The Common Physical Origin of the Gravitational, Strong and Weak Forces

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Particles moving within the flux of micro-quanta filling the space have been shown to obey the Relativistic Mechanics and to undergo a gravitational "pushing" force with G depending locally on the quantum flux constants. Due to the very little quantum energy E_o , the ratio E_o/mc^2 equals about 10^{-50} so the collisions with particles follow the optical reflection accurately. The simultaneous micro-quanta hitting upon a nucleon are about 10^{50}, a high number due to the small wavelength which results close to Planck's length. Along the joining line between two particles there is a lack of incident quanta (missing beam) which determines *unbalanced* collisions generating drawing forces between particles by mutual screening. These forces increment the particle energy, as shown for instance by the heating during the gravitational contraction of the galactic gas globules leading to protostars. This mechanism allows to predict that observations of the thermal emission from major solar planets may exceed the power received from solar light. When two particles are very close, the mutual screening highly increments the missing beam, giving rise to a short-range strong force which is of the right strength to hold protons and neutrons within the atomic nuclei. The belief that nuclear forces are "self-produced" by nucleons is disproved. Proof is given for the structure of the simple Deuterium nucleus. The same process originates also a short-range "weak" force on the electron closely orbiting a proton, giving rise to the neutron structure which undergoes β^- decay. The mutual strong forces on a nucleon pair are equal, but the weak force on the bound electron differs largely from the force on the proton (breakdown of Newton's action and reaction symmetry).

Keywords: mutual screening forces, gravitational pushing force, gravitational contraction power, "strong" and "weak" short-range forces, deuterium nuclear structure, asymmetry of the weak force.

Introduction

The micro-quanta isotropic flux filling the space imposes the relativistic laws of motion on the moving particles. The frequency of an incident quantum changes in accord with the Doppler effect. A preceding paper [1] showed that a free particle with rest mass m_o and *absolute* velocity **v** moves within this flux with momentum

$$\boldsymbol{q} = m_o \mathbf{v} / (1 - \mathrm{v}^2/\mathrm{c}^2)^{1/2}$$

imposed by the simultaneous collisions with micro-quanta producing zero net force (*principle of inertia*). When the particle undergoes some external force, the relativistic inertial forces arise suddenly due to the increment $\Delta\mathbf{v}$ of the *absolute* velocity, without reference to any external frame of bodies. Let's define the absolute velocity. A hypothetical observer based on a particle might determine the direction of motion by discovering the point of the celestial vault where the frequency of the incoming quanta takes the maximum ν_M. He might also determine the *absolute* velocity through the Doppler effect

$$v = c\,[(\nu_M/\nu_o)^2 - 1]/[1 + (\nu_M/\nu_o)^2]$$

where ν_o is the quantum frequency. The possibility of establishing a theory of the inertial mass based on the interaction of particles with the micro-quanta depends on the very small quantum wavelength λ_o (which results equal to the Planck's length) giving rise to about 10^{50} simultaneous collisions upon a nucleon during the time of quantum reflection $\tau_o = \lambda_o/c$. This high continuity of collision explains why the classical inertial forces appear to originate through purely mathematical operations on time and space, which Newton prudently named *absolute* space, guessing some unknown special characteristics.

Besides the inertial forces, particles experience even at rest some particular forces from the micro-quanta interaction, namely the gravitational and the short-range drawing forces generated with the *pushing* mechanism (mutual screening). Due to the small quantum energy E_o, the ratio E_o/mc^2 is so little that micro-quanta undergo Compton scattering following accurately the *optical* reflection upon spherical particles. The lack of isotropy in the simultaneous collisions upon a particle (i.e. the missing beam along the joining line of particle pairs) determines *unbalanced* collisions which generate forces between particles at rest, as described in the following section.

Enlarging the Special relativity theory, A.Einstein derived the gravitational force from the locally modified geometry of the void space. Einstein's reasoning was rigorous in building a general theory predicting the gravitational astronomical phenomena *as observed* through light signals (photons). As a matter of fact, G.R. unified through the same mathematical formalism two physically distinct phenomena. The consensus G.R. obtained from the three classical observations in 1919 gave it the title of "gravitational theory". But Einstein was given the Nobel prize for the photoelectric effect. Recently it has been recognised [2] that the three G.R. classical proofs can be obtained from a classical Lagrangian in the ordinary space. In the last decades several experiments and new astrophysical and cosmological observations showed that G.R. is unable to give explanations. After the discovery of the neutron stars coming from supernovae collapses, the prediction of the "black holes" produced by unlimited gravitational collapse was put in doubt. Einstein was provident in assigning the velocity of light (without speaking of gravitational waves) to the gravitational interaction, but failed in accepting without criticism the Newton's *gravitational mass* paradigm conceived as "source" of gravity, which conversely simply describes the drawing force that takes place between masses in some *unspecified* manner. The *gravitational* mass (which is responsible of the unlimited gravitational collapse) received repeated shocks by the increasing accuracy of the experimental ratio between gravitational and inertial mass, which now differs from unity by less than 1 part over 10^{12}. This fact indubitably leads towards the conclusion that one of the two physical quantities is a duplicate. In any case the unshakeable Einstein's conviction that nature can be described by deterministic laws remains intact. Among many fundamental contributions he gave physics, this is probably the most important.

