Unification of Gravitational, Strong, Weak and Inertial forces.

Maurizio Michelini
ENEA, Casaccia Research Centre, Rome, Italy
m_michelini@alice.it

A preceding paper showed that particles moving within a flux of microquanta (filling the space) obey the Relativistic Mechanics and undergo a newtonian-like pushing gravity with *G* depending on the quantum flux constants. Due to the very little quantum energy *E*, the ratio *E*/*mc2* is very little, so microquanta follow accurately optical reflection in the Compton's collision with particles. The number of microquanta simultaneously hitting upon a nucleon is very high due to the small quantum wavelength, which equals the Planck's length. Along the joining line of two particles there is a lack of incident quanta (missing beam) which determines *unbalanced* collisions generating a force between them. The pushing gravity increments the particle energy (through the microquanta collisions) during the contraction of the galactic gas globules leading to protostars. This mechanism predicts that observations of the thermal emission power for major solar planets will 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. Considering the microquanta constants, this force is of the right order to hold protons and neutrons within the atomic nuclei. The old belief that nuclear forces are produced by the nucleons is discarded. Proof is done of the structure of the Deuterium nucleus. The same process originates also a short-range weak force on the electron closely orbiting a proton, thus originating the neutron structure. While the mutual forces on a nucleon pair are equal, the weak force on the electron differs from the force on the proton (breakdown of Newton's action and reaction symmetry).

Introduction

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

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

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 without interaction with any external material frame. 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 is maximum. 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_M is the maximum frequency observed and 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 temporal continuity of collision explains why the classical inertial forces appear to originate through purely mathematical operations on the *void* 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 strong forces generated with the *pushing* mechanism. Due to the small quantum energy E_o, the ratio E_o/mc^2 is so little that micro-quanta undergo a Compton's scattering equivalent to the *optical* reflection upon spherical particles. The lack of isotropy in the simultaneous collisions (i.e. the missing beam along the joining line) determines *unbalanced* collisions which generate forces between particles even at rest, as described in the following section.

Enlarging the Special relativity theory A.Einstein was able to derive the gravitational force from the modified geometry of the void space.

Einstein's reasoning was rigorous in establishing a general theory to the aim of predicting the gravitational astronomical observations via light signals. He was also provident in assigning the velocity of light (without speaking of gravitational waves) to the gravitational interaction, but failed in accepting without criticism the *gravitational mass* paradigm denoting the property of masses to attract each other in some *unspecified* manner. The *gravitational mass* concept 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 concepts is a duplicate.

In any case, the unshakeable Einstein's conviction that nature can be described by deterministic laws remained intact. Among many contributions he gave physics, this is probably the most important.

1. The origin of the gravitational interaction

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

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

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 [1]. Of course the experimental *G* is expressed in terms of the micro-quanta constants generating the pushing gravitational force

$$G = 2E_o\phi_oK_oA_o^2/2\pi c = 2\,p_M\,K_oA_o^2/\pi \qquad (2)$$

where $2E_o/c$ is the momentum that a recoiling quantum gives up to the particle. This *G* differs from that in ref.1 since now recoiling quanta are considered which travel along the joining line of two particles. Besides, the solid angle under which a particle is seen from the other is now defined as $\gamma(r) = \sigma/2\pi r^2$. In eq(2) $p_M = E_o\phi_o/2c$ is the radiation pressure of the quanta upon any particle , $K_o = E_o/(m_o + m_e)\,c^2$ is the Compton ratio referred to the proton+electron mass for neutral matter, ϕ_o is the quantum flux. This re-normalisation halves the quantum energy E_o . Finally the ratio between cross section σ_i and rest-mass m_{oi}

$$A_o = \sigma_i / m_{oi} \qquad (3)$$

is assumed identical for any particle. This constant has been estimated $A_o \approx 4.7\text{x}10^{-11}$, whereas the constant $p_M \approx 1.2\text{x}10^{61}$, 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 of the particle *i* [1]

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

where $\tau_o = \lambda_o/c$ (i.e. the Planck's time $1.35\text{x}10^{-43}$ s) represents the time during which the simultaneous collisions take place. Notice that the number $N_c = \sigma\,\phi_o\,\tau_o$ of quanta simultaneously colliding upon a nucleon equals the inverse of the constant $K_o = E_o/m_oc^2$. In fact from eq.(4) one gets

$$N_c = \sigma\,\phi_o\tau_o \cong 1/K_o \approx 2.54\text{x}10^{50}\,. \qquad (4a)$$

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

- Compton's ratio $K_o \approx 3.93\text{x}10^{-51}$
- quantum energy $E_o \approx 5.9\text{x}10^{-61}$ Joule
- 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 $\sigma \approx 7.85\text{x}10^{-38}\,m^2$.

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.

The 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 spherical body (mass *M* and radius *R*) made of particles with cross section σ and mass *m* , is given by

$$a = \sigma M / m\pi R^{2} = A_o M / \pi R^{2}. \qquad (4b)$$

The ordinary bodies, excluding planets and stars, are transparent to the micro-quanta, i.e. their optical thickness *a* <<1. In other words, each transparent mass undergoes the gravitational interaction as a sum of the individual particles.

