $1'$ and 2.

The transversal rotational momentums have opposed rotational momentums on the rays 1 and 2 and the rays $1'$ and $2'$.

$$\bar{J}^{(s)}_{n_1} = -\bar{J}^{(s)}_{n_2} \qquad \bar{J}^{(s)\,\prime}_{n_1} = -\bar{J}^{(s)\,\prime}_{n_2} \tag{231}$$

$$\bar{J}^{(s)\,\prime}_{s_1} = -\bar{J}^{(s)}_{s_2} \qquad \bar{J}^{(s)}_{s_1} \neq \bar{J}^{(s)}_{s_2} \qquad \bar{J}^{(s)\,\prime}_{s_1} \neq \bar{J}^{(s)\,\prime}_{s_2} \tag{232}$$

$$\bar{J}'_{e_1} = -\bar{J}_{e_2} \tag{233}$$

Opposed rotational momentums are constantly generated on one place, and at the same time, equal opposed rotational momentums are destroyed on an other place, so that the sum of all rotational momentums is always zero.

4.8.3 Balance of linear momentum.

As already exposed, the linear momentum is a characteristic of BSPs, generated by rotational momentums of fundamental particles that comply with defined symmetry conditions. The concept is shown in Fig. 38.

Because of symmetry we have for two BSPs

$$dp_1 = \frac{a}{c} \left| \int_{r_{r_1}}^{\infty} dH_{s_1}\ \bar{s}_1 \times \int_{r_{r_2}}^{\infty} dH_{s_2}\ \bar{s}_2 \right| = \frac{a}{c} \left| \int_{r_{r_2}}^{\infty} dH_{s_2}\ \bar{s}_2 \times \int_{r_{r_1}}^{\infty} dH_{s_1}\ \bar{s}_1 \right| = dp_2 \tag{234}$$

For complex SPs that are formed by more than one BSP we have

$$dp_1 = a\,\frac{\Delta n_1\ \Delta n_2}{c} \left| \int_{r_{r_1}}^{\infty} dH_{s_1}\ \bar{s}_1 \times \int_{r_{r_2}}^{\infty} dH_{s_2}\ \bar{s}_2 \right| \tag{235}$$

$$dp_2 = a\,\frac{\Delta n_2\ \Delta n_1}{c} \left| \int_{r_{r_2}}^{\infty} dH_{s_2}\ \bar{s}_2 \times \int_{r_{r_1}}^{\infty} dH_{s_1}\ \bar{s}_1 \right| \tag{236}$$

resulting that

$$dp_1 = dp_2 \tag{237}$$

with $\Delta n_i = n_i^+ - n_i^-$ the difference between the number of positive and negative BSPs that form the complex particle i.

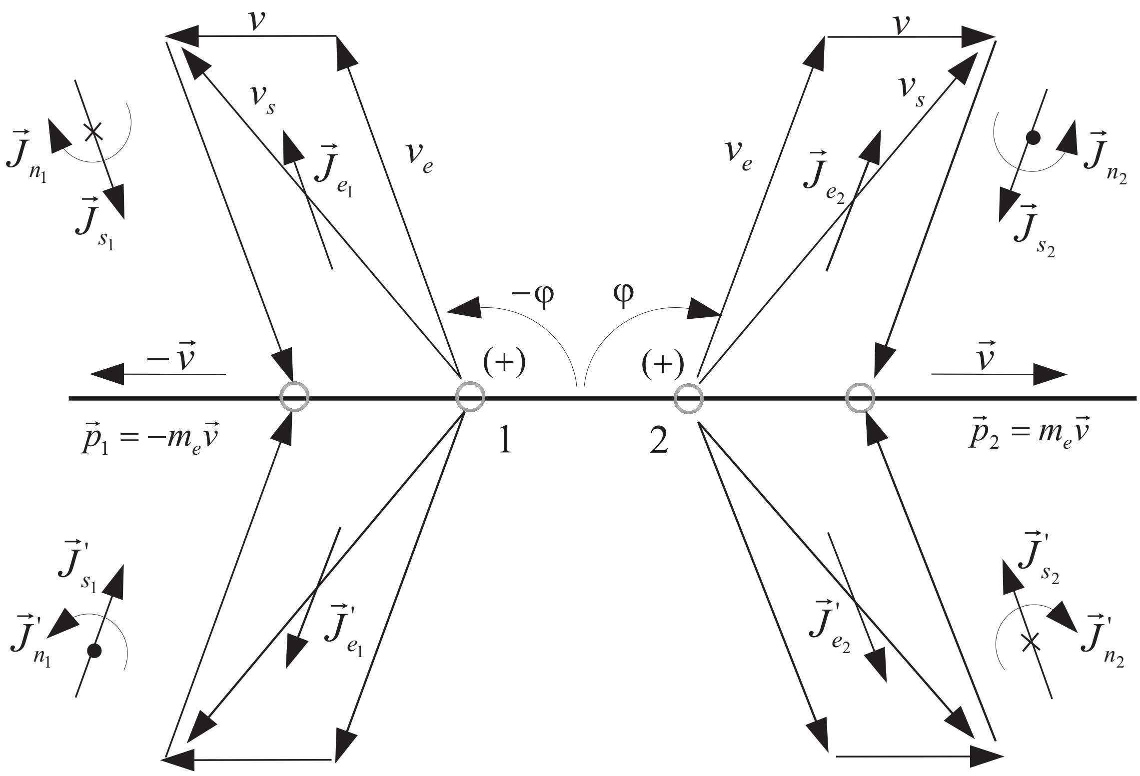


Figure 38: Balance of linear momentums between two static basic subatomic particles

4.9 Energy of transversal rotational momentums J_n at a torus with an axis that coincides with a current of BSPs with speed v.

We start with the energy equation for transversal rotational momentums J_n of a BSPs that moves with v.

$$dE_n = \frac{E_p^2}{\sqrt{E_0^2 \; + \; E_p^2}} \, \frac{c}{2\, v} \left| \frac{\bar{v}_s}{|\bar{v}_e|} \; \times \; \frac{\bar{v}_r}{|\bar{v}_r|} \right| \, w_e \, d\varphi \tag{238}$$

with

$$w_e = \frac{r_o}{r_e^2} \, dr_e \qquad and \qquad E_p = c \, \frac{m \, v}{\sqrt{1 - \frac{v^2}{c^2}}} \tag{239}$$

For **decelerating BSPs** we have

$$v_r \to \infty \qquad and \qquad t_r \to 0 \tag{240}$$

$$r_e = r_r \qquad dr_e = dr_r \qquad \varphi = \psi \qquad d\varphi = d\psi \tag{241}$$

and for dE_n we can write

$$dE_n = \frac{E_p^2}{\sqrt{E_0^2 \; + \; E_p^2}} \; \frac{c}{2\;v} \left| \; \frac{\bar{v}_s}{|\bar{v}_e|} \; \times \; \frac{\bar{v}_r}{|\bar{v}_r|} \right| \; \frac{r_o}{r_r^2} \; dr_r \; d\psi \tag{242}$$

with

$$v_s = \sqrt{v_e^2 + v^2 - 2\;v_e\;v\;\cos\;\psi} \tag{243}$$

For $v << c$ we get

$$dE_n = m\;v^2\;d\kappa = m\;v^2\;\frac{1}{2}\;\frac{r_o}{r_r^2}\;dr_r\;\sin\psi\;d\psi\;\frac{d\gamma}{2\pi} \tag{244}$$

The cumulate energy is

$$\int_{r_r}^{\infty} dE_n = m\;v^2\;\frac{1}{2}\;\frac{r_o}{r_r}\;\sin\psi\;d\psi\;\frac{d\gamma}{2\pi} \tag{245}$$

The concept is shown in Fig. 39.

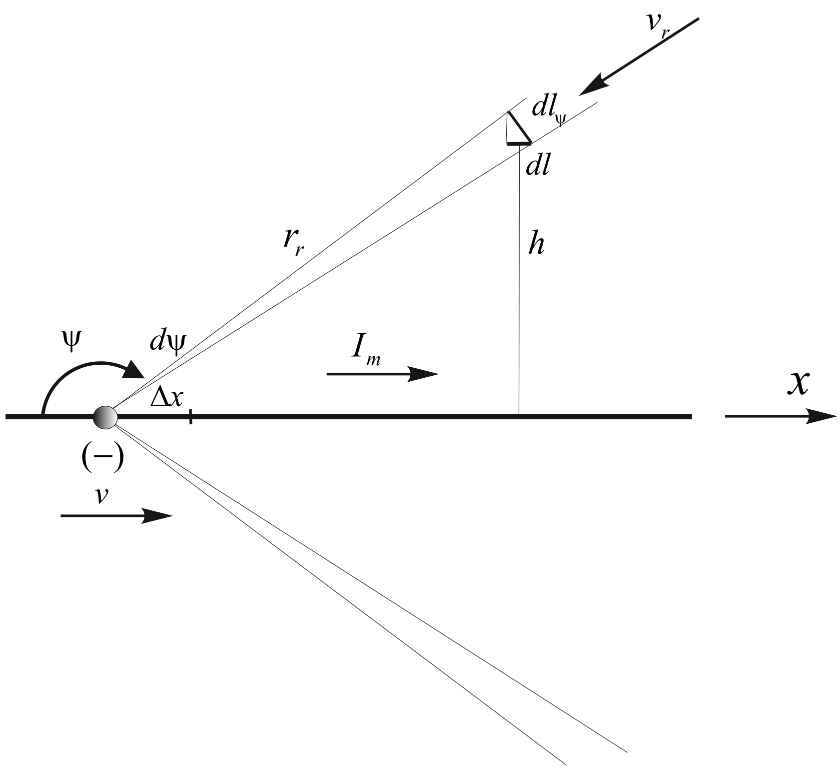


Figure 39: Geometric relations of a torus for a straight conductor with a current of basic subatomic particles I_m

From Fig 39 we have that

$$r_r \; d\psi = dl_\psi \qquad dl = \sin\psi \; dl_\psi \qquad \rightarrow \qquad \sin\psi \; d\psi = \frac{dl}{r_r} \tag{246}$$

We get for the cumulated energy

$$\int_{r_r}^{\infty} dE_n = m \; v^2 \; \frac{1}{4\pi} \; \frac{r_o}{r_r^2} \; dl \; d\gamma = dE_{n(cum)} \tag{247}$$

For ρ_x the linear density of BSPs in the conductor, where $\rho_x = N_x/\Delta x$ with N_x the number of BSPs in Δx, we get the cumulated energy for N_x BSPs

$$\int_{r_r}^{\infty} dE_n = \rho_x \; \Delta x \; m \; v^2 \; \frac{1}{4\pi} \; \frac{r_o}{r_r^2} \; dl \; d\gamma \tag{248}$$

To get the cumulated energy for all BSPs of a stright conductor with infinite lenght we write

$$\int_{-\infty}^{\infty} \int_{r_r}^{\infty} dE_n = \rho_x \; m \; v^2 \; \frac{1}{4\pi} \; r_o \; dl \; d\gamma \; \int_{-\infty}^{\infty} \frac{\Delta x}{X} \qquad X = r_r^2 = h^2 + x^2 \tag{249}$$

resulting

$$\int_{-\infty}^{\infty} \int_{r_r}^{\infty} dE_n = \rho_x \; m \; v^2 \; \frac{1}{4} \; \frac{r_o}{h} \; dl \; d\gamma = dE_{n(cum,\infty)} \tag{250}$$

if we multiply and divide the expression with h, what leaves the expression unchanged, we see that the equation represents the cumulated energy for the area $dA = h \; dl \; d\gamma$.

Note a)

Transversal rotational momenta $\bar{J}_n$ from regenerating fundamental particles of positive or negative BSPs, that move in the same direction in the conductor, have the same rotation sense. It is not possible to know from the rotation sense of the transversal rotational momenta $\bar{J}_n$ if the BSPs that move in the same direction have a positive or negative sign.

If we change the direction of the current of positive or negative BSPs in the conductor, the rotation sense of the transversal rotational momenta $\bar{J}_n$ changes.

Only the rotation sense of the longitudinal rotational momenta $\bar{J}_s$ shows, if the BSPs that move in the same direction, have a positive or negative sign.

Note b)

The relation between the masse current I_m and the electric current I_c is defined by the following equations:

$$I_c = N_x\ q\ v = 1,60217733 \cdot 10^{-19}\ N_x\ v\ \left[\frac{C}{s}\right] \tag{251}$$

$$I_m = N_x\ m\ v = 9,1093897 \cdot 10^{-31}\ N_x\ v\ \left[\frac{kg}{s}\right] \tag{252}$$

with q the elementary charge in Coulomb and m the rest masse of the electron in kilogram.

We get that

$$I_m = \frac{m}{q}\ I_c = 5,685631378 \cdot 10^{-12}\ I_c\ \left[\frac{kg}{s}\right] \tag{253}$$

4.10 Current flow of BSPs at an infinite straight conductor.

4.10.1 Current flow through a closed loop enclosing an infinite straight conductor.

We start with eq. (250) switching to the cumulated $d\bar{H}_n$ field

$$\int_{-\infty}^{\infty} \int_{r_r}^{\infty} d\bar{H}_n = \rho_x\ [m\ v^2]^{1/2}\ \frac{1}{4}\ \frac{r_o}{h}\ dl\ d\gamma\ \bar{n} \tag{254}$$

With the mass current $I_m = \rho_x\ m\ v$ and with constant Δl and $\Delta\gamma$ we get

$$\int_{-\infty}^{\infty} \int_{r_r}^{\infty} d\bar{H}_n = \frac{I_m}{\sqrt{m}}\ \frac{1}{4}\ \frac{r_o}{h}\ \Delta l\ \Delta\gamma\ \bar{n} = d\bar{H}_{n(cum,\infty)} \tag{255}$$

We now build the close loop integral

$$\oint d\bar{H}_{n(cum,\infty)} \cdot d\bar{l}_\gamma = dH_{n(cum,\infty)}\ h \int_0^{2\pi} d\gamma \qquad d\bar{l}_\gamma = h\ d\gamma\ \bar{n} \tag{256}$$

We get

$$\oint d\bar{H}_{n(cum,\infty)} \cdot d\bar{l}_\gamma = K_H\ I_m \qquad K_H = \frac{\pi}{\sqrt{m}}\ \frac{1}{2}\ r_o\ \Delta l\ \Delta\gamma = constant \tag{257}$$

If we compare with the mainstream expression

$$\oint \bar{H}_c \cdot d\bar{l}_\gamma = I_c \tag{258}$$

we conclude that

$$d\bar{H}_{n(cum,\infty)} \equiv \bar{H}_c \qquad and \qquad I_m \equiv I_c \tag{259}$$

4.10.2 Current flow through a closed loop outside an infinite straight conductor.

To obtain the current flow outside an infinite straight conductor we place the closed path integral outside the conductor.

The concept is shown in Fig. 40.

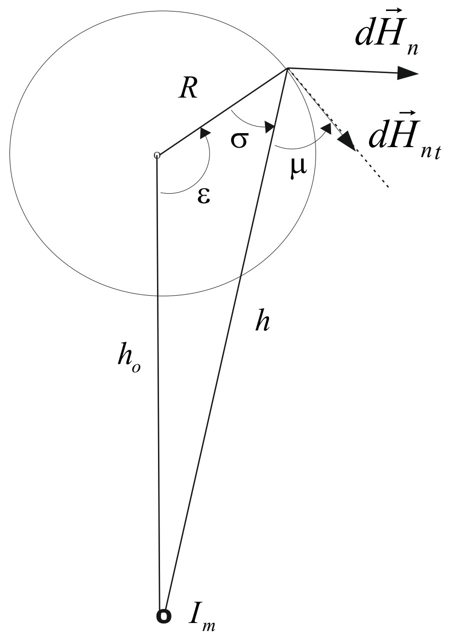


Figure 40: Geometric relations for the calculation of the closed path integral outside a straight conductor with a current of basic subatomic particles I_m

We start with equation (255) which is

$$\int_{-\infty}^{\infty}\int_{r_r}^{\infty} d\bar{H}_n = \frac{I_m}{\sqrt{m}}\,\frac{1}{4}\,\frac{r_o}{h}\,\Delta l\,\Delta\gamma\,\bar{n} = d\bar{H}_{n(cum,\infty)} \tag{260}$$

that we can write as

$$d\bar{H}_{n(cum,\infty)} = \frac{K}{h}\,\bar{n} \qquad\qquad K = \frac{I_m}{\sqrt{m}}\,\frac{1}{4}\,r_o\,\Delta l\,\Delta\gamma \tag{261}$$

As $d\bar{H}_{n(cum,\infty)} \propto d\bar{H}_n$ we use the nomenclature from Fig. 40 in what follows

$$d\bar{H}_{n_t} = dH_n \sin\mu\,\bar{t} \qquad h^2 = h_o^2 + R^2 - 2\,h_o\,R\,\cos\varepsilon \qquad \mu = \sigma - \frac{\pi}{2} \tag{262}$$

with

$$\sigma = \frac{\pi}{2} - \frac{\varepsilon}{2} + \arctan\left[\frac{h_o - R}{h_o + R}\ \cot\frac{\varepsilon}{2}\right] \tag{263}$$

.

For the closed path integral we get

$$\oint d\bar{H}_{n_t} \cdot d\bar{s} = 0 \qquad with \qquad d\bar{H}_n(h) = \frac{K}{h}\ \bar{n} \tag{264}$$

For an other relation between dH_n and h we have

$$\oint d\bar{H}_{n_t} \cdot d\bar{s} \neq 0 \qquad with \qquad d\bar{H}_n(h) \neq \frac{K}{h}\ \bar{n} \tag{265}$$

The finding that only with a relation of the type $dH_n(h) = \frac{K}{h}$ the external closed path integral is zero is important for the analysis of the laws that describe processes that are variable in time.

4.11 Linear momentum density on two infinite straight parallel conductors that have mass currents I_{m1} and I_{m2}.

We start with eq. (250) from sec. 4.9 wich represents the cumulated energy for the area $dS = dl\ h\ d\gamma$.

$$\int_{-\infty}^{\infty}\int_{r_r}^{\infty} dE_n = \rho_x\ m\ v^2\ \frac{1}{4}\ \frac{r_o}{h}\ dl\ d\gamma = dE_{n(cum,\infty)} \tag{266}$$

Now we switch to the cumulated field of $d^{'}H_{n(cum,\infty)}$ defining $H_n^{'}$ as

$$H_n^{'} = \left[m\ v^2\ \frac{dl}{h}\right]^{1/2} \tag{267}$$

and get

$$\int_{-\infty}^{\infty}\int_{r_r}^{\infty} d^{'}H_n = \rho_x\ \left[m\ v^2\ \frac{dl}{h}\right]^{1/2}\ \frac{r_o}{4}\ d\gamma = d^{'}H_{n(cum,\infty)} \tag{268}$$

We now rearrange the equation to get an expression for the current $I_m = \rho_x\ m\ v$ and get

$$d^{'}H_{n(cum,\infty)} = \frac{I_m}{4\sqrt{m}}\ \sqrt{\frac{dl}{h}}\ r_o\ d\gamma \tag{269}$$

We now take two parallel conductors at the distance d with mass currents I_{m1}

and I_{m2} that have transversal rotational momentum J_{n_1} and J_{n_2} at the distances h_1 respective h_2. Because of the existing symmetry the rotational momenta J_2 that are generated according to postulate 7 form pairs that comply with the requirements for linear momentum.

$$\bar{J}_2 = +\,\mathrm{sign}(\bar{J}_{s_1})\,\mathrm{sign}(\bar{J}_{s_2})\,(\sqrt{J_{n_1}}\,\bar{n}_1 \;\times\; \sqrt{J_{n_2}}\,\bar{n}_2) \tag{270}$$

with $\bar{n}_1$ and $\bar{n}_2$ unit vectors that are orthogonal respectively to the area formed by I_{m1} and h_1, and the area formed by I_{m2} und h_2.

The concept is shown in Fig. 41

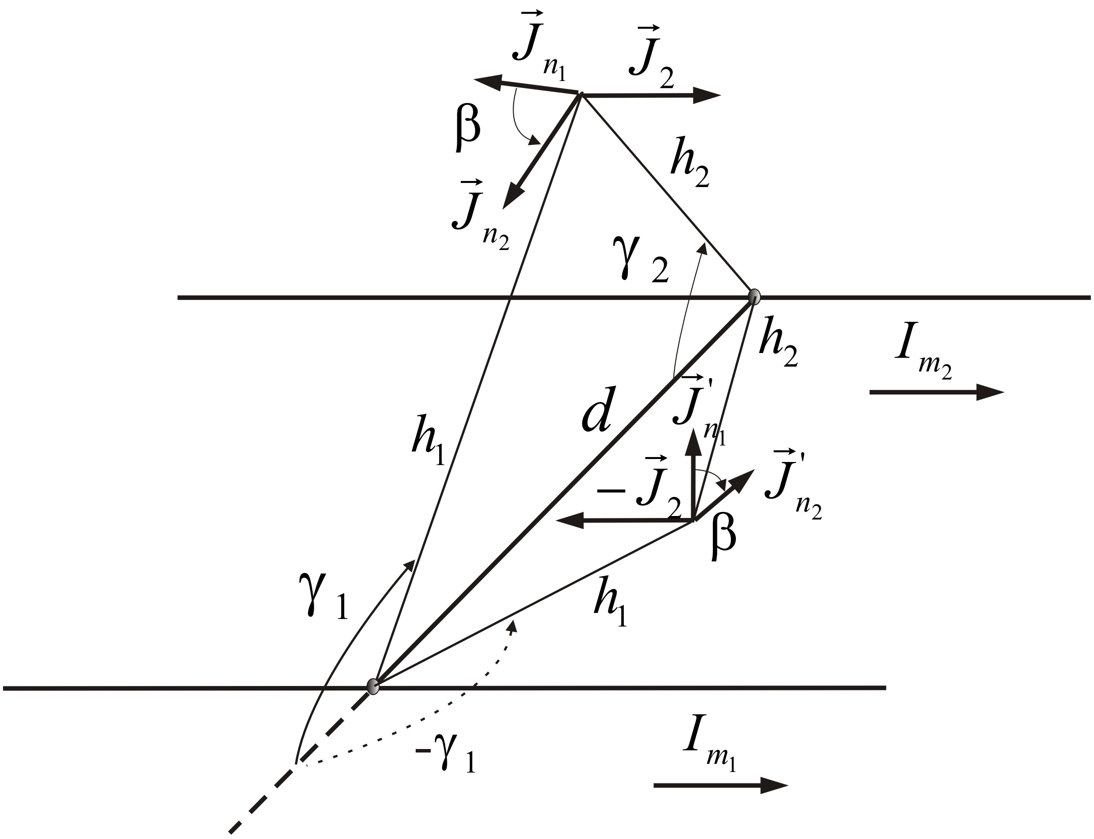


Figure 41: Angle β between the transversal angular momentum of regenerating fundamental particles of two straight conductors with currents I_{m_i}

The energy dE_{p_h} associated with J_2 is

$$dE_{p_h} = \left| \int_{x=-\infty}^{\infty} \int_{r_{r_1}}^{\infty} d^{'}H_{n_1}\,\bar{n}_1 \;\times\; \int_{x=-\infty}^{\infty} \int_{r_{r_2}}^{\infty} d^{'}H_{n_2}\,\bar{n}_2 \right| \tag{271}$$

and the linear momentum

$$dp_h = \frac{1}{c}\ dE_{p_h} \tag{272}$$

We get with $m_1 = m_2 = m$ and $r_{o_1} = r_{o_2} = r_o$ and $dl_1 = dl_2 = dl$

$$dE_{p_h} = \frac{I_{m_1}\ I_{m_2}}{16}\ \frac{r_o^2}{m}\ \frac{d\gamma_1\ d\gamma_2}{\sqrt{h_1\ h_2}}\ |\bar{n}_1\ \times\ \bar{n}_2|\ dl \tag{273}$$

with

$$|\bar{n}_1 \times \bar{n}_2| = \sin\beta = \sin(\gamma_1 - \gamma_2) \tag{274}$$

With the following geometric conditions already defined in sec. 4.2

$$R = h_1\ \sin\gamma_1 \qquad R = h_2\ \sin\gamma_2 \qquad -h_1\ \cos\gamma_1 + h_2\ \cos\gamma_2 = d \tag{275}$$

we get

$$h_1\ h_2 = d^{\,2}\ \frac{\sin\gamma_1\ \sin\gamma_2}{[\ \sin\gamma_1\ \cos\gamma_2 - \sin\gamma_2\ \cos\gamma_1\ ]^2} \tag{276}$$

As

$$\sin\gamma_1\ \cos\gamma_2 - \sin\gamma_2\ \cos\gamma_1 = \sin(\gamma_1 - \gamma_2) = \sin\beta \tag{277}$$

we obtain

$$dE_{p_h} = \frac{I_{m_1}\ I_{m_2}}{16}\ \frac{r_o^2}{m}\ \frac{\sin^2(\gamma_1 - \gamma_2)}{d\ \sqrt{\sin\gamma_1\ \sin\gamma_2}}\ d\gamma_1\ d\gamma_2\ dl \tag{278}$$

The differential force density is given by

$$\frac{dF}{\Delta l} = \frac{dp_h}{\Delta l\ dt} = \frac{1}{c\ dl\ \Delta t}\ dE_{p_h} \tag{279}$$

and we get

$$\frac{dF}{\Delta l} = \frac{1}{c\ \Delta t}\ \frac{I_{m_1}\ I_{m_2}}{16}\ \frac{r_o^2}{m\ d}\ \frac{\sin^2(\gamma_1 - \gamma_2)}{\sqrt{\sin\gamma_1\ \sin\gamma_2}}\ d\gamma_1\ d\gamma_2 \tag{280}$$

The total force density we obtain by integrating over the whole space

$$\frac{F}{\Delta l} = \frac{1}{c\ \Delta t}\ \frac{r_o^2}{16\ m}\ \frac{I_{m_1}\ I_{m_2}}{d}\ \int_{\gamma_{2_{min}}}^{\gamma_{2_{max}}} \int_{\gamma_{1_{min}}}^{\gamma_{1_{max}}} \frac{\sin^2(\gamma_1 - \gamma_2)}{\sqrt{\sin\gamma_1\ \sin\gamma_2}}\ d\gamma_1\ d\gamma_2 \tag{281}$$

In eq. (281) we can see the inverse proportionality to the distance d between the parallel conductors.

The integration limits are similar to the integration limits for two static BSPs shown in Fig. 28.

The numerical integration of eq. (281) gives a curve similar to the curve of Fig. 29 with the difference, that for $d \gg r_o$ the curve decreases with $1/d$ instead of $1/d^2$.

The double integral gives for $d \gg r_o$

$$\int_{\gamma_{2_{min}}}^{\gamma_{2max}} \int_{\gamma_{1_{min}}}^{\gamma_{1max}} \frac{\sin^2(\gamma_1 - \gamma_2)}{\sqrt{\sin\gamma_1 \ \sin\gamma_2}} \, d\gamma_1 \, d\gamma_2 = \int\int_{Ampere} = 5.8731 \tag{282}$$

Finally we get

$$\frac{F}{\Delta l} = b \, \frac{5.8731}{c \, \Delta t} \, \frac{r_o^2}{16 \, m} \, \frac{I_{m_1} \, I_{m_2}}{d} \tag{283}$$

where b is a tuning factor we introduce who's function is explained later.

The reference force density we calculate with the mainstream equation of the theory of electricity and magnetism

$$\frac{F_c}{\Delta l} = \frac{\mu_o}{2 \, \pi} \, \frac{I_{c_1} \, I_{c_2}}{d} \tag{284}$$

with I_c the current in Ampere.

The relation between the mass current I_m and the electric current I_c is given by

$$I_m = \frac{m}{q} \, I_c = 5,685631378 \cdot 10^{-12} \, I_c \, \left[\frac{kg}{s}\right] \tag{285}$$

with m the electron mass in kilogram and q the elementary charge in Coulomb.

If we make the two total force densities equal for $d \gg r_o$

$$\frac{F}{\Delta l} = \frac{F_c}{\Delta l} \qquad for \qquad d \gg r_o \tag{286}$$

we get for $b = 0.25$ the same $K = 5.4274 \cdot 10^4 \ \ s/m^2$ we got for two static BSPs. The advantage to make $K = 5.4274 \cdot 10^4 \ \ s/m^2$ we see in sec. 9.1 resulting

$$\frac{4 \, \pi^2 \, m}{K} = h \qquad\qquad with\,'h'\,the\ Planck\ Constant \tag{287}$$

The Ampere law for the mass currents takes the form

$$\frac{F}{\Delta l} = K_A \, \frac{I_{m_1} \, I_{m_2}}{d} \qquad with \qquad K_A = b \, \frac{5.8731}{c \, \Delta t} \, \frac{r_o^2}{16 \, m} = 6.18706 \cdot 10^{15} \quad \frac{m}{kg} \tag{288}$$

The energy density flow from mass-current I_{m_1} to I_{m_2} is equal to the energy density flow from mass-current I_{m_2} to I_{m_1}

$$\frac{E_{p_h,1}}{\Delta l} = \frac{F_1\ c}{\Delta l} = \frac{F_2\ c}{\Delta l} = \frac{E_{p_h,2}}{\Delta l} \tag{289}$$

Note: There is an important difference when switching from the cumulated energy equation to the dH field to arrive to the Coulomb or the Ampere equations.

- To arrive to the Coulomb law we simply passed from

$$\int_r^\infty dE = E \int_r^\infty d\kappa \qquad to \qquad \int_r^\infty dH = \sqrt{E} \int_r^\infty d\kappa \tag{290}$$

to build the cross product and obtain the inverse $d^{\,2}$ law from the Coulomb law.

- To arrive to the Ampere law we had to pass from

$$\int_r^\infty dE = E \int_r^\infty d\kappa \qquad to \qquad \int_r^\infty d^{\,\prime} H = \sqrt{E} \int_r^\infty d\kappa^{\,\prime} \tag{291}$$

with

$$\int_r^\infty d^{\,\prime}\kappa = \frac{1}{2} \sqrt{\frac{r_o}{r}}\ \sin\varphi\ d\varphi\ \frac{d\gamma}{2\pi} \tag{292}$$

to build the cross product and obtain the inverse d law from the Ampere law.

Force density as a function of the power.

Now we express the force density as a function of the powers stored in the regenerating transversal angular momentum of the BSPs of the two conductors.

We start with eq. (281) that we write with $I_m = \rho_x\ m\ v$

$$\frac{F}{\Delta l} = \frac{1}{c\ \Delta t}\ \frac{r_o^2}{16\ m}\ \frac{\rho_{x_1}\ m\ v_1\ \rho_{x_2}\ m_2\ v}{d} \int\int_{Ampere} \tag{293}$$

or

$$\frac{F}{\Delta l} = \frac{1}{16\ m\ c}\ \frac{r_{o_1}\ \rho_{x_1}\ r_{o_2}\ \rho_{x_2}}{d} \sqrt{\frac{m\ v_1^2}{\Delta_1 t}} \sqrt{\frac{m\ v_2^2}{\Delta_2 t}} \int\int_{Ampere} \tag{294}$$

where

$$\Delta t = K\ r_{o_1}\ r_{o_2} = \sqrt{K\ r_{o_1}^2} \sqrt{K\ r_{o_2}^2} = \sqrt{\Delta_1 t} \sqrt{\Delta_2 t} \tag{295}$$

and with $E_n = m\ v^2$ we get

$$\frac{F}{\Delta l} = \frac{1}{16\ m\ c}\ \frac{r_{o_1}\ \rho_{x_1}\ r_{o_2}\ \rho_{x_2}}{d} \sqrt{E_{n_1}\ \nu_{n_1}} \sqrt{E_{n_2}\ \nu_{n_2}} \int\int_{Ampere} \tag{296}$$

where $\nu_{n_i} = 1/\Delta_i t$. Finally we get with $P_n = E_n\ \nu_n$

$$\frac{F}{\Delta l} = \frac{1}{16\ m\ c} \frac{r_{o_1}\ \rho_{x_1}\ r_{o_2}\ \rho_{x_2}}{d} \sqrt{P_{n_1}} \sqrt{P_{n_2}} \int \int_{Ampere} \tag{297}$$

The dimensionless factor $r_o\ \rho_x = N_x\ r_o/\Delta x$ gives the density of the BSPs with radius r_o at the conductor.

Sign convention between currents and angular momenta.

We have seen that the transversal angular momentum $\bar{J}_n$ is oriented according the right screw rule in the direction of the velocity vector $\bar{v}$ of the BSPs and is independent of the charge of the BSPs. It is not possible to know the charge of the moving BSPs based on the direction the transversal angular momentum $\bar{J}_n$ has. The direction of the transversal angular momentum $\bar{J}_n$ gives the direction of the linear momentum $d\bar{p}$.

The equation of postulate **7** gives the opposed transversal angular momentum $\bar{J}_2$ generated by the BSPs of the current I_{m_1} and the BSPs of current I_{m_2} which generate the linear momentum $d\bar{p}_2$ on the BSPs of current I_{m_2}.

$$\bar{J}_2 = \ \mathrm{sign}(\bar{J}_{e_1})\ \mathrm{sign}(\bar{J}_{e_2})\ (\sqrt{J_{n_1}}\ \bar{n}_1\ \times\ \sqrt{J_{n_2}}\ \bar{n}_2) \tag{298}$$

The sign of the linear momentum $d\bar{p}_2$ is given by

$$\mathrm{sign}(d\bar{p}_2) = \mathrm{sign}(\bar{J}_2) \tag{299}$$

The concept is shown in Fig. 42. See also Fig. 41

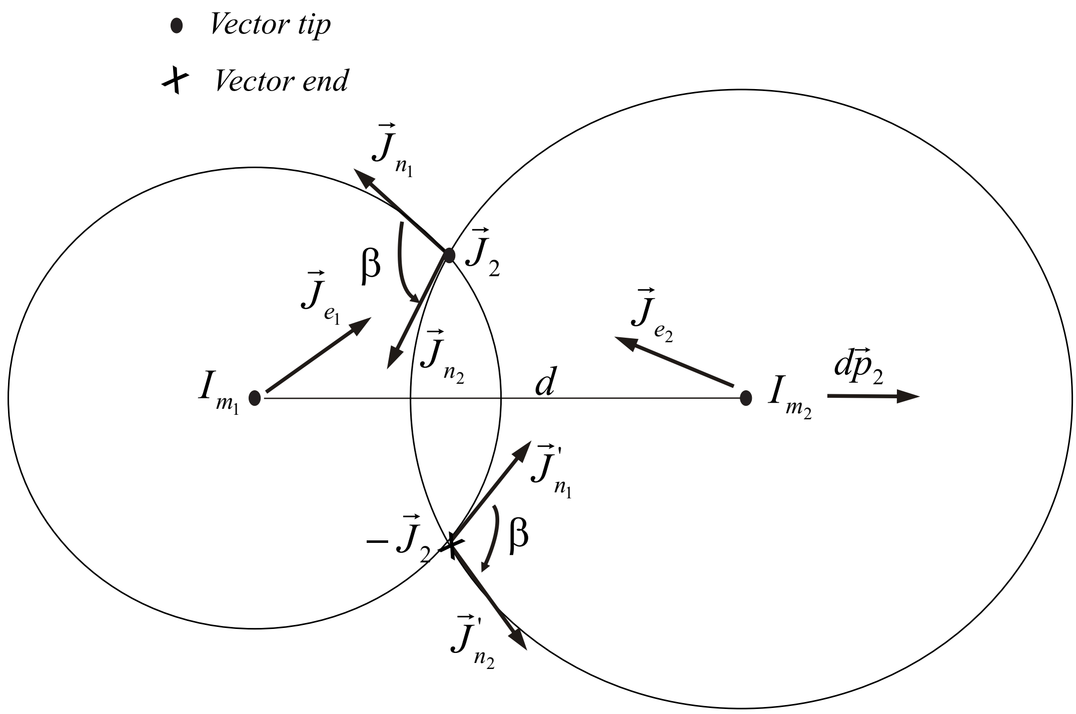


Figure 42: Sign convention for the calculation of the linear momentum dp for two straight conductors with currents I_{m_i}

4.11.1 Invariance of the Ampere force between two parallel conductors.

In Fig. 43 we have parallel negative BSPs moving at a distance d with the speeds v_1 and v_2 producing the currents $I^-_{m_1}$ and $I^-_{m_2}$ relative to a coordinate system that is fix with the positive BSPs that regenerate the negative moving BSPs. At point P the transversal angular momentum of the regenerating FPs will interact according postulate 7 and generate the opposed forces dF^-_1 and dF^-_2. After the integration of all regenerating positive BSPs of the whole space we get the forces F^-_1 and F^-_2.

If we now assume that $v_1 = v_2 = v$ and that the coordinate system is fix with the moving negative BSPs we have the case of Fig. 44 where the positive BSPs are moving at a distance d producing the currents $I^+_{m_1}$ and $I^+_{m_2}$ relative to a coordinate system that is fix with the negative BSPs that regenerate the positive moving BSPs. At point P the transversal angular momentum of the regenerating FPs will interact according postulate 7 and generate the opposed forces dF^+_1 and dF^+_2. After the integration of all regenerating negative BSPs of the whole space we get the forces F^+_1 and F^+_2. Due to the symmetry the forces F^-_1 and F^-_2 are equal to F^+_1 and F^+_2 provided that $v_1 = v_2 = v$.

Note: The selection of a coordinate system implies the definition of the environment that provides the regenerating BSPs.

Fig. 43 and Fig. 44 show the conservation of the Ampere force for inertial coordinate systems.

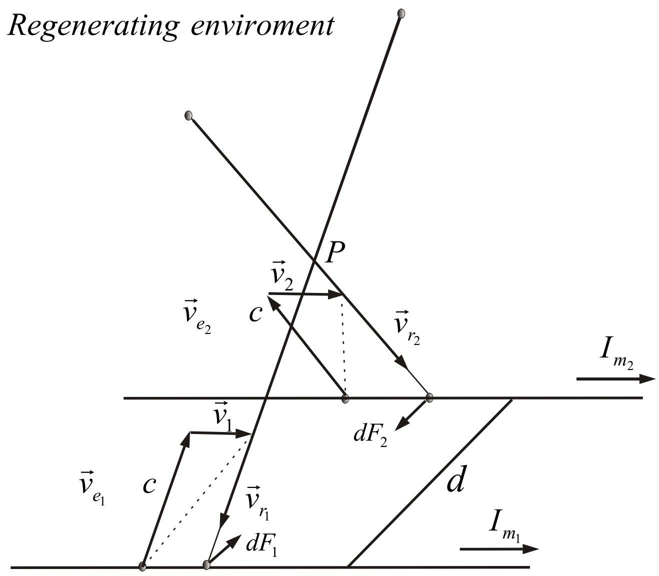


Figure 43: Moving negative BSPs and positive regenerating BSPs

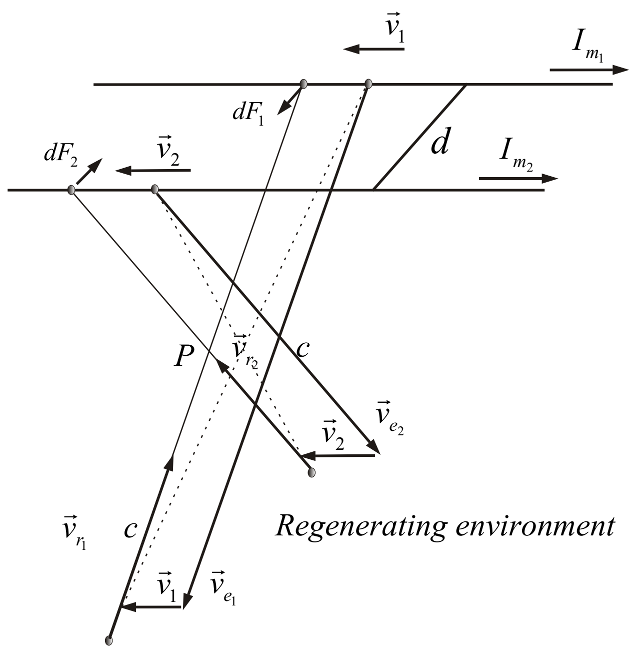


Figure 44: Moving positive BSPs and negative regenerating BSPs

4.11.2 Energy and rotational momentum balance for two parallel conductors.

Because of the constant velocities of the BSPs at the two conductors and the existing symmetry, the balances of energy and rotational momentums are reduced to the two following already analyzed cases:

- One BSP with constant speed at sec. 2.11
- Two static BSPs at sec. 4.8

The rotational momentums $\bar{J}_i^{(n)}$ are generated as opposed pairs so that the total sum of all rotational momentums is zero.

4.11.3 Calculations

The calculations were made assuming two infinite parallel conductors with currents of decelerating BSPs. To calculate the momentum time we consider that $dp_h = p_h$ and the momentum time

$$\Delta t = \frac{p_h}{F_c} \tag{300}$$

was calculated with

$m_e = 9.1093897 \cdot 10^{-31}\ kg$
$q_e = 1.60217733 \cdot 10^{-19}\ A\ s$
$\mu_o = 4\ \pi \cdot 10^{-7}\ \frac{V\ s}{A\ m}$
$v_e = c$
$v_r = 10^{30}\ \frac{m}{s}$
$r_o = 10^{-16}\ m$

For the radius r_o the same value as for the calculations for two static BSPs was used.

Results.

The results show that for a given radius r_o and for $d \gg r_o$ the momentum time Δt is the same and constant for two static BSPs and for two infinite straight conductors. The curve of Δt has the same shape as for two static BSPs inducing the conclusion, that here also the time Δt is a constant for all distances d, even for $d \ll r_o$ (see Fig. 30).

The following Fig. 45 shows a schematic representation of the generation of the linear momentum between two conductors and between a moving BSP and an oriented transversal field.

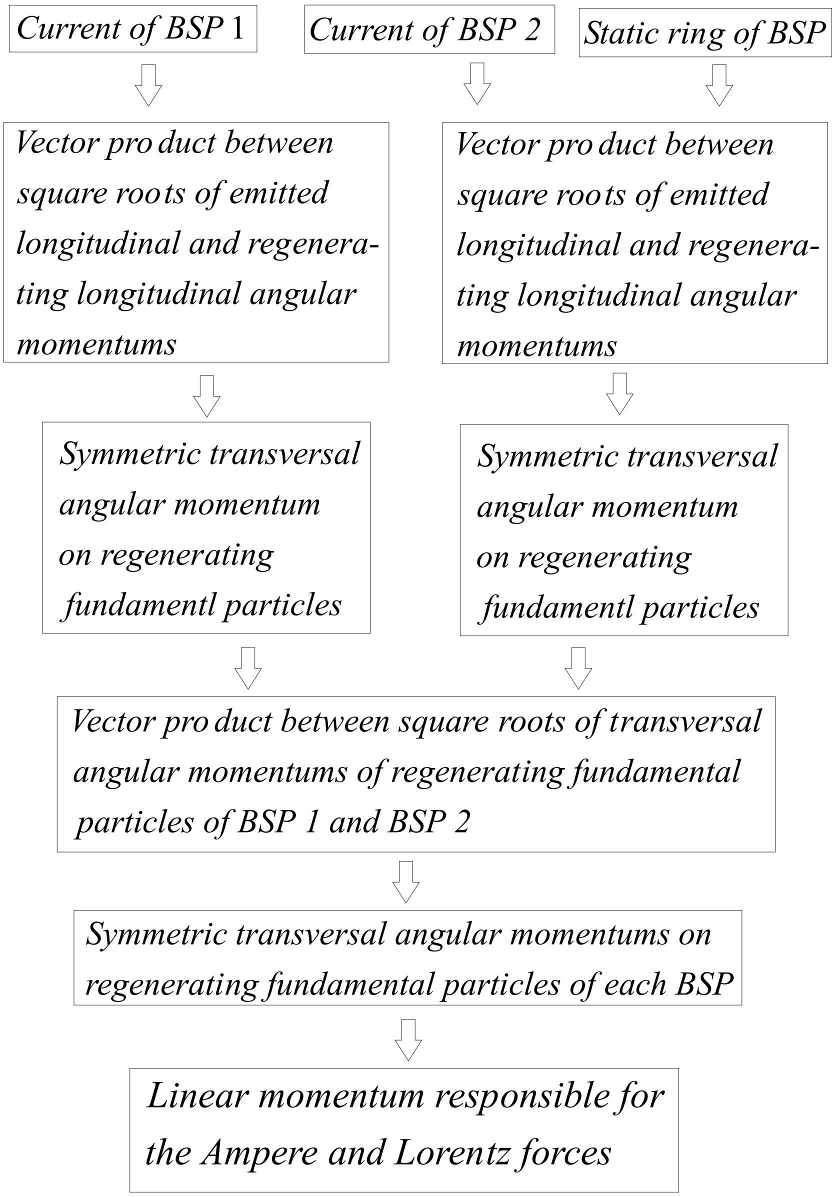


Figure 45: Generation of the linear momentum between two conductors and between a moving BSP and an oriented transversal field

4.12 Momentum on a BSP that moves with v_t in a space with oriented transversal rotational momentums.

4.12.1 General considerations

If a BSP moves with the speed v_t in a space with fundamental particles that all have transversal rotational momentums $\bar{J}_{n_h}$ oriented in the same direction, then the TRMs $\bar{J}_{n_t}$ of the regenerating fundamental particles of the BSP and the oriented TRMs of the space will generate rotational momentums according to postulate 7.

$$\bar{J}_t = -\ \mathrm{sign}(\bar{J}_{s_t})\ \mathrm{sign}(\bar{J}_{s_h})\ (\sqrt{J_{n_t}}\ \bar{n}_t\ \times\ \sqrt{J_{n_h}}\ \bar{n}_h) \tag{301}$$

$\bar{J}_{n_t}$ represents the TRMs of the moving BSP.

$\bar{J}_{n_h}$ represents the oriented TRMs in the space.

$\bar{J}_{s_t}$ und $\bar{J}_{s_h}$ are the corresponding longitudinal RMs that define the sign and will be omitted in the following analysis.

The concept is shown in Fig. 46, where the current that generates the field $\bar{J}_{n_h}$ and the corresponding regenerating longitudinal field $\bar{J}_{s_h}$, are not shown. It is important to note, that the direction of the resulting force on the moving BSP is also defined by the sign of the field $\bar{J}_{s_h}$ not shown in the figure, and not only by the direction of the field $\bar{J}_{n_h}$. The field $\bar{J}_{n_h}$ shown in Fig. 46 can be generated by a current of positive or negative BSPs moving in the direction of v_t.

If we decompose the vector $\bar{n}_h$ in a component $\bar{n}_h^{\|}$ parallel to the velocity v_t and a component $\bar{n}_h^{\perp}$ orthogonal to v_t we get

$$\bar{J}_t = \sqrt{J_{n_t}}\ \bar{n}_t\ \times\ \sqrt{J_{n_h}}\ (\bar{n}_h^{\|}\ +\ n_h^{\perp}\ ) \tag{302}$$

The components $\sqrt{J_{n_h}}\ \bar{n}_h^{\|}$ parallel to v_t generate components of the rotational momentum $\bar{J}_t$ that don't comply with the requirements for generation of linear momentum dp, namely, that they form pairs of opposed rotational momentums.

The components $\sqrt{J_{n_h}}\ \bar{n}_h^{\perp}$ orthogonal to v_t on the contrary generate components of the rotational momentums $\bar{J}_t$ that comply with the requirements for generation of linear momentum dp. The direction of the momentum dp is orthogonal to v_t and $\bar{n}_h^{\perp}$. The so generated momentum is responsible for a lateral displacement of the BSP during the regeneration.

$$\bar{J}_t^{\perp} = \sqrt{J_{n_t}}\ \bar{n}_t\ \times\ \sqrt{J_{n_h}}\ \bar{n}_h^{\perp} \tag{303}$$

$\bar{J}_t^{\perp}$ represents the opposed rotational momentum that comply with the requirements

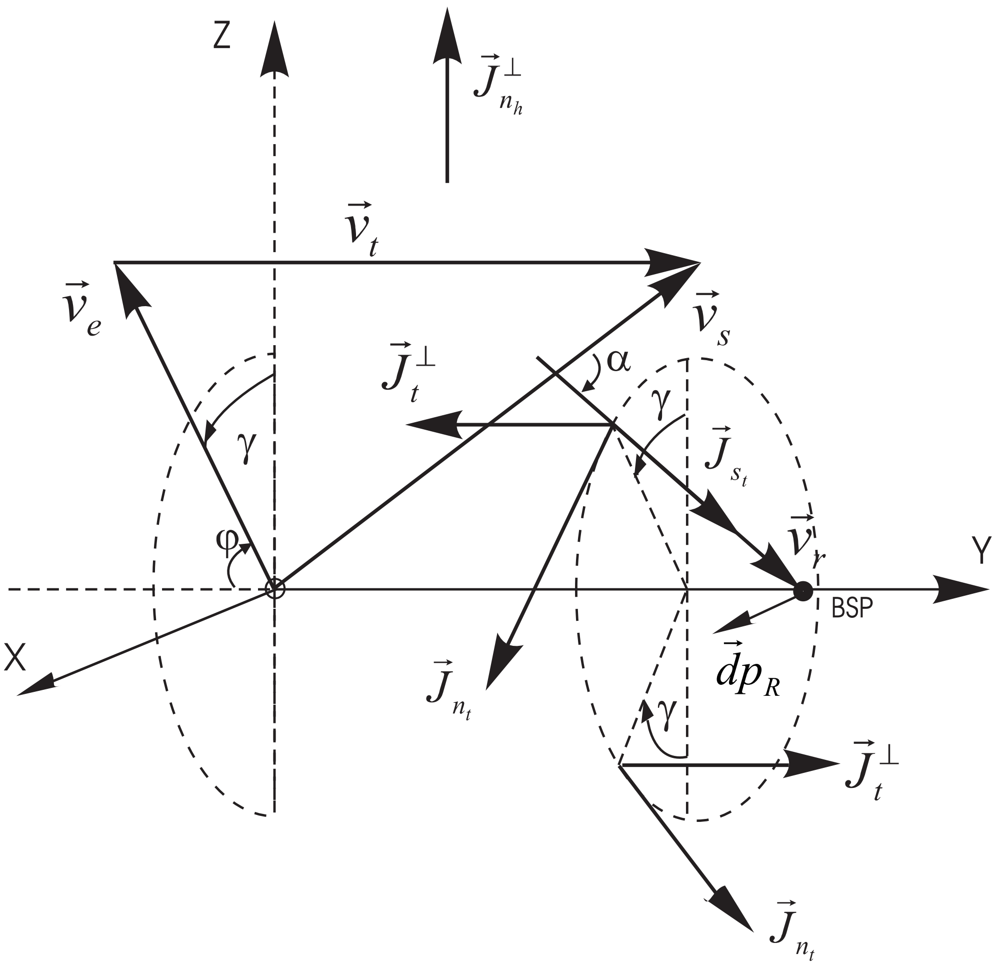


Figure 46: Generation of a pair of opposed $J_t^{\perp}$ on a basic subatomic particle that moves with v_t in a field of oriented $J_{n_h}^{\perp}$

for generation of linear momentum $\bar{p}_R$ radially to to the resulting circular movement.

If we multiply both sides of the equation with $\sqrt{\nu_{n_t}\ d\kappa_{n_t}}$ and $\sqrt{\nu_{n_h}\ d\kappa_{n_h}}$ and build then the sum of dH_{n_t} and dH_{n_h} of the regenerating fundamental particles, we get for the energy dE_{p_R} responsible for the radial impulse

$$dE_{p_R} = \left| \int_{r_{r_t}}^{\infty} dH_{n_t}\ \bar{n}_t\ \times\ \int_{r_{r_h}}^{\infty} dH_{n_h}\ \bar{n}_h^{\perp} \right| \tag{304}$$

with

$$dH_{n_i} = \sqrt{\nu_{n_i}\ J_{n_i}\ d\kappa_{n_i}} \tag{305}$$

dH_{n_h} can have its origin at a current through a straight conductor that is parallel to the y axis in the xy plane at the distance h from the moving BSP.

The total linear momentum in radial direction we get by the spatial integration of dE_{p_R}.

$$p_R = \frac{1}{c}\ E_{p_R} = \frac{1}{c}\ \int_V\ dE_{p_R} \tag{306}$$

The BSP has constant tangential v_t and radial v_R velocities.

$$v_t = \frac{E_{p_t}}{m\ c} \qquad and \qquad v_R = \frac{E_{p_R}}{m\ c} \tag{307}$$

The force on a BSP is

$$F_L = \frac{dp_R}{dt} = \frac{p_R}{\Delta t} = \frac{1}{c}\ \frac{1}{\Delta t}\ E_{p_R} = \frac{1}{c}\ \frac{1}{\Delta t}\ \int_V\ dE_{p_R} \tag{308}$$

or

$$F_L = \frac{1}{c}\ \frac{1}{\Delta t}\ \int_V\ \left| \int_{r_{r_t}}^{\infty} dH_{n_t}\ \bar{n}_t\ \times\ \int_{r_{r_h}}^{\infty} dH_{n_h}\ \bar{n}_h^{\perp} \right| \tag{309}$$

The differential dp_R is equal to the momentum p_R because the momentum is constantly reduced to zero.

For complex particles composed of more than one BSP the force is

$$F_L = \Delta n\ \frac{p_R}{\Delta t} \tag{310}$$

with $\Delta n = n^+ - n^-$ where n^+ are the number of positive and n^- the number of negative BSPs that compose the complex SP. As n^+ and n^- are integer numbers the force is quantified.

The known Lorentz force is

$$\bar{F}_c = Q\ \bar{v}_t \times \bar{B} \tag{311}$$

with $\bar{F}_c$ the Lorentz force, Q the electric charge and $\bar{B}$ the magnetic flux density.

The general expression for the linear momentum due to the transversal fields of two moving BSPs is

$$dp\ \bar{s}_R = \frac{1}{c} \oint_R \left\{ \frac{\bar{dl} \cdot (\bar{n}_1 \times \bar{n}_2)}{2\pi R} \int_{r_1}^{\infty} H_{n_1}\ d\kappa_{r_1} \int_{r_2}^{\infty} H_{n_2}\ d\kappa_{r_2} \right\}\ \bar{s}_R \tag{312}$$

The concept is shown in Fig. 47

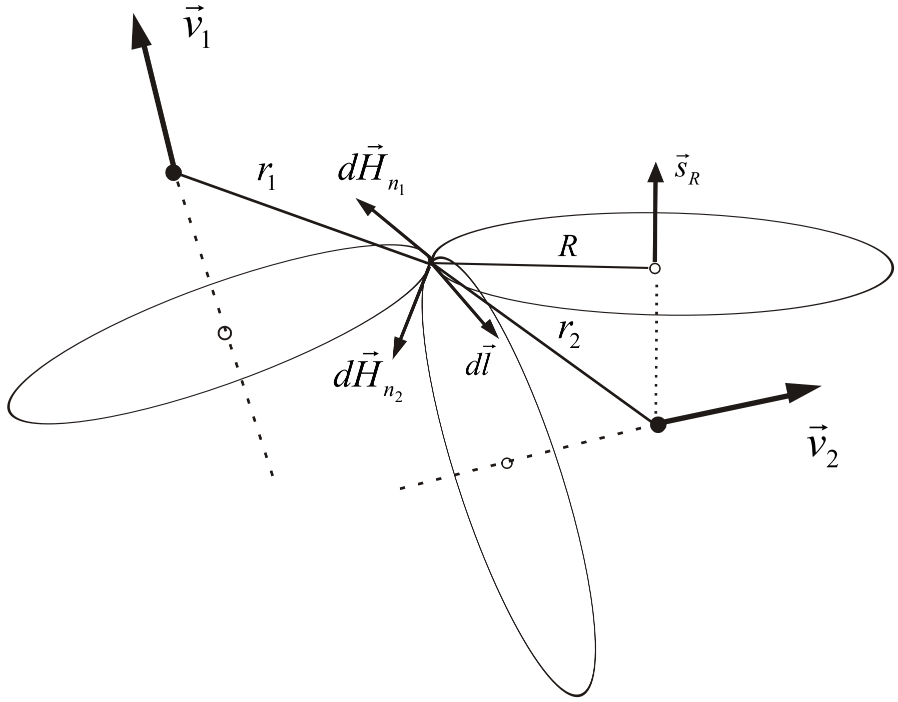


Figure 47: Linear momentum due the transversal fields of two moving BSPs

4.12.2 Lorentz law.

We start with eq. (255) from sec. 4.10.1 which gives the dH_n field at the distance h and the interval dl generated by a stright infinite current I_m.

$$\int_{-\infty}^{\infty} \int_{r_r}^{\infty} d\bar{H}_n = \frac{I_m}{\sqrt{m}} \, \frac{1}{4} \, \frac{r_o}{h} \, dl \; d\gamma \; \bar{n} = d\bar{H}_{n(cum,\infty)} \tag{313}$$

and with eq. (281) from sec. 4.11 which gives us the force density between two stright infinite currents I_{m_1} and I_{m_2}.

$$\frac{F}{\Delta l} = \frac{b}{c \, \Delta t} \, \frac{r_o^2}{16 \, m} \, \frac{I_{m_1} \, I_{m_2}}{d} \int \int_{Ampere} \tag{314}$$

with b the tuning factor introduced in eq. (283).

The dH_n field at dl generated by I_{m_1} is with eq. (313)

$$d\bar{H}_{n(cum,\infty)} = \frac{I_{m_1}}{\sqrt{m}} \, \frac{1}{4} \, \frac{r_o}{h_1} \, dl \; d\gamma \; \bar{n} \tag{315}$$

The concept is shown in Fig. 48

For $h_2 = 0$ we have that $h_1 = d$ and dl overlaps with I_{m_2} and the dH_n field generated by I_{m_1} at dl is perpendicular to I_{m_2}. It is

$$I_{m_1} = \frac{4 \, d \, \sqrt{m}}{r_o \, dl \, d\gamma} \, dH_{n(cum,\infty)} \tag{316}$$

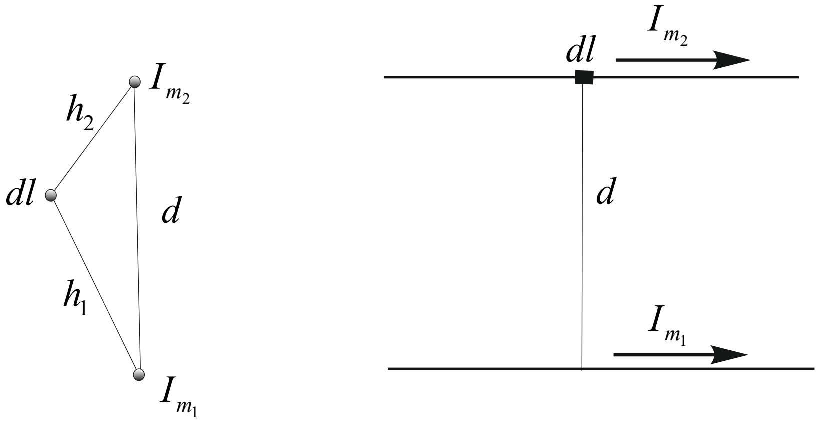


Figure 48: Geometric configuration for parallel currents

The current I_{m_2} can be expressed as a function of the velocity v_t of its BSPs as $I_{m_2} = \rho_x \; m \; v_t$ where $\rho_x = N/\Delta x$. If we now concentrate on one BSP of I_{m_2} we have that $N = 1$ and $\Delta x = r_o$ resulting $I_{m_2} = m \; v_t/r_o$. We now introduce I_{m_1} and I_{m_2} in eq. (314) and get

$$F = \frac{b}{c \; \Delta t} \sqrt{m} \; v_t \; dH_n \; \frac{1}{4 \; d\gamma} \; \int\int_{Ampere} \tag{317}$$

Note: For simplicity reasons we used the notation dH_n instead of $dH_{n(cum,\infty)}$.

The equation has two variables $d\gamma$ and dH_n that are free and if fixing one we fix the other. We decide to make

$$\frac{1}{4 \; d\gamma} \; \int\int_{Ampere} = 1 \tag{318}$$

In Fig. 46 we have defined the angular momentum $\bar{J}^{\perp}_{n_h}$ as the component perpendicular to the speed $\bar{v}_t$. It is $J^{\perp}_{n_h} = J_{n_h} \sin\mu$, with μ the angle between $\bar{v}_t$ and $\bar{J}_{n_h}$.

For the case of two parallel currents the dH_n field from eq. (317) is perpendicular to the current I_{m_2} and we express it now in a more evident form as $dH_n = dH^{\perp}_{n_h}$. It is $dH^{\perp}_{n_h} = dH_{n_h} \sin\mu$, with μ the angle between $\bar{v}_t$ and $d\bar{H}_{n_h}$.

The relation between the angular momenta J_{n_h} and the dH_{n_h} fields is

$$dH_{n_h} = \sqrt{J_{n_h} \; \nu} \qquad dH^{\perp}_{n_h} = \sqrt{J^{\perp}_{n_h} \; \nu} \tag{319}$$

We get

$$\bar{F} = \frac{b}{c \; \Delta t} \sqrt{m} \; v_t \; dH^{\perp}_{n_h} \; (\bar{n}_t \times \bar{n}^{\perp}_h) = \frac{b}{c \; \Delta t} \sqrt{m} \; \bar{v}_t \; \times \; d\bar{H}_{n_h} \tag{320}$$

The force F is perpendicular to the speed $\bar{v}_t$ and the $d\bar{H}^{\perp}_{n_h}$ field and describes the Lorentz force

$$\bar{F}_c = q\ \mu_o\ \bar{v}_t\ \times\ \bar{H}_c = q\ \mu_o\ v_t\ H_c\ \sin\mu\ \bar{n} \tag{321}$$

We make $F = F_c$ for $\mu = \pi/2$ and get

$$\frac{b}{c\ \Delta t}\ \sqrt{m}\ v_t\ dH_n = q\ \mu_o\ v_t\ H_c \qquad with \qquad H_c = \frac{1}{2\pi}\ \frac{I_c}{d} \tag{322}$$

The following equations for the conversion from mainstream to the present approach result

$$dH_n = \frac{q\ \mu_o\ c\ \Delta t}{b\ \sqrt{m}}\ H_c = \frac{q\ \mu_o\ c\ \Delta t}{b\ \sqrt{m}}\ \frac{1}{2\pi}\ \frac{I_c}{d} \tag{323}$$

From sec. 2.16.1 we have that

$$dH_n = \sqrt{\frac{1}{2}\ \mu_o\ dV\ d\kappa}\ \ \mathbf{H} \tag{324}$$

where $\mathbf{H}$ is the magnetic field strength from standard theory.

If we make $H_c = \mathbf{H}$ we get that

$$dV\ d\kappa = 2\ \frac{q^2\ \mu_o\ c^2\ \Delta^2 t}{b^2\ m} = 6.66 \cdot 10^{-36}\ \ m^3 \tag{325}$$

4.13 Momentum on a BSP that moves with light speed through a space with oriented transversal rotational momentums.

When a BSP moves with light speed through a space with fundamental particles with oriented transversal rotational momentums $\bar{J}_{n_h}$ as shown in Fig. 46, in the equation

$$\bar{J}_t = -\ \mathrm{sign}(\bar{J}_{s_t})\ \mathrm{sign}(\bar{J}_{s_h})\ (\sqrt{J_{n_t}}\ \bar{n}_t\ \times\ \sqrt{J_{n_h}}\ \bar{n}_h) \tag{326}$$

the sign of the missing LRM $\bar{J}_{s_t}$ is not defined.

The direction of the pairs of opposed TRMs $\bar{J}_t$ that comply with the requirements for linear momentum is not defined and therefore also the direction of the linear momentum generated is undefined.

Note: Each angular momentum $\bar{J}_1$ from a FP_1 of BSP_1 has its opposed $-\bar{J}_1$ on an other $FP_1^{'}$ of BSP_1, they are entangled. If the angular momentum of FP_1 interacts with an angular momentum of a FP_2 of BSP_2, then necessarily the angular momentum of $FP_1^{'}$ must interact with the angular momentum of another $FP_2^{'}$ of BSP_2 so that opposed angular momentum are generated.

4.14 Momentum on complex particles that move with the speed v in a space with oriented transversal rotational momentums.

Complex particles are formed by more than one BSP that are forced in opposed directions orthogonal to the moving direction, according to their signs, when they move through a space with oriented TRMs. Thus a polarization of the positive and negative BSPs inside the complex particle occur. There are two basic cases:

- If the complex particle has the same number of positive and negative BSPs (neutron) the sum of momentum orthogonal to the moving direction compensate and the complex particle maintain its straight direction.
- If the complex particle has different numbers of positive and negative BSPs (proton) the sum of momentum orthogonal to the moving direction does not compensate and the complex particle deviate from its straight direction.

4.15 Δt as a function of the radius r_o of the BSP.

In the equations for the momentum responsible for the force between two static BSPs and the force on a BSP that moves in a field of oriented transversal rotational momentums, the radius r_o of the BSPs appears. The momentum time Δt as a function of the radius r_o is given by

$$\Delta t = K\, r_o^2 \qquad with \qquad K = 5.42713 \cdot 10^4 \left[\frac{s}{m^2}\right] \tag{327}$$

From the calculations for two static BSPs and for two straight parallel conductors we have that

$$\Delta t = 5.4274 \cdot 10^{-28}\, sec \qquad \text{for} \qquad r_o = 10^{-16} \qquad \text{and} \qquad 0 \le d \le \infty \tag{328}$$

Note: Calculations and plots originally were made for an energy distribution (see sec. 2.3)

$$d\kappa = \frac{c}{2\, v} \left| \frac{\bar{v}_s}{|\bar{v}_e|} \times \frac{\bar{v}_r}{|\bar{v}_r|} \right| W\ \sin\varphi\, d\varphi \tag{329}$$

and changed to

$$d\kappa = \frac{c}{2\, v} \left| \frac{\bar{v}_s}{|\bar{v}_e|} \times \frac{\bar{v}_r}{|\bar{v}_r|} \right| W\, d\varphi \tag{330}$$

which allows to express the Coulomb force as an rotor of the dH_n field (see sec. 4.6). This explains, why there is a difference of approx. a factor 2 between the values of the plots of sec. 4.1 and values calculated with the new energy distribution.

We now analyze the two following expressions for the calculation of the force

1. Force between two static BSPs.

$$dF = \frac{a}{c\,\Delta t}\, dE_p^{(s)} \qquad with \qquad dE_p^{(s)} = \left| \int_{r_{r_1}}^{\infty} dH_{e_1}\, \bar{s}_1 \times \int_{r_{r_2}}^{\infty} dH_{s_2}\, \bar{s}_2 \right| \tag{331}$$

   and

$$dH_s = H_s\, d\kappa \qquad with \qquad d\kappa = \frac{2\,c}{\pi\,v} \left| \frac{\bar{v}_s}{|\bar{v}_e|} \times \frac{\bar{v}_r}{|\bar{v}_r|} \right| \frac{r_o}{r_r^2}\, d\varphi \tag{332}$$

   We see that $dE_p^{(s)}$ is proportional to r_o^2. With $\Delta t = K\, r_o^2$ also proportional to r_o^2, the equation for the force dF is independent of the radius r_o of the BSPs. As complex particles like protons, atomic nucleus, etc. are formed by the sum of BSPs, the attraction force between them is also independent of their radii.

2. Force between two straight parallel currents of BSPs.

$$dF = \frac{1}{c\,\Delta t}\, dE_{p_h} \tag{333}$$

   with

$$dE_{p_h} = \left| \int_{x=-\infty}^{\infty} \int_{r_{r_1}}^{\infty} dH_{n_1}\, \bar{n}_1 \times \int_{x=-\infty}^{\infty} \int_{r_{r_2}}^{\infty} dH_{n_2}\, \bar{n}_2 \right| \tag{334}$$

   and

$$dH_n = H_n\, d\kappa \qquad with \qquad d\kappa = \frac{2\,c}{\pi\,v} \left| \frac{\bar{v}_s}{|\bar{v}_e|} \times \frac{\bar{v}_r}{|\bar{v}_r|} \right| \frac{r_o}{r_r^2}\, d\varphi \tag{335}$$

   We see that the same considerations as for the two static BSPs are valid with the same result, that the force dF is independent of the radii r_o of the BSPs.

These results are conform with the two basic equations of classic physics for the force between two static BSPs and the force density between two parallel straight conductors of BSPs, that are also independent of their radii.

$$F = \frac{1}{4\,\pi\,\epsilon_o}\,\frac{Q_1\,Q_2}{d^{\,2}} \qquad and \qquad \frac{F}{l} = \frac{\mu_o}{2\,\pi}\,\frac{I_{c_1}\,I_{c_2}}{d} \tag{336}$$

If we now observe the following derived equations for the Coulomb-force

$$F_2 = \frac{4\,c\,a}{\pi^2\,K}\,\frac{\Delta_{n_1}\sqrt{m}\,\Delta_{n_2}\sqrt{m}}{d^{\,2}}\int_{\varphi_{1_{min}}}^{\varphi_{1_{max}}}\int_{\varphi_{2_{min}}}^{\varphi_{2_{max}}} \sin\varphi_1\,\sin\varphi_2\,\sin^3(\varphi_1-\varphi_2)\,d\varphi_2\,d\varphi_1 \tag{337}$$

and the force density between two parallel straight conductors of BSPs

$$\frac{F}{\Delta l} = \frac{1}{64\,m\,c\,K}\,\frac{I_{m_1}\,I_{m_2}}{d}\int_{\gamma_{2_{min}}}^{\gamma_{2_{max}}}\int_{\gamma_{1_{min}}}^{\gamma_{1_{max}}}\frac{\sin^2(\gamma_1-\gamma_2)}{\sqrt{\sin\gamma_1\,\sin\gamma_2}}\,d\gamma_1\,d\gamma_2 \tag{338}$$

and compare them with the basic equations of classic physics we see, that the permittivity ϵ_o and the permeability μ_o are replaced by the constant K.

4.16 Considerations on the quantized momentum time Δt.

The momentum time Δt during which reactions between two BSPs occur is

$$\Delta t = K\,r_{o_1}\,r_{o_2} \tag{339}$$

The displacement Δd of a BSP in the time Δt due to the presence of an other BSP occurs with the speed $k\,c$ with $k \neq c$, and takes place each time a pair of regenerating fundamental particles that comply with the requirements for linear momentum arrive at the nucleus of the BSP.

The displacement is given by

$$\Delta d = k\,c\,\Delta t = k\,c\,K\,r_o^2 \qquad for \qquad r_{o_1} = r_{o_2} \tag{340}$$

The linear momentum is

$$p = F\,\Delta t = F\,K\,r_o^2 \tag{341}$$

If one of the particles is a complex particle with n^+ positive and n^- negative BSPs, the momentum is

$$p = (n^+ - n^-)\,F\,\Delta t = (n^+ - n^-)\,F\,K\,r_o^2 \tag{342}$$

with F the force between the two particles at the distance d.

4.17 Momentum between BSPs that move with light speed.

At BSPs that move with light speed the longitudinal rotational momentum $\bar{J}_e = 0$ and $\bar{J}_s = 0$ and therefore $dH_e = 0$ and $dH_s = 0$.

The direction of the vector products of the transversal rotational momentums $\bar{J}_n$ of two BSPs that move with light speed, according postulate 7, are not defined because the longitudinal rotational momentums $\bar{J}_s = 0$

$$\bar{J}_1^{(n)} = \pm \ (\sqrt{J_{n_1}}\ \bar{n}_1 \ \times \ \sqrt{J_{n_2}}\ \bar{n}_2) \tag{343}$$

We get that

$$dE_p^{(n)} = |\ dH_{n_1}\ \bar{n}_1 \times dH_{n_2}\ \bar{n}_2\ | \qquad and \qquad dp = \frac{1}{c}\ dE_p^{(n)} \tag{344}$$

As photons are composed of a sequence of BSPs that move with light speed, the interaction of photons is a result of the interactions of the individual components.

BSPs with light speed have fundamental particles with only transversal rotational momentums that comply with the requirements for linear momentum. As the difference between negative and positive BSPs is given by the rotation sense of their longitudinal rotational momentums, which are zero for BSPs with light speed, BSPs with light speed have no charge.

BSPs with light speed are formed of pairs of fundamental particles with opposed transversal rotational momentums. They don't disintegrate by emitting fundamental particles in all directions and therefore don't need to be regenerated. The pairs of fundamental particles with opposed transversal rotational momentums are placed in planes orthogonal to the moving direction or in planes containing the moving direction. If placed in the orthogonal plane, the potential linear momentum is in the direction or opposed to the moving direction and, if placed in the plane containing the moving direction the potential linear momentum is transversal to the moving direction.

The closed path integral along the transversal rotational momentum is

$$\oint \bar{dl} \cdot \bar{J}_n \qquad with \qquad \sum \bar{J}_n = 0 \tag{345}$$

4.18 Classification overview of stable particles and fields.

Stable particles that emit fundamental particles have to be regenerated to not disintegrate. They require an environment that is capable to regenerate them, an environment where fundamental particles of the other velocity than the emitted one exist in sufficient quantity. As they are regenerated, they have longitudinal rotational momentums on their regenerating fundamental particles, and therefor, a positive or negative charge according to the sign of the longitudinal rotational momentums. Complex particles without charge are formed by equal number of positive and negative charged particles.

Stable particles that don't emit fundamental particles don't require to be regenerated. As they don't emit fundamental particles they don't disintegrate and can move through space without fundamental particles to regenerate them. As they are not regenerated, they have no regenerating fundamental particles with longitudinal rotational momentums and have therefor no charge.

There are two fundamental particles (sec.2.1) defined by their speeds (see Fig. 3).

- Fundamental particle with light speed c.
- Fundamental particle with infinity speed ∞.

The fundamental particles are subdivided according the angular momentums they have in:

- velocity equal c and negative longitudinal angular momentum.
- velocity equal c and positive longitudinal angular momentum.
- velocity equal ∞ and negative longitudinal angular momentum.
- velocity equal ∞ and positive longitudinal angular momentum.

The basic subatomic particles are classified in $v \neq c$ and $v = c$.
Basic subatomic particles with $v \neq c$ are:

- accelerating electron
- decelerating electron
- accelerating positron
- decelerating positron

Basic subatomic particles with $v = c$ (see Fig. 59 and Fig. 69) are Neutrinos which can have the following configurations:

- pair of opposed transversal angular momentum with positive linear momentum
- pair of opposed transversal angular momentum with negative linear momentum
- pair of opposed transversal angular momentum with transversal linear momentum

- pair of opposed longitudinal angular momentum with transversal linear momentum

Stable complex subatomic particles are:

- neutron (composed of electrons and positrons and binding energy)
- proton (composed of electrons and positrons and binding energy)
- nuclei of atoms
- photon (composed of neutrinos)

A classification of stable particles and fields is shown in Fig. 49.

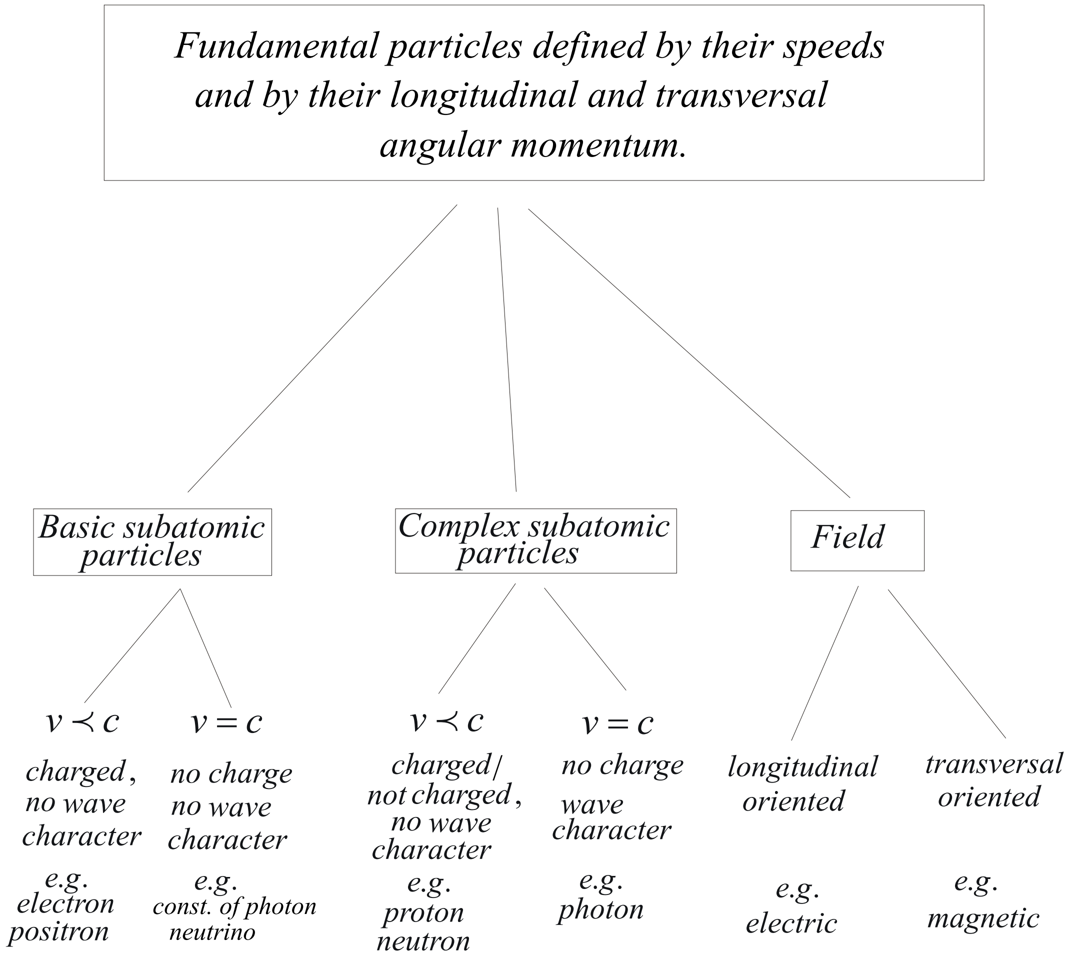


Figure 49: Classification of stable particles and fields

There are three interaction laws between fundamental particles of different BSPs, namely,

- Vector product between longitudinal angular momentums of fundamental particles (Postulate 6).
- Vector product between transversal angular momentums of fundamental particles (Postulate 7).
- Transfer of angular momentum between two fundamental particles (Postulate 8).

5 Quarks composed of electrons and positrons.

The existence of Quarks were first infered from the study of hadron spectroscopy. Infered means that they were reconstructed from the final measured products obtained after collisions of particles. The final products are neutrons, protons, pions, muons, electrons, positrons, photons, and neutrinos. As neutrons, protons, pions and muons are composed of electrons and positrons according the $E\&R$ model, the real final products are electrons, positrons, photons and neutrinos. And as also according to the $E\&R$ model the photon is a sequence of neutrinos, the final products are reduced to electrons, positrons and neutrinos.

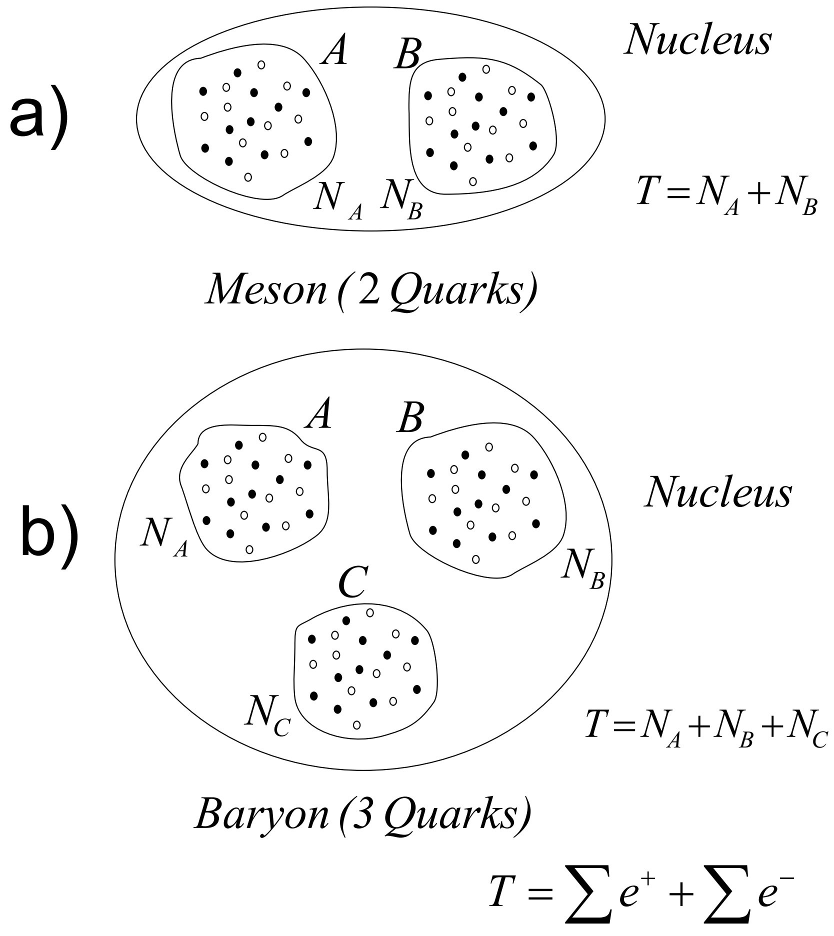


Figure 50: Nucleus composed of quarks.

The concept is shown in Fig: 50

To explain the interpretation given with the model $E\&R$ UFT we calculate an example with the proton.

Example: The proton has a mass of 938.2723 MeV/c^2. With the mass of an electron or positron of 0.511 MeV/c^2 we get $\approx$ 1837.00 electrons and positrons from which $n^+ = 919$ are positrons and $n^- = 918$ electrons. The mass of the proton m_p is equal 1837 times the mass of an electron plus the binding energy.

$$1837\ m_e + m_{binding} = m_p \tag{346}$$

The total number of electrons and positrons at the proton are

$$T = N_A + N_B + N_C = n^+ + n^- = 1837 \tag{347}$$

where N_i is the total namber of electrons and positrons at Quark i.

As the proton is a baryon it has three quarks with the electric charge uud. With the SM we get the charge of the proton adding the fractional charges

$$u\ +\ u\ -\ d = \frac{2}{3} + \frac{2}{3} - \frac{1}{3} = 1 \tag{348}$$

Charges that are a fraction of the charge of an electron or positron violate the charge conservation principle.

The finding of the "$E\&R''$ model that electrons and positrons neither attract nor repell each other when the distance between them tend to zero, allows to interprete the charge numbers Q of quarks as the relative charge

$$u = \left| \frac{N_i^+ - N_i^-}{N_i} \right| \qquad and \qquad d = \left| \frac{N_i^+ - N_i^-}{N_i} \right| \tag{349}$$

where N_i^+ and N_i^- are the number of positrons and electrons at the quark i and $N_i = N_i^+ + N_i^-$ and $\Delta N_i = N_i^+ - N_i^-$.

As the sum of the differences between electrons and positrons at each quark must give the charge of the proton we write

$$u\ N_A + u\ N_B + d\ N_C = \frac{2}{3} N_A + \frac{2}{3} N_B - \frac{1}{3} N_C = 1 \tag{350}$$

With equations (347) and (350) and the condition that the result must give positive integer numbers of N_A, N_B and N_C, we can fix arbitrarily one of them and calculate the others. As there are many possibilities, we conclude that the distribution of electrons and positrons on the three quarks of baryons is not constant and may vary from case to case. For mesons the distribution is well defined because they have only two quarks.

If we fix for the moment arbitrarily $N_A = 499$ we get

$$N_A = 499 \qquad N_B = 114.33 \qquad N_C = 1223.66 \tag{351}$$

We should get integer numbers, but this is irrelevant for the moment to understand the new interpretation and continue with the obtained results and get

$$\Delta N_A = \frac{2}{3} N_A = 332.66 \qquad \Delta N_B = \frac{2}{3} N_B = 76.22 \qquad \Delta N_C = -\frac{1}{3} N_C = -407.886 \tag{352}$$

or

$$\Delta N_A + \Delta N_B + \Delta N_C = 332.66 + 76.22 - 407.886 = 0.994 \tag{353}$$

The **rest masses** of the quarks are, with m_e the mass of the electron

$$m_A = N_A \, m_e = 4.54558 \cdot 10^{-28} \; kg \qquad m_B = N_B \, m_e = 1.03847 \cdot 10^{-28} \; kg \tag{354}$$

$$m_C = N_C \, m_e = 1.11498 \cdot 10^{-27} \; kg \tag{355}$$

Note: The rest masses m_A and m_B which belong to the same type u of quarks of the proton are not equal.

As chemical elements are composed of protons and neutrons, the atomic number Z of an element can be expressed as the sum of the ΔN of its quark constituents.

$$Z = \sum_i \Delta N_i \tag{356}$$

Note: All hadrons have a total charge equal -1, 0 or 1 while chemical elements have charges $Z \geq 1$. Quarks play a similar function at hadrons as protons and neutrons play at chemical elements.