1.The origin of pushing gravity

Let's consider the law of the gravitational *pushing* force between a large mass *M* and a particle *m* derived from the micro-quanta paradigm [1]

$$f(r,n) = (n/a)\,\frac{GMm}{r^2} \tag{1}$$

which differs from the newtonian law due to the gravity factor (n/a) related to the mass *M*. The gravity factor equals 1 for all bodies excepting the high density celestial bodies, such as the neutron stars.

Here the equation is newly derived from a conceptually different behaviour of the colliding micro-quanta, i.e. introducing the missing beam between two particles as described in par.1.2. The experimental value of G is expressed in terms of the micro-quanta constants [1]

$$G = (2E_o/c)\,\phi_o K_o A_o^2 / 2\pi \tag{2}$$

where ϕ_o is the quantum flux, $2E_o/c$ is the momentum that a recoiling quantum gives up to the particle, $K_o = E_o/m_o c^2$ is the Compton ratio referred to the average nucleon mass m_o . This expression of G differs slightly from that in ref.1 since now the solid angle under which a particle is seen from the other is defined $\gamma(r) = \sigma/2\pi r^2$. This re-normalisation halves the quantum energy E_o. Finally the ratio

$$A_o = \sigma_i \,/\, m_{oi} \tag{3}$$

between the cross section σ_i and the rest-mass m_{oi} is assumed identical for any particle. This constant has been estimated $A_o \approx 4.7\text{x}10^{-11}$ and the radiation pressure of the micro-quanta upon any particle $p_M = E_o\phi_o/2c$ equals about $1.2\text{x}10^{61}$, as reported in [1]

Obviously this scheme implies a *theory of the mass* based on the interaction of particles with the micro-quanta, giving rise to the mass-energy model [1] of the particle i

$$m_{oi}\, c^2 = \sigma_i\, \phi_o\, \tau_o\, E_o \tag{4}$$

where $\tau_o = 2\lambda_o/c$ (i.e. the Planck's time) represents the time of quantum reflection during which the simultaneous collisions take place. From eq(4) the wavelength $\lambda_o = c^2 / 4\, A_o\, p_M$ results very close to the Planck's length. Notice that the number $N_c = \sigma\phi_o\tau_o$ of quanta simultaneously colliding upon a nucleon equals the inverse of the constant $K_o = E_o/m_o c^2$. In fact from eq.(4) one gets

$$N_c = \sigma\,\phi_o\tau_o = m_o c^2/E_o = 1/K_o \approx 2.54\text{x}10^{50}\,. \tag{4a}$$

In the following we resume (SI units) the physical constants linked to the micro-quanta paradigm, which are consistent with eqs(2), (3) and (4):

quantum energy $E_o \approx 5.9\text{x}10^{-61}$ Joule
Compton's ratio $E_o/mc^2 = K_o \approx 3.93\text{x}10^{-51}$
quantum wavelength $\lambda_o = 4.049\text{x}10^{-35}$ (Planck's length)
quantum flux $\phi_o \approx 1.22\text{x}10^{130}$ $m^{-2}s^{-1}$
simultaneous collisions upon a nucleon $N_c=1/K_o \approx 2.54\text{x}10^{50}$
nucleon cross section $\sigma \approx 7.85\text{x}10^{-38}\,m^2$.
electron cross section $\sigma_e = \sigma/1836$.

The accuracy of these constants depends on the accuracy of the constants A_o and p_M, which are known with some uncertainty. Further refinements of the theory shall lead to normalise these constants with reference to other fundamental constants of physics, with particular regard to the electromagnetism.

1.1 Gravitational shielding.

The micro-quanta generate a pushing gravity which differs in particular from newtonian gravity for the difference between "transparent" and "opaque" masses. The optical thickness [1] of a body (mass *M* and radius *R*) made of particles with cross section σ and mass *m*, is given by

$$a = \sigma M / m\pi R^2 = A_o M / \pi R^2 \tag{4b}$$

The transparency $\eta \cong e^{-a}$ of a mass is given by the ratio between the flux of *non-collided* quanta crossing the body and the incoming flux. The ordinary bodies, excluding planets and stars, are transparent to the micro-quanta, i.e. their optical thickness a<<1. In other words, a transparent mass undergoes the gravitational interaction as a sum of the individual interactions of particles.

Newtonian gravitation knows this property as the *addition* of gravitational masses (no gravitational shielding). Besides, newtonian gravity affirms the equivalence (physically absurd) between a given spherical body and the same mass placed in the centre. In pushing gravity this property holds as far as the reduction of R in eq(4b) is not so dramatic to transforms M in *opaque* mass (a>10^5) reaching density up to that of neutron stars. For large celestial bodies Van Flandern [3] considers the phenomenon of gravitational shielding to be sensible.

1.2 The quantum gravitational pushing force

Assuming for simplicity the gravity factor (n/a) =1, let's now substitute G in eq.(1) and rearrange it to write the gravitational pushing force along the joining line of two nucleons with cross section σ

$$f(r) = (2E_o/c)\, K_o(\sigma\phi_o)\, (\sigma/2\pi\, r^2) \tag{5}$$

where $\sigma\phi_o$ is the collision rate on the nucleon and $\gamma(r) = \sigma/2\pi r^2$ is the thin solid angle of a particle when seen from the other. The above equation may be interpreted in two physical ways.

