Unified Field Theory

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This work presents a relativistic mathematical model for basic subatomic particles (BSPs) like electrons, positrons, and neutrinos, model that is based on fundamental particles that are continuously emitted and absorbed by the subatomic particles. Subatomic particles interact via the longitudinal and transversal angular momentum of their fundamental particles, angular momentum that are proportional to the energy of the subatomic particles. The rules of interaction between the longitudinal and transversal angular momentum of fundamental particles are specified and the corresponding equations for the calculations of the linear momentum between subatomic particles are presented. From the model results that the radius of a subatomic particle is inverse proportional to its energy and, that the incremental time to generate the force out of linear momentum is quantized. All known forces are derived as rotors from one vector field generated by the longitudinal and transversal angular momentum of the fundamental particles. The equation of the linear momentum between two static BSPs is analyzed in detail to show why protons in an atomic nucleus coexist, how gravitation is generated and why heavy atomic nuclei radiate. The mechanism of elastic and destructive scattering of particles, based on the interactions between fundamental particles, is described. A classification of BSPs with light speed is presented and the photon introduced as a sequence of BSPs. Based on the quantification of the irradiated energy of BSPs, the Bragg equation, the Stern Gerlach bending and the flattening of galaxies' rotation curve are derived, without making use respectively of the wave-particle, the magnetic spin moment and dark matter, thus introducing a different physical interpretation of the underlying phenomenon. The two states of the spin of BSPs are replaced by the pair building of two types of BSPs, namely the accelerating and decelerating BSPs.

1. Introduction

The methodology of today's theoretical physics [1-5], consists in introducing first all known forces by separate definitions independent of their origin, arriving to quantum mechanics after postulating the particle's wave, and is then followed by attempts to infer interactions of particles and fields postulating the invariance of the wave equation under gauge transformations allowing the addition of minimal substitutions.

The present approach [6] models subatomic particles as emitting and absorbing continuously fundamental particles with longitudinal and transversal angular momentums (fields), and postulates then the interaction laws between angular momentum in that way that it is possible to deduce all known forces.

Today´s theoretical physics also postulates the particle-wave (de Broglie) to explain patterns observed in particle diffraction that look similar to patterns observed in wave diffraction experiments. The present approach shows that the patterns observed in particle diffraction are generated by quantized bending momentums that result from the quantized irradiated energy.

The approach is based on the following main conceptual steps: The energy of an electron or positron is modeled as being distributed in the space around the particle`s radius r_o and stored in fundamental particles (FPs) with longitudinal and transversal angular momentum. FPs are emitted continuously with the speed $v_e\,\bar{s}_e$ and regenerate the electron or positron continuously with the speed $v_r\,\bar{s}$. There are two types of FPs, one type that moves with light speed and the other type that moves with nearly infinite speed (see Fig. 1). BSPs emit and are regenerated always by different types of FPs resulting in the "accelerating" and "decelerating" BSPs which have respectively regenerating FPs with light and infinite speed. The density of FPs around the particle's radius r_o has a radial distribution and follows the inverse square distance law.

Field magnitudes $d\bar{H}$ are defined as square roots of the energy stored in the FPs. Cross product interaction laws between the fields $d\bar{H}$ of BSPs are defined to obtain pairs of opposed angular momentum on their regenerating FPs, pairs that generate linear momentum which are responsible for the forces.

Based on the conceptual steps, equations for the vector fields $d\bar{H}$ are obtained that allow the deduction of all experimentally proven basic laws of physics, namely, Coulomb, Ampere, Lorentz, Gravitation, Maxwell, Bragg, Stern Gerlach and the flattening of galaxies' rotation curve.

Note: In this approach, Basic Subatomic Particles (BSPs) are the electron, the positron, and the neutrino as an elementary constituent of the photon. Subatomic particles like the proton, neutron, and photon are named *complex BSPs*.

2. Space Distribution of the Energy of Basic Subatomic Particles

The total energy of a basic subatomic particle (BSP) with constant $v \neq c$ is

$$E = \sqrt{E_o^2 + E_p^2} \qquad E_o = m\,c^2$$
$$E_p = pc \qquad p = \frac{m\,v}{\sqrt{1 - \frac{v^2}{c^2}}} \,. \tag{1}$$

The total energy $E = E_e$ is split in

$$E_e = E_s + E_n \qquad \text{with}$$

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

Differential emitted dE_e and regenerating dE_s and dE_n energies are defined

$$\begin{aligned} dE_e &= E_e d\kappa = \nu J_e \\ dE_s &= E_s d\kappa = \nu J_s \\ dE_n &= E_n d\kappa = \nu J_n \end{aligned} \tag{3}$$

with the distribution equation

$$d\kappa = \frac{c}{2v}\left|\hat{\mathbf{v}}_s \times \hat{\mathbf{v}}_r\right| \frac{r_o}{r^2} dr d\phi \frac{d\gamma}{2\pi} = \frac{1}{2}\frac{r_o}{r^2} dr \sin\phi d\phi \frac{d\gamma}{2\pi} \tag{4}$$

The distribution equation $d\kappa$ gives the part of the total energy of a BSP moving with $v \neq c$ contained in the differential volume $dV = dr\, rd\phi\, r\sin\phi d\gamma$ of a FP. Note: In this paper $\varphi = \phi$.

The differential energies are stored in the longitudinal angular momentum $\vec{\mathbf{J}}_e = J_e \hat{\mathbf{s}}_e$ of emitted FPs and in the longitudinal $\vec{\mathbf{J}}_s = J_s \hat{\mathbf{s}}$ and transversal $\vec{\mathbf{J}}_n = J_n \hat{\mathbf{n}}$ angular momentum of regenerating FPs.

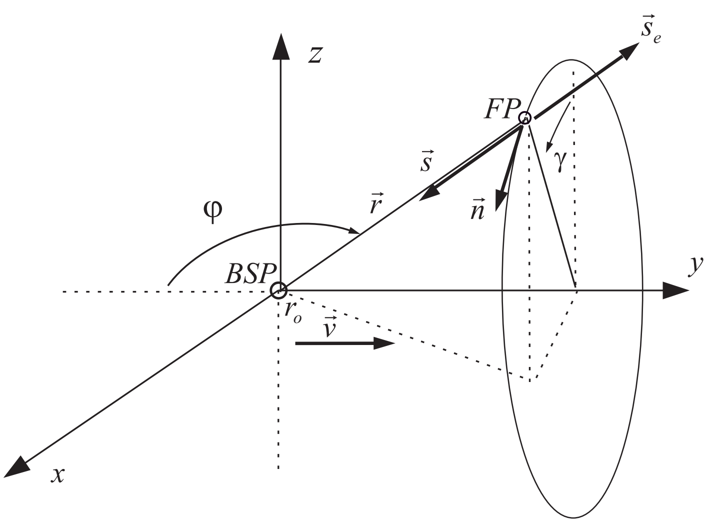

Fig. 1. Unit vector $\hat{\mathbf{s}}_e$ for an emitted FP and unit vectors $\hat{\mathbf{s}}$ and $\hat{\mathbf{n}}$ for a regenerating FP of a BSP moving with $v \neq c$.

The rotation sense in moving direction of emitted longitudinal angular momentum $\vec{\mathbf{J}}_e$ defines the sign of the charge of a BSP. Rotation sense of $\vec{\mathbf{J}}_e$ and $\vec{\mathbf{J}}_s$ are always opposed. The direction of the transversal angular momentum $\vec{\mathbf{J}}_n$ is the direction of a right screw that advances in the direction of the velocity v and is independent of the sign of the charge of the BSP. The concept is shown in Fig. 1.

Conclusion: The elementary charge is replaced by the energy (or mass) $E_e = 0.511\,\text{MeV}$ of a resting electron. The charge of a complex BSP (e.g. proton) is given by the difference between the **constituent** numbers of BSPs with positive $\vec{\mathbf{J}}_e^{(+)}$ and negative $\vec{\mathbf{J}}_e^{(-)}$ which integrate the complex BSP, multiplied by the energy of a resting electron. As examples we have for the proton with $n^+ = 919$ and $n^- = 918$ with a binding energy of $E_{B\text{-prot}} = -0.43371\,\text{MeV}$ a charge of $\left(n^+ - n^-\right)\cdot 0.511 = 0.511\,\text{MeV}$, and for the neutron with $n^+ = 919$ and $n^- = 919$ and a binding energy of $E_{B\text{-neut}} = 0.34936\,\text{MeV}$ a charge of $\left(n^+ - n^-\right)\cdot 0.511 = 0.0\,\text{MeV}$.

The unit of the charge thus is the Joule (or kg). The conversion from the electric current I_c (Ampere) to the mass current I_m is given by

$$I_m = \frac{m}{q} I_c = 5.685631378 \times 10^{-12}\, I_c \left[\frac{\text{kg}}{\text{s}}\right] \tag{5}$$

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

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 $\vec{\mathbf{J}}_e^{(+)}$ and negative $\vec{\mathbf{J}}_e^{(-)}$ which integrate the complex BSP, multiplied by the energy of a resting electron. In the present paper the denomination **charge** will be used according to the previous definition.