Now we come back to the fractional numbers of N and ΔN. If we round the fractional numbers slightly to get integer numbers as follows

$$N_A = 499 \quad N_B = 114 \quad N_C = 1224 \qquad to \;\; get \qquad T = 1837 \tag{357}$$

$$\Delta N_A = 333 \qquad \Delta N_B = 76 \qquad \Delta N_C = -408 \qquad to \;\; get \qquad \sum \Delta N = 1 \tag{358}$$

we get for the relative charge of the quarks

$$u_A = \left| \frac{\Delta N_A}{N_A} \right| = 0,6673 \approx \frac{2}{3} \qquad u_B = \left| \frac{\Delta N_B}{N_B} \right| = 0.6666 \approx \frac{2}{3}$$

$$d_C = \left| \frac{\Delta N_C}{N_C} \right| = 0.33333 \approx \frac{1}{3} \tag{359}$$

according eq.348.

More examples:

For the π^+ **particle** we have that $n^+ = 137$ and $n^- = 136$ and that it is an $u\bar{d}$ particle.

$$T = N_A + N_B = n^+ + n^- = 273 \tag{360}$$

$$u \; - \; \bar{d} = \frac{2}{3} + \frac{1}{3} = 1 \tag{361}$$

With the equations

$$\frac{2}{3}\,N_A - \frac{1}{3}\,N_B = 1 \qquad and \qquad N_A + N_B = 273 \tag{362}$$

we get

$$N_A = 92 \qquad\qquad \Delta N_A = u\;N_A = 61.333 \tag{363}$$

$$N_B = 181 \qquad\qquad \Delta N_B = d\;N_B = -60.333 \tag{364}$$

$$\Delta N_A + \Delta N_B = 61.333 - 60.333 = 1 \tag{365}$$

The **rest masses** of the quarks are

$$m_A = N_A\;m_e = 8.3806 \cdot 10^{-29}\;kg \qquad m_B = N_B\;m_e = 1.6488 \cdot 10^{-28}\;kg \tag{366}$$

For the **neutron** we have that $n^+ = 919$ and $n^- = 919$ and that it is a udd particle. We get

$$T = N_A + N_B + N_C = n^+ + n^- = 1838 \tag{367}$$

$$u \; - \; d \; - \; d = \frac{2}{3} - \frac{1}{3} - \frac{1}{3} = 0 \tag{368}$$

For the Σ^+ **particle** we have that $n^+ = 1164$ and $n^- = 1163$ and that it is an uus particle.

$$T = N_A + N_B + N_C = n^+ + n^- = 2327 \tag{369}$$

$$u \ + \ u \ + \ s = \frac{2}{3} + \frac{2}{3} - \frac{1}{3} = 1 \tag{370}$$

The distribution of electrons and positrons on the different quarks must not be necessarilly static.

Conclusion: The Q values for the electric charge at quarks refere to the relative charge of the quarks. There is no need to introduce fractional charges which were never directly measured. All charges are integer multiples of the charge of an electron, which constitutes the unit of the charge.

Note: No strong forces or gluons are necessary to hold quarks together, because for the distance tending to zero electrons and positrons neither attract nor repel each other. The distribution of electrons and positrons on the quarks is not a constant. The number N_i of the u quarks of one hadron may be different because u gives only the relative charge of a quark.

Note: The μ and τ leptons may also be composed of electrons, positrons and neutrinos.

6 Spin of level electrons and the formation of elements

In sec. 2.1 two types of electrons and positrons were identified according the velocities of their regenerating and emitting fundamental particles; they were named accelerating and decelerating BSPs.

We know, that electrons in individual energy orbits must have different states which the SM explains with two states of angular and magnetic momenta (spins). In the present approach the two states are explained with the two types of electrons, namely accelerating and decelerating electrons.

For each type of level electron, a corresponding opposed type of positron must exist in the atomic nucleus, to allow that the emitted fundamental particles of one can regenerate the other. This leads to the conclusion, that protons and neutrons are also composed of BSPs of different types.

Neutron: Composed of 919 electrons and 919 positrons. The 919 electrons are composed of 459 accelerating, 459 decelerating and 1 acc/dec electrons. The 919 positrons are composed of 459 accelerating, 459 decelerating and 1 dec/acc positrons.

Proton: Composed of 918 electrons and 919 positrons. The 918 electrons are composed of 459 accelerating and 459 decelerating electrons. The 919 positrons are composed of 459 accelerating, 459 decelerating and 1 acc/dec positrons.

The concept is shown in Fig. 51.

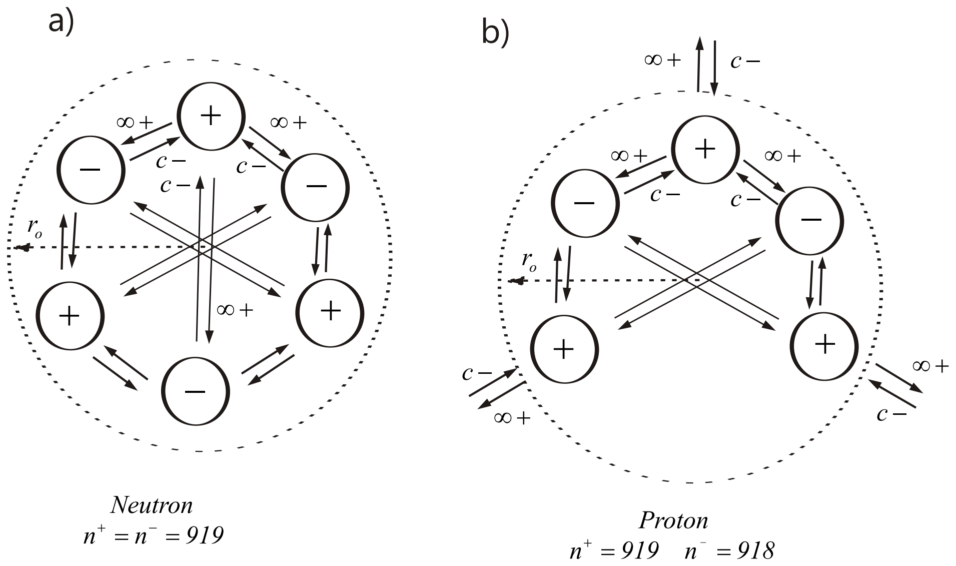


Figure 51: Neutron and proton

The definition of two types of electrons and positrons has let to protons that are formed of BSPs that complement each other and which are of two types:

- Protons formed of accelerating positrons and decelerating electrons and
- Protons formed of decelerating positrons and accelerating electrons

The level electron associated to a proton is of the same type as the electrons of the proton. Elements in the Periodic Table are classified according to the growing number of protons in their nuclei and with level electrons that alternate their spin. In the present approach the elements of the periodic table are built with alternating types of protons and the two types of electrons with opposed spin from our standard theory are replaced by the accelerating and decelerating electrons.

The formation of elements is shown in Fig. 52.

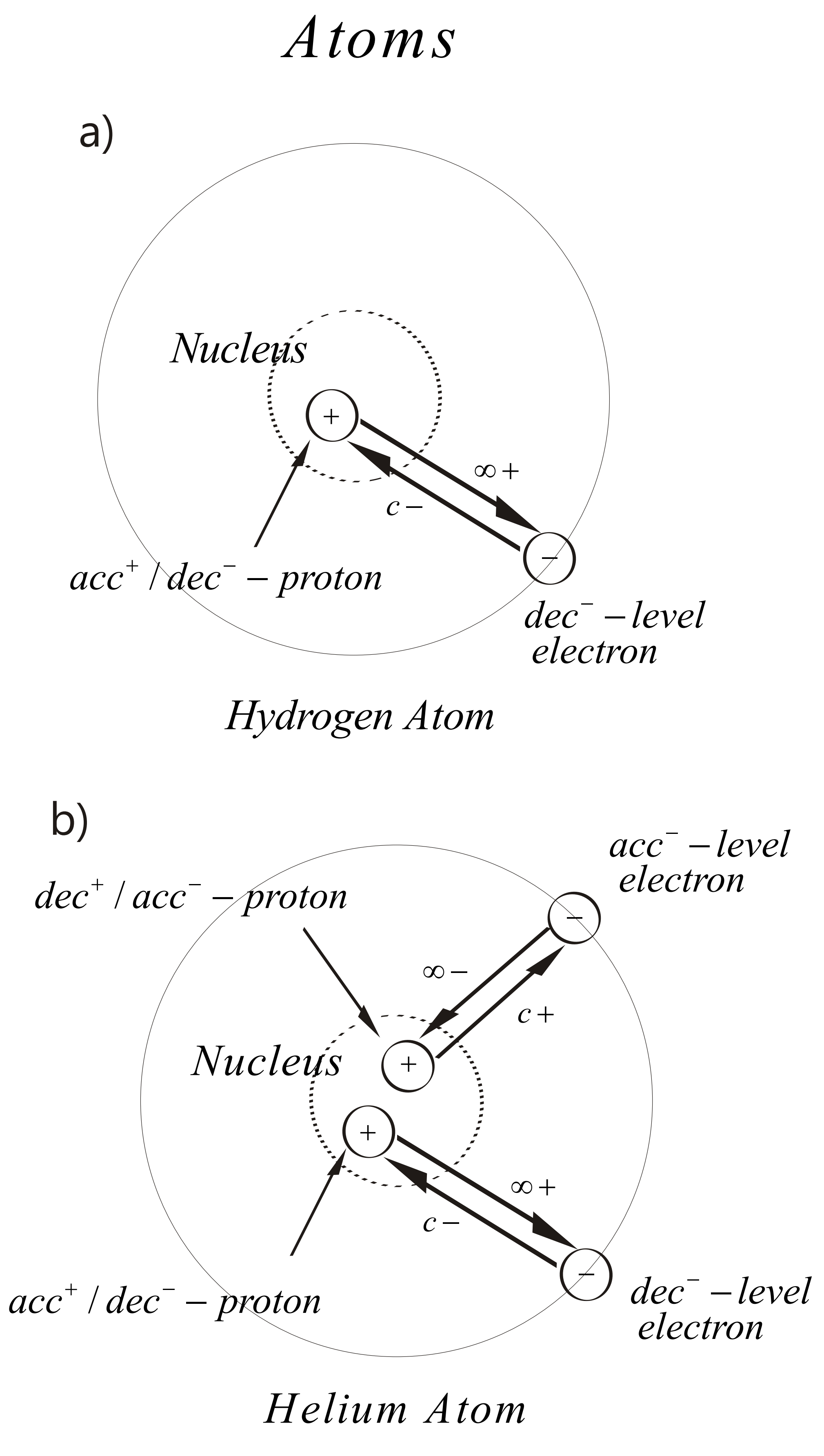


Figure 52: Level electrons of Hydrogen and Helium Atoms

Part III Dynamic Interactions

Induction between subatomic particles and deduction of the Maxwell equations.

7 Laws that describe dynamic interactions between BSPs.

In this section the forces induced on static BSPs, caused by longitudinal and transversal angular momenta of BSPs that move with constant speed, are derived.

The possibility to explain static laws through dynamic laws is presented.

The generation of gravitation forces is deduced and a proposal for gravitational momenta between galaxies and black holes is made.

The force field of an oscillating dipole is derived and the irradiated energy is decomposed in its longitudinal and transversal components.

A relation between the radius of the oscillating BSP and its energy is deduced.

The 1.Maxwell equations for the static and the far induced fields are derived.

The 2.Maxwell equation is derived and the equivalence between the vector $d\bar{H}_n$ and the magnetic Hertz field vector $\bar{\prod}_m$ is shown.

The divergence of static and induced fields are presented.

The Lorenz invariance of the deduced Maxwell-equations is presented.

7.1 Field at a point P of the space due to a BSP that moves with an instant speed v.

The time variation of the longitudinal and transversal rotational momentums fields $d\bar{H}_s$ and $d\bar{H}_n$ at a point P, produced by a BSP that moves with an instant speed $\bar{v}$ at the x coordinate, is now analyzed.

Starting with

$$d\bar{H}_s = H_s \, d\kappa \, \bar{s} \qquad and \qquad d\bar{H}_n = H_n \, d\kappa \, \bar{n} \tag{371}$$

and

$$H_s = H_s(v) \qquad H_n = H_n(v) \qquad d\kappa = d\kappa(r_r \, , \, \varphi) \qquad r_r = r_r(t) \qquad \varphi = \varphi(t) \tag{372}$$

$$\int_{r_r}^{\infty} d\bar{H}_s = H_s \int_{r_r}^{\infty} d\kappa \, \bar{s} \qquad\qquad \int_{r_r}^{\infty} d\bar{H}_n = H_n \int_{r_r}^{\infty} d\kappa \, \bar{n} \tag{373}$$

we get for the time differentiation of the longitudinal field

$$\frac{d}{dt}\int_{r_r}^{\infty} d\bar{H}_s = -\,\frac{d}{dt}[H_s]\,\int_{r_r}^{\infty} d\kappa\;\bar{s}_r\;-\;H_s\,\frac{d}{dt}\int_{r_r}^{\infty} d\kappa\;\bar{s}_r +\;H_s\,\int_{r_r}^{\infty} d\kappa\;\frac{d\varphi}{dt}\;\bar{s}_\varphi \tag{374}$$

with

$$d\kappa = \frac{1}{2}\,\frac{r_o}{r_r^2}\,dr_r\;\sin\varphi\;d\varphi \qquad and \qquad \int_{r_r}^{\infty} d\kappa = \frac{1}{2}\,\frac{r_o}{r_r}\;\sin\varphi\;d\varphi \tag{375}$$

resulting

$$\frac{d}{dt}\int_{r_r}^{\infty} d\kappa = \frac{d}{dt}\int_{r_r}^{\infty} d\kappa(r_r)\;+\;\frac{d}{dt}\int_{r_r}^{\infty} d\kappa(\varphi)\;+\;\frac{d}{dt}\int_{r_r}^{\infty} d\kappa(r_o) \tag{376}$$

With the last term of eq. 376 we have anticipated the results of sec.7.5.4 that show that the radius r_o of a BSP is a function its energy that can vary with time.

$$r_o = \frac{\hbar\,c}{E} \tag{377}$$

with

$$E = \sqrt{E_o^2 + E_p^2} \qquad for\;\;BSP\;\;with\;\;v \neq c \tag{378}$$

and

$$E = \hbar\omega \qquad for\;\;BSP\;\;with\;\;v = c \tag{379}$$

The variations in the directions r_r and φ are defined by the unit vectors $\bar{s}_r$ and $\bar{s}_\varphi$. For sign conventions see Fig. 53.

The vectors $\bar{s}_r = -\,\bar{s}$, $\bar{s}_\varphi$ and $\bar{s}_\delta = \bar{n}$ are orthogonal unit vectors.

It is important to note that for the time differentiation of the transversal field, the vector $\int_{r_r}^{\infty} d\bar{H}_n$ is normal to the surface formed by v and r_r, and doesn't change its direction with the variations of r_r and φ because of $dy = -\,v\;dt$. This means, that the variations in time of $\int_{r_r}^{\infty} d\kappa$ in the direction $\bar{s}_\gamma$ add algebraic.

$$\frac{d}{dt}\int_{r_r}^{\infty} d\bar{H}_n = \frac{d}{dt}[H_n]\,\int_{r_r}^{\infty} d\kappa\;\bar{s}_\gamma + H_n\,\frac{d}{dt}\int_{r_r}^{\infty} d\kappa\;\bar{s}_\gamma \tag{380}$$

The concept is shown in Fig. 53.

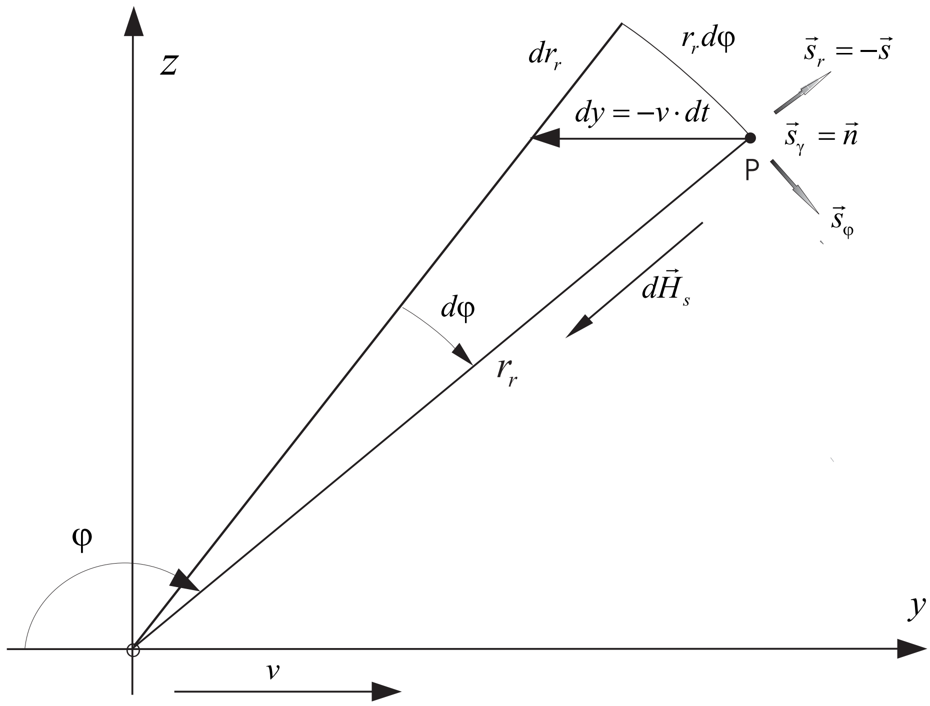


Figure 53: Geometric relations to calculate the time variation of κ

7.1.1 Deduction of $\frac{d}{dt}\int_{r_r}^{\infty} d\kappa$ at a point P for a BSP that moves with the speed v.

It is

$$d\kappa = \frac{1}{2}\,\frac{r_o}{r_r^2}\,dr_r\,\sin\varphi\,d\varphi \qquad \textit{and} \qquad \int_{r_r}^{\infty} d\kappa = \frac{1}{2}\,\frac{r_o}{r_r}\,\sin\varphi\,d\varphi \tag{381}$$

The time differentiation presents three terms depending if the differentiation is made towards r_r or φ or r_o.

$$\frac{d}{dt}\int_{r_r}^{\infty} d\kappa(r_r) = \frac{\delta}{\delta r_r}\int_{r_r}^{\infty} d\kappa(r_r)\;\frac{dr_r}{dt} \tag{382}$$

$$\frac{d}{dt}\int_{r_r}^{\infty} d\kappa(\varphi) = \frac{\delta}{\delta \varphi}\int_{r_r}^{\infty} d\kappa(\varphi)\;\frac{d\varphi}{dt} \tag{383}$$

and

$$\frac{d}{dt}\int_{r_r}^{\infty} d\kappa(r_o) = \frac{\delta}{\delta r_o}\int_{r_r}^{\infty} d\kappa(r_o)\;\frac{dr_o}{dt} \tag{384}$$

With the instant speed $v(t)$ of a BSP on the y coordinate and without signal time delay considerations, we have

$$\frac{\delta}{\delta r_r}\int_{r_r}^{\infty} d\kappa(r_r) = -\,\frac{1}{2}\,\frac{r_o}{r_r^2}\,\sin\varphi\,d\varphi \qquad\qquad \frac{dr_r}{dt} \approx v(t)\,\cos\varphi \tag{385}$$

$$\frac{\delta}{\delta\varphi}\int_{r_r}^{\infty} d\kappa(\varphi) = \frac{1}{2}\,\frac{r_o}{r_r}\,\cos\varphi\,d\varphi \qquad\qquad \frac{d\varphi}{dt} \approx -\,\frac{v(t)}{r_r}\,\sin\varphi \tag{386}$$

and

$$\frac{\delta}{\delta r_o}\int_{r_r}^{\infty} d\kappa(r_o) = \frac{1}{2}\,\frac{1}{r_r}\,\sin\varphi\,d\varphi \qquad\qquad \frac{dr_o}{dt} = \frac{dr_o}{dt} \tag{387}$$

We get for the time differentiation of $\int_{r_r}^{\infty} d\kappa$ in the direction of r_r

$$\frac{d}{dt}\int_{r_r}^{\infty} d\kappa(r_r) = -\,\frac{1}{2}\,v(t)\,\frac{r_o}{r_r^2}\,\sin\varphi\,\cos\varphi\,d\varphi \tag{388}$$

and in the direction of φ

$$\frac{d}{dt}\int_{r_r}^{\infty} d\kappa(\varphi) = -\,\frac{1}{2}\,v(t)\,\frac{r_o}{r_r^2}\,\sin\varphi\,\cos\varphi\,d\varphi \tag{389}$$

and in the direction of r_o

$$\frac{d}{dt}\int_{r_r}^{\infty} d\kappa(r_o) = \frac{1}{2}\,\frac{1}{r_r}\,\sin\varphi\,d\varphi\,\frac{dr_o}{dt} \tag{390}$$

7.1.2 Deduction of the time differentiations at a point P of the longitudinal and transversal fields for a BSP that moves with v.

The time differentiation for the longitudinal field was

$$\frac{d}{dt}\int_{r_r}^{\infty} d\bar{H}_s = -\,\frac{d}{dt}[H_s]\int_{r_r}^{\infty} d\kappa\,\bar{s}_r \;-\; H_s\,\frac{d}{dt}\int_{r_r}^{\infty} d\kappa\,\bar{s}_r + \;H_s\int_{r_r}^{\infty} d\kappa\,\frac{d\varphi}{dt}\,\bar{s}_\varphi \tag{391}$$

and for the time differentiation of the **longitudinal field** we get

$$\frac{d}{dt}\int_{r_r}^{\infty} d\bar{H}_s = -\,\frac{1}{2}\frac{d}{dt}[H_s]\,\frac{r_o}{r_r}\,\sin\varphi\,d\varphi\,\bar{s}_r \;+\; H_s\,v(t)\,\frac{r_o}{r_r^2}\,\sin\varphi\,\cos\varphi\,d\varphi\,\bar{s}_r \tag{392}$$

$$-\,\frac{1}{2}\,H_s\,\frac{1}{r_r}\,\sin\varphi\,d\varphi\,\frac{dr_o}{dt}\,\bar{s}_r \;-\; \frac{1}{2}\,H_s\,v(t)\,\frac{r_o}{r_r^2}\,\sin^2\varphi\,d\varphi\,\bar{s}_\varphi$$

The time differentiation for the transversal field was

$$\frac{d}{dt}\int_{r_r}^{\infty} d\bar{H}_n = \frac{d}{dt}[H_n] \int_{r_r}^{\infty} d\kappa\ \bar{s}_\gamma + H_n\ \frac{d}{dt}\int_{r_r}^{\infty} d\kappa\ \bar{s}_\gamma \tag{393}$$

and for the time differentiation of the **transversal field** we get

$$\frac{d}{dt}\int_{r_r}^{\infty} d\bar{H}_n = \frac{1}{2}\ \frac{d}{dt}[H_n]\ \frac{r_o}{r_r}\ \sin\varphi\ d\varphi\ \bar{s}_\gamma\ -\ H_n\ v\ \frac{r_o}{r_r^2}\ \sin\varphi\ \cos\varphi\ d\varphi\ \bar{s}_\gamma \tag{394}$$

$$+\ \frac{1}{2}\ H_n\ \frac{1}{r_r}\ \sin\varphi\ d\varphi\ \frac{dr_o}{dt}\ \bar{s}_\gamma$$

We now analyze three cases: First for speeds $v \ll c$, second for speeds where $\Delta v = c - v \ll c$ and third for $v = c$.

a) case with $v \ll c$.

For $v \ll c$ we get for H_s

$$H_s = c\ \sqrt{m} \qquad \textit{and} \qquad \frac{d}{dt}[H_s] = 0 \tag{395}$$

and for H_n

$$H_n = v\ \sqrt{m} \qquad \textit{and} \qquad \frac{d}{dt}[H_n] = \frac{dv}{dt}\ \sqrt{m} \tag{396}$$

and for r_o

$$r_o = \frac{\hbar\ c}{E_o} \qquad \textit{and} \qquad \frac{dr_o}{dt} = 0 \tag{397}$$

b) case with $\Delta v \ll c$.

We have that

$$E_p^{\ 2} \gg E_o^{\ 2} \qquad \textit{with} \qquad E_p = m\ c\ \frac{v}{\sqrt{1-\frac{v^2}{c^2}}} \tag{398}$$

and

$$\frac{d}{dt}[E_p] = m\ c\ \left\{ \left[1-\frac{v^2}{c^2}\right]^{-\frac{1}{2}}\ +\ \frac{v^2}{c^2}\ \left[1-\frac{v^2}{c^2}\right]^{-\frac{3}{2}} \right\}\ \frac{dv}{dt} \tag{399}$$

For the longitudinal field H_s we get

$$H_s \approx \frac{E_o}{\sqrt{E_p}} \qquad \textit{and} \qquad \frac{d}{dt}[H_s] \approx -\ \frac{1}{2}\ E_o\ E_p^{-\frac{3}{2}}\ \ \frac{d}{dt}[E_p] \tag{400}$$

and for the transversal field H_n we get

$$H_n \approx \sqrt{E_p} \qquad and \qquad \frac{d}{dt}[H_n] = \frac{1}{2}\, E_p^{-\frac{1}{2}}\ \frac{d}{dt}[E_p] \tag{401}$$

and for r_o we get

$$r_o = \frac{\hbar\, c}{E_p} \qquad and \qquad \frac{dr_o}{dt} = -\ \frac{\hbar\, c}{E_p^2}\ \frac{d}{dt}[E_p] \tag{402}$$

c) case with $v = c$.

If simultaneously $v \to c$ and the rest mass $m \to 0$ we define that

$$\lim_{\substack{m\to 0\\ v\to c}} \frac{m}{\sqrt{1-\frac{v^2}{c^2}}} = m_c \tag{403}$$

where m_c is the mass of the BSP with light speed. We also define that

$$m_c = \frac{E_c}{c^2} \qquad with \qquad E_c = \hbar\, \omega \tag{404}$$

With $v \to c$ and $m \to 0$ we also have

$$E_o \to 0 \qquad H_s = 0 \qquad H_n = \sqrt{E_c} = \sqrt{m_c}\ c \tag{405}$$

For $v = c$ we have

$$\frac{dv}{dt} = 0 \qquad \frac{d}{dt}[H_n] = \frac{c}{2\sqrt{m_c}}\ \frac{d}{dt}[m_c] \tag{406}$$

$$r_o = r_{o_c} = \frac{\hbar\, c}{E_c} \qquad \frac{d}{dt}[r_{o_c}] = -\ \frac{\hbar}{m_c^2\ c}\ \frac{d}{dt}[m_c] \tag{407}$$

7.2 Induced force on a static BSP placed in a field $d\bar{H}$ that changes with time.

We form the closed path integral according eq.(222) from sec. 4.6

$$\oint \frac{d\bar{l}}{2\pi R} \cdot \frac{d}{dt} \int_{r_r}^{\infty} d\bar{H}_n \tag{408}$$

The concept is shown in Fig. 54.

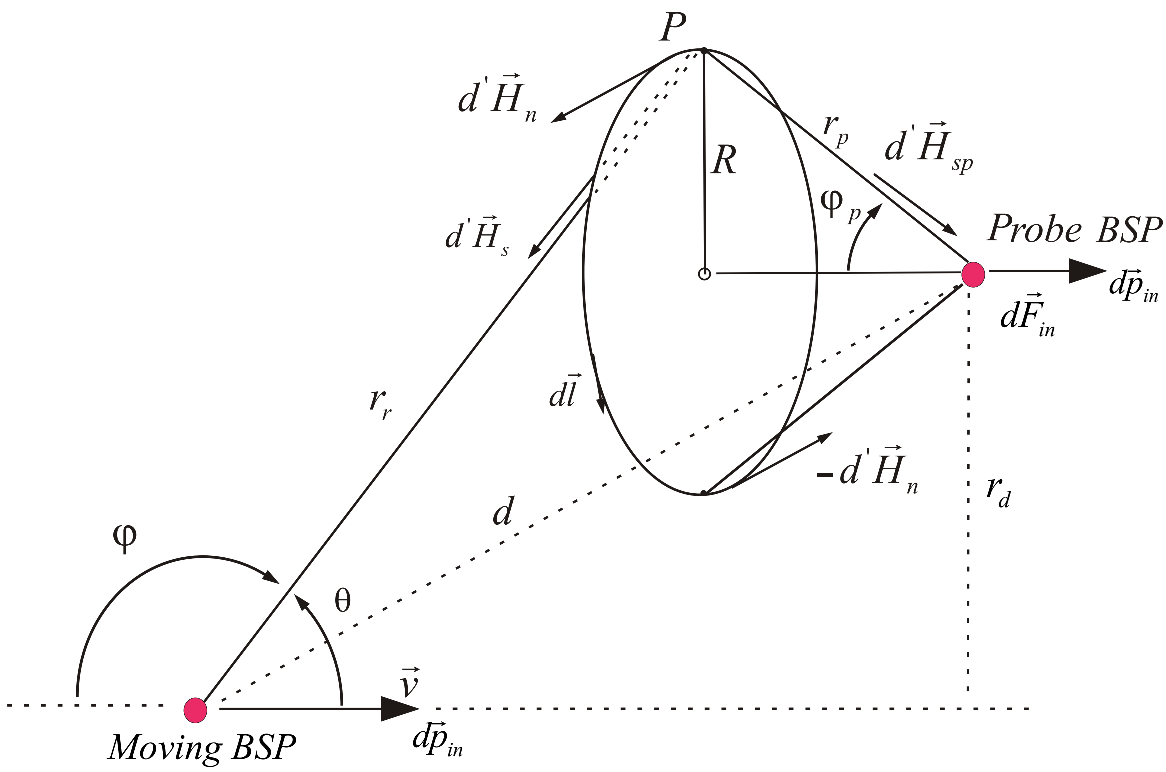


Figure 54: Geometric relations to calculate the closed path integral of $d'H_n$

Even though the tangential values $\frac{d}{dt}\int_{r_r}^{\infty} d\bar{H}_n$ of the fundamental particles are not distributed in opposed pairs symmetric to the probe BSP, so that the rotational momentums $\bar{J}_n$ form regular opposed pairs, they can be replaced by an equivalent configuration of rotational momentums of equal dimension resulting in the same closed path integral.

This equivalent configuration of opposed rotational momentums generate linear momentum dp on the probe BSP placed in the variable field.

The linear momentum generates a force dF_{i_n} given by

$$dF_{i_n} = \frac{1}{c} \oint \frac{d\bar{l}}{2\pi R} \cdot \frac{d}{dt} \int_{r_r}^{\infty} d\bar{H}_n \int_{r_p}^{\infty} dH_{s_p} \tag{409}$$

with dH_{s_p} from the static BSP.

To obtain the total force F_{i_n} on the static BSP we have to integrate over the whole space around the static BSP.

Note: The field dH_n generated by the moving BSP is the same for negative and positive moving BSPs. The induced force on the probe BSP results from pairs of opposed dH_n that pass from the moving to the probe BSP. The induced force is therefore independent of the signs of the interacting BSP's.

7.2.1 Force induced on a static BSP by the transversal field dH_n of a BSP that moves with v.

To calculate the momentum or the force on the probe BSP, all closed path integrals in the space around the probe or test BSP must be added, what is mathematically nearly impossible. To work with a more practicable instrument we take as a representant of the integral over the whole space a well defined closed path integral, divide it by its area and take the limit when the area tends to zero. The substitution of the whole space integral by the rotor at the point of the test BSP implies the existence of a proportionality between these variables.

We start with the equation for the force dF_{i_n} generated by a no specifically defined closed path integral contained in a plane orthogonal to the plane formed by $\bar{v}$ and r_r.

$$dF_{i_n} = \frac{1}{c} \oint \frac{d\bar{l}}{2\pi R} \cdot \frac{d}{dt} \int_{r_r}^{\infty} d\bar{H}_n \int_{r_p}^{\infty} dH_{s_p} \qquad [N] \tag{410}$$

and define a special closed path integral that is positioned relatively to the test BSP so that $r_p = R$ and $\varphi_p \to \frac{\pi}{2}$.

We get for

$$\int_{R}^{\infty} dH_{s_p} = \frac{1}{2}\, H_{s_p}\, \frac{r_{o_p}}{R}\, \sin\varphi_p\, d\varphi_p\, \frac{d\gamma_p}{2\pi} \approx \frac{1}{2}\, \sqrt{m_p}\, c\, \frac{r_{oP}}{R}\, d\varphi_p\, \frac{d\gamma_p}{2\pi} \tag{411}$$

We put the obtained expression in the equation for dF_{i_n} and change terms resulting

$$dF_{i_n} = \frac{1}{4}\, \sqrt{m_p}\, r_{o_p}\, d\varphi_p\, \frac{d\gamma_p}{2\pi} \oint \frac{d\bar{l}}{\pi R^2} \cdot \frac{d}{dt} \int_{r_r}^{\infty} d\bar{H}_n \tag{412}$$

Now we take the limit for $R \to 0$ and obtain

$$d\bar{F}_{i_n} = \frac{1}{4}\, \sqrt{m_p}\, r_{o_p}\, d\varphi_p\, \frac{d\gamma_p}{2\pi}\, rot\, \frac{d}{dt} \int_{r_r}^{\infty} d\bar{H}_n \tag{413}$$

or

$$d\bar{F}_{i_n} = K_{i_p}\, rot\, \frac{d}{dt} \int_{r_r}^{\infty} d\bar{H}_n \qquad [N] \tag{414}$$

with

$$K_{i_p} = \frac{1}{4}\, \sqrt{m_p}\, r_{o_p}\, d\varphi_p\, \frac{d\gamma_p}{2\pi} \tag{415}$$

Now we introduce a transformation to overcome the undefined variables $d\varphi$ and $d\gamma$ and define

$$d^{\,\prime}\kappa = \frac{d\kappa}{\Delta\varphi\, \Delta\gamma} = \frac{1}{4\pi}\, \frac{r_o}{r_{r_r}^2}\, dr_r\, \sin\varphi \tag{416}$$

and get as general expressions

$$d^{\,\prime} H_n = H_n \, d^{\,\prime} \kappa = \frac{1}{4\pi} \; H_n \; \frac{r_o}{r_{r_r}^2} \; dr_r \; \sin\varphi \tag{417}$$

and

$$d^{\,\prime} H_s = H_s \, d^{\,\prime} \kappa = \frac{1}{4\pi} \; H_s \; \frac{r_o}{r_{r_r}^2} \; dr_r \; \sin\varphi \tag{418}$$

We get as general expression for the force

$$d^{\,\prime} F_{i_n} = \frac{1}{c} \oint \frac{d\bar{l}}{2\pi R} \cdot \frac{d}{dt} \int_{r_r}^{\infty} d^{\,\prime} \bar{H}_n \int_{r_p}^{\infty} d^{\,\prime} H_{s_p} \qquad [N] \tag{419}$$

with

$$d^{\,\prime} \bar{F}_{i_n} = \frac{d\bar{F}_{i_n}}{\Delta\varphi \; \Delta\gamma \; \Delta\varphi_p \; \Delta\gamma_p} \tag{420}$$

and for the specially defined closed path integral

$$d^{\,\prime} \bar{F}_{i_n} = \; \frac{1}{8\;\pi} \; \sqrt{m_p} \; r_{o_p} \; rot \; \frac{d}{dt} \int_{r_r}^{\infty} d^{\,\prime} \bar{H}_n \tag{421}$$

with

$$d^{\,\prime} \bar{H}_n = \frac{1}{4\pi} \; H_n \; \frac{r_o}{r_{r_r}^2} \; dr_r \; \sin\varphi \; \bar{n} \tag{422}$$

7.2.2 Force induced on a static BSP by the longitudinal field dH_s of a BSP that moves with v .

We start with the equation for the force dF_{i_s} generated by a no specifically defined closed path integral contained in the plane formed by $\bar{v}$ and r_r.

$$dF_{i_s} = \frac{1}{c} \oint \frac{d\bar{l}}{2\pi R} \cdot \; \frac{d}{dt} \int_{r_r}^{\infty} d\bar{H}_s \; \int_{r_p}^{\infty} dH_{s_p} \qquad [N] \tag{423}$$

with

$$\int_{r_p}^{\infty} dH_{s_p} = \; \frac{1}{2} \; H_{s_p} \; \frac{r_{o_p}}{r_p} \; \sin\varphi_p \; d\varphi_p \; \frac{d\gamma_p}{2\pi} \tag{424}$$

and

$$H_s = \sqrt{E_s} \qquad E_s = \frac{E_o^{\,2}}{\sqrt{E_o^{\,2} + E_p^{\,2}}} \qquad H_{s_p} = c \, \sqrt{m_p} \tag{425}$$

If we put these expressions in the first equation and change terms we get with $R = r_p \ \sin\varphi_p$

$$dF_{i_s} = \frac{1}{4}\, c\, \sqrt{m_p}\, r_{o_p}\ \sin^2\varphi_p\, d\varphi_p\, \frac{d\gamma_p}{2\pi}\, \frac{1}{c} \oint \frac{d\bar{l}}{\pi R^2} \cdot \frac{d}{dt} \int_{r_r}^{\infty} d\bar{H}_s \tag{426}$$

If we chose the closed path integral so that $\varphi_p = \frac{\pi}{2}$ we get

$$d\bar{F}_{i_s} = \frac{1}{8\pi}\, \sqrt{m_p}\, r_{o_p}\, d\varphi_p\, d\gamma_p\, rot\, \frac{d}{dt} \int_{r_r}^{\infty} d\bar{H}_s \tag{427}$$

We define that

$$d'F_{i_s} = \frac{dF_{i_s}}{\Delta\varphi\ \Delta\gamma\ \Delta\varphi_p\ \Delta\gamma_p} \tag{428}$$

and get

$$d'\bar{F}_{i_s} = \frac{1}{8\,\pi}\, \sqrt{m_p}\, r_{o_p}\, rot\, \frac{d}{dt} \int_{r_r}^{\infty} d'\bar{H}_s \tag{429}$$

with

$$d'\bar{H}_s = \frac{1}{4\pi}\, H_s\, \frac{r_o}{r_r^2}\, dr_r\ \sin\varphi\ \bar{s} \tag{430}$$

Note: If we compare eq.(421) and eq.(429) with the corresponding equations from standard theoretical physics

$$\bar{B} = rot\bar{A} \qquad \bar{E} = -\frac{\partial}{\partial t}\bar{A} \qquad \bar{F} = q\bar{E} = -q\frac{\partial}{\partial t}\bar{A} \tag{431}$$

with

$$\bar{A} = \frac{\mu_o}{4\pi} \int \frac{\bar{J}(\bar{r}')}{|\bar{r} - \bar{r}'|} dV' \tag{432}$$

we conclude that the vector potential field $\bar{A}$ is related to the field $d'\bar{H}$ through

$$\bar{A} = -\frac{1}{8\,\pi\,q}\, \sqrt{m_p}\, r_{o_p} \int_V rot \int_{r_r}^{\infty} d'\bar{H} \tag{433}$$

7.3 Induced linear momentum balance between static and moving BSPs.

For practical purpose we introduced in sec. 7.2.1 the rotor as representative of the space integral assuming proportionality between them. In what follows we differentiate between aligned and not aligned particles.

7.3.1 Induced linear momentum balance between not aligned static and moving BSPs.

The forces induced on the static probe BSP are defined by the equations (429) and (421).

$$d'\bar{F}_{i_s} = \frac{1}{8\,\pi}\,\sqrt{m_p}\,r_{o_p}\,rot\,\frac{d}{dt}\int_{r_r}^{\infty} d'\bar{H}_s \tag{434}$$

and

$$d'\bar{F}_{i_n} = \frac{1}{8\,\pi}\,\sqrt{m_p}\,r_{o_p}\,rot\,\frac{d}{dt}\int_{r_r}^{\infty} d'\bar{H}_n \tag{435}$$

where

$$d'\bar{H}_s = H_s\,d'\kappa\,\bar{s} \qquad and \qquad d'\bar{H}_n = H_n\,d'\kappa\,\bar{n} \tag{436}$$

with

$$H_s = H_s(v) \qquad H_n = H_n(v) \qquad v = v(t) \tag{437}$$

The function $d'\kappa$ has a rotational symmetry around the velocity vector $\bar{v}$, and complies with

$$d'\kappa(r_r,\ \varphi) = d'\kappa(r_r,\ \pi-\varphi) \qquad for\ \ arbitrary\ \ \gamma \tag{438}$$

where

$$d'\kappa = \frac{1}{4\pi}\,\frac{r_o}{r_r^2}\,dr_r\ \sin\varphi \qquad with \qquad r_r = r_r(t) \qquad \varphi = \varphi(t) \tag{439}$$

The rotor can be interchanged with the time differentiation resulting

$$d'\bar{F}_{i_s} = \frac{d'\bar{p}_{i_s}}{dt} = \frac{1}{8\,\pi}\,\sqrt{m_p}\,r_{o_p}\,\frac{d}{dt}\,rot\,\int_{r_r}^{\infty} d'H_s\,\bar{s} \tag{440}$$

and

$$d'\bar{F}_{i_n} = \frac{d'\bar{p}_{i_n}}{dt} = \frac{1}{8\,\pi}\,\sqrt{m_p}\,r_{o_p}\,\frac{d}{dt}\,rot\,\int_{r_r}^{\infty} d'H_n\,\bar{n} \tag{441}$$

The corresponding linear momentums are shown on Fig. 55.

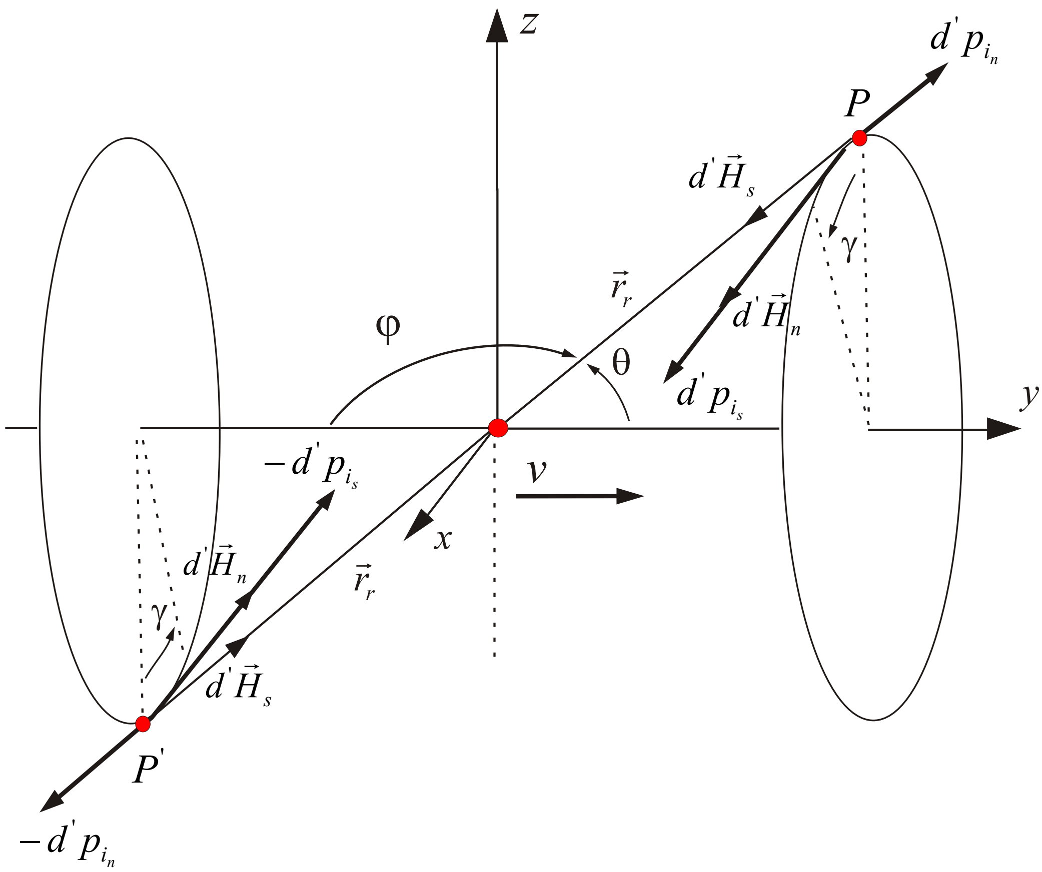


Figure 55: Linear momentum balance between not aligned static and moving BSPs

We get for a constant velocity v

$$d'\bar{p}_{i_s} = 0\ \bar{s}_r\ +\ 0\ \bar{s}_\theta\ +\ \frac{1}{32\pi^2}\sqrt{m_p}\, r_{o_p}\ \frac{r_o}{r_r^2}\ H_s\ \cos\theta\ \bar{s}_\gamma \tag{442}$$

and

$$d'\bar{p}_{i_n} = -\ \frac{1}{16\pi^2}\sqrt{m_p}\, r_{o_p}\ \frac{r_o}{r_r^2}\ H_n\ \cos\theta\ \bar{s}_r\ +\ 0\ \bar{s}_\theta\ +\ 0\ \bar{s}_\gamma \tag{443}$$

with

$$\bar{s} = -\ \bar{s}_r \qquad \bar{n} = \bar{s}_\gamma \tag{444}$$

$$\varphi = \pi - \theta \qquad \sin\varphi = \sin\theta \qquad \cos\varphi = -\ \cos\theta \qquad d\varphi = -\ d\theta \tag{445}$$

and

$$\frac{dr_r}{dt} = -\, v\ \cos\theta \qquad\qquad \frac{d\theta}{dt} = \frac{v}{r_r}\ \sin\theta \tag{446}$$

Because of the symmetry of the function $d^{'}\kappa$ the potential linear momentums $d^{'}\bar{p}_i$ at the symmetric points P and $P^{'}$ are opposed as shown on Fig. 55. That means, that if a probe BSP at the point P absorbs the angular momentums of the regenerating fundamental particles that produce the linear momentum $d^{'}\bar{p}_i$ at the moving BSP, the corresponding angular momentums at point $P^{'}$ are not more compensated when they arrive at the nucleus of the moving BSP producing there the opposed linear momentum $-d^{'}\bar{p}_i$.

Note: The direction of the induced force is independent of the sign of the longitudinal angular momentum of the regenerating fundamental particles of the probe particle.

7.3.2 Induced linear momentum balance between aligned static and moving BSPs.

We describe now the mechanism how the linear momentum is exchanged between aligned moving and static BSPs.

The concept is shown in Fig. 56.

We start with the moving BSP $1^{'}$ with the speed v_1 and momentum p_1, which is regenerated as BSP 1 through its longitudinal dH_{s_1} and transversal dH_{n_1} rotational momentums. When BSP 1 aproximates to the static BSP 2, the regenerating rotational momentums dH_{s_2} from BSP 2 will take over the rotational momentums dH_{n_1} from BSP 1. When BSP 1 looses its transversal rotational momentums it stops to $v = 0$, and BSP 2 now moves with the speed v_2 and the momentum p_2 that is equal to the momentum that BSP 1 had before stopping (conservation law).

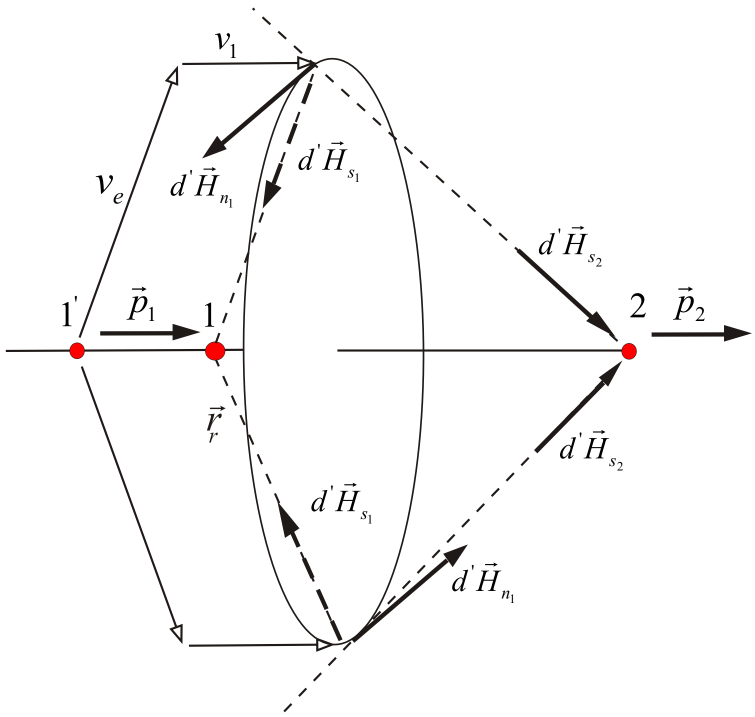


Figure 56: Linear momentum balance between aligned static and moving BSPs

7.4 Resume of origin of linear momentum.

The energy of a particle is stored in the longitudinal and transversal angular momenta of its regenerating fundamental particles.

Linear momenta are generated by opposed transversal angular momenta that comply with the requirements for generation of linear momenta (sec. 2.10).

Opposed transversal angular momenta that comply with the requirements for generation of linear momenta are generated by

- a moving particle
- the crossing of longitudinal angular momenta of two particles
- the crossing of transversal angular momenta of two moving particles

Opposed transversal angular momenta of a moving particle, that comply with the requirements for generation of linear momenta, can be absorbed by the regenerating longitudinal angular momenta of an other particle, generating on it the corresponding linear momenta (Induced linear momentum).

The following Fig. 57 shows a schematic representation of the generation of the induced force by a moving BSP on a static BSP.

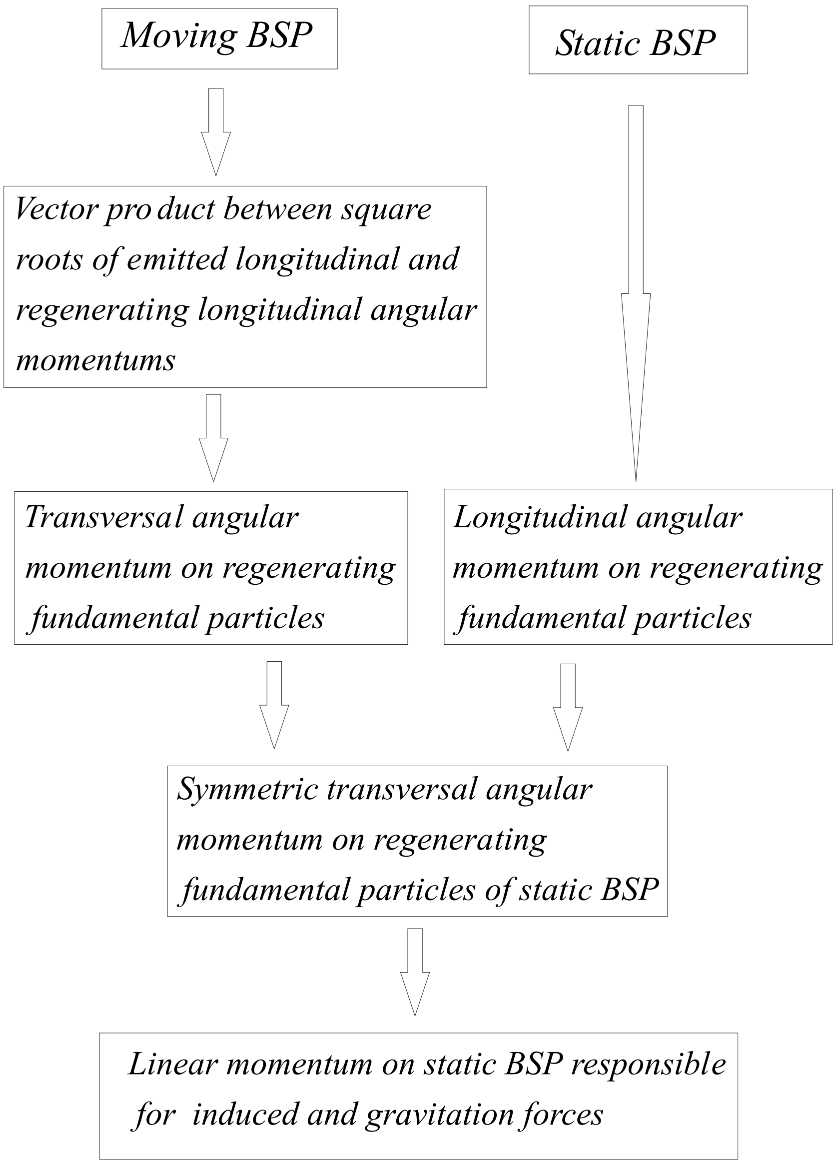


Figure 57: Generation of the induced forces.

7.5 The induced far force field of an oscillating BSP.

We start with eq. (421)

$$d'\bar{F}_{i_n} = \frac{1}{8\pi}\sqrt{m_p}\, r_{o_p}\, rot\, \frac{d}{dt}\int_{r_r}^{\infty} d'\bar{H}_n \tag{447}$$

The equation (394) of the transversal field of a BSP that moves with $v \ll c$ is with $d'\bar{H}_n = (2\pi)^{-1}\, d\bar{H}_n$ and $dr_o/dt = 0$ and $\bar{s}_\gamma = \bar{n}$

$$\frac{d}{dt}\int_{r_r}^{\infty} d'\bar{H}_n = +\frac{1}{4\pi}\sqrt{m}\,\frac{dv}{dt}\,\frac{r_o}{r_r}\,\sin\varphi\,\bar{n} - \frac{1}{2\pi}\sqrt{m}\,v^2\,\frac{r_o}{r_r^2}\,\sin\varphi\,\cos\varphi\,\bar{n} \tag{448}$$

We now calculate the far field of an oscillating BSP in neglecting the secong term that is invers proportional to r_r^2.

Note: The longitudinal field eq. (392) can also be neglected for the far field because it is also inverse proportional to r_r^2.

We introduce now a change of coordinates.

$$\theta = \pi - \varphi \qquad \sin\varphi = \sin\theta \qquad \cos\varphi = -\cos\theta \qquad d\varphi = -\,d\theta \tag{449}$$

The concept is shown in Fig. 58.

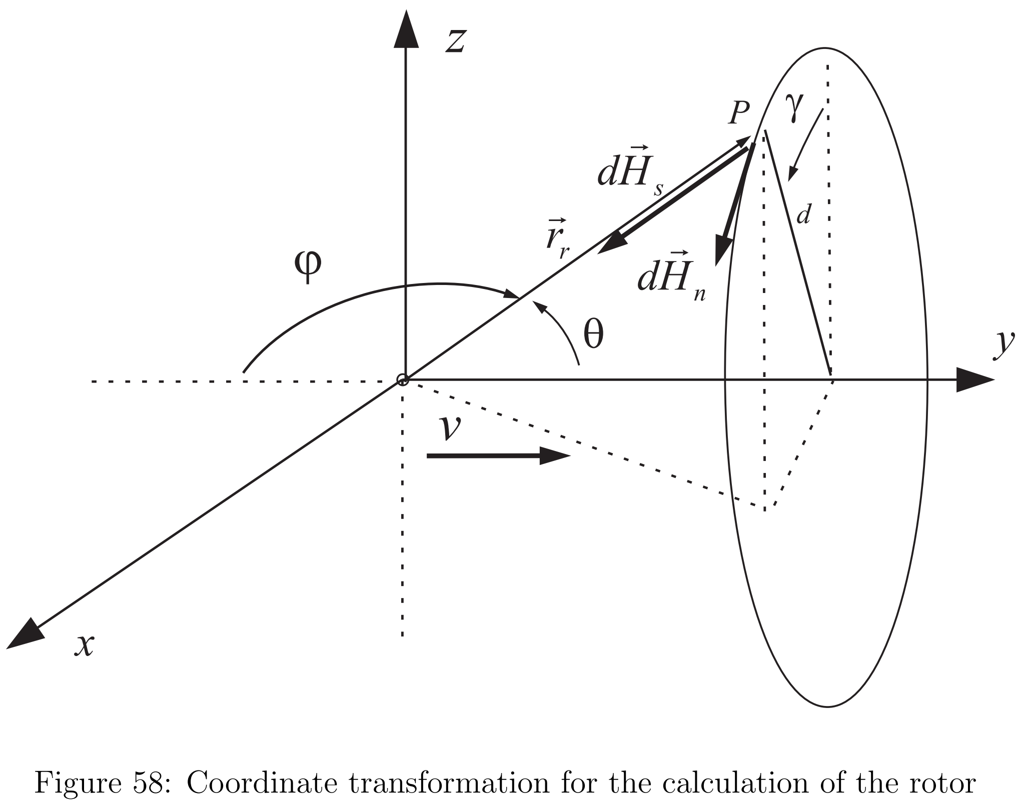


Figure 58: Coordinate transformation for the calculation of the rotor

$$\frac{d}{dt}\int_{r_r}^{\infty} d'\bar{H}_n = \bar{C}_n = C_r\ \bar{e}_r + C_\gamma\ \bar{e}_\gamma + C_\theta\ \bar{e}_\theta \tag{450}$$

To consider the time delay we define an oscillation with a time delay $t_r = \frac{r_r}{c}$ as a function of r_r.

$$y = -\ y_m\ \sin\left[\omega\left(t - \frac{r_r}{c}\right)\right] \qquad \textit{and with} \qquad v_m = y_m\ \omega \tag{451}$$

$$v = -v_m\ \cos\left[\omega\left(t - \frac{r_r}{c}\right)\right] \qquad \frac{dv}{dt} = v_m\ \omega\ \sin\left[\omega\left(t - \frac{r_r}{c}\right)\right] \tag{452}$$

and

$$\frac{dv}{dr_r} = -\ v_m\ \frac{\omega}{c}\ \sin\left[\omega\left(t - \frac{r_r}{c}\right)\right] \tag{453}$$

So we have that

$$C_r = 0 \qquad C_\gamma = \frac{1}{4\pi}\ \sqrt{m}\ v_m\ \omega\ \frac{r_o}{r_r}\ \sin\theta\ \sin\eta \qquad C_\theta = 0 \tag{454}$$

with

$$\eta = \left[\omega\left(t - \frac{r_r}{c}\right)\right] \tag{455}$$

The components of $rot\ \bar{C}_n$ are given by

$$(rot\ \bar{C}_n)_{r_r} = \frac{1}{2\pi}\ \sqrt{m}\ v_m\ \omega\ \frac{r_o}{r_r^2}\ \cos\theta\ \sin\eta \qquad (rot\ \bar{C}_n)_\gamma = 0 \tag{456}$$

$$(rot\ \bar{C}_n)_\theta = \frac{1}{4\pi}\ \sqrt{m}\ v_m\ \frac{\omega^2}{c}\ \frac{r_o}{r_r}\ \sin\theta\ \cos\eta \tag{457}$$

For the far field we neglect all terms that have an inverse proportionality greater than r_r. We get

$$(rot\ \bar{C}_n)_{r_r} \approx 0 \qquad (rot\ \bar{C}_n)_\gamma = 0 \tag{458}$$

$$(rot\ \bar{C}_n)_\theta = \frac{1}{4\pi}\ \sqrt{m}\ v_m\ \frac{\omega^2}{c}\ \frac{r_o}{r_r}\ \sin\theta\ \cos\eta \tag{459}$$

The far force field of the oscillating BSP in relation to the mass is

$$\frac{d'\bar{F}_i}{\sqrt{m_p}\ \sqrt{m}} = \frac{1}{32\pi^2}\ r_{o_p}\ r_o\ \frac{v_m}{r_r}\ \frac{\omega^2}{c}\ \sin\theta\ \cos\eta\ \bar{e}_\theta \qquad \left[\frac{N}{kg}\right] \tag{460}$$

with r_{o_p} the radius of the static test BSP and r_o the radius of the particle that moves with v.

The far force field is proportional to ω^2 and inverse proportional to r_r and coincides with the form of the far oscillating force of an electric dipole that is equal to

$$\bar{E} \;=\; \frac{\bar{F}_e}{Q} \;=\; \frac{1}{4\,\pi\,\epsilon_o}\,\frac{p_o}{r_r}\,\frac{\omega^2}{c^2}\,\sin\theta\cos\eta\;\bar{e}_\theta \qquad \left[\frac{N}{C}\right] \tag{461}$$

with $p_o = y_m\,Q$ the electric dipole moment.

7.5.1 Induced power on a static BSP that is in the far field of an oscillating BSP.

The energy of the far field is stored in the transversal rotational momentum J_n of the regenerating fundamental particles of the oscillating BSP.

If we introduce a static test BSP in the oscillating far field, a force $d'F_i = m_p\,\frac{dv_p}{dt}$ will actuate on the particle and give a kinetic energy $\Delta E = \frac{1}{2}\,m_p\,\Delta^2 v_p$ in the time $\Delta t = K r_o^2$. The imparted kinetic energy is absorbed by an external force and reduced to zero.

So we have that

$$\Delta E = \frac{1}{2}\,\frac{\Delta^2 p}{m_p} \qquad \Delta E = \frac{1}{2}\,\frac{(\Delta t\;\; d'F_i)^2}{m_p} \qquad \Delta E = \frac{1}{2}\,\frac{K^2\,r_o^4}{m_p}\,d'F_i^2 \tag{462}$$

The above energy is produced in the time Δt what gives a power of

$$P = \frac{\Delta E}{\Delta t} = \frac{1}{2}\,\frac{\Delta t}{m_p}\,d'F_i^2 \qquad\qquad P = \frac{1}{2}\,\frac{K\,r_o^2}{m_p}\,d'F_i^2 \tag{463}$$

If we consider that the test BSP oscillates with the same frequency as the main BSP and therefore both have the same radius r_o and mass m, we get for the power density

$$S = \frac{1}{2}\,\left[\frac{1}{32\pi^2}\right]^2\,\frac{K\,m\,r_o^6}{c^2}\,\frac{v_m^2\,\omega^4}{r_r^2}\,\sin^2\theta\,\cos^2\left[\omega\left(t-\frac{r_r}{c}\right)\right] \qquad \left[\frac{W}{kg}\right] \tag{464}$$

The power density is proportional to ω^4 and inverse proportional to r_r^2 and coincides with the equation of an electric oscillating dipole.

We note that the energy emitted by a BSP through their emitted fundamental particles, returns with the regenerating fundamental particles, except it is absorbed by the regenerating fundamental particles of an other BSP.

7.5.2 Quantification of the irradiated energy of an oscillating BSP.

The energy **irradiated** by an oscillating BSP is given by the change of velocity with the time, thus by terms with $\frac{dv}{dt}$. For $v \ll c$ we must consider only the time variation of $d^{'}E_n$ because the time variation of $d^{'}E_s$ has no terms with $\frac{dv}{dt}$.

In general we have for a particle moving with speed v

$$d^{'}E_n = E_n \; d^{'}\kappa \qquad \int_{r_r}^{\infty} d^{'}E_n = E_n \int_{r_r}^{\infty} d^{'}\kappa \qquad d^{'}\kappa = \frac{d\kappa}{d\varphi \; d\gamma} \tag{465}$$

$$\frac{d}{dt}\int_{r_r}^{\infty} d^{'}E_n = \frac{d}{dt}[E_n] \int_{r_r}^{\infty} d^{'}\kappa \; + E_n \frac{d}{dt}\int_{r_r}^{\infty} d^{'}\kappa(r_r) \; + E_n \frac{d}{dt}\int_{r_r}^{\infty} d^{'}\kappa(\varphi) \tag{466}$$

With the equations from sec. 7.1.1 and with $v \ll c$ we get

$$E_n = m \; v^2 \qquad \frac{d}{dt}[E_n] = 2 \; m \; v \; \frac{dv}{dt} \tag{467}$$

$$\frac{d}{dt}\int_{r_r}^{\infty} d^{'}E_n = -\frac{1}{2\pi} \; m \; v^3 \; \frac{r_o}{r_r^2} \; \sin\varphi \; \cos\varphi \; + \frac{1}{2\pi} \; m \; v \; \frac{dv}{dt} \; \frac{r_o}{r_r} \; \sin\varphi \tag{468}$$

For an oscillating BSP with

$$y = -y_m \; \sin\eta \qquad v = -v_m \; \cos\eta \qquad \frac{dv}{dt} = v_m \; \omega \; \sin\eta \qquad v_m = y_m \; \omega \tag{469}$$

we get for the time differentiation of the irradiated energy, that is defined by the second term with $\frac{dv}{dt}$

$$\frac{d}{dt}\int_{r_r}^{\infty} d^{'}E_{n_{irr}} = -\frac{1}{2\pi} \; m \; y_m^2 \; \omega^3 \; \frac{r_{o\sim}}{r_r} \; \sin\varphi \; \sin\eta \; \cos\eta \tag{470}$$

Note: We define now the following nomenclature:

- $r_{o\sim}$ for the radius of the oscillating BSP
- r_{o_p} for the static test or probe BSP
- r_o for a BSP that moves with speed v
- r_{o_c} for a BSP that moves with light speed.

We are interested in the irradiated energy during a certain time period and in the space defined by the space angle $d\varphi \; \sin\varphi \; d\gamma$. The mentioned amount of irradiated energy is the same for all distances r_r so that we can chose a convenient $r_r = r_{o\sim}$ and integrate over time. For $\omega \frac{r_{o\sim}}{c} \ll \frac{\pi}{100}$ it is $\eta \approx \omega t$ and we get

$$d^{'}E_{n_{ab}} = \frac{1}{\omega} \int_0^{\omega t} \left[\frac{d}{dt} \int_{r_{o\sim}}^{\infty} d^{'}E_{n_{irr}} \right] d\omega t = -\frac{1}{4\pi} \, m \, y_m^2 \, \omega^2 \, \sin\varphi \, \sin^2 \omega t \tag{471}$$

where

$$d^{'}E_{n_{ab}} = \int_{r_{o\sim}}^{\infty} d^{'}E_{n_{irr}} \tag{472}$$

The mean irradiated energy during a period from $\omega t = 0$ to $\omega t = \pi$ is

$$d^{'}\bar{E}_{n_{ab}} = \frac{1}{8\pi} \, m \, y_m^2 \, \omega^2 \, \sin\varphi \tag{473}$$

We consider that $dE_{n_{ab}} = d^{'}E_{n_{ab}} \, d\varphi \, d\gamma$

$$d\,\bar{E}_{n_{ab}} = \frac{1}{8\pi} \, m \, y_m^2 \, \omega^2 \, \sin\varphi \, d\varphi \, d\gamma \tag{474}$$

and calculate the irradiated energy from $\varphi = 0$ to $\varphi = \frac{\pi}{2}$

$$\int_{\varphi=0}^{\frac{\pi}{2}} d\,\bar{E}_{n_{ab}} = \frac{1}{8\pi} \, m \, y_m^2 \, \omega^2 \, d\gamma = d\,\bar{E}_{n_c} \tag{475}$$

The deduced energy $d\,\bar{E}_{n_c}$ is the energy of an irradiated BSP that moves with light speed c as shown in Fig. 22.

We define an equivalent angular momentum $\hbar_n$ so that $d\,\bar{E}_{n_c} = \hbar_n \, \omega$.

$$d\,\bar{E}_{n_c} = \frac{1}{8\pi} \, (m_\gamma \, y_m^2 \, \omega) \, \omega = \hbar_n \, \omega \tag{476}$$

with

$$\hbar_n = \frac{1}{8\pi} \; m_\gamma \, y_m^2 \, \omega \qquad and \qquad m_\gamma = m \, d\gamma \tag{477}$$

The irradiated energy was quantified for a half period of ωt. For n half periods we have

$$d\,\bar{E}_{n_c} = n \, \frac{1}{8\pi} \, (m_\gamma \, y_m^2 \, \omega) \, \omega = n \, \hbar_n \, \omega \tag{478}$$

7.5.3 Quantification of the transversal component of the irradiated energy of an oscillating BSP.

We start with the induced force on a probe particle by an oscillating BSP given by eq. (421)

$$d^{'}\bar{F}_{i_n} = \frac{1}{8\pi}\sqrt{m_p}\, r_{o_p}\, rot\, \bar{C}_n \tag{479}$$

with

$$\bar{C}_n = \frac{d}{dt}\int_{r_r}^{\infty} d^{'}\bar{H}_n \tag{480}$$

As we are interested in the irradiated part we consider only terms with $\frac{dv}{dt}$.

The longitudinal component is given by the rotor of $\bar{C}_n$ in the direction of r_r with eq. (456) already deduced.

$$(rot\, \bar{C}_n)_{r_r} = \frac{1}{2\pi}\sqrt{m}\, v_m\, \omega\, \frac{r_{o_\sim}}{r_r^2}\, \cos\theta\, \sin\eta \tag{481}$$

and the transversal component by the rotor in the direction of θ with eq. (457) already deduced.

$$(rot\, \bar{C}_n)_{\theta} = \frac{1}{4\pi}\sqrt{m}\, v_m\, \frac{\omega^2}{c}\, \frac{r_{o_\sim}}{r_r}\, \sin\theta\, \cos\eta \tag{482}$$

We get for the induced force in the direction r_r

$$d^{'}F_r = \frac{1}{16\pi^2}\sqrt{m}\,\sqrt{m_p}\, v_m\, \omega\, \frac{r_{o_\sim}\, r_{o_p}}{r_r^2}\cos\theta\, \sin\omega t \tag{483}$$

and in the direction of θ

$$d^{'}F_\theta = \frac{1}{32\pi^2}\sqrt{m}\,\sqrt{m_p}\, v_m\, \frac{\omega^2}{c}\, \frac{r_{o_\sim}\, r_{o_p}}{r_r}\, \sin\theta\, \cos\omega t \tag{484}$$

The longitudinal and transversal forces are displaced in time and in space by an angle of $\frac{\pi}{2}$ degrees. The concept is shown in Fig. 59.

For the far field we neglect the induced force in the direction r_r and concentrate on $d^{'}F_\theta$.

We assume now that the oscillating BSP and the probe BSP are electrons and that for $v_m \ll c$ the radius $r_{o_\sim} \approx r_{o_p}$. As we are interested in the average irradiated energy during a half time period in the space defined by the space angle $d\varphi\, \sin\varphi\, d\gamma$, we chose again conveniently $r_r = r_{o_\sim}$ and with $\eta = \omega t$ we get for the induced force between the oscillating BSP and the probe BSP

$$d^{'}F_\theta = \frac{1}{32\pi^2}\sqrt{m}\,\sqrt{m_p}\, v_m\, \frac{\omega^2}{c}\, r_{o_p}\, \sin\theta\, \cos\omega t \qquad with \qquad v_m = y_m\, \omega \tag{485}$$

We calculate the average value from $\omega t = -\frac{\pi}{2}$ to $\omega t = +\frac{\pi}{2}$, make $m_p = m$ and get with $v_m = y_m\, \omega$

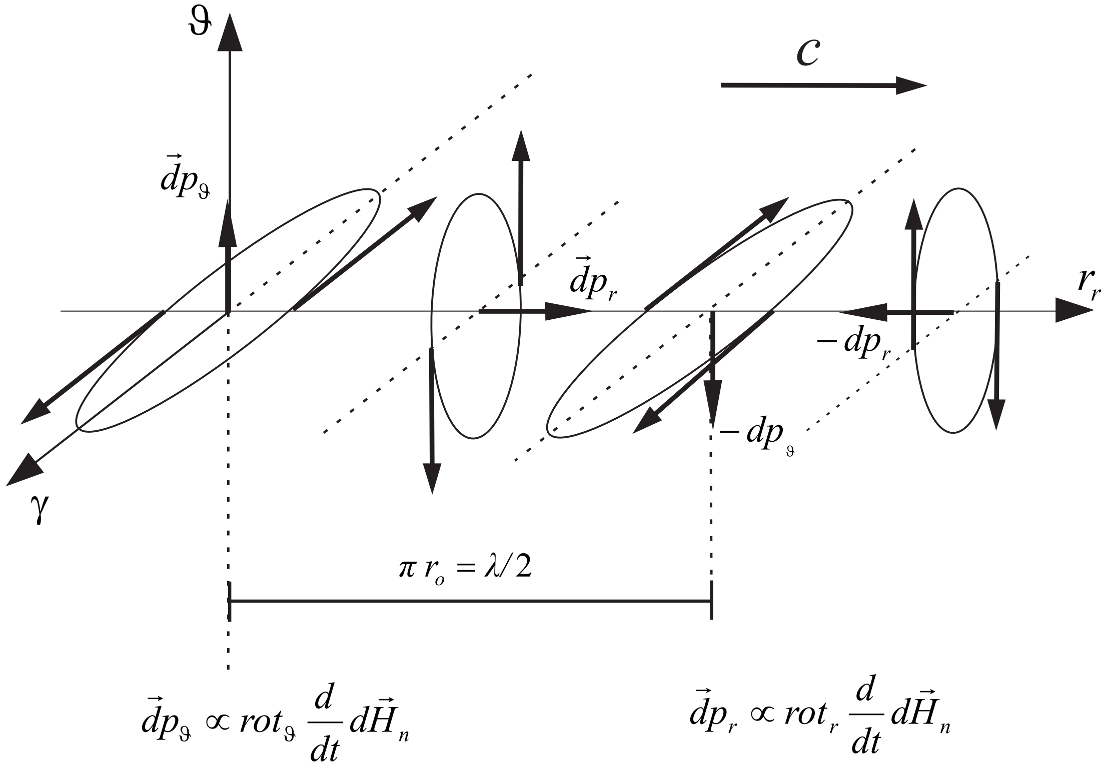


Figure 59: Longitudinal and transversal potential momentums of irradiated energy

$$d^{\,\prime}\bar{F}_\theta = \frac{1}{16\pi^{\,3}}\, m\, y_m\, \frac{\omega^3}{c}\, r_{o_p}\, \sin\theta \tag{486}$$

The force $d^{\,\prime}\bar{F}_\theta$ is transmitted from the irradiated BSP with light speed to the probe BSP in the time Δt.

The irradiated transversal linear momentum defined by the space angle $d\theta\, \sin\theta\, d\gamma$ is, considering that $d\,\bar{p}_\theta = d^{\,\prime}\bar{p}_\theta\, d\theta\, d\gamma$

$$d\,\bar{p}_\theta = \frac{1}{16\pi^{\,3}}\, \Delta t\, m\, y_m\, \frac{\omega^3}{c}\, r_{o_p}\, \sin\theta\, d\theta\, d\gamma \tag{487}$$

We now integrate over θ from $\theta = 0$ to $\theta = \frac{\pi}{2}$

$$\int_{\theta=0}^{\frac{\pi}{2}} d\,\bar{p}_\theta = \frac{1}{16\pi^{\,3}}\, \Delta t\, m\, y_m\, \frac{\omega^3}{c}\, r_{o_p}\, d\gamma \tag{488}$$

The transversal linear momentum, defining $m_\gamma = m\, d\gamma$ is

$$d\,\bar{p}_{\theta_c} = \frac{1}{16\pi^{\,3}}\, \Delta t\, m_\gamma\, y_m\, \frac{\omega^3}{c}\, r_{o_p} \tag{489}$$

and the energy of the transversal linear momentum is

$$d\,\bar{E}_{\theta_c} = \frac{1}{16\pi^{\,3}}\, \Delta t\, r_{o_p}\, m_\gamma\, y_m\, \omega^3 \tag{490}$$

The irradiated energy was quantified for a half period of ωt. For n half periods we have

$$d\,\bar{E}_{\theta_c} = n\,\frac{1}{16\pi^{\,3}}\,\Delta t\; r_{o_p}\; m_\gamma\; y_m\; \omega^3 = n\;\hbar_{\theta_c}\;\omega \tag{491}$$

7.5.4 Analysis of the quantified components of the irradiated energy of an oscillating BSP.

For the far field the irradiated energy $d\,\bar{E}_{n_c}$ must be equal to the transversal irradiated energy $d\,\bar{E}_{\theta_c}$.

If we now take into consideration that the energy $\hbar\omega$ is the minimum irradiated energy of a BSP that oscillates with the frequency ω we have that

$$d\,\bar{E}_{n_c} = \frac{1}{8\pi}\,(m_\gamma\; y_m^2\;\omega)\;\omega = \hbar\,\omega = m_c\,c^2 \tag{492}$$

and with $m_\gamma = m_c$ we have

$$y_m = \sqrt{8\pi}\,\frac{c}{\omega} \tag{493}$$

Also we have that

$$\frac{1}{8\pi}\,m_\gamma\; y_m^2\;\omega^2 \;=\; \frac{1}{16\pi^{\,3}}\,\Delta t\; r_{o_p}\; m_\gamma\; y_m\;\omega^3 \tag{494}$$

From the last two expressions and with $\Delta t = K\; r_{o_1}\; r_{o_2}$ we get

$$r_{op}\; r_{o1}\; r_{o2} = \frac{2\;\pi^2\,\sqrt{8\pi}\;c}{K\;\omega^2} = \frac{2\;\pi^2\,\sqrt{8\pi}\;c}{K\;c^2}\;\frac{\hbar c}{\hbar\omega}\;\frac{\hbar c}{\hbar\omega} \qquad K = 5.42713\cdot 10^4\;s/m^2 \tag{495}$$

and with

$$\frac{2\pi^2\,\sqrt{8\pi}\;m\;c}{K} = 4.9828\cdot 10^{-25}\;[Jm] \quad and \quad \hbar\;c = 3.16152929\cdot 10^{-26}\;[Jm] \tag{496}$$

we can write that

$$\frac{2\pi^2\,\sqrt{8\pi}\;m\;c}{K} = 15.76056\cdot\hbar\;c \tag{497}$$

We get that

$$r_{op}\; r_{o1}\; r_{o2} = 15.76056\;\frac{\hbar c}{m\;c^2}\;\frac{\hbar c}{\hbar\omega}\;\frac{\hbar c}{\hbar\omega} = 15.76056\;\frac{\hbar c}{E_o}\;\frac{\hbar c}{E_c}\;\frac{\hbar c}{E_c} \tag{498}$$

We conclude that

$$r_{op} = 2.507\,\frac{\hbar c}{E_o} \qquad r_{o1} = 2.507\,\frac{\hbar c}{E_c} \qquad r_{o2} = 2.507\,\frac{\hbar c}{E_c} \tag{499}$$

We have deduced the forgoing equations under the assumption that $v \ll c$ what means that $E_o \gg E_p$.

Note: The irradiated energies $d\,\bar{E}_{n_c}$ and $d\,\bar{E}_{\theta_c}$ were deduced on different differential bases what explains that the factor $2.507 \neq 1$. The first differential energy $d\,\bar{E}_{n_c}$ was deduced based on $d\kappa$ while the second $d\,\bar{E}_{\theta_c}$ on the rotor of $d\kappa$.

We now define that in general the radius of a BSP is given by

$$r_o = \frac{\hbar\, c}{E} \tag{500}$$

where for the energy E we have

$$E = \sqrt{E_o^2 + E_p^2} \qquad for\ \ BSP\ \ with\ \ v \neq c \tag{501}$$

and

$$E = \hbar\omega \qquad for\ \ BSP\ \ with\ \ v = c \tag{502}$$

7.5.5 Distance between one pair of BSPs with $v = c$ and its relation with the stored energy.

The energy of one pair of BSPs with $v = c$ is

$$E = \hbar\omega = h\,\nu \qquad for\ \ BSP\ \ with\ \ v = c \tag{503}$$

The energy of one BSP we designate with $E_{(BSP)}$ and have that $E = 2\ E_{(BSP)}$. Also we define the distance between the two BSPs as $d = c\,\tau$, where τ is the time to move from one BSP of the pair to the other with light speed.

Because of

$$r_{o_c} = \frac{\hbar\, c}{E_c} = \frac{\hbar\, c}{\hbar\,\omega} = \frac{\lambda}{2\pi} \tag{504}$$

we have

$$d = c\,\tau = \pi\, r_{o_c} = \lambda/2 \tag{505}$$

We now write

$$E = h\,\nu = 2\ E_{(BSP)}\ \tau\ \nu \qquad with \qquad h = 2\ E_{(BSP)}\ \tau = constant \tag{506}$$

or

$$h = 2\ E_{(BSP)}\ \frac{d}{c} = constant \qquad with \qquad d = \frac{\lambda}{2} \tag{507}$$

resulting that

$$h\ c = 2\ E_{(BSP)}\ d = 2\ E_{(BSP)}\ \pi\ r_{o_c} = E_{(BSP)}\ \lambda = constant \tag{508}$$

We see that if we concentrate the energy of a photon on one pair of BSPs at the distance $d = \lambda/2$, the product of the energy of the BSP and the distance is a constant. It is like a spring with a force $f \propto 1/d^2$, where the product of the stored energy with the distance is also a constant. We also see, that for BSPs with light speed, the radius r_o decreases with the energy.

From

$$r_o = \frac{\hbar\ c}{E} \qquad E = \hbar\,\omega \qquad c = \nu\ \lambda \tag{509}$$

we conclude that

$$r_o = \frac{\lambda}{2\pi} \tag{510}$$

7.6 The Maxwell equations.

7.6.1 The 1. Maxwell equation for the far induced force field.

We start with eq. (460) of the far induced force field of an oscillating BSP with $m = m_p$ and $r_o = r_{o_p}$

$$d^{'}\bar{F}_i \ = \frac{1}{32\pi^{\,2}}\ m\ r_o^2\ \frac{v_m}{r_r}\ \frac{\omega^2}{c}\ \sin\theta\ \cos\left[\omega\left(t - \frac{r_r}{c}\right)\right]\ \bar{e}_\theta \qquad [N] \tag{511}$$

To arrive to an expression that is equivalent to the 1.Maxwell equation

$$\frac{d}{dt}[\bar{E}] = \frac{1}{\epsilon}\ rot\bar{H} \tag{512}$$

we calculate the time differentiation of $d^{'}\bar{F}_i$, take three times the rotor of the cumulated value of $d^{'}H_n$ and show that the results obtained are proportional.

$$\frac{d}{dt}[d'\bar{F}_i] = -\frac{1}{32\pi^2}\, m\, r_o^2\, \frac{v_m}{r_r}\, \frac{\omega^3}{c}\, \sin\theta\, \sin\left[\omega\left(t-\frac{r_r}{c}\right)\right]\, \bar{e}_\theta \qquad \left[\frac{N}{s}\right] \tag{513}$$

The cumulated value from $d'\bar{H}_n$ for $v \ll c$ is

$$\int_{r_r}^{\infty} d'\bar{H}_n = \frac{1}{4\pi}\, \sqrt{m}\, v\, \frac{r_o}{r_r}\, \sin\theta\, \bar{n} \tag{514}$$

and with

$$v = -v_m\, \cos\left[\omega\left(t-\frac{r_r}{c}\right)\right] \qquad \eta = \left[\omega\left(t-\frac{r_r}{c}\right)\right] \tag{515}$$

we get after the three rotors, neglecting for the far field all terms with an inverse proportionality greater than r_r, the components

$$(rot\ rot\ rot \int_{r_r}^{\infty} d'\bar{H}_n)_{r_r} = 0 \qquad (rot\ rot\ rot \int_{r_r}^{\infty} d'\bar{H}_n)_{\gamma} = 0 \tag{516}$$

$$(rot\ rot\ rot \int_{r_r}^{\infty} d'\bar{H}_n)_{\theta} = \frac{1}{4\pi}\, \frac{v_m}{r_r}\, \frac{\omega^3}{c^3}\, r_o\, \sqrt{m}\, \sin\theta\, \sin\eta\, \bar{e}_\theta \tag{517}$$

If we now compare the time differentiation from $d'\bar{F}_i$ with the θ-component of the three rotors we see that they are proportional and that we can write

$$\frac{d}{dt}[d'\bar{F}_i] = -\frac{1}{8\pi}\, c^2\, r_o\, \sqrt{m}\, rot\, \left[rot\ rot \int_{r_r}^{\infty} d'\bar{H}_n\right] \tag{518}$$

This is the flow-law for regions free of BSPs.