The **first picture** considers the micro-quanta as the smallest kind of quanta, since their energy cannot be further reduced. Recalling from eq(4) that $\sigma\phi_o = N_c/\tau_o$, eq(5) becomes

$$f(r) = (2E_o/c\tau_o)N_c\, \gamma_k(r) \tag{6}$$

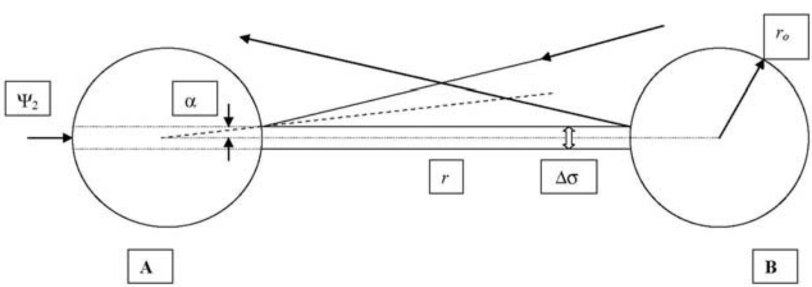
where $\gamma_k(r) = (\sigma K_o/2\pi r^2)$ is the very thin solid angle within which any particle *does not receive* quanta from others. This equation shows formally that the gravitational pushing force is due to the momentum given up in the time τ_o by $N_c\gamma_k(r)$ quantum collisions *which result unbalanced* due to the lack along the joining line of the beam

$$\psi_g(r) = N_c\, \gamma_k(r) / \tau_o = \gamma(r) / \tau_o \quad \text{quanta/sec.} \tag{7}$$

This beam is forbidden by the *optical* reflection law upon spherical surfaces. In fact quanta would have to do many "guided" optical collisions between two particles (a extremely rare event) before finally travelling *along* the joining line (see Fig.1). Of course the pushing force is due to a beam equal to $\psi_g(r)$ which hit the particle on the opposite side. To give an idea of the missing beam strength, a pair of nucleons distant about 306 m. (that is a ultra rarefied hydrogen gas) shows $\psi_g(r) = 1$ quantum/sec. Between a nucleon on the Earth and a nucleon on the Sun the gravitational force would be due, on the average, to a missing beam $\psi_g(r) = 1$ quantum/10^{10}y, creating some temporal problems. However between each nucleon of the Earth and all nucleons of the Sun the total missing beams amount to 10^{90} quanta/second, thus restoring the proper balance. Analogously, between the usual masses of a laboratory gravitational balance the missing beams amount to about 10^{63} quanta/sec. These numbers are adequate to generate the observed gravity.

The **second picture** interpreting eq.(5) is to assume the hypothesis, as reported in [1], that quantum energy loses at any collision a fraction $\Delta E = E_n - E_{n+1} = K_o E_o$, where $K_o \approx 10^{-50}$. In this case, quanta hitting *both* particles make *one more* collision than those scattered by

Fig.1 – Optical reflection of micro-quanta on particles.



only one particle. The momentum given up by E_o and E_1 recoiling after hitting a particle on opposite sides along the joining line of a pair is

$$\Delta q = (E_o + E_1)/c - (E_1 + E_2)/c\,.$$

Then the gravitational force

$$f(r) = (\Delta q/\tau_o)\mathrm{N}_c\gamma(r)$$

after substitution becomes

$$f(r) = (2K_oE_o/c\,\tau_o)N_c\gamma(r) \qquad (8)$$

which results equal to eq.(6).

However this conceptual picture implies a universe evolution characterised by degradation of the quantum energy. The decrement of energy is not the major handicap, because a quantum penetrating an ordinary star makes about 60-500 collisions before escaping. Only a very dense neutron star compels quanta to make $10^{11} \div 10^{12}$ collisions before escaping. Even considering the probability that a quantum might encounter several neutron stars, the quantum energy reduction during the life of the universe remains very small. The very objection against the energy degradation is that it could take place if micro-quanta were complex objects (like photons) losing energy in ordinary Compton's collisions.

1.3 May micro-quanta transfer energy to matter ?

In general a quantum with momentum $|\boldsymbol{q}| = E_o/c$ colliding consecutively with two particles, undergoes in the last collision a deviation θ from its trajectory, so the change $\Delta\boldsymbol{q}_r$ of momentum along the joining line is

$$\Delta q_r = (E_o/c)(1 - \cos\vartheta)\,. \qquad (9)$$

The N_c simultaneous collisions uniformly hit a spherical particle, so the sum of the momenta $\Delta \boldsymbol{q}_{\perp}$ released orthogonally to the joining line is zero. The collisions give rise only to radial forces through the mechanism of *unbalanced* collisions due to the missing beam $\psi_g(r)$ along the joining line. The momentum released $\Delta q_r = 2(E_o/c)$ by an unbalanced recoiling collision ($\cos\theta = -1$) implies a transfer of energy to the particle *even if* the quantum energy E_o does not change. The inter-particles pushing force $f(r)$ (see eq.6) arises from the unbalanced collisions. During the quanta *reflection* (i.e. the collisions with the e.m. field of the particle) the work done by the pushing force $f(r)$ along the distance $(c\tau_o)$ is given by

$$\Delta L = \int f(r)\mathrm{d}r \cong f(r)(c\tau_o) = 2E_o N_c \gamma_k(r).$$

Recalling that $\gamma_k(r) = K_o\gamma(r)$ and $K_o N_c = 1$, one gets that in the time τ_o the quanta gives up each particle the energy

$$\Delta L = 2E_o\gamma(r)\,. \tag{10}$$

This happens *without* change of E_o. Hence the first way of interpreting eq(5) appears to be more in accordance with the natural phenomena.