3. Definition of Field Magnitudes dH_s and dH_n

The field dH at a point in space is defined as part of the square root of the energy of a BSP, part defined by the distribution equation $d\kappa$ which is related to the volume $dV = dr\, rd\phi\, r\sin\phi d\gamma$ of a FP (see also Eq. (2)). For the emitted field we have

$$d\vec{\mathbf{H}}_e = H_e d\kappa \hat{\mathbf{s}}_e\, ; \qquad H_e^2 = E_e\, . \tag{6}$$

The longitudinal component of the regenerating field at a point in space is defined as

$$d\vec{\mathbf{H}}_s = H_s d\kappa \hat{\mathbf{s}}\, ; \qquad H_s^2 = E_s = \frac{E_o^2}{\sqrt{E_o^2 + E_p^2}}\, . \tag{7}$$

The transversal component of the regenerating field at a point in space is defined as

$$d\vec{\mathbf{H}}_n = H_n d\kappa\, \hat{\mathbf{n}}\, ; \qquad H_n^2 = E_n = \frac{E_p^2}{\sqrt{E_o^2 + E_p^2}}\, . \tag{8}$$

The total field magnitude H_e is

$$H_e^2 = H_s^2 + H_n^2\, ; \qquad H_e^2 = E_e\, . \tag{9}$$

The vector $\hat{\mathbf{s}}_e$ is a unit vector in the moving direction of the emitted FP. The vector $\hat{\mathbf{s}}$ is a unit vector in the moving direction of the regenerating FP. The vector $\hat{\mathbf{n}}$ is a unit vector transversal to the moving direction of the regenerating FP and oriented according the right screw rule relative to the velocity $\vec{\mathbf{v}}$ of the BSP.

Conclusion: BSPs are structured particles with emitted and regenerating FPs with longitudinal and transversal angular momentum. The rotation sense of the angular momentum of the emitted FPs defines the sign of the charge of the BSP, and the transversal angular momentum of the regenerating FPs define the mechanical and magnetic moments.

4. Interaction Laws for Field Components and Generation of Linear Momentum

The interaction laws for the field components $d\vec{\mathbf{H}}_s$ and $d\vec{\mathbf{H}}_n$ are derived from the following interaction postulates for the longitudinal $\vec{\mathbf{J}}_s$ and transversal $\vec{\mathbf{J}}_n$ angular momentum.

1. If two fundamental particles from two static BSPs cross, their longitudinal rotational momentum J_s generate the following transversal rotational momentum (sg=signum):

$$\vec{\mathbf{J}}_{n_1}^{(s)} = -\mathrm{sg}\left(\vec{\mathbf{J}}_{s_1}\right)\mathrm{sg}\left(\vec{\mathbf{J}}_{s_2}\right)\left(\sqrt{J_{s_1}}\,\hat{\mathbf{s}}_1 \times \sqrt{J_{s_2}}\,\hat{\mathbf{s}}_2\right). \tag{10}$$

If both sides of Eq. (10) are multiplied with $\sqrt{\nu_{s_1} d\kappa_1}$ and $\sqrt{\nu_{s_2} d\kappa_2}$, with ν_s the rotational frequency, results the differential energy

$$dE_{n_1}^{(s)} = \left|\sqrt{\nu_{s_1} J_{s_1} d\kappa_1}\,\hat{\mathbf{s}}_1 \times \sqrt{\nu_{s_2} J_{s_2} d\kappa_2}\,\hat{\mathbf{s}}_2\right|, \tag{11}$$

or

$$dE_{n_1}^{(s)} = \left|dH_{s_1}\hat{\mathbf{s}}_1 \times dH_{s_2}\hat{\mathbf{s}}_2\right|,\quad dH_{s_i}\hat{\mathbf{s}}_i = \sqrt{\nu_{s_i} J_{s_i} d\kappa_i}\,\hat{\mathbf{s}}_i . \tag{12}$$

If at the same time two other fundamental particles from the same two static BSPs generate a transversal rotational momentum $-\vec{\mathbf{J}}_{n_1}^{(s)}$, so that the components of the pair are equal and opposed, the generated linear momentum on the two BSPs is

$$dp = \frac{1}{c} dE_p^{(s)}\ ;\quad dE_p^{(s)} = \left|\int_{r_{r_1}}^{\infty} dH_{s_1}\hat{\mathbf{s}}_1 \times \int_{r_{r_2}}^{\infty} dH_{s_2}\hat{\mathbf{s}}_2\right|. \tag{13}$$

2. If two fundamental particles from two moving BSPs cross, their transversal rotational momentum J_n generate the following rotational momentum (sg=signum):

$$\vec{\mathbf{J}}_1^{(n)} = +\mathrm{sg}\left(\vec{\mathbf{J}}_{s_1}\right)\mathrm{sg}\left(\vec{\mathbf{J}}_{s_2}\right)\left(\sqrt{J_{n_1}}\,\hat{\mathbf{n}}_1 \times \sqrt{J_{n_2}}\,\hat{\mathbf{n}}_2\right). \tag{14}$$

If both sides of the equation are multiplied with $\sqrt{\nu_{n_1} d\kappa_1}$ and $\sqrt{\nu_{n_2} d\kappa_2}$, with ν_n the rotational frequency, and the absolute value is taken, it is

$$dE_1^{(n)} = \left|dH_{n_1}\hat{\mathbf{n}}_1 \times dH_{n_2}\hat{\mathbf{n}}_2\right|,\quad dH_{n_i}\hat{\mathbf{n}}_i = \sqrt{\nu_{n_i} J_{n_i} d\kappa_i}\,\hat{\mathbf{n}}_i . \tag{15}$$

If at the same time two other fundamental particles from the same two moving BSPs cross, and their transversal rotational momentum generate a rotational momentum $-\vec{\mathbf{J}}_1'^{(n)}$, so that the components of the pair are equal and opposed, the generated linear momentum on the two BSPs is

$$dp = \frac{1}{c} dE_p^{(n)}\ ;\quad dE_p^{(n)} = \left|\int_{r_{r_1}}^{\infty} dH_{n_1}\hat{\mathbf{n}}_1 \times \int_{r_{r_2}}^{\infty} dH_{n_2}\hat{\mathbf{n}}_2\right|. \tag{16}$$

3. If two fundamental particles with opposed angular momentum from a moving BSP cross with regenerating fundamental particles of a static or probe BSP_p, the opposed angular momentum of the moving BSP are appropriated by the regenerating fundamental particles of the static BSP_p, generating opposed linear momentums on the two BSPs (Fig. 14).

5. Fundamental Equations for the Calculation of Linear Momentum between Subatomic Particles

The Fundamental equations for the calculation of linear momentum according to the interaction postulates of Section 4 are:

a. The equation for the calculation of linear momentum between two static BSPs according postulate (**1**) is

$$dp_{\mathrm{stat}}\hat{\mathbf{s}}_R = \frac{1}{c}\oint_R \left\{ \frac{d\vec{\mathbf{l}} \bullet \left(\hat{\mathbf{s}}_{e_1} \times \hat{\mathbf{s}}_{s_2}\right)}{2\pi R} \int_{r_1}^{\infty} H_{e_1} d\kappa_{r_1} \int_{r_2}^{\infty} H_{s_2} d\kappa_{r_2} \right\} \hat{\mathbf{s}}_R , \tag{17}$$

where $H_{e_1}\, d\kappa_{r_1} \overline{s}_{e_1}$ is the longitudinal field of the emitted FPs of particle 1 and $H_{s_2} d\kappa_{r_2} \hat{\mathbf{s}}_{s_2}$ is the longitudinal field of the regenerating FPs of particle 2. The unit vector $\hat{\mathbf{s}}_R$ is orthogonal to the plane that contains the closed path with radius R.

The linear momentum generated between two static BSPs is the origin of all movements of particles. The law of Coulomb is deduced from Eq. (17) and because of its importance is analyzed in chapter 6.

b. The equation for the calculation of linear momentum between two moving BSPs according to postulate (**2**) is

$$dp_{\mathrm{dyn}}\hat{\mathbf{s}}_R = \frac{1}{c}\oint_R \left\{ \frac{d\vec{\mathbf{l}} \bullet \left(\hat{\mathbf{n}}_1 \times \hat{\mathbf{n}}_2\right)}{2\pi R} \int_{r_1}^{\infty} H_{n_1} d\kappa_{r_1} \int_{r_2}^{\infty} H_{n_2} d\kappa_{r_2} \right\} \hat{\mathbf{s}}_R , \tag{18}$$

where $H_{n_1} d\kappa_{r_1} \hat{\mathbf{n}}_1$ is the transversal field of the regenerating FPs of particle 1 and $H_{n_2} d\kappa_{r_2} \hat{\mathbf{n}}_2$ is the transversal field of the regenerating FPs of particle 2.