Defining the flow density as

$$\bar{\Theta} = -\ rot\ rot \int_{r_r}^{\infty} d'\bar{H}_n \tag{519}$$

we get

$$\frac{d}{dt}[d'\bar{F}_i] = \frac{1}{8\pi}\, c^2\, r_o\, \sqrt{m}\ \ rot\, \bar{\Theta} \tag{520}$$

This equation has the form of the 1.Maxwell equation

$$\frac{d}{dt}[\bar{E}] = \frac{1}{\epsilon}\, rot\bar{H} \tag{521}$$

Written in integral form we get

$$\int_A \frac{d}{dt}[d'\bar{F}_i] \cdot d\bar{A} = -\frac{1}{8\pi}\, c^2\, r_o\, \sqrt{m}\, \oint \left[rot\; rot \int_{r_r}^{\infty} d'\bar{H}_n \right] \cdot d\bar{l} \tag{522}$$

7.6.2 The 2. Maxwell equation.

To get the induction in a closed circuit we must build the rotor of $d'\bar{F}_{i_n}$ from eq.(421)

$$rot\; d'\bar{F}_{i_n} = \frac{1}{8\pi}\, \sqrt{m}\, r_o\, rot\; rot\, \frac{d}{dt} \int_{r_r}^{\infty} d'\bar{H}_n \tag{523}$$

The time differentiation we can exchange with the rotors and we get

$$rot\; d'\bar{F}_{i_n} = \frac{1}{8\pi}\, \sqrt{m}\, r_o\, \frac{d}{dt} \left[rot\; rot \int_{r_r}^{\infty} d'\bar{H}_n \right] \tag{524}$$

Introducing the previously defined flow density

$$\bar{\Theta} = -\, rot\; rot \int_{r_r}^{\infty} d'\bar{H}_n \tag{525}$$

we obtain the 2. Maxwell equation

$$rot\; d'\bar{F}_{i_n} = -\, \frac{1}{8\pi}\, \sqrt{m}\, r_o\, \frac{d\bar{\Theta}}{dt} \tag{526}$$

This equation has the form of the 2.Maxwell equation

$$rot\bar{E} = -\mu\, \frac{d}{dt}\, [\, \bar{H}\,] \tag{527}$$

In the two Maxwell equations we recognize the equivalence between

$$\bar{E} \equiv d'\bar{F}_{i_n} \qquad and \qquad \bar{H} \equiv \bar{\Theta} \tag{528}$$

If we define a vector potential $\bar{A}_\Theta$ as follows,

$$\bar{\Theta} = rot\bar{A}_\Theta \qquad with \qquad div\bar{\Theta} = 0 \tag{529}$$

we get the wave equation

$$\Delta\bar{A}_\Theta - \frac{1}{c^2}\, \frac{d^2}{dt^2}\bar{A}_\Theta = 0 \qquad with \qquad \bar{A}_\Theta = -rot \int_{r_r}^{\infty} d'\bar{H}_n \tag{530}$$

7.6.3 Equivalence between traditional fields based on Coulomb charge and fields based on mass charge.

From the 1. Maxwell equation (520) we have:

$$\frac{d}{dt}[d\,'\bar{F}_i] = \frac{1}{8\pi}\, c^2\, r_o\, \sqrt{m}\;\; rot\; \bar{\Theta} \qquad with \qquad \bar{\Theta} = -\; rot\; rot \int_{r_r}^{\infty} d\,'\bar{H}_n \tag{531}$$

The present work defines the charge as the difference between the mass of the constituent BSPs of opposed signs of a particle (Q_m =mass -charge).

$$Q_m = N\; m\;\; [kg] \qquad\qquad Q = N\; q\;\; [C] \qquad\qquad Q_m = \frac{m}{q}\; Q \tag{532}$$

with q and m respectively the charge in Coulomb and the mass in kilogram of an electron. N represents the difference between the constituent number of electrons and positrons of a particle.

The electric field is then defined as the force per mass-charge as

$$\bar{E}_m = \frac{d\,'\bar{F}_i}{Q_m}\;\; [N/kg] \qquad\qquad E_m = \frac{q}{m}\; E \tag{533}$$

with E representing the electric field in Newton per Coulomb. We get

$$\frac{d\bar{E}}{dt} = \frac{m}{q}\,\frac{d}{dt}\bar{E}_m = \frac{1}{8\pi}\,\frac{c^2\, r_o}{Q}\,\sqrt{m}\;\; rot\; \bar{\Theta} \tag{534}$$

With

$$\frac{d\bar{E}}{dt} = \frac{1}{\epsilon_o}\; rot\; \bar{H} \qquad and \qquad \bar{H}_m = \bar{\Theta} = -\; rot\; rot \int_{r_r}^{\infty} d\,'\bar{H}_n \tag{535}$$

we conclude that

$$\bar{H} = \frac{\epsilon_o}{8\pi}\frac{c^2\, r_o}{Q}\,\sqrt{m}\;\bar{H}_m \qquad and \qquad \bar{E} = \frac{m}{q}\;\bar{E}_m \tag{536}$$

and define that

$$B_m = \mu_o\; H_m \qquad and \qquad D_m = \epsilon_o\; E_m \tag{537}$$

7.7 Divergence.

7.7.1 Divergence of the transversal field dH_n.

The components of the transversal field from a not polarized BSP are

$$\int_{r_r}^{\infty} d\bar{H}_n = C_r\;\bar{e}_r + C_\gamma\;\bar{e}_\gamma + C_\theta\;\bar{e}_\theta \tag{538}$$

with

$$C_{r_r} = 0 \qquad\qquad C_\gamma = \left| \int_{r_r}^{\infty} d\bar{H}_n \right| \qquad\qquad C_\theta = 0 \tag{539}$$

If we use the already defined coordinate transformations we get

$$div \int_{r_r}^{\infty} d\bar{H}_n = 0 \tag{540}$$

which is equivalent to the Maxwell law

$$div \bar{H} = 0 \tag{541}$$

Note: The defined forms of polarizations for BSPs with light speed allow that $div \int_{r_r}^{\infty} d\bar{H}_n \neq 0$. The source of the field dH_n is then a surface.

7.7.2 Divergence of the force field $d\bar{F}$.

The total force on a probe BSP results from the static (Coulomb) and the dynamic forces.

$$\bar{F} = \bar{F}_s + \bar{F}_i \qquad or \qquad \int_\sigma d\bar{F} = \int_\sigma d\bar{F}_s + \int_\sigma d\bar{F}_i \tag{542}$$

Now we analyze the two components of the total force.

- In sec.4.2 eq.(201) we have seen that the static force F_2 on a probe BSP(2) produced by a BSP(1) is radial to BSP(1). The divergence outside the radius of the BSP(1) is therefore zero. The divergence at the point of the BSP(1) is proportional to the mass density ρ_m of the BSP(1). In sec. 4.7 we have calculated the divergence of $F_2 = F_s$ with $\triangle n_1 = \triangle n_2 = 1$ and $K = 5.42713 \cdot 10^4$ we got

$$\bar{\nabla} \cdot \bar{F}_s = 3.1826 \cdot 10^3 \; \rho_m \tag{543}$$

  For a complex particle formed by more than two BSPs we have

$$\bar{\nabla} \cdot \bar{F}_s = 3.1826 \cdot 10^3 \; \Delta n \; \rho_m \tag{544}$$

  with Δn the difference between positive and negative BSPs.

- We have defined that the total induced force on a probe BSP, produced by the field of a moving BSP, is proportional to a special closed path integral when the area enclosed tends to zero. That definition has lead us to the following expression.

$$d\bar{F}_i = K_i \; rot \; \frac{d}{dt} \int_{r_r}^{\infty} d\bar{H}_n \tag{545}$$

with K_i a proportional constant.

As the divergence of a rotor is always zero we have

$$div \; d\bar{F}_i = K_i \; div \left\{ rot \; \frac{d}{dt} \int_{r_r}^{\infty} d\bar{H}_n \right\} = 0 \tag{546}$$

7.8 Lorentz transformation.

The present theory is based on fundamental particles with longitudinal and transverasl rotational momentums. Based on this new approach we have deduced the four Maxwell equations.

- 1. Maxwell equation for the induced force field $d'\bar{F}_i$

$$\frac{d}{dt}[d'\bar{F}_i] = \frac{1}{8\pi} \, c^2 \, r_o \, \sqrt{m} \;\; rot \; \Theta \qquad with \qquad \Theta = - \; rot \; rot \int_{r_r}^{\infty} d'\bar{H}_n \tag{547}$$

- 2. Maxwell equation for the induced force field $d'\bar{F}_i$.

$$rot \; d'\bar{F}_i = - \; \frac{1}{8\pi} \, \sqrt{m} \, r_o \, \frac{d\,\bar{\Theta}}{dt} \qquad with \qquad \bar{\Theta} = - \; rot \; rot \int_{r_r}^{\infty} d'\bar{H}_n \tag{548}$$

- Divergence of the static force field of a complex particle

$$\bar{\nabla} \cdot \bar{F}_s = 3.1826 \cdot 10^3 \; \Delta n \; \rho_m \tag{549}$$

and the divergence of the induced force field of an BSP

$$div \; d'\bar{F}_i = div \; \left(\frac{1}{8\pi} \, \sqrt{m} \, r_o \; rot \; \frac{d}{dt} \int_{r_r}^{\infty} d'\bar{H}_n \right) = 0 \tag{550}$$

- Divergence of the cummulated transversal rotational momentum field of a BSP

$$div \int_{r_r}^{\infty} d'\bar{H}_n = 0 \tag{551}$$

The four Maxwell equations deduced with the present approach have the same form as the four Maxwell equations of the standard theory, and are therefore also invariant to the Lorentz transformation.

7.9 Basic field equations.

The fields of the present theory are:

$$d' \bar{H}_s = -H_s \, d' \kappa \, \bar{e}_r \quad and \quad d' \bar{H}_n = H_n \, d' \kappa \, \bar{e}_\gamma \tag{552}$$

with

$$d' H^2 = d' H_s^2 \ + \ d' H_n^2 = [\, d' E_s \ + \ d' E_n \,] \, d' \kappa \tag{553}$$

where $d' \kappa$ in the coordinates of Fig. 58 is

$$d' \kappa = \frac{c}{2\, v} \left| \frac{\bar{v}_s}{|\bar{v}_e|} \ \times \ \frac{\bar{v}_r}{|\bar{v}_r|} \right| \frac{r_o}{r_r^2} \, dr_r \tag{554}$$

which is for $0 \leq v \leq c$

$$d' \kappa = \frac{1}{2} \, \frac{r_o}{r_r^2} \, dr_r \ \sin \theta \tag{555}$$

The divergences of the two fields for $v \ll c$ are

$$\bar{\nabla} \cdot d' \bar{H}_s = \frac{3\pi}{8} \, \frac{c\sqrt{m}}{r_o} = \frac{3\pi^{3/2}}{4} \sqrt{\frac{m\, c^2}{4\pi r_o^2}} = \frac{3\pi^{3/2}}{4} \sqrt{\frac{E_o}{S_o}} \qquad and \qquad \bar{\nabla} \cdot d' H_n = 0 \tag{556}$$

with $S_o = 4\pi r_o^2$ the area of the particle and $\frac{E_o}{S_o}$ the energy density.
For massless points we get

$$\bar{\nabla} \cdot d' \bar{H}_s = 0 \qquad and \qquad \bar{\nabla} \cdot d' \bar{H}_n = 0 \tag{557}$$

and we can define vector fields

$$d' \bar{H}_s = \bar{\nabla} \times d' \bar{M}_s \qquad and \qquad d' \bar{H}_n = \bar{\nabla} \times d' \bar{M}_n \tag{558}$$

For the **cumulated fields** we have

$$\int_{r_r}^{\infty} d' \bar{H}_s = -H_s \int_{r_r}^{\infty} d' \kappa \, \bar{e}_r \quad and \quad \int_{r_r}^{\infty} d' \bar{H}_n = H_n \int_{r_r}^{\infty} d' \kappa \, \bar{e}_\gamma \tag{559}$$

with

$$\int_{r_r}^{\infty} d^{'}\kappa = \frac{1}{2}\,\frac{r_o}{r_r}\,\sin\theta \tag{560}$$

The divergences for $v \ll c$ are

$$\bar{\nabla}\cdot\int_{r_r}^{\infty} d^{'}\bar{H}_s = \frac{3}{8}\,\frac{c\,\sqrt{m}}{r_o} \qquad and \qquad \bar{\nabla}\cdot\int_{r_r}^{\infty} d^{'}H_n = 0 \tag{561}$$

From

$$d^{'}\bar{F}_{i_n} = \frac{d^{'}p_n}{dt} = \frac{1}{8\,\pi}\,\sqrt{m}\,r_o\,rot\,\frac{d}{dt}\int_{r_r}^{\infty} d^{'}\bar{H}_n \tag{562}$$

we get

$$d^{'}\bar{p}_n = \frac{1}{8\,\pi}\,\sqrt{m}\,r_o\,rot\,\int_{r_r}^{\infty} d^{'}\bar{H}_n \tag{563}$$

and

$$\bar{\nabla}\cdot d^{'}\bar{p}_n = 0 \tag{564}$$

which is the conservation law for the linear momentum due to the $d^{'}\bar{H}_n$ field. The same result we get for the linear momentum due to the $d^{'}\bar{H}_s$ field from eq.(429) for $d^{'}\bar{F}_{i_s}$.

We define vector fields

$$d^{'}\bar{p}_n = \bar{\nabla}\times\bar{N}_n \qquad with \qquad \bar{N}_n = \frac{1}{8\,\pi}\,\sqrt{m}\,r_o\,\int_{r_r}^{\infty} d^{'}\bar{H}_n \tag{565}$$

and

$$d^{'}\bar{p}_s = \bar{\nabla}\times\bar{N}_s \qquad with \qquad \bar{N}_s = \frac{1}{8\,\pi}\,\sqrt{m}\,r_o\,\int_{r_r}^{\infty} d^{'}\bar{H}_s \tag{566}$$

and the corresponding divergences are

$$\bar{\nabla}\cdot\bar{N}_n = 0 \qquad because \qquad \bar{\nabla}\cdot\int_{r_r}^{\infty} d^{'}\bar{H}_n = 0 \tag{567}$$

and

$$\bar{\nabla}\cdot\bar{N}_s = \frac{1}{8\,\pi}\,\sqrt{m}\,r_o\,\bar{\nabla}\cdot\int_{r_r}^{\infty} d^{'}\bar{H}_s = \frac{3}{64\pi}\,m\,c \tag{568}$$

With the 1. Maxwell equation (518) where $d^{'}\bar{F}_i = d^{'}\bar{F}_{i_n}$

$$\frac{d}{dt}[d^{'}\bar{F}_{i_n}] = -\frac{1}{8\pi}\, c^2\, r_o\, \sqrt{m}\; rot\, \left[rot\; rot \int_{r_r}^{\infty} d^{'}\bar{H}_n \right]$$

and the equation (562) for the force $d^{'}\bar{F}_{i_n}$ we get

$$\bar{\nabla} \times \bar{\nabla} \times \int_{r_r}^{\infty} d^{'}\bar{H}_n \;+\; \frac{1}{c^2}\,\frac{d^2}{dt^2} \int_{r_r}^{\infty} d^{'}\bar{H}_n \;=\; 0 \tag{569}$$

Because of

$$\bar{\nabla} \times \bar{\nabla}\times = \bar{\nabla}\bar{\nabla} \;-\; \Delta \tag{570}$$

we get

$$\Delta \int_{r_r}^{\infty} d^{'}\bar{H}_n \;-\; \frac{1}{c^2}\,\frac{d^2}{dt^2} \int_{r_r}^{\infty} d^{'}\bar{H}_n \;=\; 0 \tag{571}$$

A similar expression we have in standard theory for the vector field $\bar{A}$ after introducing the Lorenz gauge condition. We conclude, that the present theory is Lorentz invariant without the need of any gauge.

7.10 Synopsis of the fundamental equations for the generation of linear momentum between BSPs.

The Fundamental equations for the generation of linear momentum can be classified in

1. between two static BSPs
2. between two moving BSPs
3. between a moving and a static BSP

1) The equation for the generation of linear momentum between two static BSPs (static) is (See Fig. 26) based on the postulate 6 for the interaction between longitudinal angular momentums $\bar{J}_s$ of FPs.

$$d^{'}p_{stat}\; \bar{s}_R = \frac{a}{c} \oint_R \left\{ \frac{\bar{dl} \cdot (\bar{s}_{e_1} \times \bar{s}_{s_2})}{2\pi R} \int_{r_1}^{\infty} H_{e_1}\; d\kappa_{r_1} \int_{r_2}^{\infty} H_{s_2}\; d\kappa_{r_2} \right\}\; \bar{s}_R \tag{572}$$

where $\bar{s}_R$ is a unit vector perpendicular to the plane that contains the closed path with radius R.

After integration over the whole space we get

$$p_{stat}\ \bar{s}_R = \int_\sigma d'p_{stat}\ \bar{s}_R \tag{573}$$

The linear momentum generated between two static BSPs is the motor of all movement of particles.

Equation (572) gives the curve from Fig. 29 that describes the Coulomb law for $d \gg r_o$.

2) The equation for the generation of linear momentum between two moving BSPs (dynamic) is based on the postulate 7 for the interaction between transversal angular momentums $\bar{J}_n$ of FPs.

$$d'p_{dyn}\ \bar{s}_R = \frac{1}{c}\oint_R \left\{ \frac{\bar{dl}\cdot(\bar{n}_1 \times \bar{n}_2)}{2\pi R} \int_{r_1}^{\infty} H_{n_1}\ d\kappa_{r_1} \int_{r_2}^{\infty} H_{n_2}\ d\kappa_{r_2} \right\}\ \bar{s}_R \tag{574}$$

(See Fig. 47). Equation (574) contains the Lorentz, Ampere, Bragg and one component of the gravitation laws.

3) The equation for the generation of linear momentum between a moving and a static BSP (induced) is based on the postulate 8 for the interaction between the angular momentum $\bar{J}$ of one BSP and the longitudinal angular momentum $\bar{J}_s$ of another BSP.

$$d'p_{ind}^{(s)}\ \bar{s}_R = \frac{1}{c}\oint_R \left\{ \frac{\bar{dl}\cdot\bar{s}}{2\pi R} \int_{r_r}^{\infty} H_s\ d\kappa_{r_r} \int_{r_p}^{\infty} H_{s_p}\ d\kappa_{r_p} \right\}\ \bar{s}_R \tag{575}$$

$$d'p_{ind}^{(n)}\ \bar{s}_R = \frac{1}{c}\oint_R \left\{ \frac{\bar{dl}\cdot\bar{n}}{2\pi R} \int_{r_r}^{\infty} H_n\ d\kappa_{r_r} \int_{r_p}^{\infty} H_{s_p}\ d\kappa_{r_p} \right\}\ \bar{s}_R \tag{576}$$

(See Fig. 53 and Fig. 54). The upper indexes (s) or (n) denote that the linear momentum $d'p_{ind}$ on the static BSP is induced by the longitudinal (s) or transversal (n) field of the moving BSP.

Equation (576) contains the first and the second Maxwell laws and one component of the gravitation law.

The force for all the fundamental equations is given by

$$d'F\ \bar{s}_R = \frac{d'p}{\Delta t}\ \bar{s}_R \qquad with \qquad \Delta t = K\ r_{o_1}\ r_{o_2} \qquad \bar{F} = \int_\sigma d'\bar{F} \tag{577}$$

Note: The coordinate system selected to decide if a BSP under observation is moving or not is the coordinate system of the measuring equipment of the laboratory with its BSPs in rest in that coordinate system, BSPs that provide the regenerating fundamental particles for the BSP under observation.

The force on a BSP that moves with the speed v and which is exposed to the above listed momenta is

$$\bar{F}_{tot} = \bar{F}_{stat} + \bar{F}_{dyn} + \bar{F}^{(s)}_{ind} + F^{(n)}_{ind} \tag{578}$$

If there is no isolated moving BSP inducing on the BSP under observation we have that

$$\bar{F}_{tot} = \bar{F}_{stat} + \bar{F}_{dyn} \tag{579}$$

Note: With the adequate definitions all above listed forces are derived as rotors from the vector field generated by the longitudinal and transversal angular momenta of the two types of fundamental particle defined at the beginning of this work.

$$d^{'}\bar{F} = \frac{d^{'}p}{dt} = \frac{1}{8\,\pi}\,\sqrt{m}\,r_o\,rot\,\frac{d}{dt}\int_{r_r}^{\infty} d^{'}\bar{H} \tag{580}$$

7.10.1 Relativistic expressions of the fundamental equations.

In sec. 7.10 the general form of the fundamental equations for the generation of linear momentum between BSPs was presented. This section shows the relativistic influence of each differential part of the equations. We start first with the repetition of some definitions and conveniently formulation of equations for our objective:

$$d^{'}\kappa = \int_{r_r}^{\infty} d\kappa = r_o \int_{r_r}^{\infty} d\xi = r_o\,d^{'}\xi \qquad with \qquad d^{'}\xi = \int_{r_r}^{\infty} d\xi \tag{581}$$

$$\Delta t = K r_{o_1} r_{o_2} \quad with \quad r_o = \frac{\hbar\,c}{E} = \frac{\hbar\,c}{\sqrt{E_o^2 + E_p^2}} = \frac{\hbar\,c}{m\,c^2}\,\beta \tag{582}$$

$$\Delta t = K\,\frac{\hbar^2\,c^2}{m^2 c^4}\,\beta_1\,\beta_2 \qquad with \qquad \beta_i = \sqrt{1 - \frac{v_i^2}{c^2}} \tag{583}$$

$$H_s = \sqrt{E_s} = \frac{E_o}{\sqrt{E}} \qquad H_n = \sqrt{E_n} = \frac{E_p}{\sqrt{E}} \qquad H_e = \sqrt{E} \tag{584}$$

$$E = \sqrt{E_o^2 + E_p^2} = mc^2\,\beta^{-1} \qquad E_p = mcv\beta^{-1} \tag{585}$$

1) Equation (572) for the Coulomb force can be written in a different differential form as:

$$d^{''}F_{stat} = \frac{d^{''}p_{stat}}{dt} = \frac{\Delta^{''}p_{stat}}{\Delta t} = \frac{a}{c}\frac{\Delta^{''}E_p}{\Delta t} = \frac{a}{c\,\Delta t}\,H_{e_1}\,H_{s_2}\,d^{'}\kappa_{r_1}\,d^{'}\kappa_{r_2} \tag{586}$$

For Coulomb the BSPs don't move and it is $H_{e_1} = H_{s_2} = \sqrt{m}c$ and we get

$$d^{''}F_{stat} = \frac{a}{c\,\Delta t}\,mc^2\,d^{'}\kappa_{r_1}\,d^{'}\kappa_{r_2} = \frac{a}{c\,\Delta t}\,mc^2\,r_{o_1}\,r_{o_2}\,d^{'}\xi_{r_1}\,d^{'}\xi_{r_2} \tag{587}$$

and finally with $\Delta t = K r_{o_1} r_{o_2}$

$$d^{''}F_{stat} = \frac{a}{c\,K}\,mc^2\,d^{'}\xi_{r_1}\,d^{'}\xi_{r_2} \tag{588}$$

It is clear that for the Coulomb force the relativistic factors are $\beta = 1$ because the speeds of the BSPs are zero and therefore β doesn't appear in the equations.

2) Now we make the same procedure for equation (574) which is the basic equation for the Lorentz, Ampere and Bragg forces. The currents that generate the forces are continuous currents and H_{n_1} and H_{n_2} are not functions of the time.

$$d^{''}F_{dyn} = \frac{1}{c\,\Delta t}d^{''}E_{p_{dyn}} = \frac{1}{c\,\Delta t}H_{n_1}\,H_{n_2}\,r_{o_1}\,r_{o_2}\,d^{'}\xi_{r_1}\,d^{'}\xi_{r_2} \tag{589}$$

With $H_n = \sqrt{m}\,v\,\beta^{-1/2}$ we get

$$d^{''}F_{dyn} = \frac{m\,v_1\,v_2}{c\,K}\,\beta_1^{-1/2}\,\beta_2^{-1/2}\,d^{'}\xi_{r_1}\,d^{'}\xi_{r_2} \tag{590}$$

The β factors in eq. (590) show the relativistic behaviour of the equation.

3) Now we make the procedure for eq. (576) which is the basic equation for the Maxwell and gravitation forces. In this case H_n is function of the time and we have to start with eq. (394) and eq. (421) that follow:

$$\frac{d}{dt}\int_{r_r}^{\infty} d\bar{H}_n = \frac{1}{2}\,\frac{d}{dt}[H_n]\,\frac{r_o}{r_r}\,\sin\varphi\,d\varphi\,\bar{s}_\gamma\;-\;H_n\,v\,\frac{r_o}{r_r^2}\,\sin\varphi\,\cos\varphi\,d\varphi\,\bar{s}_\gamma \tag{591}$$

$$d^{'}\bar{F}_{i_n} = \frac{1}{8\,\pi}\,\sqrt{m_p}\,r_{o_p}\,rot\,\frac{d}{dt}\int_{r_r}^{\infty} d^{'}\bar{H}_n \tag{592}$$

We modify eq. (591) including the variable $d\gamma$ that was omitted before because of symmetry reasons.

$$\frac{d}{dt}\int_{r_r}^{\infty} d''\bar{H}_n = \frac{1}{2}\,\frac{d}{dt}[H_n]\,\frac{r_o}{r_r}\,\sin\varphi\,d\varphi\,\frac{d\gamma}{2\pi}\,\bar{s}_\gamma \;-\; H_n\,v\,\frac{r_o}{r_r^2}\,\sin\varphi\,\cos\varphi\,d\varphi\,\frac{d\gamma}{2\pi}\,\bar{s}_\gamma \quad (593)$$

Correspondingly eq. (592) is modified.

$$d''\bar{F}_{i_n} = \frac{1}{8\,\pi}\,\sqrt{m_p}\,r_{o_p}\,rot\,\frac{d}{dt}\int_{r_r}^{\infty} d''\bar{H}_n \quad (594)$$

The terms in eq. (593) can be separated in factors that are exclusively functions of $v(t)$ and factors that are exclusively functions of the space coordinates. We can write eq. (594) as

$$d''\bar{F}_{i_n} = \frac{1}{8\,\pi}\,\sqrt{m_p}\,r_{o_p}\,\left\{\frac{d}{dt}[H_n]\,rot\bar{K}_{1_{ind}} \;-\; v\,H_n\,rot\bar{K}_{2_{ind}}\right\} \quad (595)$$

where

$$\bar{K}_{1_{ind}} = \frac{1}{2}\,\frac{r_o}{r_r}\,\sin\varphi\,d\varphi\,\frac{d\gamma}{2\pi}\,\bar{s}_\gamma \qquad and \qquad \bar{K}_{2_{ind}} = \frac{r_o}{r_r^2}\,\sin\varphi\,\cos\varphi\,d\varphi\,\frac{d\gamma}{2\pi}\,\bar{s}_\gamma \quad (596)$$

For $\Delta v = c - v << c$ it is

$$H_n \approx \sqrt{E_p} = \sqrt{m\,c\,v}\,\beta^{-1/2} \qquad and \qquad \frac{d}{dt}[H_n] \approx \frac{d}{dt}\left[(m\,c\,v)^{1/2}\,\beta^{-1/2}\right] \quad (597)$$

and eq. (595) writes

$$d''\bar{F}_{i_n} = \frac{1}{8\pi}\sqrt{m_p}r_{o_p}\left\{\frac{d}{dt}\left[(mcv)^{1/2}\beta^{-1/2}\right]rot\bar{K}_{1_{ind}} - v\sqrt{mcv}\beta^{-1/2}rot\bar{K}_{2_{ind}}\right\} \quad (598)$$

The β factors in eq. (598) show the relativistic behaviour of the equation.

8 Corner-pillars of the "E & R" UFT model

The corner-pillars of the proposed model are:

1. Nucleons are composed of electrons and positrons
2. A space with Fundamental Particle (FPs) with angular momenta is postulated.
3. Electrons and positrons are represented as focal points of rays of FPs where the energy of the electrons and positrons is stored as rotation.

4. FPs are emited with c or ∞ from the focus. The focus is regenerated by FPs that move with c or ∞ relative to the focus.
5. Regenerating FPs are those that are emited by other focuses. A focus is stable when emission and regeneration is energetically balanced.
6. Pairs of FPs with opposed angular momenta generate linear momenta on focuses.
7. Interactions between subatomic particles are the product of the interactions of their FPs when they cross in space. The probability that they cross follows the radiation law.
8. The interactions between FPs are so defined, that the fundamental equations (Coulomb, Ampere, Lorentz, Newton, Maxwell, etc.) can be mathematically derived.
9. Neutrinos are parallel moving pairs of FPs with opposed angular momenta.
10. Photons are a sequence of neutrinos with their potential linear momenta oriented alternatelly oposed.
11. Photons that move with $c \pm v$ are reflected and refracted by optical lenses and electric antenas with c.

All experiments that can be explained with the SM must also be at least explained with the E & R model. The explanations must not be equal to those of the SM.

Note: The fundamental laws (Coulomb, Ampere, Lorentz, Newton, Maxwell, etc.) were deduced with measurements that took place under conditions where the nucleons involved were adequatelly regenerated to be stable. At relativistic speeds and at heavy atomic nuclei the regeneration can become deficient and produce instability. They decay in configurations that can be adequtely regenerated by the enviroment, in other words, in stable configurations.

The interactions between subatomic particles take place at the regenerating FPs that move along the rays with the speed c or ∞. The laws that were deduced for stable configurations (Coulomb, Ampere, Lorentz, Newton, Maxwell, etc.) not necessarilly must work for unstable particles where emission and regeneration are not in balance.

The model "E & R" only takes into consideration stable partikles, in other words, electrons, neutrons, protons, neutrinos, photons and their antiparticles. Positrons are only stable in configurations like the nucleons. The many short-lived configurations are not taken into account because they not necessarilly follow the known fundamental laws.

Part IV Miscellaneous I

9 Quantification of irradiated energy and movement.

9.1 Quantification of irradiated energy.

To express the energy irradiated by a BSP as quantified in angular momenta over time we start with

$$E = E_e = E_s + E_n = \sqrt{E_o^2 + E_p^2} \qquad \Delta t = K r_o r_{o_p} \qquad r_o = \frac{\hbar\, c}{E_e} \qquad r_{o_p} = \frac{\hbar\, c}{E_o} \tag{599}$$

with r_o the radius of the moving particle and r_{o_p} the radius of the resting probe particle. It is

$$\Delta t = K r_o r_{o_p} \frac{r_{o_p}}{r_{o_p}} = K r_{o_p}^2 \frac{r_o}{r_{o_p}} = \Delta_o t\, \frac{r_o}{r_{o_p}} \tag{600}$$

with

$$\Delta_o t = \Delta t_{(v=0)} = K\, \frac{\hbar^2\, c^2}{E_o^2} = 8.082097 \cdot 10^{-21}\ \ s \quad with \quad K = 5.4274 \cdot 10^4\ s/m^2 \tag{601}$$

We now define $E_e\, \Delta t$ and get

$$E_e\, \Delta t = K\, \frac{\hbar^2\, c^2}{E_o} = K\, \frac{h^2}{4\, \pi^2\, m} = h \tag{602}$$

equation that is valid for every speed $0 \le v \le c$ of the BSP giving

$$E_e\, \Delta t = E_o\, \Delta_o t = h \tag{603}$$

where h is the Planck constant.

Note: In the equation $E_e\, \Delta t = h$ the energy E_e is the total energy of the moving particle and the differential time Δt is the time the differential momentum Δp is active to give the force $F = \Delta p/\Delta t$ between the moving and the probe particle.

In connection with the quantification of the energy $E = J\, \nu$ the following cases are possible:

- A common frequency ν_g exists and the angular momentum J is variable. This assumption was made in Sec. 2.8.1, for FPs of BSPs with $v \neq c$ that define an electron or a positron.

- A common angular momentum J_g exists and the frequency ν is variable. This assumption was made in sec. 2.8.2 for FPs of BSPs with $v \neq c$ that define an electron or a positron.

The concept is shown in Fig. 60.

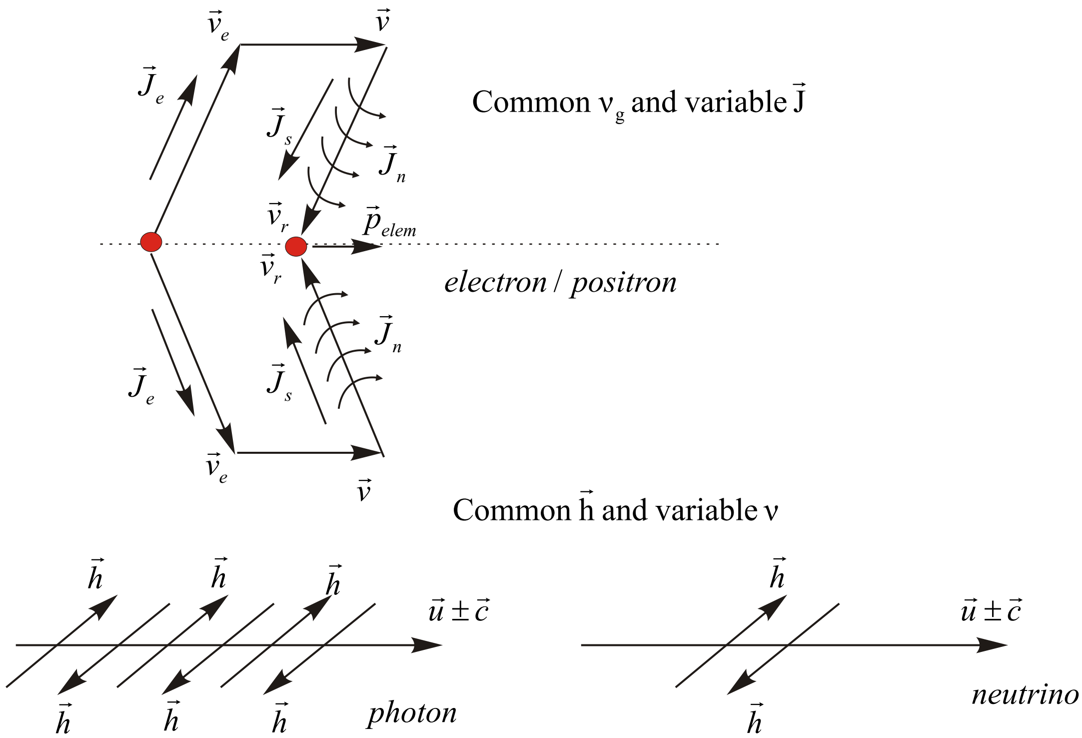


Figure 60: Quantification of linear momentum

We define for a common angular momentum $J_g = h$ the equivalent angular frequencies ν, ν_o and ν_p with the following equations

$$E = E_e = h\ \nu \qquad \nu = \frac{1}{\Delta t} \qquad and \qquad E_p = p\ c = h\ \nu_p \tag{604}$$

and

$$E_o = m\ c^2 = h\ \nu_o \qquad \nu_o = \frac{1}{\Delta_o t} = 1.2373 \cdot 10^{20}\ \ s^{-1} \tag{605}$$

We have already defined the angular frequencies ν_e, ν_s and ν_n for the FPs with the following equations

$$E_e = E_s\ +\ E_n \qquad and \qquad dE_e = dE_s\ +\ dE_n \tag{606}$$

With a common angular momentum $J_g = h$ it is

$$dE_e = E_e \, d\kappa = h \, \nu_e \qquad dE_s = E_s \, d\kappa = h \, \nu_s \qquad dE_n = E_n \, d\kappa = h \, \nu_n \tag{607}$$

The relation between the angular frequencies of FPs and the equivalent angular frequencies is

$$\nu = \sum_i \nu_{e_i} = \sum_i \nu_{s_i} \; + \; \sum_i \nu_{n_i} = \sqrt{\nu_o^2 \; + \; \nu_p^2} \tag{608}$$

If all FPs have the same angular frequency $\nu_{e_i} = \nu_{s_i} = \nu_{n_i} = \nu_{FP}$ we get

$$\nu = N_e \, \nu_{FP} = N_s \, \nu_{FP} \; + \; N_n \, \nu_{FP} = \sqrt{\nu_o^2 \; + \; \nu_p^2} \tag{609}$$

with N the corresponding total number of FPs of the BSP. If we multiply the equation with h we get

$$h \, \nu = N_e \, h \, \nu_{FP} = N_s \, h \, \nu_{FP} \; + \; N_n \, h \, \nu_{FP} = h \, \sqrt{\nu_o^2 \; + \; \nu_p^2} \tag{610}$$

or

$$E = E_e = E_s \; + \; E_n = \sqrt{E_o^2 \; + \; E_p^2} \tag{611}$$

with $E_{FP} = h \, \nu_{FP}$ the energy of one FP.

We define the quantized emission of energy for a BSP with $v \neq c$ defining the power as

$$P_e = \frac{E_e}{\Delta t} = E_e \, \nu \qquad \nu = \frac{1}{\Delta t} \tag{612}$$

$$P_e = \frac{E_e}{\Delta t} = \frac{1}{\Delta t} \, \sqrt{E_o^2 + E_p^2} = \sqrt{{P_o}^2 + {P_p}^2} = E_s \, \nu \; + \; E_n \, \nu = P_s \; + \; P_n \tag{613}$$

where

$$P_o = E_o \, \nu \qquad P_p = E_p \, \nu \qquad P_s = E_s \, \nu \qquad P_n = E_n \, \nu \tag{614}$$

For the differential powers we get

$$dP_e = \nu \, E_e \, d\kappa \qquad dP_s = \nu \, E_s \, d\kappa \qquad dP_n = \nu \, E_n \, d\kappa \tag{615}$$

Fundamental equations expressed with the powers exchanged by the

BSPs.

Now we show that the fundamental equations of sec 7.10 for the generation of linear momentum can be expressed as functions of the powers of their interacting BSPs.

With

$$dE = E\,d\kappa \qquad dH = \sqrt{E}\,d\kappa = H\,d\kappa \qquad and \qquad \frac{H}{\sqrt{\Delta t}} = \sqrt{E\,\nu} = \sqrt{P} \tag{616}$$

the equations for the Coulomb, Ampere and induction forces of sec. 7.10 can be transformed to

$$d'F\,\bar{s}_R = \frac{d'p}{\Delta t}\,\bar{s}_R \;\propto\; \frac{1}{c}\oint_R \left\{ \int_{r_1}^{\infty} \frac{H_1}{\sqrt{\Delta t}}\,d\kappa_{r_1} \int_{r_2}^{\infty} \frac{H_2}{\sqrt{\Delta t}}\,d\kappa_{r_2} \right\} \bar{s}_R \tag{617}$$

and expressed as a function of the powers of the interacting BSPs

$$d'F\,\bar{s}_R = \frac{d'p}{\Delta t}\,\bar{s}_R \;\propto\; \frac{1}{c}\oint_R \left\{ \int_{r_1}^{\infty} \sqrt{P_1}\,d\kappa_{r_1} \int_{r_2}^{\infty} \sqrt{P_2}\,d\kappa_{r_2} \right\} \bar{s}_R \tag{618}$$

It is also possible to define differential energy fluxes for BSPs. We start with

$$dP_e = \nu\,E_e\,d\kappa \qquad dP_s = \nu\,E_s\,d\kappa \qquad dP_n = \nu\,E_n\,d\kappa \tag{619}$$

and with

$$d\kappa = \frac{1}{2}\,\frac{r_o}{r^2}\,dr\;\sin\varphi\,d\varphi\,\frac{d\gamma}{2\pi} \qquad and \quad dA = r^2\;\sin\varphi\,d\varphi\,d\gamma \tag{620}$$

The concept is shown in Fig. 61.

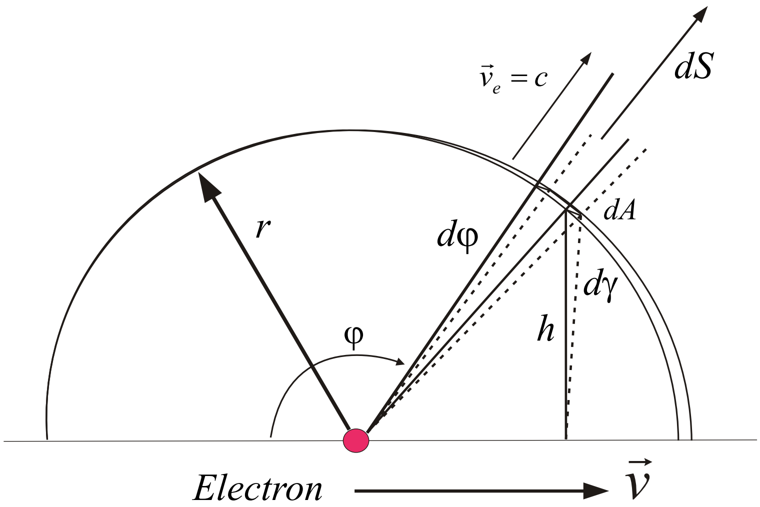


Figure 61: Emitted Energy flux density dS of a moving electron

The cumulated differential energy flux is

$$\int_r^\infty dP_e = \nu\ E \int_r^\infty d\kappa = \nu\ E\ \frac{1}{2}\ \frac{r_o}{r}\ \sin\varphi\ d\varphi\ \frac{d\gamma}{2\pi} \quad J\ s^{-1} \tag{621}$$

The cumulated differential energy flux density is

$$\int_r^\infty dS_e = \frac{1}{dA} \int_r^\infty dP_e = \nu\ E_e\ \frac{1}{4\pi}\ \frac{r_o}{r^3} \quad \frac{J}{m^2\ s} \tag{622}$$

To get the total cumulated energy flux through a sphere with a radius r we make $r_o = r$ and integrate over the whole surface $A = 4\pi\ r^2$ of the sphere and get

$$4\pi\ r^2 \int_r^\infty dS_e = \nu\ E_e \quad \frac{J}{m^2\ s} \tag{623}$$

Note: The differential energy flux density is independent of φ and γ and therefore independent of the direction of the speed v. This is because of the relativity of the speed v that does not define who is moving relative to whom.

Physical interpretation of an electron and positron as radiating and absorbing FPs:

The emitted differential energy is

$$dE_e = E_e\ d\kappa = \frac{h}{\Delta t}\ \frac{1}{2}\ \frac{r_o}{r^2}\ dr\ \sin\varphi\ d\varphi\ \frac{d\gamma}{2\pi} \tag{624}$$

With the help of Fig. 61 we see that the area of the sphere is $A = 4\pi r^2$, and we get

$$dE_e = \frac{h}{\Delta t\ A}\ \ r_o\ dr\ \sin\varphi\ d\varphi\ d\gamma \tag{625}$$

We now define

$$dE_e = \sigma_h\ \ r_o\ dr\ \sin\varphi\ d\varphi\ d\gamma \quad with \quad \sigma_h = \frac{h}{\Delta t\ A} \tag{626}$$

where σ_h is the *current density of fundamental angular momentum h.*

We can also write

$$dE_e = \sigma_h\ \ dA \quad with \quad dA = r_o\ dr\ \sin\varphi\ d\varphi\ d\gamma \tag{627}$$

9.2 Energy and density of Fundamental Particles.

9.2.1 Energy of Fundamental Particles.

The emission time of photons from **isolated** atoms is approximately $\tau = 10^{-8}\ s$ what gives a length for the train of waves of $L = c\ \tau = 3\ m$. The total energy of the emitted photon is $E_t = h\ \nu_t$ and the wavelength is $\lambda_t = c/\nu_t$. We have defined (see Fig. 60, Fig 68 and Fig. 69), that the photon is composed of a train of FPs with alternated opposed angular momenta where the distance between two consecutive FPs is equal $\lambda_t/2$. The number of FPs that build the photon is therefore $N_{\mathbf{FP}} = L/(\lambda_t/2)$ and we get for the energy of one FP

The concept is shown in Fig. 62

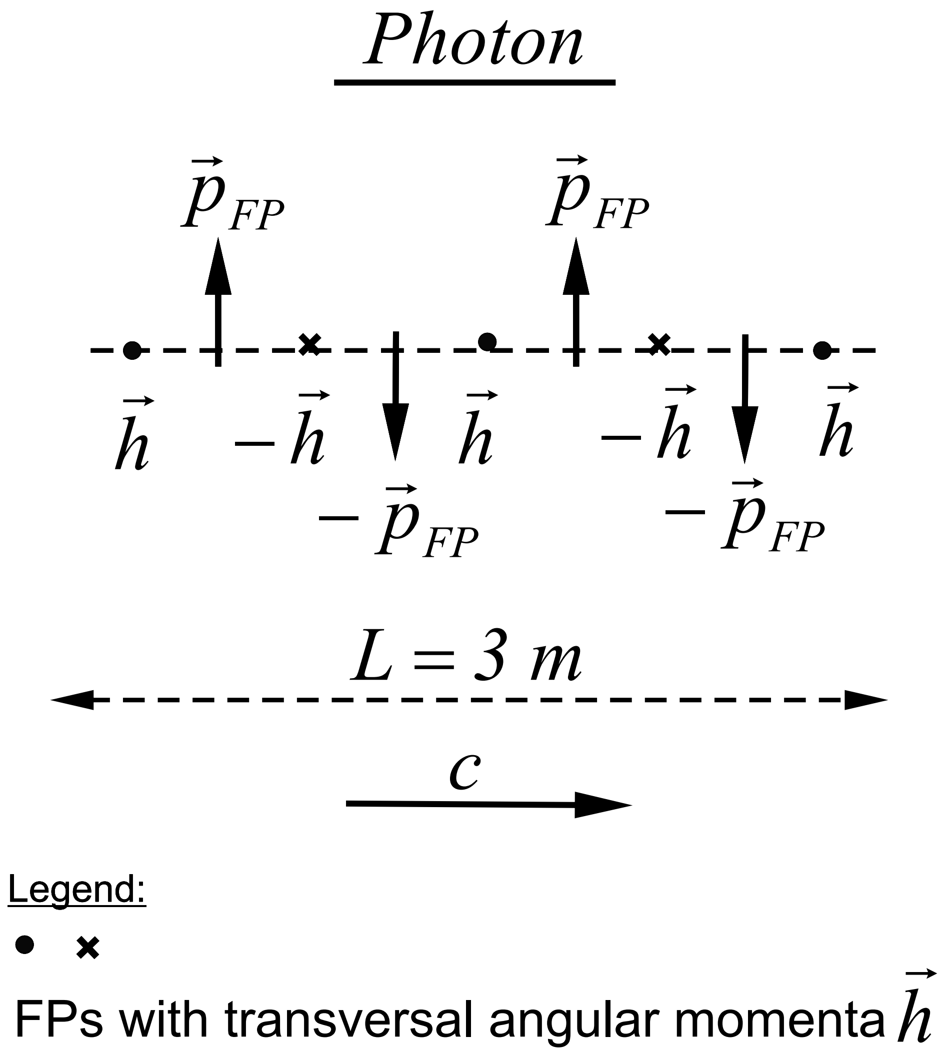


Figure 62: Photon as sequence of opposed angular momenta

$$E_{\mathbf{FP}} = \frac{E_t}{N_{\mathbf{FP}}} = \frac{E_t\ \lambda_t}{2\ L} = \frac{h}{2\ \tau} = 3.313 \cdot 10^{-26}\ J = 2.068 \cdot 10^{-7}\ eV \tag{628}$$

and for the angular frequency of the angular momentum h

$$\nu_{\mathbf{FP}} = \frac{E_{\mathbf{FP}}}{h} = \frac{1}{2\ \tau} = 5 \cdot 10^{7}\ s^{-1} \tag{629}$$

Finally we get

$$\nu_t = N_{\mathbf{FP}}\, \nu_{\mathbf{FP}} = \ 5 \cdot 10^7\ N_{\mathbf{FP}}\ s^{-1} \qquad with \qquad N_{\mathbf{FP}} = \frac{c\,\tau}{\lambda_t/2} \tag{630}$$

Note: The frequency ν_t represents a linear frequency where the relation with the velocity v and the wavelength λ_t is given by $v = \lambda_t\ \nu_t$. The frequency $\nu_{\mathbf{FP}}$ represents the angular frequency of the angular momentum h.

The momentum generated by a pair of FPs with opposed angular momenta is

$$p_{\mathbf{FP}} = \frac{2\ E_{\mathbf{FP}}}{c} = 2.20866 \cdot 10^{-34}\ kg\ m\ s^{-1} \tag{631}$$

Note: Isolated FPs have only angular momenta, they have no linear momenta and therefore cannot generate a force through the change of linear momenta . Linear momentum is generated only out of pairs of FPs with opposed angular momentum as defined in sec. 2.10. It makes no sense to define a dynamic mass for FPs because they have no linear inertia, which is a product of the energy stored in FPs with opposed angular momenta. FPs that meet in space interact changing the orientation of their angular momenta but conserving each its energy $E_{FP} = 3.313 \cdot 10^{-26}\ J$.

The number N_{FP_o} of FPs of an resting BSP (electron or positron) is

$$N_{FP_o} = \frac{E_o}{E_{FP}} = 2.4746 \cdot 10^{12} \tag{632}$$

9.2.2 Density of Fundamental Particles.

From sec. 2.15 we have that

$$dE = E\ d\kappa = E\ \frac{1}{2}\ \frac{r_o}{r^2}\ dr\ \sin\varphi\ d\varphi\ \frac{d\gamma}{2\pi} \qquad and \qquad dV = r^2\ dr\ \sin\varphi\ d\varphi\ d\gamma \tag{633}$$

resulting for the energy density

$$\omega = \frac{dE}{dV} = \frac{E}{4\pi}\ \frac{r_o}{r^4} \qquad J\ m^{-3} \tag{634}$$

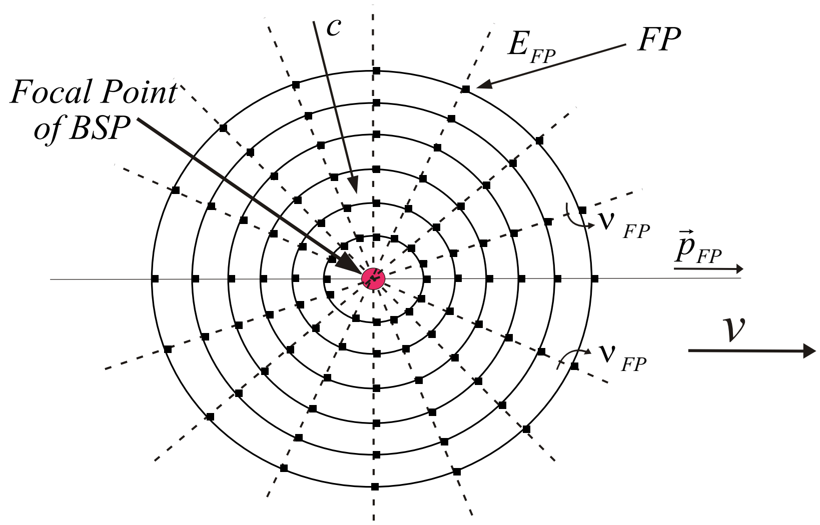
The density of FPs we define as

$$\omega_{FP} = \frac{\omega}{E_{FP}} = \frac{1}{4\pi}\ \frac{E}{E_{FP}}\ \frac{r_o}{r^4} \qquad m^{-3} \tag{635}$$

with $E_{FP} = h\ \nu_{FP} = 3.313 \cdot 10^{-26}\ J$.

The concept is shown in Fig. 63

The energy emitted by a BSP is equal to the sum of the energies of the regenerating FPs with longitudinal (s) and transversal (n) angular momenta. The corresponding



$$dE = dN_{FP} E_{FP} \qquad dN_{FP} = \omega_{FP} dV = \frac{1}{2\pi} \frac{E}{E_{FP}} d\kappa$$

Figure 63: Regenerating Fundamental Particles of a BSP

densities are

$$\omega_{FP}^{(s)} = \frac{1}{4\pi} \frac{E_s}{E_{FP}} \frac{r_o}{r^4} \qquad \omega_{FP}^{(n)} = \frac{1}{4\pi} \frac{E_n}{E_{FP}} \frac{r_o}{r^4} \qquad m^{-3} \tag{636}$$

As $E_e = E_s + E_n$ we get

$$\omega_{FP}^{(e)} = \omega_{FP}^{(s)} + \omega_{FP}^{(n)} \qquad m^{-3} \tag{637}$$

The number dN_{FP} of FPs in a volume dV is given with

$$dN_{FP} = \omega_{FP}\, dV \qquad and\ \ with \qquad dV = r^2\, dr\, \sin\varphi\, d\varphi\, d\gamma \tag{638}$$

we get

$$dN_{FP} = \frac{1}{2\pi} \frac{E}{E_{FP}}\, d\kappa \tag{639}$$

With the definition of $\mu_{FP} = E_{FP}/c^2$, where μ_{FP} is the dynamic mass of a FP, we get for the density of the mass

$$\omega_\mu = \frac{\mu_{FP}\, dN_{FP}}{dV} = \mu_{FP}\, \omega_{FP} \qquad kg\, m^{-3} \tag{640}$$

The rest mass m of a BSP expressed as a function of the dynamic mass μ_{FP} of its FPs is

$$m = N_{FP_o}\, \mu_{FP} = \frac{\nu_o}{\nu_{FP}}\, \mu_{FP} \tag{641}$$

Note: In the present theory all BSPs are expressed through FPs with the Energy E_{FP}, the angular frequency ν_{FP} and the dynamic mass μ_{FP}.

9.3 Quantification of movement.

An isolated moving BSP has a potential energy

$$E = E_s \ + \ E_n \tag{642}$$

which is a function of the relative speed v to the selected reference coordinate. The potential energy will manifest when the isolated moving BSP interacts with a BSP which is static in the selected coordinate system.

The time variation Δt derived for the variation dp of the momentum for the Coulomb, Ampere and Induction forces between two BSPs, we use also as time variation to describe the movement of a BSP that moves with constant speed $v = \Delta x / \Delta t$ where $dp = 0$.

The energy E_n is responsible for the movement of the BSP and the number of FPs that generate the movement during the time Δt is

$$N_{FP}^{(n)} = \frac{E_n}{E_{FP}} \tag{643}$$

The total momentum of a BSP moving with constant speed v is therefore

$$p = m\ v = N_{FP}^{(n)}\, p_{FP} = m\ \frac{\Delta x}{\Delta t} \tag{644}$$

with p_{FP} defined in eq. (631). For Δx we get

$$\Delta x = N_{FP}^{(n)}\, p_{FP}\ \frac{\Delta t}{m} \tag{645}$$

For $v = 0$ we get

$$v = 0 \qquad E_n = 0 \qquad N_{FP}^{(n)} = 0 \qquad \Delta x = 0 \tag{646}$$

For $v \to c$ we get with $\Delta t = K\ r_o^2$ with r_o the radius of the moving BSP

$$v \to c \qquad E_p \to \infty \qquad E_n \to \infty \qquad N_{FP}^{(n)} \to \infty \qquad \Delta t \to 0 \tag{647}$$

$$\lim_{v \to c} \Delta x = \lim_{v \to c} \frac{2\ K\ \hbar^2\ c}{m\ E_p} = 0 \qquad for \qquad v \to c \tag{648}$$

$$\lim_{v \to c} \frac{\Delta x}{\Delta t} = v \tag{649}$$

Note: For the isolated BSP moving with constant speed v we have no static probe BSP with radius r_{o_p} that measures the force between them, force that is zero because $dp = 0$. There is no difference between the two BSPs and the equation $\Delta t = K\ r_o\ r_{o_p}$ becomes $\Delta t = K\ r_o^2$ with r_o the radius of the moving BSP.

10 Analysis of linear momentum between two static BSPs.

In this section the static eq.(572) is analyzed in order to explain

- why BSPs of equal sign don't repel in atomic nuclei
- how gravitation forces are generated
- why atomic nuclei radiate

Although the analysis is based only on the static eq.(572) for two BSPs, neglecting the influence of the important dynamic eq.(574) that explains for instance the magnetic moment of nuclei, it shows already the origin of the above phenomena.

With the integration limits shown in Fig. 64

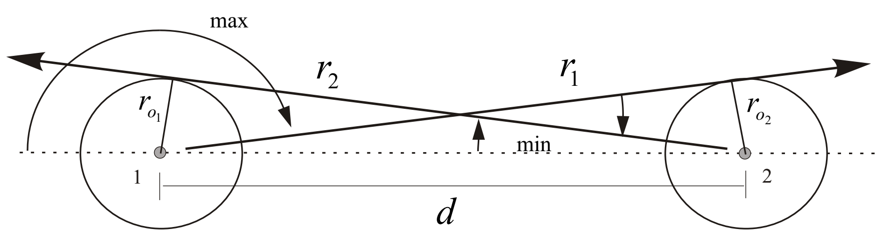


Figure 64: Integration limits for the calculation of the linear momentum between two static basic subatomic particles at the distance d

and considering that for static BSPs it is $r_{o_1} = r_{o_2} = r_o$ and $m_1 = m_2 = m$, the integration limits are

$$\varphi_{min} = \arcsin \frac{r_o}{d} \qquad \varphi_{max} = \pi - \varphi_{min} \quad for \quad d \geq \sqrt{r_o^2 + r_o^2} \tag{650}$$

$$\varphi_{min} = \arccos \frac{d}{2\ r_o} \qquad \varphi_{max} = \pi - \varphi_{min} \quad for \quad d < \sqrt{r_o^2 + r_o^2} \tag{651}$$

and eq.(572) transforms to

$$p_{stat} = \frac{m\,c\,r_o^2}{4\,d^{\,2}} \int_{\varphi_{1_{min}}}^{\varphi_{1_{max}}} \int_{\varphi_{2_{min}}}^{\varphi_{2_{max}}} |\sin^3(\varphi_1 - \varphi_2)|\; d\varphi_2\; d\varphi_1 \tag{652}$$

The double integral becomes zero for $d \to 0$ because the integration limits approximate each other taking the values $\varphi_{min} = \frac{\pi}{2}$ and $\varphi_{max} = \frac{\pi}{2}$. For $d \gg r_o$ the double integral becomes a constant because the integration limits tend to $\varphi_{min} = 0$ and $\varphi_{max} = \pi$.

Fig.65 shows the curve of eq.(194) where five regions can be identified with the help of $d/r_o = \gamma$ from the integration limits:

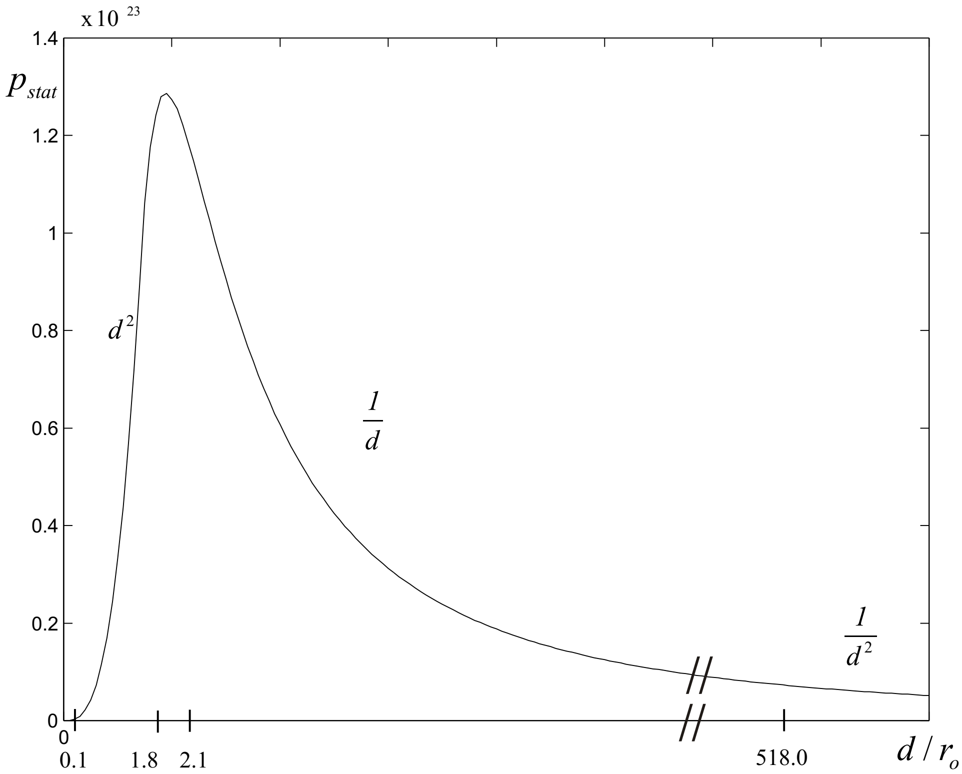


Figure 65: Linear momentum p_{stat} as function of $\gamma = d/r_o$ between two static BSPs with equal radii $r_{o_1} = r_{o_2}$

1. From $0 \ll \gamma \ll 0.1$ where $p_{stat} = 0$
2. From $0.1 \ll \gamma \ll 1.8$ where $p_{stat} \propto d^{\,2}$
3. From $1.8 \ll \gamma \ll 2.1$ where $p_{stat} \approx constant$
4. From $2.1 \ll \gamma \ll 518$ where $p_{stat} \propto \frac{1}{d}$
5. From $518 \ll \gamma \ll \infty$ where $p_{stat} \propto \frac{1}{d^{\,2}}$ (Coulomb)

See also Fig. 66

The **first and second regions** are where the BSPs that form the atomic nucleus are confined and in a dynamic equilibrium. BSPs of different charges don't mix in the nucleus because of the different signs their longitudinal angular momentum of the emitted FPs have.

For BSPs that are in the first region, the attracting or repelling forces are zero because the angle between their longitudinal rotational momentum is $\beta = \pi$. BSPs that migrate outside the first region are reintegrated or expelled with high speed when their FPs cross with FPs of the remaining BSPs of the atomic nucleus because the angle $\beta < \pi$. At stable nuclei all BSPs that migrate outside the first region are reintegrated, while at unstable nuclei some are expelled in all possible combinations (electrons, positrons, hadrons) together with neutrinos and photons maintaining the energy balance.

As the force induced on other particles during reintegration described by eq. (576) has always the direction and sense of the reintegrating particle (right screw of $\bar{J}_n$) independent of its charge, BSPs that are reintegrated induce on other atomic nuclei the gravitation force. The inverse square distance law for the gravitation force results from the inverse square distance law of the radial density of FPs that transfer their angular momentum from the moving to the static BSPs according postulate **8)**. See sec. 17.3 for induced gravitation force.

The **third region** gives the width of the tunnel barrier through which the expelled particles of atomic nuclei are emitted. As the reintegration process of BSPs that migrate outside the first region depend on the special dynamic polarization of the remaining BSPs of the atomic nucleus, particles are not always reintegrated but expelled when the special dynamic polarization is not fulfilled. The emission is quantized and follows the exponential radioactive decay law.

The **fourth region** is a transition region to the Coulomb law.

The transition value $\gamma_{trans} = 518$ to the Coulomb law was determined by comparing the tangents of the Coulomb equation and the curve from Fig.65. At $\gamma_{trans} = 518$ the ratio of their tangents begin to deviate from 1.

At the transition distance d_{trans}, where $\gamma_{trans} = 518$, the inverse proportionality to the distance d_{trans} from the neighbor regions must give the same force F_{trans}

$$F_{trans} = \frac{1}{\Delta t} \frac{K^{'}}{d_{trans}} = \frac{1}{\Delta t} \frac{K_F^{'}}{d_{trans}^2} \tag{653}$$

with $K^{'}$ and $K_F^{'}$ the proportionality factors of the fourth and fifth regions.

The transition distance for BSPs (electron and positron) is:

$$d_{trans} = \gamma_{trans}\, r_o = \gamma_{trans}\, \frac{\hbar\, c}{E_o} = 518 \;\cdot\; 3.859 \cdot 10^{-13} = 2.0 \cdot 10^{-10}\, m \qquad (654)$$

which is of the order of the radii of neutral isolated atoms.

The **fifth region** is where the Coulomb law is valid.
The concept is shown in Fig. 66

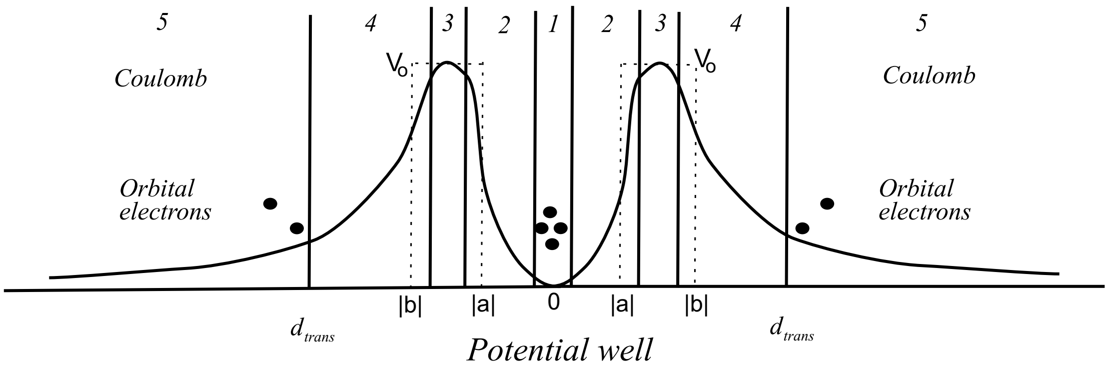


Figure 66: Potential well of an atom.

Fig. 67 shows potential energies corresponding to different theoretical models. All potential energies from existing models are not defined for the distance between charged particles tending to zero, what forces to define the potential energy as negative and to place the zero at infinite.

The potential energy of the present approach is defined for the distance between charged particles tending to zero allowing to place the the origin of the potential energy at $d = 0$.

The potential is given by

$$V(d) = \int_0^d F_{stat}\, \delta d = \frac{1}{\Delta t} \int_0^d p_{stat}\, \delta d \qquad for \quad d \rightarrow \infty \quad we \quad get \quad \approx 1.0\, GeV \quad (655)$$

The energy of 1.0 GeV is the energy necessary to separate an electron from a positron from the distance between them $d = 0$ to $d = \infty$.

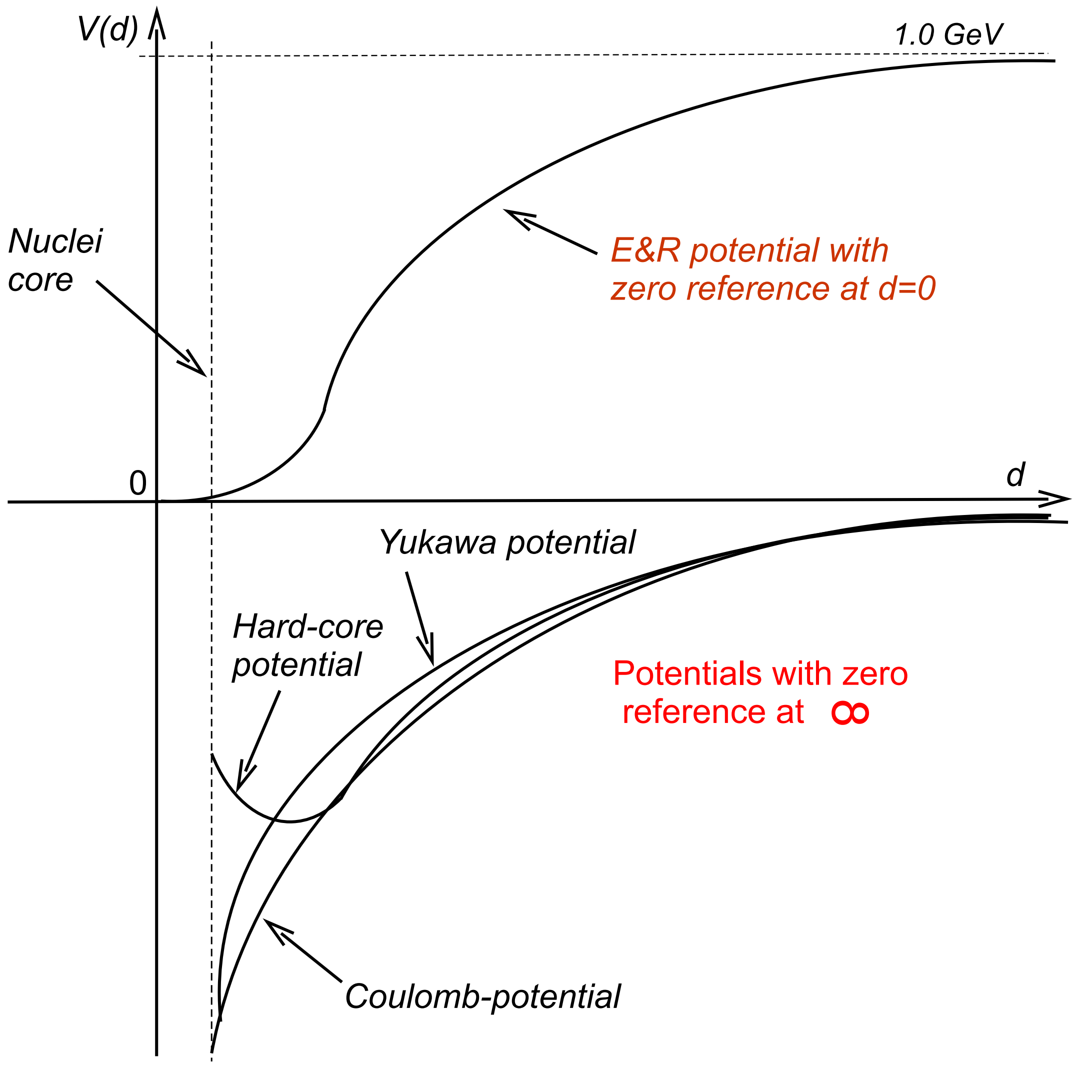


Figure 67: Comparison of potential energies between charged particles

11 Classification of BSPs with $v = c$.

BSPs with $v = c$ have no nucleus where fundamental particles are emitted and absorbed and therefore have no charge characteristics and pass through each other without collision. They are constituted of fundamental particles with the energy stored in pairs of opposed angular momentums $\bar{J}$.

BSPs with $v = c$ are classified in two types according if they were generated on emitted or regenerating FPs.

BSPs with $v = c$ generated on regenerating FPs can be classified according to the linear momentum they may generate on a static probe BSP, in

- BSP with potential linear momentum $p_y = p_c^{\parallel}$ in propagation direction Fig. 68 a).

- BSP with potential linear momentum $p_y = p_c^{\|}$ opposed to propagation direction. Same as Fig. 68 a) but with inverted directions of angular momentum $J_{xy}^{'}$ and linear momentum $p_y = p_c^{\|}$.
- BSP with potential linear momentum $p_z = p_c^{\perp}$ perpendicular to the propagation direction Fig. 68 b).
- Complex SP with potential linear momentum perpendicular and in propagation direction. Fig. 68 c).

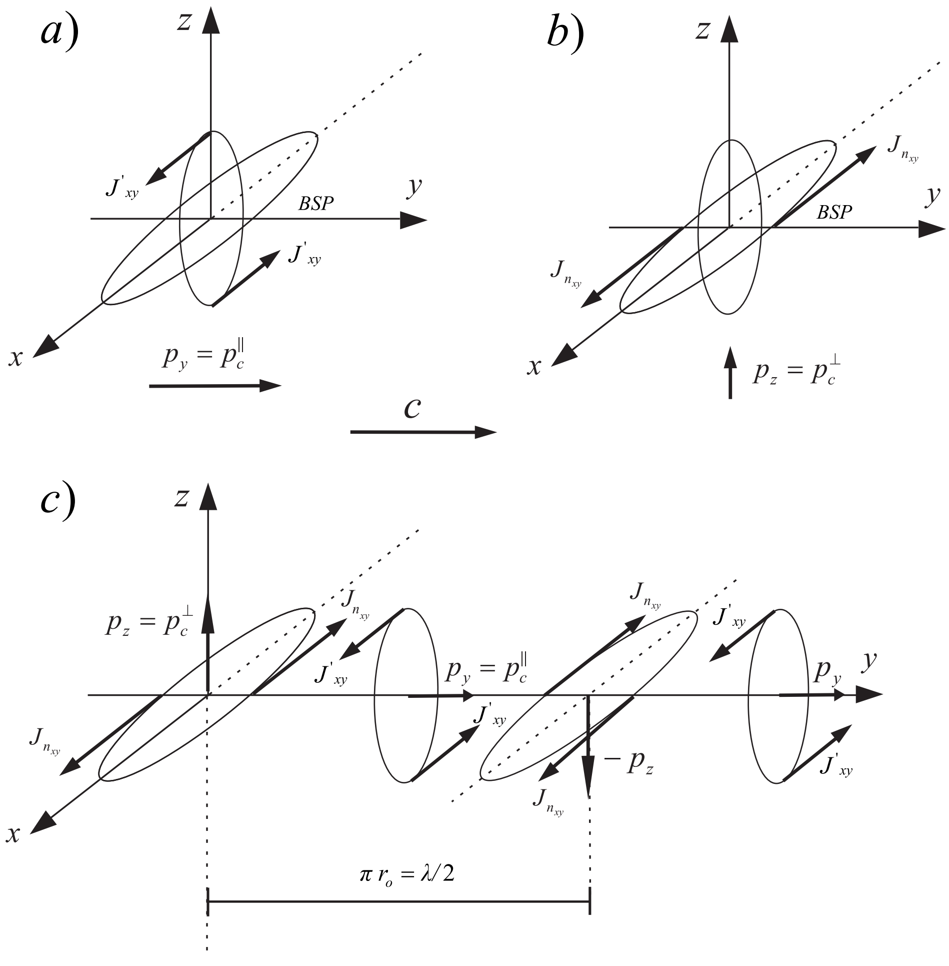


Figure 68: BSPs with light speed generated on regenerating FPs

Fig.69 d) shows BSPs with $v = c$ generated on emitted FPs which are the neutrinos.

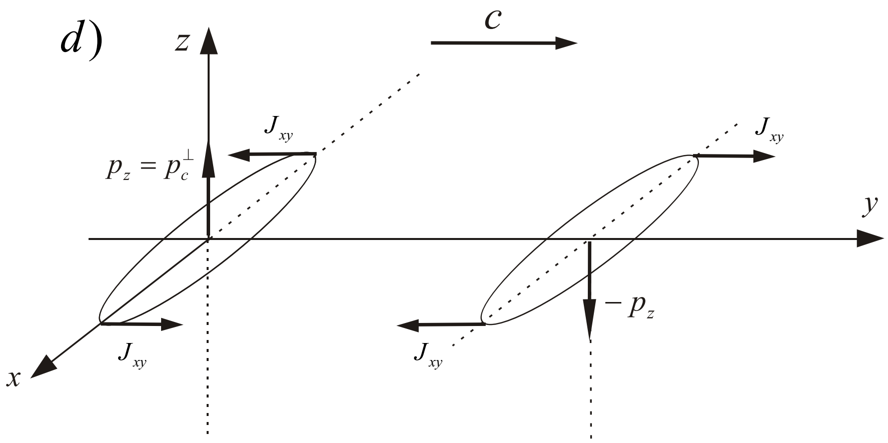


Figure 69: BSPs with light speed generated on emitted FPs (neutrinos)

Note: Photons are complex particles formed by more than one BSP separated by the distance $\lambda/2$ in the direction of movement Fig. 68 c). BSPs with transversal linear momentum p_z of a complex particle form pairs with opposed transversal directions and give the complex SP the character of a wave. The energy associated independently with the longitudinal or transversal linear momentum is $\hbar\omega$. The resulting linear momentum at each BSP is shown in Fig. 70. Considering the possibility of BSPs with potential linear momentum $p_y = p_c^{\parallel}$ opposed to the propagation direction, the wave character may also be generated in longitudinal direction.

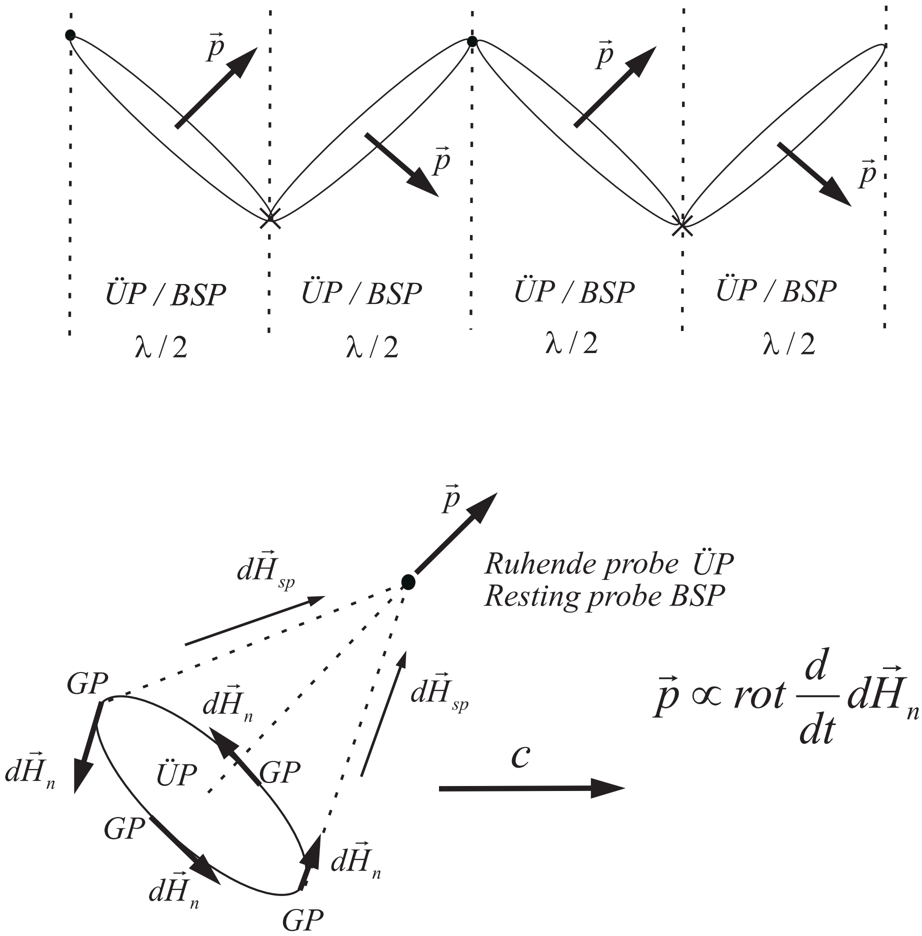


Figure 70: Linear momentum p on a probe BSP generated by a basic subatomic particle with $v = c$ (GP=FP)

12 Induction between a moving and a probe BSP.

In the present approach the energy of a BSP is distributed in space around the radius of the BSP. The carriers of the energy are the angular momentums of FPs that are continuously emitted, and regenerate the BSP. At a free moving BSP each angular momentum of a FP is balanced by an other angular momentum of a FP of the same BSP. Opposed transversal angular momentums ($d\bar{H}_n$ and $-d\bar{H}_n$ in Fig. 71) from two FPs that regenerate the BSP produce the linear momentum $\bar{p}$ of the BSP. If a second static probe BSP_p appropriates with its regenerating angular momentums ($d\bar{H}_{s_p}$) angular momentums ($d\bar{H}_n$) from FPs of the first BSP according postulate 3, angular momentums that built a rotor different from zero in the direction of the second BSP_p generating $d\bar{p}_{i_p}$, the first BSP loses energy and its linear momentum changes to $\bar{p} - d\bar{p}_i$. The angular momentums appropriated at point P by the probe BSP_p generating the linear momentum $d\bar{p}_{i_p}$ are missing now at the first BSP to compensate the angular momentums at the symmetric point $P^{'}$. The linear momentums at the two symmetric points are therefore equal and opposed $d^{'}\bar{p}_i = -d\bar{p}_{i_p}$ because of the symmetry of the energy distribution function $d\kappa(\pi - \theta) = d\kappa(\theta)$.

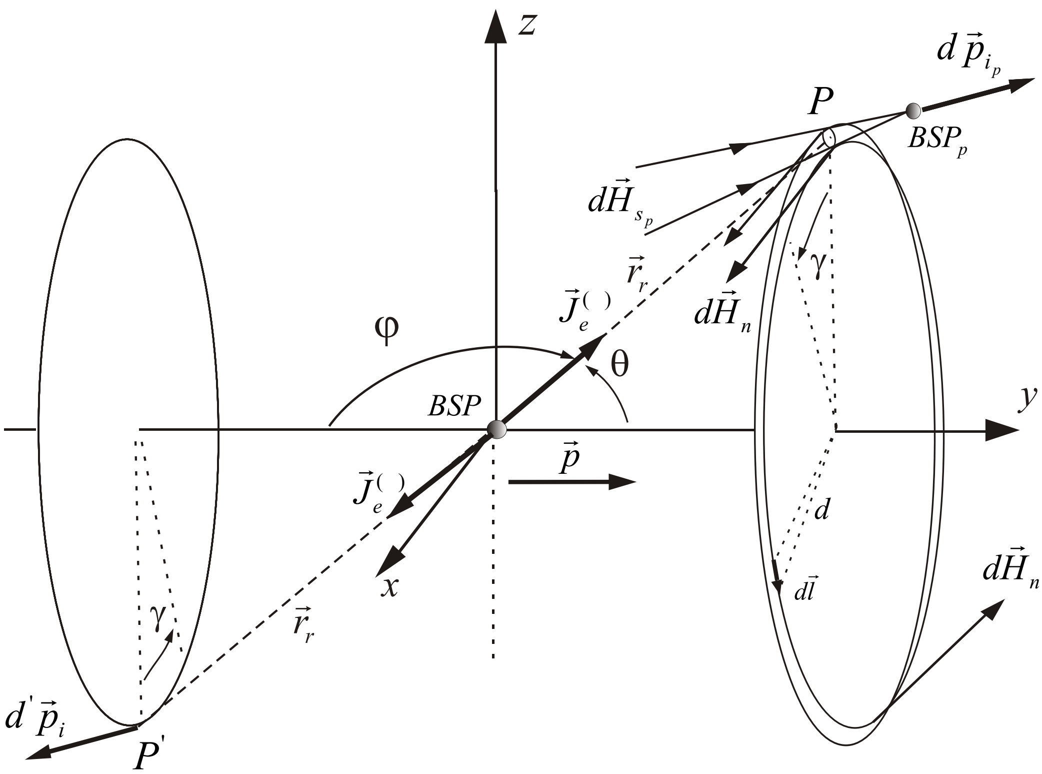


Figure 71: Linear momentum balance between static and moving BSPs

As the closed linear integral $\oint d\bar{H}_n\, d\bar{l}$ generates the linear momentum $\bar{p}$ of a BSP, the orientation of the field $d\bar{H}_n$ (right screw in the direction of the velocity) is independent of the sign of the BSP, sign that is defined by $\bar{J}_e^{(\pm)}$.

13 Conventions introduced for BSPs.

Fig. 72 shows the convention used for the two types of electrons and positrons introduced.

The accelerating positron emits FPs with high speed $v_e = v_h \approx \infty$ and positive longitudinal angular momentum $\bar{J}_s^+$ $(\infty+)$ and is regenerated by FPs with low speed $v_r = v_l = c$ and negative longitudinal angular momentum $\bar{J}_s^-$ $(c-)$.

The decelerating electron emits FPs with low speed $v_e = v_l = c$ and negative longitudinal angular momentum $\bar{J}_s^-$ $(c-)$ and is regenerated by FPs with high speed $v_r = v_h \approx \infty$ and positive longitudinal angular momentum $\bar{J}_s^+$ $(\infty+)$.

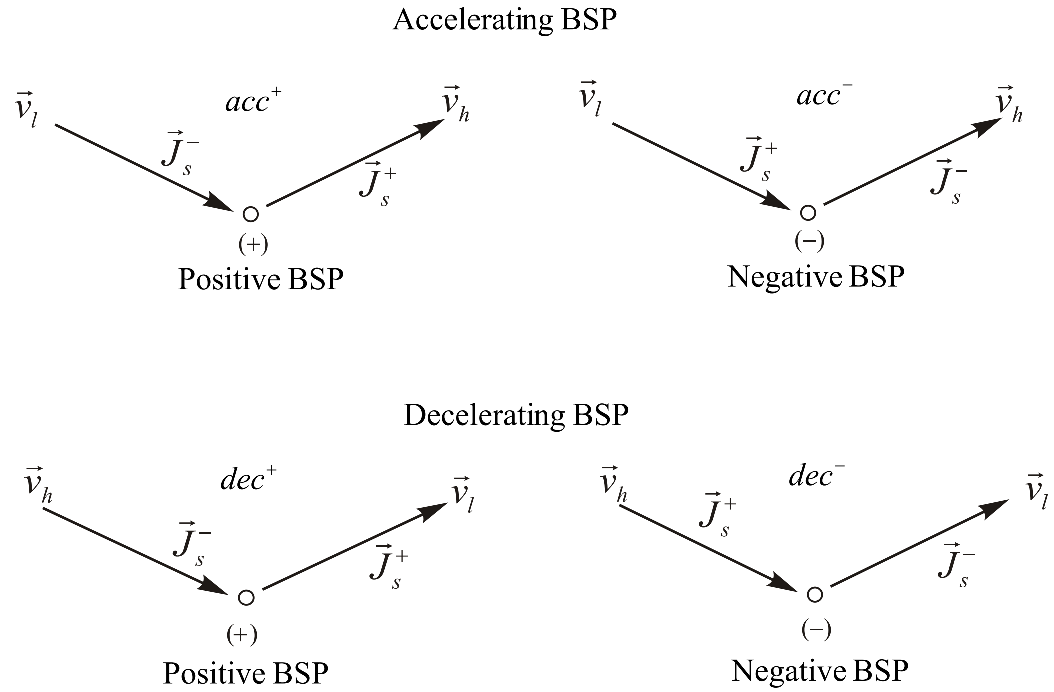


Figure 72: Conventions for BSPs

FPs emitted by BSPs are the regenerating FPs for other BSPs as follows:

- emitted FPs of the acc^+ regenerate the dec^-
- emitted FPs of the acc^- regenerate the dec^+
- emitted FPs of the dec^+ regenerate the acc^-
- emitted FPs of the dec^- regenerate the acc^+

FPs of the same speed, direction and opposed angular momentum compensate each other so that the following compensation of BSPs results:

- acc^+ compensates acc^-
- dec^+ compensates dec^-

Protons and neutrons can be seen as composed of electrons and positrons except for the binding energy.