2. Power of gravitational contraction

During the gravitational contraction, the work done by the pushing gravitational force compresses and makes the celestial bodies hot as happens, for instance, to the galactic gas globule leading to a future star. In a general way, the contraction of a body depends on the contraction of the volume Δx^3 pertaining to each particle.

Two adjacent nuclei at a distance $\Delta x = (m_N/\delta)^{1/3}$, where $m_N = (Z+N)m$ is the nuclear mass and δ is the local density, undergo the self-gravitational force given by eq(6) when the pair is placed *orthogonal* to the radial direction, because the high gravitational force of the body does not create a tidal force between them. The presence in general of the radial tidal force complicates the problem, but does not substantially alter the result. Assuming this case, each nucleon receive in the time $2\tau_o$ from micro-quanta a gravitational energy ΔL given by eq.(10) which generates the contraction power

$$\mathrm{P}_{gi} = 2E_o\gamma(r)/2\tau_o = (E_o/\tau_o)(\sigma_i/2\pi r_i^2) \qquad (12)$$

Substituting the average distance between nuclei $r_i = \Delta x$, one may specialise the term

$$(\sigma_i/2\pi r_i^2) = (\sigma_N/2\pi\,\Delta x^2) = (\sigma_N\delta^{2/3}/2\pi\,m_N^{2/3}) \qquad (12b)$$

where σ_N is the nucleus cross section. The atomic nuclei, in spite of its high density, are transparent to the micro-quanta since the optical thickness

$$a_N = A_o m_N/\pi r_N^2 \approx 10^{-6}$$

is much less than unity for all nuclei . Then we have $\sigma_N \cong (Z+N)\sigma$ and by consequence $\sigma_N/m_N \cong (\sigma/m) = A_o$.

To calculate the total power of contraction we have to sum the contribution $P_{gi}(r) = (E_o/\tau_o)A_o\, m_N^{1/3}\,\delta^{2/3}(r)/2\pi$ of the nuclei comprised in the elementary shell $dN(r) = 4\pi r^2 dr\,\delta(r)/m_N$ and then to integrate to the body volume. Performing the operations one gets the gravitational contraction power

$$P_g = (E_o A_o/2\pi\,\tau_o m^{2/3})\int_o^R 4\pi r^2\delta^{5/3}(r)\,dr\,/\,[Z(r)+N(r)]^{2/3}\,. \qquad (13)$$

The numerical calculation with eq(13) requires to know the internal density of the body, as well as the local number of nucleons per atom.

In contrast with the classical gravitational contraction, which follows a very complicate process in the absence of the micro-quanta paradigm, eq(13) appears simple.

To the aim of making some comparisons without knowing the internal structure, we made quick calculations of the heat flows escaping from the Earth and other planets, observing that in eq(13) the ratio $\xi(r) = \delta^{2/3}(r)/[Z(r)+N(r)]^{2/3}$ varies slowly along the radius, since the density is proportionally linked to the number of nucleons. Then it appears acceptable to substitute $\xi(r)$ with the number $\xi_x = [\delta_{av}/(Z+N)_{av}]^{2/3}$ calculated with averaged quantities

$$P_g \approx (E_o A_o / 2\pi\, \tau_o m^{2/3})\, \xi_x \int_o^R 4\pi r^2 \delta(r)\, dr \ .$$

This assumption should give an accuracy better than 10% .

Substituting the numerical quantities we find

$$P_g \approx 2.36\text{x}10^{-11} M[\delta_{av}/(Z+N)_{av}]^{2/3} \qquad (14)$$

where M is the body mass. Whenever this relationship does not work well, one can better use eq(13). Eq(14) allows us to make quickly some comparisons with the results obtained from internal structure models available in literature, as reported in the following table.

Table 1 – Some calculations of gravitational contraction power (watt)

	From eq.14	From literature
- Earth	$P_g \approx 4.5\text{x}10^{15}$	$4.42\text{x}10^{13}$ [4]
- Mars	$\approx 3.6\text{x}10^{14}$	-
- Jupiter	$\approx 1.7\text{x}10^{18}$	-
- Saturn	$\approx 3.2\text{x}10^{17}$	$3.05\text{x}10^{17}$ [5]
- Uranus	$\approx 5.1\text{x}10^{16}$	$3.4\text{x}10^{14}$ [6] [7]
- Neptune	$\approx 7.2\text{x}10^{16}$	$6.5\text{x}10^{15}$ [7]

The calculated contraction power P_g of the giant planets results just comparable to that coming from internal structure models, as in the case of Saturn [5]. Models for Mars and Jupiter appear lacking.

The contraction power of the Earth, as currently calculated through the heat flux measured from boreholes and wells in the outer crust (excepting the seafloor, accounting for 71% of the crust) equals $4.42x10^{13}$ watt [4]. In contrast, the calculated P_g is about one hundred times greater.

This situation is repeated for Uranus, whose observed thermal emission [5] exceeds the absorbed solar energy of only 6%, equivalent to an internal heat flow of $3.4x10^{14}$ watt, that is 1/150 of the contraction power P_g . This result does not astonish since specific studies suggest that Uranus presents a discontinuity of the internal density [7], probably near the surface, which constitutes a barrier to the internal heat flow. The case of Neptune is somewhat similar because the observed heat flow is 9% of the theoretical P_g , but it does not probably require to assume a discontinuity [7]. The problem now is : may the little heat flow from the Earth crust (1% of the theoretical value) be due to the Mohorovich's discontinuity at 10-60 km under the surface? In any case the remaining 99% of the generated heat flow must anyway escape from the internal mantle, if we do not accept that internal Earth temperature is continuously increasing.