The laws of Lorentz, Ampere and Bragg are deduced from equation (18).

c. The equations for the calculation of the induced linear momentum between a moving and a static probe BSP_p according to postulate (**3**) are

$$dp_{\mathrm{ind}}^{(s)}\hat{\mathbf{s}}_R = \frac{1}{c}\oint_R \left\{ \frac{d\vec{\mathbf{l}} \bullet \hat{\mathbf{s}}}{2\pi R} \int_{r_r}^{\infty} H_s d\kappa_{r_r} \int_{r_p}^{\infty} H_{s_p} d\kappa_{r_p} \right\} \hat{\mathbf{s}}_R , \tag{19}$$

$$dp_{\mathrm{ind}}^{(n)}\hat{\mathbf{s}}_R = \frac{1}{c}\oint_R \left\{ \frac{d\vec{\mathbf{l}} \bullet \hat{\mathbf{n}}}{2\pi R} \int_{r_r}^{\infty} H_n d\kappa_{r_r} \int_{r_p}^{\infty} H_{s_p} d\kappa_{r_p} \right\} \hat{\mathbf{s}}_R . \tag{20}$$

The upper indexes (s) or (n) denote that the linear momentum $dp_{\mathrm{ind}}^{(\cdot)}$ on the static probe BSP_p (subindex s_p) is induced by the longitudinal (s) or transversal (n) field component of the moving BSP.

The Maxwell and the gravitation laws are deduced from equations (19) and (20). The total linear momentum for all equations is given by

$$\vec{\mathbf{p}} = \int_\sigma dp\,\hat{\mathbf{s}}_R\,, \tag{21}$$

where $\int_\sigma$ symbolizes the integration over the whole space.

Conclusion: All forces can be expressed as rotors from the vector field $d\bar{H}$ generated by the longitudinal and transversal angular momentum of the two types of fundamental particles defined in chapter 1.

$$d\vec{\mathbf{F}} = \frac{d\vec{\mathbf{p}}}{dt} = \frac{1}{8\pi}\sqrt{m}\,r_o\,\vec{\nabla}\times\frac{d}{dt}\int_{r_r}^{\infty} d\vec{\mathbf{H}} \tag{22}$$

6. Analysis of Linear Momentum between Two Static BSPs

In this section the static Eq. (17) 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. (17) for two BSPs, neglecting the influence of the important dynamic Eq. (18) that explains for instance the magnetic moment of nuclei, it shows already the origin of the above listed phenomena.

With the integration limits shown in Fig. 2

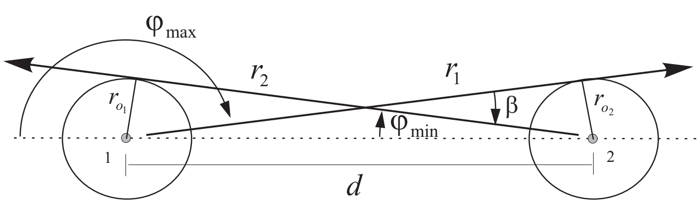

Fig. 2. Integration limits for the linear momentum calculation between two static basic subatomic particles at the distance d .

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

$$\phi_{\min} = \arcsin\frac{r_o}{d}\,,\quad \phi_{\max} = \pi - \phi_{\min}\,,\quad \text{for}\quad d \ge \sqrt{r_o^2 + r_o^2} \tag{23}$$

$$\phi_{\min} = \arccos\frac{d}{2r_o}\,,\quad \phi_{\max} = \pi - \phi_{\min}\,,\quad \text{for}\quad d < \sqrt{r_o^2 + r_o^2} \tag{24}$$

and Eq. (17) transforms to

$$p_{\text{stat}} = \frac{mcr_o^2}{4d^2}\int_{\phi_{1\min}}^{\phi_{1\max}}\int_{\phi_{2\min}}^{\phi_{2\max}}\left|\sin^3(\phi_1 - \phi_2)\right| d\phi_2 d\phi_1\,. \tag{25}$$

The double integral becomes zero for $d \to 0$ because the integration limits approximate each other taking the values $\phi_{\min} = \pi/2$ and $\phi_{\max} = \pi/2$. For $d \gg r_o$ the double integral becomes a constant because the integration limits tend to $\phi_{\min} = 0$ and $\phi_{\max} = \pi$.

Fig. 3 shows the curve of Eq. (17) where five regions can be identified with the help of $d/r_o = \gamma$ from the integration limits:

1. From $0 < \gamma \le 0.1$, where $p_{\text{stat}} = 0$.
2. From $0.1 < \gamma \le 1.8$, where $p_{\text{stat}} \propto d^2$.
3. From $1.8 < \gamma \le 2.1$, where $p_{\text{stat}} \approx \text{const}$.
4. From $2.1 < \gamma \le 518$, where $p_{\text{stat}} \propto \dfrac{1}{d}$.
5. From $518 < \gamma < \infty$, where $p_{\text{stat}} \propto \dfrac{1}{d^2}$.

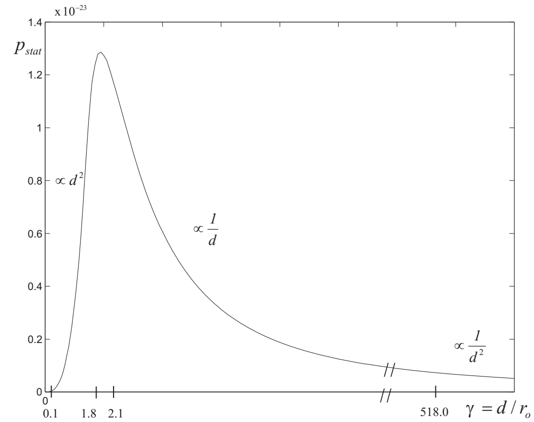

Fig. 3. Linear momentum p_{stat} as function of $\gamma = d / r_o$ between two static BSPs with maximum at $\gamma = 2$.

The **first and second regions** are where the BSPs that form the atomic nucleus are confined and in a dynamic equilibrium. BSPs of different signs of charge 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 β between their longitudinal rotational momentum is $\beta = \pi + \phi_1 - \phi_2 = \pi$. 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 $\beta < \pi$.

Fig. 4 shows two neutrons where at neutron 1 the migrated BSP ' b ' is reintegrated, inducing at neutron 2 the gravitational linear momentum according postulate 3) of Section 4.

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.

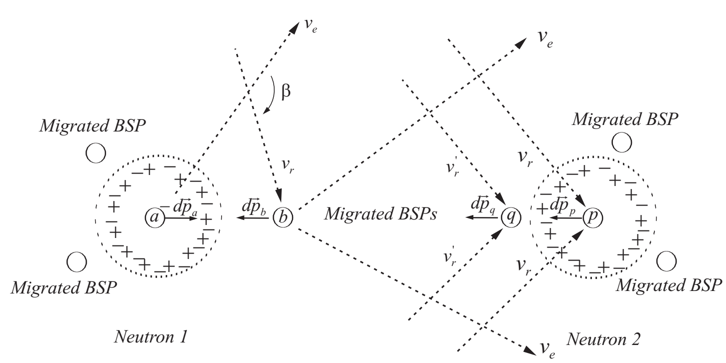

Fig. 4. Transmission of momentum dp from neutron 1 to neutron 2.

As the force described by Eq. (20) induced on other particles during reintegration has always the direction and sense of the reintegrating particle (right screw of $\vec{\mathbf{J}}_n$) 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 which transfer their angular momentum from the moving to the static BSPs according postulate **3)** of Section 4. Gravitation force is thus a function of the number of BSPs that migrate and are reintegrated in the time Δt (migration current), and the reintegration velocity.

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 $\gamma_{\text{trans}} = 518$ to the Coulomb law was determined by comparing the tangents of the Coulomb equation and the curve from Fig. 3. At $\gamma_{\text{trans}} = 518$ the ratio of their tangents begin to deviate from 1.

At the transition distance d_{trans}, where $\gamma_{\text{trans}} = 518$, the inverse proportionality to the distance d_{trans} from the neighbor regions must give the same force F_{trans}

$$F_{\text{trans}} = \frac{1}{\Delta t} \frac{K'}{d_{\text{trans}}} = \frac{1}{\Delta t} \frac{K'_F}{d^2_{\text{trans}}} , \tag{26}$$

with K' and K'_F the proportionality factors of the fourth and fifth regions.

The transition distance for a Carbon nucleus C^{12} is, with m_p and m_n the mass of the proton and neutron respectively,

$$d_{\text{trans}} = \gamma r_o = \gamma \frac{\hbar c}{E_o} = 518 \frac{\hbar\, c}{6\left(m_p + m_n\right)c^2} = 9.0724 \text{ fm} . \tag{27}$$

The **fifth region** is where the Coulomb law is valid.

7. Time Quantification and the Radius of BSPs

The relation between the total force and the linear momentum for all the fundamental equations of chapter 5 is given by

$$\vec{\mathbf{F}} = \frac{\Delta p}{\Delta t} \hat{\mathbf{s}}_R , \qquad \Delta p = p - 0 = p , \tag{28}$$

with the momentum time Δt between the two BSPs defined as

$$\Delta t = K\, r_{o_1} r_{o_2} , \qquad K = 5.4271 \times 10^4 \left[\frac{\text{s}}{\text{m}^2}\right], \tag{29}$$

K is a constant and r_{o_1} and r_{o_2} are the radii of the BSPs.

The constant K results when Eqs. (17) and (18) are equalized respectively with the Coulomb and the Ampere equations

$$F_{\text{stat}} = \frac{1}{4\pi\varepsilon_o} \frac{Q_1 Q_2}{d^2} , \qquad F_{\text{dyn}} = \frac{\mu_o}{2\pi} \frac{I_1 I_2}{d} . \tag{30}$$

The radius r_o of a particle is given by

$$r_o = \frac{\hbar c}{E} , \qquad E = \sqrt{E_o^2 + E_p^2} \qquad \text{for} \quad v \neq c , \tag{31}$$

and

$$E = \hbar\omega \quad \text{for} \quad v = c , \tag{32}$$

and is derived from the quantified far field of the irradiated energy of an oscillating BSP [6].