We have the following possible types of protons, anti-protons and neutrons:

- $dec^+/acc^- - proton$ with $n^+ = 919$ and $n^- = 918$
- $acc^+/dec^- - proton$ with $n^+ = 919$ and $n^- = 918$
- $dec^-/acc^+ - anti - proton$ with $n^- = 919$ and $n^+ = 918$
- $acc^-/dec^+ - anti - proton$ with $n^- = 919$ and $n^+ = 918$
- $dec^+/acc^- - neutron$ with $n^+ = 919$ and $n^- = 919$
- $acc^+/dec^- - neutron$ with $n^+ = 919$ and $n^- = 919$

The two possible types of protons are shown in Fig. 73
The two possible types of anti-protons are shown in Fig. 74
The two possible types of neutrons are shown in Fig. 75

If we overlap the two types of protons the internal FPs compensate because of the acc^+ / acc^- and the dec^+ / dec^- compensations, remaining only the external FPs which have same speed, opposed angular momentum but different directions. The same we have for the two types of anti-protons. This is important to explain nuclear magnetic resonsnce.

Protons

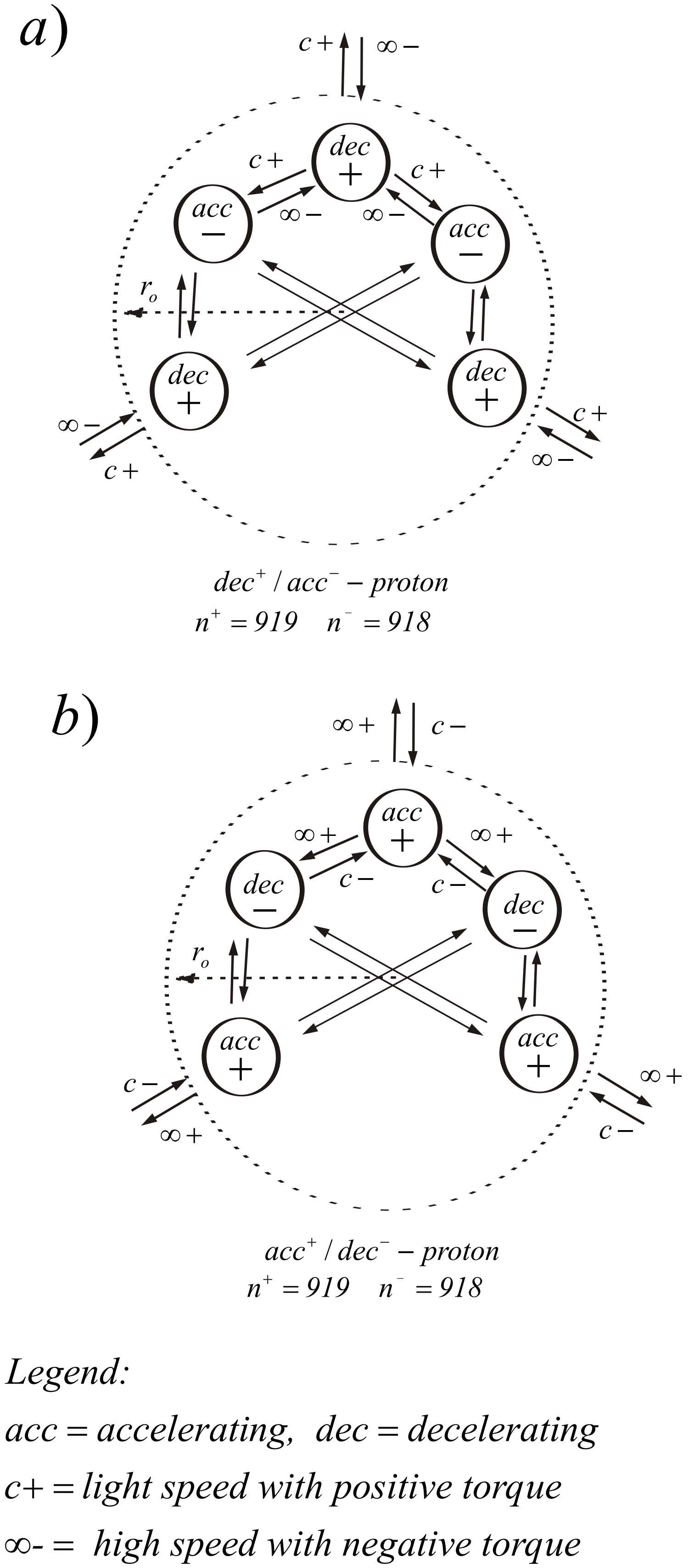
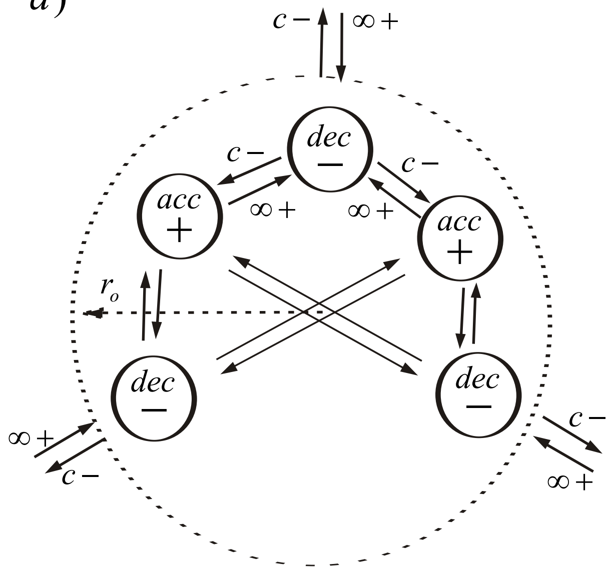


Figure 73: Protons

Antiproton

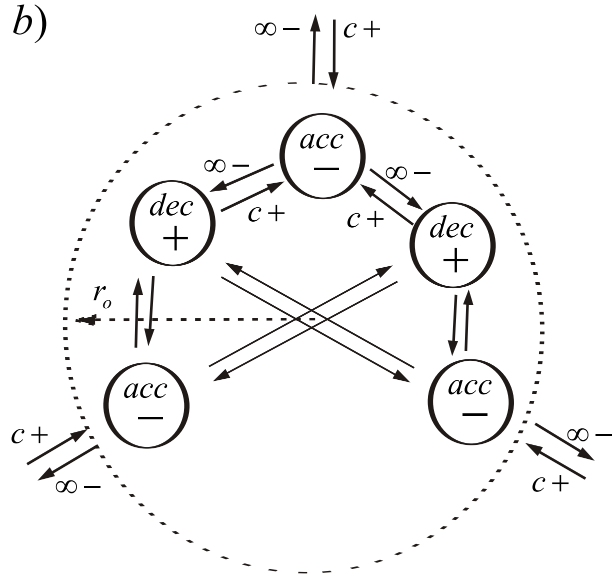
a)



$dec^- \,/\, acc^+ - antiproton$

$n^- = 919 \quad n^+ = 918$

b)



$acc^- \,/\, dec^+ - antiproton$

$n^- = 919 \quad n^+ = 918$

Legend:

acc = accelerating, dec = decelerating

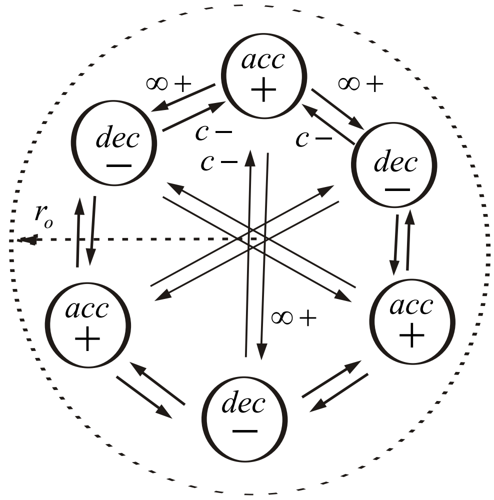
c+ = light speed with positive torque

∞- = high speed with negative torque

Figure 74: Anti-Protons

Neutrons

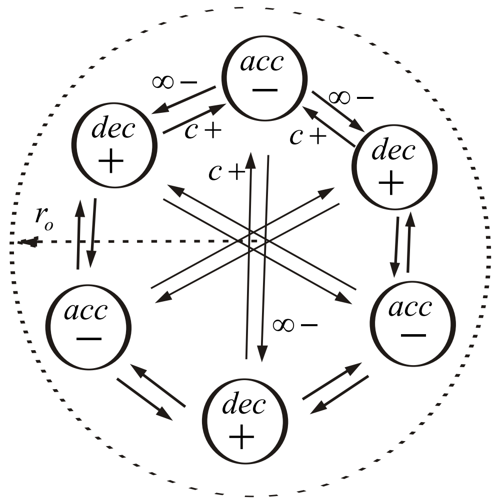
a)



$acc^{+} / dec^{-} - neutron$

$n^{+} = n^{-} = 919$

b)



$dec^{+} / acc^{-} - neutron$

$n^{+} = n^{-} = 919$

Legend:

acc = accelerating, dec = decelerating

c+ = light speed with positive torque

∞- = high speed with negative torque

Figure 75: Neutrons

Atoms are composed of protons, neutrons and electrons. The energy levels of atoms are filled by electrons with alternated spins, what corresponds in the present approach to the two types of electrons, namely acc^- and dec^-.

Fig. 76 shows the Hydrogen and the Helium atoms. Each type of level electron interacts only with that type of proton in the nucleus that can deliver the right FPs for its regeneration, what requires that nuclei of atoms are filled with alternate types of protons in the Mendelejew periodic table , namely acc^+dec^- and dec^+/acc^-.

Fig. 77 shows neutrinos and photons.

Neutrinos are pairs of FPs with opposed angular momenta which carry a potential linear momentum. The linear momentum can be oriented in all directions relative to the direction of movement of the neutrino. On Fig. 77 longitudinal and transversal oriented neutrinos are shown.

A photon is a sequence of transversal or longitudinal oriented neutrinos at a distance equal to the semi wavelength $\lambda/2$. On Fig. 77 longitudinal and transversal oriented photons are shown.

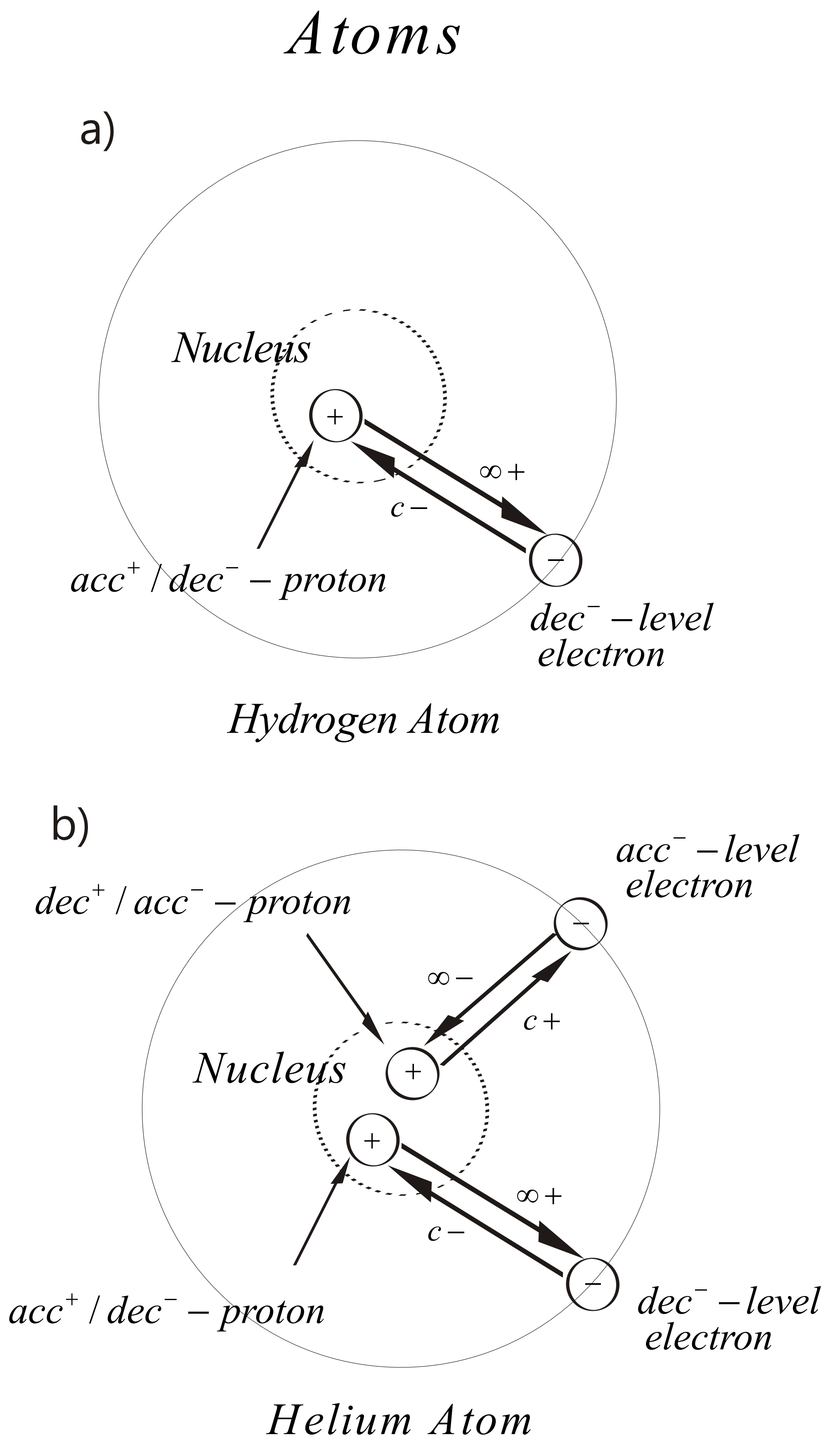


Figure 76: Hydrogen and Helium atoms

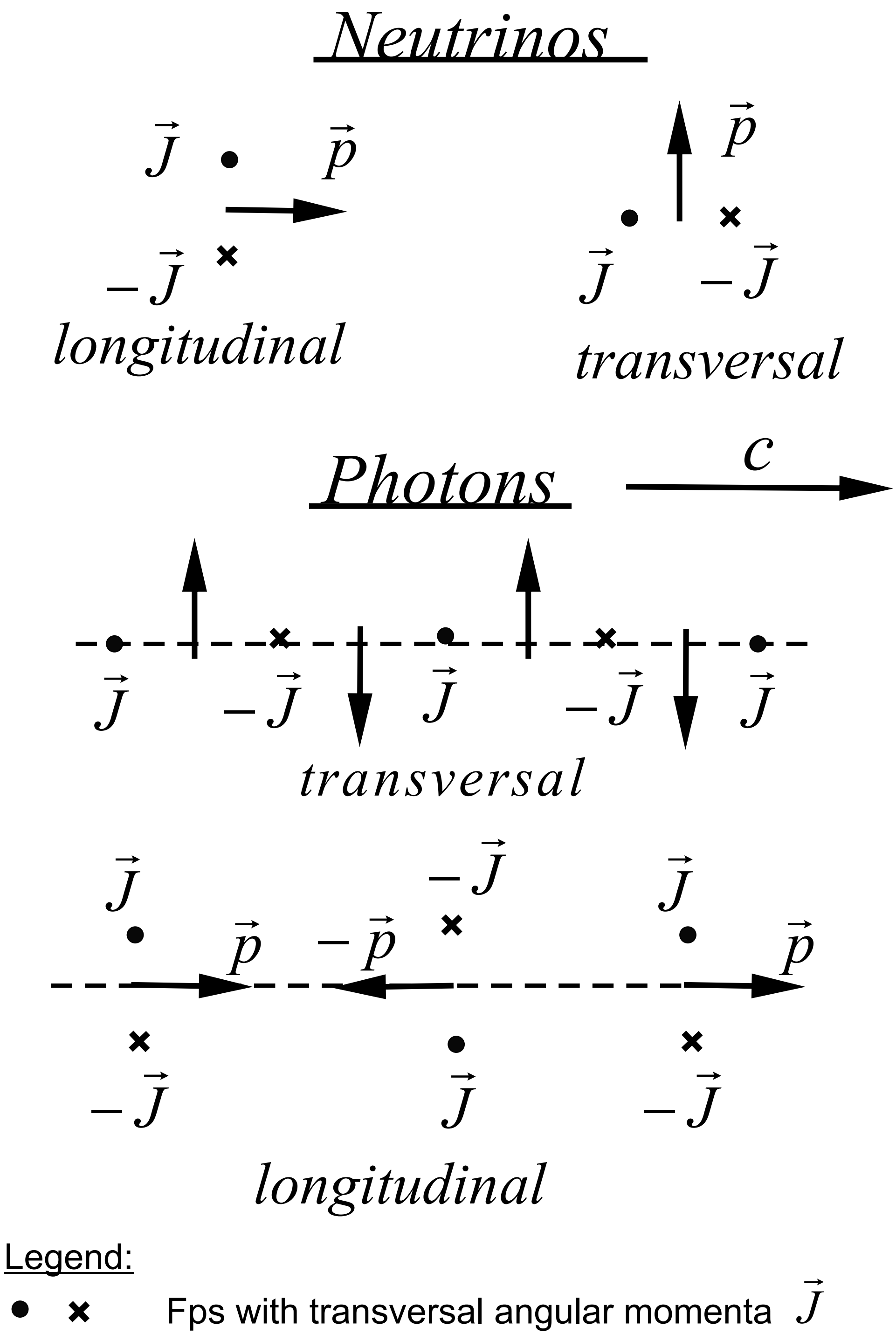


Figure 77: Neutrinos and Photons

Fig. 78 shows the difference between Fermions and Bosons at the "E&R" UFT and the Standard Model.

	SM	E&R	Examples
Fermions	Rest mass	Focal Point	Basic: electron, positron Composed: Proton, Neutron
Bosons	No Rest mass	No Focal Point	Basic: Neutrino Composed: Photon

Figure 78: Difference between Fermions and Bosons

Fig. 79 shows the difference between the two states of a Fermion at the "E&R" UFT and the Standard Model.

	SM	E&R
Two states	Spin $\pm\frac{1}{2}$	acc/dec electrons or positrons

acc=accelerated Fundamental Particles
dec=decelerated Fundamental Particles

Figure 79: Difference between Fermions and Bosons

14 Flux density of FPs and scattering of particles.

14.1 Flux density of FPs.

At each BSP the flux density of emitted FPs is equal to the flux density of regenerating FPs although the different speeds of the FPs.

In a complex SP formed by more than one BSP (Fig. 73), a mutual internal regeneration between the BSPs of the complex SP exists. Part of the emitted positive rays of FPs with $\bar{J}_e^{(+)}$ of the positive BSPs of the complex SP regenerate the negative BSPs of the complex SP, and part of the emitted negative rays of FPs with $\bar{J}_e^{(-)}$ of the negative BSPs regenerate the positive BSPs. The other part of the emitted and regenerating rays of FPs respectivelly radiate into space and regenerate from space.

At a complex SP with equal number of positive and negative BSPs Fig. 75 the flux density of FPs radiated into space with positive angular momenta is equal to the flux density of FPs radiated into space with negative angular momenta. The same is valid for the flux density of regenerating FPs.

At a complex SP with different number of positive and negative BSPs Fig. 73 the flux density of FPs radiated into space with positive angular momenta is not equal to the flux density of FPs radiated into space with negative angular momenta. If the complex SP has more positive BSPs in the nucleous, the flux density of FPs radiated into space with positive angular momenta is bigger than the flux density of FPs radiated into space with negative angular momenta and vice versa.

14.2 Scattering of particles.

Elastic scattering.

Elastic scattering we have when the scattering partners conserve their identity. No photons, neutrinos, electrons, positrons, protons, neutrons are emitted.

There are two types of elastic scatterings according the smallest scattering distance d_s that is reached between the scattering partners.

"**Electromagnetic**" scatering we have when the smallest scattering distance d_s is in the fifth region of the linear momentum curve p_{stat} of Fig.65 where the Coulomb force is valid. Electromagnetic scattering is characterized by the inverse square distance force between particles.

"**Mechanical**" scatering we have when the smallest scattering distance d_s is in the fourth region of Fig.65. Mechanical scattering is characterized by the combination of inverse square distance and inverse distance forces between particles.

Plastic or destructive scattering.

Plastic scattering we have when the identity of the scattering partners is modified and photons, neutrinos, electrons, positrons, protons or neutrons are emitted.

In plastic or destructive scattering the smallest scattering distance d_s enters the third and second region of the linear momentum curve p_{stat} of Fig.65.

The internal distribution of the BSPs is modified and the acceleration disturbs the internal mutual regeneration between the BSPs. The angular momenta of each BSP of the scattering partners interact heavily, and new basic configurations of angular momenta are generated, configurations that are balanced or unbalanced (stable or unstable).

In today's point-like representation the energy of a BSP is concentrated at a point and scattering with a second BSP requires the emission of a particle (gauge boson) to overcome the distance to the second BSP which then absorbs the particle. The energy violation that results in the rest frame is restricted in time through the uncertainty principle and the maximum distance is calculated assigning a mass to the interchanged particle (Feynman diagrams).

Conclusion: In the present approach the emission of FPs by BSPs is continuous and not restricted to the instant particles are scattered. In the rest frame of the scattering partners no energy violation occurs. When particles are destructively scattered, during a transition time the angular momenta of all their FPs interact heavily according to the three interaction postulates defined in chapter 2.2 and new basic arrangements of angular momenta are produced, resulting in balanced and unbalanced configurations of angular momenta that are stable or unstable, configurations of quarks, hadrons, leptons and photons. The interacting particles (force carriers) for all types of interactions (electromagnetic, strong, weak, gravitation) are the FPs with their longitudinal and transversal angular momenta.

The concept is shown in Fig. 80

Note: The proposed theory considers **elementary particles** those which are stable as free particles or as part of composed particles like the electron, positron, neutron, proton, neutrino, photon, nuclei of atoms. All particles with a short life time (transitory particles) are not elementary particles and are produced at collisions. With increasing collision energies more and more transitory particles of higher energies can be produced without adding new substantial information to the theory.

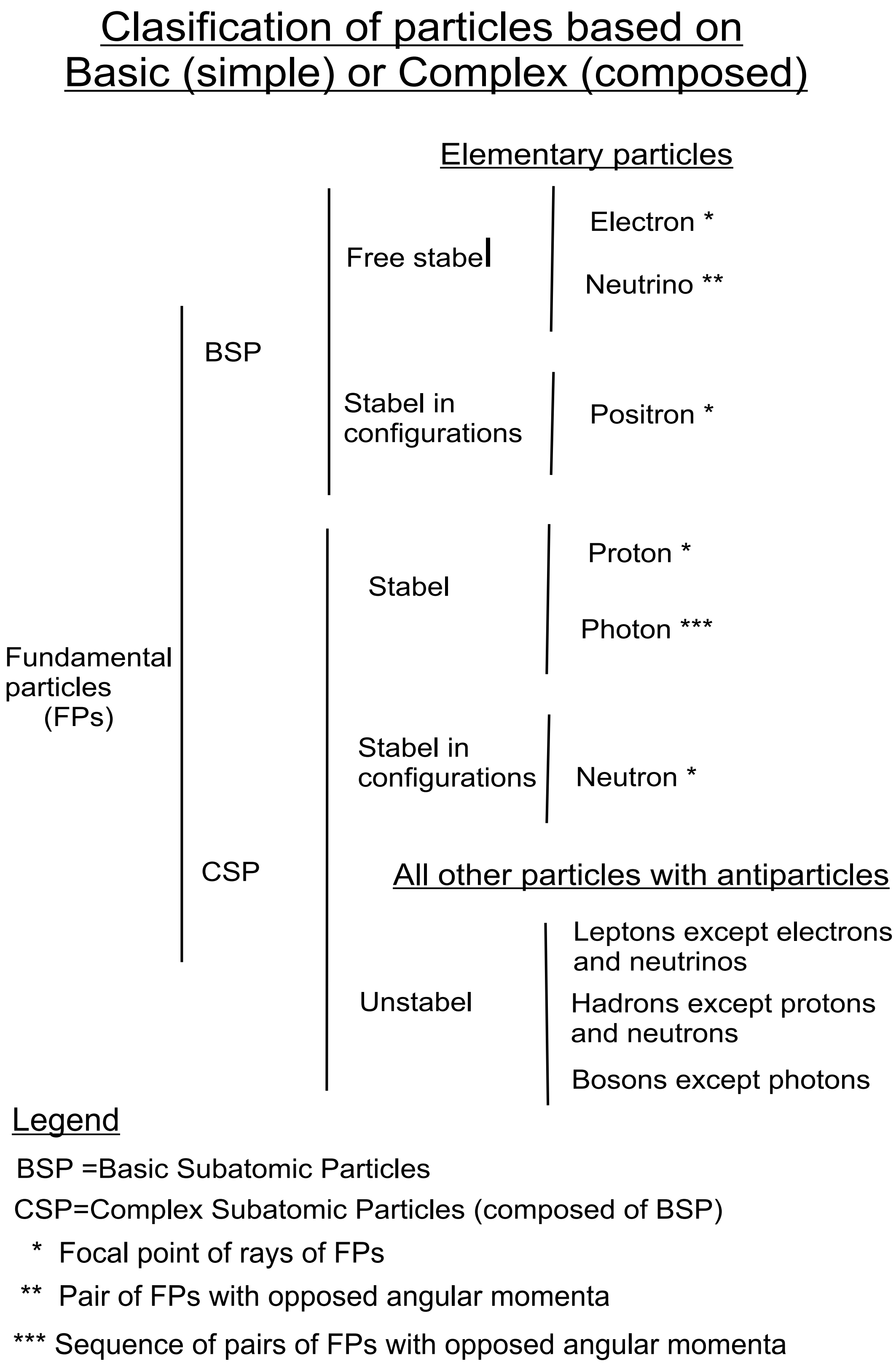


Figure 80: Clasification of particles based on stability

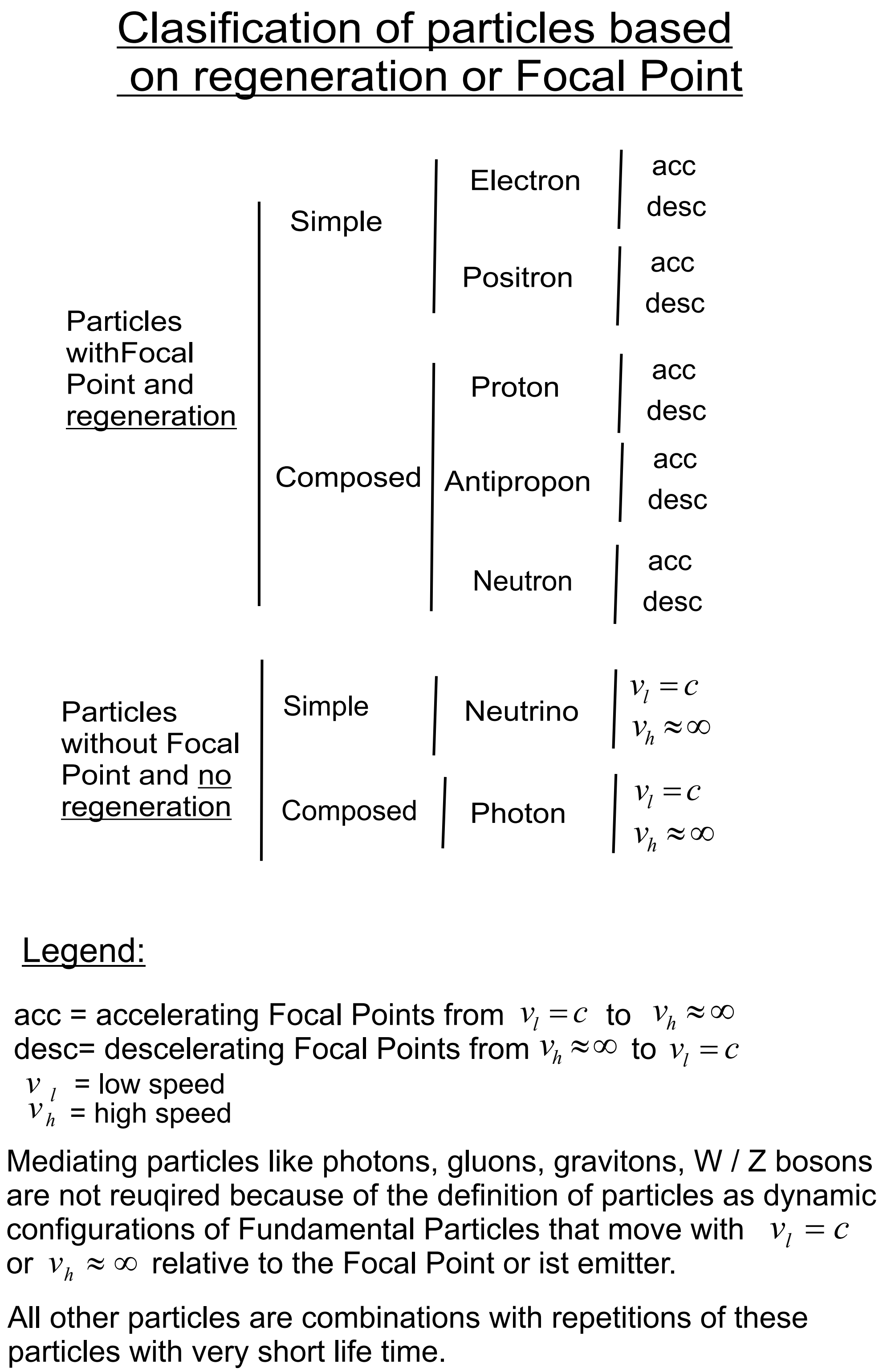


Figure 81: Clasification of particles based on regeneration

14.2.1 Feynman diagram.

The proposed approach postulates that subatomic particles (electrons and positrons) are focal points of rays of FPs that move from infinite to infinite with light and infinite speed relative to the focal point. The forces between the subatomic particles are generated by the interactions of the angular momenta of their FPs or dH fields, and not by the exchanges of particles as the standard model teaches.

An analysis of the decay of radioactive nuclei shows that there is no violation of conservation of energy. Feynmans flaw consists in assuming that electrons and positrons are not stable particles and can decay.

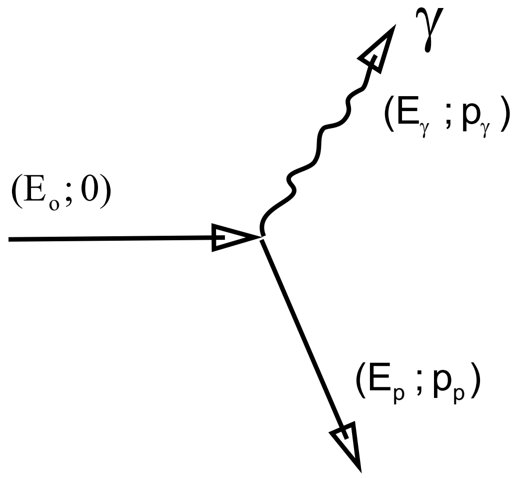


Figure 82: Feynman diagram

The concept is shown in Fig. 82.

Note: For the following analysis the expression $(E_p\ ;\ p_p)$ in Fig. 82, is replaced by $(E_k\ ;\ p_p)$.

In the rest frame of the incident particle we have that

$$(E_o\ ;\ 0) \rightarrow (E_k\ ;\ p_p)\ +\ (E_\gamma\ ;\ p_\gamma) \tag{656}$$

$$E_k = \sqrt{E_o'^{\,2} + E_p^2} \qquad\qquad E_p = p_p\ c \qquad E_\gamma = p_\gamma\ c \tag{657}$$

with

$$\bar{p}_p = -\bar{p}_\gamma \qquad E_p = E_\gamma \tag{658}$$

$$\Delta E = E_k + E_\gamma - E_o = \sqrt{E_o'^{\,2} + E_p^2} + E_\gamma - E_o \tag{659}$$

For $\Delta E = 0$ we get

$$E_o^{'} = \sqrt{E_o^2 - 2\ E_o\ E_p} = \sqrt{E_o^2 - 2\ E_o\ E_\gamma} \tag{660}$$

For stable BSPs like the electron and the positron which don't decay by radiation $E_p = E_\gamma = 0$ and $E_o^{'} = E_o$.

For CSPs like heavy nuclei that decay by radiation $E_p > 0$ and $E_o^{'} < E_o$.

The same analysis is valid for nuclei that radiate α, β and γ particles. The radiated energy goes always in detriment of the rest mass E_o of the nuclei. No violation of conservation of energy occurs.

15 Bending of the trajectory of a BSP.

In this section the equations for the quantified bending momentum for BSP's that move with $v \neq c$ are deduced.

A BSP that moves with the speed v relatively far from matter does not exchanges linear momentum with the positive and negative BSP's that form the matter.

If the distance to the matter is reduced, linear momentums are exchanged with the BSP's of the matter, bending the trajectory of the moving BSP. As the BSP's forming matter are quantified, also the bending trajectories of the moving BSP's are quantified. Responsible for bending are the Coulomb, the Ampere and the induced forces. Basically we have to analyze for BSP with $v \neq c$

- Coulomb bending (sec. 15.2)
- Ampere bending (sec. 15.3)
- Induction bending (sec. 15.4)

The basic forms of bending are:

1. Bending at a free target edge
2. Bending through a target slit
3. Bending through a double target slit

15.1 General considerations.

When a BSP is bent the bending momentum $p_b = F_b\, \Delta t$ is quantized. The concept is shown in Fig. 83.

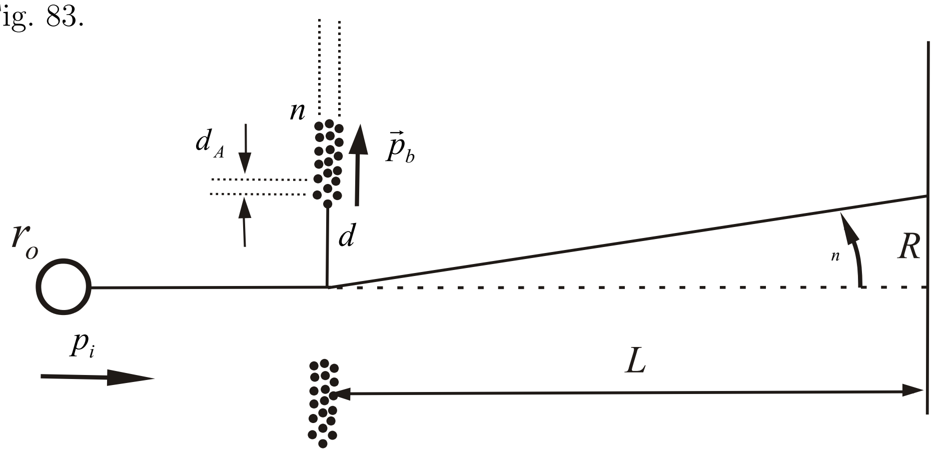


Figure 83: Bending of BSPs

The quantized bending of BSPs are indirectly observed through the bending patterns generated in diffraction experiments. Sharp patterns are only generated if the bending distance r_{d_i} is well defined and equal for all BSPs that are bent. This condition is fulfilled when electrons have the right energy when they pass between two atoms of a crystal. As the radius of a BSP is a function of the energy of the BSP, each target defines with its inter-atomic distance the energy a BSP must have to be properly bent. The concept is shown in Fig. 84.

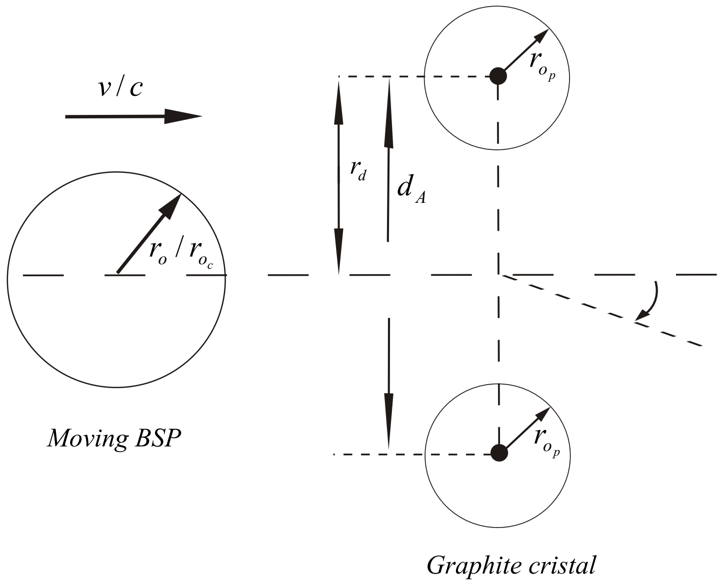


Figure 84: Relation between interatomic distance d_A and radius r_o/r_{o_c} of moving BSP.

The vectorial relation between the bending momentum $\bar{p}_b$, the input momentum $\bar{p}_i$ and the output momentum $\bar{p}_a$ is shown in Fig. 85.

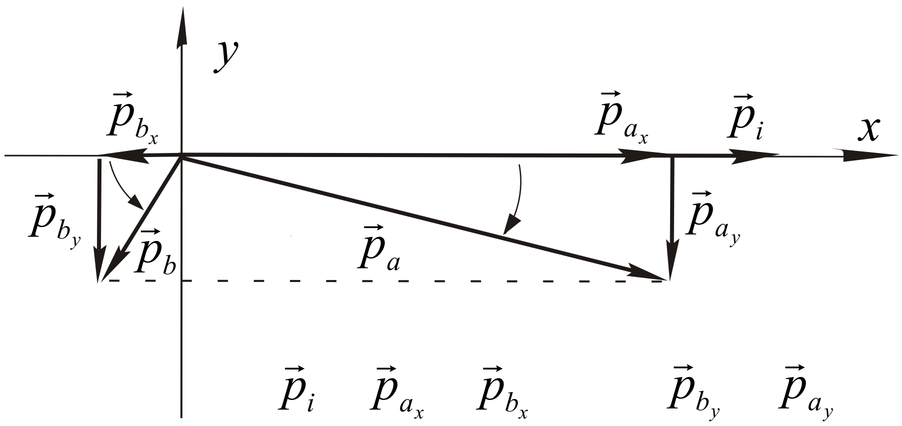


Figure 85: Vector diagram for the bending of particles.

For small bending angles η the bending momentum p_b is nearly orthogonal to the input momentum p_i and we can write that

$$\tan\eta = \frac{p_{a_y}}{p_{a_x}} \approx \frac{p_b}{p_i} \tag{661}$$

15.2 Coulomb bending.

In sec. 4.2 we have derived the equation for the force between two static BSPs which is

$$F_2 = \frac{K_F}{d^{\,2}} \int_{\varphi 1_{min}}^{\varphi 1_{max}} \int_{\varphi 2_{min}}^{\varphi 2_{max}} |\sin^3(\varphi_1 - \varphi_2)| \; d\varphi_2 \; d\varphi_1 \tag{662}$$

with

$$K_F = \frac{a}{4\,K}\,\sqrt{m_1}\sqrt{m_2}\;c = 1.104516 \cdot 10^{-28}\;\left[\frac{kg\;m^3}{s^2}\right] \tag{663}$$

For $d \gg r_o$ we get the Coulomb law with $\int\int_{Coulomb} = 2.088768$ for the double integral.

We adapt now the equation for the bending analyses where the distance r between the moving and static BSPs is variable with the angle φ between the speed v_2 and the distance r. The length from the static BSP perpendicular to the direction of the speed v_2 we designate with r_d. We assume that the speed $v_2 << c$ to allow the use of the static Coulomb law. We get

$$F_2 = K_F\,\frac{1}{r^2}\int\int_{Coulomb} \qquad with \qquad K_F = \frac{a}{4\,K}\;m\;c \qquad [N\;m^2] \tag{664}$$

with $r\sin\varphi = r_d$ we get

$$F_2 = K_F\,\frac{1}{r_d^2}\sin^2\varphi\int\int_{Coulomb} \tag{665}$$

We build now the average of F_2 for the BSP moving from $-\infty\;to\;+\infty$.

$$\bar{F}_2 = K_F\,\frac{1}{r_d^2}\int\int_{Coulomb}\int_{\varphi=0}^{\pi}\sin^2\varphi\;d\varphi = \frac{\pi}{8}\,\frac{K_F}{r_d^2}\int\int_{Coulomb} \tag{666}$$

The force F_2 acts during the time $\Delta''t = \Delta''l/v_2$ where $\Delta''l$ is a constant acting distance for all BSPs independent of the speed v_2.

The total bending moment is

$$p_b = \bar{F}_2\;\Delta''t = \frac{\pi}{8}\,\frac{K_F}{r_d^2}\int\int_{Coulomb}\frac{\Delta''l}{v_2} \qquad\qquad \Delta''l = constant \tag{667}$$

The bending equation is

$$\tan\eta = \frac{p_b}{p_i} = \frac{\pi}{8}\,\frac{K_F}{r_d^2}\int\int_{Coulomb}\frac{\Delta'' l}{v_2\,p_i}\,n \tag{668}$$

15.3 Ampere bending (Bragg law).

15.3.1 Ampere bending deduced from the equation for two infinite parallel currents of BSPs.

From sec. 4.11 we have that the momentum $d\bar{p}$ generated between two moving BSPs due to the interaction of their transversal angular momentum is

$$d\bar{p} = \frac{1}{c}\left|\int_{r_{r_1}}^{\infty} dH_{n_1}\,\bar{n}_1 \times \int_{r_{r_2}}^{\infty} dH_{n_2}\,\bar{n}_2\right| \tag{669}$$

The BSPs that interact now trough their transversal angular momentum are the moving BSP and the parallel reintegrating BSP of a nucleon described in sec. 17.3. The concept is shown in Fig. 86

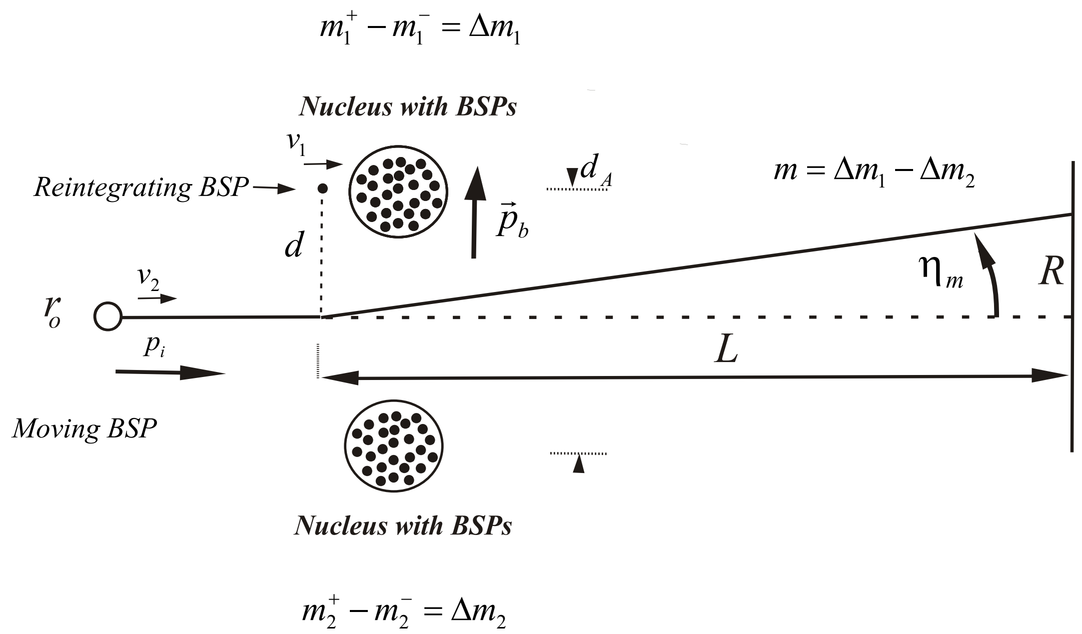


Figure 86: Bending of BSPs

The deduction of the Bragg equation is similar to the deduction of the force density of sec. 4.11 with the following variable transformations:

$$x = v\, t \qquad\qquad \Delta x = v\, \Delta' t \tag{670}$$

and integrating then the time from $t = -\infty$ to $t = +\infty$.
With these transformations we arrive to the same eq. (281) of sec. 4.11 for the total force density

$$\frac{F}{\Delta l} = \frac{b}{c\, \Delta_o t}\, \frac{r_o^2}{64\, m}\, \frac{I_{m_1}\, I_{m_2}}{d} \int_{\gamma_{2min}}^{\gamma_{2max}} \int_{\gamma_{1min}}^{\gamma_{1max}} \frac{\sin^2(\gamma_1 - \gamma_2)}{\sqrt{\sin\gamma_1\, \sin\gamma_2}}\, d\gamma_1\, d\gamma_2 \tag{671}$$

with $\int\int_{Ampere} = 5.8731$.
The concept is shown in Fig. 87

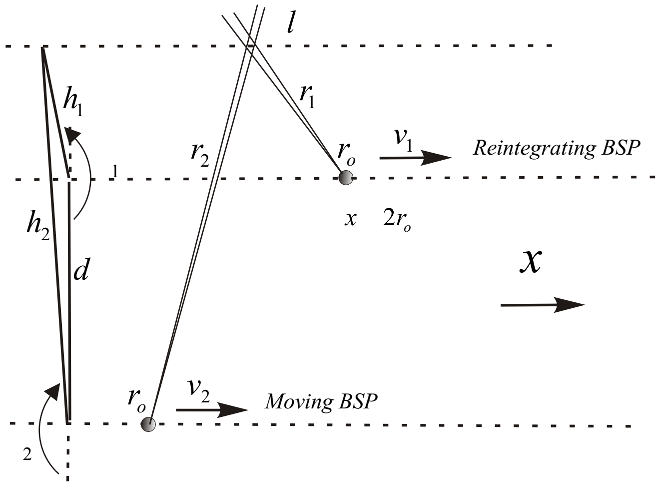


Figure 87: Geometric relations for single moving BSPs.

It is also for $v \ll c$

$$\rho_x = \frac{N_x}{\Delta x} = \frac{1}{2\, r_o} \qquad I_m = \rho\, m\, v \qquad \Delta_o t = K\, r_o^2 \qquad p = F\, \Delta_o t \tag{672}$$

We get for the force

$$F = \frac{b}{4\, \Delta_o t}\, \frac{5.8731}{64\, c}\, \frac{\sqrt{m}\, v_1\, \sqrt{m}\, v_2}{d}\, \Delta l \tag{673}$$

We have defined a density ρ_x of BSPs for the current so that one BSP follows immediately the next without space between them. As we want the force between one pair of BSPs of the two parallel currents we take $\Delta l = 2\, r_o$.

The interaction between the two parallel BSPs takes place along a distance $\Delta'' l = v_2\, \Delta'' t$ giving a total bending momentum $p_b = F\, \Delta'' t$. With all that we get

$$p_b = \frac{b}{2\, K\, r_o}\, \frac{5.8731}{64\, c}\, \frac{m\, v_1}{d}\, \Delta'' l \tag{674}$$

which is independent of the speed v_2. In sec. 17.1 the speed of a reintegrating BSP is deduced giving $v_1 = k\ c$ with $k = 7.4315 \cdot 10^{-2}$. We get

$$p_b = \frac{b}{2\ K\ r_o}\ \frac{5.8731}{64\ c}\ \frac{m\ k\ c}{d}\ \Delta'' l \tag{675}$$

If we now write the bending equation with the help of $\tan \eta = 2 \sin \theta$ for small η and with $2\ d = d_A$ we get

$$\sin \theta = \frac{p_b}{2\ p_i} = \left(\frac{5.8731\ b\ m\ v_1}{64\ c\ K\ r_o\ h}\ \Delta'' l \right)\ \frac{h}{2\ p_i\ d_A}\ n \tag{676}$$

To get the Bragg law the expression between brackets must be constant and equal to the unit what gives for the constant interaction distance $\Delta'' l$

$$\Delta'' l = \frac{64\ c\ K\ r_o\ h}{5.8731\ b\ m\ k\ c} = 8.9357 \cdot 10^{-9}\ \ m \tag{677}$$

We get for the bending momentum and force

$$p_b = \frac{h}{d_A}\ n \qquad F_b = \frac{1}{2}\ \frac{h}{d\ \Delta_o t} = \frac{1}{2}\ \frac{n\ E_o}{d} \tag{678}$$

The bending force is quantized in energy quanta equal to the rest energy E_o of a BSP.

Conclusion: We have derived the Bragg equation without the concept of particle-wave introduced by de Broglie. Numerical results obtained using the quantized irradiated energy instead of the particle-wave are equivalent, different is the physical interpretation of the underlying phenomenon.

15.3.2 Ampere bending deduced from two parallel moving BSPs.

We start with the equation for one BSP

$$\int_{r_r}^{\infty} dE_n = \int_{r_r}^{\infty} E_n\ d\kappa = \frac{1}{2}\ E_n\ \frac{r_o}{r_r}\ \sin \varphi\ d\varphi\ \frac{d\gamma}{2\pi} \tag{679}$$

From Fig. 39 with $\varphi = \Psi$ we get $h = r_r\ \sin \varphi$ resulting

$$\int_{r_r}^{\infty} dE_n = \frac{1}{2}\ E_n\ \frac{r_o}{h}\ \sin^2 \varphi\ d\varphi\ \frac{d\gamma}{2\pi} \tag{680}$$

We now pass to the dH_n field taking the square root of the energy according the **Note** for the Ampere law from sec. 4.11 and get

$$\int_{r_r}^{\infty} dH_n = \frac{1}{2}\ H_n\ \sqrt{\frac{r_o}{h}}\ \sin^2 \varphi\ d\varphi\ \frac{d\gamma}{2\pi} \tag{681}$$

The equation gives the cumulated dH field for the different angles φ of the moving

BSP to the distance h. To get all contributions at the distance h of the dH field for all positions the moving BSP takes during its path, we must integrate from $\varphi = 0$ to $\varphi = 2\pi$.

$$\int_{\varphi=0}^{\pi} \int_{r_r}^{\infty} dH_n = \frac{1}{2}\, H_n \sqrt{\frac{r_o}{h}} \int_{\varphi=0}^{\pi} \sin^2\varphi\, d\varphi\, \frac{d\gamma}{2\pi} = \frac{\pi}{4}\, H_n \sqrt{\frac{r_o}{h}}\, \frac{d\gamma}{2\pi} = dH_n(h) \tag{682}$$

Now we build the cross product of the $dH_n(h)$ (see Fig. 41) and get

$$d\bar{H}_n(h_1) \times d\bar{H}_n(h_2) = \frac{\pi}{4}\, H_{n_1} \sqrt{\frac{r_o}{h_1}}\, \frac{d\gamma_1}{2\pi}\, \frac{\pi}{4}\, H_{n_2} \sqrt{\frac{r_o}{h_2}}\, \frac{d\gamma_2}{2\pi}\, (\bar{n}_1 \times \bar{n}_2) \tag{683}$$

For the differential linear momentum we get

$$dp = \frac{r_o}{64\, c\, \sqrt{h_1\, h_2}}\, H_{n_1}\, H_{n_2}\, d\gamma_1\, d\gamma_2\, |\bar{n}_1 \times \bar{n}_2| \tag{684}$$

With $\sqrt{E_n} = H_n = \sqrt{m}\, v$ and $|\bar{n}_1 \times \bar{n}_2| = \sin(\gamma_1 - \gamma_2)$ we get

$$dp = \frac{r_o}{64\, c}\, \frac{\sqrt{m} v_1\, \sqrt{m} v_2}{d}\, \frac{\sin^2(\gamma_1 - \gamma_2)}{\sqrt{\sin\gamma_1\, \sin\gamma_2}}\, d\gamma_1\, d\gamma_2 \tag{685}$$

For the momentum we get

$$p = \frac{r_o}{64\, c}\, \frac{m\, v_1\, v_2}{d} \int\int_{Ampere} \tag{686}$$

and for the force

$$F = \frac{p}{\Delta_o t} = \frac{r_o}{64\, c\, \Delta_o t}\, \frac{m\, v_1\, v_2}{d} \int\int_{Ampere} \tag{687}$$

The force acts during the path length $\Delta'' l = v_2\, \Delta'' t$ giving the total bending momentum

$$p_b = F\, \Delta'' t = \frac{m\, k}{64\, c\, K\, r_o}\, \frac{\Delta'' l}{d} \int\int_{Ampere} \tag{688}$$

With $2d = d_A$, $v_1 = k\, c$ and $\sin\theta = \frac{p}{2\, p_i}$ we arrive to

$$\sin\theta = \frac{p_b}{2\, p_i} = \left(\frac{2\, m\, k}{64\, K\, r_o\, h}\, \Delta'' l \int\int_{Ampere} \right) \frac{h}{2\, p_i\, d_A} \tag{689}$$

Comparing with the Bragg equation the expression in brackets must be equal to the unit. With $\int\int_{Ampere} = 5.8731$ and $k = 7.4315 \cdot 10^{-2}$ we get

$$\Delta'' l = \frac{64\ K\ r_o\ h}{5.8731\ m\ k\ 2} = 1.11697 \cdot 10^{-9} \quad m \tag{690}$$

The difference to the path length of the previous section is due to the factor $2/b$ with $b = 0.25$.

15.4 Induction bending of a BSP.

The induction bending is based on postulate **8** and described by eq. (394) which has a term with H_n for constant speed v and a term with dH_n/dt for variable speed v.

$$\frac{d}{dt} \int_{r_r}^{\infty} d\bar{H}_n = \frac{1}{2} \frac{d}{dt}[H_n]\ \frac{r_o}{r_r}\ \sin\varphi\ d\varphi\ \bar{s}_\gamma\ -\ H_n\ v\ \frac{r_o}{r_r^2}\ \sin\varphi\ \cos\varphi\ d\varphi\ \bar{s}_\gamma$$

The bending is analyzed for constant speed v.

a) Bending with $v \ll c$.

When a BSP passes near a sharp matter edge with the speed v the following forces are induced on the BSP's of the matter edge, caused by the longitudinal $d'\bar{H}_s$ and transversal $d'\bar{H}_n$ fields.

$$d'\bar{F}_i = d'\bar{F}_{i_n}\ +\ d'\bar{F}_{i_s} \tag{691}$$

with

$$d'\bar{F}_{i_n} = \frac{1}{8\pi}\ \sqrt{m_p}\ r_{o_p}\ rot\ \frac{d}{dt} \int_{r_r}^{\infty} d'\bar{H}_n \tag{692}$$

and

$$d'\bar{F}_{i_s} = \frac{1}{8\pi}\ \sqrt{m_p}\ r_{o_p}\ rot\ \frac{d}{dt} \int_{r_r}^{\infty} d'\bar{H}_s \tag{693}$$

For $v \ll c$ and constant speed we have with eq. (394) and $d'\bar{H}_n = \frac{1}{2\pi} d\bar{H}_n$ that

$$\frac{d}{dt} \int_{r_r}^{\infty} d'\bar{H}_n = -\ \frac{1}{2\pi}\ \sqrt{m}\ v^2\ \frac{r_o}{r_r^2}\ \sin\varphi\ \cos\varphi\ \bar{n} \tag{694}$$

We neglect the influence of $d'\bar{H}_s$ because our interest is on the induced force in the $\bar{r}_r$ direction.

With the already introduced transformations (see Fig. 58)

$$\theta = \pi - \varphi \qquad \sin\theta = \sin\varphi \qquad \cos\theta = -\cos\varphi \qquad d\theta = -d\varphi \tag{695}$$

and

$$\bar{C}_n^{'} = C_r^{'} \, \bar{e}_r + C_\gamma^{'} \, \bar{e}_\gamma + C_\theta^{'} \, \bar{e}_\theta \qquad\qquad and \qquad\qquad \bar{e}_\gamma = \bar{n} \tag{696}$$

we get

$$C_r^{'} \, \bar{e}_r = 0 \qquad C_\gamma^{'} \, \bar{e}_\gamma = \frac{d}{dt} \int_{r_r}^{\infty} d^{'} \bar{H}_n = \frac{1}{2\pi} \sqrt{m} \, v^2 \, \frac{r_o}{r_r^2} \, \sin\theta \, \cos\theta \, \bar{e}_\gamma \qquad C_\theta^{'} \, \bar{e}_\theta = 0 \tag{697}$$

Because of the small distances r_r between the moving BSP and the BSP's of the sharp edge we can neglect the time differences of the emitted fundamental particles and calculate without considering retardation.

We get for the rotor

$$rot \, \bar{C}_n^{'} = \frac{1}{2\pi} \sqrt{m} \, v^2 \, \frac{r_o}{r_r^{\,3}} \left[2 \, \cos^2\theta - \sin^2\theta \right] \, \bar{e}_r \; + \; 0 \cdot \bar{e}_\gamma \tag{698}$$

$$\frac{1}{2\pi} \sqrt{m} \, v^2 \, \frac{r_o}{r_r^3} \, \sin\theta \cos\theta \, \bar{e}_\theta$$

When the particle reaches the closest position to the matter edge, n induction bursts will occur each lasting $\Delta t = K \, r_o \, r_{o_p}$ seconds, between the moving BSP and the BSP's of the matter edge. The concept is shown in Fig. 88.

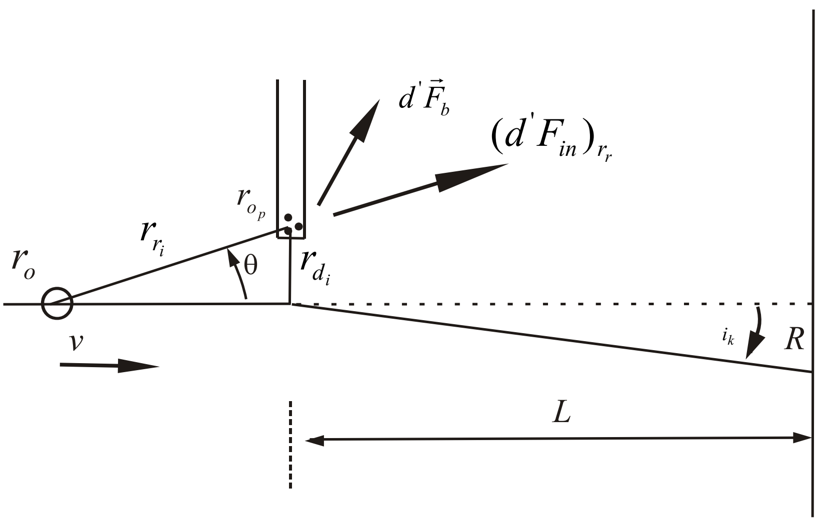


Figure 88: Quantification of the bending trajectory of a basic subatomic particle at a free matter edge.

The induced force is

$$d^{'} \bar{F}_{i_n} = \frac{1}{8\,\pi} \sqrt{m_p} \, r_{o_p} \, rot \, \bar{C}_n^{'} \tag{699}$$

For $r_r \approx r_d$ we have that $\theta \approx \pi/2$ and we get for the induced force

$$d^{'}\bar{F}_b = \frac{1}{16\pi^{\,2}} \sqrt{m_p}\,\sqrt{m}\, r_{o_p}\, r_o\, \frac{v^2}{r_d^3} \tag{700}$$

The induced bending momentum $d^{'}\bar{p}_b$ we get with the elementary time $\Delta t = K\, r_{o_p}\, r_o$

$$d^{'}\bar{p}_b = d^{'}\bar{F}_b\;\; \Delta t = \frac{1}{16\pi^{\,2}} \sqrt{m_p}\,\sqrt{m}\, r_{o_p}^2\, r_o^2\, K\, \frac{v^2}{r_d^3} \tag{701}$$

The total bending momentum is

$$\bar{p}_b = \int_\sigma d^{'}\bar{p}_b = K^{'''} d^{'}\bar{p}_b = \frac{K^{'''}}{16\pi^{\,2}} \sqrt{m_p}\,\sqrt{m}\, r_{o_p}^2\, r_o^2\, K\, \frac{v^2}{r_d^3} \tag{702}$$

with $K^{'''}$ an equalization constant to be determined trough experimental data.

The bending angle is

$$\sin\eta = \frac{p_{a_y}}{p_a} \approx \frac{p_b}{p_i} = \frac{K^{'''}}{16\pi^{\,2}} \sqrt{m_p}\,\sqrt{m}\, r_{o_p}^2\, r_o^2\, \frac{K}{p_i}\, \frac{v^2}{r_d^3} \quad for \quad \eta < \frac{\pi}{10} \tag{703}$$

The radius r_o of a BSP is defined by

$$r_o = \frac{\hbar\, c}{E} = \frac{\hbar\, c}{\sqrt{E_o^2 + E_p^2}} \qquad r_{o_p} = \frac{\hbar\, c}{E_o} \tag{704}$$

with $\hbar\, c = 3.161529299\ 10^{-26}\, [J\ m]$.

The bending equation gives the force on the probe BSP at the bending edge. As velocity is relativ, the same force actuates on the moving BSP but with opposed sign.

Because of the discrete number of BSPs in the matter edge the resulting momentum is quantified and thus the corresponding bending angle η_{i_k}.

With a constant speed v the moving BSP and the static BSPs of the edge change linear momentum resulting in a bending angle η_{i_k}

$$\sin\eta_{i_k} \approx \eta_{i_k} \propto \frac{k_i}{r_{d_i}^3} \tag{705}$$

with r_{d_i} the distance between the moving BSP and the BSPs of the edge that exchanges linear momentum, and k_i the number of BSP's of the edge that exchange linear momentum.

The bending due to the induced force is always in the same direction independent of the sign (electron or positron) of the BSPs that interchanges linear momentum. The two BSP's always repel each other so that the bending of the moving BSP is always away from the bending edge.

b) Bending with relativistic v.

From sec. 7.1.2 and eq. (394) and the deductions made at b) for $\Delta v \ll c$ we get for the time differentiation of the transversal field

$$\frac{d}{dt} \int_{r_r}^{\infty} d\bar{H}_n = - \sqrt{E_p}\, v\, \frac{r_o}{r_r^2} \sin\varphi \, \cos\varphi \, d\varphi \, \bar{n} \tag{706}$$

For $r_r \approx r_d$ we have that $\theta \approx \pi/2$ and we get for the induced force

$$d'\bar{F}_b = \frac{1}{16\pi^2} \sqrt{m_p} \sqrt{E_p}\, r_{o_p}\, r_o \, \frac{v}{r_d^3} \tag{707}$$

With the elementary time $\Delta t = K\, r_{o_p}\, r_o$ we get the induced bending momentum

$$d'\bar{p}_b = d'\bar{F}_b \;\; \Delta t = \frac{1}{16\pi^2} \sqrt{m_p} \sqrt{E_p}\, r_{o_p}^2\, r_o^2\, K \, \frac{v}{r_d^3} \tag{708}$$

The total bending momentum is

$$\bar{p}_b = \int_{\sigma} d'\bar{p}_b = \frac{K'''}{16\pi^2} \sqrt{m_p} \sqrt{E_p}\, r_{o_p}^2\, r_o^2\, K \, \frac{v}{r_d^3} \tag{709}$$

with K''' an equalization constant to be determined trough experimental data.

The bending angle is

$$\sin\eta = \frac{p_{a_y}}{p_a} \approx \frac{p_b}{p_i} = \frac{K'''}{16\pi^2} \sqrt{m_p} \sqrt{E_p}\, r_{o_p}^2\, r_o^2\, \frac{K}{p_i} \, \frac{v}{r_d^3} \quad for \quad \eta < \frac{\pi}{10} \tag{710}$$

15.5 Bending schemas for BSPs with $v \neq c$.

1) At a free target edge.

The bending of BSPs with $v \neq c$ is mainly due to the Ampere force which is inverse proportional to the distance d, while the Coulomb bending is inverse to d^2, and the induction bending is inverse to d^3. The bending at a free matter edge is shown in Fig. 89. To the distance r_{d_i} corresponds the bending angle η_i and to the distance r_{d_j} the smaller bending angle η_j. BSP's designated with the index "i" pass through the interatomic spaces of the bending matter. If the radii of the BSPs are comparable with the interatomic distances, the distance r_{d_i} is well defined and equal for all BSPs and the bending is therefore quantized producing bright and dark patterns. BSP's designated with the index "j" have no defined bending distance and are arbitrarily bend not producing bright and dark patterns.

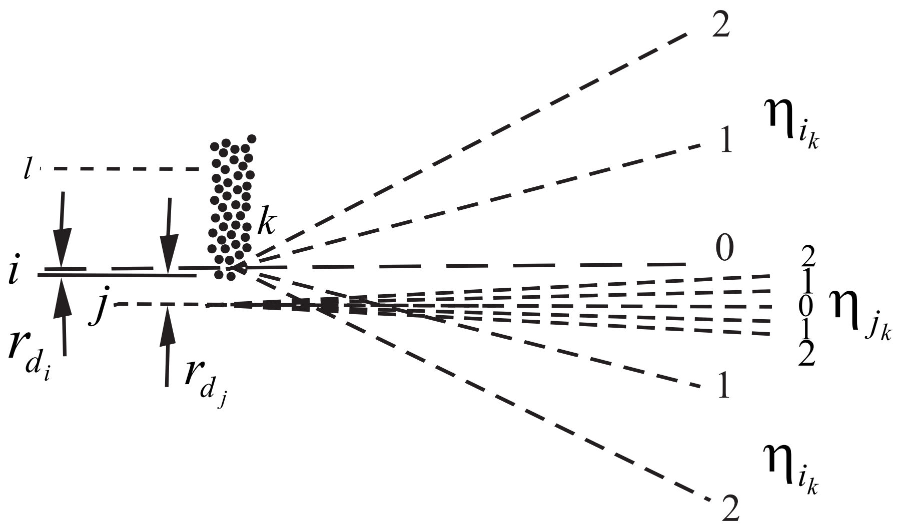


Figure 89: Quantification of the bending trajectories of basic subatomic particles with $v \neq c$ at a free metal edge.

2) At a target slit.

The bending of BSP with $v \neq c$ at a metal slit is shown in Fig. 90.

The bending pattern observed is a superposition of the bending patterns produced by two bending free matter edges. To get well defined bright and dark patterns, the distance L to the screen must be much greater compared with the distance b between the bending edges.

As particles with $v \neq c$ have no wave character and therefore no interference is possible, it is not possible to calculate the distance b.

If neutral complex particles (neutrons) are used instead of negative BSP's (electrons), the discrete bending has its origin in that during the way through the crystal some BSP's that form the neutral complex particle change linear momentum with the BSP's of the bending edge.

3) At a double slit, grating or crystal.

The bending of BSP's with $v \neq c$ at a double slit, a grating or a crystal is the superposition of the bending of BSP's at single matter edges.

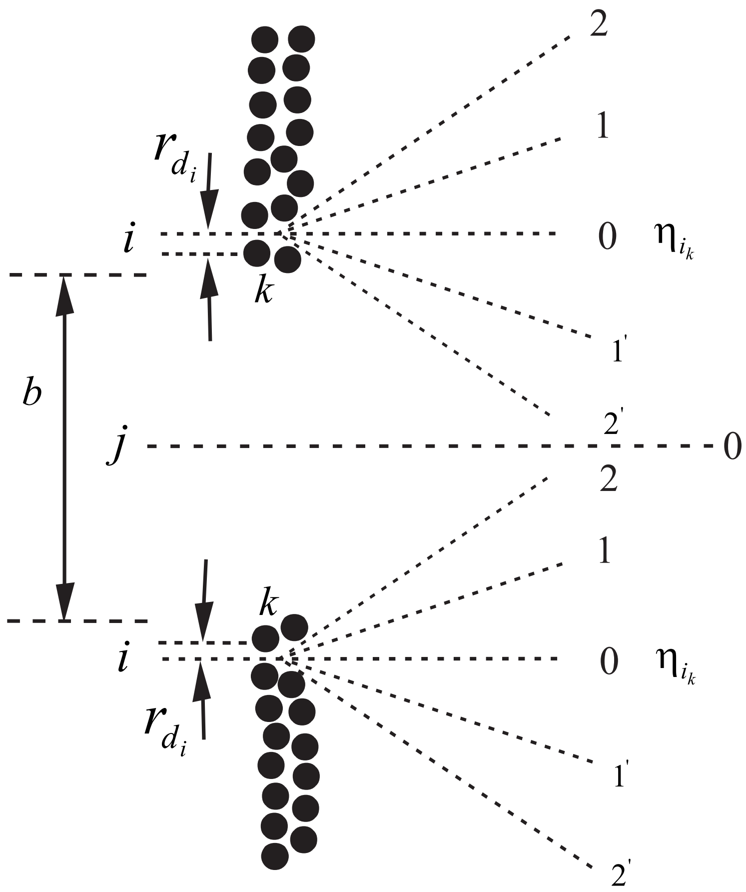


Figure 90: Quantification of the bending trajectories of basic subatomic particles with $v \neq c$ (electron) at a metal slit.

16 Interaction of complex BSPs with v = c (photons) with regenerating and emitted FPs from BSPs of matter.

16.1 General considerations.

A sequence of BSPs with light speed (photon) is not bent when it interacts with regenerating or emitted fundamental particles of BSPs of matter. They are absorbed by the regenerating FPs of BSPs of the matter and

- partly passed to the emitted FPs from the BSPs of matter at the reflection level. (reflected).
- and partly re-emitted by the BSPs of the matter (refracted).

The concept is shown in Fig. 91.

Fig. 91 shows a piece of matter with its two parallel refraction levels and two BSPs **a** and **b** with their regenerating and emitted rays of FPs.

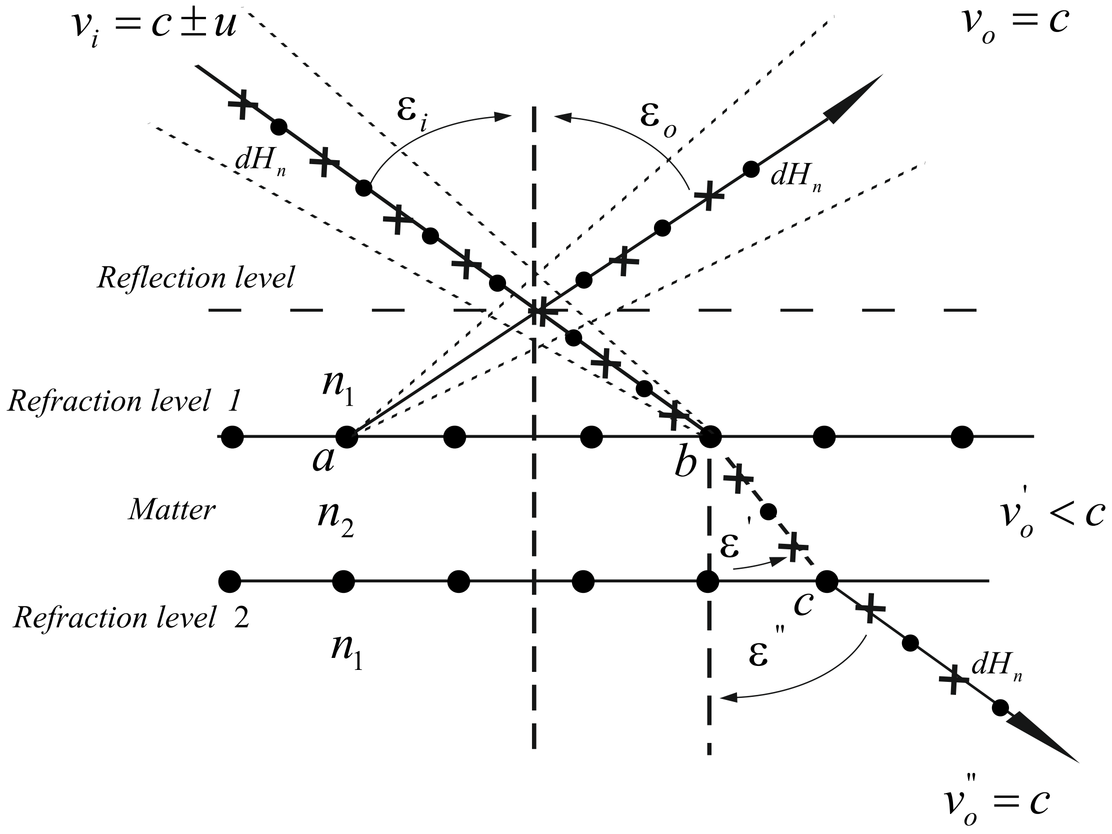


Figure 91: Light reflection and refracction

From left to right a photon is shown as a sequence of opposed dH_n (dots and crosses) fields perpendicular to the drawing plane. Each pair of opposed dH_n fields is a potential linear momentum perpendicular to the plain that contains the opposed pair. At the reflection level part of the energy of each pair of dH_n field is reflected and the rest of the energy is refracted at the refraction level 1. The reflection follows postulate 8 of interactions between FPs from sec. 2.2 passing part of the energy of pairs of opposed dH_n from regenerating rays of FPs to rays of emitted FPs. The separation between reflection level and refraction level 1 shown in the figure has only a didactic purpose to emphasize the interaction between incoming FPs of the light ray and the FPs of the emitted ray of BSP a.

At the refraction level each dH_n pair is absorbed by a BSP of matter transforming the potential linear momentum in an actually one. The now moving BSP is stopped after a certain interval because of its bindings with the other BSPs of the matter and emits the previously absorbed dH_n pair with light speed.

The present approach is a emission theory where FPs are emitted by BSPs with light speed relative to a coordinate system fixed to the BSPs. Light that arrives to matter with speed $c \pm u$ is reflected and refracted at the refraction level 2 with light speed. The reduced speed of the light inside matter is due to the time needed for absorbtion and re-emission when moving from BSP to BSP.

16.2 Splitting of BSPs with v = c.

At Fig. 91 the separation between reflection level and refraction level 1 shows first the splitting of the light ray followed by the refraction to comply with conservation of potential linear momentum. An isolated splitting of the light ray is also possible without the need of a subsequent refraction as the following Fig. 92 shows.

The ray that passes between the two BSP with $v = 0$ carries two FPs with opposed angular momenta J_n (dot and cross) which give the potential linear momentum p_n. The two BSPs with $v = 0$ emit FPs with longitudinal angular momenta J_s which are not paired and are not opposed to give a potential linear momentum.

At point O, where the three rays cross, their angular momenta interact according postulate 8 resulting the angular momenta $J_n^{'}$ and $J_n^{''}$. Both types of angular momenta have an opposed pair giving respectively potential linear momenta $p_n^{'}$ and $p_s^{'}$ on the two rays. Longitudinal angular momenta $J_s^{'}$ remain at each ray contributing to the balance of linear momentum and energy.

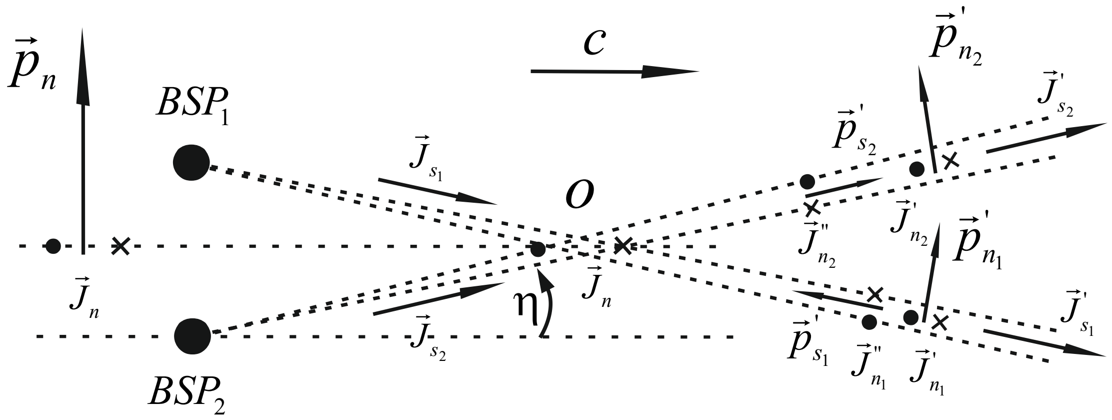


Figure 92: Splitting of a BSP with light speed.

Fig. 93 shows the geometric relations for the balance of linear momentum. We have assumed, that the splitting is symmetric to make calculations easier.

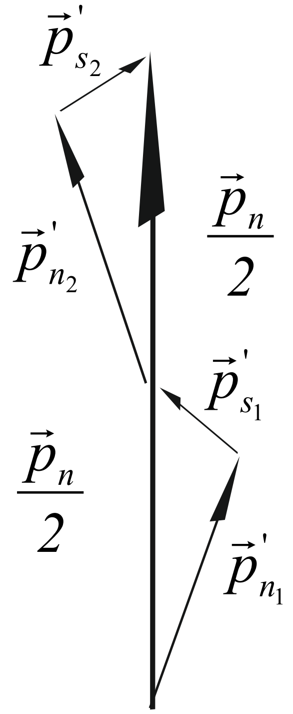


Figure 93: Geometric relations for the splitting of a BSP with light speed.

Fig. 94 shows the splitting of a train of alternated linear momentum p_n.

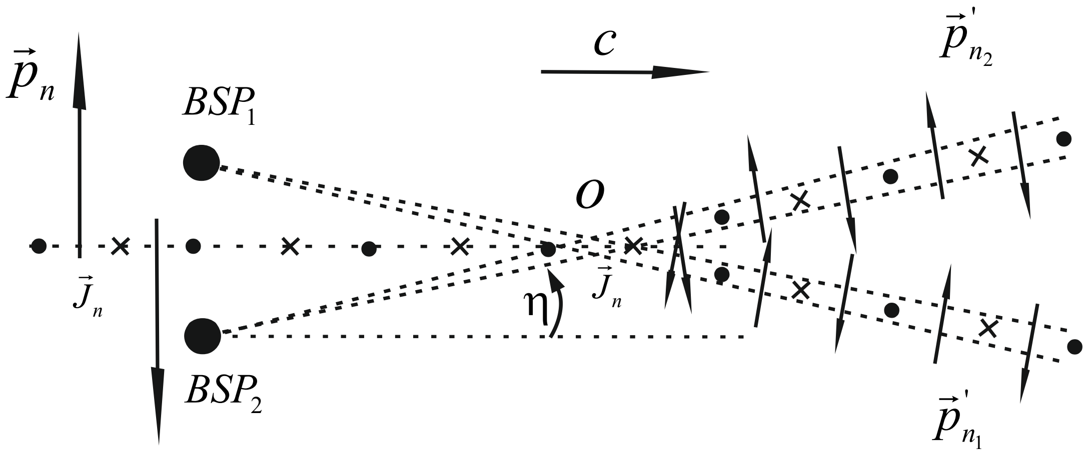


Figure 94: Splitting of a train of BSP with light speed.

The train of linear momenta $p_n^{'}$ interfere as shown in Fig. 95.

We have that

$$dp = \frac{1}{8\pi} \sqrt{m_p}\, r_{o_p}\, rot \int_{r_r}^{\infty} dH \tag{711}$$

As a BSP with light speed is independent of the BSP that has emitted it, it is independent of the distance r_r. We define that

$$\int_{r_r}^{\infty} dH = \sqrt{J\,\nu} \qquad and \qquad rot\,\sqrt{J\,\nu} = \frac{\sqrt{J\,\nu}}{r_o} \tag{712}$$

and get for the potential lineal momentum p for each pair of opposed angular momenta

$$p = \frac{1}{8\pi}\,\sqrt{m_p}\,\sqrt{J\,\nu} \tag{713}$$

with m_p the mass of the probe particle. The energy of a train of potential linear momenta that moves with light speed (photon) is $E_{ph} = h\,\nu$ with h the Planck konstant. If the train has k links we have that

$$E_{ph} = h\,\nu = k\,J\,\nu = k\,h\,\nu^{'} \qquad with \qquad \nu^{'} = \frac{\nu}{k} \tag{714}$$

16.3 Differences between bending, reflection, refraction and splitting.

- Bending occurs between BSPs with speeds $v \neq c$ (with rest mass) which emit and are regenerated by FPs. The bending is the product of the exchange of quantized energy between the bending partners and the bending linear momenta between them are opposed and have equal absolute value.

- Reflection occurs between BSPs with speeds $v = c$ with potential linear momenta (pair of opposed dH_n) which don't emit and are not regenerated by FPs. Reflection is always paired with refraction because of momentum conservation, also in the case of total reflection.

- Refraction occurs between BSPs with $v \neq c$ and BSPs with $v = c$. The pairs of opposed dH_n are absorbed by the BSPs with $v \neq c$ and then re-emitted. Refraction is always paired with reflection because of momentum conservation, also in the case of total refraction.

- Splitting occurs between BSPs with $v = c$. Because of momentum conservation splitting requires the interaction of three BSPs with $v = c$.

16.4 Interference schemas for BSPs with v = c.

A BSP with light speed is formed by a pair of equal but opposed angular momenta which, when absorbed by the regenerating FPs of a probe BSP gives it a linear momentum. The possibility to transform the energy stored in opposed angular momenta to energy stored in linear momentum is expressed with **potential liner momentum**. At a single BSP with light speed the potential linear momentum can adopt all directions relative to the moving direction of the BSP. Single BSPs with light speed are called neutrinos.

A train of BSPs with light speed with alternating opposed potential linear momenta perpendicular to the moving direction is called photon. Photons interfere giving the known interference patterns at a target edge, at a single slit and at a double slit.

The following schematic representations show how the interference patterns are generated based on the concept of splitting of a train of BSPs with light speed.

1) At a free target edge. Fig. 95 shows a free target edge where some rays pass between the limiting atoms of the edge and rays that pass outside the edge. As BSPs with light speed are not bend, the rays outside the edge move without change of direction. The two rays **a** and **b** are split according Fig. 92 and Fig. 94. The interference patterns are generated the same way we know from standard theory. The incoming ray is split in rays with splitting angle $\pm\eta$. Interference produced by splitting angles $-\eta$ is not visible because of the intensity of outside rays. The distance d_A between atoms is given by

$$d_A = \frac{n\,\lambda}{\sin\eta_n} \tag{715}$$

2) At a target with a single slit. Fig. 96 shows the bending and corresponding interferences at a single slit. The interference pattern observed with a single slit is simply the superposition of the interference patterns from free edges. To make them visible certain geometric relations between the dimension of the slit and the distance to the screen must be observed. The slit is given by the following equation:

$$b = \frac{\Delta x}{\sin\eta_n} \qquad with \qquad \Delta x = n\,\lambda \tag{716}$$

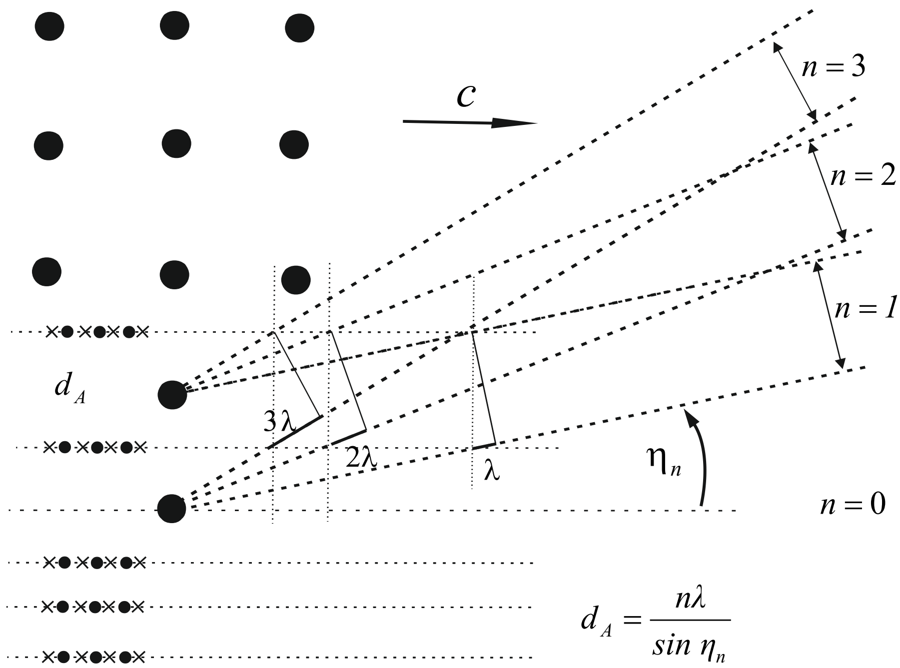


Figure 95: Splitting and interference of BSPs with $v = c$ at a free matter edge.

3) At a target with a double slit.

The interference of BSPs with $v = c$ at a double slit, a grating or a crystal is the superposition of the two interference cases **1)** and **2)** previously presentsd.

The distance g between the two slits is given by

$$g = \frac{n\,\lambda}{\sin\eta} \tag{717}$$

Note: As a photon is composed of a train of BSPs with opposed potential linear momenta, it is possible to explain the interference of a single photon at the double slit, in that part of the train passes trough one and the other part through the other slit. The two parts are then split in rays that interfere.