A possible explanation of the mystery may come from the current assumption that heat flux from the seafloor is mainly due to heat conduction across the lithosphere whose age exceeds 10÷20 million years [4]. The author makes clear that younger lithosphere (1 million years) shows heat fluxes higher than 250 w/m^2, compared with the average 101 w/m^2 computed for the whole ocean seafloor. She also reports that the hydrothermal circulation, which takes place when the seafloor cracks, is a very active mechanism with heat fluxes well over 10^3 w/m^2. However it is currently taken for granted that the new lithosphere continuously forming from the hot mantle, for instance to enlarge the Mid Atlantic Ridge at a rate of 2.5 cm/y, does not sensibly contribute through the hydrothermal mechanism. This unsatisfying situation might open a new area of searching. Let's recall that 8-9 earthquakes of magnitude higher than 4 are everyday detected [8], some of them resulting in a fracture of the seafloor which gives rise to active hydrothermal circulation. The observed large tsunami may be mostly considered coming from the *exploding* hydrothermal contact of magmas (giant vapour bubbles) at a depth less than 2180 m, corresponding to the critical pressure of water. The numerous fractures of lithosphere at a depth higher than 2180 m. do not show tsunami because the supercritical vapour produced by magma has the same density of water and cannot produce bubbles. To give an idea of the heat flow from the mantle, the earthquake of the large tsunami of 26 Dec. 2004 in the Indian Ocean showed a total energy $M_w \approx 4 \times 10^{22}$ J [8] equivalent to 30 times the currently estimated annual Earth heat flow .

3. The origin of the strong force

The possibility that a short-range strong force can arise between particles through the interaction with micro-quanta has been shown [9] by theoretical reasoning assuming the conservation of energy in the collision process with particles. The plain description in the preceding paragraph of the gravitation mechanism between two particles encourages to attempt the same way to explain the origin of the strong force. Eq(7) shows that the missing beam $\psi_g(r)$, originating the gravitation force between two particles, depends on the thin solid angle

$$\gamma_k(r) = \sigma K_\mathbf{o} / 2\pi r^2$$

within which any particle does not receive quanta *along* the joining line.

It appears natural to analyse the physical conditions which determine in general a lack of quanta reflection along the joining line.

Let's now consider the reflection of quanta hitting the small fraction of cross section $\Delta\sigma = \pi\varepsilon^2$ upon the line joining two nucleons considered as spherical particles (Fig.1).

Let's now calculate the ratio $\Delta\sigma/\sigma$. Putting r_o the radius of the particle having cross section $\sigma = \pi r_o^2$, from Fig.1 one gets

$$\varepsilon = \alpha\, r_o \,, \quad \text{where the angle} \quad \alpha \cong r_o/2r.$$

It follows that

$$\Delta\sigma = \pi\varepsilon^2 = \pi\, r_o^4/4r^2 = \tfrac{1}{2}\,\sigma\gamma(r) \tag{14a}$$

where $\gamma(r) = \sigma/2\pi r^2$. The beam of quanta scattered by nucleon B and hitting the region $\Delta\sigma$ on the nucleon A is

$$\psi_1(r) = \Delta\sigma\, \phi_o \gamma(r)\,.$$

A negligible number of quanta hitting *the periphery* of $\Delta\sigma_A$ is optically reflected *parallel* to the joining line (Fig.1), hit the nucleon B and are reflected away. The beam $\psi_1(r)$ hitting the interior of $\Delta\sigma_A$ is reflected on the whole cross section of nucleon B. If the reflection were *uniform* upon σ, the small beam hitting $\Delta\sigma_B$ would be

$$\psi_2(r) \cong \psi_1(r)\,(\Delta\sigma/\sigma)$$

which, considering eq.(14a), becomes

$$\psi_2(r) \cong \tfrac{1}{2}\,\Delta\sigma\,\phi_o\,\gamma^2(r)\,. \tag{15}$$

But the reflection law reduces the beam on $\Delta\sigma_B$ to the small beam $\psi_3(r) \approx \Delta\sigma\,\phi_0\gamma^3(r)$ which is negligible respect to $\psi_2(r)$ since $\gamma(r) \ll 1$.

Considering that $\psi_2(r)$ does not reach any particle along the joining line of a pair, it appears that $\psi_2(r)$ is the *missing* beam that gives rise to the pushing strong force between nucleons through the unbalanced collisions. In fact the real beam $\psi_2(r)$, symmetrically opposite (Fig.1) to the missing $\psi_2(r)$, gives rise following the structure of eq.(6) to the strong force

$$\Phi(r) = (2E_o/c)\,\psi_2(r) = (E_o/c)\Delta\sigma\,\phi_o\gamma^2(r)\,. \qquad (16)$$

Substituting $\Delta\sigma$ and recalling that $\sigma\phi_o = N_c/\tau_o$ one finally gets the short-range strong force

$$\Phi(r) = ½\,(E_o/c\tau_o)N_c\gamma^3(r) \qquad (17)$$

Comparing with the gravitational force between a pair of particles

$$f(r) = (2E_o/c\tau_o)\,\gamma(\mathrm{r})$$

one gets that $\Phi(r) = f(r)$ when $2 = ½\,N_c\,\gamma^2(r)$, that is when

$$1/N_c = ¼\,(\sigma/2\pi r^2)^2 \approx 3.93\mathrm{x}10^{-51} \qquad (18)$$

which occurs at a distance $r \approx 2\mathrm{x}10^{-7}$ m.