8. Quantification of Irradiated Energy

To express the energy irradiated by a BSP as quantified irradiation we start with

$$\begin{gathered} E = E_e = E_s + E_n = \sqrt{E_o^2 + E_p^2} , \\ \Delta t = K r_o r_{o_p} , \qquad r_o = \frac{\hbar c}{E_e} , \qquad r_{o_p} = \frac{\hbar c}{E_o} , \end{gathered} \tag{33}$$

with r_o the radius of the moving particle and r_{o_p} the radius of the probe particle and

$$\begin{gathered} \Delta_o t = \Delta t_{(v=0)} = K \frac{\hbar^2 c^2}{E_o^2} = 8.082097 \times 10^{-21} \text{ s} \\ K = 5.4274 \times 10^4 \text{ s/m}^2 \end{gathered} \tag{34}$$

We now define $E_e \Delta t$ and get

$$\begin{gathered} E_e \Delta t = K \frac{\hbar^2 c^2}{E_o} = K \frac{h^2}{4\pi^2 m} = h , \\ E_e = h\, \nu_e , \qquad \nu_e = \frac{1}{\Delta t} , \end{gathered} \tag{35}$$

an equation that is valid for every speed v of the BSP, also for $v = 0$ giving

$$\begin{gathered} E_e \Delta t = E_o \Delta_o t = h , \\ E_o = h\nu_o , \qquad \nu_o = \frac{1}{\Delta_o t} = 1.2373 \times 10^{20} \text{ s}^{-1} , \end{gathered} \tag{36}$$

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.

We now define the quantized emission of energy at a BSP defining the power as

$$P_e = \frac{E_e}{\Delta_o t} = E_e \nu_o . \tag{37}$$

With the equation (36) which states that $E_e\ \Delta t = E_o\ \Delta_o t = h$ we get

$$\begin{aligned} P_e &= \frac{E_e}{\Delta_o t} = E_e \nu_o = \frac{E_o}{\Delta t} = E_o \nu_e \\ &= E_o\left(\nu''_s + \nu''_n\right) = P''_s + P''_n = \frac{E_s + E_n}{\Delta_o t} . \end{aligned} \tag{38}$$

The emitted and regenerating powers are

$$\begin{gathered} P_e = E_o \nu_e = E_e \nu_o , \\ P''_s = E_o \nu''_s = E_s \nu_o , \\ P''_n = E_o \nu''_n = E_n \nu_o . \end{gathered} \tag{39}$$

Note: The emitted and regenerating powers have different frequencies ν_e, ν''_s and ν''_n, but a common energy quanta E_o. We also get

$$\begin{aligned} \nu_s'' &= \frac{E_s}{E_o \Delta_o t} = \frac{E_s}{E_o}\nu_o = \frac{E_s}{h}\,, \\ \nu_n'' &= \frac{E_n}{E_o \Delta_o t} = \frac{E_n}{E_o}\nu_o = \frac{E_n}{h}\,, \end{aligned} \tag{40}$$

and conclude that

$$E_e = h\nu_e\,, \qquad E_s = h\nu_s''\,, \qquad E_n = h\nu_n''\,, \qquad \nu_e = \nu_s'' + \nu_n''\,, \tag{41}$$

with

$$dE = E\,d\kappa\,, \qquad dH = \sqrt{E}\,d\kappa = H\,d\kappa\,, \tag{42}$$

and

$$\frac{H}{\sqrt{\Delta t}} = \sqrt{E\,\nu} = \sqrt{P}\,, \tag{43}$$

The equations for the Coulomb, Ampere and induction forces of Section 5 can be transformed to

$$d'F\hat{\mathbf{s}}_R = \frac{d'p}{\Delta_o t}\hat{\mathbf{s}}_R \propto \frac{1}{c}\oint_R \left\{ \int_{r_1}^{\infty} \frac{H_1}{\sqrt{\Delta_o t}}\,d\kappa_{r_1} \int_{r_2}^{\infty} \frac{H_2}{\sqrt{\Delta_o t}}\,d\kappa_{r_2} \right\} \hat{\mathbf{s}}_R\,, \tag{44}$$

and expressed as a function of the powers of the interacting BSPs

$$d'F\,\overline{s}_R = \frac{d'p}{\Delta_o t}\overline{s}_R \propto \frac{1}{c}\oint_R \left\{ \int_{r_1}^{\infty} \sqrt{P_1}\,d\kappa_{r_1} \int_{r_2}^{\infty} \sqrt{P_2}\,d\kappa_{r_2} \right\} \overline{s}_R\,, \tag{45}$$

with

$$\begin{aligned} P_1 &= E_1\nu_o = E_o\nu_1\,, \\ P_2 &= E_2\nu_o = E_o\nu_2\,. \end{aligned} \tag{46}$$

The differential energy fluxes are

$$\begin{aligned} dP_e &= \nu_e E_o d\kappa\,, \\ dP_s &= \nu_s E_o d\kappa\,, \\ dP_n &= \nu_n E_o d\kappa\,, \end{aligned} \tag{47}$$

and with

$$\begin{aligned} d\kappa &= \frac{1}{2}\frac{r_o}{r^2}\,dr\,\sin\phi\,d\phi\,\frac{d\gamma}{2\pi} \qquad \textit{and} \\ dA &= r^2\sin\phi\,d\phi\,d\gamma \end{aligned} \tag{48}$$

The concept is shown in Fig. 5.

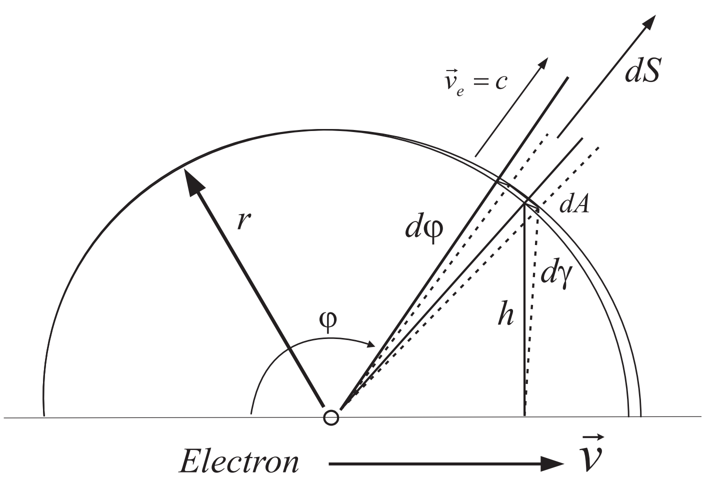

Fig. 5. Emitted Energy flux density dS of a moving electron

we define the differential energy flux density as

$$dS = \frac{dP}{dA} = \frac{1}{4\pi}\,\nu\,E_o\,\frac{r_o}{r^4}\,dr \qquad \frac{J}{m^2\,s}\,. \tag{49}$$

The cumulated differential energy flux density is

$$\int_r^{\infty} dS = \frac{1}{dA}\int_r^{\infty} dP = -\frac{1}{12\pi}\,\nu\,E_o\,\frac{r_o}{r^3} \qquad \frac{J}{m^2\,s}\,. \tag{50}$$

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 doesn't define who is moving relative to whom.

9. Ampere Bending (Bragg's Law)

From Section 4 we have that the momentum $d\vec{p}$ generated between two moving BSPs due to the interaction of their transversal angular momentum is

$$d\vec{\mathbf{p}} = \frac{1}{c}\left| \int_{r_{r_1}}^{\infty} dH_{n_1}\hat{\mathbf{n}}_1 \times \int_{r_{r_2}}^{\infty} dH_{n_2}\hat{\mathbf{n}}_2 \right|. \tag{51}$$

The Bragg equation is now deduced from the equation of the force density between two parallel conductors [6]

$$\frac{F}{dl} = \frac{1}{c\Delta_o t}\frac{r_o^2}{64\,m}\frac{I_{m_1}I_{m_2}}{d}\int_{\gamma_{2_{\min}}}^{\gamma_{2_{\max}}}\int_{\gamma_{1_{\min}}}^{\gamma_{1_{\max}}} \frac{\sin^2(\gamma_1-\gamma_2)}{\sqrt{\sin\gamma_1\,\sin\gamma_2}}\,d\gamma_1 d\gamma_2 \tag{52}$$

with $\iint = 5.8731$.

Eq. (52) results from Eq. (18) of Section 4 when applied to two parallel conductors with mass currents I_{m_1} and I_{m_2}, where for $v \ll c$

$$I_m = \rho_x m v\,, \qquad \rho_x = \frac{N_x}{\Delta x}\,, \qquad \Delta_o t = K r_o^2\,. \tag{53}$$

The linear density ρ_x is defined as the number N_x of BSPs per length Δx of the conductor. The relation between the mass current I_m and the electric current I_c is given by

$$I_m = \frac{m}{q}I_c = 5.685631378\times 10^{-12}\,I_c\left[\frac{\text{kg}}{\text{s}}\right], \tag{54}$$

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

The BSPs that interact now trough their transversal angular momentum are the moving BSP and the parallel reintegrating BSP of a nucleon described in Section 6. Fig. 6 shows the concept.