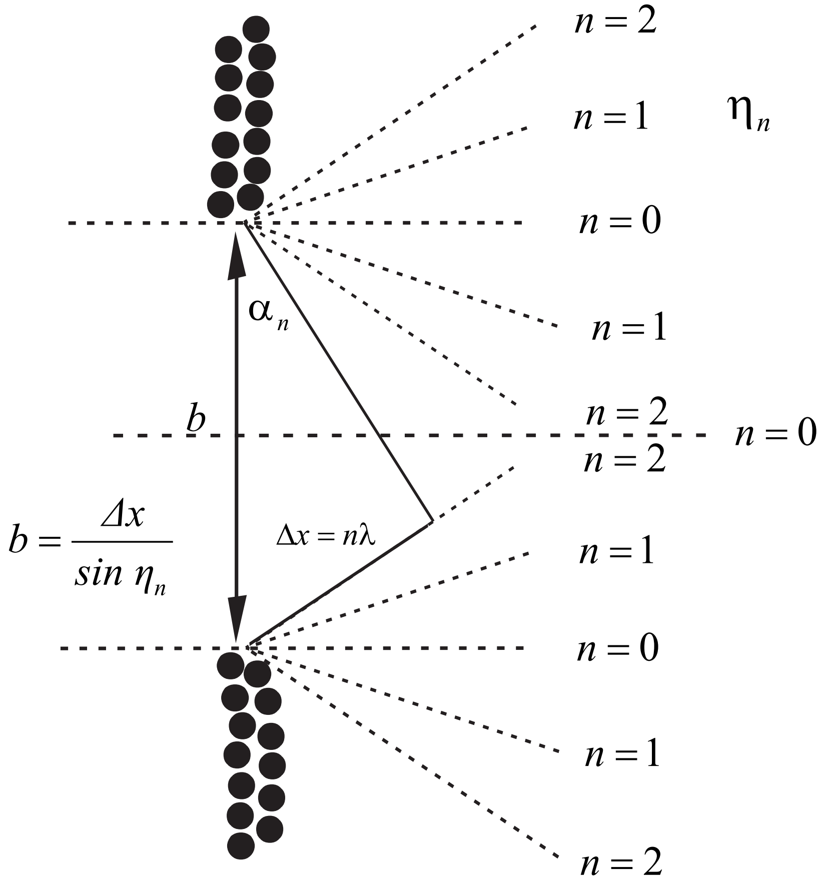


Figure 96: Interference of BSPs
with $v = c$ at a single slit.

16.5 Derivation of Snell's refraction law.

In Fig. 97 the potential linear momentum of each pair of opposed dH_n field at each light ray is shown. The potential liner momentum is given by

$$p = \frac{1}{8\pi}\,\sqrt{m_p}\,dH_n \tag{718}$$

where m_p is the mass of the probe BSP.

Because of momentum conservation the linear momenta must have for $\epsilon_i = \epsilon_o$ the geometric relation shown which give the following equations.

$$p_r = p_i\,\frac{\sin(\epsilon_i - \epsilon^{'})}{\sin(\epsilon_i + \epsilon^{'})} \qquad\qquad p_o = p_i\,\frac{\sin(\pi - 2\epsilon_i)}{\sin(\epsilon_i + \epsilon^{'})} \tag{719}$$

Additionally with the energy conservation $p_i c = p_r c + p_o c^{'}$ we get after some mathematics the Snell's law of refraction.

$$\frac{c^{'}}{c} = \frac{\sin\epsilon^{'}}{\sin\epsilon_i} \tag{720}$$

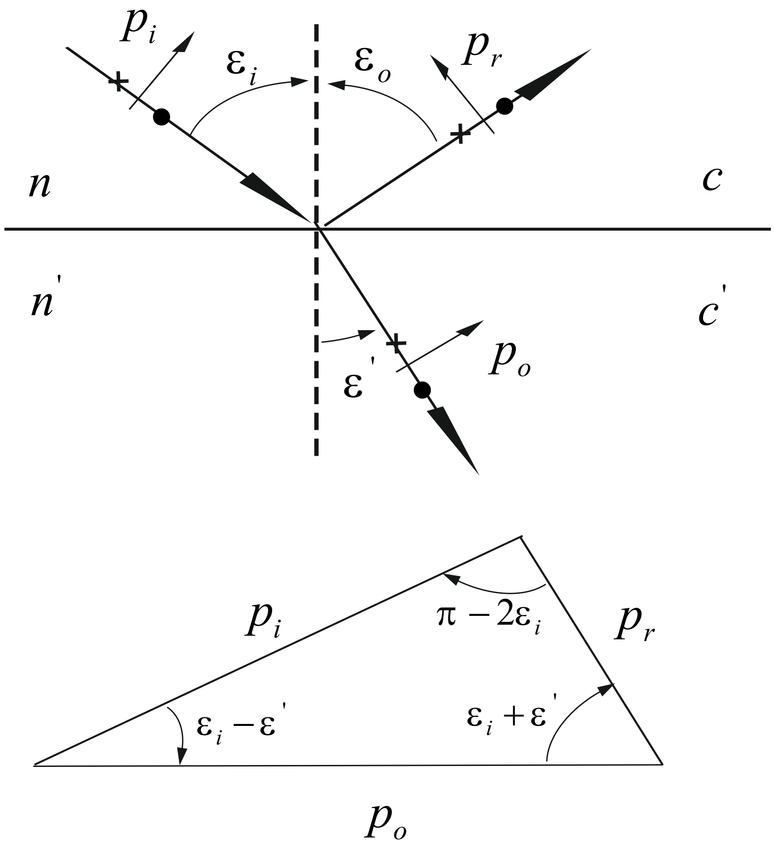


Figure 97: Geometric relations between potential linear momenta of reflected and refracted rays.

16.6 Redshift of the energy of a BSP with light speed in the presence of matter.

Fig. 98 shows a sequence of BSP with light speed with their potential linear momenta p (photon) before and after the interaction with the ray of regenerating FPs of the BSPs of matter. When the regenerating rays are approximately perpendicular to the trajectory of the opposed dH_n (dots and crosses) fields of the photon, part of the energy of the dH_n field is absorbed by the regenerating FPs of the ray and carried to the BSPs of the matter. The photon doesn't change its direction and loses energy to the BSPs of the matter shifting its frequency to the red. The inverse process is not possible because the BSPs of the photon (opposed dH_n fields) have no regenerating rays of FPs that can carry energy from the BSPs of matter and shift the frequency to the violet.

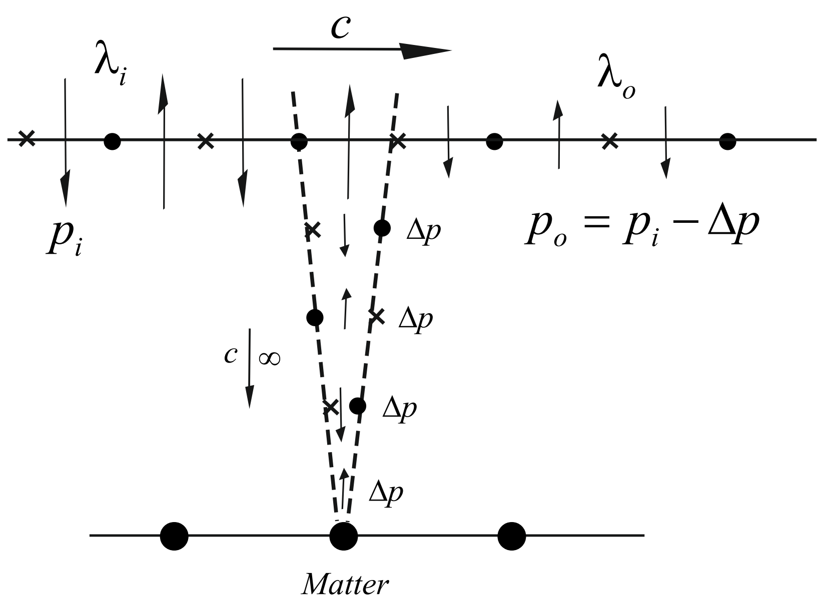


Figure 98: Loss of energy of a BSP with $v = c$

The process of loss of energy is according postulate **8** which postulates that pairs of regenerating FPs with longitudinal angular momenta from a BSP can adopt opposed pairs of transversal angular momentum from another BSP. As photons have no regenerating FPs they can only leave pairs of transversal angular momentum to other BSPs and lose energy. During the red shift, two adjacent opposed potential linear momenta of the photon compensate partially by passing part of their opposed linear momenta to the BSP of matter.

The energy exchanged between a photon and an electron is

$$E_i = \frac{h\ c}{\lambda_i} \qquad\qquad E_b = \frac{p_b^2}{2\ m_p} \tag{721}$$

The frequency shift of the photon is with $E_i = E_o + E_b$

$$\Delta\nu = \nu_i - \nu_o = \frac{1}{h}(E_i - E_o) = \frac{E_b}{h} \qquad z = \frac{\Delta\nu}{\nu_i} \tag{722}$$

where $E_i = h\ c/\lambda_i$ is the energy before the interaction, $E_o = h\ c/\lambda_o$ the energy after the interaction and E_b the energy carried to the BSP of matter.

Light that comes from far galaxies loses energy to cosmic matter resulting in a red shift approximately proportional to the distance between galaxy and earth (Big Bang).

Light is not bent by gravitation nor by a bending target, it is reflected and refracted by a target.

16.6.1 Refraction and red-shift at the sun.

Fig.99 shows two light rays one passing outside the atmosphere of the sun and one through the atmosphere. The first ray is red shifted due to regenerating FPs of matter of the sun as explained in sec.16.6. The second ray is refracted in the direction of the sun surface when crossing the sun atmosphere. Due to the refractions the speed in the atmosphere is $v < c$. Red-shift is also possible at the second ray but not shown in the drawing.

Note: Bending takes place only between BSPs with rest mass.

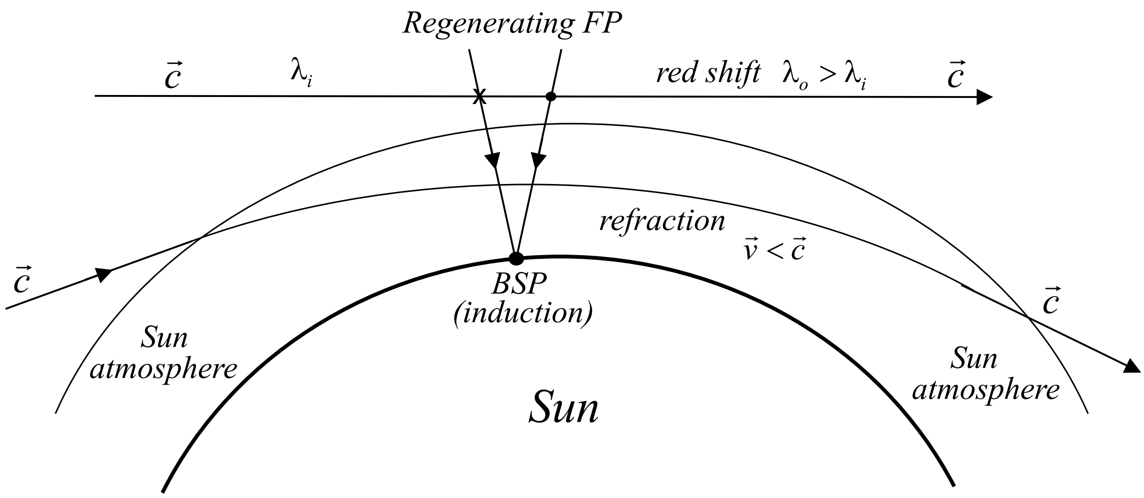


Figure 99: Refraction and red-shift at the Sun

16.6.2 Cosmic Microwave Background radiation as gravitation noise.

Two explanations are possible:

From Fig. 98 we have learned how a photon passes energy to matter shifting its frequency to red. The transfer of energy takes place according postulate 8 from rays that not necessarily hit directly matter. If we put on the place of the matter the microwave detector of the COBE satellite we see how microwave radiation from radiating bodies that are not placed directly in front of the detector lenses can reach the detector. What is measured at the FIRAS (Far-InfraRed Absolute Spectrophotometer), a spectrophotometer (Spiderweb Bolometer) used to measure the spectrum of the CMB, is the energy lost by microwave rays that pass in front of the detector lenses. The so called Cosmic- Background Radiation is not energy that comes from microwave rays that have their origin in the far space in a small space angle around the detector axis. As the loss of energy from rays of photons to the microwave detector that don't hit directly the detector is very low, the detector must be cooled down to very low temperatures to detect them.

A more plausible explanation for the CMB radiation is based on gravitation forces. Gravitation also follows postulate 8, which is the foundation of the induction law.

Nuclei of atoms are composed of electrons and positrons. Atoms are formed by nuclei and level electrons which move in orbits with quantized energies. When level electrons pass from a higher to a lower energy level the energy difference is emitted as gamma radiation of energy $\Delta E = \hbar\omega$.

At very low temperatures all level electrons are at the lowest possible energy level and no gamma radiation exists.

Gravitation is independent of the temperature because it has its origin at the atomic nuclei by reintegrating migrated electrons and positrons to their nuclei. The reintegration of migrated electrons and positrons to their nuclei generates momenta not only at electrons and positrons of other nuclei, but also at level electrons of other atoms. The gravitation momenta on the level electrons move them to a higher energy level, energy difference that is radiated as gamma signal when the electrons return to their original energy level.

The detectors of FIRAS, etc. are oriented to the Cosmic Background where no radiation is generated, nevertheless microwaves are detected. The only possible source of the measured microwaves at very low temperatures are the microwaves generated by gravitation between the components of the satellite. It is the gravitation noise that is detected when no thermal noise is present.

Part V Gravitation

Deduction of the gravitation as an induction force with a Coulomb and Ampere component. The Ampere component explains the flattening of galaxie's rotation curve.

17 Induction between an accelerated and a static BSPs.

We assume, that a BSPs is accelerated from $v = 0$ to a fraction k of the light speed $v_{max} = k\,c$ in the time Δt and returned then to its original position through an external force in the time $\Delta t \to \infty$. We also assume that the acceleration has the direction of the probe BSP. According to postulate 8 the induced force on the static probe BSP is independent of the sing of the accelerated BSP and has always the direction of the acceleration. See Fig. 101 where BSP b is accelerated in the direction of the nucleus of neutron 1 and BSP p from neutron 2 is the probe BSP.

17.1 Induction between an accelerated and a probe BSP expressed as closed path integration over the whole space.

We start with the general dynamic equation (409) for the induced force on a static probe BSP produced by a BSP with speed v

$$dF_i = \frac{1}{c} \oint \frac{d\bar{l}}{2\pi R} \cdot \frac{d}{dt} \int_{r_r}^{\infty} d\bar{H}_n \int_{r_p}^{\infty} dH_{s_p} \tag{723}$$

and the eq. (394) with $\bar{n} = \bar{s}_\gamma$

$$\frac{d}{dt} \int_{r_r}^{\infty} d\bar{H}_n = \frac{1}{2}\,\frac{d}{dt}[H_n]\,\frac{r_o}{r_r}\,\sin\varphi\; d\varphi\; \bar{s}_\gamma \;-\; H_n\, v\,\frac{r_o}{r_r^2}\,\sin\varphi\;\cos\varphi\; d\varphi\; \bar{s}_\gamma \tag{724}$$

$$+\,\frac{1}{2}\,H_n\,\frac{1}{r_r}\,\sin\varphi\; d\varphi\,\frac{dr_o}{dt}\,\bar{s}_\gamma$$

For $v = k\,c \ll c$ with k a dimensionless factor (see also sec. 4.6), we have

$$H_n = v\,\sqrt{m} \qquad \mathit{and} \qquad \frac{d}{dt}[H_n] = \frac{dv}{dt}\,\sqrt{m} \tag{725}$$

and

$$r_o = \frac{\hbar\, c}{E_o} \qquad \mathit{and} \qquad \frac{dr_o}{dt} = 0 \tag{726}$$

We now assume in Fig. 54 that $r_d = 0$ and that the moving BSP has a speed $v = 0$ but is accelerated in the direction of the probe BSP from $v = 0$ to $v = k\ c$ in the time Δt over the distance Δx, and then returned to its original position in the time $\Delta t \to \infty$ by an external force. We get

$$\frac{d}{dt}\int_{r_r}^{\infty} d\bar{H}_n = \sqrt{m}\,\frac{k\ c}{\Delta t}\,\frac{1}{2}\,\frac{r_o}{r_r}\,\sin\varphi\,d\varphi\,\bar{n} \tag{727}$$

For the static probe BSP we have

$$H_{s_p} = c\,\sqrt{m} \qquad and \qquad \frac{d}{dt}[H_{s_p}] = 0 \tag{728}$$

and we get

$$\int_{r_p}^{\infty} dH_{s_p} = \frac{1}{2}\,c\,\sqrt{m_p}\,\frac{r_{o_p}}{r_p}\,\sin\varphi_p\,d\varphi_p \tag{729}$$

We introduce this expressions in the first equation and get

$$dF_i = \frac{k\ c\,r_o\,r_{o_p}\,\sqrt{m}\,\sqrt{m_p}}{4\ \Delta t}\oint\frac{\bar{d}l}{2\pi R}\cdot\frac{\sin\varphi\ \sin\varphi_p}{r_r\ r_p}\,d\varphi\,d\varphi_p\,\bar{n} \tag{730}$$

With the following geometric relations already defined in sec.4.2 for the Coulomb law

$$R = r_r\ \sin\varphi \qquad R = r_p\ \sin\varphi_p \qquad -r_r\ \cos\varphi + r_p\ \cos\varphi_p = d \tag{731}$$

we get

$$r_r\ r_p = d^{\,2}\,\frac{\sin\varphi\ \sin\varphi_p}{[\,\sin\varphi\ \cos\varphi_p - \sin\varphi_p\ \cos\varphi\,]^2} \tag{732}$$

resulting

$$dF_i = \frac{k\ c\,r_o\,r_{o_p}\,\sqrt{m}\,\sqrt{m_p}}{4\ \Delta t\ d^{\,2}}\,\sin^2(\varphi-\varphi_p)\,d\varphi\,d\varphi_p \tag{733}$$

We get for the total force

$$F_i = \frac{k\ c\,r_o\,r_{o_p}\,\sqrt{m}\,\sqrt{m_p}}{4\ \Delta t\ d^{\,2}}\int_{\varphi_{min}}^{\varphi_{max}}\int_{\varphi_{p\ min}}^{\varphi_{p\ max}}|\sin^2(\varphi-\varphi_p)|\,d\varphi\,d\varphi_p \tag{734}$$

where the integration limits are functions of the radii r_o and r_{o_p} and the distance d. For $d \geq \sqrt{r_o^2 + r_{o_p}^2}$ the integration limits are

$$\varphi_{min} = \arcsin\frac{r_o}{d} \qquad \varphi_{max} = \pi - \arcsin\frac{r_{o_p}}{d} \tag{735}$$

$$\varphi_{p\ min} = \arcsin \frac{r_o}{d} \qquad \varphi_{p\ max} = \pi - \arcsin \frac{r_{o_p}}{d} \tag{736}$$

For $d \gg r_o$ the $\int\int$ is independent of the distance d and equal to $\int\int_{Induction} = 2.4662$.

$$F_i = \frac{k\ c\ \sqrt{m}\ \sqrt{m_p}}{4\ K\ d^2} \int\int_{Induction} \qquad with \qquad \int\int_{Induction} = 2.4662 \tag{737}$$

We get

$$F_i = 3.10447 \cdot 10^{-27}\ \frac{k}{d^2}\ \ N \tag{738}$$

If we make F_i equal to the attraction force between an electron and a positron

$$F_s = \frac{1}{4\pi\epsilon_o}\ \frac{q^2}{d^2} \qquad we\ \ get \qquad k = 7.4315 \cdot 10^{-2} \tag{739}$$

The maximum speed is thus $v_{max} = k\ c = 2.22944 \cdot 10^7\ m/s < c$.

Note: If we compare $k = 7.4315 \cdot 10^{-2}$ with $a = 8.7743 \cdot 10^{-2}$ from sec. 4.2 we see that they are very close. The difference comes from sec. 4.6 where we have introduced the equation for the induced force based on the equation for the Coulomb force. We have eliminated the cross product $|\bar{s}_1 \times \bar{s}_2| = \sin\beta$ from eq. (186) resulting in the difference between $\int\int_{Coulomb}$ and $\int\int_{Induction}$.

17.2 Induction between an accelerated and a probe BSP expressed as rotor.

We start with the induced force expressed as rotor of the $d'\bar{H}_n$ field

$$d'\bar{F}_{i_n} = \frac{1}{8\ \pi}\ \sqrt{m_p}\ r_{o_p}\ rot\ \frac{d}{dt} \int_{r_r}^{\infty} d'\bar{H}_n \tag{740}$$

We make the same assumptions from sec. 17.1 that $r_d = 0$ and that the moving BSP has a speed $v = 0$ but is accelerated in the direction of the probe BSP from $v = 0$ to $v = k'\ c$ in the time Δt over the distance Δx, and then returned to its original position in the time $\Delta t \to \infty$ by an external force. With the transformation $\varphi = \pi - \theta$ we get

$$\frac{d}{dt} \int_{r_r}^{\infty} d'\bar{H}_n = \frac{1}{4\pi}\ \sqrt{m}\ \frac{k'\ c}{\Delta t}\ \frac{r_o}{r_r}\ \sin\theta\ \bar{n} \tag{741}$$

We build the rotor

$$rot \, \frac{d}{dt} \int_{r_r}^{\infty} d' \bar{H}_n = \frac{1}{2\pi} \sqrt{m} \, \frac{k' \, c}{\Delta t} \, \frac{r_o}{r_r^2} \, \cos\theta \, \bar{s}_r \tag{742}$$

and get the force

$$d' \bar{F}_{i_n} = \frac{1}{16 \, \pi^2} \sqrt{m_p} \sqrt{m} \, \frac{r_{o_p} \, r_o}{r_r^2} \, \frac{k' \, c}{\Delta t} \, \cos\theta \, \bar{s}_r \tag{743}$$

For aligned BSPs we have that $\theta = 0$ and with $\Delta t = K \, r_o^2$ we get

$$d' \bar{F}_{i_n}|_{\theta=0} = \frac{1}{16 \, \pi^2} \sqrt{m_p} \sqrt{m} \, \frac{k' \, c}{K} \, \frac{1}{d^{\,2}} \, \bar{s}_r \tag{744}$$

or

$$d' \bar{F}_{i_n}|_{\theta=0} = 3.1886 \cdot 10^{-29} \, \frac{k'}{d^{\,2}} \, \bar{s}_r \;\; [N] \tag{745}$$

If we make F_i equal to the attraction force between an electron and a positron

$$F_s = \frac{1}{4\pi\epsilon_o} \frac{q^2}{d^2} \qquad we \;\; get \qquad k' = 7.2354 \tag{746}$$

The maximum speed thus is $v'_{max} = k' \; c = 2.1706 \cdot 10^9 \; m/s > c$, which is not realistic, but shows, that the rotor gives a smaller value compared with the exact space integration of the previous section. The rotor nevertheless can be used as a more practical calculation instrument if the right proportionality factor is introduced as follows:

Eq. (740) must be written as

$$d' \bar{F}_{i_n} = \frac{97.3612}{8 \, \pi} \sqrt{m_p} \, r_{o_p} \, rot \, \frac{d}{dt} \int_{r_r}^{\infty} d' \bar{H}_n \tag{747}$$

and eq. (741) as

$$\frac{d}{dt} \int_{r_r}^{\infty} d' \bar{H}_n = \frac{1}{4\pi} \sqrt{m} \, \frac{v_{max}}{\Delta t} \, \frac{r_o}{r_r} \, \sin\theta \, \bar{n} \quad with \quad v_{max} = 2.22944 \cdot 10^7 \; m/s \tag{748}$$

$$|d' \bar{F}_{i_n}|_{\theta=0}| = dF_r = 2.30706 \cdot 10^{-28} \, \frac{1}{r^2} \, [N] \tag{749}$$

17.2.1 Fundamental moment for the generation of forces.

The calculations of the variation of the speed $\Delta v = v_{max} - v = v_{max}$ to generate the Coulomb force of the previous sections, namely integration over the whole space and as a rotor, gave values very close to the light speed.

$$v_{max} = 2.22944 \cdot 10^7 \; m/s < c < v^{'}_{max} = 2.1706 \cdot 10^9 \; m/s \tag{750}$$

Our intention now is to give the force F_r the following form

$$dF_r = dp_o \, \nu_r \;\; [N] \qquad with \qquad dp_o = m \, v_{max} \tag{751}$$

We are free to choose any value for the fundamental moment $dp_o = m \; v_{max}$ and take $v_{max} = c$. The reason is that it gives a simple relation between dp_o and $\nu_o = \frac{1}{\Delta_o t}$ as shown in sec. 9.1 where we have deduced that

$$E_e \, \Delta t = E_o \, \Delta_o t = h \qquad or \qquad m \, c = \frac{h}{c} \nu_o \tag{752}$$

where h is the Planck constant.

We now define that the force dF_r is the product of a fundamental momentum $dp_o = m \, v_{max}$ and the frequency ν_r at which the fundamental moment is generated.

$$dF_r = dp_o \, \nu_r \;\; [N] \qquad with \qquad dp_o = m \, v_{max} \tag{753}$$

and make $v_{max} = c \;\; m/s$. We get

$$dp_o = m \, c = 2.73282 \cdot 10^{-22} \qquad and \qquad \nu_r = 8.44205 \cdot 10^{-7} \, \frac{1}{r^{\,2}} \, [s^{-1}] \tag{754}$$

The linear momentum dp_o is the momentum generated by the transversal angular momenta of regenerating FPs when they arrive to the focus, as shown in Fig. 100. From

$$dE_n = \nu \, |\bar{J}_n| \qquad dE_p = \frac{\nu}{2\pi R} \oint \bar{J}_n \cdot \bar{l} \qquad dp = \frac{1}{c} dE_p \tag{755}$$

with $J_n = h$ and $\nu = \nu_o = 1/\Delta_o t$ we get

$$dp = \frac{\nu_o \, h}{c} = 2.73282 \cdot 10^{-22} = m \, c = dp_o \tag{756}$$

a simple relation between between dp_o and $\nu_o = \frac{1}{\Delta_o t}$ as anticipated.

To get a moment $dp_o = m \, c$ the electron or positron must move with

$$dp_o = m\,c = \frac{m\,v}{\sqrt{1-\frac{v^2}{c^2}}} \qquad \rightarrow \qquad v = \frac{1}{\sqrt{2}}\,c = 2.12132 \cdot 10^8 \;\; m/s \tag{757}$$

The fundamental force $F_o = dp_o\ \nu_o$ is generated with $\nu_o = 1/\Delta_o t = 1.23725 \cdot 10^{20}\ [s^{-1}]$ and gives $F_o = 2.51271 \cdot 10^{-3}\ N$.

The concept is shown at Fig. 100

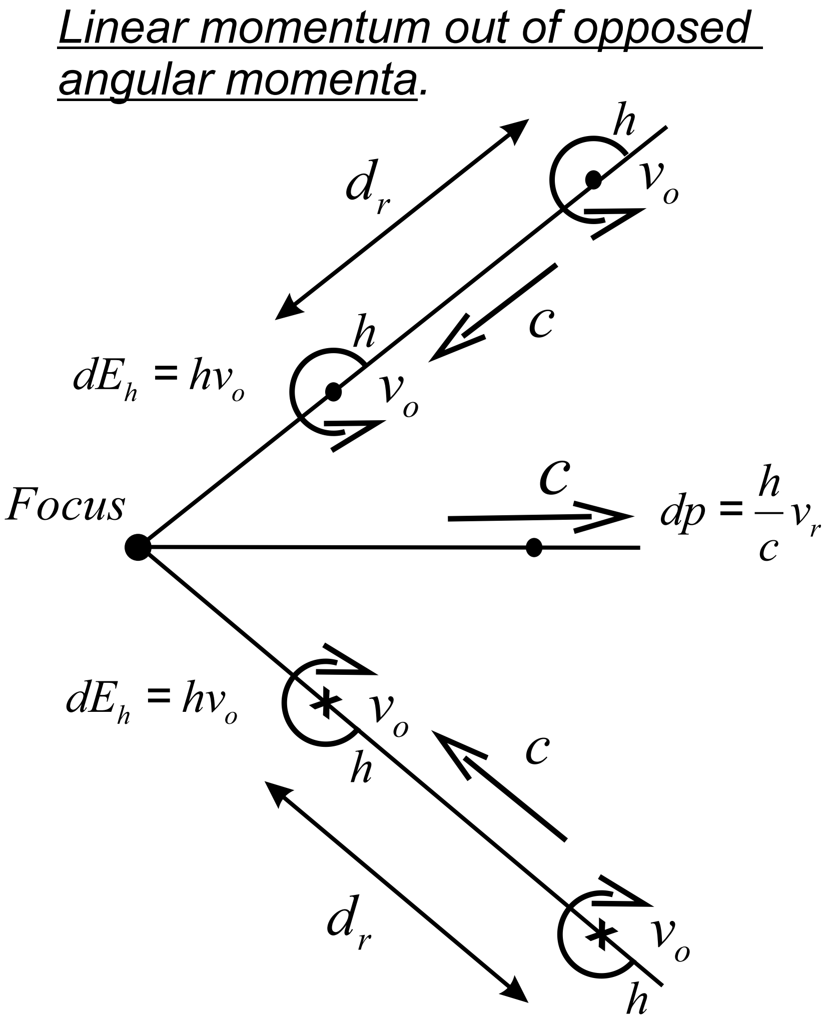


Figure 100: Linear momentum out of opposed angular momenta.

If we now concentrate on the orbit electron with the Bohr radius $a_o = 5.29189 \cdot 10^{-11}\ m$ we get from (754)

$$\nu_B = 8.44205 \cdot 10^{-7} \frac{1}{a_o^2} [s^{-1}] = 3.014576 \cdot 10^{14}\ s^{-1} \tag{758}$$

and

$$\Delta_B t = \frac{1}{\nu_B} = 3.31722 \cdot 10^{-15}\ \ s >> \Delta_o t = 8.0824 \cdot 10^{-21}\ \ s \tag{759}$$

The distance between two consecutive Fundamental Particles for the Bohr radius is

$$d_r = d_B = c\,\Delta_B t = 9.951648 \cdot 10^{-7}\ m \tag{760}$$

Note: In the previous analysis we have concentrated on region 5 of the curve Fig. 66 of sec. 10 where the Coulomb law is valid. At the region 2 we must write in (754) that

$$\nu_r \propto r^2 \tag{761}$$

17.3 Induced gravitation force between two complex SPs.

We have defined complex subatomic particles (SPs) like the proton, neutron, etc, as composed of positive and negative BSPs that are grouped in the zone left to the maximum of the momentum curve of Fig. 29 (See also lower part of Fig. 101). The neutron for instance with 919 positrons and 919 electrons, neglecting the binding energy. Accelerating and decelerating BSPs of Fig. 3 don't mix in the nucleus of complex SPs. They have different emitting and regenerating fundamental particles with different angular momentums and speeds. They are in a dynamic equilibrium in the nucleus of the complex SP.

We now show at Fig. 101 the generation of the gravitation force between two neutrons. If at neutron 1 a positron or electron migrates outside the zone where $\beta = 0$, opposed momentums dp are induced at the positron or electron and the rest of the neutron 1. The momentum dp_b reintegrates the escaped positron or electron to the nucleus of the neutron 1 generating the transversal field dH_n, whose direction is the same for the positron or electron. If now during the reintegration process the transversal field dH_n is transferred according postulate 8 to the regenerating FPs of neutron 2 with its field dH_{s_p}, the positron or electron will stop moving towards the center of the nucleus of neutron 1, and neutron 2 will now move in the direction of neutron 1 with the momentum $dp_p = dp_b$. If to the contrary, during the reintegration process the transversal field dH_n is not transferred to the regenerating FPs of neutron 2 with its longitudinal field dH_{s_p}, then the opposed momentums dp_a at the positron or electron and dp_b at the rest of the neutron 1 compensate. Escaped electrons and positrons are continuously forced to reintegrate to the center of the nucleus of neutron 1. The probability that the transversal field dH_n is transferred to the regenerating FPs of neutron 2 follows the law of the inverse square distance d between the neutrons, resulting the known gravitation force for distances $d \gg r_n$, where r_n is the radius of the neutron.

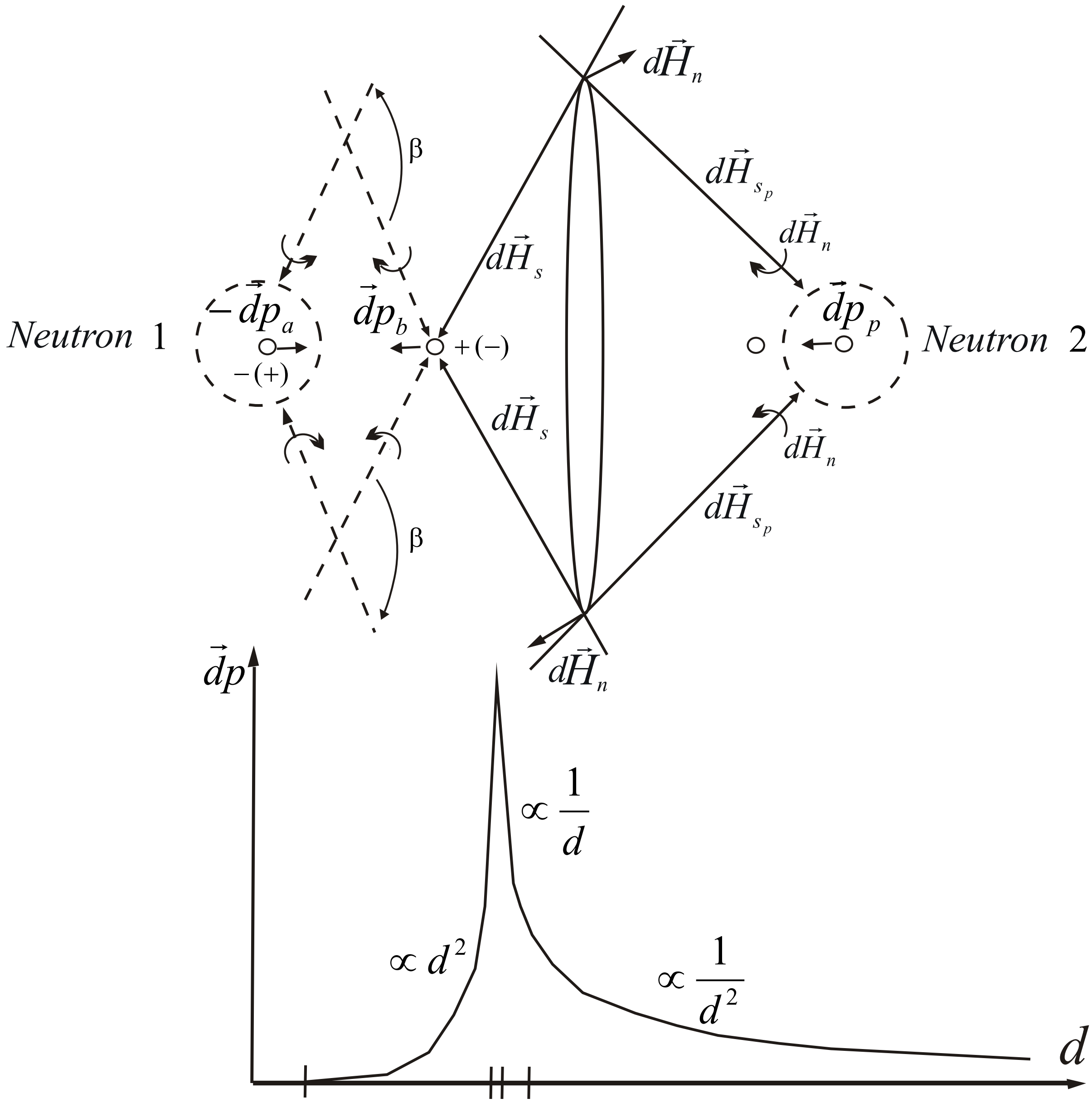


Figure 101: Induced gravitation force between two neutrons.

17.4 Transmission of gravitation momentum.

The neutron is composed of $n^+ = 919$ positrons and $n^- = 919$ electrons. Positrons of the neutron provide the required regenerating FPs to electrons and vice versa. The fields of positrons and electrons compensate and no external field of FPs exist. The proton is composed of $n^+ = 919$ positrons and $n^- = 918$ electrons. One positron of the proton is not compensated by an electron and therefore an external field exists. The concept is shown in Fig. 102.

For the following figures see conventions introduced for the representation of the positron and electron in sec. 4.3.

Fig. 103 shows a neutron with one migrated BSP and the corresponding leaking

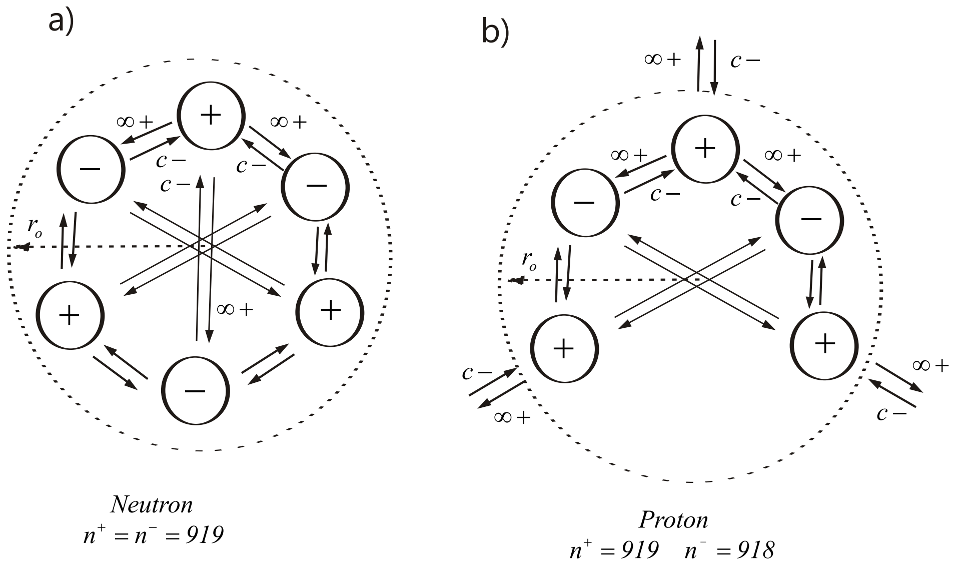


Figure 102: Neutron and proton

fields.

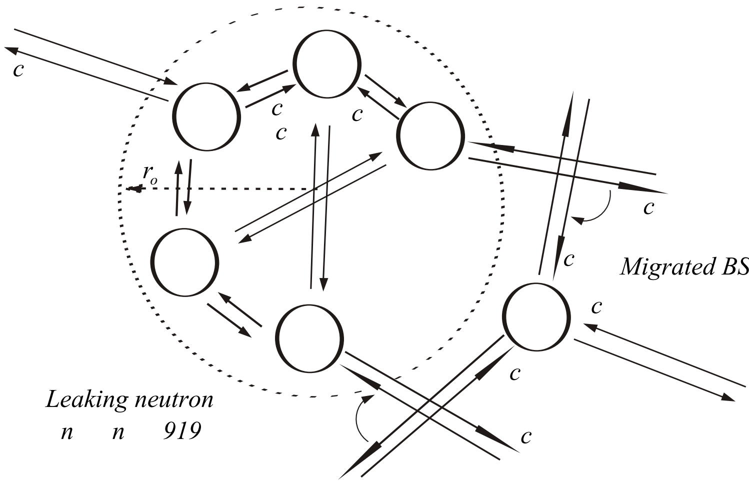


Figure 103: Neutron with migrated BSP

Fig. 104 shows the linear momentum dp_b generated by a migrated BSP when reintegrated to the nucleus of neutron 1. Also rays (v_e) followed by emitted FPs of the migrated BSP and rays (v_r *and* v_r') followed by regenerating FPs of BSPs of neutron 2 are shown.

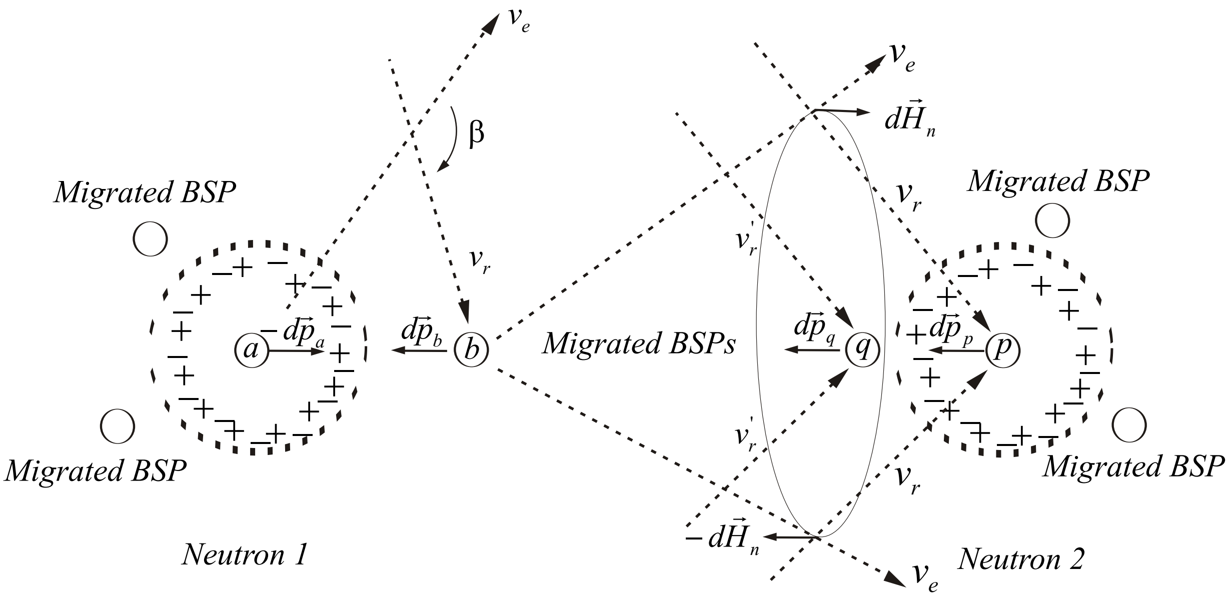


Figure 104: Transmission of momentum dp from neutron 1 to neutron 2

18 The $\bar{d}H_n$ field induced at a point P during reintegration of a migrated BSP to its nucleus.

En electron that has migrated slowly outside the core of a neutron formed by $n^+ = 919$ positrons and $n^- = 919$ electrons will interact with one of the positrons of the core of the neutron and be reintegrated to the neutron. Because of moment conservation they will have the same moment. The moment of the positron who moves in the core of the neutron will pass its moment to the $n^+ = 919$ positrons and now $n^- = 918$ electrons so that the core will move as a unit.

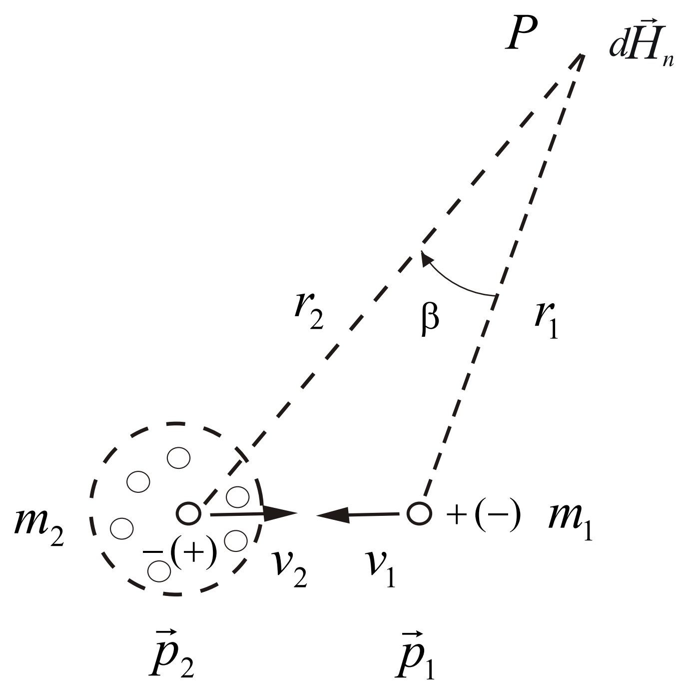


Figure 105: Field dH due to reintegration of an electron to its neutron

The $\bar{d}H_n$ fields induced at a point P in space due to the moving electron and neutron core are:

$$dH_{n_1} = v_1 \sqrt{m_1}\, d\kappa_1 \qquad\qquad dH_{n_2} = v_2 \sqrt{m_2}\, d\kappa_2 \tag{762}$$

where the sub-index **1** stands for the electron and **2** for the neutron which now has a positive charge. The distances r_1 and r_2 to the point in space are nearly equal so that $r_1 = r_2$ and $d\kappa_1 = d\kappa_2$. We also have

$$p_1 = m_1\, v_1 \qquad p_2 = m_2\, v_2 \qquad with \qquad p_1 = p_2 \qquad v_2 = \frac{m_1}{m_2}\, v_1 \tag{763}$$

and we get

$$dH_{n_2} = \sqrt{\frac{m_1}{m_2}}\, dH_{n_1} \qquad resulting \qquad dH_{n_2} \; = 2.3321 \cdot 10^{-2}\, dH_{n_1} \tag{764}$$

For the analysis of the induced gravitation force and the induced current in an superconductor only the dH_{n_1} field generated by the reintegrating electron or positron is relevant. The induced opposed dH_{n_2} field generated by the movement of the neutron core can be neglected.

19 Newton gravitation force.

To calculate the gravitation force induced by the reintegration of migrated BSPs, we need to know the number of migrated BSPs in the time Δt for a neutral body with mass M.

The equation (737) for the **induced gravitation** force generated by one reintegrated electron or positron is

$$F_i = \frac{dp}{\Delta t} = \frac{k\; c\, \sqrt{m}\; \sqrt{m_p}}{4\; K\; d^{\,2}} \int\!\!\int_{Induction} \qquad with \qquad \int\!\!\int_{Induction} = 2.4662 \tag{765}$$

with m the mass of the reintegrating BSP, m_p the mass of the resting BSP, $k = 7.4315 \cdot 10^{-2}$. It is also

$$\Delta t = K\; r_o^2 \qquad r_o = 3.8590 \cdot 10^{-13}\;\; m \qquad and \qquad K = 5.4274 \cdot 10^4\;\; s/m^2 \tag{766}$$

The direction of the force F_i on BSP p of neutron 2 in Fig. 104 is independent of the sign of the BSPs and is always oriented in de direction of the reintegrating BSP b of neutron 1.

Fig. 106 shows reintegrating BSPs a and d at Neutron 1 that transmit respectively opposed momenta p_g and p_e to neutron 2. Because of the grater distance from neutron 2 of BSP a compared with BSP d, the probability for BSP d to transmit his momentum is grater than the probability for BSP a. Momenta are quantized and have all equal absolute value independent if transmitted or not. The result computed over a mass M gives a net number of transmitted momentum to neutron 2 in the direction of neutron 1, what explains the attraction between neutral masses.

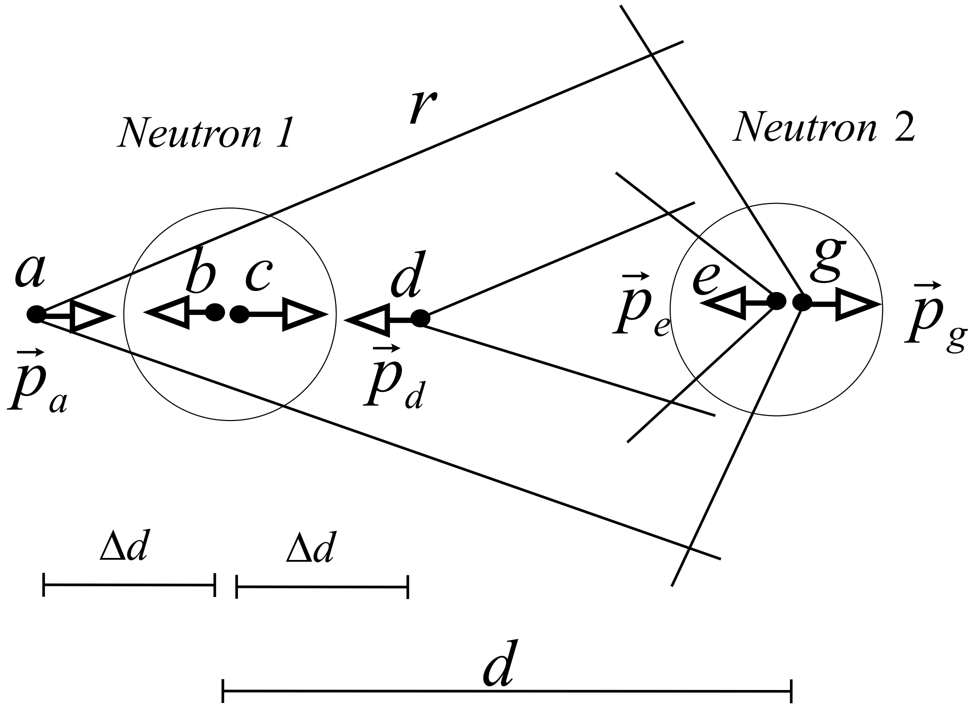


Figure 106: Net momentum transmitted from neutron 1 to neutron 2

For two bodies with masses M_1 and M_2 and where the number of reintegrated BSPs in the time Δt is respectively Δ_{G_1} and Δ_{G_2} it must be

$$F_i\ \Delta_{G_1}\ \Delta_{G_2} = G\ \frac{M_1\ M_2}{d^{\,2}} \qquad with \qquad G = 6.6726 \cdot 10^{-11}\ \frac{m^3}{kg\ s^2} \tag{767}$$

As the direction of the force F_i is the same for reintegrating electrons Δ_G^- and positrons Δ_G^+ it is

$$\Delta_G = |\Delta_G^-| + |\Delta_G^+| \tag{768}$$

We get that

$$\Delta_{G_1}\ \Delta_{G_2} = G\ \frac{4\ K\ M_1\ M_2}{m\ k\ c\ \int\int_{Induction}} \tag{769}$$

or

$$\Delta_{G_1}\ \Delta_{G_2} = 2.8922 \cdot 10^{17}\ M_1\ M_2 = \gamma_G^2\ M_1\ M_2 \tag{770}$$

The number of migrated BSPs in the time Δt for a neutral body with mass M is thus

$$\Delta_G = \gamma_G\ M \qquad with \qquad \gamma_G = 5.3779 \cdot 10^{8}\ \ kg^{-1} \tag{771}$$

Calculation example: The number of migrated BSPs that are reintegrated at the sun and the earth in the time Δt are respectively, with $M_\odot = 1.9891 \cdot 10^{30}\ kg$ and $M_\dagger = 5.9736 \cdot 10^{24}\ kg$

$$\Delta_{G_\odot} = 1.0697 \cdot 10^{39} \qquad and \qquad \Delta_\dagger = 3.2125 \cdot 10^{33} \tag{772}$$

The power exchanged between two masses due to gravitation is

$$P_G = F_i\ c = \frac{E_p}{\Delta t} = \frac{k\ m\ c^2}{4\ K\ d^{\,2}}\ \Delta_{G_1}\ \Delta_{G_2} \int\int_{Induktion} \tag{773}$$

The power exchanged between the sun and the earth is, with $d_{\odot\dagger} = 1.49476 \cdot 10^{11}\ m$

$$P_G = F_G\ c = \ G\ \frac{M_\odot\ M_\dagger}{d^2_{\odot\dagger}}\ c = 1.0646 \cdot 10^{31}\ \ J/s \tag{774}$$

20 Ampere gravitation force.

In the previous sections we have seen that the induced gravitation force is due to the reintegration of migrated BSPs in the direction d of the two gravitating bodies (longitudinal reintegration). When a BSP is reintegrated to a neutron, the two BSPs of different signs that interact, produce an equivalent current in the direction of the positive BSP as shown in Fig. 107.

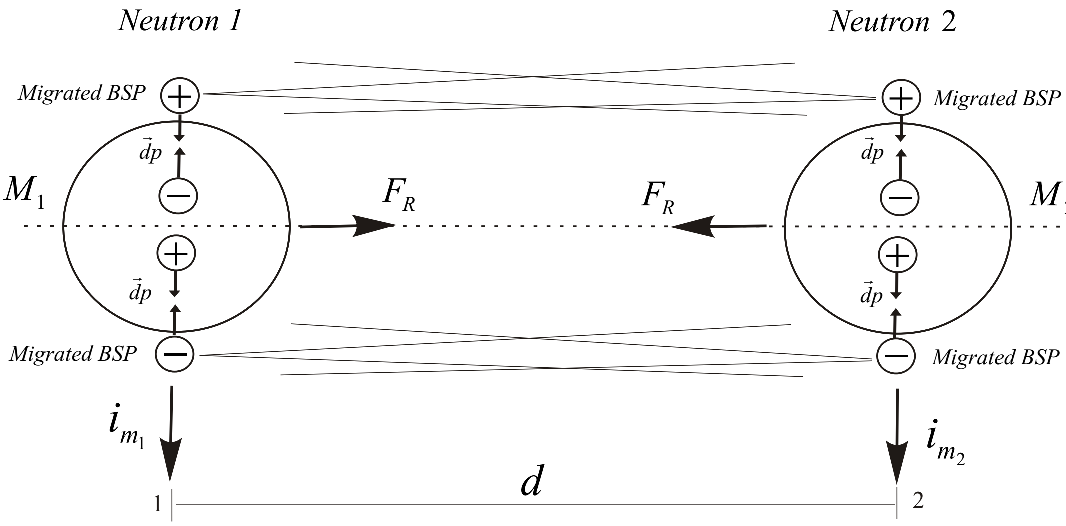


Figure 107: Resulting current due to reintegration of migrated BSPs

As the numbers of positive and negative BSPs that migrate in one direction at one neutron are equal, no average current should exists in that direction in the time Δt. It is

$$\Delta_R = \Delta_R^+ + \Delta_R^- = 0 \tag{775}$$

We now assume that because of the power exchange (773) between the two neutrons, a synchronization between the reintegration of BSPs of equal sign in the direction orthogonal to the axis defined by the two neutrons is generated, resulting in parallel currents of equal sign that generate an attracting force between the neutrons. The synchronization is generated by the relative movements between the gravitating bodies and is zero between static bodies. Thus the total attracting force between the two neutrons is produced first by the induced (Newton) force and second by the currents of reintegrating BSPs (Ampere).

$$F_T = F_G + F_R \qquad with \qquad F_G = G\,\frac{M_1\,M_2}{d^2} \qquad and \qquad F_R = R\,\frac{M_1\,M_2}{d} \tag{776}$$

To derive an equation we start with the following equation (281) derived for the total force density due to Ampere interaction.

$$\frac{F}{\Delta l} = \frac{b}{c\,\Delta_o t}\,\frac{r_o^2}{64\,m}\,\frac{I_{m_1}\,I_{m_2}}{d}\int_{\gamma_{2min}}^{\gamma_{2max}}\int_{\gamma_{1min}}^{\gamma_{1max}}\frac{\sin^2(\gamma_1-\gamma_2)}{\sqrt{\sin\gamma_1\,\sin\gamma_2}}\,d\gamma_1\,d\gamma_2 \tag{777}$$

with $\int\int_{Ampere} = 5.8731$.

It is also for $v \ll c$

$$\rho_x = \frac{N_x}{\Delta x} = \frac{1}{2\,r_o} \qquad I_m = \rho\,m\,v \qquad \Delta_o t = K\,r_o^2 \qquad I_m = \frac{m}{q}\,I_q \tag{778}$$

We have defined a density ρ_x of BSPs for the current so that one BSP follows immediately the next without space between them. As we want the force between one pair of BSPs of the two parallel currents we take $\Delta l = 2\,r_o$.

For one reintegrating BSP it is $\rho = 1$. The current generated by one reintegrating BSP is

$$I_{m_1} = i_m = \rho\,m\,v_m = \rho\,m\,k\,c \qquad with \qquad v_m = k\,c \qquad k = 7.4315\cdot 10^{-2} \tag{779}$$

We get for the force between one transversal reintegrating BSP at the body with mass M_1 and one longitudinal reintegrating BSP at M_2 moving parallel with the speed v_2

$$dF_R = 5.8731\,\frac{b}{\Delta_o t}\,\frac{2\,r_o^3}{64}\,\rho^2\,m\,k\,\frac{v_2}{d} = 2.2086\cdot 10^{-50}\,\frac{v_2}{d}\ N \tag{780}$$

with $I_{m_2} = i_2 = \rho\, m\, v_2$.
The concept is shown in Fig. 108.

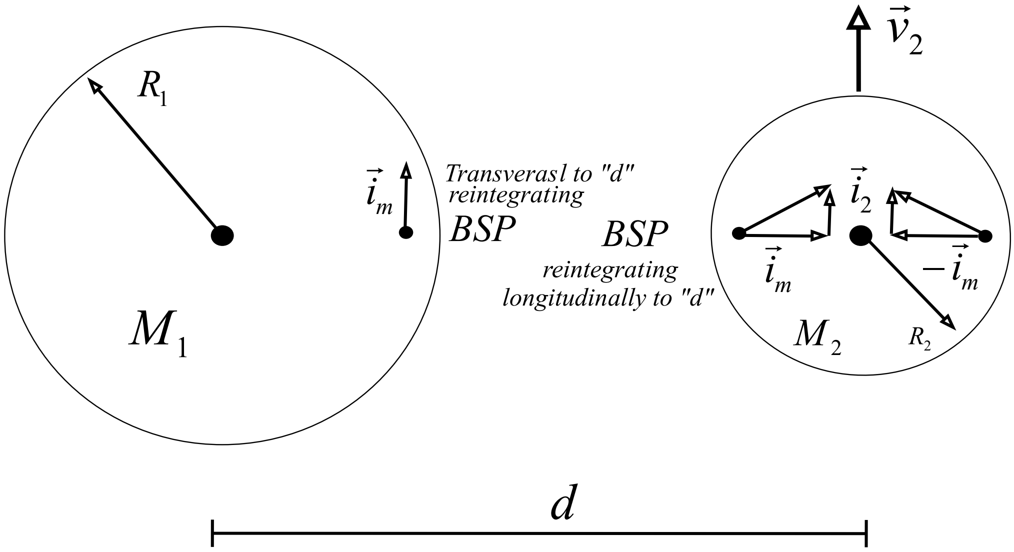


Figure 108: Ampere gravitation

Note: The sign that takes the current i_m of the reintegrating BSP at the body with mass M_1 which interacts with the current i_2, is a function of the direction of the magnetic poles of M_1. The Ampere gravitation force F_R is therefore an attraction or a repulsion force depending on the relative directions of the magnetic poles of M_1 and the speed v_2.

In sec. 19 we have derived the mass density γ_G of reintegrating BSPs. At Fig. 106 we have seen that half of the longotudinal reintegrating BSPs of a neutron 1 induce momenta on neutron 2 in one direction while the other half of longitudinal reintegrating BSPs induce momenta in the opposed direction on neutron 2. In Fig. 108 we see, that all longitudinal reintegrating BSPs at M_2 generate a current component i_2 in the direction of the speed v_2. This means that we have to take for the density γ_A of reintegrating BSPs for the Ampere gravitation force approximately twice the value of the density γ_G of the Newton gravitation force

$$\gamma_A \approx 2\,\gamma_G = 2 \cdot 5.3779 \cdot 10^8 = 1.07558 \cdot 10^9 \;\; kg^{-1} \tag{781}$$

resulting for the total Ampere gravitation force between M_1 and M_2

$$F_R = \; 5.8731\,\frac{b}{\Delta_o t}\,\frac{2\,r_o^3}{64}\,\rho^2\,m\,k\,v_2\,\gamma_A^2\,\frac{M_1\,M_2}{d} = 2.5551 \cdot 10^{-32}\,v_2\,\frac{M_1\,M_2}{d} \;\; N \tag{782}$$

where

$$F_R = R\,\frac{M_1\,M_2}{d} \qquad with \qquad R = 2.5551 \cdot 10^{-32}\,v_2 = R(v_2) \tag{783}$$

The total gravitation force gives

$$F_T = F_G + F_R = \left[\frac{G}{d^2} + \frac{R}{d}\right]\,M_1\,M_2 \tag{784}$$

The concept is shown in Fig. 109.

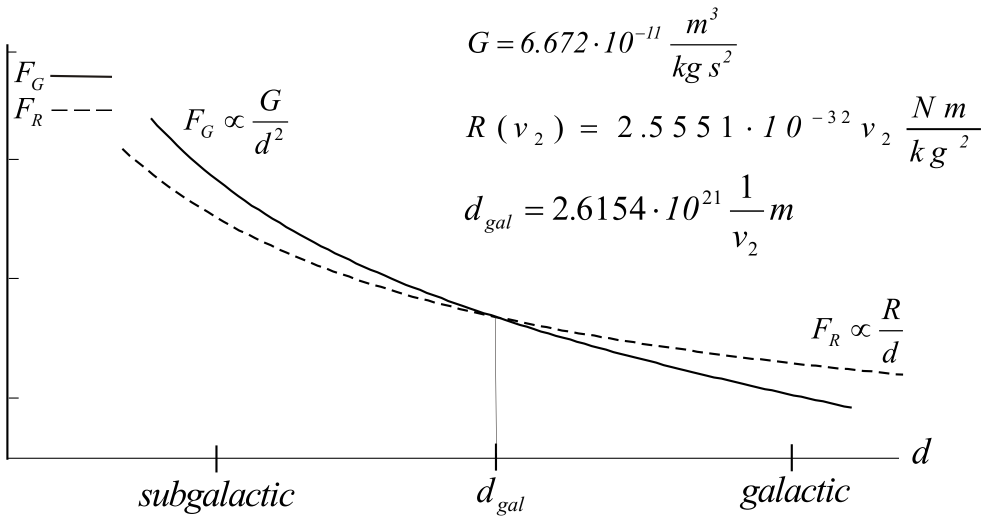


Figure 109: Gravitation forces at sub-galactic and galactic distances.

20.1 Flattening of galaxies' rotation curve.

For galactic distances the Ampere gravitation force F_R predominates over the induced gravitation force F_G and we can write eq. (784) as

$$F_T \approx F_R = \frac{R}{d}\,M_1\,M_2 \tag{785}$$

The equation for the centrifugal force of a body with mass M_2 is

$$F_c = M_2\,\frac{v_{orb}^2}{d} \qquad\qquad with\ v_{orb}\ the\ tangential\ speed \tag{786}$$

For steady state mode the centrifugal force F_c must equal the gravitation force F_T. For our case it is

$$F_c = M_2\,\frac{v_{orb}^2}{d} = F_T \approx F_R = \frac{R}{d}\,M_1\,M_2 \tag{787}$$

We get for the tangential speed

$$v_{orb} \approx \sqrt{R\, M_1} \qquad constant \tag{788}$$

The tangential speed v_{orb} is independent of the distance d what explains the flattening of galaxies' rotation curves.

Calculation example

In the following calculation example we assume that the transition distance d_{gal} is much smaller than the distance between the gravitating bodies and that the Newton force can be neglected compared with the Ampere force.

For the Sun with $v_2 = v_{orb} = 220\ km/s$ and $M_2 = M_\odot = 2 \cdot 10^{30}\ kg$ and a distance to the core of the Milky Way of $d = 25 \cdot 10^{19}\ m$ we get a centrifugal force of

$$F_c = M_2\, \frac{v_{orb}^2}{d} = 3.872 \cdot 10^{20}\ \ N \tag{789}$$

With

$$R(v_2) = 2.5551 \cdot 10^{-32}\ v_2 = 5.6212 \cdot 10^{-27}\ \ Nm/kg^2 \tag{790}$$

and

$$F_c \approx R\, \frac{M_1\, M_2}{d} \tag{791}$$

we get a Mass for the Milky Way of

$$M_1 = F_c\, d\, \frac{1}{R\, M\odot} = 4.3 \cdot 10^6\ M\odot \tag{792}$$

and with

$$F_G = F_R \qquad we\ get \qquad d_{gal} = \frac{G}{R} = 1.1870 \cdot 10^{16}\ \ m \tag{793}$$

justifying our assumption for $F_T \approx F_R$ because the distance between the Sun and the core of the Milky Way is $d \gg d_{gal}$.

Note: The mass of the Milky Way calculated with the Newton gravitation law gives $M_1 \approx 1.5 \cdot 10^{12}\ M\odot$ which is huge more than the bright matter and therefore called dark matter. The mass calculated with the present approach corresponds to the bright matter and there is no need to introduce virtual masses in space.

For sub-galactic distances the induced force F_G is predominant, while for galactic distances the Ampere force F_R predominates, as shown in Fig. 109.

$$d_{gal} = \frac{G}{R} \tag{794}$$

Note: The flattening of galaxies' rotation curve was derived based on the assumption that the gravitation force is composed of an induced component and a component due to parallel currents generated by reintegrating BSPs and, that for galactic distances the induced component can be neglected.

20.2 Current induced on a rotating body.

In sec. 20 we have analysed the interactions between reintegrating BSPs of two bodies that move relative with the speed v_2. Now we analyse the case of two bodies where one of them rotates relative to the other.

The concept is shown in Fig. 110

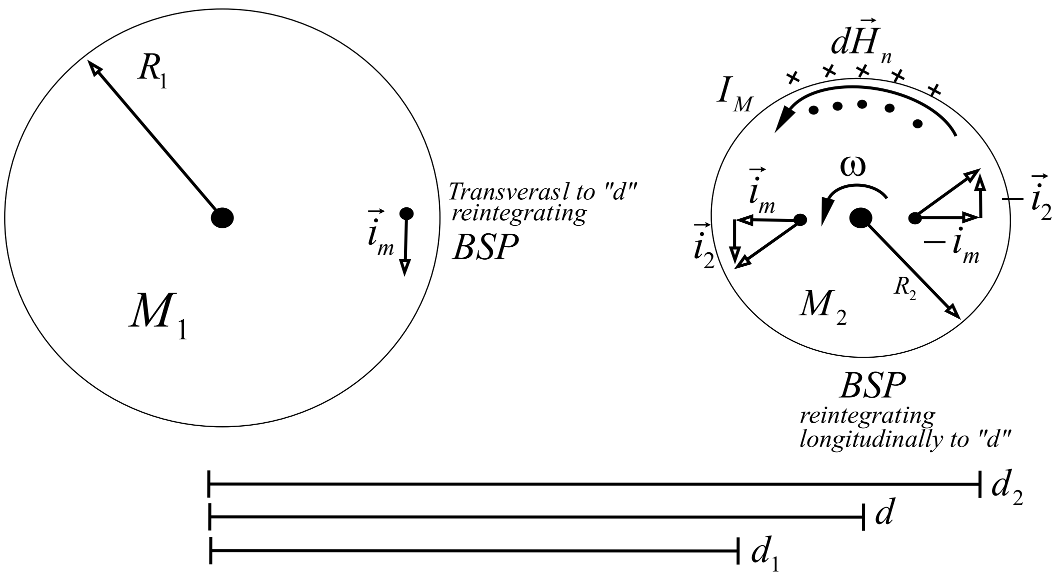


Figure 110: Induced current I_M and field dH_n on a rotating neutral body.

Comparing with Fig.108 all BSPs at the distance d_1 move with $-v_2$ and all BSPs at the distance d_2 move with v_2. Reintegrating BSPs at M_2 that are at the distance d_1 from M_1 define the direction of the currents i_m at M_1 because they are closer than reintegrating BSPs of M_2 at the distance d_2. The net result is a closed loop of currents i_2 at M_2 giving the current I_M which generates the transversal field dH_n. Please see also subsection **Permanent magnetism** at [25.9].

21 Electromagnetic and Gravitation emissions.

Fig. 111 shows the generation of the electromagnetic emission and the gravitation emission.

At **a)** a Subatomic Particle (SP), electron or positron, shows transversal angular momenta J_n of its Fundamental particles (FPs) when moving with constant moment p relative to a second SP (not shown). The transversal angular momenta of its FPs follow the right screw law in moving direction independent of the charge. FPs with opposed angular momenta are entangled and are fixed to the SP. No FPs are emitted when moving with constant speed.

When the moving SP approaches a second SP (not in the drawing), the opposed transversal angular momenta are passed to the second SP via their regenerating FPs so that the first SP looses moment while the second SPs gains moment.

At **b**) a oscillating SP is shown with the pairs of emitted FPs with opposed angular momenta at the closed circles changing ciclically their directions. At far distances from the SP trains of FPs with opposed angular momenta become independent from the SP and move with light speed (photons) relative to its source. According to which combination of opposed entangled FPs become independent we have a train with potentially transversal momenta p (shown) or potentially longitudinal momenta p (not shown).

At **c**) a SP is shown that migrates slowly to the right outside the atomic nucleus and is than reintegrated to the left with high speed to its nucleus . The migration is so slow that no transversal angular momenta are generated at their FPs. When reintegrated, FPs with opposed transversal angular momenta become independent and move until absorbed by regenerating FPs of a second SP (not shown). As the transversal angular momenta of a moving SP follow the right screw law in moving direction independent of the charge of the SP, the reintegration will generate always potential longitudinal momenta p in the direction of the nucleus. The emitted pairs of opposed angular momenta with potential longitudinal momenta p have all the same direction, and when passed to a second SP generate the gravitation force.

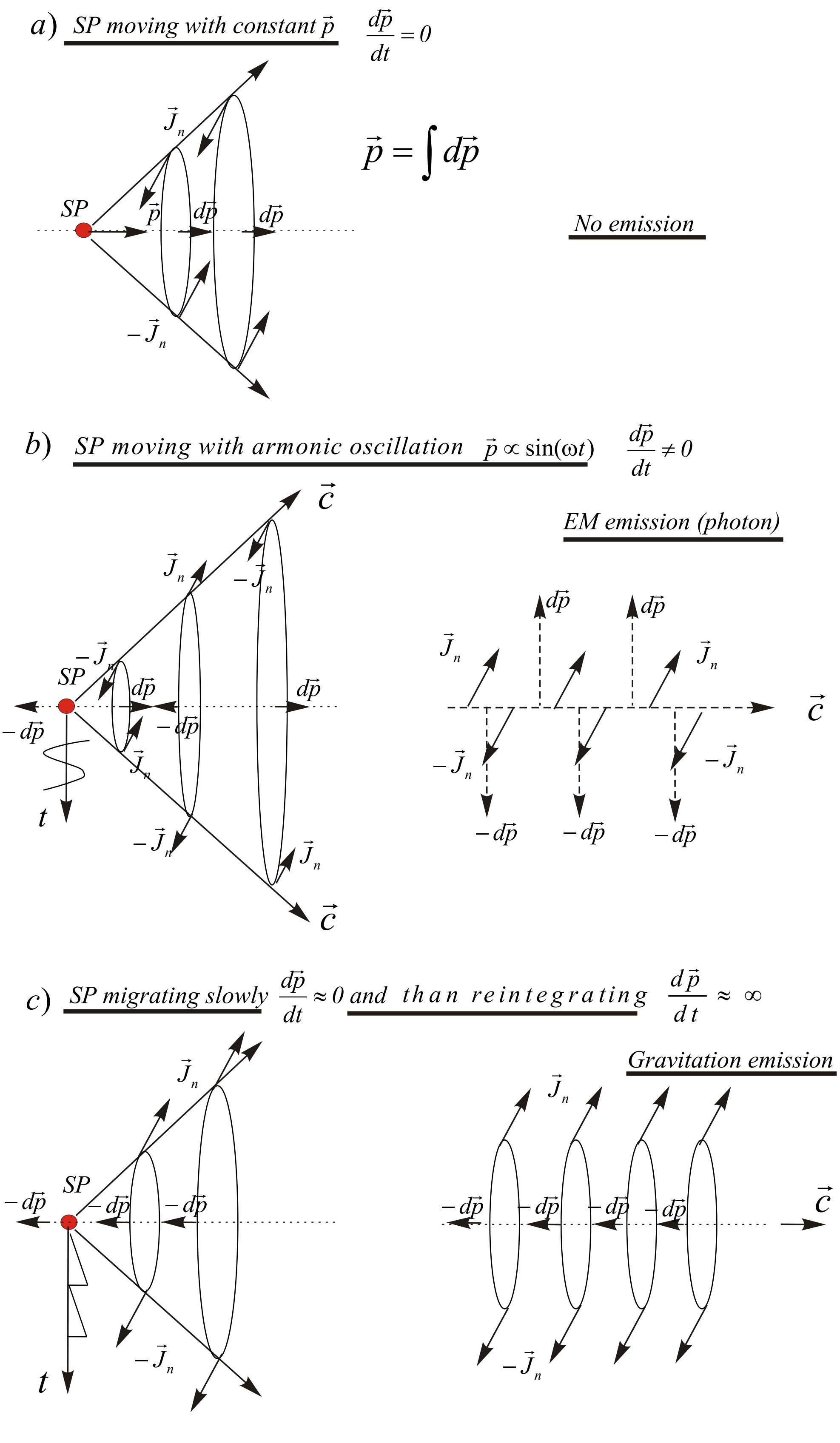


Figure 111: Electromagnetic and Gravitation emissions

22 Quantification of forces between BSPs and CSPs.

In sec. 17.1 we have derived the speed $v = k\ c$ with which migrated BSP are reintegrated generating the Coulomb force and the two components of the gravitation force. In sec. 9.2.1 we have seen that the momentum generated by one pair of FPs with opposed angular momenta is

$$p_{FP} = \frac{2\ E_{FP}}{c} = 2.20866 \cdot 10^{-34}\ \ kgms^{-1} \tag{795}$$

We define now an elementary momentum

$$p_{elem} = m\ k\ c = 2.0309 \cdot 10^{-23}\ \ kgms^{-1} \tag{796}$$

The number of pairs of FPs required to generate the momentum p_{elem} in the time $\Delta_o t$ is

$$\frac{p_{elem}}{p_{FP}} = 9.1951 \cdot 10^{10} \tag{797}$$

In the following subsections we express all known forces quantized in elementary linear momenta p_{elem}.

22.1 Quantification of the Coulomb force.

In Sec. 4.2 we have derived the Coulomb force between two BSPs arriving to eq. (202) that follows

$$F_2 = \frac{a\ m\ c\ r_o^2}{4\ \Delta_o t\ d^{\,2}} \int\int_{Coulomb} \qquad with \qquad \int\int_{Coulomb} = 2.0887 \tag{798}$$

We now write the equation as follows

$$F_2 = N_C(d)\ \frac{1}{\Delta_o t}\ p_{elem} = N_C(d)\ \nu_o\ p_{elem} \qquad p_{elem} = m\ k\ c \qquad a = 8.774 \cdot 10^{-2} \tag{799}$$

with

$$N_C(d) = \frac{a\ r_o^2}{4\ k\ d^{\,2}} \int\int_{Coulomb} = 9.1808 \cdot 10^{-26}\ \frac{1}{d^2} \tag{800}$$

$\nu_C(d) = N_C(d)\ \nu_o$ gives the number of elementary linear momenta p_{elem} during the time $\Delta_o t$ resulting in the force F_2.

For an inter-atomic distance of $d = 10^{-10}\ m$ we get $N_C = 9.1808 \cdot 10^{-6}$ resulting a frequency of elementary momenta of

$$\nu_C(d) = N_C(d)\ \nu_o = 1.1359 \cdot 10^{15}\ \ s^{-1} \qquad for \qquad d = 10^{-10}\ m \tag{801}$$

22.2 Quantification of the Ampere force between straight infinite parallel conductors.

In Sec. 4.11 we have derived the Ampere force between two parallel conductors arriving to eq. (281) that follows

$$\frac{F}{dl} = \frac{b}{c\ \Delta t}\ \frac{r_o^2}{64\ m}\ \frac{I_{m_1}\ I_{m_2}}{d} \int\int_{Ampere} \qquad with \qquad \int\int_{Ampere} = 5.8731 \tag{802}$$

and $b = 0.25$. We now write the equation in the following form assuming that the velocity of the electrons is $v << c$ so that $\Delta t \approx \Delta_o t$ and the currents are $I_m \approx \rho_x\ m\ v$, where $\rho_x = N_x/\Delta x$ is the linear density of electrons that move with speed v in the conductors.

$$F = N_A(d, I_{m_1}, I_{m_2},\ \Delta l)\ \nu_o\ p_{elem} \qquad p_{elem} = k\ m\ c \qquad \nu_o = \frac{1}{\Delta_o t} \tag{803}$$

with

$$N_A(d, I_{m_1}, I_{m_2},\ \Delta l) = \frac{b\ r_o^2}{64\ k\ m^2\ c^2}\ \frac{I_{m_1}\ I_{m_2}}{d} \int\int_{Ampere} \Delta l \tag{804}$$

or

$$N_A(d, I_{m_1}, I_{m_2},\ \Delta l) = 6.1557 \cdot 10^{17}\ \frac{I_{m_1}\ I_{m_2}}{d}\ \Delta l \tag{805}$$

For a distance of $1m$ between parallel conductors with a length of $\Delta l = 1m$ and currents of $1A$ we get $N_A = 6.1557 \cdot 10^{17}$. The frequency of elementary momenta for this particular case

$$\nu_A = N_A(d, I_{m_1}, I_{m_2},\ \Delta l)\ \nu_o = 7.6158 \cdot 10^{37}\ \ s^{-1} \tag{806}$$

22.3 Quantification of the induced gravitation force (Newton).

From sec. 19 eq. (765) we have that the gravitation force for **one** aligned reintegrating BSPs is

$$F_i = \frac{k\ m\ c}{4\ K\ d^2} \int\int_{Induction} \qquad with \qquad \int\int_{Induction} = 2.4662 \tag{807}$$

which we can write with $\Delta_o t = K\ r_o^2$ and $p_{elem} = k\ m\ c$ as

$$F_i = N_i\ \nu_o\ p_{elem} \qquad with \qquad N_i = \frac{r_o^2}{4\ d^2} \int\int_{Induction} \tag{808}$$

Considering that $\Delta G_1\ \Delta G_2 = \gamma_G^2\ M_1\ M_2$ we can write for the total force between two masses M_1 and M_2

$$F_G = F_i\ \Delta G_1\ \Delta G_2 = N_G\ \nu_o\ p_{elem} \qquad with \qquad N_G = N_i\ \Delta G_1\ \Delta G_2 \tag{809}$$

where N_G represents the probability of elementary forces $f_{elem} = \nu_o\ p_{elem}$ in the time $\Delta_o t = K\ r_o^2$.

Finally we get

$$F_G = N_G(M_1, M_2, d)\ \nu_o\ p_{elem} \qquad with \qquad N_G = 2.6555 \cdot 10^{-8}\ \frac{M_1\ M_2}{d^2} \tag{810}$$

The frequency with which elementary momenta are generated is

$$\nu_G = N_G(M_1, M_2, d)\ \nu_o = 3.2856 \cdot 10^{12}\ \frac{M_1\ M_2}{d^2} \tag{811}$$

For the earth with a mass of $M_\oplus = 5.974 \cdot 10^{24}\ kg$ and the sun with a mass of $M_\odot = 1.9889 \cdot 10^{30}\ kg$ and a distance of $d = 147.1 \cdot 10^9\ m$ we get a frequency of $\nu_G = 1.8041 \cdot 10^{45}\ s^{-1}$ for aligned reintegrating BSPs.

22.4 Quantification of the gravitation force due to parallel reintegrating BSPs (Ampere).

From sec. 20 eq. (780) we have for a pair of parallel reintegrating BSPs that

$$dF_R = 5.8731\ \frac{b}{\Delta_o t}\ \frac{2\ r_o^3}{64}\ \rho^2\ m\ k\ \frac{v_2}{d} = 2.2086 \cdot 10^{-50}\ \frac{v_2}{d}\ \ N \tag{812}$$

which we can write as

$$dF_R = N\ \nu_o\ p_{elem} \qquad with \qquad N = 8.7893 \cdot 10^{-48}\ \frac{v_2}{d} \tag{813}$$

where

$$p_{elem} = k\ m\ c \qquad and \qquad k = 7.4315 \cdot 10^{-2} \tag{814}$$

The total Ampere force between masses M_1 and m_2 is given with eq. (782)

$$F_R = 2.5551 \cdot 10^{-32}\ v_2\ \frac{M_1\ M_2}{d}\ \ N \tag{815}$$

We now write the equation in the form

$$F_R = N_R(M_1, M_2, d)\ \nu_o\ p_{elem} \qquad with \qquad N_R = 1.01682 \cdot 10^{-29}\ v_2\ \frac{M_1\ M_2}{d} \tag{816}$$

The frequency with which pairs of FPs cross in space is

$$\nu_R = N_R(M_1, M_2, d)\ \nu_o = 1.25811 \cdot 10^{-9}\ v_2\ \frac{M_1\ M_2}{d}\ \ s^{-1} \tag{817}$$

For the earth with a mass of $M_\oplus = 5.974 \cdot 10^{24}\ kg$ and the sun with a mass of $M_\odot = 1.9889 \cdot 10^{30}\ kg$ and a distance of $d = 1.5 \cdot 10^{8}\ m$ and a tangential speed of the earth around the sun of $v_2 = 30\ m/s$ we get a frequency of $\nu_R = 2.9896 \cdot 10^{39}\ s^{-1}$ for parallel reintegrating BSPs. The frequency ν_G for aligned BSPs is nearly 10^6 times grater than the frequency for parallel reintegrating BSPs and so the corresponding forces.

22.5 Quantification of the total gravitation force.

The total gravitation force is given by the sum of the induced force between aligned reintegrating BSPs and the force between parallel reintegrating BSPs.

$$F_T = F_G + F_R = [N_G(M_1, M_2, d)\ +\ N_R(M_1, M_2, d)]\ p_{elem}\ \nu_o \tag{818}$$

or

$$F_T = F_G + F_R =\ p_{elem}\ \nu_o\ \left[\frac{2.6555 \cdot 10^{-8}}{d^2} + \frac{1.01682 \cdot 10^{-29}}{d}\ v_2\right]\ M_1\ M_2 \tag{819}$$

We define the distance d_{gal} as the distance for which $F_G = F_R$ and get

$$d_{gal} = \frac{2.6555 \cdot 10^{-8}}{1.01682 \cdot 10^{-29}\ v_2} = 2.6116 \cdot 10^{21}\ \frac{1}{v_2}\ \ m \tag{820}$$

22.6 Transmission speed of elementary momenta between BSPs.

Fig. 112 shows at a) and b) for the Ampere and at c) for the Coulomb and the Induction laws the emission v_e and regeneration v_r speeds of the rays of FPs with the corresponding distribution function $d\kappa$ drawn for r or h constant and variable emission angle φ.

Accelerating BSPs emit FPs with infinite speed and are regenerated by FPs with light speed. Decelerating BSPs emit FPs with light speed and are regenerated by FPs with infinite speed.

As accelerating BSPs provide the FPs for decelerating BSPs and vice versa only two combinations of BSPs for the Ampere, the Coulomb and the Induction laws must be analysed.

At Fig. 112 the distribution function $d\kappa$ was drawn for each BSP for a constant distance r to show the contribution of the emitted FPs in the directions of φ and γ (see also Fig. 107 and Fig. 41).

$$d\kappa = \frac{1}{2}\,\frac{r_o}{r_r^2}\,dr_r\,\sin\varphi\,d\varphi \qquad and \qquad \int_{r_r}^{\infty} d\kappa = \frac{1}{2}\,\frac{r_o}{r_r}\,\sin\varphi\,d\varphi \tag{821}$$

For the Ampere Law the distribution functions for $\varphi = \pi/2$ are shown for the two BSPs in b) which is a view from below of a). We see that for $\varphi = \pi/2$ the distribution faction $d\kappa$ is independent of γ. The transmission speed v_{trans} of the elementary momenta between the two BSPs is a function of the distances h_1 and h_2 as shown in b).

- For the Ampere law the elementary momenta dp_2 are passed from a accelerating BSP to a decelerating BSP with the speed $v_{trans} = \infty$.
- For the Ampere law the elementary momenta dp_2 are passed from a decelerating BSP to a accelerating BSP with the speed $v_{trans} = c$.

For the Coulomb and the Induction laws the distribution functions $d\kappa$ at the two BSPs are functions of the distances r_1 and r_2 and the angle φ.

- For the Coulomb and the Induction laws the elementary momenta dp_2 are passed from a accelerating BSP to a decelerating BSP with the speed $v_{trans} = \infty$.
- For the Coulomb and the Induction laws the elementary momenta dp_2 are passed from a decelerating BSP to a accelerating BSP with the speed $v_{trans} = c$.

We have seen in sec. 6 that a neutron is composed of 919 electrons and 919 positrons. The 919 electrons are composed of 459 accelerating, 459 decelerating and 1 acc/dec electrons. The 919 positrons are composed of 459 accelerating, 459 decelerating and 1 dec/acc positrons. We see, that at each neutron the required combinations are present to pass the elementary momenta between neutrons with speed $v_{trans} = \infty$ what explains that gravitation transmits with infinite speed.