At lower distances the missing beam produces the strong force, at higher distances produces the gravitational force.

The electric force between protons equals everywhere about 10^{39} times the gravitational one. The strong force, working in the nucleus, is negligible at distances greater than atomic radii, where electromagnetic forces largely predominate. For instance, at a distance of 0.53 Angstrom (Hydrogen atom) $\Phi(r)$ equals about 10^{-17} times the electrical force.

It is known that the strong force within nuclei exceeds many times the repulsive Coulomb's force between two protons distant about a half of the *average* distance between nucleons

$$d_n = (m/\delta_N)^{1/3} \approx 3.8\text{x}10^{-16}$$

(where δ_N is the nuclear density) showing the "chain" structure - nucleon by nucleon - of the force holding the nuclei. On the other hand the strong force is roughly balanced by the electrical force when the distance between protons equals d_n . Let's put eq.(17) in the more suitable form

$$\boldsymbol{\Phi}\,(r) = \sigma\, p_M\, (\sigma / 2\pi\, r^2)^3 \tag{17a}$$

where $\sigma \approx 7.85\text{x}10^{-38}$ is the nucleon cross section and $p_M \approx 1.2\text{x}10^{61}$ is the radiation pressure of micro-quanta upon particles [1]. The above mentioned balance then becomes

$$\boldsymbol{\Phi}\,(d_N) = \sigma\, p_M\, (\sigma / 2\pi\, d_n^{\,2})^3 \approx e^2/4\pi\varepsilon_o d_n^{\,2}$$

which, substituting the numerical quantities, shows the left side roughly equals the right side, as expected.

Recently a team of researchers [10] studying the low energy elastic H-D_2 collisions has discovered that the D_2 molecule undergoes vibrations caused by *extension* (not compression) of the D-D bond through interaction with the passing H atom. This proves that an unexpected strong attraction develops between grazing nuclei. According to its definition, the strong force $\boldsymbol{\Phi}(r)$ overcomes the proton electric repulsion when the distance between the H-D grazing nuclei becomes lower than 4 $\text{x}10^{-16}$ m. Obviously, this could be better observed with high energy H protons.

Note on a possible experiment. The generation of the strong force between nucleons is similar to the process generating the electromagnetic radiation pressure upon two facing macroscopic reflecting spheres of little weight immersed in a uniform photon flux, provided the number of simultaneous collisions is very high. The mutual shielding of spheres may give rise to a detectable pushing force when the photon flux and the sphere radius are adequate.

3.1- The nuclear structure of Deuterium

The simplest compound nucleus is Deuterium, a stable isotope with 1 proton and 1 neutron. The nucleons are bound by the strong force $\Phi(r)$, but the proton feels also the electromagnetic Lorentz force due to the neutron magnetic moment $\Im_n = 1.912\mu_B = 9.66\text{x}10^{-27}$ which generates the magnetic field

$$B_n = (\mu_o/4\pi)(\Im_n/r^3).$$

It has been shown [1] that particles moving within the micro-quanta flux undergo the relativistic mechanics. Adopting the correct centrifugal force, the relativistic equation of forces on the neutron is

$$\Phi(r) = \sigma\, p_M\, (\sigma/2\pi r^2)^3 = m_o\, \mathrm{v}_n^{\,2}/r_n\, \beta_n \tag{18}$$

whereas the equation for proton is

$$\sigma\, p_M (\sigma/2\pi r^2)^3 \pm e\mathbf{B}_n \times \mathbf{v}_p = m_o \mathrm{v}_p^{\,2}/r_p \beta_p \tag{19}$$

where: m_o/β_i denotes the relativistic mass of each particle, r is the distance between particles, $r_n = xr$ and $r_p = (1\text{-}x)r$ are the orbital radii of neutron and proton. Finally $\mathrm{v}_n = \omega xr$, $\mathrm{v}_p = \omega(1\text{-}x)r$ are the nucleon and proton velocities. Recalling that $\mathrm{v}_n = \mathrm{v}_p\, x/(1\text{-}x)$ and substituting the numerical quantities one gets, after putting $\mathrm{v}_n^{\,2} = c^2 (1-\beta_n^{\,2})$,

$$1.836\times10^{-90}/r^5 = m_o c^2 (1-\beta_n^{\,2})/x\beta_n \tag{18a}$$

$$1.836\times10^{-90}/r^5 \pm 1.545\times10^{-52}\,\mathrm{v}_p/r^2 = m_o \mathrm{v}_p^{\,2}/(1-x)\beta_n \tag{19a}$$