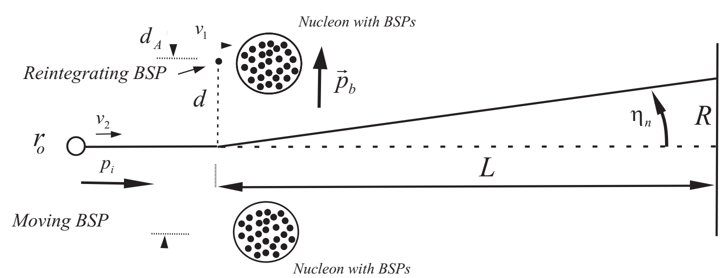

Fig. 6. Bending of BSPs

We get with

$$I_m = \rho_x m v\,, \quad \rho_x = \frac{N_x}{\Delta x} = \frac{1}{2r_o}\,, \quad p = F\Delta_o t\,, \tag{55}$$

the bending momentum p,

$$p = \frac{1}{4}\frac{5.8731}{64\,c}\frac{\sqrt{m}\,v_1\sqrt{m}\,v_2}{d}\Delta l\,, \tag{56}$$

and with $\sqrt{E_n} = \sqrt{h\,\nu_n} = H_n = \sqrt{m\,v^2} = \sqrt{m}\,v$ we get

$$p = \frac{1}{4}\frac{5.8731}{64\,c}\frac{h\sqrt{\nu_{n_1}\nu_{n_2}}}{d}\Delta l\,. \tag{57}$$

The concept is shown in Fig. 7.

From Section 8 we have that

$$P_n = \frac{E_n}{\Delta_o t} = E_n\,, \quad \nu_o = E_o\nu_n\,, \quad \nu_n = \frac{E_n}{E_o}\nu_o\,, \tag{58}$$

and we get

$$p = \frac{1}{4}\frac{5.8731}{64\,c}\frac{h\sqrt{E_{n_1}E_{n_2}}\,\nu_o}{E_o d}\Delta l\,. \tag{59}$$

For the moving BSP we have, that $\Delta l = v_1\Delta'' t$ and the product $\sqrt{E_{n_1}}\Delta'' t = H_{n_1}\Delta'' t = \sqrt{m}\,\Delta l$ is independent of the velocity v_1 for a given Δl. The increase of H_{n_1} with the speed v_1 is compensated by the reduction of the time $\Delta'' t$ the moving BSP remains in Δl, reducing proportionally the number of fundamental particles emitted by the moving BSP that can interact with fundamental particles of the reintegrating BSP, while moving through Δl.

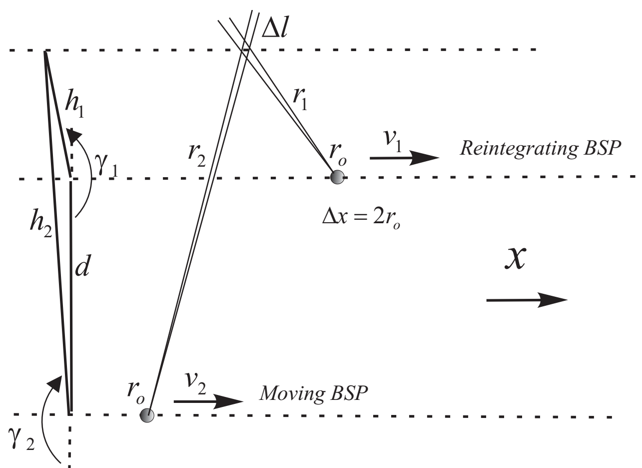

Fig. 7. Geometric relations for single moving BSPs.

We know that the bending is quantized and we introduce in the equation the quantization of the energy making $E_{n_1} = E_{n_2} = E_o$ and we get

$$p_b = \frac{1}{4}\frac{5.8731}{64\,c}\frac{h\nu_o}{d}\Delta l\,n\,, \tag{60}$$

where n gives the number of energy quanta of E_o interchanged between the two BSPs.

If we now write the bending equation with the help of $\tan\eta = 2\sin\theta$ for small η we get

$$\sin\theta = \frac{p_b}{2p_i} = \frac{1}{4}\frac{5.8731}{64}\frac{\nu_o}{c}\Delta l\frac{h}{2p_i d}n\,, \tag{61}$$

and with $2d = d_A$, where d_A is the interatomic distance, we get

$$\sin\theta = \frac{p_b}{2p_i} = \left(\frac{1}{2}\frac{5.8731}{64}\frac{\nu_o}{c}\Delta l\right)\frac{h}{2p_i d_A}n\,, \tag{62}$$

which is the Bragg equation except for the proportionality factor which can be adapted to the Bragg equation through the distance Δl which we assume is constant.

The Bragg equation is

$$\sin\theta = \frac{h}{2p_i d_A}n\,, \tag{63}$$

resulting for Δl with $\nu_o = 1.2373\times 10^{20}$ s^{-1}

$$\Delta l = 2\frac{64c}{5.8731\nu_o} = 5.2843\times 10^{-11}\text{ m}\,, \tag{64}$$

which is in the order of interatomic distances that are constant for each electron diffraction experiment.

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.

10. BSP with Light Speed

BSPs with speeds $v \neq c$ emit and are regenerated continuously by fundamental particles that have longitudinal and transversal angular momentums. With $v \to c$, Eq. (7) becomes zero and so the longitudinal field $d\mathbf{H}_s$ and the corresponding angular momentum $\vec{\mathbf{J}}_s$. According Eq. (8) only the transversal field $d\vec{\mathbf{H}}_n$ and the corresponding angular momentum $\vec{\mathbf{J}}_n$ remain. With $v \to c$, the BSP reduces to a pair of FPs with opposed transversal angular momentums $\vec{\mathbf{J}}_n$, with no emission (no charge) nor regeneration.

The concept is shown in Fig. 8.

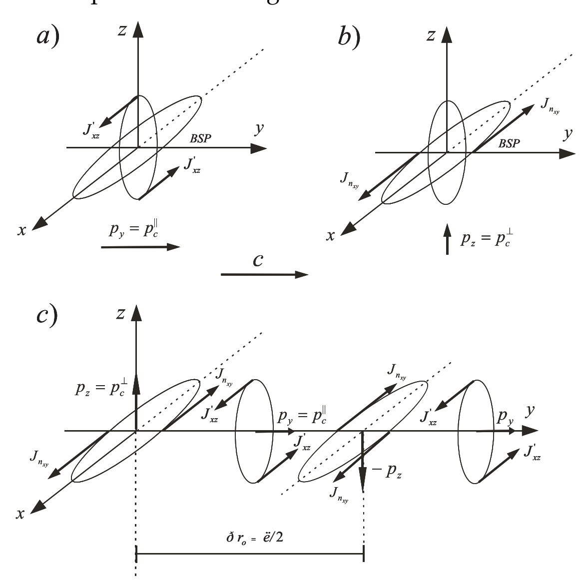

Fig. 8. Different forms of BSP with light speed.

Fig. 8 shows at **a)** a BSP with parallel $\vec{\mathbf{p}}_c^{\amalg}$ linear momentum and at **b)** with transversal $\vec{\mathbf{p}}_c^{\perp}$ linear momentum. At **c)** a possible configuration of a photon is shown as a sequence of BSPs with light speed with alternated transversal linear momentums $\vec{\mathbf{p}}_c^{\perp}$, which gives the wave character, and intercalated BSPs with longitudinal momentums $\vec{\mathbf{p}}_c^{\amalg}$ that gives the particle character to the photon.

Conclusion: BSPs with light speed are composed of pairs of FPs with opposed angular momentum $\vec{\mathbf{J}}_n$, they don't emit and are not regenerated by FPs. They are not bound to en environment that supplies continuously FPs to regenerate them. The potential linear momentum $\vec{\mathbf{p}}_c$ of each pair of opposed angular momentum can have any orientation relative to the speed $\vec{\mathbf{c}}$. BSPs with light speed can be identified with the neutrinos.

10.1. Ampere Bending of BSPs with Light Speed

The bending mechanism for BSPs with light speed at a static matter is in this case the same as for the bending of BSPs with speed $v \neq c$. In both cases the Ampere law is responsible for bending according postulate 2) of Section 4.

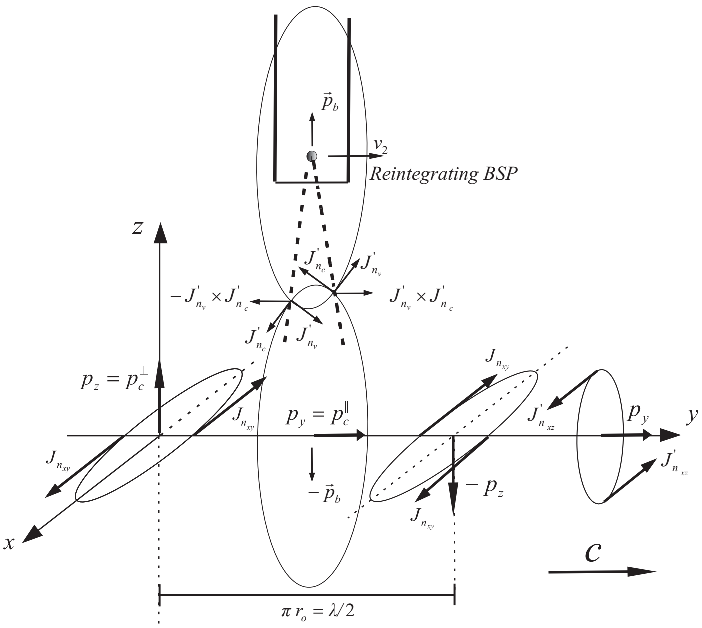

Fig. 9. Bending mechanism for a BSP with light speed.