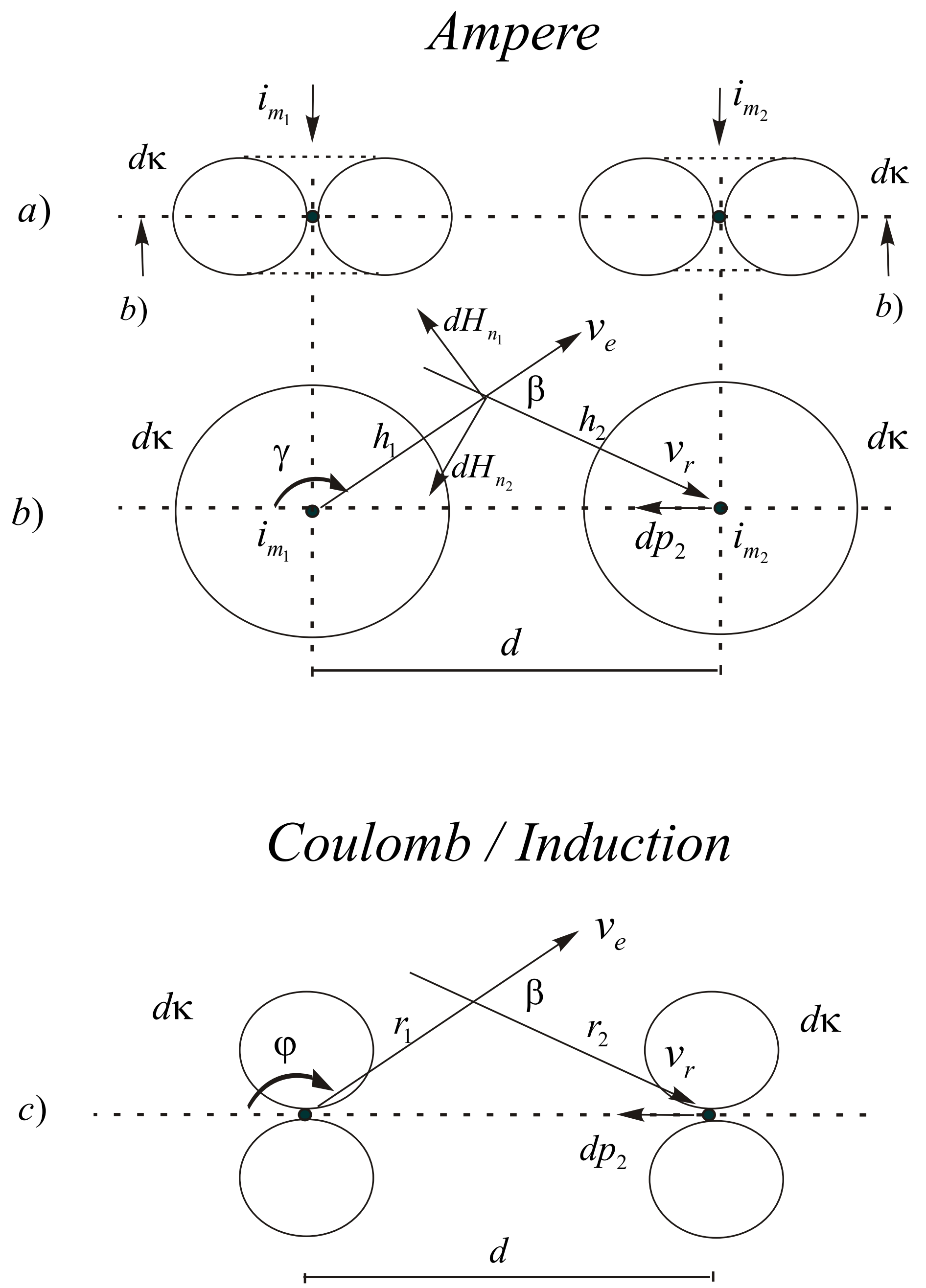


Figure 112: Transmission speeds of elementary momenta dp between BSPs

23 Types of particles and interactions.

General considerations.

FPs are the energy recipients of all kind of manifestations in physics. The energy is stored in longitudinal and transversal rotations of FPs, storage that is independent of any kind of coordinate system. Rotation momentum of FPs is transformed into linear momentum of BSPs out of pairs of opposed angular momentum of FPs. Interactions between FPs are described as products between the square roots of their energies.

Types of Particles

- Fundamental Particles (FPs)
  - FPs are the energy recipients of all kind of manifestations in physics. The energy is stored in as rotation, storage that is independent of any kind of coordinate system.
- Basic Subatomic Particles (BSPs = Elementary Particles)
  - BSPs with FPs bound to focal points in space (electron and positron)
  - BSPs with FPs independent of focal points in space formed by two FPs with opposed angular momenta (neutrinos)
- Complex Subatomic Particles (CSPs)
  - CSPs with FPs bound to focal points in space (neutrons and protons which are formed by electrons and positrons)
  - CSPs with FPs independent of focal points in space but bound to a sequence of FPs with opposed angular momenta (photons which are formed by neutrinos)
- Transitory Subatomic particles
  - Particles with unstable configurations of FPs with short lifetimes (Leptons and Hadrons except electrons, positrons, neutrinos, neutrons, protons and photons).

Types of Interactions

Interaction laws between FPs of two BSPs are defined as products between their $d\bar{H}$ fields.

- **Coulomb law**: The close path integration of the cross product between longitudinal $d\bar{H}_s$ fields gives the Coulomb equation.

- **Ampere law**: The close path integration of the cross product between transversal $d\bar{H}_n$ fields gives the Lorentz, Ampere, Bragg and one component of the gravitation equations.

- **Induction law**: The close path integration of the product between the transversal field $d\bar{H}_n$ and the absolute value of the longitudinal $d\bar{H}_s$ field of a static BSP gives the Maxwell equations and one component of the gravitation equations.

Part VI Relativity

Relativity is deduced as exclusively a speed problem with time and space absolut variables.

24 Relativity.

24.1 Introduction.

Space and time are variables of our physical world that are intrinsically linked together. Laws that are mathematically described as independent of time, like the Coulomb and gravitation laws, are the result of repetitive actions of the *time variations* of linear momenta.

To arrive to the transformation equations Einstein made abstraction of the physical interactions that make that light speed is the same in all inertial frames. The result of the abstraction are transformation rules that show time dilation and length contraction.

The physical interactions omitted by Einstein are:

- photons are emitted with light speed c relative to their source
- photons emitted with c in one frame that moves with the speed v relative to a second frame, arrive to the second frame with speed $c \pm v$.
- photons with speed $c \pm v$ are reflected with c relative to the reflecting surface
- photons refracted into a medium with $n = 1$ move with speed c independent of the speed they had in the first medium with $n \neq 1$.

The concept is shown in Fig. 113

The Lorenz transformation applied on speed variables, as shown in the proposed approach, is formulated with absolute time and space for all frames and takes into account the physical interactions at measuring instruments that produce the constancy of the measured light speed in all inertial frames.

24.2 Lorenz transformation based on speed variables.

The general Lorentz Transformation (LT) in orthogonal coordinates is described by the following equation and conditions for the coefficients [6]:

$$\sum_{i=1}^{4}(\theta^i)^2 = \sum_{i=1}^{4}(\bar{\theta}^i)^2 \qquad \sum_{i=1}^{4} \bar{a}_k^i \bar{a}_l^i = \delta_{kl} \qquad \sum_{i=1}^{4} \bar{a}_i^k \bar{a}_i^l = \delta^{kl} \tag{822}$$

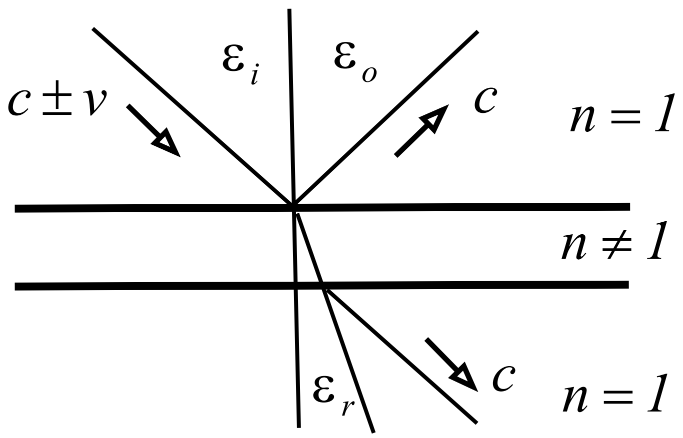


Figure 113: Light speed at reflections and refractions

with

$$\bar{\Theta}^i = \bar{a}^i_k \Theta^k \; + \; \bar{b}^i \tag{823}$$

The transformation represents a relative displacement $\bar{b}^i$ and a rotation of the frames and conserves the distances $\Delta\Theta$ between two points in the frames.

Before we introduce the LT based on speed variables we have a look at Einstein's formulation of the Lorentz equation with space-time variables as shown in Fig. 114.

$$x^2 + y^2 + z^2 + (ic_o\, t)^2 = \bar{x}^2 + \bar{y}^2 + \bar{z}^2 + (ic_o\, \bar{t})^2 \tag{824}$$

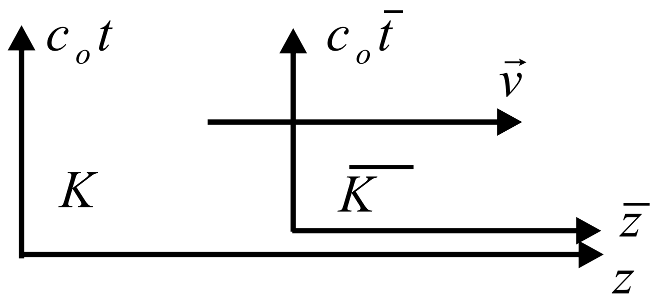


Figure 114: Transformation frames for **space-time** variables

For distances between two points eq. (824) writes now

$$(\Delta x)^2 + (\Delta y)^2 + (\Delta z)^2 + (ic_o\, \Delta t)^2 = (\Delta\bar{x})^2 + (\Delta\bar{y})^2 + (\Delta\bar{z})^2 + (ic_o\, \Delta\bar{t})^2 \tag{825}$$

The fact of equal light speed in all inertial frames is basically a speed problem and not a space-time problem. Therefor, in the proposed approach, the Lorentz equation is formulated with speed variables and absolut time and space. Dividing eq. (825) through the **absolute time** $(\Delta t)^2$ and introducing the forth speed v_c we have

$$v_x^2 + v_y^2 + v_z^2 + (iv_c)^2 = \bar{v}_x^2 + \bar{v}_y^2 + \bar{v}_z^2 + (i\bar{v}_c)^2 \tag{826}$$

The concept is shown in Fig. 2.

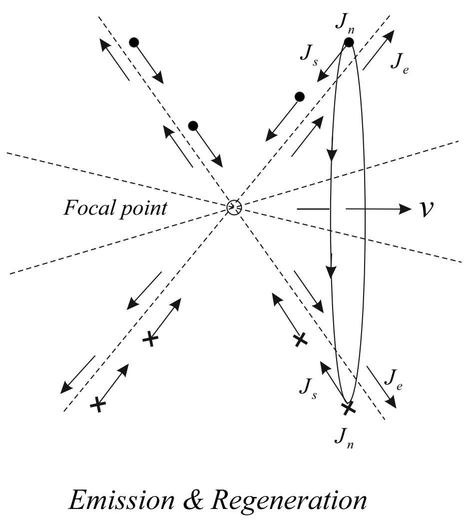


Figure 115: Particle as focal point in space

The forth speed v_c introduced is the speed of the Fundamental Particles (FPs) that move radially through a focus in space as shown in Fig. 115.

The FPs store the energy of the subatomic particles as rotations defining longitudinal and transversal angular momenta. The speed v_c is independent of the speeds v_x, v_y and v_z, forming together a four dimensional speed frame.

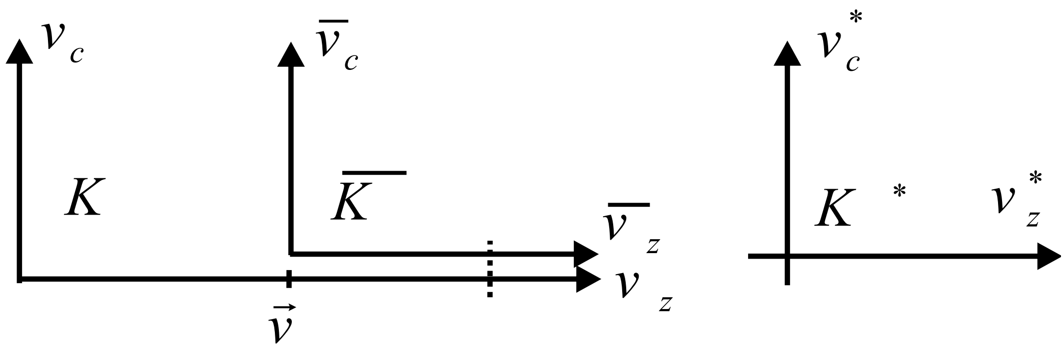


Figure 116: Transformation frames for **speed** variables

For the Lorentz transformation with speed variables Fig. 116 we get the following transformation rules between the source frame K and the virtual frame $\bar{K}$:

a) $\bar{v}_x = v_x$ $\qquad\qquad$ $v_x = \bar{v}_x$

b) $\bar{v}_y = v_y$ $\qquad\qquad$ $v_y = \bar{v}_y$

c) $\bar{v}_z = (v_z - v)\,\gamma_v$ $\qquad\qquad$ $v_z = (\bar{v}_z + v)\,\gamma_v$

d) $\bar{v}_c = (v_c - \frac{v}{v_c}\,v_z)\,\gamma_v$ $\qquad\qquad$ $v_c = (\bar{v}_c + \frac{v}{\bar{v}_c}\,\bar{v}_z)\,\gamma_v$

with $\quad \gamma_v = [1 - v^2/v_c^2]^{-1/2}$

24.3 Transformations for momentum and energy of a particle.

For $v_z = 0$ and $v_c = c$, where c is the light speed, we get

a) $\bar{v}_x = v_x$ $\qquad\qquad$ b) $\bar{v}_y = v_y$

c) $\bar{v}_z = -v\,\gamma_v$ $\qquad\qquad$ d) $\bar{v}_c = c\,\gamma_v$

We see that for $v_z = 0$ the transformed speeds $\bar{v}_z$ and $\bar{v}_c$ are not linear functions of the relative speed v because

$$\gamma_v = \left(1 - \frac{v^2}{v_c^2}\right)^{-1/2} = 1 + \frac{1}{2}\,\frac{v^2}{v_c^2} + \frac{1 \cdot 3}{2 \cdot 4}\,\left(\frac{v^2}{v_c^2}\right)^2 + \frac{1 \cdot 3 \cdot 5}{2 \cdot 4 \cdot 6}\,\left(\frac{v^2}{v_c^2}\right)^3 + \cdots \tag{827}$$

The case $v_z = 0$ is the case of a particle placed at the origin of the frame K. The momentum and the energy of the particle in the frame $\bar{K}$ are given by

$$\bar{p} = m\,\bar{v}_z = -m\,v\gamma_v \qquad\qquad \bar{E} = mc\,\bar{v}_c = mc\,c\gamma_v = \sqrt{E_o^2 + E_p^2} \tag{828}$$

$$E_o = mc^2 \qquad \textit{and} \qquad E_p = mc\bar{v}_z = mc\,v\gamma_v \tag{829}$$

As the speed v_z in the frame K is parallel to the relative speed v between the frames, the momentum and the energy of a particle moving with v in the frame K and a relative speed v_z between the frames must give the same values. That we obtain multiplying the transformed speeds $\bar{v}_i$ with γ_{v_z}

$$\gamma_{v_z} = \left[1 - v_z^2/v_c^2\right]^{-1/2} \tag{830}$$

We get for the general case with $v_z \neq 0$ the momentum and the energy in the frame $\bar{K}$

$$\bar{p} = m\ \bar{v}_z\gamma_{v_z} = m\ (v_z - v)\gamma_v\gamma_{v_z} \qquad \bar{E} = mc\ \bar{v}_c\gamma_{v_z} = mc\ (v_c - \frac{v}{v_c}v_z)\gamma_v\gamma_{v_z} \quad (831)$$

Note: The frame $\bar{K}$ is a *virtual* frame because the speeds calculated with the Lorentz transformation equations for this frame are virtual speeds and not the real Galilean speeds of the particles, which are $\bar{v}_{r_z} = v_z \pm v$. The frame $\bar{K}$ gives the virtual velocities that allow the calculation of the values of the momentum and energy, which are not linear functions of the real Galilean speed $\bar{v}_{r_z}$.

For the distances between the frames K and $\bar{K}$ the Galilean relativity is valid.

$$\Delta\bar{z} = z_o \pm v\ \Delta t \qquad with \qquad \Delta\bar{t} = \Delta t \quad for\ all\ speeds \quad v \tag{832}$$

If we start counting time when the origin of all frames coincide so that it is

$$z = \bar{z} = z^* = 0 \qquad for \qquad t = 0 \tag{833}$$

we get for the different types of measurements

Measurement	**K**	$\bar{\mathbf{K}}$	$\overset{*}{\mathbf{K}}$
ideal	$z = z_o$	$\bar{z} = z_o \pm v\ t$	$z^* = z_o \pm v\ t$
non destructive	$z = z_o$	$\bar{z} = z_o \pm v\ t$	$z^* \approx z_o \pm v\ t$
destructive	$z = z_o$	$\bar{z} = z_o \pm v\ t$	$z^* = z_o \pm v\ t_{meas}$

where t_{meas} is the time the destructive measurement took place at the instrument placed in K^*.

As time and space are absolute variables it is

$$\Delta t = \Delta\bar{t} = \Delta t^* \qquad \Delta z = \Delta\bar{z} = \Delta z^* \tag{834}$$

Note: The Lorentz transformation equations a),b) and c) are independent equations with the variables v_x, v_y and v_z; there is no cross-talking between them. Not so equation d) where $\bar{v}_c$ is a function of v_c and v_z. The speed v_z is modifying $\bar{v}_c$.

24.4 Transformations for electromagnetic waves at measuring instruments .

According to the present approach measuring instruments are composed of an interface and the signal comparing part. Interfaces are optical lenses, mirrors or electric antennas.

The concept is shown in Fig.117

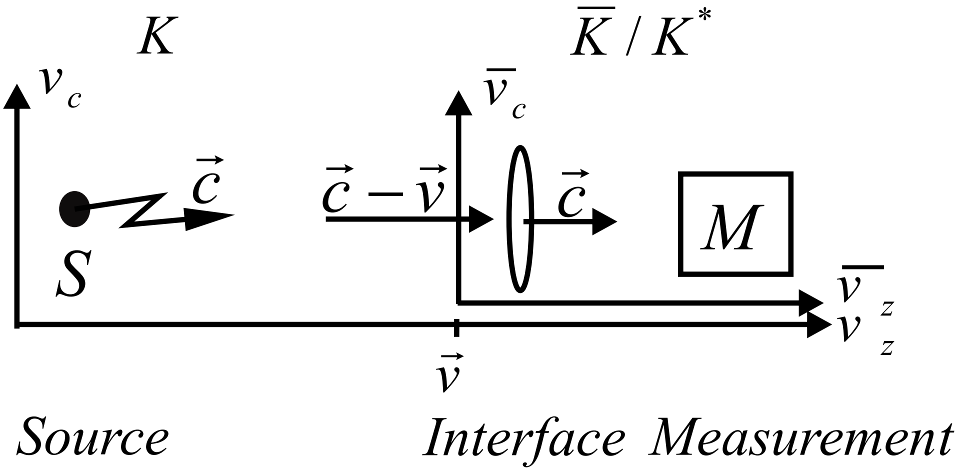


Figure 117: Transformation at measuring equipment's interface

Electromagnetic waves that are emitted with the speed c_o from its source, arrive to a relative moving frame of the measuring instrument with speeds different than light speed, are first absorbed by the atoms of the interface and than emitted with light speed c_o to the signal comparing part .

To take account of the behaviour of light in measuring instruments an additional transformation is necessary.

In Fig 117 the instruments are placed in the frame K^* which is linked rigidly to the *virtual* frame $\bar{K}$. Electromagnetic waves from the source frame K move with the real speed $\bar{v}_{r_z} = c_o \pm v$ in the *virtual* frame $\bar{K}$. The real velocity $\bar{v}_{r_z}$ can take values that are bigger than the light speed c_o.

The links between the frames for an electromagnetic wave that moves with c_o in the frame K are:

	$\mathbf{K}$	$\bar{\mathbf{K}}$	$\overset{*}{\mathbf{K}}$
e)	λ_z	$\bar{\lambda} = \lambda_z$	
f)	$v_z = c_o$	$\bar{v}_{r_z} = c_o \pm v$	$v_z^* = c_o$
g)	$f_z = c_o/\lambda_z$	$\bar{f}_{r_z} = \bar{v}_{r_z}/\lambda_z$	
h)		$\bar{f}_z = \bar{f}_{r_z}\ \gamma$	$f_z^* = \bar{f}_z$
i)	$E = h\ f_z$	$\bar{E} = h\ \bar{f}_z$	$E_z^* = h\ f_z^*$

e) shows the link between the frames K and $\bar{K}$. The wavelengths $\lambda_z = \bar{\lambda}_z$ because there is **no length contraction**.

f) shows the real Galilean speed $\bar{v}_{r_z}$ in frame $\bar{K}$.

g) shows the real frequency $\bar{f}_{r_z}$ in the frame $\bar{K}$.

h) shows the virtual frequency $\bar{f}_z$ in the frame $\bar{K}$ and the link to the frequency f^* of the frame K^*.

i) shows the equation for the energy of a photon for each frame.

Note: Also for electromagnetic waves the frame $\overset{-}{K}$ gives the virtual velocity that allows the calculation of the values of the momentum, energy and frequency, which are not linear functions of the real speed $\bar{v}_{r_z}$.

For electromagnetic waves we have the following real speeds for the different types of measurements:

Measurement	**K**	$\overset{-}{\mathbf{K}}$	$\overset{*}{\mathbf{K}}$	**Refraction**
ideal	$v_z = c_o$	$\bar{v}_{r_z} = c_o \pm v$	$v_z^* = c_o$	$n = 1$
non destructive	$v_z = c_o$	$\bar{v}_{r_z} = c_o \pm v$	$v_z^* < c_o$	$n > 1$
destructive	$v_z = c_o$	$\bar{v}_{r_z} = c_o \pm v$	$v_z^* = 0$	$n \Rightarrow \infty$

with n the optical refraction index $n = c_o/v_z^*$.

24.5 Equations for particles with rest mass $m \neq 0$.

Following, equations for physical magnitudes are derived for particles with rest mass $m \neq 0$ that are measured in an inertial frame that moves with constant speed v. For this case the transformation equations a), b), c) and d) from K to $\overset{-}{K}$ are used. The transfomation from $\overset{-}{K}$ to K^* is the **unit** transformation, because of conservations of momentum and energy between rigid linked frames.

24.5.1 Linear momentum.

To calculate the linear momentum in the virtual frame $\bar{K}$ of a particle moving in the source frame K with v_z and $v_x = v_y = 0$ we use the equation c) of sec 24.2, with $v_c = c_o$. The speed $v_c = c_o$ describes the speed of the Fundamental Particles (FP) emitted continuously by electrons and positrons and which continuously regenerate them, also when they are in rest in the frame K ($v_x = v_y = v_z = 0$). From (831) we define

$$\bar{v}_z^{'} = (v_z - v)\gamma_{v_z}\gamma_v \tag{835}$$

The linear momentum $\bar{p}_z$ we get multiplying $\bar{v}_z^{'}$ with the rest mass m of the particle.

$$\bar{p}_z = m\,\bar{v}_z^{'} = m\,(v_z - v)\gamma_{v_z}\gamma_v = p_z^* \tag{836}$$

Because of momentum conservation the momentum we measure in K^* is equal to the momentum calculated for $\overset{-}{K}$, expressed mathematically $p_z^* = \bar{p}_z$.

Eq. (836) is the same equation as derived with special relativity.

Note: The rest mass is simply a proportionality factor which is not a function of the speed and is invariant for all frames.

24.5.2 Acceleration.

To calculate the acceleration in the virtual frame $\bar{K}$ we start with

$$\bar{a}_z = \frac{d\bar{v}_z^{'}}{dt} \qquad with \qquad \bar{v}_z^{'} = \bar{v}_z\ \gamma_{v_z} = (v_z - v)\gamma_v\gamma_{v_z} \tag{837}$$

what gives for $v_z(t)$ and $\gamma_{v_z}(t)$

$$\bar{a}_z = \frac{d\bar{v}_z^{'}}{dt} = \frac{d\bar{v}_z}{dt}\gamma_{v_z} + \bar{v}_z\frac{d\gamma_{v_z}}{dt} = \frac{dv_z}{dt}\ \gamma_{v_z}\gamma_v + (v_z - v)\gamma_v\ \frac{d}{dt}\gamma_{v_z} \tag{838}$$

From momentum conservation $p_z^* = \bar{p}_z$ we have that

$$\bar{a}_z = a_z^* \tag{839}$$

24.5.3 Energy.

To calculate the energy in the virtual frame $\bar{K}$ for a particle that moves with v_z in the frame K we use the equation $d)$ of sec 24.2, with $v_c = c_o$. The equation $d)$ is used because it gives the speeds of the FPs where the energy of the subatomic particles is stored.

$$\bar{v}_c = \frac{v_c - \dfrac{v}{v_c}\ v_z}{\sqrt{1 - v^2/v_c^2}} = (v_c - \frac{v}{v_c}\ v_z)\gamma = \bar{v}_{r_c}\ \gamma \tag{840}$$

To get the energy in the frame $\bar{K}$ we multiply $\bar{v}_c$ with $mc\gamma_{v_z}$. See also eq. (831). We get

$$\bar{E} = mc\ \bar{v}_c\gamma_{v_z} = mc\ (v_c - \frac{v}{v_c}v_z)\gamma_v\gamma_{v_z} \tag{841}$$

Eq. (841) is the same equation as derived with special relativity.
With $v_z = 0$ we get

$$\bar{E} = \frac{m\ c_o^2}{\sqrt{1 - v^2/c_o^2}} = \sqrt{E_o^2\ +\ \bar{E}_p^2} \tag{842}$$

with

$$\bar{E}_p = m\ |\bar{v}_z|\ c_o = |\bar{p}_z|\ c_o \qquad \bar{v}_z = v_z\ \gamma_{v_z} \qquad E_o = m\ c_o^2 \tag{843}$$

To calculate the energy $\bar{E}_p = m\ \bar{v}_z\ c_o$ we must calculate $\bar{v}_z$ as explained in sec. 24.5.1 with $v_z = 0$.

The energy E_o is part of the energy in the frame $\bar{K}$ and invariant, because if we make $v = 0$ we get E_o as the rest energy of the particle in the frame K.

Because of energy conservation between frames without speed difference the energy E^* in the frame K^* is equal to the energy $\bar{E}$ in the frame $\bar{K}$.

24.6 Equations for particles with rest mass $m = 0$.

In this section the equations for electromagnetic waves observed from an inertial frame that moves with the relative speed v are derived. A comparison between the proposed approach and the Standard Model is made.

24.6.1 Relativistic Doppler effect.

The speed $v_c = c_o$ describes the speed of the Fundamental Particles (FP) emitted continuously by electrons and positrons and which continuously regenerate them, also when they are in rest in frame K ($v_x = v_y = v_z = 0$). In the case of the photon no emission and regeneration exist.

The photon can be seen as a particle formed by only two parallel rays of FPs. The first ray carries FPs with opposed transversal angular momenta of equal orientation and the second ray carries FPs with transversal angular momenta opposed to the first ray. At each ray FPs exist only along the length L of the photon.

The concept is shown in Fig. 118

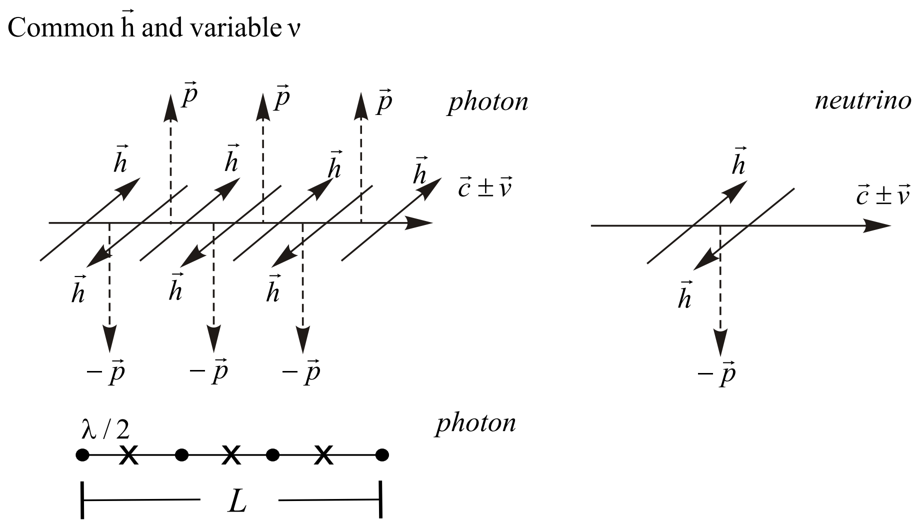


Figure 118: Photon and neutrino

To calculate the energy of a photon in the virtual frame $\bar{K}$ that moves with $v_z = c_o$ in the frame K we use the same equation $d)$ of sec 24.2 used for particles with $m \neq 0$, with $v_z = c_o$ and $v_c = c_o$. We use equation $d)$ because the energy is stored in FPs. We get

$$\bar{v}_c = \frac{v_c - \dfrac{v}{v_c}\, v_z}{\sqrt{1 - v^2/v_c^2}} = (c_o - v)\gamma_v \tag{844}$$

Note: As the energy of a photon is a function of the frequency, the energy in the frame $\bar{K}$ is not afected by the non linear factor γ_z.

The momentum of a photon in the frame K is $p_c = E_{ph}/c_o = h\ f/c_o$ which we multiply with $\bar{v}_c$ to get the energy of the photon in the frame $\bar{K}$. The transformation of the energy between the frames $\bar{K}$ and K^* is $E^* = \bar{E}$ and we get:

For the measuring instrument moving away from the source

$$\bar{E} = p_c\, \bar{v}_c = \frac{E_{ph}}{c_o}\, (c_o - v)\, \gamma_v = E_{ph}\, \frac{\sqrt{c_o - v}}{\sqrt{c_o + v}} = E^* = h\ f^* \tag{845}$$

With $E_{ph} = h\ f$ we get the well known equation for the relativistic Doppler effect

$$f^* = f\, \frac{\sqrt{c_o - v}}{\sqrt{c_o + v}} \qquad or \qquad \frac{f}{f^*} = \frac{\sqrt{1 + v/c_o}}{\sqrt{1 - v/c_o}} \tag{846}$$

and with $c_o = \lambda\ f$ and $c_o = \lambda^*\ f^*$ we get the other well known equation for the relativistic Doppler effect

$$\frac{\lambda}{\lambda^*} = \frac{\sqrt{1 - v/c_o}}{\sqrt{1 + v/c_o}} \tag{847}$$

Eq. (846) is the same equation as derived with special relativity.

Note: No transversal relativistic Doppler effect exists.

Note: The real frequency $\bar{f}_{r_z}$ in the frame $\bar{K}$ is given by the Galilean speed $\bar{v}_{r_z} = c_o \pm v$ divided by the wavelength $\bar{\lambda} = \lambda$. The energy of a photon in the frame $\bar{K}$ is given by the equation $\bar{E}_{ph} = h\ \bar{f}_z$ where $\bar{f}_z = \bar{f}_{r_z}\ \gamma$, with $\bar{f}_{r_z} = (c_o \pm v)/\lambda_z$ the real frequency of particles in the frame $\bar{K}$.

Note: All information about events in frame K are passed to the frames $\bar{K}$ and K^* exclusively through the electromagnetic fields E and B that come from frame K. Therefore all transformations between the frames must be described as transformations of these fields, what is achieved through the invariance of the Maxwell wave equations.

24.6.2 Transformation steps for photons from emitter to receiver.

Electromagnetic signals (photons) have to pass an interface at the receiver until a measurement can be made. The interface is an optical lense, a mirror or an antenna. The signals undergo two transformations when travelling from the emitter to the receiver. The first transformation occurs before the interface and the second behind the interface.

The concept is shown in Fig.119

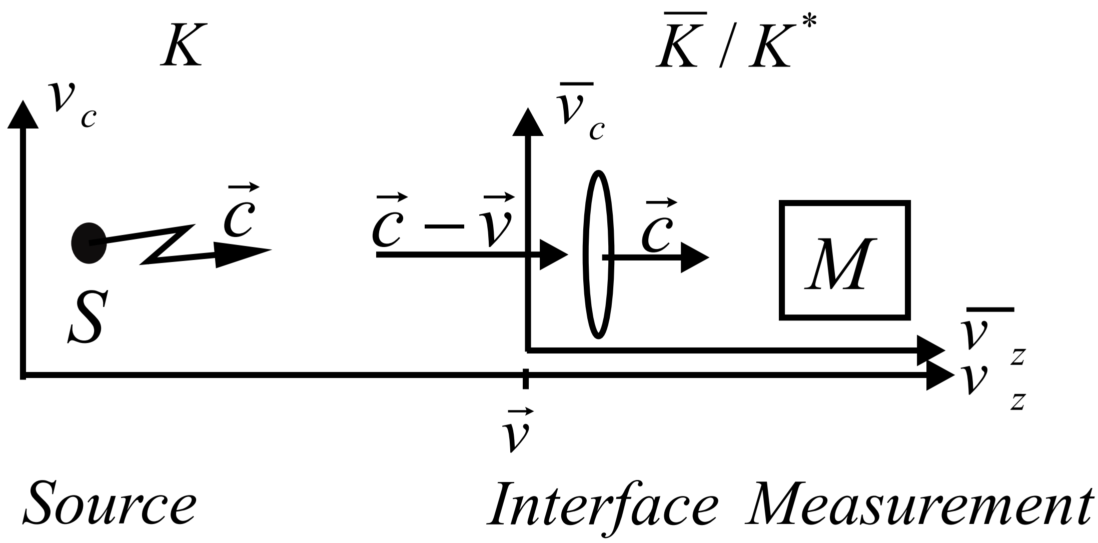


Figure 119: Transformation at measuring equipment's interface

If we assume that the emitters signal in the K frame is

$$c = \lambda\, f \tag{848}$$

the signal befor the interface of the receiver in the $\bar{K}$ frame is;
for the measuring instrument moving away from the source

$$\bar{f} = f\, \frac{\sqrt{c-v}}{\sqrt{c+v}} \qquad and \qquad \bar{\lambda} = \lambda \qquad and \qquad \bar{v}_z = c - v \tag{849}$$

At the output of the interface we get the signal in the K^* frame that is finally processed by the receiver.

$$f^* = f\, \frac{\sqrt{c-v}}{\sqrt{c+v}} \qquad and \qquad \lambda^* = \lambda\, \frac{\sqrt{c+v}}{\sqrt{c-v}} \qquad and \qquad v_z^* = c \tag{850}$$

At the first transformation the wavelength $\lambda = \bar{\lambda}$ doesn't transform (absolute space) and at the second transformation the frequency $\bar{f} = f^*$ (absolute time).

The speed before the interface $c \pm v$ is the galilean speed which changes to $v_z^* = c$, the speed of light, before the processing in the receiver. This explains why always c is measured in all relative moving frames.

24.7 Relativistic energy of FPs.

A photon is a sequences of pairs of FPs with opposed angular momenta at the distance $\lambda/2$ as shown in Fig. 118. The potential linear moment p of a pair of FPs with opposed angular momenta is perpendicular to the plane that contains the opposed angular momenta. The potential linear moment of a pair of FPs with opposed angular momenta can take every direction in space relative to the moving direction of the pair.

The emission time of photons from **isolated** atoms is approximately $\tau = 10^{-8}\ s$ what gives a length for the wave train of $L = c\ \tau = 3\ m$. The total energy of the emitted photon is $E_t = h\ \nu_t$ and the wavelength is $\lambda_t = c/\nu_t$. We have defined that the photon is composed of a train of FPs with alternated angular momenta where the distance between two consecutive FPs is equal $\lambda_t/2$. The number of FPs that build the photon is therefore $L/(\lambda_t/2)$ and we get for the energy of one FP

$$E_{\texttt{FP}} = \frac{E_t\ \lambda_t}{2\ L} = \frac{h}{2\ \tau} = 3.313 \cdot 10^{-26}\ J = 2.068 \cdot 10^{-7}\ eV \tag{851}$$

and for the angular frequency of the angular momentum h

$$\nu_{\texttt{FP}} = \frac{E_{\texttt{FP}}}{h} = \frac{1}{2\ \tau} = 5 \cdot 10^{7}\ s^{-1} \tag{852}$$

We can define an equivalent proportionality factor $m_{\texttt{FP}}$

$$E_{\texttt{FP}} = m_{\texttt{FP}}\ c^2 \qquad with \qquad m_{\texttt{FP}} = 2.29777 \cdot 10^{-24}\ \ kg \tag{853}$$

The relativistic energy of a FP is

$$\bar{E}_{\texttt{FP}} = m_{\texttt{FP}}\ c_o\ \bar{v}_c = \frac{m_{\texttt{FP}}\ c_o^2}{\sqrt{1 - v^2/c_o^2}} = \frac{2.068 \cdot 10^{-7}}{\sqrt{1 - v^2/c_o^2}}\ eV \tag{854}$$

A neutrino can be seen as $N_{\texttt{FP}}$ pairs of FPs with opposed angular momenta that all contribute to one potential linear momentum.

$$E_{\texttt{Neutrino}} = N_{\texttt{FP}}\ E_{\texttt{FP}} = N_{\texttt{FP}}\ 2.068 \cdot 10^{-7}\ eV \tag{855}$$

Photons can be seen as a sequence of neutrinos with opposed potential linear momenta at the distance $\lambda/2$.

24.8 The proposed approach and the Standard Model.

The proposed approach represents a photon as a package of a sequence of FPs with opposed angular momenta. Packages are emitted with the speed c_o relative to its source. A monochromatic source emitts packages with equal distances λ between FPs.

A package emitted with the speed c_o, the frequency f and the vawelength λ in the frame K will move in the virtual frame $\bar{K}$ with the real speed $\bar{v}_r = c_o \pm v$, will have the same vawelength $\bar{\lambda} = \lambda$ and a real frequency $\bar{f}_r = (c_o \pm v)/\lambda$. In the frame K^* the package is absorbed by the atoms of the measuring instruments and immediately reemitted with the speed c_o relative to K^*. The frequency f^* in the frame K^* is equal to the virtual frequency $\bar{f}$ in the frame $\bar{K}$ which is given by the product of the real frequency $\bar{f}_r$ and the factor γ.

The proposed approach unifies the frames $\bar{K}$ and K^* defining that the packages move from their source in frame K through space with the speed $c_o \pm v$ relative to the frame K^* of the instruments.

The Standard Model unifies the frames K and $\bar{K}$ to one frame defining that the packages (photons) move already from their source through space with the speed c_o relative to the frame K^* where the measuring instruments are located. This gives the impression that an absolute frame (aether) must exist for the photons to move always with ligth speed c_o independent of their sources.

For the Standard Model the length of a package in space (length of the wave train or coherence length) is $l = (c_o \pm v)\tau$ while for the present approach it is $l = c_o\ \tau$ (τ is the time needed for traversing the coherence length l), which is independent of the relative speed v .

Theories normally known as “Emission Theories” analysed by Willem de Sitter and Daniel Frost Camstock are theories that don’t produce well defined spectroscopic lines for a star rotating around a neutron star (Astrometric binaries), contrary to what is observed. In the proposed approach packages with equal distances between their FPs (equal λ) but with different speeds $c_o \pm v$ from a star rotating around a neutron star (Astrometric binaries) produce well defined spectroscopic lines in accordance with experimental observations.

24.9 Conclusions.

The special Lorentz transformation formulated by Einstein is based on space and time variables and the definition of different times for inertial frames, what leads to transformation rules between frames with time dilation and space contraction.

Based on the proposed approach “Emission & Regeneration” Unified Field Theory, where electrons and positrons continuously emit and are regenerated by Fundamental Particles (FP), the following conclusions about *special relativity based on* ***speed variables*** were deduced:

- The fact of equal light speed in all inertial frames is basically a speed problem and not a space and time problem. Time and space are absolute variables and equal for all frames according to Galilean relativity.

- Electromagnetic waves are emitted with light speed c_o relative to the frame of the emitting source.

- Electromagnetic waves that arrive at the atoms of measuring instruments like optical lenses or electric antennae are absorbed and subsequently emitted with light speed c_o relative to the measuring instruments, independent of the speed they have when arriving to the atoms of the measuring instruments. That explains why always light speed c_o is measured in the frame of the instruments.

- The transformation rules of *special relativity based on space-time variables* as done by Einstein describe the macroscopic results between frames making abstraction of the physical cause (measuring instruments) of constant light speed in all frames and require therefore space and time distortions. The transformation rules of *special relativity based on speed variables* as done in the proposed approach, take into consideration the physical cause (measuring instruments) of the constant light speed in all frames and therefore don't require space and time distortions.

- All relevant relativistic equations can be deduced with the proposed approach. The transformation rules have no transversal components, nor for the speeds neider for the Doppler effect.

- The speed v_c of the fourth orthogonal coordinate gives the speed of the FPs emitted continuously by electrons and positrons and which continuously regenerate them.

- Particles with rest mass are more stable when moving because of the interactions of their Fundamental Particles (FPs) with the FPs of the masses of real reference frames as explained in the proposed approach, and not because of time dilation .

The transformation equations based on speed variables are free of time dilation and length contraction and all the transformation rules already existent for the electric and magnetic fields, deduced on the base of the invariance of the Maxwell wave equations are still valid for the proposed approach.

The electric and magnetic fields have to pass two transformations on the way from the emitter to the receiver. The first transformation is between the relative moving frames while the second is the transformation that takes into account that measuring instruments convert the speed of the arriving electromagnetic waves to the speed of light c_o in their frames.

The present work shows how the measuring equipment must be integrated in the chain of interactions to avoid unnatural conclusions like time dilation and length contraction.

Note: General Relativity introduced by Einstein is based on time dilation and length contraction and is the gravitation theory of the Standard Model. With the abolition of time and length distortions General Relativity is not more valid and is replaced by the gravitation theory based on the reintegration of migrated electrons and positrons to their nuclei as explained in sec. 17 of the proposed approach.

Part VII Miscellaneous II

25 Miscellaneous.

The strong and weak forces are presented as forces that don't need to be especially defined as separate forces.

The possibility of entanglement of BSPs is explained with the strong coupling of corresponding opposed angular momenta of fundamental particles.

The origin of permanent magnetic fields is explained with the energy flow between atoms or molecules.

The relation between the elementary bending momentum and the total momentum between two straight conductors is presented.

The Stern-Gerlach experiment and the spin of the electron are explained based on Ampere bendin.

The origin of the instability of free positrons is explained.

Energy levels of electrons in atoms are commented.

Radiation of accelerated BSPs is explained.

Coulomb force on a level electron.

Gravitation and background-noise.

Binding energy of BSPs in the nucleons.

25.1 Strong and weak forces.

a) Strong forces are defined in standard physics theory as those forces that bind quarks into hadrons. They explain why protons coexist in the atomic nucleus even having the same charge.

The proposed approach explains the coexistence of BSPs with equal signs (electrons or positrons) in nuclei with the annulation of linear momenta when the distance between them tends to zero. As nucleons are formed by electrons and positrons, no special strong force has to be defined to explain this physical phenomenon, thus allowing the existence of stable complex particles (see Fig. 29). When electrons and positrons join to form protons or neutrons, the difference between the rest masses is emitted or absorbed as photons or neutrinos.

We have defined as $\Delta n_i = n_i^+ - n_i^-$ the difference between the number of positive and negative BSPs that form the complex particle i.

For the proton we have $n^+ = 919$ and $n^- = 918$ with a binding Energy of $E_{B_{prot}} = -6.9489 \cdot 10^{-14}\ J = -0.43371\ MeV$. For the neutron we have $n^+ = 919$ and $n^- = 919$ with a binding Energy of $E_{B_{neutr}} = 5.59743 \cdot 10^{-14}\ J = 0.34936\ MeV$.

b) Weak forces are defined in standard physics theory as those forces that bind heavy leptons and quarks.

According to the proposed approach all BSPs (electrons and positrons) that form protons and neutrons of an atomic nucleus must move in the zones left of the maximum of the momentum curve of Fig. 29. BSPs in zone 1 don't repel neither attract each other because the linear momenta are zero. For BSPs that migrate outside zone 1 of the atomic nucleus the linear momenta are not more zero. A polarization with the remaining BSPs of zone 1 emerges, generating an attracting or repelling force. At nuclei with low atomic numbers Z all migrated BSPs are reintegrated to the nucleus. At nuclei with high Z and high numbers of protons and neutrons forming their atomic nuclei, migrated BSPs at zone 2 of the nuclei are closer to the maximum of the curve of Fig. 29, and less energy is required to overcome the maximum of the curve allowing a tunnelling effect explaining radioactivity.

25.2 Light speed.

All fundamental particles emitted by an electron move with light speed relative to a coordinate system which is fix with the electron. When a level electron changes its energy level it looses or gains pairs of fundamental particles with opposed angular momenta. The pairs of fundamental particles form chains with alternated potential linear momenta, resulting in a configuration known as photon (see Fig. 68 c). Photons that are emitted by a coordinate system that moves with the speed u relative to a second coordinate system will arrive at the second with the speed $c \pm u$. In Fig. 120 one constituent of a photon (opposed dH_n) is shown just before being absorbed by an electron of the second coordinate system transferring its potential linear momentum dp_r. The now moving electron in the second coordinate system will generate opposed transversal dH_n which are irradiated with the speed of light when the electron is stopped after a distance Δx because of the bindings to its atom. The Light that we measure is first absorbed by level electrons of our instrument (glass of the optical system, etc.) and subsequently emitted with light speed relative to the instrument, what explains why we always measure light speed. Light that moves through matter (glass, water, etc.) is constantly absorbed by level electrons and immediately emitted with light speed. The resulting reduced speed through matter is due to the time spent in the absorbtion and emission by level electrons.

The concept is shown in Fig. 120.

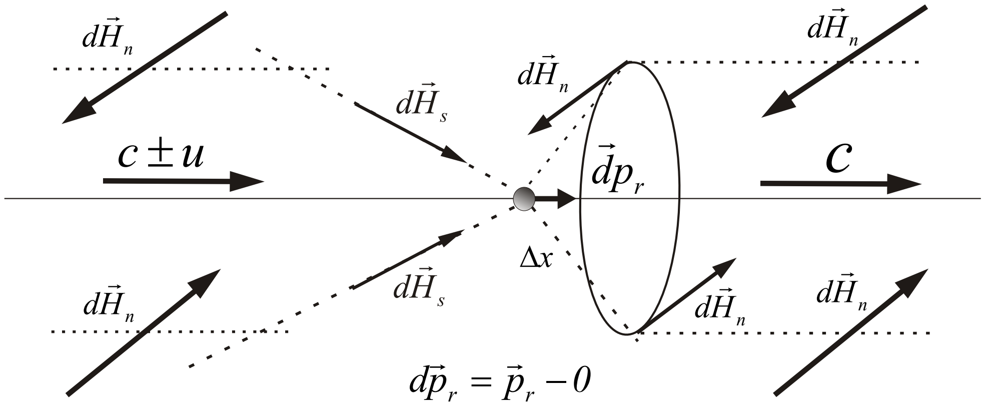


Figure 120: Mechanism responsible for constant light speed in all inertial frames

25.3 Life time of muons.

The life time of muons increases with speed according experimental verifications. On Fig. 121 we will show the mechanism how the mean life of muons increases with speed. Muons are complex SPs composed of electrons and positrons except for the binding energy. Electrons or positrons that migrate outside the first region (see sec. 10) will be reintegrated or expelled. For a muon with $v = 0$ the tunnel barrier for expelled particles is given by curve p_{stat}, which flattens with increasing v while the field dH_n increases. For $v \neq 0$ electrons and positrons that are accelerated to v_{exp} in the second region are forced by the dH_n field to follow a circular path, thus reducing the probability for the electron and positron to be expelled.

The comparison of the statistical counts of muons made at different heights involves no measurements of time nor length with the help of light, and therefore does not require time nor length corrections according to special relativity.

The concept is shown in Fig. 121.

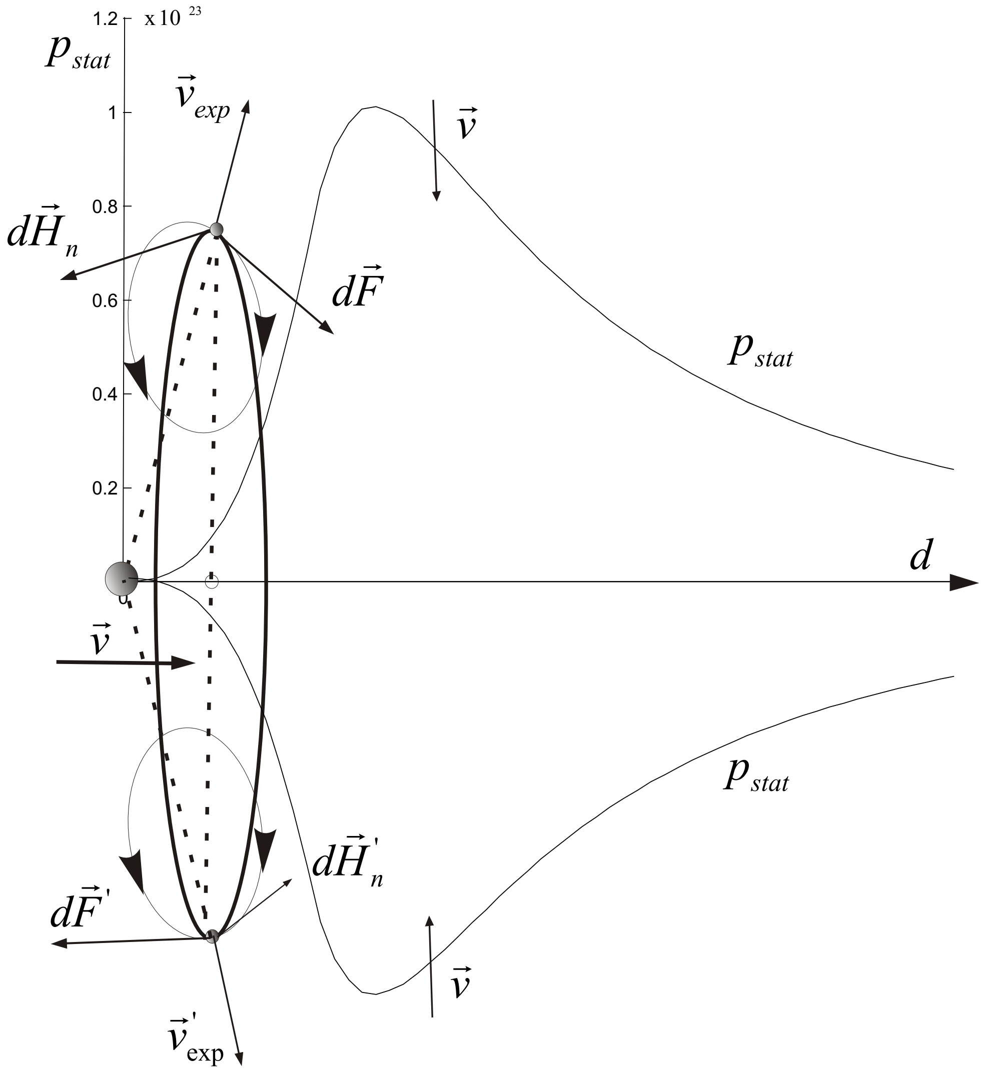


Figure 121: Increase of mean life time of muons with speed

25.4 Reflection and refraction of light.

On sec. 25.2 we have seen, that light adjusts its speed to the light speed c relative to a coordinate system fix with matter that has absorbed and then emitted it. Light that is reflected also takes the speed c relative to a coordinate system fix with matter that has reflected it because of the emission speed of FPs of the BSPs of the matter.

25.5 Entangled BSP.

When we analyzed the balance of energy and rotational momenta in the following sections

- 2.11 for BSPs that move with constant speed v and
- 4.8 for induced momentums between two static BSPs and
- 4.11.2 for induced momentums between two parallel straight conductors

we have seen that there is a strong coupling between the rotational momenta of fundamental particles, so that constantly **corresponding** opposed rotational momenta are generated and destroyed. We have also seen that the coupling is independent of the distance between **corresponding** rotational momenta and that it is defined by $d\kappa(\varphi, r, v) = d\kappa(\pi - \varphi, r, v)$.

There is a configuration that is common for all BSPs, namely rings of transversal rotational momenta $\bar{J}_n$ with sum zero. For BSPs with $v \neq c$ this rings cannot exist independently because of the balance conditions for the longitudinal rotational momenta $\bar{J}_s$. For BSPs with $v = c$ the longitudinal rotational momenta $\bar{J}_s$ are zero and therefore the rings exist as independent configurations in the form of opposed transversal angular momenta.

When complex particles with $v = c$ (photons) are split, couplings remain between the two parts of the trains of opposed transversal rotational momenta, couplings that are independent of the distance between the splitting products. Because of the near infinite speed of one of the two types of fundamental particles, the splitting products change their quantum state instantly independent of the distance between them.

25.6 Electron and positron compensation and annihilation.

The representation of electrons and positrons as focal points of rays of FPs, where the energy is stored in the angular momenta of their FPs, explains the compensation and annihilation of electrons and positrons as follows: (see also Fig. 7)

Fig. 122 shows the electron positron compensation. When the electron shown at a) and the positron shown at b) are moved slowly together, they compensate each other

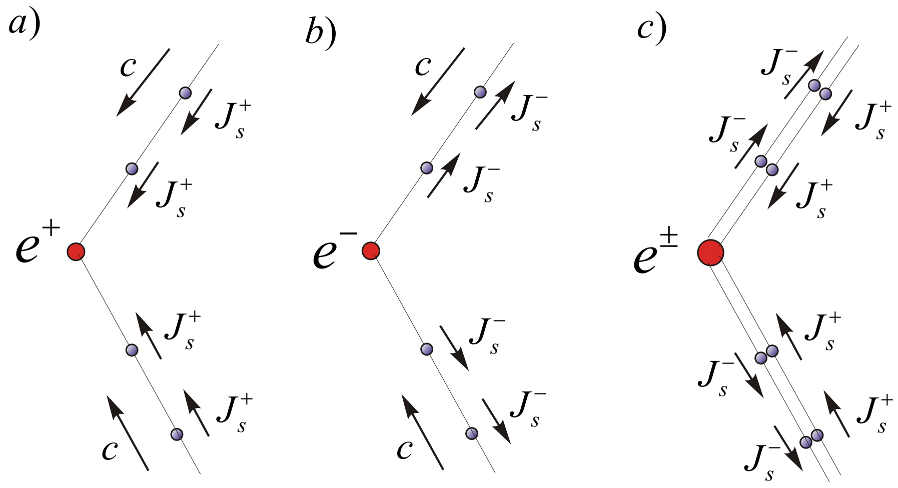


Figure 122: Electron positron compensation

for the interactions with other external charged particles. At c) the compensation is shown as the result of the compensation of the longitudinal angular momenta J_s of all their FPs.

Fig. 123 shows the annihilation of an electron with an positron. At the regenerating FPs of moving electrons or positrons transversal angular momenta J_n are generated as shown at a) and b. When the electron and positron collide, trains of pairs of FPs with opposed transversal angular momenta (photons) are expelled with the speed " c ", as shown at c). Also individual pairs of FPs with opposed transversal angular momenta (neutrinos) may be expelled with the speed c. The photons and neutrinos are entities where the sum of their angular momenta is equal zero and therefore they can become independent entities of the focal point.

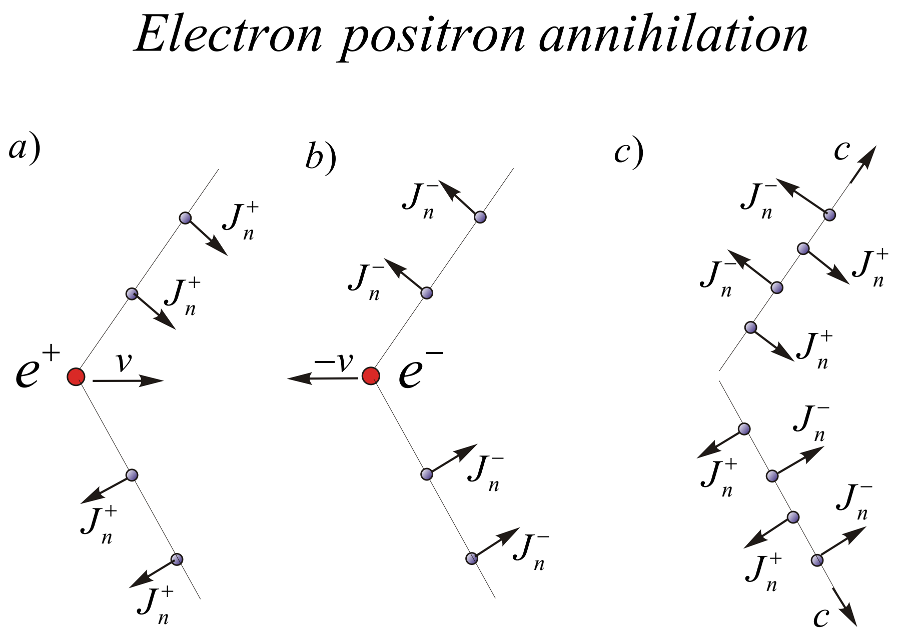


Figure 123: Electron positron annihilation

25.7 Differences between the Standard and the E & R Models in Particle Physics.

An important difference between the two models we have in particle physics. The concept is shown in Fig.124

The SM defines carrier particles X for the interaction between particles A and B and leads to energy violation during the time $\hbar/\Delta E$. The range R of these carrier particles defines the distance over which the interaction can take place and is given by

$$R = \frac{\hbar}{M_X\ c} \tag{856}$$

where M_X is the mass of the carrier particle with the coupling strength g to the particles A and B. For electromagnetic interactions the carrier particles are the photons with $M_X = 0$, the range is $R = \infty$. For the weak interactions the carrier particles are the W and Z bosons with masses in the order of $80 - 90\ GeV/c^2$ corresponding to a range of $2 \cdot 10^{-3}\ fm$. For the strong and gravitation interactions the carrier particles are the gluons and gravitons respectively with $M_X = 0$ and range $R = \infty$.

The E & R model has no carrier. The particles A and B are formed by rays of FPs that go from ∞ to ∞ through a point in space which is called "Focal Point". FPs are continously emited from the Focal Point and FPs continously regenerate the Focal Point. The regenerating FPs are the FPs emited by other Focal Points in space. The particles A and B are continously interacting through their FPs, independent of the

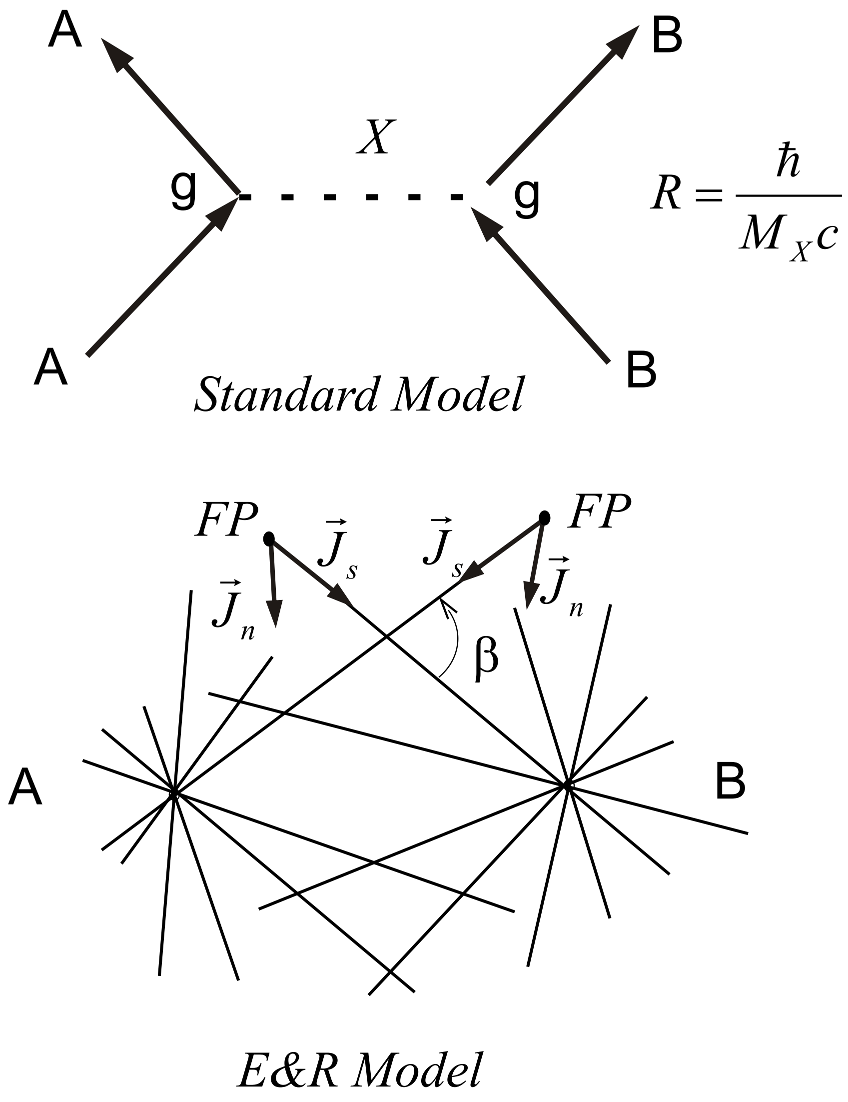


Figure 124: Differences between the Standard and the E & R Models

distance between them. There is no difference between subatomic particles and their FPs which are the constituents of subatomic particles.

FPs have no rest mass and are emitted with the speed c or ∞ relative to the Focal Point. They have longitudinal and transversal angular momenta and their interaction is given by the cross product of their angular momenta, cross product which is proportional to $\sin\beta$. To get the total force between the particles A and B, the integration over the whole space of all the interactions of their FPs is required.

All interactions are **electromagnetic interactions** and are generated out of the combinations of the interactions of the longitudinal and transversal angular momenta of the FPs.

The **strong interaction** is explained with the zero electromagnetic force between electrons and positrons, which are the constituents of nucleons, for the distance between A and B tending to zero. No force is required to hold nucleons together.

Weak interactions is an electromagnetic interaction between migrated electrons or positrons that interact with the remaining electrons and positrons of the nuclei core. The small electromagnetic force is explained with the small distances between A and B, force which is proportional to the cross product which is proportional to $\sin\beta$. See Fig. 124.

Gravitational interactions are the result of electromagnetic interactions between electrons and positrons that have migrated slowly out of their nuclei and are then reintegrated with high speed.

25.8 Mass and charge in the E & R Model

The SM defines mass and charge as different physical characteristics, although it cannot explain what charge is. It defines particles like the neutrons having mass but no charge.

The E & R Model defines mass and charge as physical characteristics that are intrinsic to particles and cannot be separated. The charge of an electron and positron is defined by the sign of the longitudinal angular momentum of emited FPs. Positive rotation in moving direction corresponds to a positive charge and negative rotation to a negative charge. Neutrons are composed of equal numbers of electrons and positrons so that their longitudinal angular momenta of emited FPs compensate, resulting an effective zero charge.

A mass unit is associated with a charge unit. To the mass $9.1094 \cdot 10^{-31}\ kg$ of a positron or electron corresponds a charge of $\pm\ 1.6022 \cdot 10^{-19}\ C$.

For complex particles that are formed by more than one electron or positron we have for the Coulomb force

$$F = 2.307078 \cdot 10^{-28}\ \frac{\Delta n_1\ \cdot \Delta n_2}{d^2}\ N \tag{857}$$

The charge Q of the Coulomb law is replaced by the expression $\Delta n = n^+ - n^-$ which gives the difference between the **constituent** numbers of positive and negative particles (positrons and electrons) that form the complex particle. As the n_i are integer numbers, the Coulomb force is quantified.

The expression $\Delta n = n^+ - n^-$ corresponds to the nuclear charge number or atomic number Z.

$$\Delta n = n^+ - n^-\ =\ Z \tag{858}$$

As examples we have for the proton $n^+ = 919$ and $n^- = 918$ with a binding Energy of $E_{B_{prot}} = -6.9489 \cdot 10^{-14}\ J = -0.43371\ MeV$, and for the neutron $n^+ = 919$ and

$n^- = 919$ with a binding Energy of $E_{B_{neutr}} = 5.59743 \cdot 10^{-14}\ J = 0.34936\ MeV$.

25.9 Permanent magnetism.

Based on the present theory, two possible mechanism of how permanent magnetism is generated can be imagined:

- An energy flow along a closed chain of static BSPs.
- A current flow along a closed chain of reintegrating BSPs.

An energy flow along a closed chain of static BSPs.

Between two static isolated BSPs that are separated by the distance d, energy is exchanged because of the flow of fundamental particles. The transversal rotational momenta $\bar{J}_n^{(s)}$ generated on the regenerating fundamental particles compensate each other. The concept is shown in Fig. 125.

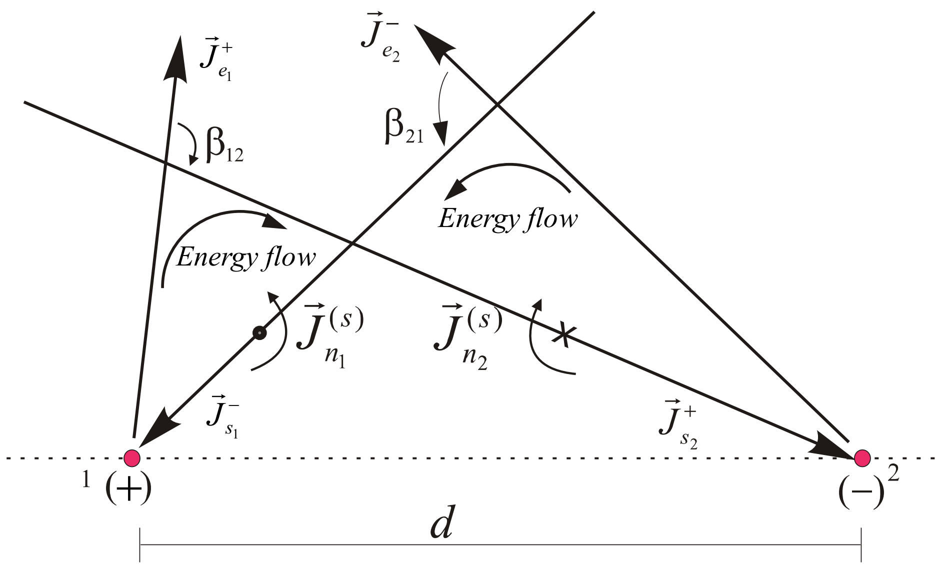


Figure 125: Energy flow between two static basic subatomic particles

If the energy flow is between static BSPs that belong to a close chain of atoms or molecules as shown in Fig. 126, the transversal rotational momenta $\bar{J}_n^{(s)}$ generated between two adjacent BSPs of the chain don't compensate, resulting in a field that is equal to the magnetic field generated by a current of BSPs in a closed circuit but without the moving of the BSPs.

The concept is shown in Fig. 126.

The same is valid for a closed chain of positive complex particles (atomic nucleus or ions).

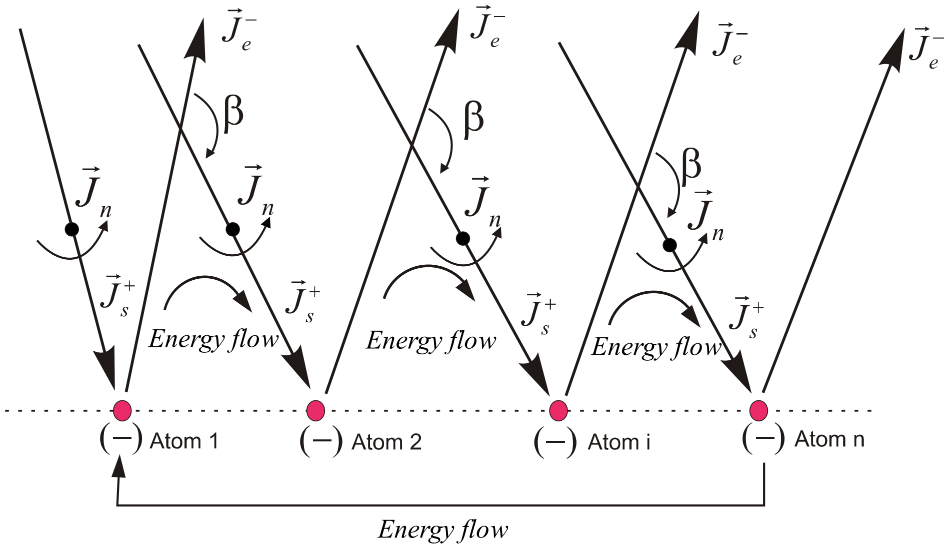


Figure 126: Energy flow along a closed chain of static basic subatomic particles

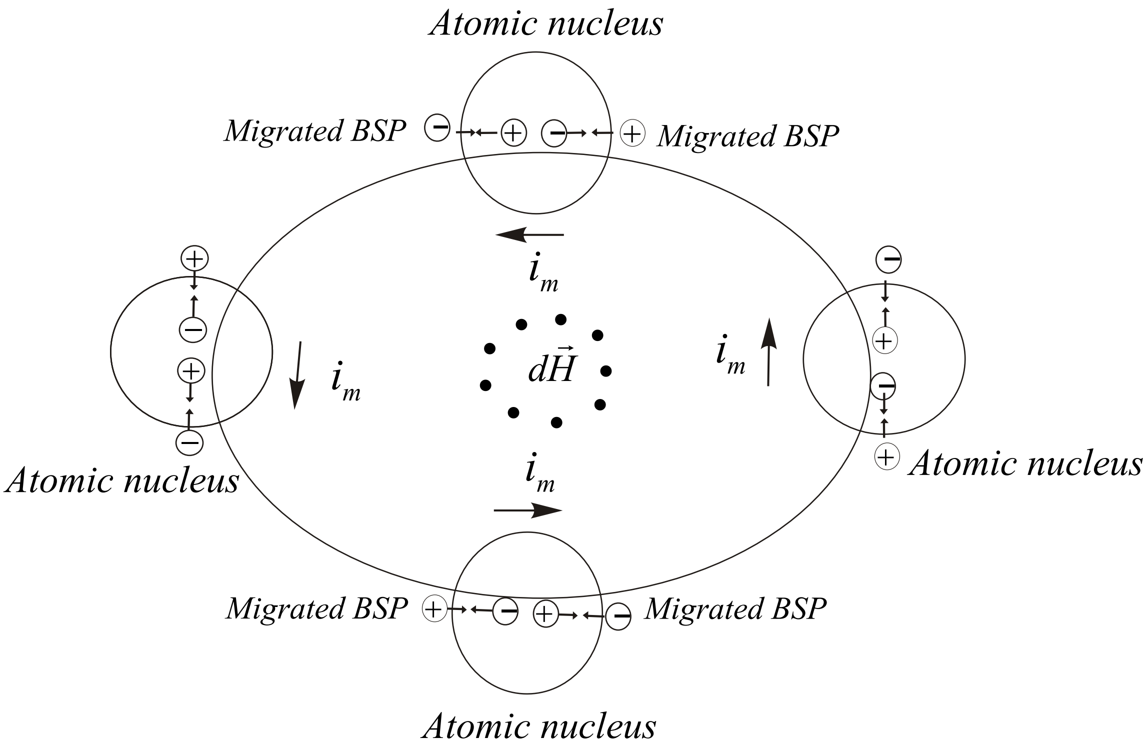


Figure 127: Current flow along a closed chain of reintegrating BSPs

A current flow along a closed chain of reintegrating BSPs. The concept is shown in Fig. 127.

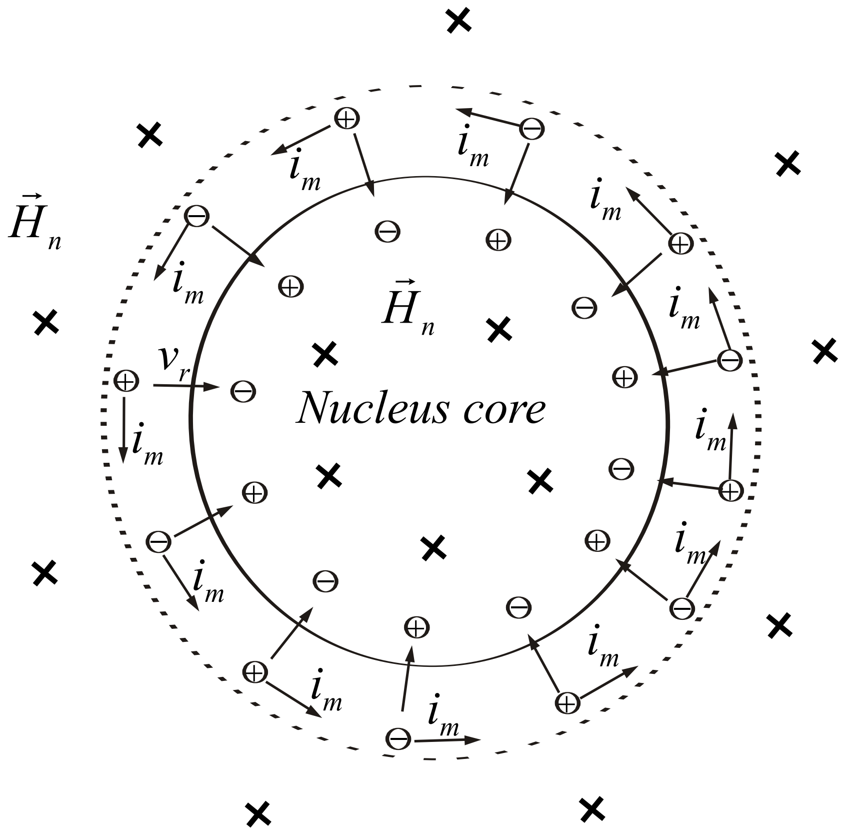
In sec.20 we have described how the reintegration of BSPs to their nuclei generates a current. If we have a synchronized reintegration of BSPs along a closed chain of nuclei, a closed current I_m is generated that produces a permanent magnetic field. It is important to remember that BSPs migrate slowly outside their nuclei and are then reintegrated with high speed.

25.9.1 Induced Magnetic spin in nucleons by an external magnetic field.

Fig. 128 shows a nucleon in an external permanent magnetic field H_n. Electrons and positrons that have migrated outside the nucleus core are reintegrated with the speed v_r. The Lorentz force generates a current i_m which generates a magnetic field H_r opposed to H_n.

$$\bar{i}_m \propto \bar{H}_n \ \times \ \bar{v}_r \tag{859}$$

An external applied perturbating electro-magnetic field, usually radio frequency pulse, absorbe and re-emit electro-magnetic radiation. This is the mechanism used in nuclear magnetic resonance.



$$\vec{i}_m \propto \vec{H}_n \times \vec{v}_r$$

Figure 128: Induced magnetic spin in nucleons.

Nucleons have a magnetic moment independent of the externally applied magnetic field H_n because of the mutually interacting magnetic fields of the reintegrating electrons and positrons.

25.9.2 Faraday paradox.

The Faraday paradox or Faraday's paradox is an experiment in which Michael Faraday's law of electromagnetic induction appears to predict an incorrect result. The paradoxes fall into two classes:

- Faraday's law appears to predict that there will be zero EMF but there is a non-zero EMF.
- Faraday's law appears to predict that there will be a non-zero EMF but there is a zero EMF.

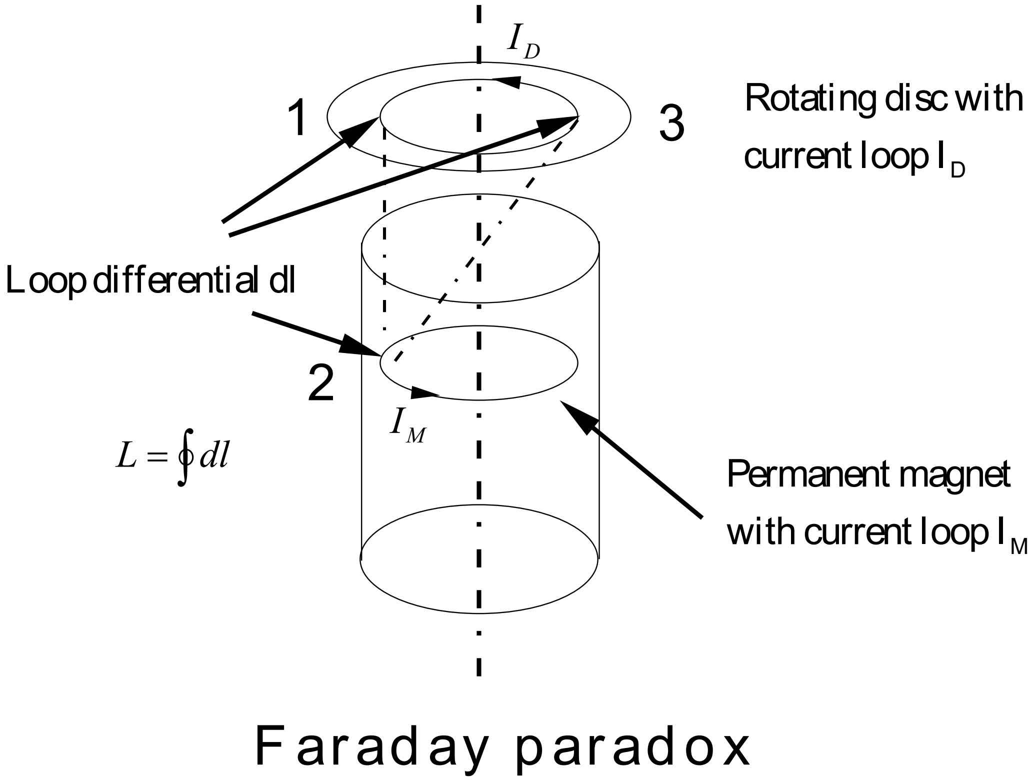


Figure 129: Setup to explain Faraday's paradox.

The setup consists of a disc and a magnet that are fitted a short distance apart on the axle, on which they are free to rotate about their own axes of symmetry. An electrical circuit is formed by connecting sliding contacts: one to the axle of the disc, the other to its rim. A galvanometer can be inserted in the circuit to measure the current.

The concept is shown in Fig. 129

According to the present approach permanent magnets are generated by current loops i_m that are produced by the reintegration of electrons and positrons to their nuclei. In a metal that is not magnetized, the reintegration occurs randomly in all directions at each nucleus and no current loop exists. When magnetized, the reintegration is oriented along a closed loop of nuclei what gives a current I_M where each reintegrating electron and positron remains associated to its nucleus. When the magnet rotates, according the direction of rotation the current in the magnet increases or decreases relative to the measuring equipment.

When the disc rotates, the free electrons at the disc generate a current loop I_D relative to the measuring equipment. So we have two parallel current loops, one at the magnet and one at the rotating disc. The parallel currents will attract or repel each other according the Ampere law. Between differential dl of the loops at points **1** and **2** the force is perpendicular to the surface of the disc and no EMF is induced at the disc by these currents. Between points **2** and **3** the force has a component in the direction of the surface of the disc and an EMF is generated.

The following situations are possible:

a) Only the disc rotates. We have two parallel current loops that induce an EMF at the disc.

b) Only the magnet rotates. We have no current in the disc and no EMF is induced in the disc.

c) Disc and magnet rotate. We have again case a) and an EMF is induced in the disc.

If one intends to explain the above situations with the help of the Lorentz law which describes the forces based on the magnetic field, the question arises if the field rotates or not with the magnet. With the Ampere law no use of a magnetic field is made and all situations are explained satisfactorily.

25.10 Emission Theory.

The present approach is based on the postulate that light is emitted with light speed relative to the emission source.

Fig 130 shows how bursts of FPs with opposed angular momenta (photons) emitted with light speed c travel from frame K to frames $\bar{K}$ and K^* with speeds $c+u$ from A and $c-u$ from B. When they arrive at the measuring instruments at C, the transformations to the frames $\bar{K}$ and K^* take place from where they continue than with the speed of light c (See also sec. 24.6)

The assumption of our standard model that light moves with light speed c independent of the emitting source induces the existence of an absolute reference frame or ether, but at the same time the model is not compatible with such absolute frames. The objections made by Willem de Sitter in 1913 about Emission Theories is based on a representation of light as a continuous wave and not as a sequence of bursts of equal length L of FPs of opposed angular momenta with equal wave length λ. The analysis of de Sitter makes no use of the quantized description of nature. Photons with speeds $c+v$ and $c-v$ may arrive simultaneously at the measuring equipment showing the two Doppler spectral lines corresponding to the red and blue shifts in accordance with Kepler's laws of motion. No bizarre effects will be seen because photons of equal length L and λ with speeds $c+v$ and $c-v$ giving well defined lines corresponding to the Doppler effects will arrive to the spectral instruments.

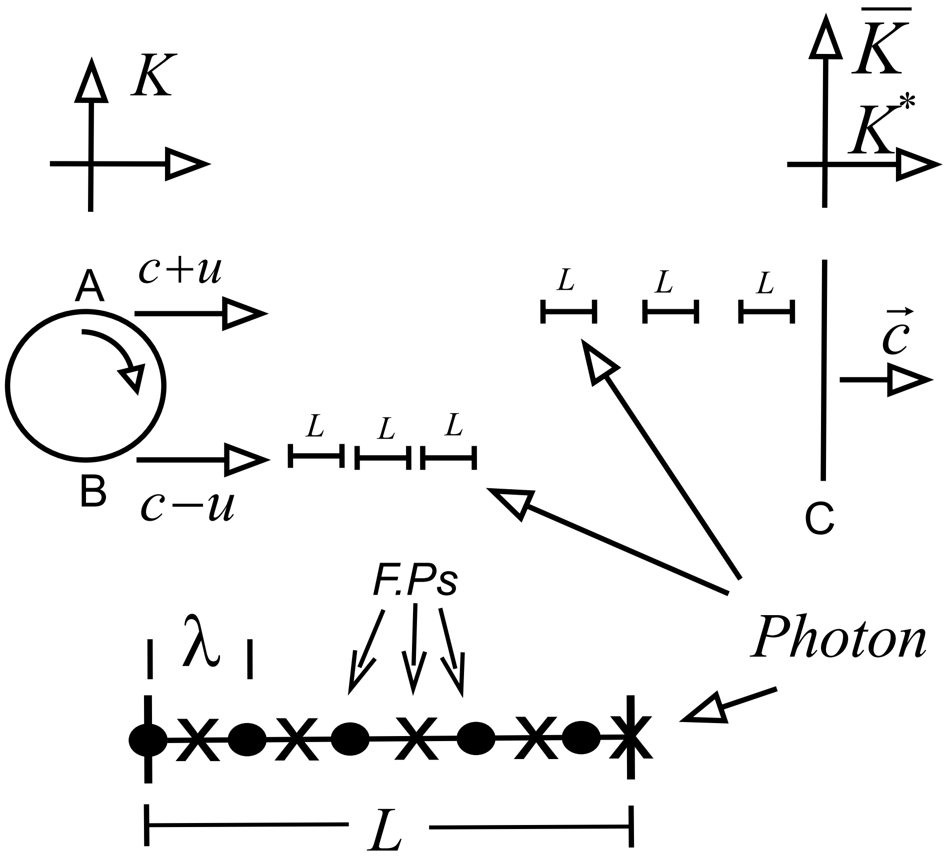


Figure 130: Emission Theory.

The present approach is based on a modern physical description of nature postulating that

- photons are emitted with light speed c relative to their source
- photons emitted with c in one frame that moves with the speed v relative to a second frame, arrive to the second frame with speed $c \pm v$.
- photons with speed $c \pm v$ are reflected with c relative to the reflecting surface
- photons refracted into a medium with $n = 1$ move with speed c independent of the speed they had in the first medium with $n \neq 1$.

The concept is shown in Fig. 131

When the Lorentz transformation is applied with the above postulates, "Relativity without time delay and length contraction" results as shown in Sec. 24.1.

The frequency change of a photon is produced by:

- the interaction with orbital electrons in the case of optical lenses and electric antennas of measuring equipment (Doppler-Effect). The change of frequency is due to the change of the relative speed.

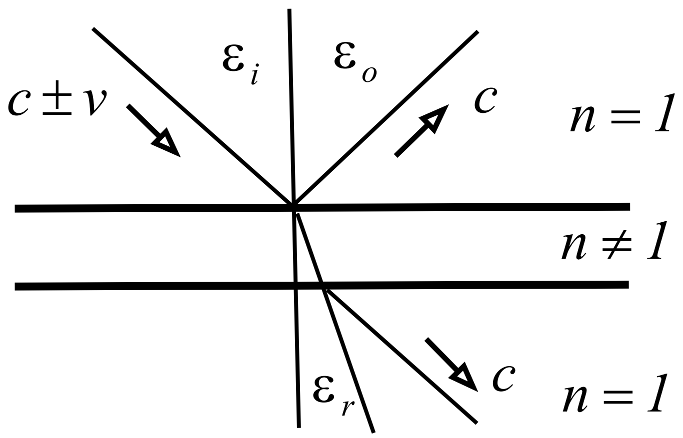


Figure 131: Light speed at reflections and refractions

- the interaction with gravitation fields. The change of frequency is due to the change of the number N_F of FPs per photon (red-shift).