Since the electromagnetic force is considerably less than the strong force $\Phi(r)$, it appears that the orbits of the two nucleons are very similar ($r_n \approx r_p$) and by consequence the velocities are also similar. Thus the problem is to calculate the exact value of x, which is close to ½ corresponding to perfect symmetry. An exact analysis shows that $(1-x)^2/x^2 = (1-\beta_p^2)/(1-\beta_n^2)$ and the difference between the two orbits is very little $\Delta r / r = \Delta x / x \cong 7.8\text{x}10^{-3}$, so that $x \cong ½$ and by consequence $\beta_p \cong \beta_n \cong \beta$. Taking this in mind, let's rearrange eq(18a) to show the orbit as a function of β

$$r^5 = 0.612\times10^{-80}\beta/(1-\beta^2)\,. \qquad (20)$$

To the aim of calculating the term $(1-\beta^2)$ we need the velocity v_p. An expression of v_p can be obtained solving the 2nd degree eq(19a). Being the magnetic force a few percent of other terms, we may put $\beta_p \approx 1$ (as it can be later verified) thus obtaining

$$v_p \cong 2.34\times10^{-32}/r^{5/2} \pm 2.31\times10^{-26}/r^2 \qquad (21)$$

where the second term results about 1% of the first.

Then we calculate

$$v_p^{\ 2} \cong 5.475\times10^{-64}/r^5 \pm 1.08\times10^{-57}/r^{9/2}$$

which gives

$$1-\beta^2 \cong 0.612\times10^{-80}/r^5 \pm 1.2\times10^{-74}/r^{9/2}\,.$$

Substituting in eq(20) one gets

$$\beta \cong 1 - 1.96\times10^6\, r^{1/2}$$

and finally we obtain the orbit diameter

$$r \cong 1.65\times10^{-16} \qquad (22)$$

of the pair constituting the nucleus of Deuterium.

More complex nuclei are probably made of groups of alpha-particles, which are the most massive particles coming from natural disintegration of nuclei. The distance between the 4 nucleons of alpha-particles should be of the same order of the orbit of Deuterium.

This vision appears to be reinforced by a recent research of a team [11] reporting that scattering experiments, where a proton is knocked out of the nucleus, show that within carbon-12 the proton-neutron pairs are nearly 20 times as prevalent as the proton-proton pairs.

Methodological note. The centrifugal force in eqs(18) is written in the most general way, without recourse to the angular momentum $\hbar$ which characterises the electron orbit in the Hydrogen atom.

It has been shown that the relativistic centrifugal force

$$F_c = m_o \mathrm{v}^2/\beta\, r = (m_o/\beta)\, \omega^2 r$$

on a particle in circular motion depends on the interaction with the flux of micro-quanta [1]. The corresponding angular momentum C_i is constant (due to the pure radial forces) for each particular orbit. But C_i is in general not known. *A priori* there are no reasons by which the nucleons mutually orbiting within nuclei have the same angular momentum of the electron in the Hydrogen atom.

To make a comparison with the preceding study, we assume for two mutually orbiting nucleons the angular momentum

$$m_o\, \mathrm{v}_n r_n = \hbar$$

and substitute in the centrifugal force of eq(18)

$$m_o\, \mathrm{v}_\mathrm{n}^2/r_n = \hbar^2/ m_\mathrm{o}\, r_n^3.$$

Recalling that $r_n \cong r/2$, one finally obtains

$$1.836\mathrm{x}10^{-90}\, \beta_n / r^5 = 8\, \hbar^2/ m_o\, r^2.$$

Coherently, by definition we have

$$\beta_n^{\,2} = 1 - 4\hbar^{\,2} / m_o^{\,2}\, c^2\, r^2$$

which, substituted in the above equation, leads to an equation for r without real solutions.

From the preceding study about deuterium one may get the numerical value of the angular momentum pertaining to each nucleon

$$m_o\, \mathrm{v}_n\, r_n \cong 9.2\mathrm{x}10^{-36}$$

which is about 12 times lower than $\hbar$.

4- The asymmetry of the self-screening forces

Newton's original formulation of *"equality between action and reaction"* related to the force exchanged by two bodies. The strong force between two equal particles satisfies this rule. But different interacting particles do not satisfy the force symmetry. Considering a pair proton-electron, the mutual-screening "weak" force acting on the electron

$$\Psi_e(r) = \sigma_e\, p_M\, (\sigma_p / 2\pi\, r^2)^3 \tag{23a}$$

is 1836 times weaker than the nucleon-nucleon force, since σ_e is 1836 times smaller than σ_p . On the other hand, the force acting on the proton

$$\Psi_p(r) = \sigma_p\, p_M\, (\sigma_e / 2\pi\, r^2)^3 \tag{23b}$$

results $(\sigma_p / \sigma_e)^2 = (m_p / m_e)^2 = 1836^2$ times lower than $\Psi_e(r)$.

This fact breaks the Newton's law on the equality of action and reaction. The "weak" force $\Psi_e(r)$, together with the electromagnetic one, binds the pair electron-proton to form a neutron. The bound electron has high kinetic energy at detachment from orbit originating the β^- decay. The observed energy of β^- particles results slightly lower than expected. Besides β^- particles show an energy spectrum which was considered incompatible with the expected monochromatic emission. These facts were assumed as a proof of the existence of neutrino.

5. The reasons for a new physical paradigm

It is a matter of history that in the 1933 Solvay's conference W. Pauli announced with some reluctance his hypothesis about the neutrino.

The present explicit definition of the weak force $\Psi_e(r)$ gives new insight on the uncoupling of the tightly bound electron. This might produce a re-examination of the reasons for neutrino proposal.

As a matter of fact, the neutrino characteristics have not been definitely established after 70 years. Several kinds of neutrinos with different energy have been proposed to explain the experiments, while from a theoretical standpoint it has been concluded [12] that the "*Majorana neutrinos are in general expected to run (significantly) faster than Dirac neutrinos*".