In Fig. 9 we see that the complex BSP with light speed is composed of BSPs with potential linear momentum p_y oriented in moving direction and linear momentum p_z in orthogonal direction. The linear momentum p_y is responsible for the particle character of the complex BSP and the linear momentum p_z is responsible for the wave character of the complex BSP. The interaction according postulate 2) of Section 4 between the transversal angular momentum of the "particle-component" of the complex BSP with light speed and the transversal angular momentum of the regenerating BSPs of the matter, is responsible for bending. The bending direction is attractive or repulsive according to the relative directions of the complex BSP with light speed and the regenerating BSP.

The deduction of the Bragg equation for BSPs with light speed we get in changing the sub-index 1 by the sub-index c in the corresponding equations of Section 9.

Conclusion: The energy of the regenerating BSP increases in the same amount the energy of the BSP with light speed decreases. A complex BSP with light speed always loses energy when it is bent.

10.2. Induction Bending of a Photon

According postulate **3)** of Section 4, pairs of regenerating FPs with longitudinal angular momentum from a BSP can absorb 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. BSPs that appropriate opposed transversal angular momentum from photons can be static, moving or accelerated BSPs.

10.3. Red Shift of a Photon

The energy exchanged between a photon and a bending electron is

$$E_i = \frac{h\,c}{\lambda_i}, \qquad E_b = \frac{p_b^2}{2\,m_p}. \tag{65}$$

The frequency shift of the photon is with $E_i = E_a + E_b$

$$\Delta\nu = \nu_i - \nu_o = \frac{1}{h}\left(E_i - E_a\right) = \frac{E_b}{h}, \qquad z = \frac{\Delta\nu}{\nu_i}. \tag{66}$$

The concept is shown in Fig. 10.

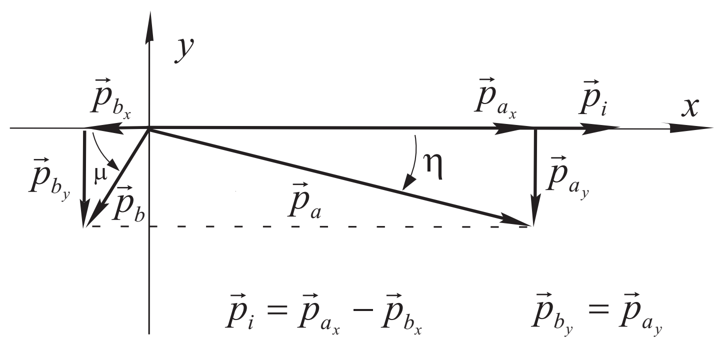

Fig. 10. Vector diagram for the bending of particles.

Conclusion: Photons that are bent lose energy and their frequencies are shift to the red. Light that comes from far galaxies is bent by cosmic matter during the trajectory to earth resulting in a red shift approximately proportional to the distance between galaxy and earth. The red shift is not the result of an expansion of the universe (Big Bang).

11. Conventions introduced for BSPs

Fig. 11 shows the convention used for the electrons and positrons. The accelerating positron emits FPs with high speed $v_e = \infty$ and positive longitudinal angular momentum $\vec{\mathbf{J}}_s^{+}$ $(\infty +)$ and is regenerated by FPs with low speed $v_r = c$ and negative longitudinal angular momentum $\vec{\mathbf{J}}_s^{-}$ $(c-)$. The decelerating electron emits FPs with low speed $v_e = c$ and negative longitudinal angular momentum $\vec{\mathbf{J}}_s^{-}$ $(c-)$ and is regenerated by FPs with high speed $v_r = \infty$ and positive longitudinal angular momentum $\vec{\mathbf{J}}_s^+$ $(\infty +)$. The emitted FPs of the accelerating positron regenerate the decelerating electron and the emitted FPs of the decelerating electron regenerate the accelerating positron.

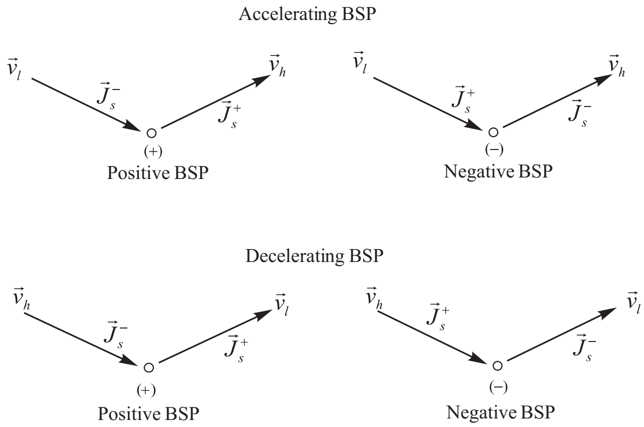

Fig. 11. Conventions for BSPs.

Fig. 12 shows a neutron and a proton with the rays for emitted and regenerating FPs. The complex BSPs are formed of accelerating positrons and decelerating electrons.

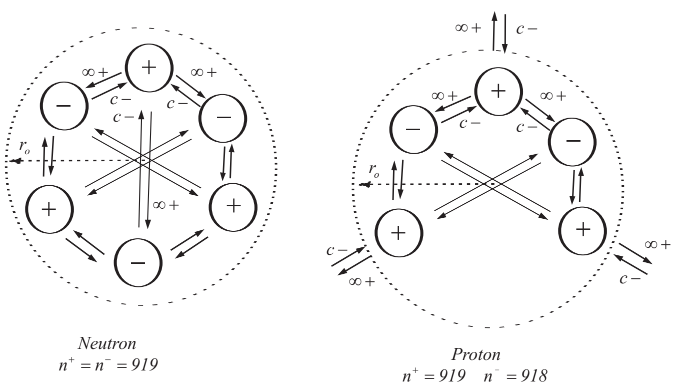

Fig. 12. Neutron and proton composed of accelerating positrons and decelerating electrons.

Fig. 13 shows a neutron with one migrated BSP and the corresponding leaking fields.

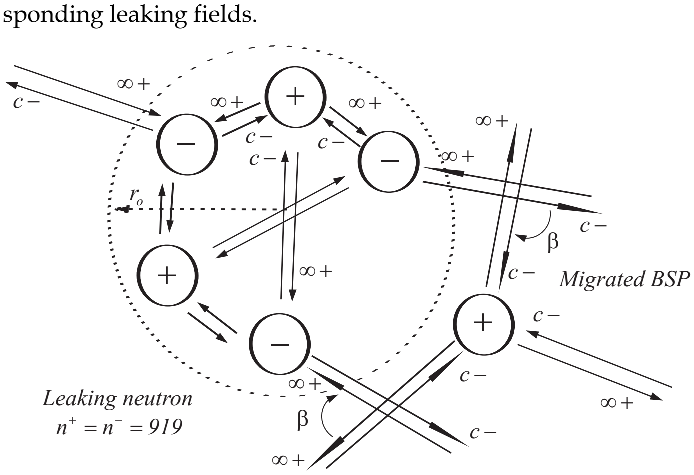

Fig. 13. Neutron with migrated BSP.

12. Mechanism of Elastic and Destructive Scattering of Particles

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 FPs with angular momentum, FPs that are continuously emitted and regenerate the BSP. At a free moving BSP each angular momentum of a FP is balanced by another angular momentum of a FP of the same BSP.

At Fig. 14 the opposed transversal angular momentum $d\vec{\mathbf{H}}_n$ at point P and $-d\vec{\mathbf{H}}_n$ at point P'' from two FPs that regenerate the BSP produce the linear momentum $\vec{\mathbf{p}}$ of the BSP. If a second static probe BSP_p appropriates with its regenerating angular momentum $d\vec{\mathbf{H}}_{s_p}$ angular momentum $d\vec{\mathbf{H}}_n$ from FPs of the first BSP according postulate 3) of Section 4, angular momentum that built a rotor different from zero in the direction of the second BSP_p generating $d\vec{\mathbf{p}}_{i_p}$, the first BSP loses energy and its linear momentum changes to $\vec{\mathbf{p}} - d\vec{\mathbf{p}}_{i_p}$. The angular momentum appropriated at point P by the probe BSP_p generating the linear momentum $d\vec{\mathbf{p}}_{i_p}$ are missing now at the first BSP to compensate the angular momentum at the symmetric point P'. The linear momentum at the two symmetric points are therefore equal and opposed $d'\vec{\mathbf{p}}_i = -d\vec{\mathbf{p}}_{i_p}$ because of the symmetry of the energy distribution function $d\kappa(\pi - \theta) = d\kappa(\theta)$.