25.11 Redshift of photons in gravitation fields

The emission time of photons from **isolated** atoms is approximately $\tau = 10^{-8}\ s$ what gives a length for the wave train of $L = c\ \tau = 3\ m$. The total energy of the emitted photon is $E_t = h\ \nu_t$ and the wavelength is $\lambda_t = c/\nu_t$. We have defined that the photon is composed of a train of FPs with alternated angular momenta where the distance between two consecutive FPs is equal $\lambda_t/2$. The number of FPs that build the photon is therefore

$$N_F = 2\ L/\lambda_t = 2\ L\ \frac{\nu_t}{c} \tag{860}$$

and we get for the energy of one FP

$$E_F = \frac{E_t}{N_F} = \frac{E_t\ \lambda_t}{2\ L} = \frac{h}{2\ \tau} \tag{861}$$

and for the angular frequency of the angular momentum h

$$\nu_F = \frac{E_F}{h} = \frac{1}{2\ \tau} \tag{862}$$

Calculation example: With $\tau = 10^{-8}\ s$ we get a length for the wave train of $L = c\ \tau = 3\ m$ what gives $E_F = 3.313 \cdot 10^{-26}\ J = 2.068 \cdot 10^{-7}\ eV$ and $\nu_F = 5 \cdot 10^7\ s^{-1}$.

The gravitational field and the photons are composed of FPs with transversal angular momenta which interact when the photon moves through the gravitation field.

We now assume, that the length L of a photon remains constant when moving with c through a gravitational field. The number N_F of FPs contained in the length L of a photon vary proportional with the intensity g of the gravitation field and the pass length Δr through it, according to

$$\Delta N_F \; \propto N_F \; g \; \Delta r \tag{863}$$

with

$$g = \frac{F_g}{M_2} = G \; \frac{M_1}{r^2} \tag{864}$$

We get for the relative variations from (860)

$$\frac{\Delta N_F}{N_F} = \frac{\Delta \nu_t}{\nu_t} = -2 \; \frac{\Delta \lambda_t}{\lambda_t} \tag{865}$$

and for the variation of the wavelength

$$\frac{\Delta \lambda_t}{\lambda_t} \propto g \; \Delta r = G \; M_1 \; \frac{\Delta r}{r^2} \tag{866}$$

Calculation example: In 2020 a group at the University of Tokyo measured the gravitational redshift of two strontium-87 optical lattice clocks. The measurement took place at Tokyo Tower where the clocks were separated by approximately $\Delta r = 450m$ and connected by telecom fibers. The gravitational radius $r = 6.378 \; km$.

By Ramsey spectroscopy of the strontium-87 optical clock transition (429 THz, 698 nm) the group determined the gravitational redshift between the two optical clocks to be 21.18 Hz, corresponding to $\frac{\Delta \lambda_t}{\lambda_t} = 5 \cdot 10^{-14}$. With

$$\frac{\Delta \lambda_t}{\lambda_t} \;\; = \;\; K_\lambda \; G \; M_1 \; \frac{\Delta r}{r^2} \tag{867}$$

we get $K_\lambda = 1.15 \cdot 10^{-17} \;\; s^2/m^2$.

25.12 The Newton gravitation field.

The gravitation field is an induction field and has its origin in the reintegration of migrated electrons/positrons to their atomic nuclei . When reintegrated, rays of FPs emitted with light speed carry opposed transversal angular momenta J_n, which are passed to electrons and positrons of an other atomic nuclei generating at them the gravitation force.

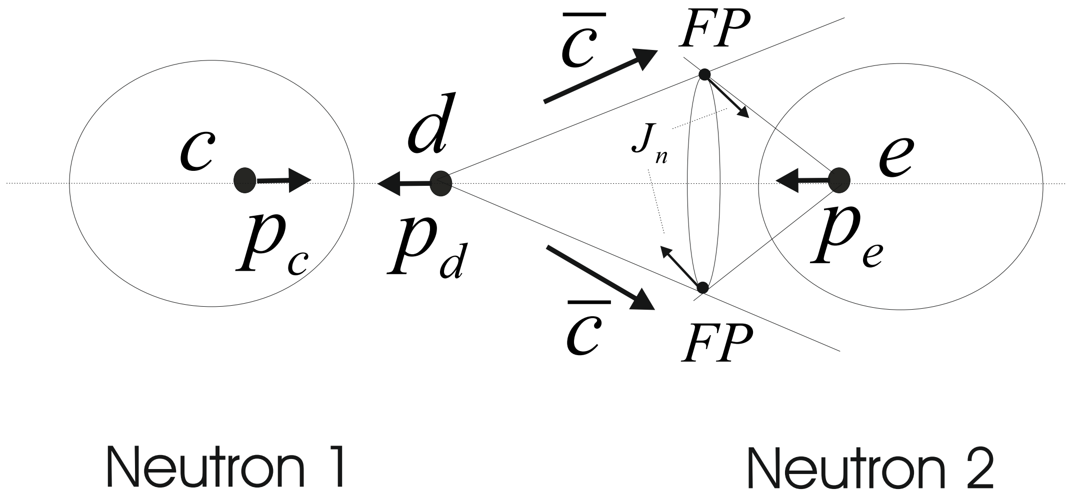


Figure 132: Momentum transmitted from neutron 1 to neutron 2

Fig. 132 shows two neutrons which are composed of electrons and positrons. At neutron 1 we have an electron/positron d which has migrated out of the neutron core and which is reintegrated to the core when its FPs interact with FPs of an electron/positron c. The moment p_d generated during the reintegration is passed per induction to an electron/positron of neutron 2, remaining finally the opposed momenta p_c and p_e which explains the attraction of the two neutrons. The gravitational moment p_d is passed through the FPs emitted with light speed "c" by the electron/positron d.

If Neutron 1 moves with the speed u relative to neutron 2 the gravitational moment is passed through FPs that move with the speed $c \pm u$.

25.13 Sagnac effect.

In the SM the results of the Sagnac experiment are not compatible with Special Relativity and are easily explained with non relativistic equations but still assuming that light moves with light speed independent of its source. As the present approach postulates that light is emitted with light speed relative to its source, equations for the Sagnac experiment are derived based on the mentioned postulate.

The concept is shown in Fig. 133

The Postulate also includes the possibility of speeds that are greater than the light speed "c".

Fig. 1 of Fig. 133 shows the arrangement with a light source at point "0" and a detector for the two counter-rotating light rays also at point "0'. Mirrors are placed at points "1", "2", ..."n" of the ring. The tangential speed of the rotating arrangement is "v".

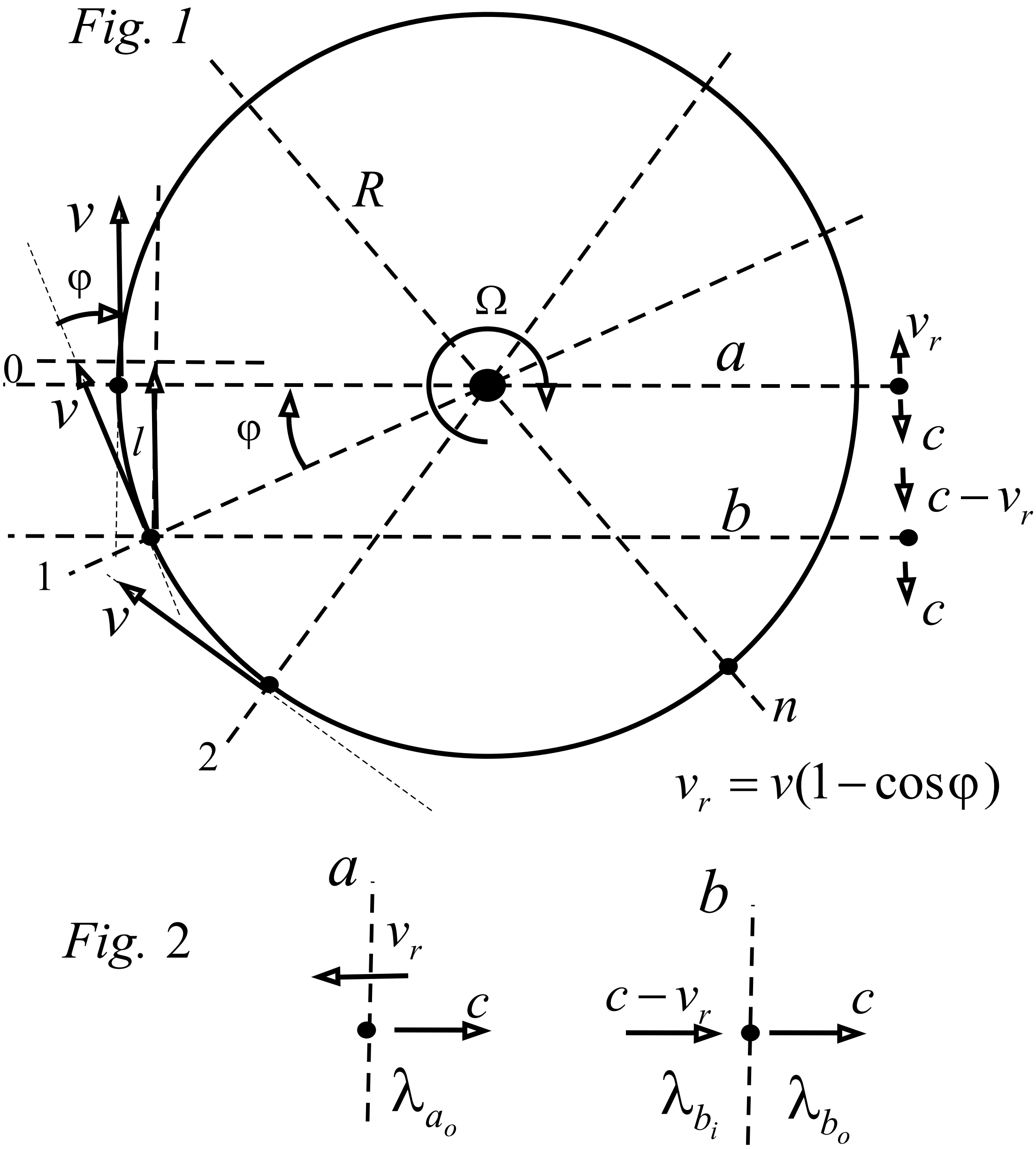


Figure 133: Sagnac experiment

Points "0" and "1" are placed in the parallel planes "a" and "b". For the time a photon of the length L and wavelength λ takes to pass from plane "a" to plane "b" the relative speed between them of $v_r = v(1-\cos\varphi)$ can be assumed constant. If we imagin that plane "a" moves relative to plane "b" then, according to the emission theory, the speed of the ray that leaves "a" in the direction of " b " has the speed $v_{b_i} = c - v_r$ as shown in Fig. 2 of Fig. 133.

Also according to the emission theory the output wavelength λ_{a_o} at "a" must be equal to the input wavelength λ_{b_i}. We get for the frequancies ν

$$\lambda_{b_i} = \frac{c - v_r}{\nu_{b_i}} = \lambda_{a_o} \qquad \rightarrow \qquad \nu_{b_i} = \frac{c - v_r}{\lambda_{a_o}} \tag{868}$$

The frequencies at the input and output of plane "b" must be equal

$$\nu_{b_i} = \frac{c - v_r}{\lambda_{a_o}} = \nu_{b_o} = \frac{c}{\lambda_{b_o}} \qquad \rightarrow \qquad \lambda_{b_o} = \frac{c}{c - v_r}\lambda_{a_o} \tag{869}$$

Writing the last equation with the nomenclature used for the points "0" and "1" we get

$$\lambda_{1_o} = \frac{c}{c - v_r}\lambda_{0_o} \tag{870}$$

and for the points "1" and "2" we get

$$\lambda_{2_o} = \frac{c}{c - v_r}\lambda_{1_o} = \left(\frac{c}{c - v_r}\right)^2 \lambda_{0_o} \tag{871}$$

Generalising for "n" we get for the ray in counter clock direction

$$\lambda_{n_o} = \left(\frac{c}{c - v_r}\right)^n \lambda_{0_o} = \frac{1}{(1 - v_r/c)^n}\, \lambda_{0_o} \tag{872}$$

and for the ray in clock direction

$$\lambda'_{n_o} = \left(\frac{c}{c + v_r}\right)^n \lambda_{0_o} = \frac{1}{(1 + v_r/c)^n}\, \lambda_{0_o} \tag{873}$$

With

$$(1 \pm v_r/c)^{-n} = 1 \mp n(v_r/c) + \frac{n(n+1)}{2!}(v_r/c)^2 \mp ...... \qquad for\ \ |v_r/c| < 1 \tag{874}$$

neglecting all non linear terms we get for the wavelength

$$\lambda_{detect} = 1 + n(v_r/c)\lambda_{0_o} \qquad\qquad \lambda'_{detect} = 1 - n(v_r/c)\lambda_{0_o} \tag{875}$$

and for the difference

$$\Delta\lambda_{detect} = \lambda_{detect} - \lambda'_{detect} = 2\, n(v_r/c)\lambda_{0_o} \tag{876}$$

With R the radius of the ring we have that $\Omega = v/R$ and with $v_r = v(1 - \cos\varphi)$ we get

$$\Delta\lambda_{detect} = 2\, n\, \frac{R(1 - \cos\varphi)\lambda_{0_o}}{c}\, \Omega \tag{877}$$

For $n >> 1$ and with l the length of the arc on the ring between two consecutive mirrors, we can write that $2\pi\ R\ m \approx n\ l$ with m the number of windings of the fibre coil. We also have that $\cos\varphi \approx 1 - \varphi^2/2$ and that $\varphi = l/R$. We get

$$\Delta\lambda_{detect} = 2\,\pi\,m\,\frac{l}{c}\,\lambda_{0_o}\,\Omega \tag{878}$$

The wavelength difference between the clock and anticlockwise waves is proportional to the angular speed Ω of the arrangement.

The interference of two sinusoidal waves with nearly the same frequencies ν and wavelengths λ is given with

$$F(r,t) = 2\cos\left[2\pi\,\left(\frac{r}{\lambda_{mod}}\;-\;\Delta\nu\,t\right)\right]\,\sin\left[2\pi\,\left(\frac{r}{\lambda}\;-\;\nu\,t\right)\right] \qquad \lambda_{mod} \approx \frac{\lambda^2}{\Delta\lambda} \tag{879}$$

For our case it is $\Delta\nu = 0$ and $\Delta\lambda = \Delta\lambda_{detect}$ and we get

$$F(r,t) = 2\cos\left[4\pi^2\,m\,\frac{l}{\lambda_0\,c}\,r\,\Omega\right]\,\sin\left[2\pi\,\left(\frac{r}{\lambda_0}\;-\;\nu_0\,t\right)\right] \tag{880}$$

For a given arrangement the argument of the sinus wave varies with r for a given Ω following a cosinus function.

For the intensity of the interference of two light waves with equal frequencies but differing phases we have

$$I(r) = I_1(r) + I_2(r) + 2\,\sqrt{I_1(r)\,I_2(r)}\,\cos[\varphi_1(r) - \varphi_2(r)] \tag{881}$$

The phases are in our case

$$\varphi_1(r) = 2\pi\frac{r}{\lambda_0^2}\,\Delta\lambda_{detect} \qquad \varphi_2(r) = \;-\,2\pi\frac{r}{\lambda_0^2}\,\Delta\lambda_{detect} \tag{882}$$

The intensity of the interference fringes are given with

$$I(r) = I_1(r) + I_2(r) + 2\,\sqrt{I_1(r)\,I_2(r)}\,\cos\left[4\pi^2\,m\,\frac{l}{\lambda_0\,c}\,r\,\Omega\right] \tag{883}$$

The fringes of the intensity vary with r for a given Ω following a cosinus function .

We have derived the interference patterns for the sagnac arrangement based on the emission postulate that light is emitted with light speed c relative to its source and that light is refracted or reflected with light speed independent of the input speed. There is no incompatibility with “SR without time delay and length contraction”.

25.14 Precession of a gyroscope due to the Ampere gravitation force.

To derive the precession of a gyroscope in the presence of a massive body we start with equation (281) derived for the total force density due to Ampere interaction.

$$\frac{F}{\Delta l} = \frac{b}{c\,\Delta_o t}\,\frac{r_o^2}{64\,m}\,\frac{I_{m_1}\,I_{m_2}}{d}\int_{\gamma_{2min}}^{\gamma_{2max}}\int_{\gamma_{1min}}^{\gamma_{1max}}\frac{\sin^2(\gamma_1-\gamma_2)}{\sqrt{\sin\gamma_1\,\sin\gamma_2}}\,d\gamma_1\,d\gamma_2 \tag{884}$$

with $\int\int_{Ampere} = 5.8731$.
It is also for $v \ll c$

$$\rho_x = \frac{N_x}{\Delta x} = \frac{1}{2\,r_o} \qquad I_m = \rho\,m\,v \qquad \Delta_o t = K\,r_o^2 \qquad I_m = \frac{m}{q}\,I_q \tag{885}$$

We have defined a density ρ_x of BSPs for the current so that one BSP follows immediately the next without space between them. As we want the force between one pair of BSPs of the two parallel currents we take $\Delta l = 2\,r_o$.

The concept is shown in Fig. 134

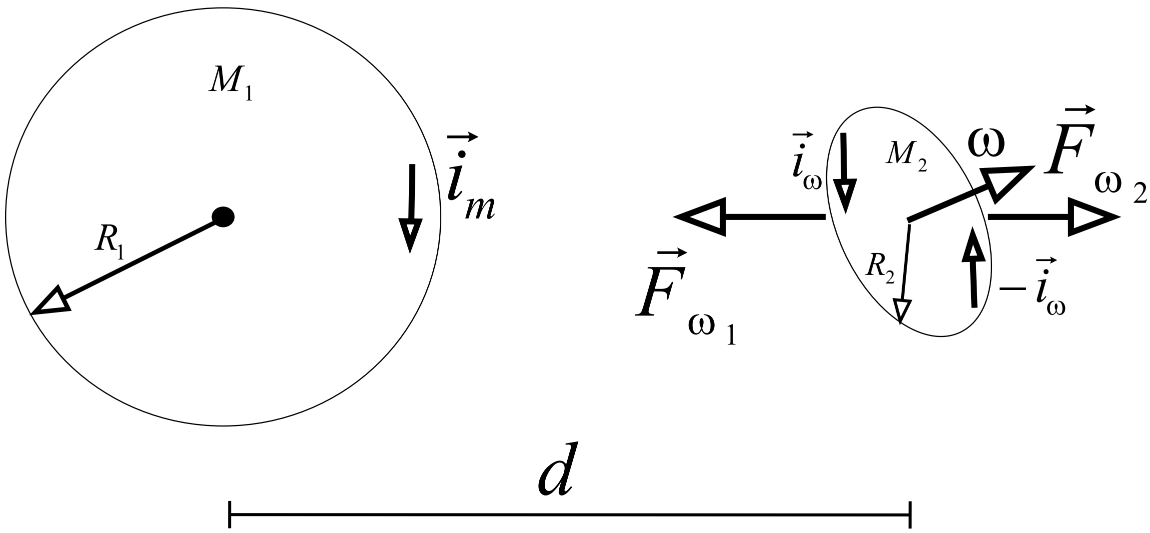


Figure 134: Gyroscopic precession.

For one reintegrating BSP it is $\rho = 1$. The current generated by one reintegrating BSP is

$$i_m = \rho\,m\,v_m = \rho\,m\,k\,c \qquad with \qquad v_m = k\,c \qquad k = 7.4315 \cdot 10^{-2} \tag{886}$$

The currents at the rotating gyroscope that are parallel to the current i_m of M_1 are

$$i_\omega = \pm\,\rho\,m\,v_\omega \qquad with \qquad v_\omega = \omega\,R_2 \tag{887}$$

For the two opposed forces that give the momentum at the gyroscope and which generate the precession we get

$$F_{\omega_1} \propto + \frac{v_m\ v_\omega}{d - R_\omega} \qquad\qquad F_{\omega_2} \propto - \frac{v_m\ v_\omega}{d + R_\omega} \tag{888}$$

From eq. (884) with $v_1 = v_m = k\ c$ we get for a pair of moving BSPs

$$dF_R = \ 5.8731\ \frac{b}{c\ \Delta_o t}\ \frac{2\ r_o^3}{64}\ \rho^2\ m\ \ \frac{v_1\ v_2}{d}\ \ N \tag{889}$$

and $d >> R_2$ we get the total force

$$F_R = \ 5.8731\ \frac{b}{c\ \Delta_o t}\ \frac{2\ r_o^3}{64}\ \rho^2\ m\ v_m\ v_\omega\ \gamma_A^2\ \frac{M_1\ M_2}{d}\ \ \ N \tag{890}$$

$$F_R = 2.551 \cdot 10^{-32}\ \ v_\omega\ \ \frac{M_1\ M_2}{d}\ \ \ N \tag{891}$$

with M_1 and M_2 the masses of the bodies.

Note: For distances d between gravitating masses smaller than d_{gal} the precession due to the Ampere force is neglect able compared with the precession due to the Newton gravitation force.

25.15 Thirring-Lense-Effect.

The Thirring-Lense-Effect is an effect that is based on the induction law and on the Doppler effect.

In sec. 15.4 about induction bending the following equation was deduced for the force induced on a probe BSP by a BSP moving with speed v.

The concept is shown in Fig. 135

$$d^{'}\bar{F}_{i_n} = \ \frac{1}{8\ \pi}\ \sqrt{m_p}\ r_{o_p}\ rot\ \bar{C}_n^{'} \tag{892}$$

with

$$rot\ \bar{C}_n^{'} = \ \frac{1}{2\pi}\ \sqrt{m}\ v^2\ \frac{r_o}{r_r^{\,3}}\ \left[2\ \cos^2\theta - \sin^2\theta\right]\ \bar{e}_r\ +\ 0 \cdot \bar{e}_\gamma \tag{893}$$

$$\frac{1}{2\pi}\ \sqrt{m}\ v^2\ \frac{r_o}{r_r^3}\ \sin\theta\cos\theta\ \bar{e}_\theta$$

For the analysis of the dragging produced by a rotating mass on a probe mass placed in the equatorial plane, the components of the induced force in the direction $\bar{e}_r$ and the direction $\bar{e}_\theta$ are required.

The concept is shown in Fig. 136

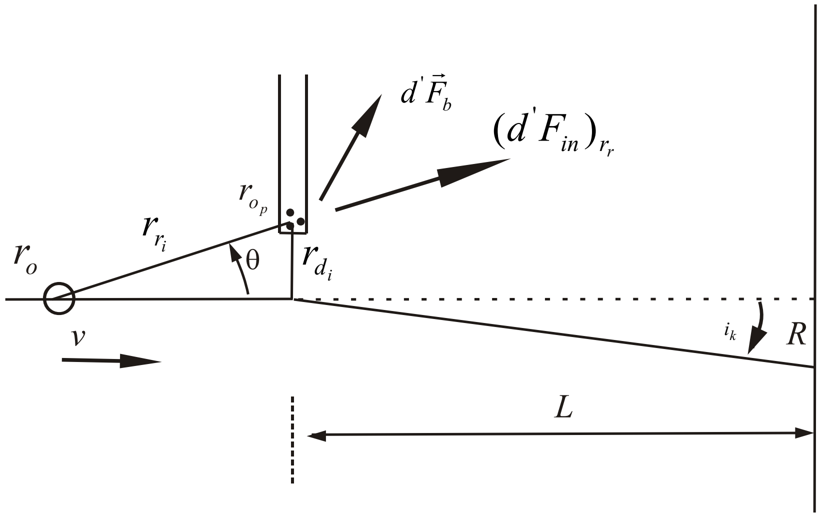


Figure 135: Force induced on a BSP at a bending edge by a BSP moving with speed v.

$$d'F_{i_n}\bar{e}_r = \frac{1}{16\,\pi^2}\, m\, v^2\, \frac{r_o^2}{r_r^3}\left[2\,\cos^2\theta - \sin^2\theta\right]\ \bar{e}_r \tag{894}$$

$$d''F_{i_n}\bar{e}_\theta = \frac{1}{16\,\pi^2}\, m\, v^2\, \frac{r_o^2}{r_r^3}\ \sin\theta\cos\theta\ \bar{e}_\theta \tag{895}$$

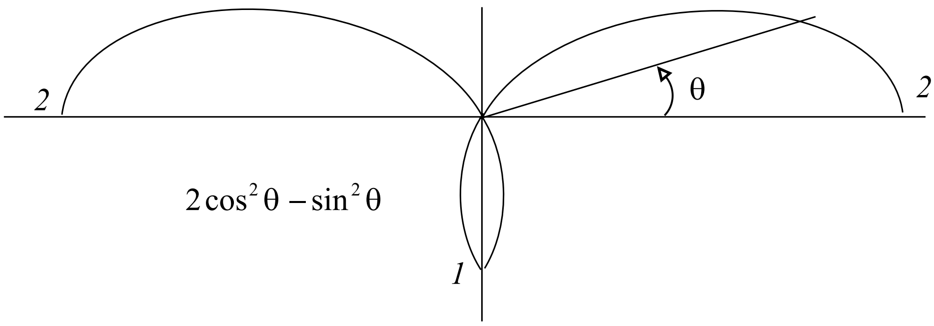


Figure 136: Plotting of the trigonometric relation for the analysis of Dragging.

For equal speed v and distance r_r the components of the forces in the direction of the speed v are equal but opposed for the angles θ and $2\pi - \theta$. This means that two BSPs located at θ and $2\pi - \theta$ induce on the probe BSP forces in the direction of v that compensate each other.

Fig. 137 shows two BSPs from the surface of the earth that moves with the speed v relative to a probe BSP_p located at the distance d. Each moving BSP emittes rays of FPs with light speed c relative to the BSP, with a constant interval λ between them. The speed of the FPs relative to a probe BSP_p located at the ray is

$$c + v\ \cos\theta = \lambda\,\nu \tag{896}$$

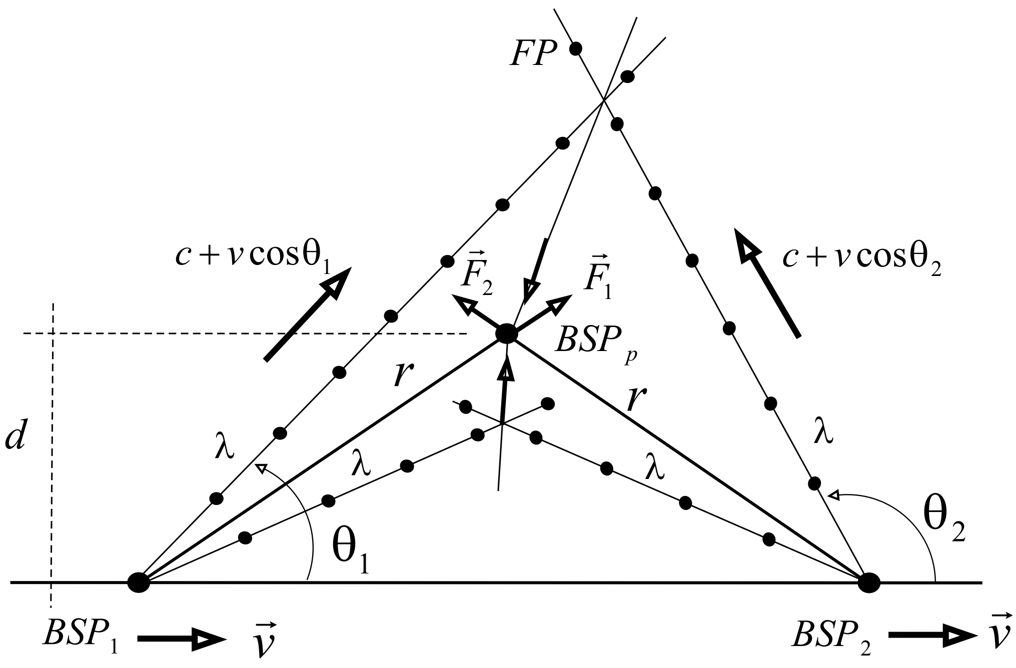


Figure 137: Dragging due to Doppler effect.

FPs located at the proximity of the probe BSP_p have a higher probability to contribute to the generation of the force on the probe BSP_P. The angle $\theta = \arcsin(d/r)$ of the probe BSP_p is therefore used to calculate the force.

For the two BSPs located at the angles $\theta_1 = \theta$ and $\theta_2 = 2\pi - \theta$ we get the frequencies of FPs at the probe BSP_P

$$\nu_1 = \frac{c + v\ \cos\theta_1}{\lambda} \qquad \nu_2 = \frac{c + v\ \cos\theta_2}{\lambda} \qquad \nu_o = \frac{c}{\lambda} \tag{897}$$

With eqs. (894) and (895) we get for the components of the forces in the direction of the speed v taking into consideration the Doppler effect

$$d'\bar{F}_v = \frac{\nu}{\nu_o}\ d'F_{i_n}\ \cos\theta\ \bar{e}_r \qquad \theta = \arcsin(d/r) \tag{898}$$

$$d''\bar{F}_v = \frac{\nu}{\nu_o}\ d''F_{i_n}\ \sin\theta\ \bar{e}_\theta \qquad \theta = \arcsin(d/r) \tag{899}$$

The dragging forces in the direction of the speed v on the probe BSP_p are

$$d'\bar{F}_{drag} = (d'\bar{F}_{v_1} - d'\bar{F}_{v_2}) = \frac{\nu_1 - \nu_2}{\nu_o}\ d'\bar{F}_{i_n}\ \cos\theta\ e_r \tag{900}$$

$$d''\bar{F}_{drag} = (d''\bar{F}_{v_1} - d''\bar{F}_{v_2}) = \frac{\nu_1 - \nu_2}{\nu_o}\ d''\bar{F}_{i_n}\ \sin\theta\ e_\theta \tag{901}$$

The total dragging force is

$$\bar{F}_{drag} = \frac{2}{\pi} \int_{\theta=0}^{\pi/2} (d'\bar{F}_{drag} + d''\bar{F}_{drag})\, d\theta \tag{902}$$

25.16 Atomic clocks and gravitation.

Oscillations of mechanical instruments like a pendulum have been used in the past to define time unit of second. Big efforts were made to minimise the influence of factors like temperature, vibrations, humidity, gravitation, etc. on the precision. Modern clocks make use of the quantized change of states of atoms which takes place at a much higher frequency leading to better precisions. When comparing the precision of clocks it is very important to compare them under the same conditions of temperature, vibrations, humidity, gravitation, etc. If this is not possible, corrections for each deviation must be made. The origin of the variation of the precision of atomic clocks due to gravitation is unknown and can be attributed to changes in the energy levels of the atoms itself or to changes in the frequencies of photons after emission.

The intention of the present section is to show a possible mechanism based on the approach that gravitation is generated by the reintegration of BSP to their nuclei. According to the approach, the energies of level electrons are given by stable dynamic configurations of BSPs in nuclei, which change for each atom and its ions. The number of regenerating FPs with opposed angular momenta that arrive to a nucleus is a function of the distance to the other gravitating nucleus. They influence the stable dynamic configuration of BSPs in the nucleus changing the energy of level electrons.

The gravitation components are due to:

- Reintegration of BSPs in the direction of the distance between the gravitating bodies (induction, Newton).

$$F_G = G\, \frac{M_1\, M_2}{r^2} \tag{903}$$

- Reintegration of BSPs perpendicular to the distance between the gravitating bodies (Ampere).

$$F_R = \pm\, R(v)\, \frac{M_1\, M_2}{r} \qquad \textit{with} \qquad R(v) = 2.551 \cdot 10^{-32}\, v \tag{904}$$

25.16.1 Hafele-Keating Experiment.

We assume that the atomic transition frequencies of the atoms used in atomic clocks change proportional to the gravitation force and so the gains and losses expressed in ns.

Each Caesium atom C_s^{133} of an atomic clock changes its frequency with the gravitation force.

The following measured data were obtained during the Hafele-Keating Experiment: The concept is shown on Fig. 138.

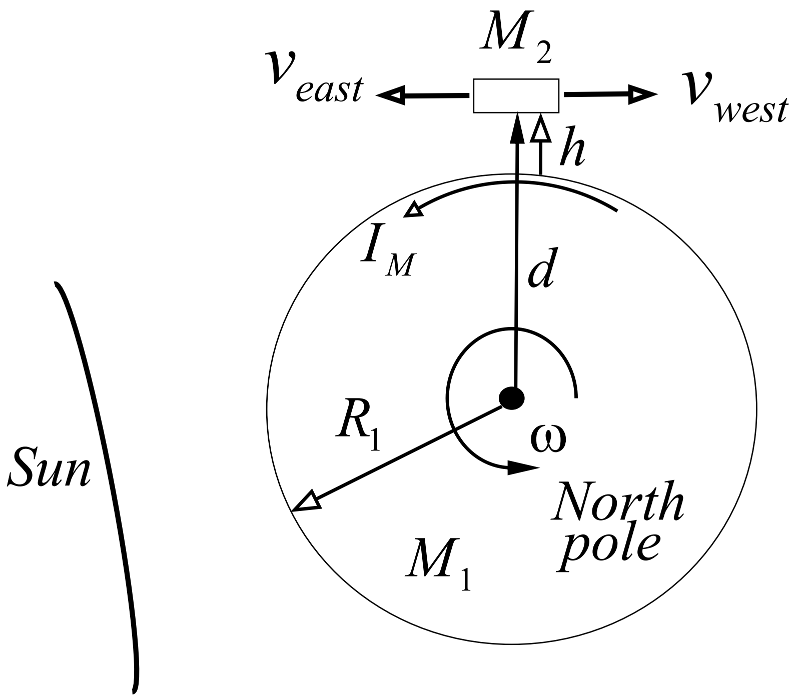


Figure 138: Influence of gravitation on clocks frequency.

a) Flying eastwards a total loss of $\Delta t^E = -59\ ns$ was measured during a flight of 41.2 hours at a hight of $h^E = 8.900$ m and a speed of $v = 950\ km/h$ relative to the earth surface.

b) Flying westwards a total gain of $\Delta t^W = 273\ ns$ was measured during a flight of 48.6 hours at a hight of $h^W = 9.400$ m and a speed of $v = 950\ km/h$ relative to the earth surface.

The gain or loss was measured relative to an equivalent atomic clock based on the earth.

At Fig. 138 we have the earth with mass M_1 and the mass M_2 of an Caesium atom C_s^{133} moving with the speed v east or westwards relative to the surface of the earth at an altitude h. The current I_M due to the interaction of reintegrating BSPs of the earth and the sun has the same direction as the rotation ω of the earth on its axis relative to the sun (see sec.20.2).

The results of the Hafele-Keating Experiment are better expressed in ns loss or gain per day.

Eastwards the plane was flying during $41,2\ h$ which is equivalent to $1,716\ days$ and which gives a total loss eastwards of $\Delta t^E = -59/1.716 = -34,38\ ns/day$.

Westwards the plane was flying during $48,6\ h$ which is equivalent to $2,025\ days$ and which gives a total loss westwards of $\Delta t^W = 273/2,025 = 134,81\ ns/day$.

We get for the losses and gains in ns/day

$$\Delta t^E = -34,38\ \ ns/day \qquad and \qquad \Delta t^W = 134,81\ \ ns/day \tag{905}$$

The total gain or loss eastwards and westwards is

$$\Delta t^E = \Delta t^E_G\ +\ \Delta t^E_R \qquad and \qquad \Delta t^W = \Delta t^W_G\ +\ \Delta t^W_R \tag{906}$$

The proportionality factors are not the same for the Newton and Ampere gravitation forces because of the different generation mechanism of the gravitation forces.

The proportionality factors are defined as

$$K_G = \frac{\Delta t_G}{\Delta F_G} \qquad and \qquad K_R = \frac{\Delta t_R}{\Delta F_R} \tag{907}$$

where Δt_G are the ns/day due to the Newton gravitation and Δt_R are the ns/day due to the Ampere gravitation.

The difference between the Newton gravitation forces between the distances d_1 and d_2 from the centre of the earth is given by

$$\Delta F_G = F_{G_2} - F_{G_1} = G\ M_1\ M_2\ \left[\frac{1}{d_2^2} - \frac{1}{d_1^2}\right] \qquad where \qquad d_2 < d_1 \tag{908}$$

The difference between the Ampere gravitation forces of a body moving with v_{tot} at the hight d_1 and d_2 from the centre of the earth is given by

$$\Delta F_R = R(v_{tot})\ M_1\ M_2\ \left[\frac{1}{d_2} - \frac{1}{d_1}\right] \qquad where \qquad d_2 < d_1 \tag{909}$$

where v_{tot} is a velocity still to be deduced.

As the Hafele-Keating experiment doesn't give measured values of Δt_G, we calculate the proportionality factor K_G with measured values of an experiment made by **Briatore and Leschiutto** in 1976. The experiment concentrates exclusively on the influence of the Newton gravitation on the frequency of clocks. The measured data are:

a) Turin $h_2 = 250\ m$ and Plateau Rosa $h_1 = 3.500\ m$

b) $\Delta t_G = 33,8 - 36,5\ \ ns/day$

For the calculation of ΔF_G we use

a) The mass of C_s^{133} with $M_2 = 2,2061 \cdot 10^{-25}\ kg$

b) The mass of the earth $M_1 = 5,972 \cdot 10^{24}\ kg$

c) For Plateau Rosa $d_1 = R_\oplus + h_1 = 6.378,0\ km + 3,5\ km = 6.381,5\ km$

d) For Turin $d_2 = R_\oplus + h_2 = 6.378,0\ km + 0,25\ km = 6.378,25\ km$

We get $\Delta F_G = 2,2201 \cdot 10^{-27}\ N$ and for the proportionality factor

$$K_G = \frac{\Delta t_G}{\Delta F_G} = \frac{33,8}{2,2201 \cdot 10^{-27}} = 1,5362 \cdot 10^{28}\ \frac{ns}{N\ day} \tag{910}$$

Now we can calculate for the Hafele-Keating Experiment the clock variations that correspond to the Newton gravitation for the east flight with $d_2^E = 8,9\ km$ and the west flight with $d_2^W = 9,4\ km$. We get

$$\Delta t_G^E = 92,45\ \frac{ns}{day} \qquad and \qquad \Delta t_G^W = 97,63\ \frac{ns}{day} \tag{911}$$

With

$$\Delta t^E = \Delta t_G^E\ +\ \Delta t_R^E \qquad and \qquad \Delta t^W = \Delta t_G^W\ +\ \Delta t_R^W \tag{912}$$

we get

$$\Delta t_R^E = -126,83 \qquad and \qquad \Delta t_R^W = 37,18 \tag{913}$$

With

$$\Delta t_R = K_R\ R(v_{tot})\ M_1\ M_2\ \left[\frac{1}{d_2} - \frac{1}{d_1}\right] \qquad\qquad R(v_{tot}) = 2.551 \cdot 10^{-32}\ v_{tot} \tag{914}$$

we get with $v_{tot} = v_E$ in the east direction and $v_{tot} = v_W$ in the west direction

$$\frac{\Delta t_R^E}{\Delta t_R^W} = -\ \frac{v_E}{v_W}\ \left[\frac{1}{d_2^E} - \frac{1}{d_1^E}\right]\ /\ \left[\frac{1}{d_2^W} - \frac{1}{d_1^W}\right] \tag{915}$$

and

$$\frac{\Delta t_R^E}{\Delta t_R^W} = -\ 0,9468\ \frac{v_E}{v_W} \qquad or \qquad \frac{v_E}{v_W} = k = 3,6029 \tag{916}$$

We define that

$$v_E = v_S + v \qquad and \qquad v_w = v_S - v \tag{917}$$

where v is the velocity of the plane relative to the surface of the earth and v_S a velocity still to be determined. We get that

$$v_S = \frac{k+1}{k-1}\, v = 1,7683\, v \tag{918}$$

If we assume that the velocity of the commercial plane used was $v = 750\ km/h$ we get for $v_S = 1.326\ km/h$ or $v_S = 368\ m/s$.

The speed of the surface of the earth at the equator in a frame with centre at the sun and the earth placed at an axis of the frame is $v_{center} = 463\ m/s$, which is not far from $v_S = 368\ m/s$. The difference could come from the not very reliable data of the Hafele-Keating experiment.

The conclusion is, that the speed $v_S = 368\ m/s$ calculated on the basis of the variations of the frequencies of atomic clocks due to the influences of the Newton and Ampere gravitation forces based on the mass of the C_s^{133} atom, is not far from the speed $v_{center} = 463\ m/s$ of the surface of the earth at the equator for a frame placed at the centre of the earth. This can be seen as a confirmation of the proposed approach for the gravitation mechanism as the result of the reintegration of migrated electrons and positrons to their nuclei.

Finally we calculate also the proportionality factor K_R for the Ampere gravitation.

$$K_R = \frac{\Delta t_R}{\Delta F_R}\Big|^{E} = \frac{\Delta t_R}{\Delta F_R}\Big|^{W} \tag{919}$$

$$\Delta F_R = R(v_{tot})\ M_1\ M_2\ \left[\frac{1}{d_2} - \frac{1}{d_1}\right] \qquad where \qquad d_2 < d_1 \tag{920}$$

with $v_{tot} = v_E$ for the east direction and $v_{tot} = v_W$ for the west direction. We get

$$K_R = \frac{\Delta t_R}{\Delta F_R}\Big|^{E} = \frac{\Delta t_R}{\Delta F_R}\Big|^{W} = 2,9965 \cdot 10^{40}\ \frac{ns}{N\ day} \tag{921}$$

For K_G we had

$$K_G = \frac{\Delta t_G}{\Delta F_G} = \frac{33,8}{2,2201 \cdot 10^{-27}} = 1,5362 \cdot 10^{28}\ \frac{ns}{N\ day} \tag{922}$$

Now we calculate the current I_M generated by the speed v_S of BSPs. From sec.20 we have with v_S that $i_S = \rho_x\ m\ v_S$ and for the earth we get $I_M = i_S\ \gamma_A\ M_\oplus$.

We defined a density ρ_x of BSPs for the current I_M so that one BSP follows immediately the next without space between them and get

$$\rho_x = \frac{N_x}{\Delta x} = \frac{1}{2\, r_o} \qquad with \qquad r_o = 3,8590 \cdot 10^{-13}\ m \tag{923}$$

With $\rho_x = 1,2957 \cdot 10^{12}\ m^{-1}$, $m = 9,1094 \cdot 10^{-31}\ kg$, $v_S = 368\ m/s$, $\gamma_A = 1,07558 \cdot 10^{9}\ kg^{-1}$, and $M_\oplus = 5,972 \cdot 10^{24}\ kg$ we get for the current I_M at the equator that generates the transversal field dH_n of the earth.

$$I_M = \rho_x\, m\, v_S\, \gamma_A\, M_\oplus = 2,7900 \cdot 10^{18}\ kg/s \tag{924}$$

25.17 Instability of positive BSP.

In sec. 6 we have assumed that bright matter is composed of accelerating and decelerating BSPs that regenerate each other. Positive accelerating with negative decelerating BSPs and positive decelerating with negative accelerating BSPs form two independent groups of BSPs.

The condition for BSPs to become level BSPs is that they have BSPs in the nucleus that provide them with regenerating FPs instantaneously and without fluctuations.

Fig. 36 shows a negative decelerating level BSP and a positive accelerating nuclei BSP.

Level electrons move constantly while electrons and positrons that constitute the nuclei are confined in a small volume with a bigger inertia and provide the FPs required by the level electrons. Emitted FPs from level electrons are fully used to regenerate the corresponding positrons in the nucleus. In such an environment a free positron has not a stable regenerating source of FPs and transforms to photons and neutrinos, which don't need regeneration.

25.18 Energy levels of electrons in atoms.

To analyze qualitatively the origin of the **energy levels** for electrons in atoms we take a hydrogen atom which has in his nucleus 919 positive BSPs and 918 negative BSPs. These BSPs in the nucleus are in a dynamic balance and their emitted fundamental particles meet with the fundamental particles of an external level-electron. The probability that the emitted fundamental particles of a BSP in the nucleus meet with the regenerating fundamental particles of a level-electron depends on the position the BSP has relatively to the other BSP in the nucleus. This relative position varies constantly and is influenced by the external level-electron.

If we now take an atom with more than one proton, the first level-electron will influence the distribution of the BSPs in the atomic nucleus to get the maximum binding force. Each following level-electron will find a less favourable distribution of the BSPs in the atomic nucleus and thus have a weaker binding force than the previous one.

The external electrons are therefore coupled to the atomic nucleus by different binding forces and have different energy levels. Because of the quantified numbers of BSPs in the atomic nucleus the energy levels of the external electrons are also quantified.

25.19 Radiation of accelerated BSPs.

We have seen, that BSPs that move with constant velocity v emit and are regenerated constantly by FPs. At the time $t_o = 0$ a BSP is regenerated by FPs that have interacted with FPs that were emited during the time $-\infty < t < 0$. FPs emitted by the BSP in the past, interact with regenerating FPs that meet the same BSP at $t_o = 0$, if the BSP moves with constant speed. If the constant movement of the BSP is perturbated (acceleration), part of the regenerating FPs miss the BSP and are irradite in space.

In the case of a level electron that is constantly accelerated in radial direction, the regenerating FPs that miss the electron are not irradiated into space, but absorbed by the regenerating FPs of a BSP of the nucleus that is very close. The BSP of the nucleus is accelerated generating transversal angular momenta on its regenerating FPs that are absorbed by the level electron. The energy, that in the case of an accelerated free electron is irradiated into space, is in the case of the radially accelerated level electron returned to the level electron via the atomic nucleus.

25.20 Coulomb force on a level electron.

For increasing speed of a BSP, the regenerating longitudinal field $d\bar{H}_s$ of the BSP decreases while the transversal regenerating field $d\bar{H}_n$ increases. With decreasing longitudinal field $d\bar{H}_s$ the Coulomb force to an other BSP decreases.

If we imagin an electron with an elliptic orbit around the nucleus, moving from the aphelion to the perihelion the speed increases, decreasing the Coulomb force. When the electron is moving from the perihelon to aphelion the speed decreases and the Coulomb force increases.

25.21 Binding energy of BSPs in the nucleons.

The binding energy is defined as

$$E_B = (n^+ \ + \ n^-) \, m_e \, c^2 - m_{nucleon} \, c^2 \tag{925}$$

with n^+ the number of positive and n^- the number of negative BSP that form the nucleon. m_e and $m_{nucleon}$ are the masses of the electron and the nucleon.

For the proton we have $n^+ = 919$ and $n^- = 918$ with a binding Energy of $E_{B_{prot}} = 6.9489 \cdot 10^{-14} \ J = 0.43371 \ MeV$.

For the neutron we have $n^+ = 919$ and $n^- = 919$ with a binding Energy of $E_{B_{neutr}} = -5.59743 \cdot 10^{-14} \ J = -0.34936 \ MeV$.

Stable complex particles have positive binding energies, meaning that the nucleon has less energy than the sum of the rest energies of its component BSPs.

26 Characteristics of a good theory.

The present work is not only limited to show the pragmatic approach of SR and GR by Einstein and its consequences, it presents also an alternative theory where the interactions omitted by Einstein are considered. The question that arises is how to decide for one of these theories .

The primordial objective of a physical theory or a scientific model is to allow calculations that match with experimental data obtained with measurements. A second objective is to allow theoretical predictions that still must be corroborated through experimental data.

A good theory is a theory that

- describes mathematically the biggest number of physical interactions based on the fewest postulates.
- has mathematical descriptions that give calculated data that best match experimental data.
- needs the less number of fictious entities (particle wave, gluons, gravitons, dark matter, dark energy, time dilation, length contraction, Higgs particle, etc.)
- needs the less number of helpmates (duality principle, equivalent principle, uncertainty principle, violation of energy conservation (Feynman), etc.)
- is consistent with the less number of paradoxes and contradictions.
- has the biggest potential to predict new interactions and particles.

26.1 Impediments for scientific progress.

26.1.1 Experimentally proven.

A theory like our Standard Model was improved over time to match with experimental data introducing fictious entities (particle wave, gluons, gravitons, dark matter, dark energy, time dilation, length contraction, Higgs particle, Quarks, Axions, etc.) and helpmates (duality principle, equivalent principle, uncertainty principle, violation of energy conservation, etc.) taking care that the theory is as consistent and free of paradoxes as possible. The concept is shown in Fig. 139. These improvements were integrated to the existing model trying to modify it as less as possible what led, with the time, to a model that resembles a monumental patchwork. To return to a mathematical consistent theory without paradoxes (contradictions) a completely new approach is required that starts from the basic picture we have from a particle. “E & R” UFT is such an approach representing particles as focal points in space of rays of FPs. This representation contains from the start the possibility to describe interactions between particles through their FPs, interactions that the SM with its particle representation attempts to explain with fictious entities.

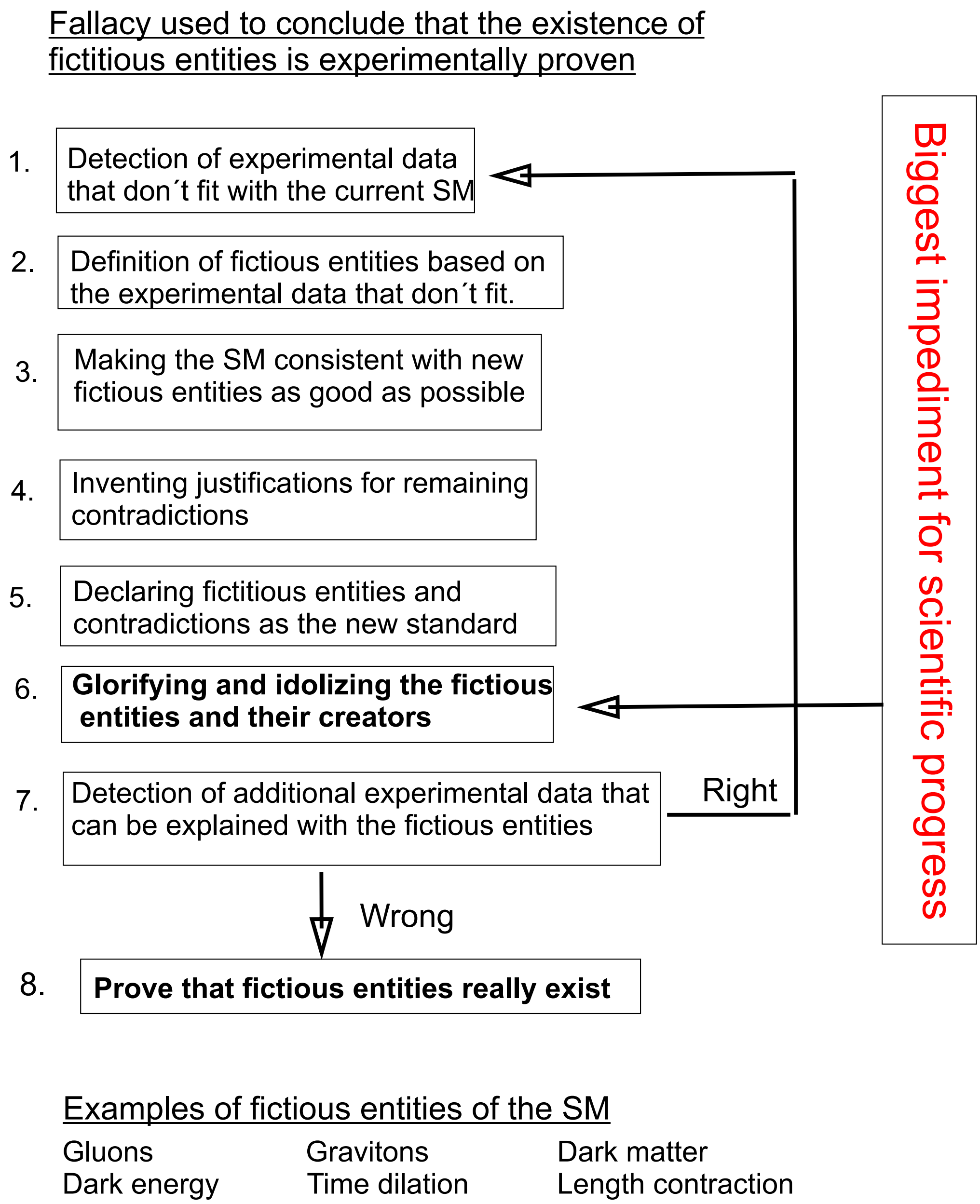


Figure 139: Fallacy used to conclude that fictious entities really exist

Fig. 139 is an organigram where the main steps of the integration of fictious entities to the SM are shown. All experiments where the previously defined fictious entities are indirectly detected (point 7. of Fig. 139) are not a confirmation of the existence of the fictious entities (point 8. of Fig. 139), they are simply the confirmation that the model was made consistent with the fictious entities (point 3. of Fig. 139).

All experiments where time dilation or length contraction are apparently measured are indirect measurements and where the experimental results are explained with time dilation or length contraction, which stand for the interactions between light and the measuring instruments, interactions that were omited.

In the case of the increase of the life time of moving muons the increase is because of the interactions between the FPs of the muons with the FPs of the matter that constitute the real frame relative to which the muons move. To explain it with time dilation only avoids that scientists search for the real physical origin of the increase of the life time.

26.1.2 Epicycles of the Standard Model.

The Geocentric model with its circular orbits was too simple to get a good match between experimental and calculated data. The model was improved adding for each planet a set of epicycles to the circular orbits resulting a complicated description which was still far from the real movement of the planets.

The concept is shawn in Fig. 140

A big improvement was done when switching first to the Heliocentric representation and then introducing the eliptic orbits.

The concept is shawn in Fig. 141

If we have a look on the presently accepted SM, also big efforts are made to improve the capacity to describe new experimental data adding more and more new particles and concepts, trying at the same time to make the model consistent. This procedure has its limits as shawn with the geocentric model and its epicycles, which became so abstract and strange from reality that a radical new approach was required. This is the present state of our SM.

Following a list of epicycles added to the SM during the last 150 years:

Examples	**Epicycles**
Special Relativity	time dilation and length contraction
General relativity	time space curvature
Coexistence of protons in nuclei	Strong force (Gluons)
Radioactivity	Weak force (W, Z Bosons)
Stern Gerlach	Electron intrinsic magnetic spin

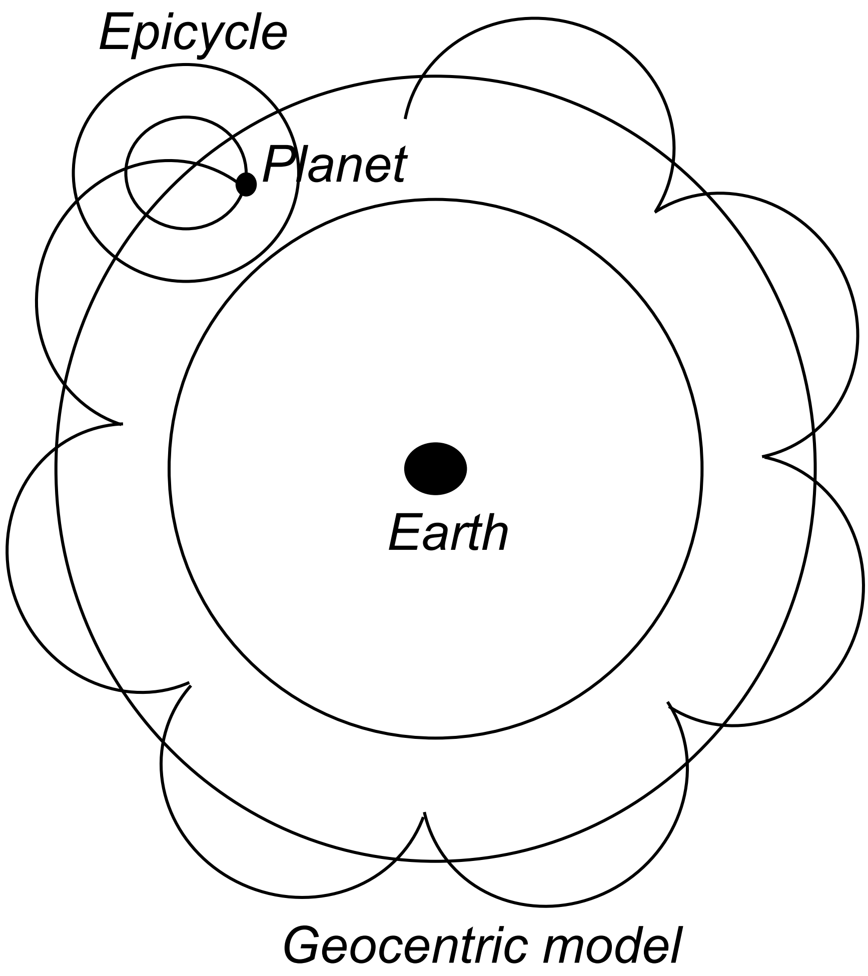


Figure 140: Epicycles of the Geocentric model

Flattening of Galaxie's speed curve	Dark matter
Expansion of Galaxies	Dark energy
Quarks	Fraction of electric charge Q/e

With the "E & R " UFT approach, where particles are represented as focal points, and the finding that electrons and positrons neither attract nor repel each other when the distance between them tend to zero, the epicycles added during the last 150 years are not more required.

The affirmation that epicycles are experimentally confirmed is a fallacy.

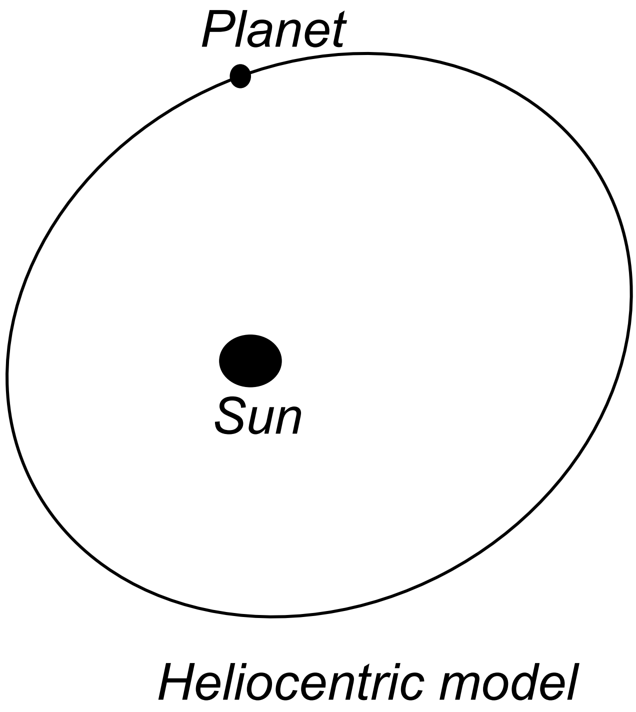


Figure 141: Heliocentric model

26.1.3 Peer-review, a fire-wall against new approaches.

In science, peers are those persons that use scientific models with the same postulates to describe nature. A person who uses the geocentric model is not a peer of a person that uses the heliocentric model to describe nature. In religion, a person who uses a theology based on the christian dogmas is not a peer of a person that uses a theology based for instance on the Islamic dogmas.

The mechanism of peer-review to decide about the acceptance of a paper makes only sense, if the content of the paper is based on the same model (theory) the reviewer uses to judge it, for instance the standard model. It has the advantage, to eliminate papers that are based on the standard model but doesn't use it correctly.

It is logically not acceptable, to subject a paper that presents a new model to peer-reviewing using a different model than the proposed. The review of such a paper requires first the study of the new model and the effort to understand the new approach, and second, to confront it only with existent experimental data. In practice, reviewers have not the time and interest to do such an intensive work without remuneration, and therefore prefer to reject the paper, what is in the interest of the established institutions and has no negative repercussions on the reviewer.

Part VIII Quantum Mechanics

Quantum mechanics formulated with the focal point representation of subatomic particles.

27 Quantum mechanics expressed in terms of the approach "Emission & Regeneration" UFT.

Quantum mechanics differential equations are based on the de Broglie postulate. In the theoretical work about the interaction of charged particles, where particles are represented by a non local model emitting and absorbing continuously fundamental particles, a relation between the radius r_o and the energy of a particle is derived.

$$r_o = \frac{\hbar\, c}{E} \qquad with \qquad E = \sqrt{E_o^2 + E_p^2} \quad the\ relativistic\ energy. \tag{926}$$

This relation is used instead of the de Broglie wavelength, to build wave packages with a Gauss distribution, and to derive the corresponding probability differential equations of quantum mechanics.

The effects on the uncertainty relations and the most important quantum mechanics operators are presented.

Note: When deriving the wave-package with the radius-energy relation, the mass of a particle is considered as concentrated in a sphere with a diameter equal approximately to two times the radius r_o given by the radius energy-relation. This is not according to the approach that represents particles as Focal Points which led to the radius-energy relation where the mass (energy) of a particle is distributed from r_o to infinity, outside the sphere with radius r_o.

27.1 General considerations.

To make use of the of Fourier-Transformation, the movement of a particle is first described as a sequence of particles represented by a sinus wave, having a wavelength λ equal to $2\pi r_o$. Then the Fourier-Transformation of a wave package of sinus waves with a Gauss shaped amplitude is build.

We have that

$$\lambda = 2\pi r_o = 2\pi \frac{\hbar\, c}{E_{rel}} \qquad with \qquad E_{rel} = \sqrt{E_o^2 + E_p^2} \tag{927}$$

with

$$E_o = m_o\, c^2 \qquad E_p = p\, c \qquad p = \frac{m_o\, v}{\sqrt{1-\frac{v^2}{c^2}}} \tag{928}$$

The sinus wave on the x-axis is

$$\xi_x = A\, e^{i(k_x\, x - \omega_x\, t)} \qquad with \qquad k_x = \frac{2\pi}{\lambda_x} \qquad and \qquad \omega_x = 2\pi\, \frac{v_x}{\lambda_x} \tag{929}$$

If we now introduce in the expression that $\lambda_x = 2\pi r_{o_x} = 2\pi\hbar c/E_{rel_x}$ we get

$$\xi_x = A\; exp\left[i\frac{c}{\hbar}\left(\frac{E_{rel_x}}{c^2}\, x - \frac{v_x}{c^2}\, E_{rel_x}\, t\right)\right] \tag{930}$$

or

$$\xi_x = A\; exp\left[i\frac{c}{\hbar}\left(\frac{E_{rel_x}}{c^2}\, x - p_x\, t\right)\right] \tag{931}$$

with

$$E_{rel_x} = m_o\, c^2\left(1 - \frac{v_x^2}{c^2}\right)^{-1/2} \qquad and \qquad p_x = \frac{v_x}{c^2}\, E_{rel_x} \tag{932}$$

with E_{rel_x} the relativistic energy of the particle on the x-axis.

Note: The wave-length used by Schroedinger is based exclusively on the kinetic energy E_{kin_x} for the non-relativistic case as follows.

$$\lambda = 2\pi r_o = 2\pi\frac{\hbar\, c}{E_{rel}} \quad with \quad E_o = 0 \quad and \quad E_p = p\, c \quad where \quad p = m\, v \tag{933}$$

The proposed approach includes for the calculation of the wave-length the total energy with the rest energy of a particle. For the relativistic cases we get

$$\lambda = 2\pi r_o = 2\pi\frac{\hbar\, c}{E_{rel}} = 2\pi\frac{\hbar}{m\, c\, \gamma} \quad with \quad \gamma = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}} \tag{934}$$

For $v \to c$ we get that $\lambda \to 0$.

27.2 The wave package.

We define the Fourier-Transformation of a wave package [1,2]; on the x-axis as

$$\phi_x(x,t) = \frac{1}{2\pi}\int_{-\infty}^{+\infty} \kappa_x(p_x)\; exp\left\{i\frac{c}{\hbar}\left[m_{rel_x}(p_x)\; x - p_x\, t\right]\right\} dp_x \tag{935}$$

with a Gauss distribution $\kappa_x(p_x)$ on the p_x-axis

$$\kappa_x(p_x) = B\ exp\ \left\{ -\frac{(p_x - p_{x_o})^2}{4(\Delta p_x)^2} \right\} \tag{936}$$

and the dispersion $m_{rel_x} = m_{rel_x}(p_x)$ with

$$m_{rel_x} = \frac{E_{rel_x}}{c^2} \qquad m_{rel_x} = m_{rel_x}(p_x) = \frac{1}{c^2}\sqrt{E_o^2 + p_x^2 c^2} \qquad and \qquad E_o = m_o c^2 \tag{937}$$

Because of symmetry reasons we can write also a wave package

$$\psi_x(x,t) = \frac{1}{2\pi}\int_{-\infty}^{+\infty} \chi_x(m_{rel_x})\ exp\left\{ i\frac{c}{\hbar}\left[m_{rel_x}\ x -\ p_x(m_{rel_x})\ t\right]\right\} dm_{rel_x} \tag{938}$$

with the Gauss distribution on the m_{rel_x}-axis

$$\chi_x(m_{rel_x}) = A\ exp\ \left\{ -\frac{(m_{rel_x} - m_{rel_{x_o}})^2}{4(\Delta m_{rel_x})^2} \right\} \tag{939}$$

and the dispersion

$$p_x(m_{rel_x}) = c\ \sqrt{m_{rel_x}^2\ -\ m_o^2} \qquad and \qquad m_o = \frac{E_o}{c^2} \tag{940}$$

27.3 Differential equations.

27.4 Unrestricted differential equations.

In this and the following section the probability differential equations are derived. The differential equations are classified into unrestricted and non-relativistic. Then they are subclassified in groups of general, time or space independent.

The unrestricted differential equations are valid for the whole range of speed $0 \leq v \leq c$.

We start with the wave package

$$\psi_x(x,t) = \frac{1}{2\pi}\int_{-\infty}^{+\infty} \chi_x(m_{rel_x})\ exp\left\{ i\frac{c}{\hbar}\left[m_{rel_x}\ x -\ p_x(m_{rel_x})\ t\right]\right\} dm_{rel_x} \tag{941}$$

with

$$m_{rel_x} = \frac{E_{rel_x}}{c^2} \qquad and \qquad p_x(m_{rel_x}) = c\ \sqrt{m_{rel_x}^2 - m_o^2} \tag{942}$$

with

$$E_{rel_x} = E_o + E_{kin_x} = \sqrt{E_o^2 + E_{p_x}^2} \qquad E_o = m_o c^2 \qquad E_{p_x} = p_x\, c \tag{943}$$

For the unrestricted range of velocities $0 \leq v \leq c$ we have that

$$p_x = \frac{v_x}{c^2} E_{rel_x} \tag{944}$$

and E_{kin_x} represents the kinetic energy for the whole range of speed.

27.4.1 The wave equation.

The wave differential equation we obtain by derivation of ψ_x two times versus t and two times versus x. The results are then connected through

$$p_x = \frac{v_x}{c^2} E_{rel_x} \tag{945}$$

We get

$$\frac{\partial^2}{\partial x^2}\psi_x \;=\; \frac{1}{v_x^2}\,\frac{\partial^2}{\partial t^2}\psi_x \tag{946}$$

For $v_x \to c$ we have

$$\frac{\partial^2}{\partial x^2}\psi_x(x,t) \;=\; \frac{1}{c^2}\,\frac{\partial^2}{\partial t^2}\psi_x(x,t) \tag{947}$$

the well known wave equation

27.4.2 The time independent differential equation.

Time independent differential equations are deduced deriving one time and two times the wave function ψ_x.

a) We derive the wave function ψ_x one time versus x and get the following time independent differential equation on the x coordinate

$$\frac{\partial}{\partial x}\psi_x = \frac{i}{\hbar\, c}\; E_{rel_x}\;\psi_x = \frac{i}{\hbar\, c}\;(E_o + E_{kin_x})\;\psi_x \tag{948}$$

E_{kin_x} represents the kinetic energy for the whole range of speed, relativistic and non-relativistic.

The equation writes for conserved systems with the potential energy $U(x)$ as

$$-i\,\hbar\, c\frac{\partial}{\partial x}\psi_x - E_o\;\psi_x \;+\; U(x)\;\psi_x = [E_{kin_x} \;+\; U(x)]\;\psi_x = E_{tot}\;\psi_x \tag{949}$$

where E_{tot} is the conserved energy.

b) We derivate the wave function ψ_x two times versus x and get the following time independent differential equation on the x coordinate

$$\frac{\partial^2}{\partial x^2}\psi_x = -\ \frac{c^2}{\hbar^2}\ m_{rel_x}^2\ \psi_x \tag{950}$$

With

$$m_{rel_x} = \frac{1}{c^2}\sqrt{E_o^2 + E_{p_x}^2} \qquad E_o = m_o c^2 \qquad and \qquad E_{p_x} = p_x\ c \tag{951}$$

we get

$$\frac{\partial^2}{\partial x^2}\psi_x = -\ \frac{1}{\hbar^2\ c^2}\ (E_o^2 + E_{p_x}^2)\ \psi_x \tag{952}$$

27.4.3 The space independent differential equation.

We derivate the wave function ψ_x two times versus t

$$\frac{\partial^2}{\partial t^2}\psi_x = -\ \frac{c^2}{\hbar^2}\ p_x^2\ \psi_x \tag{953}$$

and with

$$E_{p_x} = p_x\ c \qquad and \qquad E_p^2 = E_{p_x}^2 + E_{p_y}^2 + E_{p_z}^2 \tag{954}$$

we get

$$-\ \hbar^2\ \frac{\partial^2}{\partial t^2}\psi_x = E_{p_x}^2\psi_x \tag{955}$$

and for the space

$$-\ \hbar^2\ \Delta_{\mathbf{t}}\psi = E_p^2\psi \tag{956}$$

with the operator $\Delta_{\mathbf{t}}$ defined in sec. 27.7.

27.5 Non relativistic differential equations

For non relativistic speeds we have that $v \ll c$ and that $E_{kin_x} \approx p^2/(2m_o)$.

27.5.1 General non relativistic differential equation.

The general non relativistic differential equation we obtain by deriving ψ_x two times versus t and one time versus x. The results are then connected through $E_{rel_x} - E_o = E_{kin_x} \approx p^2/(2m_o)$. We get

$$- i\,\hbar\, c\frac{\partial}{\partial x}\psi_x(x,t) \;-\; E_o\,\psi_x(x,t) \approx \;-\frac{\hbar^2}{2\,m_o\,c^2}\,\frac{\partial^2}{\partial t^2}\psi_x(x,t) \quad with \quad E_o = m_o\,c^2 \tag{957}$$

The differential equation with the constant energy E_o describes the movement of a non-accelerated particle in a cero potential energy field.

With E_{tot} the total energy, E_{kin} the kinetic energy, E_{pot} the potential energy and E_{rel} the relativistic energy, the above equation is equivalent to $E_{rel} \;-\; E_o = E_{kin}$. If we add at to the kinetic energy E_{kin} the potential energy $E_{pot} = U_x(x,t)$ we get the total energy E_{tot} for an accelerated movement. The result is

$$- i\,\hbar\, c\frac{\partial}{\partial x}\psi_x(x,t) \;-\; E_o\,\psi_x(x,t) \;+\; U_x(x,t)\psi_x(x,t) = E_{tot}\psi_x(x,t) \tag{958}$$

$$-\frac{\hbar^2}{2\,m_o\,c^2}\,\frac{\partial^2}{\partial t^2}\psi_x(x,t) \;+\; U_x(x,t)\psi_x(x,t) = E_{tot}\psi_x(x,t) \tag{959}$$

In a conservative system the total energy is time independent with $E_{tot} = constant$.

Comparing equation (957) with the **General SchrÃ¶dinger** differential equation, the main difference is that equation (957) derives one time versus space and two times versus time, in other words, time and space are interchanged.

27.5.2 The time independent non relativistic differential equation.

Differential equations are deduced in derivating one time or two times the wave function ψ_x.

a) We derivate the wave function ψ_x one time versus x

$$\frac{\partial}{\partial x}\psi_x = \frac{i}{\hbar\,c}\,E_{rel_x}\,\psi_x = \frac{i}{\hbar\,c}\,(E_o + E_{kin_x})\,\psi_x \tag{960}$$

For a conservative field $U_x = q_e\,V_x$ with a total energy E_{tot_x} we have

$$E_{tot_x} = E_{kin_x} + U_x \qquad and\;\; with \qquad E_{kin_x} \approx \frac{1}{2\,m_o}\,p_x^2 \tag{961}$$

we get

$$\left\{- i\,\hbar\,c\,\frac{\partial}{\partial x} + U(x)\right\}\psi(x) \approx E_x\,\psi(x) \tag{962}$$

with

$$E_x = E_{tot_x} + E_o \tag{963}$$

the Eigenvalue.

b) For the time independent differential equation deduced derivating the wave function ψ_x two times versus x see sec. 27.8.

27.5.3 Space independent non relativistic differential equation.

We take two times the derivate of the wave function ψ_x versus t

$$\frac{\partial^2}{\partial t^2}\psi_x = -\ \frac{c^2}{\hbar^2}\ p_x^2\ \psi_x \tag{964}$$

and with eq. (956)

$$-\ \hbar^2\ \Delta_{\mathbf{t}}\psi = E_p^2\psi \tag{965}$$

and $v \ll c$ and a conservative potential U

$$E_{kin} \approx \frac{1}{2\ m_o}\ p^2 = \frac{E_p^2}{2\ E_o} \qquad and \qquad E_{tot} = E_{kin} + U \tag{966}$$

we obtain the space independent non relativistic differential equation

$$\left\{-\ \frac{\hbar^2}{2\ E_o}\ \Delta_{\mathbf{t}} + U\right\}\psi \approx E_{tot}\ \psi \tag{967}$$

which is equivalent to the time inependent equation from Schroedinger.

27.6 Uncertainty principle.

In the proposed model the pairs of canonical conjugated variables lead to the following uncertainty relations

$$(\Delta E)\cdot(\Delta x) \geq \frac{1}{2}\ \hbar\ c \tag{968}$$

and

$$(\Delta p)\cdot(\Delta t) \geq \frac{1}{2}\ \frac{\hbar}{c} \tag{969}$$

Noticeable at this point is the relation

$$E\ r_o = \hbar\ c \tag{970}$$

for a particle, that connects the radius r_o and the relativistic energy E through $\hbar\ c$.

27.7 Operators.

27.7.1 Relativistic operator for the linear momentum.

The relativistic operator for the linear momentum of a particle is

$$\hat{p} = \; i \, \frac{\hbar}{c} \, \frac{\partial}{\partial t} \tag{971}$$

The linear momentum we get with

$$\bar{p} \, \chi = \; i \, \frac{\hbar}{c} \, \nabla_t \, \chi \tag{972}$$

where χ is the total mass-probability function

$$\chi = \psi_x \; \psi_y \; \psi_z \tag{973}$$

and $\nabla_{\mathbf{t}}$

$$\nabla_{\mathbf{t}} = \; \frac{\partial}{\partial t}|_x \, \mathbf{e}_x \; + \; \frac{\partial}{\partial t}|_y \, \mathbf{e}_y \; + \; \frac{\partial}{\partial t}|_z \, \mathbf{e}_z \tag{974}$$

27.7.2 Relativistic operators for the energy.

For the relativistic energy of a non-accelerated particle we obtain the operator

$$\hat{E}_{rel_x} = - \, i \, \hbar \, c \, \frac{\partial}{\partial x} \tag{975}$$

Application example.
If we apply the relativistic operators to the relativistic energy of a particle

$$E_x^2 = m_o^2 \, c^4 \; + \; p_x^2 \, c^2 \tag{976}$$

we get

$$- \, \hbar^2 \, c^2 \, \frac{\partial^2}{\partial x^2} \psi_x = m_o^2 \, c^4 \, \psi_x \; - \; \hbar^2 \, \frac{\partial^2}{\partial t^2} \psi_x \tag{977}$$

the **Klein-Gordon** equation.
With $m_o = 0$ we have

$$\frac{\partial^2}{\partial x^2} \psi_x \; = \; \frac{1}{c^2} \, \frac{\partial^2}{\partial t^2} \psi_x \tag{978}$$

27.7.3 Non-relativistic operator for the kinetic energy.

The non-relativistic operator for the kinetic energy on the x coordinate is

$$\hat{E}_{kin_x} = -\frac{\hbar^2}{2\ m_o\ c^2}\ \frac{\partial^2}{\partial t^2}|_x \tag{979}$$

and the total kinetic energy E_{kin} in the three dimensional space

$$E_{kin} = E_{kin_x} + E_{kin_y} + E_{kin_z} = -\frac{\hbar^2}{2\ m_o\ c^2}\ \Delta_{\mathbf{t}}\chi \tag{980}$$

with

$$\Delta_{\mathbf{t}} = \frac{\partial^2}{\partial t^2}|_x\ +\ \frac{\partial^2}{\partial t^2}|_y\ +\ \frac{\partial^2}{\partial t^2}|_z \tag{981}$$

27.7.4 Non-relativistic Hamilton operator.

The operator for the non-relativistic total energy on the x coordinate has the form

$$\hat{E}_x = \frac{1}{2\ m_o}\left(i\ \frac{\hbar}{c}\ \frac{\partial}{\partial t}|_x\right)^2\ +\ \hat{U}_x \tag{982}$$

or

$$\hat{E}_x = \frac{\hat{p}_x^{\,2}}{2\ m_o}\ +\ \hat{U}_x \tag{983}$$

which is equal to the Hamilton operator $\hat{H}_x$.
The general non-relativistic differential equation thus takes the form

$$i\ \hbar c\ \frac{\partial}{\partial x}\psi_x(x,t) = \hat{H}_x\ \psi_x(x,t) \tag{984}$$

with

$$\hat{H}_x = \frac{\hat{p}_x^{\,2}}{2\ m_o}\ +\ \hat{U}_x \tag{985}$$

the non-relativistic Hamilton operator.

27.7.5 Non-relativistic operator for the orbital-angular-momentum.

The wave function for the three dimentional space is

$$\psi_x(\mathbf{r},t) = \frac{1}{2\pi}\int_{-\infty}^{+\infty}\chi(m_{rel})\ exp\left\{i\frac{c}{\hbar}\left[m_{rel}\ \mathbf{r} -\ \mathbf{p}(m_{rel})\ t\right]\right\}dm_{rel} \tag{986}$$

with

$$\mathbf{r} = x\,\mathbf{e}_x + y\,\mathbf{e}_y + z\,\mathbf{e}_z \qquad and \qquad \mathbf{p} = p_x\,\mathbf{e}_x + p_y\,\mathbf{e}_y + p\,\mathbf{e}_z \tag{987}$$

We define the linear momentum operator for the different coordinates as:

$$\hat{p}_k = \; i\,\frac{\hbar}{c}\,\frac{\partial}{\partial t}|_k \tag{988}$$

The orbital-angular-momentum-operator can be expressed as

$$\mathbf{M}\left(\mathbf{r},\; i\,\frac{\hbar}{c}\,\nabla_{\mathbf{t}}\right) = \left(\mathbf{r}\;\times\; i\,\frac{\hbar}{c}\,\nabla_{\mathbf{t}}\right) \tag{989}$$

with

$$\nabla_{\mathbf{t}} = \;\frac{\partial}{\partial t}|_x\,\mathbf{e}_x \;+\; \frac{\partial}{\partial t}|_y\,\mathbf{e}_y \;+\; \frac{\partial}{\partial t}|_z\,\mathbf{e}_z \tag{990}$$

The operators for the vectorcomponents are:

$$\hat{M}_x = \hat{y}\,\hat{p}_z - \hat{z}\,\hat{p}_y \qquad \hat{M}_y = \hat{z}\,\hat{p}_x - \hat{x}\,\hat{p}_z \qquad \hat{M}_z = \hat{x}\,\hat{p}_y - \hat{y}\,\hat{p}_z \tag{991}$$

The conmutations are as known

$$[\hat{M}_k, \hat{M}_{k+1}] \neq 0 \qquad [\hat{M}_k, \hat{Q}] = 0 \qquad with \qquad \hat{Q} = \hat{M}_x^2 + \hat{M}_y^2 + \hat{M}_z^2 \tag{992}$$

27.8 The proposed theory and the Correspondence Principle.

The present theory is based on the radius-energy relation that substitutes the de Broglie wavelength.

The accordance of the proposed theory with the correspondence principle of quantum mechanics is ensured, in that the time independent differential equation from Schroedinger, deduced from the wave package constructed with the de Broglie wavelength, can be derived from the wave package constructed with the radius-energy relation presented in this work.

We start derivating the wave function ψ_x two times versus space, to get the time independent differential equation

$$\frac{\partial^2}{\partial x^2}\psi_x = -\,\frac{c^2}{\hbar^2}\,m_{rel_x}^2\,\psi_x \tag{993}$$

With

$$m_{rel_x} = \frac{1}{c^2}\sqrt{E_o^2 + E_{p_x}^2} \qquad\qquad E_o = m_o c^2 \qquad and \qquad E_{p_x} = p_x\,c \tag{994}$$

we get

$$\frac{\partial^2}{\partial x^2}\psi_x = - \frac{1}{\hbar^2 \; c^2} \; (E_o^2 + E_{p_x}^2) \; \psi_x \tag{995}$$

For non-relativistic velocities $v \ll c$ we have that

$$E_{kin_x} = \frac{p_x^2}{2 \; m_o} \qquad and \qquad E_{p_x}^2 = p_x^2 \; c^2 = 2 \; m_o \; c^2 \; E_{kin_x} \tag{996}$$

and we get

$$\frac{\partial^2}{\partial x^2}\psi_x = - \frac{2 \; m_o}{\hbar^2} \; \left[\frac{1}{2}E_o + E_{kin_x}\right] \; \psi_x \tag{997}$$

With a conservative potential $E_{tot_x} = U_x + E_{kin_x}$ we get finally

$$\left[- \frac{\hbar^2}{2 \; m_o}\frac{\partial^2}{\partial x^2} \; + \; U_x\right] \psi_x \; = \; E_x \; \psi_x \qquad with \qquad E_x = \frac{1}{2} \left[E_o + 2 \; E_{tot_x}\right] \tag{998}$$

For the three dimensional space we have

$$\left[- \frac{\hbar^2}{2 \; m_o} \; \Delta_{\mathbf{r}} \; + \; U \; \right] \; \chi = E \; \chi \tag{999}$$

with $\Delta_{\mathbf{r}}$ the Laplace operator and

$$E = \frac{1}{2} \left[E_o + 2 \; E_{tot}\right] \tag{1000}$$

If we make $E_o = 0$ we get

$$\left[- \frac{\hbar^2}{2 \; m_o} \; \Delta_{\mathbf{r}} \; + \; U \; \right] \; \chi = E_{tot} \; \chi \tag{1001}$$

Eq. (1001) is exactly the time independent differential equation constructed by **Schroedinger** with E_{tot} the Eigenvalue.

27.9 The mass conservation equation.

The mass conservation differential equation we obtain by derivating ψ_x one time versus t and one time versus x. The results are then connected through

$$p_x = \frac{v_x}{c^2} E_{rel_x} \tag{1002}$$

We get

$$\frac{\partial}{\partial t}\psi_x(x,t) \; = \; - \; v_x \; \frac{\partial}{\partial x}\psi_x(x,t) \tag{1003}$$

We define the mass probability density as

$$\rho_x(x,t) = \psi_x^*(x,t)\ \psi_x(x,t) \qquad or \qquad \rho(\mathbf{r},t) = \psi^*(\mathbf{r},t)\ \psi(\mathbf{r},t) \tag{1004}$$

We derive the mass probability density versus time

$$\frac{\partial}{\partial t}\rho_x(x,t) = \frac{\partial}{\partial t}\left[\psi_x^*(x,t)\ \psi_x(x,t)\right] = \frac{\partial}{\partial t}\psi_x^*(x,t)\ \psi_x(x,t)\ +\ \psi_x^*(x,t)\ \frac{\partial}{\partial t}\psi_x(x,t) \tag{1005}$$

With eq. (1003) we get

$$\frac{\partial}{\partial t}\rho_x(x,t) = -v_x\left[\frac{\partial}{\partial x}\psi_x^*(x,t)\ \psi_x(x,t)\ +\ \psi_x^*(x,t)\ \frac{\partial}{\partial x}\psi_x(x,t)\right] \tag{1006}$$

or

$$\frac{\partial}{\partial t}\rho_x(x,t) = -v_x\ \frac{\partial}{\partial x}\left[\psi_x^*(x,t)\ \psi_x(x,t)\right] = -\frac{\partial}{\partial x}\left[v_x\ \rho_x(x,t)\right] = -\frac{\partial}{\partial x}j(x,t) \tag{1007}$$

or

$$\frac{\partial}{\partial t}\rho(\mathbf{r},t)\ =\ -\ \nabla_{\mathbf{r}}\ \mathbf{j}(\mathbf{r},t) \qquad with \qquad \mathbf{j}(\mathbf{r},t) = \mathbf{v}\ \psi^*(\mathbf{r},t)\ \psi(\mathbf{r},t) \tag{1008}$$

where $\mathbf{j}(\mathbf{r},t)$ is the mass-current probability density.