The described common origin from the paradigm of micro-quanta of the "strong" and "weak" forces, together with the gravitational and inertial forces, points out the opportunity of re-interpreting current methods of conceiving the nuclear forces between nucleons and other particles.

In his recent book "The trouble with physics" L. Smolin [13] discussed five great problems of physics. He defines the "standard" model of particles as "*the theory that accounts for all of these particles and for all of the forces, excepting gravity. [...] For all its usefulness, the standard model has a big problem: it has a long list of adjustable constants*". Smolin concluded that an urgent problem of physics is *"to explain how the values of the free constants are chosen in nature"*.

Some unsatisfying situations of experimental physics arise from the troubles existing in pure theory. Smolin affirms that another conceptual big problem - the foundations of quantum mechanics - must be resolved "*either by making sense of the theory as it stands or by inventing a new theory that does make sense*".

The second suggestion had a clear formulation in the paper of M.Cini [14] discussing the proposal of "*pursuing a line of research which takes for granted the irreducible nature of randomness in the quantum world. This can be done by eliminating from the beginning the unphysical concept of wave function*".

While classical physics shows the unacceptable negative gravitational energy, current physics support the unphysical concept of "black hole" and appears unable to explain the astronomical observations which gave rise to the concepts of "dark mass" and "dark energy". The vagueness of these concepts may be due however to the fact that the related physical phenomena are not yet deeply known. Also the recently observed galactic obscure supermasses may constitute sometimes a problem. For instance, the obscure body of 2.6 million Sun masses, individuated [15] in the nucleus of the Milky Way, can hardly be explained by means of newtonian accretion [1] of galactic gas upon a neutron star during the *standard* age of the universe (Big bang).

Very interesting, according to L. Smolin, is to question ourselves about the possible breakdown of Special relativity due to the structure of the so called "void" space. In connection with the theoretical GZK energy cutoff, new studies [16] about the observation of the extremely high energy cosmic rays and γ-ray bursts put the problem of a theoretical limit to this energy, whereas Special relativity, assuming the void space, assigns no limit. A Japanese experiment (AGASA) has detected cosmic rays with energy up to 30-50 Joule which ruled out the GZK cutoff. Considering the experimental uncertainty, a new experiment (Auger) is now operating in the pampas of Argentina. The near future will establish if special relativity is fully accurate or if an upper energy limit exists as predicted by the micro-quanta paradigm.

References

[1] M.Michelini, A flux of Micro-quanta explains Relativistic Mechanics and the Gravitational Interaction, *Apeiron*, Vol.14, April 2007, http://redshift.vif.com

[2] P.Wagener, *Progress in Physics*, Vol.3, 21-23 (June 2008)

[3] T.Van Flandern Possible new properties of gravity*, Astrophysics and Space Sci*., 244, 249-261 (1996)

[4] Carol A. Stein, Heat flow of the Earth, *Global Earth Physics*, American Geophysical Union, 1995

[5] J.J. Fortney, Looking into the giant planets, *Science*, Vol. 305, N.5689, pp 1414 (2004)

[6] J.C. Pearl, B.J. Conrath, *et al*., *Icarus*, Vol.84, 12-28, March 1990

[7] M.Podolak, J.Podolak, M.S.Marley, *Amer. Astron. Soc. Bulletin*, Vol.29, p.994 (1997)

[8] US Geological Service - *Measuring the Size of an Earthquake.*

[9] M.Michelini, arXiv: physics/0509017, (2005)

[10] S.J.Greaves, E.Wrede, *et al*., *Nature*, 454, 88-91, (July 2008)

[11] R.Subedi, R.Shneor, *et al*., *Science*, Vol.320,1476-1478, (2008)

[12] Zhi-Zhong Xing, He Zhang, *Electronic J. Theor. Physics*, Vol.10, 191-209, (2006)

[13] L. Smolin *The trouble with Physics*, Houghton Mifflin Company, Boston, New York, 2006

[14] M. Cini, Electronic *J. Theor. Physics*, Vol.13, 1-10, (2006)

[15] R.Schoedel, T.Ott *et al*., *Nature*, **419,** 694-696 (2002)

[16] S.Coleman, S. Glashow, arxiv:hep-ph/9808446

Historical Note

"*The core of the Almagest (originally Mathematiké Syntaxis) written by Claudius Ptolemy in II century A.D. is the mathematical description of the motion of the Sun, Moon and the five planets known at the epoch. For each celestial body he developed* *a theory capable of describing and predicting with notable accuracy the position of planets visible to the naked eye. To obtain this result, Ptolemy considered the uniform circular motion centred on the Earth together with three other possible motions*

- *eccentrics, that is circular orbits not centred on the Earth*
- *equants, circular motions not uniform since the angular velocity is constant respect a point (equant) different from the orbital centre*
- *epicycles: circular orbits around a point which describes a circular motion around the Earth.*

Since Ptolemy was interested only in the angular co-ordinate of the celestial bodies and not in the variation of their distances, he did not attempt to explain the variation of the planet luminosity, which in some cases was evident." [Quoted from a scientific Encyclopaedia]

This story shows one of the highest teachings of experience in the history of science. The knowledge of the heliocentric theory would have greatly simplified the Ptolemy's work. In a certain sense, his story may help to solve our problems.