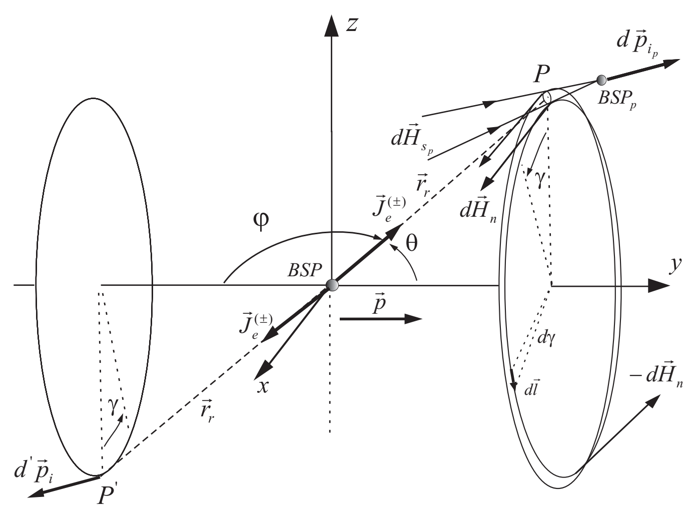

Fig. 14. Linear momentum balance between static and moving BSPs.

As the closed linear integral $\oint d\vec{\mathbf{H}}_n \bullet d\vec{\mathbf{l}}$ generates the linear momentum $\vec{\mathbf{p}}$ of a BSP, the orientation of the field $d\vec{\mathbf{H}}_n$ (right screw in the direction of the velocity) must be independent of the sign of the BSP, sign that is defined by $\vec{\mathbf{J}}_e^{(\pm)}$.

In a complex BSP formed by more than one BSP, a mutual regeneration between the BSPs exists. The emitted positive $\vec{\mathbf{J}}_e^{(+)}$ of the positive BSPs regenerate the negative BSPs, and the emitted negative $\vec{\mathbf{J}}_e^{(-)}$ of the negative BSPs regenerate the positive BSPs. BSPs that have no opposed pairs inside the nucleus emit their

FPs with the longitudinal angular momentums $\overline{J}_e^{(+)}$ generating $d\overline{H}$ fields beyond the radius of the nucleus. Opposed angular momentums of the $d\vec{\mathbf{H}}$ field beyond the radius are responsible for the "electromagnetic" interactions.

12.1. Elastic Scattering

Elastic scattering occurs "electromagnetically" beyond the radius r_o of the nucleus, and "mechanically" at the radius r_o.

Elastic electromagnetic scattering occurs when charged (difference between the constituent numbers of BSPs with different sign) complex BSPs interact without entering in mechanical contact. Interactions are limited to the interactions of their fields beyond the radius r_o of the particles. The complex particles maintain the internal distribution of their BSPs and, because of the weak accelerations, the internal mutual regeneration between the BSPs that form the complex particles is not disturbed.

Elastic mechanic scattering occurs when complex particles enter in mechanical contact maintaining the internal distribution of their BSPs, but the acceleration is already strong enough to disturb the internal mutual regeneration between the BSPs. The angular momentum of the pairs of BSPs are not more compensated inside the nucleus and each BSP of the complex BSP interchanges opposed angular momentums with the scattering partner.

12.2. Plastic or Destructive Scattering

Plastic or destructive scattering we have when distances between the scattering partners are smaller than r_o. The internal distribution of the BSPs is modified and the acceleration disturbs the internal mutual regeneration between the BSPs. The angular momentum of each BSP of the scattering partners interact heavily, and new basic configurations of angular momentum 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 bosons) to overcome the distance to the second BSP, that 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 momentum of all their FPs interact heavily according the three interaction postulates defined in chapter 4 and new basic arrangements of angular momentum are produced, resulting in balanced and unbalanced configurations of angular momentum 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 momentums.

13. Dark Matter

In Section 6 we have seen that the origin of the gravitation force is the induced force due to the reintegration of migrated BSPs in the direction of the two gravitating bodies. 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. 15.

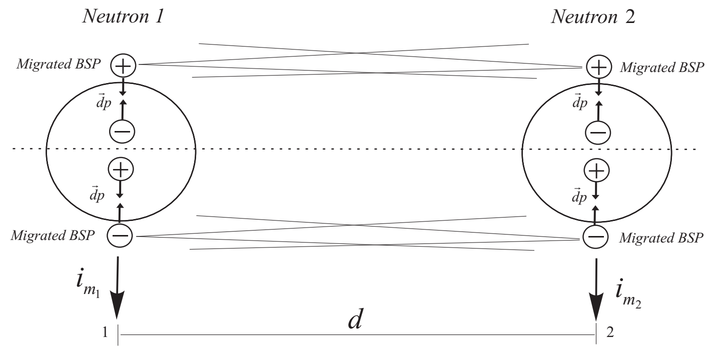

Fig. 15. Resulting current due to reintegration of migrated BSPs.

As the numbers of positive (Δ_R^+) and negative (Δ_R^-) 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

$$\Delta_R = \Delta_R^+ + \Delta_R^- = 0 \, . \tag{67}$$

We now assume, that because of the energy interchange between the two neutrons [6], a synchronization exists between the reintegration of BSPs of equal sign in the orthogonal direction of the two neutrons, resulting in parallel currents of equal signs that generate an attracting force between the neutrons. Thus the resulting attractive force between the two neutrons is produced by two components:

- the induced force F_G due to the reintegration of BSPs in the direction of the two neutrons as described in Section 6 and shown in Fig. 4 and
- the force F_R due to the reintegration of BSPs of equal sign in the orthogonal direction of the two neutrons resulting in parallel currents.

$$F_T = F_G + F_R \, , \qquad F_G = G\,\frac{M_1\, M_2}{d^2} \, , \qquad F_R = R\,\frac{M_1\, M_2}{d} \, , \tag{68}$$

where $G = 6.6726 \times 10^{-11}\, \mathrm{m}^3 / \mathrm{kg\text{-}s}^2$.

To obtain an equation for the force F_R, we start with Eq. (60) from Section 9, which was calculated for one pair of BSPs

$$p_b = \frac{1}{4}\frac{5.8731}{64\, c}\frac{h\nu_o}{d}\Delta l\, n \tag{69}$$

with

$$\begin{aligned} \nu_o &= 1.2373 \times 10^{20} \ \mathrm{s}^{-1} \\ \Delta l &= 5.2843 \times 10^{-11} \ \mathrm{m} \\ \Delta_o t &= 8.0821 \times 10^{-21} \ \mathrm{s}^{-1} \end{aligned} \tag{70}$$

and

$$dF_R = \frac{p_b}{\Delta_o t} \, , \qquad n = 1 \, . \tag{71}$$

The force for one pair of BSPs is given by

$$dF_R = \frac{p_b}{\Delta_o t} = \frac{K_{\text{Dark}}}{d}$$
$$K_{\text{Dark}} = \frac{1}{2}\frac{h}{\Delta_o t} = 4.09924\times10^{-14}\ \text{m}\,. \tag{72}$$

The total force is

$$F_R = \frac{K_{\text{Dark}}}{d}\Delta_{R_1}\Delta_{R_2} = R\,\frac{M_1 M_2}{d}\,. \tag{73}$$

We get

$$\Delta_{R_1}\Delta_{R_2} = \frac{R}{K_{\text{Dark}}}M_1 M_2\,, \tag{74}$$

or

$$\Delta_{R_1}\Delta_{R_2} = \gamma_R^2 M_1 M_2\,, \qquad \gamma_R^2 = \frac{R}{K_{\text{Dark}}}\,, \tag{75}$$

and

$$\Delta_R = \gamma_R M\,. \tag{76}$$

The total attraction force gives

$$F_T = F_G + F_R = \left[\frac{G}{d^2} + \frac{R}{d}\right]M_1 M_2\,. \tag{77}$$

For sub-galactic distances the induced force F_G is predominant, while for galactic distances the force of parallel reintegrating BSPs F_R predominates, as shown in Fig. 16.

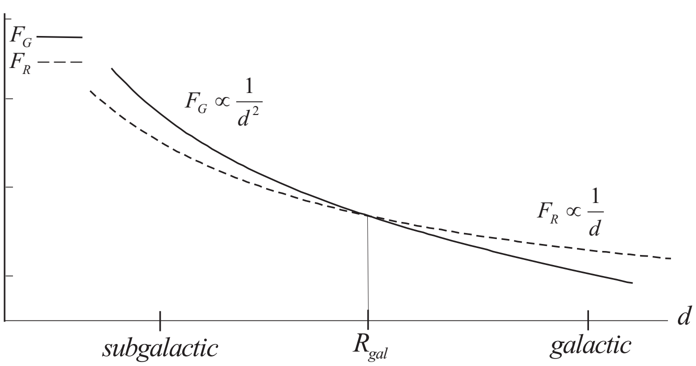

Fig. 16. Gravitation forces at sub-galactic and galactic distances.