Newtonian gravitation knows this property as the theorem of summation of gravitational masses . The equivalence between a given spherical mass and the same mass compressed at a certain degree in the centre, holds as far as the reduction of *R* in eq(4b) transforms *M* in opaque mass ($a>10^5$). For high density celestial bodies the phenomenon of gravitational shielding may become sensible [1,2].

The quantum gravitational force

Let's now substitute *G* in eq.(1) and rearrange to write the gravitational pushing force between two nucleons of cross sect

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

where $\sigma\phi_o$ is the collision rate on the nucleon and $\gamma(r) = \sigma/2\pi r^2$ is the thin solid angle by which a particle is seen from the other. The above equation may be interpreted in two physical ways. Considering the micro-quanta as the *smallest* kind of quanta (i.e. their energy cannot be reduced) and recalling from eq(4) that $\sigma\phi_o = N_c/\tau_o$, the first way corresponds to the force

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

where $\gamma_k(r) = (\sigma K_o/2\pi r^2) = K_o\gamma(r)$ is the very thin solid angle within which a particle *does not receive* quanta from the other. This equation shows formally that the gravitational force is due to the momentum given up during τ_o by $N_c\gamma_k(r)$ collisions, which are *unbalanced* due to the lack of the radial beam

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

that cannot be exchanged between the very small surfaces (σK_o) orthogonal to the joining line of two particles (Fig.1). This beam is forbidden by the *optical* reflection law. 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.

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 a $\psi_g(r) = 1$ 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 of 1 quantum every 10^{10} years, thus 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 able to generate the observed gravitational forces.

The second way of interpreting eq.(5) is to assume the hypothesis, as reported in [1], that the 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 exceeding those made by other scattered quanta. Then the momentum given up by two quanta hitting the particle on opposite sides along the joining line is

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

so the alternative picture of the gravitational force between two particles results

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

which is numerically 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 the quanta to make $10^{12} \div 10^{13}$ 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 can take place if micro-quanta were complex objects (like photons) losing energy in ordinary Compton's collisions. Such a thing appears unlikely to micro-quanta, which are infinitesimal wave structures .

1.1 – May micro-quanta transfer energy ?

In general a quantum with momentum $|\boldsymbol{q}| = E_o/c$ colliding with a particle of mass m , undergoes a deviation θ from its trajectory, so the change of momentum $\Delta \boldsymbol{q}_r$ along the joining line is

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

Since the simultaneous collisions uniformly hit a spherical particle, the sum of the momenta $\Delta \boldsymbol{q}_\perp$ released orthogonal to the joining line is zero. Thus collisions with particles give rise only to radial forces through the unbalanced collisions due to the missing beam $\psi_g(r)$ along the joining line ($\cos\theta \cong -1$).

The released momentum $\Delta q_r = 2(E_o/c)$ implies a transfer of energy to the particle *even if* the quantum energy E_o does not change. We know the inter-particles force $f(r)$ (see eq.6) arising from the simultaneous *unbalanced* collisions. During the quanta *reflection* (i.e. the collisions with the particle field in the time τ_o), the work done by the gravitational force $f(r)$ along the distance ($c\tau_o$) is

$$\Delta L \cong f(r)\, c\tau_o = 2E_o \mathrm{N}_c\, \gamma_k(r)$$

which, recalling that $\gamma_k(r) = K_o\gamma(r)$ and $K_o\mathrm{N}_c = 1$, shows the energy given up to the particle

$$\Delta L = E_o\, \gamma(r) \qquad (10)$$

without change of E_o .

2. Power of gravitational contraction

During the gravitational contraction, the work done by the pushing gravitational force compresses and makes hot the celestial bodies as it 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 atoms/nuclei at a distance $\Delta x = (m_\mathrm{N}/\delta)^{1/3}$, where $m_\mathrm{N} = (\mathrm{Z+N})m$ is the nuclear mass and δ is the local density, undergo the auto-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 tidal force complicates the problem, but does not substantially alter the result.

Considering this case, each nucleon receive in the time τ_o from micro-quanta a gravitational energy ΔL given by eq.(10) which generates the contraction power

$$P_{gi} = E_o\, \gamma(r)\, /\tau_o = (E_o/\tau_o)\, (\sigma/2\pi r^2). \qquad (12)$$

Substituting the average distance $r = \Delta x$, one may specialise the term

$$(\sigma/2\pi r^2) = (\sigma_\mathrm{N}\, /2\pi\Delta \mathrm{x}^2) = (\sigma_\mathrm{N}\, \delta^{2/3}/2\pi\, m_\mathrm{N}^{\ 2/3}) \qquad (12b)$$

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

$$a_\mathrm{N} = A_\mathrm{o} m_\mathrm{N} /\, \pi\, r_\mathrm{N}^{\ 2} \approx 10^{-6}$$

is much less than unity for all nuclei . In fact we have $\sigma_\mathrm{N} \cong (\mathrm{Z+N})\sigma$ and by consequence $\sigma_\mathrm{N}/m_\mathrm{N} \cong (\sigma/m) = A_\mathrm{o}$.