27.10 The wave equation for relativistic speeds.

We start with the wave eq. (938) from sec. 27.2

$$\psi_x(x,t) = \frac{1}{2\pi}\int_{-\infty}^{+\infty}\chi_x(m_{rel_x})\ exp\left[i\frac{c}{\hbar}\left(m_{rel_x}\ x -\ p_x(m_{rel_x})\ t\right)\right]dm_{rel_x} \tag{1009}$$

and analyze the equation for relativistic speeds where $\Delta v = c - v \ll c$. We get

$$E_{rel} = E_p = p\ c = \frac{m\ v}{\beta}\ c \qquad \beta = \sqrt{1-\frac{v^2}{c^2}} \qquad \lambda = \frac{h}{p} \tag{1010}$$

The resulting wave equation is

$$\psi_x(x,t) = \frac{1}{2\pi}\int_{-\infty}^{+\infty}\chi_x(m_{rel_x})\ exp\left[\frac{i}{\hbar}\left(p\ x -\ E_{pv}\ t\right)\right]dm_{rel_x} \tag{1011}$$

where

$$E_{pv} = p\ v = \frac{m\ v}{\beta}\ v \tag{1012}$$

With $E_{rel} = pc^2/v$ and $E_o^2 \ll E_p^2$ we get

$$E_{pv} = p\ v = \frac{p^2\ c^2}{E_{rel}} = \frac{p^2\ c^2}{\sqrt{E_o^2 + E_p^2}} \approx pc = E_p \tag{1013}$$

We now derive the wave equation one time versus space and one time versus time and connect the results with $E_{pv} = pc$. We get

$$\frac{\partial}{\partial t}\psi_x = -\ c\ \frac{\partial}{\partial x}\psi_x \tag{1014}$$

28 Wave equations for free moving particles.

28.1 The relativistic wave equation for the free moving particle.

Until now we have worked with the wave package defined with eq. (938) where the integration is made versus dm_{rel_x}. In what follows the wave package defined with eq. (935) is used where the integration is made versus dp.

We start with the dispersion equations for the relativistic mass m_{rel_x} of sec. 27.2. In what follows we omit the sub-index x and write m_{rel} instead of m_{rel_x}.

$$m_{rel} = \frac{E_{rel}}{c^2} \qquad m_{rel} = m_{rel}(p) = \frac{1}{c^2}\sqrt{E_o^2 + p^2c^2} \qquad and \qquad E_o = m_o c^2 \tag{1015}$$

which can be transformed to

$$m_{rel} = \frac{1}{c}\left[p^2 + \frac{E_o^2}{c^2}\right]^{1/2} = \frac{1}{c}\ \left[p + p^{'}\right] \tag{1016}$$

with

$$p^{'}_{1,2} = -p \pm \sqrt{p^2 + \frac{E_o^2}{c^2}} \tag{1017}$$

We also transform

$$p(m_{rel}) = c\ \sqrt{m_{rel}^2\ -\ m_o^2} \qquad and \qquad m_o = \frac{E_o}{c^2} \tag{1018}$$

to

$$p = \frac{1}{c}\left[E_{rel}^2 - m_o^2\ c^4\right]^{1/2} \qquad with \qquad E_{rel} = E_o + E_{kin} \tag{1019}$$

and

$$p = \frac{1}{c} \left[E_{kin}^2 + 2 \; E_o \; E_{kin} \right]^{1/2} = \frac{1}{c} \left[E_{kin} + E^{'} \right] \tag{1020}$$

with

$$E_{1,2}^{'} = -E_{kin} \pm \sqrt{E_{kin}^2 + 2 \; E_o \; E_{kin}} \tag{1021}$$

Note: In what follows we changed the symbol for the wave function from ϕ to Ψ to follow the convention.

If we now introduce (1016) and (1020) in eq. (935)

$$\Psi(x,t) = \frac{1}{2\pi} \int_{-\infty}^{+\infty} \kappa_x(p_x) \; exp \left\{ i \frac{c}{\hbar} \left[m_{rel_x}(p_x) \; x - \; p_x \; t \right] \right\} dp_x \tag{1022}$$

we get

$$\Psi(x,t) \propto \; exp \left\{ \frac{i}{\hbar} \left[\; [p + p^{'}]x - [E_{kin} + E^{'}]t \; \right] \right\} \tag{1023}$$

what we can write in the form

$$\Psi(x,t) \propto \; exp \left\{ \frac{i}{\hbar} \left[p^{'} x - E^{'} t \; \right] \right\} \cdot exp \left\{ \frac{i}{\hbar} \left[p \; x - E_{kin} \; t \; \right] \right\} \tag{1024}$$

We know that

$$E_{rel} = E_o \; + \; E_{kin} = E_s \; + \; E_n \tag{1025}$$

with

$$E_s = \frac{E_o^2}{\sqrt{E_o^2 + E_p^2}} \qquad E_n = \frac{E_p^2}{\sqrt{E_o^2 + E_p^2}} \qquad E_p = p \; c \tag{1026}$$

For *relativistic speeds* $v > 0.95c$ we have that

$$E_s << E_n \qquad E_{rel} \approx E_n \approx E_p \qquad E_{kin} \approx E_n \; - \; E_o \tag{1027}$$

and

$$p_1^{'} = 0 \qquad p_2^{'} = -2p \qquad E_1^{'} = 0 \qquad E_2^{'} = -2E_{kin} \tag{1028}$$

and get

$$\Psi(x,t) \propto \; exp \left\{ \pm \frac{i}{\hbar} \left[p \; x - E_{kin} \; t \; \right] \right\} = \; exp \left\{ \pm \frac{i}{\hbar} \left[p \; x - (E_n - E_o) \; t \; \right] \right\} \tag{1029}$$

where E_{kin} is the relativistic kinetic energy.

28.1.1 The wave package for the relativistic wave equation.

To get the wave package we derive (1029) one time versus space and one time versus time.

$$c\,\frac{\partial}{\partial x}\psi_x \;\propto\; \pm\,\frac{i}{\hbar}\;p\;c\;\psi_x \tag{1030}$$

$$\frac{\partial}{\partial t}\psi_x \;\propto\; \pm\,\frac{i}{\hbar}\;[p\;c\;-\;E_o]\;\psi_x \tag{1031}$$

We now eliminate from the two equations $p\;c\;\psi_x$ and get

$$\frac{\partial}{\partial t}\psi_x \;\propto\; -\;c\,\frac{\partial}{\partial x}\psi_x \;\pm\; \frac{i}{\hbar}\;E_o\;\psi_x \tag{1032}$$

The time independent equation is

$$-i\,\hbar\,c\,\frac{\partial}{\partial x}\psi_x \;=\; \pm\,E_o\;\psi_x \tag{1033}$$

which with an potential $U(x)$ gives

$$-i\,\hbar\,c\,\frac{\partial}{\partial x}\psi_x \;+\; U(x)\psi_x = \;[\pm\,E_o\;+\;E_{tot}]\;\psi_x = E\psi_x \tag{1034}$$

If we compare it with (958) which was derived with the wave package defined with eq. (938) where the integration is made versus dm_{rel_x}, and which was derived as non relativistic

$$-\;i\,\hbar\,c\frac{\partial}{\partial x}\psi_x(x,t)\;-\;E_o\;\psi_x(x,t)\;+\;U_x(x,t)\psi_x(x,t) = E_{tot}\psi_x(x,t) \tag{1035}$$

we see that they are equal. This means that we have the same equation for non relativistic and relativistic problems.

28.2 The slightly relativistic wave equation for the free moving particle.

For $v << c$ we have that $p \approx mv$

$$E_s \approx E_o \qquad and \qquad E_n \approx E_{rel} - E_o = E_{kin} \tag{1036}$$

Also for $v \to 0$ we get that

$$E_{kin} \rightarrow 0 \qquad and \qquad E^{'} \rightarrow 0 \qquad for \qquad v \rightarrow 0 \tag{1037}$$

and

$$p \rightarrow 0 \qquad and \qquad p^{'} \rightarrow \; mc \qquad for \qquad v \rightarrow 0 \tag{1038}$$

From (1024) we get

$$\Psi(x,t) \propto \; exp\left\{ \frac{i}{\hbar} \left[mc \; x \; \right] \right\} \cdot exp\left\{ \frac{i}{\hbar} \left[p \; x - E_{kin} \; t \; \right] \right\} \tag{1039}$$

where we have that the first exponent is not a function of p and E_{kin}. As $p = mv$ from the second exponent is much smaller than mc from the first exponent, the first exponent oscillates along the $x - axis$ between plus and minus of its absolute value which is one. The frequency of the oscillation of the first factor is very high compared with the second, and the first factor can be made equal to one for all x.

$$\Psi(x,t) \propto \; exp\left\{ \frac{i}{\hbar} \left[p \; x - E_{kin} \; t \; \right] \right\} \tag{1040}$$

With $p \approx mv$ we also can write

$$E_{kin} \approx -\frac{c^2}{2E_o} \, p^2 \; + \; \frac{1 \cdot 3}{2 \cdot 4} \, \frac{c^4}{E_o^3} \, p^4 \; - \; \frac{1 \cdot 3 \cdot 5}{2 \cdot 4 \cdot 6} \, \frac{c^6}{E_o^5} \, p^6 + \cdots \tag{1041}$$

and arrive to the relativistic wave equation for a free moving particle

$$i \, \hbar \, \frac{\partial}{\partial t} \Psi = \; \left[\; \frac{\hbar^2}{2m} \, \frac{\partial^2}{\partial x^2} \; + \; \frac{1 \cdot 3}{2 \cdot 4} \, \frac{\hbar^4}{m^3 c^2} \, \frac{\partial^4}{\partial x^4} \cdots \right] \; \Psi \tag{1042}$$

If we take into consideration only the first two terms of E_{kin} and introduce an external potential $U(x)$, we get the following time independent wave equation for a slightly relativistic moving charged particle in an external potential.

$$\left[\; \frac{\hbar^2}{2m} \, \frac{\partial^2}{\partial x^2} \; + \; \frac{1 \cdot 3}{2 \cdot 4} \, \frac{\hbar^4}{m^3 c^2} \, \frac{\partial^4}{\partial x^4} \; + \; U(x) \right] \; \Psi = E \; \Psi \tag{1043}$$

To calculate the maximum velocity v_{max} for this case we make the third term of eq. (1041) ten times smaller than the second term and get $v_{max} = 0.346 \; c$. It is not recommended to use more than two terms of eq. 1041 because of the approximations made for the deduction.

Note: Eq. 1043 allows to calculate the solutions for QM systems which are slightly relativistic instead of using the strong relativistic Dirac formulation.

28.3 The non-relativistic wave equation for the free moving particle

If we make $E_o = 0$ because we want an equation that describes only the kinetic energy we get $p^{'} = 0$ and $E^{'} = 0$, and if we reduce our observation to non-relativistic speeds with $v << c$ we have from eq. (1024)

$$\Psi(x,t) \propto exp\left\{\frac{i}{\hbar}\left[p\,x - E_{kin}\,t\,\right]\right\} \qquad with \qquad E_{kin} = \frac{1}{2}\,\frac{p^2}{m} = E_{kin}(p) \tag{1044}$$

$$\Psi(x,t) = \frac{1}{2\pi}\int_{-\infty}^{+\infty} \kappa_x(p_x)\; exp\left\{\frac{i}{\hbar}\left[p\,x - E_{kin}(p)\;t\right]\right\} dp_x \tag{1045}$$

The wave function derived two times versus x and one time versus t gives the differential equation of the free moving particle of mass m. If we introduce an external potencial U we have the SchrÃ¶dinger equation for an accelerated particle.

$$i\,\hbar\,\frac{\partial}{\partial t}\Psi(x,t)\;\approx\left[-\,\frac{\hbar^2}{2\,m_o}\,\frac{\partial^2}{\partial x^2} + U\right]\Psi(x,t) \tag{1046}$$

29 Applications of the non-relativistic differential equation

The solutions of the time independent non-relativistic differential equation (958) for a potential pot, the harmonic oscillator and the hydrogen atom are derived.

29.1 Potential pot

The non-relativistic time independent differential equation is

$$-\,i\,\hbar\,c\,\frac{\partial}{\partial x}\psi_x(x)\;+\;U_x(x)\;\psi_x(x) = [E_{tot}\;+\;E_o]\;\psi_x(x) = E\;\psi_x(x) \tag{1047}$$

With $y = \psi_x(x)$ we can write

$$-\,i\,\hbar\,c\,\frac{dy}{y} = [E - U]\;dx \tag{1048}$$

After integration we get

$$-\,i\,\hbar\,c\;\left[\ln|y| + \ln C_y\right] = \int [E - U]\;dx \tag{1049}$$

resulting

$$|y| = \frac{1}{C_y}\, exp\left\{ \frac{i}{\hbar\, c} \int [E - U]\, dx \right\} \tag{1050}$$

Equation (1050) is valid for all potential energies U and gives real values for y if

$$\left\{ \frac{i}{\hbar\, c} \int [E - U]\, dx \right\} = k\, \pi \qquad and \qquad k = 0,\ \pm 1,\ \pm 2,\ \pm 3, \cdots \tag{1051}$$

defining the quantization condition, which together with the normalization condition allows the calculation of the eigenfunctions.

The potential pot is defined as

$$U = \begin{cases} \infty & \text{for } x \leq 0 \\ 0 & \text{for } 0 < x < a \\ \infty & \text{for } x \geq a \end{cases}$$

and we have for $U = 0$ and a constant E because of the assumption of energy conservation

$$\frac{1}{\hbar\, c}\, E\, x = k\, \pi \qquad resulting\ with\ x = a \qquad E_k = \pi\, \frac{\hbar\, c}{a}\, k \tag{1052}$$

with $k = 0,\ \pm 1,\ \pm 2,\ \pm 3, \cdots$ the eigenvalues E_k.

The total energy is with $E_k = E_{tot} + E_o$

$$E_{tot} = E_k - E_o = \pi\, \frac{\hbar\, c}{a}\, k\ -\ E_o \tag{1053}$$

and for $E_{tot} = 0$ we get

$$a_o = k\, \frac{\pi \hbar\, c}{E_o} = k\, \pi\, r_o \qquad with \qquad \frac{\hbar\, c}{E_o} = r_o \tag{1054}$$

the radius of of a rest electron or positron.

The eigenfunction is

$$y_k = \frac{1}{C_y}\, exp\left\{ \frac{i}{\hbar\, c}\, E_k\, x \right\} \tag{1055}$$

The integration constant C_y we get with the normalization condition

$$\int_{-\infty}^{\infty} y_{k'}^{*}\, y_k\, dx = \delta_{(k',k)} \tag{1056}$$

For $k' = k$ we get

$$\frac{1}{C_y^2} \int_0^a exp\left\{\frac{i}{\hbar\, c}\, [E_{k'} - E_k]\, x\right\}\, dx = 1 \tag{1057}$$

resulting

$$\frac{1}{C_y^2} = a \qquad or \qquad C_y = \sqrt{a} \tag{1058}$$

The normalized eigenfunction is

$$y_k = \frac{1}{\sqrt{a}}\, exp\left\{\frac{i}{\hbar\, c}\, E_k\, x\right\} \tag{1059}$$

Conclusion: The main differences compared with the solution obtained with the Schroedinger equation is that the quantization of the energy E_k is proportional to k instead of k^2 and for defined values of a the total energy E_{tot} becomes zero.

29.2 Harmonic oscillator

The potential energy for the harmonic oscillator is

$$U(x) = \frac{K}{2}\, x^2 = \frac{m\, \omega^2}{2}\, x^2 \qquad with \qquad \omega^2 = K/m \tag{1060}$$

With eq. (1050) we get

$$|y| = \frac{1}{C_y}\, exp\left\{\frac{i}{\hbar\, c} \int \left[E - \frac{K}{2}\, x^2\right]\, dx\right\} \tag{1061}$$

With the quantization condition we get

$$\frac{1}{\hbar\, c} \int_0^a \left[E - \frac{K}{2}\, x^2\right]\, dx = \frac{1}{\hbar\, c}\, \left[E\, a - \frac{K}{6}\, a^3\right] = k\, \pi \tag{1062}$$

resulting for the quantized energy with $E_{tot} = E_k - E_o$

$$E_{tot} = \pi\, \frac{\hbar\, c}{a}\, \left[k\, +\, \frac{1}{6}\, \frac{m\, \omega^2}{\pi\, \hbar\, c}\, a^3\right] - E_o = E_k - E_o \tag{1063}$$

The minimum quantum change between two adjacent energy levels is

$$\Delta E_{tot} = \Delta E_k = \pi\, \frac{\hbar\, c}{a} \tag{1064}$$

For $E_{tot} = 0$ we get

$$a\, \left[E_o - \frac{1}{6}\, m\, \omega^2\, a^2\right] = k\, \pi\, \hbar\, c \tag{1065}$$

which for $k = 0$ gives

$$a_1 = 0 \qquad or \qquad a_{2,3} = \pm\sqrt{\frac{6\ E_o}{m\ \omega^2}} \qquad for \qquad k = 0 \tag{1066}$$

We get for the minimum quantum change between two adjacent energy levels

$$\Delta E_{tot} = \pm\ \frac{\pi}{\sqrt{6}}\ \hbar\omega \tag{1067}$$

The minimum quantum energy difference ΔE_{tot} between two adjacent energy levels is proportional to $\hbar\omega$.

With the normalization condition given by equation (1056) we have that

$$\int_{-\infty}^{\infty} y_{k'}^{*}\ y_k\ dx = \frac{1}{C_y^2}\ \int_{-\infty}^{\infty} exp\left\{\frac{i}{\hbar\ c}\ [E_{k'} - E_k]\ x\right\}\ dx \tag{1068}$$

or

$$\frac{\hbar\ c}{C_y^2}\ \int_{-\infty}^{\infty} exp\{\ i\ [E_{k'} - E_k]\ \eta\}\ d\eta = \frac{\hbar\ c}{C_y^2}\ \delta_{(k',k)} \quad with \quad \eta = \frac{x}{\hbar\ c} \tag{1069}$$

With $k^{'} = k$ we get the integration constant $C_y = \sqrt{\hbar\ c}$ resulting the normalized eigenfunctions

$$y_k = \frac{1}{\sqrt{\hbar\ c}}\ exp\left\{\ \frac{i}{\hbar\ c}\ \left[E_k\ x - \frac{K}{6}\ x^3\right]\right\} \tag{1070}$$

29.3 Hydrogen atom

We start with the deduction of the quantization conditions from eq. (958) which was deduced for non relativistic speeds but is also valid for relativistic speeds as shown in sec. 28.1.1.

$$-\ i\ \hbar\ c\ \frac{\partial}{\partial x}\psi_x(x)\ +\ U_x(x)\ \psi_x(x) = [E_o\ +\ E_{tot}]\ \psi_x(x) = E\ \psi_x(x) \tag{1071}$$

which is equivalent to

$$E_{rel} + U = E_o + E_{kin} + U = E \qquad E_{tot} = E_{kin} + U \qquad E_{rel} = E_o + E_{kin} \tag{1072}$$

We define the operator

$$\vec{\nabla}\ \cdot\ \vec{E} = \nabla E = \frac{\partial}{\partial x}\ +\ \frac{\partial}{\partial y}\ +\ \frac{\partial}{\partial z} \quad with \quad \vec{E} = \vec{e}_x\ +\ \vec{e}_y\ +\ \vec{e}_z \tag{1073}$$

$$\nabla E\ \psi(x,y,z) = \frac{\partial}{\partial x}\psi(x,y,z)\ +\ \frac{\partial}{\partial y}\psi(x,y,z)\ +\ \frac{\partial}{\partial z}\psi(x,y,z) \tag{1074}$$

For polar coordinates we write

$$-\ i\,\hbar\,c\,\nabla\ \chi(r,\theta,\varphi)\ +\ U\ \chi(r,\theta,\varphi) = E\ \chi(r,\theta,\varphi) \tag{1075}$$

with the ∇ operator expressed in polar coordinates

$$\nabla = \frac{\partial}{\partial r}\ +\ \frac{2}{r}\ +\ \frac{1}{r\ \sin\theta}\ \frac{\partial}{\partial\varphi}\ +\ \frac{1}{r}\ \frac{\partial}{\partial\theta}\ +\ \frac{1}{r}\ \cot\theta \tag{1076}$$

The differential equation has now the form

$$\left[\nabla\ +\ \frac{i}{\hbar\,c}\ U\right]\ \chi = \frac{i}{\hbar\,c}\ E\ \chi \tag{1077}$$

We now assume that the wave function χ can be expressed as a product of a function exclusively of the distance r and a function of the angular variables θ and φ.

$$\chi(r,\theta,\varphi) = R(r)\ Y(\theta,\varphi) \tag{1078}$$

We get

$$\left[\frac{d}{dr} + \frac{4}{r}\right] R\cdot Y + \frac{1}{r}\ \Lambda Y\cdot R + \frac{i}{\hbar\,c}U\cdot R\cdot Y = \frac{i}{\hbar\,c}E\cdot R\cdot Y \tag{1079}$$

with the operator Λ

$$\Lambda = \frac{1}{\sin\theta}\ \frac{\partial}{\partial\varphi}\ +\ \frac{\partial}{\partial\theta}\ +\ 2\ \cot\theta \tag{1080}$$

We now assume that

$$\Lambda Y = -\lambda Y \tag{1081}$$

and get two separate differential equations for $R(r)$ and $Y(\theta,\varphi)$.

$$\frac{d}{dr}R - \frac{i}{\hbar\,c}\,[E-U]\,R + \frac{1}{r}\,[4-\lambda]\,R = 0 \tag{1082}$$

and

$$\left[\frac{1}{\sin\theta}\ \frac{\partial}{\partial\varphi}\ +\ \frac{\partial}{\partial\theta}\ +\ 2\ \cot\theta\right] Y = -\lambda Y \tag{1083}$$

After multiplying Eq. (1082) with dr/R and integrating we get

$$\ln R = \frac{i}{\hbar\,c}\int_{r_u}^{r}[E-U]\,dr - [4-\lambda]\ln\frac{r}{r_u} \tag{1084}$$

where r_u and r are arbitrary integrating limits that will be defined later on.

From the solution of eq. (1083) results that $\lambda = i\, l$ with $l = \ 0,\ \pm 1,\ \pm 2; \cdots$ as will be shown later at sec. 29.3.2. We get

$$R = \ exp\left\{-4\ \ln \frac{r}{r_u}\right\}\ exp\left\{\frac{i}{\hbar\, c}\left[\int_{r_u}^{r}(E-U)dr + l\, \hbar\, c\ \ln \frac{r}{r_u}\right]\right\} \tag{1085}$$

The quantization condition requires that

$$\frac{1}{\hbar\, c}\left[\int_{r_u}^{r}(E-U)dr + l\, \hbar\, c\ \ln \frac{r}{r_u}\right] = k\,\pi \quad with \quad k = \ 0,\ \pm 1,\ \pm 2; \cdots \tag{1086}$$

Equation (1086) is valid for all point symmetrical potentials U. We now introduce the potential of an atomic nucleus

$$U = \ -\, Z\, \frac{K_u}{r} \qquad with \qquad K_u = \frac{e^2}{4\pi\, \epsilon_o} \tag{1087}$$

Note: According to the focal-point approach, nuclei are composed of electrons and positrons that neither attract nor repel each other for the distance between them tending to zero.

If N_p are the number of positrons and N_e the number of electrons which constitute the nucleus we have that

$$Z = N_p\ -\ N_e \tag{1088}$$

For the hydrogen it is $N_p = 919$ and $N_e = 918$.

For energy conservation conditions we have that

$$\int_{r_u}^{r} E dr = E\ (r - r_u) \tag{1089}$$

with the value E a constant. We get

$$E = \left[\ k\ \pi\ \hbar\, c - (Z\ K_u + l\, \hbar\, c)\ \ln \frac{r}{r_u}\right]\ \frac{1}{r - r_u} \tag{1090}$$

In eq. (1090) the terms represent $E = \bar{E}_k + \bar{U} + \bar{E}_l$ where

$$\bar{E}_k = \frac{k\ \pi\ \hbar\ c}{r - r_u} \qquad \bar{U} = -\ \frac{Z\ K_u}{r - r_u} \ln \frac{r}{r_u} \qquad \bar{E}_l = -\ \frac{l\, \hbar\, c}{r - r_u} \ln \frac{r}{r_u} \tag{1091}$$

To arrive to the Balmer equation for the hydrogen atom the following steps are necessary.

Step one:

The term that describes the potential energy

$$\bar{U} = -\frac{Z\ K_u}{r - r_u} \ln\frac{r}{r_u} = -\frac{Z\ e^2}{4\pi\ \epsilon_o} \frac{1}{r - r_u} \ln\frac{r}{r_u} \tag{1092}$$

gives the potential energy $\bar{U}$ for an orbital electron and Z charges e^+ at the atomic nucleus.

We now assume, that the orbital electron can interact with n_p positrons of the N_p positrons of the nucleus, where $n_p >= Z$.

$$\bar{U}_n = -\frac{n_p\ e^2}{4\pi\ \epsilon_o} \frac{1}{r - r_u} \ln\frac{r}{r_u} \tag{1093}$$

The concept is shown in Fig. 142

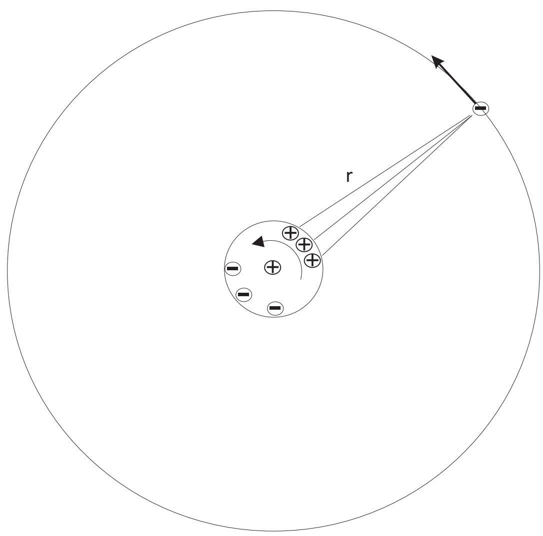


Figure 142: Orbital electron with $n_p = 3$.

Step two:

As the radius $r^{'}$ of an atom is constant, the potential energy is constant for all number n_p of positrons the orbital electron can interact. We can write

$$\bar{U}_n = -\ K_u \frac{n_p}{r - r_u} \ln\frac{r}{r_u} = -\frac{e^2}{4\pi\ \epsilon_o} \frac{1}{r^{'}} = -\frac{K_u}{r^{'}} \qquad n_p >= Z \tag{1094}$$

We get that

$$\frac{1}{r - r_u} \ln\frac{r}{r_u} = \frac{1}{n_p\ r^{'}} \qquad r^{'} = constant \tag{1095}$$

Step three:

From eq. (1092) we get

$$\bar{U} = -\, Z\, \frac{K_u}{r - r_u} \ln \frac{r}{r_u} = -\, Z\, \frac{K_u}{n_p\, r'} \tag{1096}$$

If we now assume that the quantization of the charges of the nucleus which interact with the orbital electron follows the rule $n_p = n^2$, we get for the energy levels

$$\bar{U} = -\, Z\, \frac{K_u}{n^2\;\, r'} \qquad n = 1,\; 2,\; 3, \cdots \qquad\qquad n_p = n^2 \tag{1097}$$

The energy levels of the orbital electron have their origin in the number of positrons n_p of the nucleus with which they interact. The number is given by the quantum number n. We have for

$$n = 1,\; 2,\; 3,\; 4 \qquad \textit{respectively} \qquad n_p = 1,\; 4,\; 9,\; 16 \tag{1098}$$

The difference between energy levels is

$$\Delta\bar{U} = Z\, \frac{K_u}{r'}\, \left[\frac{1}{n^2} - \frac{1}{(n + \Delta n)^2}\right] \qquad \Delta n = 0,\; 1,\; 2, \cdots \tag{1099}$$

For $\Delta n = 1$ we get

$$\Delta\bar{U} = Z\, \frac{K_u}{r'}\, \left[\frac{1}{n^2} - \frac{1}{(n+1)^2}\right] \tag{1100}$$

which for $Z = 1$ is equal to Balmers spectroscopic equation for the hydrogen, namely

$$E = h\; c\; R_H\; \frac{1}{n^2} \qquad \textit{and} \qquad \Delta E = h\; c\; R_H\; \left[\frac{1}{n^2} - \frac{1}{(n+1)^2}\right] \tag{1101}$$

with R_H the Rydberg constant and $n = 1,\; 2, ...$
From the two equations (1100) and (1101) for the potential energy we get

$$\frac{K_u}{r'_H} = h\, c\, R_H \qquad r'_H = \frac{K_u}{h\, c\, R_H} = 1.05811 \cdot 10^{-10}\;\; m \tag{1102}$$

The relation between the **mean** distance r'_H and the Bohr radius a_o is

$$r'_H = 2\; a_o = 1.05811 \cdot 10^{-10}\;\; m \tag{1103}$$

We conclude, that the potential levels of the orbital electron at the hydrogen atom have their origin in the number of positrons of the nucleus that interact with the orbital electron. From the 919 positrons of the hydrogen nucleus, at each potential level $n_p = n^2$ interact with the orbital electron.

The proposed approach " Emission & Regeneration" UFT is based on focal-point representation of subatomic particles. Electrons and positrons are represented as focal-points of rays of Fundamental Particles (FPs) that move from infinite to infinite with light speed or infinite speed. A focal-point emits FPs with light speed and is regenerated by FPs with infinite speed and vice-versa. There are two types of electrons and positrons according they emit FPs with light (deccelerating=dec) or with infinite (accelerating=acc) speed. Acceleration or deceleration refers to the speed of the outgoing FPs relative to the incoming FPs at the focal-point. Lets call them

- acc^+ positron that emits FPs with infinite speed
- dec^+ positron that emits FPs with light speed
- acc^- electron that emits FPs with infinite speed
- dec^- electron that emits FPs with light speed

In the proposed approach electrons and positrons don't have an **intrinsic** spin. The spin has its origin in a circular movement of the focal point on the orbit of the electron similar to the movement of an epysicle. See sec. 30.2.

The infinite speed for FPS is a requirement that comes from the need that subatomic particles must be regenerated immediately after having emitted FPs. The infinite speed also explains entanglement.

Regenerating FPs of subatomic particles are those FPs that have been emitted previously by other subatomic particles. All existing electrons and positrons are connected through their rays of emitted and regenerating FPs.

29.3.1 Generalization of the procedure to derive the splitting of the energy levels

From the previous steps required to derive the splitting of the potential energy, we now establish the general rule to derive the splitting of the energies of the orbital electrons.

The rule is as follows:

With a term of the type

$$B = A\,\frac{\ln\frac{r}{r_u}}{r - r_u} \tag{1104}$$

where r and r_u are arbitrary integration limits, we can build an equation with a constant radius $r^{'}$ of the type

$$B_\gamma^{'} = A\,\gamma\,\frac{\ln\frac{r}{r_u}}{r - r_u} = \frac{A}{r^{'}} \qquad what\ \ gives \qquad \frac{\ln\frac{r}{r_u}}{r - r_u} = \frac{1}{\gamma\, r^{'}} \tag{1105}$$

If we introduced the result in eq. 1104 we get

$$B = A\,\frac{\ln\frac{r}{r_u}}{r - r_u} = \frac{A}{\gamma\, r^{'}} \tag{1106}$$

We start applying the rule to the term of the **potential energy** to show that we arrive to the same eq. (1097) which led to the Balmer equation. We start with

$$\bar{U} = -K_u \; \frac{\ln \frac{r}{r_u}}{r - r_u} \tag{1107}$$

We introduce to the equation the factor $\gamma = n^2$ and impose that it must be equal to $K_u/r^{'}$.

$$\bar{U}^{'} = -K_u \, n^2 \, \frac{\ln \frac{r}{r_u}}{r - r_u} = -\frac{K_u}{r^{'}} \quad what \;\; gives \quad \frac{\ln \frac{r}{r_u}}{r - r_u} = \frac{1}{n^2 \, r^{'}} \tag{1108}$$

and with eq. (1107)

$$\bar{U} = -\; \frac{K_u}{n^2 \, r^{'}} \tag{1109}$$

which is equal to eq. (1097) which led us to the Balmer equation except for the factor Z.

Now we calculate the splitting of the energy also for the orbital angular momentum quantum number l.

We start with

$$E = K_u \; \frac{\ln \frac{r}{r_u}}{r - r_u} \tag{1110}$$

and with eq. (1090) with a potential $n_p >= Z$

$$E^{'} = \left[-n_p \, K_u - l \, \hbar \, c \;\; + \;\; \frac{k \, \pi}{\ln \frac{r}{r_u}} \, \hbar \, c \right] \frac{\ln \frac{r}{r_u}}{r - r_u} \tag{1111}$$

and apply the rule to eq. (1111) that we can write with $K_u = \alpha \, \hbar \, c$

$$E^{'} = K_u \; \left[-n_p - \frac{l}{\alpha} \; + \; \frac{k \, \pi}{\alpha \, \ln \frac{r}{r_u}} \right] \frac{\ln \frac{r}{r_u}}{r - r_u} \; = \; \frac{K_u}{r^{'}} \qquad\qquad K_u = \alpha \, \hbar \, c \tag{1112}$$

with $\alpha = \frac{1}{137}$ the fine-structure constant.

We get

$$\frac{\ln \frac{r}{r_u}}{r - r_u} = \frac{1}{r^{'} \, \left[-n_p - \frac{l}{\alpha} \; + \; \frac{k \, \pi}{\alpha \, \ln \frac{r}{r_u}} \right]} \tag{1113}$$

and with eq. 1110 we get that

$$E = \frac{K_u}{r^{'} \, \left[-n_p - \frac{l}{\alpha} \; + \; \frac{k \, \pi}{\alpha \, \ln \frac{r}{r_u}} \right]} \tag{1114}$$

and with $n_p = n^2$ we get

$$E = -\frac{K_u}{r' \left[n^2 + \frac{1}{\alpha}\left(l + \frac{k\,\pi}{\ln\frac{r}{r_u}}\right)\right]} \tag{1115}$$

If we make $k = 0$ we get

$$E' = -\frac{K_u}{r'\ [n^2 + l\ \alpha^{-1}\ ]} = -\frac{K_u}{r'\ [n^2 + 137\ l\ ]} \tag{1116}$$

With $l = 0$ we get again Balmers equation
Now we calculate $\ln\frac{r}{r_u}$ from eq. 1085

$$R(r) = \exp\left(-4\ \ln\frac{r}{r_u}\right) \qquad k = 0, \pm1, \pm2, \cdots \tag{1117}$$

For the hydrogen atom it is $R = r'_H = 2\ a_o = 1.06 \cdot 10^{-10}\ m$ we get $\ln\frac{r}{r_u} = 5.74$ what gives

$$\frac{k\ \pi}{\ln\frac{r}{r_u}} = 0.547\ k \approx \frac{1}{2}\ k \qquad k = 0, \pm1, \pm2, \cdots \tag{1118}$$

We see that the total orbital angular momentum quantum number is

$$j = l\ +\ 0.547\ k\ \approx\ l\ +\ \frac{1}{2}\ k \qquad with \qquad k = 0, \pm1, \pm2, \pm3, \cdots \tag{1119}$$

The spectroscopic energy is given by

$$\Delta E = \frac{K_u}{r'}\left\{\frac{1}{\left[n^2 + \frac{1}{\alpha}\left(l + \frac{k\,\pi}{\ln(r/r_u)}\right)\right]} - \frac{1}{\left[n'^{\,2} + \frac{1}{\alpha}\left(l' + \frac{k'\,\pi}{\ln(r/r_u)}\right)\right]}\right\} \tag{1120}$$

where

$$\ln(r/r_u) = -\frac{1}{4}\ln R(r) \qquad with \qquad R(r) = r' \ \ the\ atomic\ radius \tag{1121}$$

As electrons repel each other they place themselves as far as possible on the orbit. The orbit can be occupied only by two electrons which are placed at the opposite sides of the diameter of the orbit, which is now characterized by the quantum number $k = \pm1$. This quantum number replaces the fictitious spin $s = \pm1/2$. The Pauli principle refers now to the following quantum numbers $n,\ l,\ m_l,\ k$ which cannot be all equal for two orbital electrons.

Configuration of electrons

n	l	ml	k	Electr. per shell
1	0	0	± 1	2
2	0	0	± 1	2
	1	$1,\ 0,\ -1$	± 1	6
3	0	0	± 1	2
	1	$1,\ 0,\ -1$	± 1	6
	2	$2,\ 1,\ 0,\ -1,\ -2$	± 1	10

Note: The present approach gives the principal quantum number a physical interpretation, namely, the number of positrons n_p that interact with the orbital electron.

29.3.2 Deduction of the condition $\lambda = i\, l$.

Now we deduce the condition $\lambda = i\, l$ introduced previously in eq. (1083).

$$\left[\frac{1}{\sin\theta}\,\frac{\partial}{\partial\varphi} \;+\; \frac{\partial}{\partial\theta} \;+\; 2\,\cot\theta\right] Y = -\lambda Y \tag{1122}$$

We assume that

$$Y(\theta,\phi) = \Theta(\theta)\;\Phi(\varphi) \qquad \textit{and} \qquad \frac{d}{d\varphi}\Phi = m\;\Phi \tag{1123}$$

and with $\Phi(\varphi) = \Phi(\varphi + 2\pi)$ we get

$$\Phi = exp\{m\;\varphi\} \qquad \textit{with} \qquad m = i\;m_l \qquad \textit{and} \qquad m_l = \pm 0,\ \pm 1,\ \pm 2;\cdots \tag{1124}$$

With eq. (1123) we have that eq. (1083) transforms to

$$\frac{m}{\sin\theta}\;\;\Theta + \frac{d}{d\theta}\Theta \;+\; 2\;\cot\theta\;\Theta = -\;\lambda\;\Theta \tag{1125}$$

and

$$\frac{d\Theta}{\Theta} = \;-\;\left[\;\frac{m}{\sin\theta}\;+\;2\;\cot\theta\;+\;\lambda\;\right]\;d\theta \tag{1126}$$

which gives the solution

$$\Theta = \frac{1}{C_\Theta}\, exp\left\{ - \int \left[\frac{i\, m_l}{\sin\theta} \,+\, 2\,\cot\theta \,+\, \lambda \right] d\theta \right\} \tag{1127}$$

With $\Theta(\theta) = \Theta(\theta + 2\pi)$ we conclude that

$$\Theta = \frac{1}{C_\Theta}\, exp\{-2\ln\sin\theta\}\;\, exp\{-i\; [\, m_l \ln(\csc\theta - \cot\theta) \,+\, l\,\theta\,]\} \tag{1128}$$

with $\lambda = i\, l$ and $l = \pm 0,\ \pm 1,\ \pm 2;\cdots$ what we have anticipated for eq. (1085).
Eq.(1125) we can now write as

$$\frac{d}{d\theta}\Theta \,+\, i\,\frac{m_l}{\sin\theta}\;\Theta \;=\; -\,2\,\cot\theta\,\Theta \,-\, i\,l\,\Theta \tag{1129}$$

In this equation the real and the imaginary terms must be equal, and we get from the imaginary terms that

$$\frac{m_l}{l} = -\sin\theta \qquad with \qquad m_l = \pm 0,\ \pm 1,\ \pm 2;\cdots \quad and \quad l = \pm 0,\ \pm 1,\ \pm 2;\cdots \tag{1130}$$

We conclude, that the relation between the orbital quantum number l and the magnetic quantum number m_l is

$$\left|\frac{m_l}{l}\right| = |-\sin\theta| \le 1 \qquad or \qquad |m_l| \;\le\; |-l\sin\theta| \tag{1131}$$

m_l is the projection of l on the $x - y$ plane and gives the projection of the orbital area $A = \pi\, l^2$ on the $x - y$ axis.

$$A_{x,y} = \pi\; m_l^2 = \pi\;(l\;\sin\theta)^2 \qquad m_l \le l \tag{1132}$$

$A_{x,y}$ is the part of the orbital area perpendicular to the $z - axis$. The $z - axis$ defines the magnetic flux Φ for an external magnetic field in z direction.

$$\Phi = \vec{B}_z \cdot \vec{A} \qquad \Phi = B_z\; A_z \tag{1133}$$

An unbound orbital electron is always forced by an external magnetic field B_z to move in a plane perpendicular to the z axis.

An inhomogeneous magnetic field B_z, generates a force in the z direction on an unbound orbital electron.

$$\vec{F}_z = (\vec{m} \cdot \frac{\delta}{\delta\vec{r}_z})\vec{B}_z \qquad \vec{m} = I\;\vec{A}\;\cos\theta \qquad I = \frac{e\,\omega}{2\pi} \tag{1134}$$

This force is measured in the Stern-Gerlach experiment. The standard model associates an angular momentum to the magnetic field of an orbiting electron. As unbound orbital electrons have no angular momentum, a fictitious angular momentum (spin) was postulated.

The energy splitting in a magnetic field is given by

$$\Delta E = g_l\, m_l\, \mu_B\, B_z \tag{1135}$$

with g_l the Lande factor, m_l the quantum number projection of angular momentum, μ_B the Bohr magneton, and B_z the magnetic flux density.

Conclusions: The present approach is based on the "E & R " model, where nucleons are composed of electrons and positrons that neither attract nor repel each other when the distance between them tends to zero. A nucleon can polarize, so that an orbital electron can interact during a short time with more than one positron of the nucleon. In the case of the hydrogen, the orbital electron can be attracted during a short time by two or more positrons of the proton defining the higher energy levels for the orbital electron.

As nucleons are composed of electrons and positrons, also quarks are composed of electrons and positrons. The fractional charges of quarks are simply the relation between the number of electrons or positrons that integrate the quark, to the total number of electrons and positrons that compose the quark. No fractional charges exist.

The electron shells of atoms is the result of the accommodation of the electrons and positrons of the atomic nuclei in the quarks. The combination principle used in spectroscopy becomes with the "E & R " model a physical interpretation.

29.4 Helium atom.

Fig. 143 shows the Helium atom where one orbital electron interacts with n_1 positrons and the other with n_2 positrons of the nucleus.

The potential energy of the excited system is given by

$$E_{He} = E_{n_1} + E_{n_2} + E_{1,2} \tag{1136}$$

where

$$E_{n_1} = K_u\, \frac{1}{r'_{He}}\, \frac{1}{n^2} \tag{1137}$$

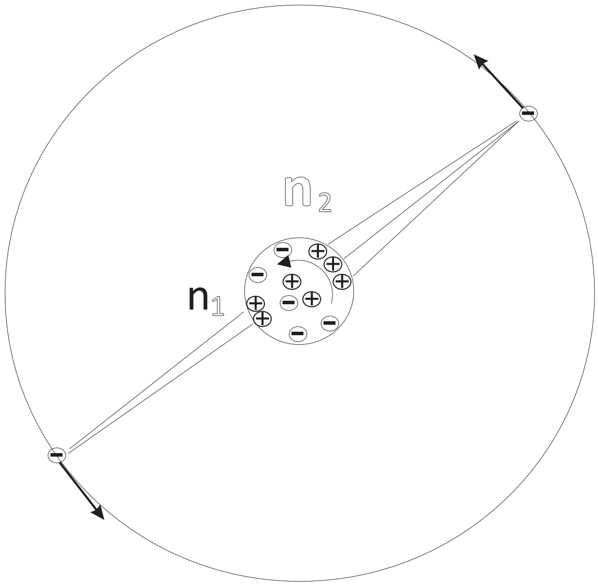


Figure 143: Energy levels at an excited helium atom.

$$E_{n_2} = K_u \, \frac{1}{r'_{He}} \, \frac{1}{n^2} \tag{1138}$$

$$E_{1,2} = \frac{K_u}{2 \, r'_{He} \, n^2} \tag{1139}$$

Note: The present approach explains energy levels with:

- the number n_p of positrons of the nucleus that interact with the orbital electron.
- the quantization of radii of orbital electrons expressed with $r' = r'(n, l, m_l, k)$.

The last explains the energy quantization at the positronium where $n_p = n_e = 1$.

The general explanation is given by the interaction between FPs emitted by external nuclei and orbital electrons, and the own emitted FPs. The quantization of energy levels is finally reduced to the quantization of the energy of each FP.

$$E_{FP} = h \, \nu_{FP} \qquad with \qquad \nu_{FP} \qquad a \;\; universal \;\; constant \tag{1140}$$

Part IX Miscellaneous III

30 Splitting of atoms and energy levels.

The present approach gives different interpretations for the splitting of atoms at the Stern-Gerlach experiment and the splitting of energy levels at the hydrogen atom.

30.1 Splitting of atoms in the Stern-Gerlach experiment.

To explain the splitting of the atomic ray in the Stern-Gerlach experiment, electrons were assigned an intrinsic spin with a quantized magnetic field that takes two positions, up and down relative to an external magnetic field, although it is not possible to explain how the intrinsic spin and magnetic field are generated. Measurements with individual electrons to detect the magnetic spin are fruitless because of the strong Lorenz force.

Classical physics associates to an orbital electron an angular moment $\vec{l}$ and a magnetic moment $\vec{\mu}$

$$\vec{\mu} = I\vec{A} = -\frac{e}{2m_e}\vec{l} \qquad (1141)$$

An external field $\vec{B}$ generates a potential magnetic energy E_{pot} and an angular moment $\vec{D}$

$$E_{pot} = -\vec{\mu}\vec{B} \qquad\qquad \vec{D} = \vec{\mu} \times \vec{B} = \frac{d}{dt}\vec{l} \qquad (1142)$$

If the angular moment $\vec{l} = 0$ we have that $\vec{\mu} = 0$, $E_{pot} = 0$ and $\vec{D} = 0$.

Unbound orbital electrons have in quantum mechanics angular moment $\vec{l} = 0$ what would give an magnetic moment $\vec{\mu} = 0$ and make impossible to explain the splitting of the neutral atom in the Stern-Gerlach experiment. To solve the problem, an intrinsic spin $\vec{s}$ was postulated for the electron with an operator with an eigenstate of the z component of the spin operator with the projection quantum number $m_s = \pm\frac{1}{2}\hbar$ parallel to the external field $\vec{B}$. The magnetic moment then becomes

$$\hat{\vec{\mu_s}} = g_s\, \mu_B\, \frac{\hat{\vec{s}}}{\hbar} \qquad with \qquad \mu_B = -\frac{e\hbar}{2m_e} \qquad (1143)$$

The postulate of an intrinsic spin makes the magnetic moment $\vec{\mu_s}$ independent of the existence of the angular moment l of the orbital electron and the Stern-Gerlach experiment can be explained.

For the standard model the unbound orbital electron has no angular orbital moment and the generated magnetic field takes the direction of maximum compensation of the external magnetic field. This field is opposed to the external magnetic field what is expressed with the projection quantum number $m_s = \pm 1/2$.

The proposed approach has no unbound orbital electrons because atomic nuclei are composed of electrons and positrons that move with the orbital electron and generate an angular moment $l \neq 0$.

Fig: 144 shows the generation of the magnetic field dH_n independent of the angular moment l of an orbital electron.

The concept is shown in Fig: 144

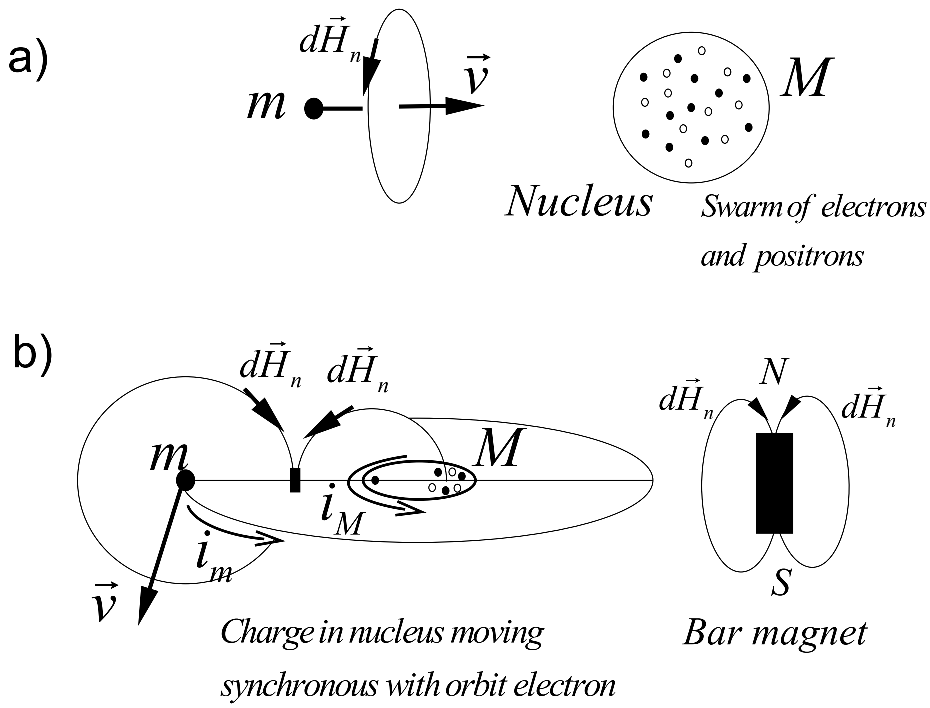


Figure 144: Magnetic field dH_n of an orbital electron.

The approach $E\&R$ UFT shows that electrons and positrons coexist in nucleons without repelling or attracting each other. They can be seen as swarms of electrons and positrons forming the nucleon. As nuclei are composed of nucleons they are also composed of electrons and positrons as shown in Fig. 144 a).

The charge Q of a nucleus is replaced by the expression $\Delta n = n^+ - n^-$ which gives the difference between the **constituent** numbers of electrons and positrons that form the nucleus. As the n_i are integer numbers, the Charge of the nucleus is quantified.

As examples we have for the proton $n^+ = 919$ and $n^- = 918$ with a binding Energy of $E_{B_{prot}} = -6.9489 \cdot 10^{-14}\ J = -0.43371\ MeV$, and for the neutron $n^+ = 919$ and $n^- = 919$ with a binding Energy of $E_{B_{neutr}} = 5.59743 \cdot 10^{-14}\ J = 0.34936\ MeV$.

The dH_n field is generated by the orbital electron and the interacting positron of the nucleus that follows the orbital electron. The two opposed currents generate a dH_n

field equal to the field of a bar magnet as shown in Fig. 144 b).

The neutral atoms used in the Stern-Gerlach experiment have all complete shells plus one electron of the next shell, which is not unbound, because it interacts with one positron of the nucleus which follows him. The configuration of the Ag is $[Kr]4d^{10}5s^1$.

30.2 The splitting of energy levels at the hydrogen atom.

The proposed approach represents electrons and positrons as focal points of rays of FPs that move from infinite to infinite with light speed and infinite speed. FPs are emitted by focal points and at the same time, FPs emitted by other focal points regenerate them. Focal points that emit FPS with light speed are regenerated by FPs with infinite speed and vice versa. At the focal point the speed of the FPs changes.

We start with (1115)

$$E = -\frac{K_u}{r' \left[n^2 + \frac{l}{\alpha} + \frac{k\,\pi}{\alpha\,\ln\frac{r}{r_u}} \right]} \tag{1144}$$

with

$$K_u = \frac{e^2}{4\pi\,\epsilon_o} \qquad K_u = \alpha\,\hbar\,c \tag{1145}$$

The energy E is defined by three quantum numbers, namely n, l and k. The term in the denominator that is associated with the intrinsic spin of the orbital electron, namely

$$\frac{k\,\pi}{\alpha\,\ln\frac{r}{r_u}} \approx \frac{1}{\alpha}\,\frac{1}{2}\,k = \frac{4\,\pi\,\epsilon_o}{e^2}\,\hbar\,c\,\frac{1}{2}\,k \qquad k = 0, \pm1, \pm2, \pm3, \cdots \tag{1146}$$

is a function of the product of the charge of the hydrogen nucleus e and the charge of the orbital electron e, and a function of the integration limits r and r_u, what shows, that the above term is not the product of an intrinsic spin of the orbital electron. It is given by the interaction between nucleus and orbital electron, the same as the orbital angular momentum.

31 Radiation of accelerated particles.

Experience shows that all accelerated charged particles emit energy as electromagnetic radiation. The stability of orbital electrons, which are radially accelerated, is explained with the quantization of the energy levels of orbital electrons.

The present approach explains the origin of energy levels of orbital electrons with the number of positrons of the nucleus that interact with the orbital electron. In other words, the linear superposition of potential fields of positrons, leaving open the question of stability of the radially accelerated orbital electrons.

The E&R model represents subatomic particles (SPs) as focal points of rays of Fundamental Particles (FPs) that move from infinity to infinity. FPs have longitudinal and transversal angular momenta where the energy of the SP is stored. FPs are emitted by the focal point and at the same time regenerate the focal point. Regenerating FPs are those FPs that were emitted previously by external subatomic particles. Because of the energy conservation principle, the current of emitted FPs must be equal to the current of regenerating FPs. SPs interact through the cross product of the angular momenta of their FPs.

The regenerating FPs of a SP are activated by their emitted FPs when they arrive to external SPs. There is a time delay between the emitted FP and the arrival of the regenerating FP that was activated by the first. The emitted FP takes with it the information of the location of the focal point from which it was emitted. The information is stored in the direction of the longitudinal angular momenta. This information is transmitted to the regenerating FP when activated, and allows that the regenerating FP meets the focal point.

At SPs that are at rest or move with constant speed, the externally activated regenerating FPs meet the focal point. At SPs that are accelerated, the externally activated regenerating FPs fail the focal point, because of the acceleration during the time delay. The regenerating FPs that fail the focal point move then independent from the focal point as radiated photons or neutrinos.

In the case of the orbital electron with its radial acceleration, the regenerating FPs don't fail the electron because of the small radius of the orbit. It is equivalent to a resting electron for all external SPs where the regenerating FPs are activated. Because of the small energy of the orbital electron the uncertainty principle between energy and space includes the orbit of the electron.

$$(\Delta E) \cdot (\Delta x) \geq \frac{1}{2}\, \hbar\, c \tag{1147}$$

Example: The energy of the orbital electron of the hydrogen atom with $l = 0$ is $E_e = 3.4250 \cdot 10^{-18}\ J$ which gives an uncertainty of $\Delta x = 4.6182 \cdot 10^{-9}\ m$ which is grater than the diameter of the atom with approximately $2\ a_o = 1.0584 \cdot 10^{-10}\ m$.

32 Stable and unstable particles.

Particles in the SM are classified as Gauge Bosons, Leptons, Quarks, Baryons and Mesons. The classification makes no difference between stable and unstable particles. Unstable particles with energies much grater than the energies of the stable electron (0.511 MeV/c^2), positron or neutrino are defined as Basic Subatomic Particles (BSPs), violating the concept of basic particles which must be the constituents of all not basic particles. The result is the search for basic particles like the unstable Quarks with energies above 0.35 GeV/c^2.

The approach "Emission and Regeneration" UFT

1. defines as BSPs the electron, positron and the neutrino which are stable particles, and defines all particles with higher energies, stable or unstable, as Composed Subatomic Particles (CSPs) which are integrated by BSPs.

2. defines electrons and positrons as focal points of rays of Fundamental Particles (FPs) which go from infinite to infinite and have longitudinal and transversal angular momenta. Interactions between electrons and positrons are the result of the interactions of the angular momenta of their FPs. No carrier bosons are required to describe interactions between subatomic particles.

3. defines neutrinos as pairs of FPs with opposed angular momenta which generate linear momenta, and photons as a sequence of pairs of FPs with opposed angular momenta that generate a sequence of opposed linear momenta.

4. shows that no strong forces are required to hold electrons and positrons together, which are the constituents of protons and neutrons. The forces between the constituents electrons and positrons tend to zero for the distance between them tending to zero.

5. shows that weak forces which are responsible for the decay of atomic nuclei are electromagnetic forces.

6. shows that gravitation forces are also electromagnetic forces.

The conclusion is, that all interactions between subatomic particles are electromagnetic interactions and described by QED. Interactions as described by QCD are simply the product of the primitive definition of particles as point-like entities which require carriers to explain their interactions.

32.1 The potentials of the four interactions.

Our SM differentiates between the following potentials to explain interactions between particles.

- Strong
- Weak
- Gravitation
- Electromagnetic

In sec. 4 the momentum curve between two static charged BSAs (electron/positron) was derived resulting Fig. 145 and the following regions were defined:

1. From $0 \lll \gamma \lll 0.1$ where $p_{stat} = 0$
2. From $0.1 \lll \gamma \lll 1.8$ where $p_{stat} \propto d^{\,2}$
3. From $1.8 \lll \gamma \lll 2.1$ where $p_{stat} \approx constant$
4. From $2.1 \lll \gamma \lll 518$ where $p_{stat} \propto \frac{1}{d}$
5. From $518 \lll \gamma \lll \infty$ where $p_{stat} \propto \frac{1}{d^{\,2}}$ (Coulomb)

The static momentum curve of Fig. 145 is part of the potential well of an atomic nucleus as shown in Fig. 146, which can be approximated by a piecewise constant potential for the analytical analysis in quantum mechanics.

The force on electrons or positrons that move in the defined regions of the potential well is given by the following equations derived in sec. 7:

$$d\bar{F}_{i_n} = \frac{1}{8\,\pi}\,\sqrt{m_p}\,r_{o_p}\,rot\,\frac{d}{dt}\int_{r_r}^{\infty} d\bar{H}_n \qquad with \tag{1148}$$

$$\frac{d}{dt}\int_{r_r}^{\infty} d\bar{H}_n = \frac{1}{2}\,\frac{d}{dt}[H_n]\,\frac{r_o}{r_r}\,\sin\varphi\,d\varphi\,\bar{s}_\gamma\;-\;H_n\,v\,\frac{r_o}{r_r^2}\,\sin\varphi\,\cos\varphi\,d\varphi\,\bar{s}_\gamma \tag{1149}$$

$$+\,\frac{1}{2}\,H_n\,\frac{1}{r_r}\,\sin\varphi\,d\varphi\,\frac{dr_o}{dt}\,\bar{s}_\gamma$$

For the regions we have that:

- BSPs that are in region **1** don't attract nor repel each other. The static force is zero and no binding Gluons nor **strong forces** to hold them together are needed.

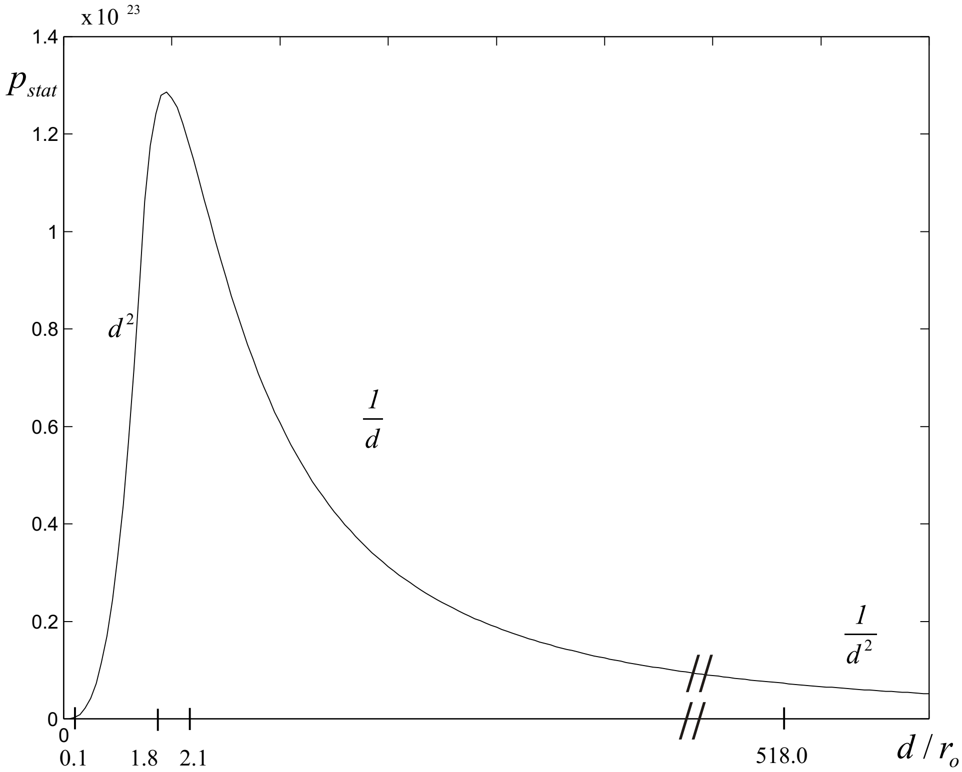


Figure 145: Linear momentum p_{stat} as function of $\gamma = d/r_o$ between two static BSPs with equal radii $r_{o_1} = r_{o_2}$

- BSPs that have migrated slowly from region **1** to region **2** where the potential groves approximately with d^2, are accelerated to or away from the potential wall by the static force according the charge of the particle and the charge of the remaining particles in region **1**. We can differentiate between:
  - BSPs that are accelerated away from the potential wall (region **3**) induce on BSPs of other atoms the **gravitation force**. The accelerated BSPs transmit their acquired momentum to BSPs of other atoms (induction) and stop their movement immediately according the conservation law of momentum. The force on accelerated BSPs is given with $\frac{d}{dt}[H_n] = \sqrt{m}\frac{dv}{dt}$.
  - BSPs that are accelerated to the potential wall may tunnel the wall what results in the decay of the atom with the corresponding radiations. No special **weak force** is required.
- BSPs in the region **5** where the Coulomb force exists, orbit around the atom nucleus. This is called in the SM the **electromagnetic force**.

The "Emission & Regeneration" UFT approach shows that all forces are derived from one Field, the dH field. It also shows that all interactions are of electromagnetic type and described by QEDs (Quantum Electrodynamics) and that no other type of

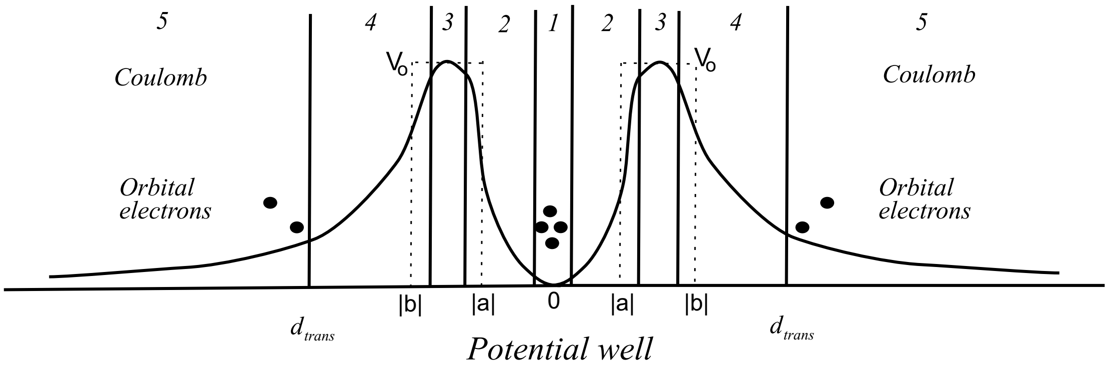


Figure 146: Potential well of an atom.

interactions are required. It shows that all particles are composed of electrons, positrons and neutrinos and that particles of very short lifetime are composed particles.

33 Compatibility of gravitation with Quantum mechanics.

The potential in which an orbital electron in an Hidrogen atom with $Z = 1$ moves is

$$U(r)_{Coul} = -\left(\frac{Z\,e^2}{4\pi\epsilon_o}\right)\frac{1}{r} = 2.3072\cdot 10^{-28}\,\frac{1}{r}\;J \qquad with \quad Z = 1 \tag{1150}$$

We know from [5] page 178 that the discrete energy levels for the orbital electron of the H-atom is

$$E_{n_{Coul}} = -\,\frac{m}{2\hbar^2}\left(\frac{Z\,e^2}{4\pi\epsilon_o}\right)^2\frac{1}{n^2} = 2.1819\cdot 10^{-18}\,\frac{1}{n^2}\;J \tag{1151}$$

The difference between the energy levels is

$$\Delta E_{n_{Coul}} = 2.1819\cdot 10^{-18}\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]\;J \tag{1152}$$

33.1 Quantized gravitation.

In the present approach of "Emission & Regeneration" UFT gravitation is presented based on the reintegration of migrated electrons and positrons to their nuclei. According to that model the force on one electron/positron of a mass M_1 due to the reintegration of an electron/positron to an atomic nucleus of a mass M_2 is given by

$$F_i = \frac{dp}{\Delta t} = \frac{k\,c\,\sqrt{m}\,\sqrt{m_p}}{4\,K\,d^2}\int\!\!\int_{Induction} \qquad with \qquad \int\!\!\int_{Induction} = 2.4662 \tag{1153}$$

and the corresponding potential is

$$U(r)_{Grav} = \left(2.4662\,\frac{k\,c\,\sqrt{m}\,\sqrt{m_p}}{4\,K}\right)\frac{1}{r} = 2.3071\cdot 10^{-28}\,\frac{1}{r}\;J \tag{1154}$$

If we write the Schroedinger equation with the gravitation potential instead of the Coulomb potential for the H-atom, we get discrete energy levels simply in replacing the expression in brackets of eq.(1151) with the expression in brackets of eq. (1154)

$$E_{n_{Grav}} = -\,\frac{m}{2\hbar^2}\left(2.4662\,\frac{k\,c\,\sqrt{m}\,\sqrt{m_p}}{4\,K}\right)\frac{1}{n^2} = 2.1816\cdot 10^{-18}\,\frac{1}{n^2}\;J \tag{1155}$$

In the same model of gravitation the number of reintegrating electrons/positrons for a mass M is derived as $\Delta G = \gamma_G\,M$ with $\gamma_G = 5.3779\cdot 10^8\;kg^{-1}$. The resulting energy level due to all reintegrating electrons/positrons of M_1 and M_2 is

$$E_{n_{Grav\ tot}} = 2.1816 \cdot 10^{-18}\ \Delta G_1\ \Delta G_2\ \frac{1}{n^2}\ J \tag{1156}$$

For the H-Atom M_2 is formed by one proton composed of 918 electrons and 919 positrons and M_1 is the mass of the electron. The mass of a proton is $M_2 = m_{prot} = 1.6726 \cdot 10^{-27}\ kg$ and the mass of the electron $M_1 = m_{elec} = 9.1094 \cdot 10^{-31}\ kg$. We get $\Delta G_2 = 8.9951 \cdot 10^{-19}$ and $\Delta G_1 = 4.8989 \cdot 10^{-22}$. We get for the energy difference for orbital electrons at the H-Atom due to gravitation potential

$$\Delta E_{n_{Proton}} = 9.6134 \cdot 10^{-58}\ \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]\ J \tag{1157}$$

If we compare the factors of the brackets for the energy difference due to the Coulomb potential of eq. (1152) and the gravitational potential of eq. (1157), we see that even between very different energy levels n_1 and n_2 of the gravitational levels the energy differences of the gravitation are neglectible compared with the Coulomb.

For the energy difference between two levels n_1 and n_2 of an atom we can write:

$$\Delta E_{n_{Coul}} \pm \Delta E_{n_{Grav}} = h(\nu \pm \Delta\nu) = 2.1819 \cdot 10^{-18}\ [1 \pm \Delta G_1\ \Delta G_2]\ \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]\ J \tag{1158}$$

with $\Delta G = \gamma_G\ M$ where $\gamma_G = 5.3779 \cdot 10^8\ kg^{-1}$.

Now we make the same calculations for the difference between the energy levels due to the gravitation potential of the sun with $M_2 = M_\odot = 1.9891 \cdot 10^{30}\ kg$ and the earth with $M_1 = M_\dagger = 5.9736 \cdot 10^{24}\ kg$. We we get $\Delta_{G_\odot} = 1.0697 \cdot 10^{39}$ and $\Delta_{G_\dagger} = 3.2125 \cdot 10^{33}$ resulting

$$\Delta E_{n_{\odot,\dagger}} = 7.4968 \cdot 10^{54}\ \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]\ J \tag{1159}$$

As the earth shows no quantization in its orbit around the sun, two adjacent levels n_1 and n_2 must be very large outer levels so that $\Delta E_{n_{\odot,\dagger}} \approx 0$, similar to the large outer levels of the conducting electrons of conducting materials. Mathematically we can write with $n_2 = n_1 + 1$

$$\lim_{n_1 \Rightarrow \infty} \Delta E_{n_{\odot,\dagger}} = 7.4968 \cdot 10^{54}\ \left[\frac{1}{n_1^2} - \frac{1}{(n_1+1)^2}\right]\ = 0\ \ J \tag{1160}$$

33.2 Relation between energy levels and space.

The compatibility of gravitation as the reintegration of migrated electrons/positrons to their nuclei is also shown by the following calculations. From eq. (1156) we get the energy difference between two gravitation levels

$$\Delta E_{n_{Grav}} = 2.1816 \cdot 10^{-18}\ \Delta G_1\ \Delta G_2\ \left[\frac{1}{n_1^2}\ -\ \frac{1}{n_2^2}\right]\ J \tag{1161}$$

and with the difference between two gravitation potentials at different distances

$$\Delta U_{Grav} = G\ M_1\ M_2\ \left[\frac{1}{r_1}\ -\ \frac{1}{r_2}\right]\ J \tag{1162}$$

we can write that $\Delta E_{n_{Grav}} = \Delta U_{Grav}$ what gives with $r_1\ r_2 \approx r^2$

$$\frac{\Delta r}{r^2} = \frac{2.1816 \cdot 10^{-18}\ \gamma_G^2}{G}\ \left[\frac{1}{n_1^2}\ -\ \frac{1}{n_2^2}\right] \tag{1163}$$

For the H-atom with $r \approx 10^{-13}\ m$ we get for the difference between the two first energy levels $n_1 = 1$ and $n_2 = 2$

$$\Delta r = \frac{2.1816 \cdot 10^{-18}\ \gamma_G^2}{G}\ r^2\ \left[\frac{3}{4}\right] = 7.0926 \cdot 10^{-17}\ m \tag{1164}$$

what is a reasonable result because $\Delta r << r$.

Now we make the same calculations for the earth and the sun with $r_{\odot,\dagger} \approx 150.00 \cdot 10^9\ m$. We get

$$\Delta r_{\odot,\dagger} = 2.1164 \cdot 10^{32}\ \left[\frac{1}{n_1^2}\ -\ \frac{1}{n_2^2}\right] \tag{1165}$$

As the earth shows no quantization in its orbit around the sun, two adjacent levels n_1 and n_2 must be very large outer levels so that $\Delta r_{\odot,\dagger} \approx 0$, similar to the large outer levels of the conducting electrons of conducting materials.

33.3 Superposition of gravitation and Coulomb forces.

The "Emission & Regeneration" UFT shows that the Coulomb and the Ampere forces tend to zero for the distance between electrons/positrons tending to zero. The behaviour is explained with the cross product of the angular momenta of the regenerating rays of FPs that tends to zero.

The induction force is not a function of the cross product but simply the product between angular momenta of the regenerating rays of FPs. The result is that the induction force does not tend to zero with the distance between inducing particles tending to zero. As the gravitation was defined as the reintegration of migrated electrons/positrons to their nuclei and as a induction force, the gravitation force prevails over the Coulomb or Ampere forces for the distance tending to zero.

Fig. 147 shows qualitatively the resulting momentum due to Coulomb/Ampere and Gravitation momenta between an atomic nucleus of a target and a He nucleus.

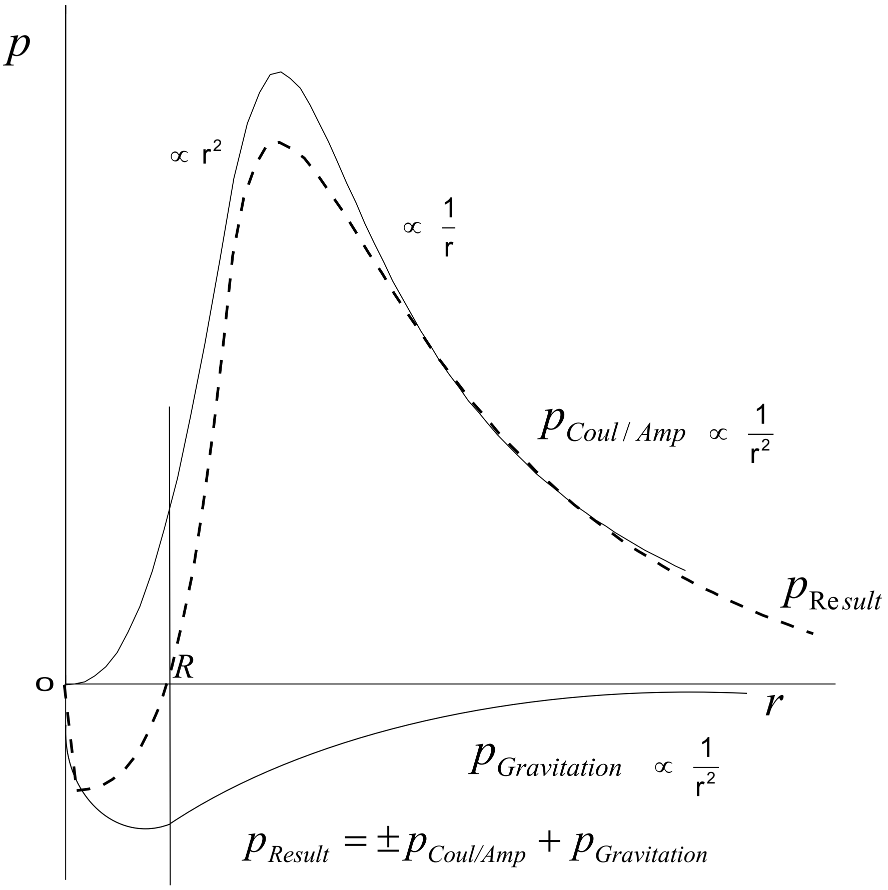


Figure 147: Resulting linear momentum p due to Coulomb/Ampere and Gravitation momenta.

Note: The gravitation model of "Emission & Regeneration" UFT is based on a physical approach of reintegration of migrated electrons/positrons to their nuclei and compatible with quantum mechanics, while General Relativity, the gravitation model of the SM, based on a mathematical-geometric approach is not compatible with quantum mechanics.

34 Table comparing the SM and the 'E & R' model.

Model	Sub-division	Particle representation	Force Carriers	Fields	Interactions	Gauges	Comment
SM (Poly-particle)	Classic	Point-like	Gluons W-Boson Photons Gravitons	Strong Weak Electromagnetic Gravitation	Strong Weak Electromagnetic Gravitation		Four fields, one for each type of force
	QM	Wave Packet				QCD Electroweak QED Gravity Duality	
E & R (Mono-particle)	Classic	***Focal-point*** of rays of Fundamental Particles	***Fundamental Particle*** with Longitudinal and Transversal angular momenta	***dH*** field with Longitudinal and Transversal components	Electromagnetic (Long x Long, Trans x Trans, Trans - Long)		One field for all forces
	QM	Wave Packet				QED	

Figure 148: Table comparing the SM and the 'E & R' model.

Fig. 148 shows the SM and the 'E & R' model subdivided in classical physics and QM. The classic part of the SM with its point-like representation of particles has four force-carriers, four fields and four interactions. QM based on the classical physics of the SM has correspondingly four gauge theories.

The classic part of the 'E & R' model with its focal-point representation of particles has only one type of force-carrier, only one field and only one type of interaction. QM based on the classical physics of the 'E & R' model has correspondingly only one type of gauge theory, namely QED.

The SM has four fields one for each type of force while the 'E & R' model has only one field for all forces and is therfore a UFT.

The SM is a poly-particle model while the 'E & R' model is a mono-particle model.

35 Spin, magnetic moment and photon.

35.1 The spin.

According the E&R model, electrons and positrons are composed of Fundamental Particles (FPs) which have an energy defined by

$$E_{FP} = h\nu_o \tag{1166}$$

with ν_o a universal frequency.

The energy of an electron or positron can thus be expressed as

$$E_e = N_e\ E_{FP} \qquad\qquad N_e = \frac{E_e}{E_{FP}} = \frac{\sqrt{E_o^2 + E_p^2}}{E_{FP}} = \frac{E_s + E_n}{E_{FP}} \tag{1167}$$

where N_e is the number of FPs that composes the electron or positron. For the non relativistic case we have

$$N_e = \frac{E_e}{E_{FP}} = \frac{E_s + E_n}{E_{FP}} = \frac{1}{E_{FP}}\,[E_o + pc] \tag{1168}$$

An orbital electron interacts with the nucleus and has an orbital moment given by

$$L = m_e\ \rho\ v_t = \rho\ v_t\ N_e\ \frac{E_{FP}}{c^2} \qquad\qquad m_e = \frac{E_e}{c^2} = N_e\frac{E_{FP}}{c^2} \tag{1169}$$

where ρ is the radius of the orbit and v_t the tangential speed.

As the nucleus of the atom is also composed of electrons and positrons which are composed of FPs, the orbital electron can pass or receive FPs from the nucleus. The number of FPs of the orbital electron can thus vary between

$$N = N_e\ \pm\ \Delta N_e \qquad with \qquad \Delta N_e = 0,\ 1,\ 2,\ 3, \cdots \tag{1170}$$

We get for the total angular moment of an orbital electron for the case of $N = N_e\ \pm\ 1$

$$\vec{J} = me\ \vec{\rho} \times \vec{v}_t = \frac{\nu_o}{c^2}\,[N_e\ h\ \pm\ h]\ \vec{\rho} \times \vec{v}_t = \vec{L}\ \pm\ \vec{S} \tag{1171}$$

where L is the orbital angular moment and S is the spin of the electron.

The quantum number $\Delta N_e = 0,\ 1,\ 2,\ 3, \cdots$ gives the number of FPs at which the orbital electron is increased or decreased.

Equation (1171) includes the relativistic mass increase due to the definition of the mass as

$$m_e = \frac{E_e}{c^2} = N_e\ \frac{E_{FP}}{c^2} = N_e\ \frac{h\ \nu_o}{c^2} \tag{1172}$$

Note: According to the shell structure of the Ag atom the individual electron carries no angular momentum and $\vec{L} = 0$. That is because there is no moment of inertia and that the area vector of the orbit aligns immediately parallel to the external magnetic field. According to the E&R model the energy variation at the electrons is due to the variation of the number of FPs given by $\pm\Delta N_e$. For the special case of $\vec{L} = 0$ only a variation $-\Delta N_e$ is possible. The variation of the number of FPs produces a variation of the mass of the electron and consequently a variation of the kinetic energy.

The splitting of the energy level is the product of the interactions between subatomic particles. There is no need to introduce the postulate of S.Goudsmit and G.E.Uhlenbeck.

35.2 The magnetic moment.

The energy of FPs are stored in the angular momentum $\vec{h}$ what generates a magnetic momentum in an external magnetic field.

The charge q_{FP} and the mass m_{FP} of a FP is given with

$$q_{FP} = \frac{e}{N_e} = e\,\frac{E_{FP}}{E_e} \qquad\qquad m_{FP} = \frac{m_e}{N_e} = m_e\,\frac{E_{FP}}{E_e} \tag{1173}$$

The magnetic moment of a FP is defined as

$$\vec{\mu}_{FP} = -\,\frac{q_{FP}}{2\,m_{FP}}\vec{h} = -\,\frac{N_e\,q_{FP}}{2\,N_e\,m_{FP}}\vec{h} = -\,\frac{e}{2\,m_e}\vec{h} = \vec{\mu}_B \tag{1174}$$

where $\vec{\mu}_B$ is the Bohr magneton.

The potential magnetic energy is defined as

$$H_{mag} = -\,\vec{\mu}\,\vec{B} \tag{1175}$$

with

$$\vec{\mu} = -\,g_l\,\mu_B\,\frac{\vec{l}}{h} \tag{1176}$$

where $\vec{l}$ is the orbital angular moment.

35.3 The photon.

The photon is defined in the E&R model as a sequence of FPs with opposed angular momenta. The energy of a photon expressed as a function of the energy of a FP is

$$E_{ph} = N_{ph}\,E_{FP} \qquad\qquad E_{FP} = h\,\nu_o \tag{1177}$$

where N_{ph} is the number of FPs that integrates the photon. With $E_{ph} = h\ \nu$ we get

$$N_{ph} = \frac{\nu}{\nu_o} = \frac{c}{\lambda\ \nu_o} \qquad\qquad \nu\lambda = c \tag{1178}$$

If we take the Hyperfine-shift of $\nu = 1.42\ MHz.$ for $n = 1$ between $F = 1$ and $F = 0$ as caused by one FP, so that $\nu_o = 1.42\ MHz.$, we get that the energy of a FP is

$$E_{FP} = h\ \nu_o = 5.88 \cdot 10^{-9}\ eV \qquad with \qquad \nu_o = 1.42\ MHz \tag{1179}$$

36 Summery of main characteristics and conclusions of the proposed model.

The following abbreviations are used:

1. Basic Subatomic Particles (BSPs) are electrons, positrons and neutrinos.
2. Subatomic Particles (SPs)
3. Fundamental Particles (FPs)

The main characteristics of the proposed model are:

- Subatomic particles (SPs) are represented as focal points of rays of Fundamental Particles (FPs) that go from infinite to infinite. FPs store the energy of the SPs as rotation defining longitudinal and transversal angular momenta.
- FPs are emitted at the focal point and regenerate the focal point. Regenerating FPs are the FPs that were emitted by other focal points in space.
- The charge of a SP is defined by the rotation sense of the longitudinal angular momenta of the emitted FPs.
- The interacting particles for all types of interactions (electromagnetic, strong, weak, gravitation) are the FPs with their longitudinal and transversal angular momenta.
- All known forces are derived from one vector field generated by the longitudinal and transversal angular momenta of fundamental particles.
- All the basic laws of physics (Coulomb, Ampere, Lorentz, Maxwell, Gravitation, bending of particles and interference of photons, Bragg, Schroedinger) are mathematically derived from the proposed model, making sure that the approach is in accordance with experimental data.

- Electrons and positrons neither attract nor repel each other for the distance between them tending to zero. Nucleons are interpreted as swarms of electrons and positrons.

- The coexistence of protons in the atomic nucleus does not require the definition of a special strong force nor additional mediating particles (gluons).

- Quarks are composed of electrons and positrons and the charge Q is the relation between the difference of positrons and electrons of the quark and the total number of electrons and positrons. Q is the relative charge of the quark.

- The emission of particles from a heavy atomic nucleus does not require the definition of a special weak force nor additional mediating particles.

- Gravitation has its origin in the linear momenta induced by the reintegration of migrated electrons and positrons to their nuclei. No special mediating particles are required (gravitons).

- The gravitation force is composed of an induced Newton component and an Ampere component due to parallel currents of reintegrating electrons and positrons. For galactic distances the induced component can be neglected. A positive Ampere component explains the flattening of galaxies' rotation curve (no dark matter is required) and a negative Ampere component explains the expansion of galaxies (no dark energy is required).

- The inertia of particles is explained with the time delay between the emission and the regeneration of FPs. No special mediating particles are required.

- Permanent magnets are explained with the synchronization along a closed path of reintegrating BSPs to their nuclei.

- The two possible states (spins) in one energy level of orbiting electrons are replaced by the two types of electrons defined in the present theory, namely the accelerating and decelerating electrons.

- The splitting of the atomic beam in the Stern-Gerlach experiment is explained with the magnetic field generated by the parallel currents composed of the orbital electron and the current induced in the atomic nucleus. The magnetic spin is not an intrinsic characteristic of the electron.

- Relativity deduced on speed variables instead of space-time variables gives the same equations as special relativity but without the fictitious concepts of time dilation and length contraction. The transversal Doppler effect, which was never experimentally detected, doesn't appear.

- The wave character of the photon is defined as a sequence of FPs with opposed transversal angular momenta which carry opposed transversal linear momenta.

- Light that moves trough a gravitation field can only lose energy, what explains the red shift of light from far galaxies (no expansion of the universe is required).

- Diffraction of particles such as the Bragg diffraction of electrons is now the result of the quantized interaction of parallel currents.

- As the model relies on BSPs permitting the transmission of linear momenta at infinite speed via FPs, it is possible to explain that entangled photons show no time delay when they change their state.

- The addition of a wave to a particle (de Broglie) is effectively replaced by a relation between the particles radius and its energy.

- The Schroedinger equation is replaced by an equation where the wave function is derived one time versus space and two times versus time in analogy to Newton's second law.

- The uncertainty relation of quantum mechanics derived with the new wave function forms pairs of canonical conjugated variables between "energy and space" and "momentum and time".

- The time independent Schroedinger equation results deriving the new wave function two times versus space, the same as for the established wave function.

- The new quantum mechanics theory, based on wave functions derived from the radius-energy relation, is in accordance with the quantum mechanics based on the correspondence principle.

- All interactions are of electromagnetic type and described by QEDs (Quantum Electrodynamics) and no other type of interactions are required.

- The gravitation of the present approach "Emission & Regeneration" UFT is compatible with quantum mechanics, what is not the case with General Relativity, which is the gravitation model of the SM.

- Finally the hypothesis is made that the apparent CMB radiation is a gravitational effect between the mass of the satellite and the signal evaluating part of the satellite, what would explaining the isotropy of the radiation.

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Note: The present approach is based on the concept that fundamental particles are constantly emitted by electrons and positrons and constantly regenerate them. As the concept is not found in mainstream theory, no existing paper can be used as reference.

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