13.1. Calculation Example

For the sun with $v_{\text{orb}} = 220\ \text{km/s}$, $M_2 = M_{\text{sun}} = 2\times10^{30}\ \text{kg}$, and a distance to the core of the Milky Way of $d = 25\times10^{19}\ \text{m}$, we get a centrifugal force of

$$F_c = M_2\frac{v_{\text{orb}}^2}{d} = 3.872\times10^{20}\ \text{N}\,. \tag{78}$$

With the mass of the core of the Milky Way of $M_1 = 4\times10^6\ M_{\text{sun}}$ and assuming that $F_T \approx F_R = F_C$ we get that

$$F_C = R\,\frac{M_1\,M_2}{d}\,, \qquad R = 6.05\times10^{-27}\ \text{N-m/kg}^2\,. \tag{79}$$

To calculate d_{gal} we write

$$F_G = F_R\,, \qquad d_{\text{gal}} = \frac{G}{R} = 1.103\times10^{16}\ \text{m}\,, \tag{80}$$

which justifies our assumption for $F_c \approx F_R$ because the distance between the sun and the core of the Milky Way is $d \gg d_{gal}$. We also have that

$$\gamma_R = \sqrt{\frac{R}{K_{\text{Dark}}}} = 3.842\times10^{-7}\ \text{kg}^{-1}\,. \tag{81}$$

Conclusion: The gravitation force is composed of an induced component and a component due to parallel currents of reintegrating BSPs. For galactic distances the induced component can be neglected, leaving the component generated by parallel currents, responsible for the flattening of galaxy rotation curves.

Note: We also may assume that the synchronization of the reintegrating BSPs in the orthogonal direction of the two neutrons results in parallel currents of opposed signs, generating a repulsive force between the two neutrons.

14. The Stern-Gerlach Experiment and the Spin of the Electron

According to the present theory, the bending force on the valence electron of the Atom at the Stern-Gerlach experiment is the force deduced at Section 9 for Ampere bending with $v \prec c$ (Bragg bending).

We start with Eq. (60)

$$p_b = \pm\frac{1}{4}\frac{5.8731}{64\,c}\frac{h\,\nu_o}{d}\Delta l n\,,$$
$$\nu_o = 1.2373\times10^{20}\ \text{s}^{-1}\,, \quad \Delta l = 5.2843\times10^{-11}\ \text{m}\,, \tag{82}$$

and with $F_b = \frac{p_b}{\Delta_o t}$ we get

$$F_b = \pm\frac{1}{2}\frac{h}{\Delta_o t}\frac{1}{d} \quad \text{or} \quad \pm\frac{h}{2} = F_b \Delta_o t\, d\,. \tag{83}$$

The deduced bending force is inverse proportional to the distance d and independent of the intensity of the magnetic field H. At each Stern Gerlach experiment the distance d is constant resulting the splitting of the ray of atoms, which in standard theory is attributed to the two states $\pm h/2$ of the electron spins.

In what follows we will show that in the experiment of Stern-Gerlach the ray of atoms must cross a region of the magnetic field where the gradient is strong to properly work.

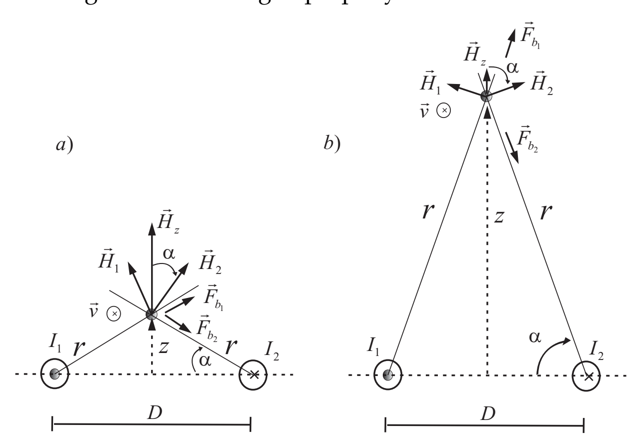

Fig. 17. Geometric relations for the magnetic field H_z generated with two parallel conductors with opposed currents.

We analyze the geometric configuration of Fig. 17, where

$$r = \sqrt{\left(\frac{D}{2}\right)^2 + z^2}\,, \qquad \alpha = \arcsin\frac{z}{r}\,,$$
$$H_z = 2\,H_i\,\cos\alpha\,, \qquad H_i \propto \frac{I_i}{r}\,. \tag{84}$$

1. With $z \ll D$ we get

$$r \approx \frac{D}{2}\,, \qquad \alpha \approx \frac{z}{r}\,, \tag{85}$$

resulting in a homogeneous field

$$H_z \propto 4\,\frac{I_i}{D}\cos\frac{z}{r} \approx 4\,\frac{I_i}{D}\,, \qquad \frac{\partial H_z}{\partial z} = 0\,. \tag{86}$$

2. With $z \gg D$ we get

$$z \approx r\,, \qquad H_z \propto 2\,\frac{I_i}{z}\cos\alpha\,. \tag{87}$$

The gradient is

$$\frac{\partial H_z}{\partial z} \propto -2\,\frac{I_i}{z^2}\cos\alpha + 2\,\frac{I_i}{z}\frac{\partial}{\partial z}\cos\alpha \neq 0 \quad \text{for} \quad \alpha \neq \frac{\pi}{2}\,, \tag{88}$$

which means that the field is inhomogeneous.

Conclusion: From Fig. 17 we see that to get opposed bending forces F_{b_1} and F_{b_2} it is necessary that z>>D as deduced in case **b)**, what implies a strong gradient of the magnetic field. With the homogeneous magnetic field of case **a)** the bending forces are nearly parallel and the ray of atoms is not split. Important to note is that the bending forces are independent of the intensity of the magnetic field and that they are not the result of the existence of a magnetic moment μ associated with the spin of the electron.

15. Spin of Level Electrons and the Formation of Elements

In Section 11 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 the two electrons in any individual orbit must have opposed spins. This is interpreted in the present model that the two electrons in any individual orbit must be of the opposed type, 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.

The concept is shown in Fig. 18.

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.

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.

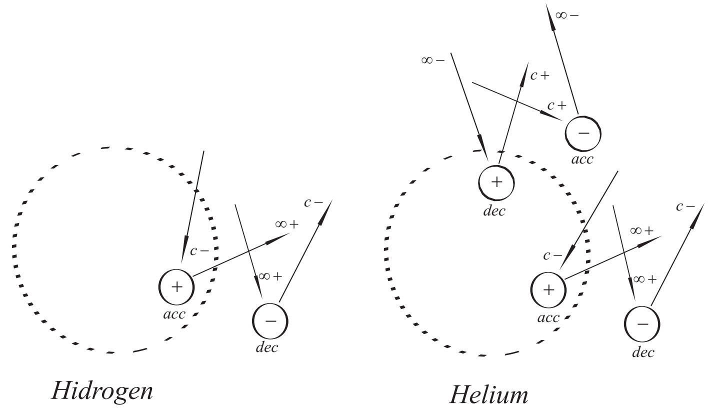

Fig. 18. Level electrons of Hydrogen and Helium Atoms.

16. Findings of the Proposed Approach

The main findings of the proposed model [6], from which the present paper is an extract, are:

- The energy of a BSP is stored in the longitudinal angular momentum of the emitted fundamental particles. The rotation sense of the longitudinal angular momentum of emitted fundamental particles defines the sign of the charge of the BSP.
- All the basic laws of physics (Coulomb, Ampere, Lorentz, Maxwell, Gravitation, bending of particles and interference of photons, Bragg) are derived from one vector field generated by the longitudinal and transversal angular momentum of fundamental particles, laws that in today's theoretical physics are introduced by separate definitions.
- The interacting particles (force carriers) for all types of interactions (electromagnetic, strong, weak, gravitation) are the FPs with their longitudinal and transversal angular momentums.
- Quantification and probability are inherent to the approach.
- The incremental time to generate the force out of linear momentum is quantized.
- The emitted and regenerating energies of a BSP are quantized in energy quanta $E_o = mc^2$.
- Gravitation has its origin in the induced momentum when BSPs that have migrated outside the nucleons are reintegrated.
- The gravitation force is composed of an induced component and a component due to parallel currents of reintegrating BSPs. For galactic distances the induced component can be neglected explaining the flattening of galaxies´ rotation curve (dark matter).
- The photon is a sequence of BSPs with potentially opposed transversal linear momentum, which are generated by transversal angular momentum of FPs that comply with specific symmetry conditions.
- The magnetic spin moment μ_s that is responsible for the splitting of the atomic beam in the Stern-Gerlach experiment is replaced by the quantized bending moment of parallel currents of electrons.

- The two possible states of the electron spin are replaced by the two types of electrons defined by the present theory, namely the accelerating and decelerating electrons.
- Permanent magnets are explained through closed energy flows stored in transversal angular momentums of FPs.
- The addition of a wave to a particle (de Broglie) is effectively replaced by a relation between the particles radius and its energy. Deflection of particles such as the electron is now a result of the quantified bending linear momentum between BSPs.
- The uncertainty relation of quantum mechanics form pairs of canonical conjugated variables between "energy and space" and "momentum and time". The general Schrödinger equation is replaced by a differential equation where the wave function is differentiated two times towards time and one towards space.
- The new quantum mechanics theory, based on wave functions derived from the radius-energy relation, is in accordance with the older quantum mechanics theory based on the correspondence principle.
- The present approach has no energy violation in a virtual process at a vertex of a Feynman diagram.
- As the model relies on BSPs permitting the transmission of linear momentums at infinite speed via FPs, it is possible to explain that entangled photons show no time delay when they change their state.

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