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

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

The numerical calculation of the gravitational contraction power requires to know the internal density of the body, as well as the average local number of nucleons ($Z+N$) per atom.

In contrast with the classical definition (which results very complicate in absence of the micro-quanta paradigm) eq(13) appears simple.

To the aim of doing some comparisons with the known heat flow escaping from the Earth and other planets, we attempt to do quick calculations observing that in eq(13) the ratio $\xi(r) = \delta(r)/(Z+N)$ results to vary slowly along the radius. Thus it is acceptable to substitute $\xi(r)$ with the number $\xi(r_x) = \delta_{av}/(Z+N)_{av}$ calculated at r_x , that is near the point where the multiplying function $4\pi r^2\delta(r)$ takes its maximum. This process should give an accuracy better than 10% .

Substituting the numerical quantities in eq(13) we found

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

where M is the 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)

	Calculated from eq(14)	From literature
-	Earth . . . . $P_g \approx 4.5\mathrm{x}10^{15}$	. . . . . $4.42\mathrm{x}10^{13}$ [3]
-	Mars . . . .$\approx 3.6\mathrm{x}10^{14}$	. . . . -
-	Jupiter . . . .$\approx 1.7\mathrm{x}10^{18}$	. . . . -
-	Saturn . . . .$\approx 3.2\mathrm{x}10^{17}$	. . . . $3.05\mathrm{x}10^{17}$ [4]
-	Uranus . . . . . . $\approx 5.1\mathrm{x}10^{16}$	. . . . $3.4\mathrm{x}10^{14}$ [5] [6]
-	Neptune . . . . . $\approx 7.2\mathrm{x}10^{16}$	. . . . $6.5\mathrm{x}10^{15}$ [6]

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 [4].

The contraction power of the Earth, as currently calculated through the heat flux measured from boreholes and wells in the outer crust, equals $4.42\mathrm{x}10^{13}$ watt [3]. In contrast, the calculated P_g is one hundred times greater.

This situation repeats for Uranus, whose observed thermal emission [5] exceeds the absorbed solar energy of only 6%, equivalent to an internal heat flow of $3.4\mathrm{x}10^{14}$ watt, that is 1/150 of the contraction power P_g. This result does not astonish since specific studies suggested that Uranus presents a discontinuity of the internal density [6], 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 [6].

The problem now is: the little heat flow from the Earth crust (1% of the theoretical value) may be due to the Mohorovich's discontinuity at 10-60 km under the surface? In any case the remaining 99% of the heat flow must anyway escape from the internal mantle.

A possible explanation of the mystery may come from the current assumption that heat flux from the seafloor (which accounts for 80% of the total planet) refers mainly to heat conduction across the lithosphere whose age exceeds 10÷20 million years [3]. 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. He 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 per granted that the new lithosphere continuously forming from the hot mantle (to enlarge for instance the Mid Atlantic Ridge at a rate of 2.5 cm/y) does not sensibly contribute through the hydrothermal mechanism. This problematic might open a new area of searching. It can be recalled that 8-9 earthquakes of magnitude higher than 4 are everyday detected [7], 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 (large vapour bubbles) at a depth less than 2180 m. (i.e. 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. 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 $M_w = 4x10^{22}$ Joule [7], equivalent to 30 times the calculated annual Earth heat flow .

3. The origin of the strong force

The possibility that a short range strong force could arise between particles through the interaction with micro-quanta has been shown [8] 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 solid angle

$$\gamma_k(r) = \sigma K_o/4\pi r^2$$

related to the very little cross section fraction (σK_o) which cannot reflect 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 $\Delta\sigma = \pi\varepsilon^2$ around the joining line of two nucleons considered as spherical particles (Fig.1). The beam of quanta scattered by nucleon A and hitting the region $\Delta\sigma_B$ on the nucleon B is

$$\psi_1(r) = \Delta\sigma\,\phi_o\gamma(r) = \Delta\sigma\,\phi_o\,(\sigma/2\pi r^2).$$

Let's consider the fraction that is optically reflected by $\Delta\sigma_A$ *parallel* to the joining line

$$\psi_2(r) = \psi_1(r)(\Delta\sigma/\sigma).$$

These quanta are reflected away from B, excepting the very little beam

$$\psi_3(r) = \psi_2(r)(\Delta\sigma/\sigma)$$

which comes back to $\Delta\sigma_A$ along the joining line. Taking into account (eq.15a), the ratio $\Delta\sigma/\sigma = ½\,\gamma(r) \ll 1$ implies that $\psi_3(r) = ¼\,\Delta\sigma\,\phi_o\gamma^3(r)$ is a negligible fraction of the beam

$$\psi_2(r) = ½\,\Delta\sigma\,\phi_o\gamma^2(r) \qquad (15)$$

which is just the missing beam that would hit $\Delta\sigma_A$ in the *absence* of particle B. Thus the missing beam $\psi_2(r)$ generates the strong force on the particle A. Let's now demonstrate the ratio $\Delta\sigma/\sigma$.

Putting r_o the radius of the particle (being the 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

$$\Delta\sigma = \pi\varepsilon^2 = \pi\, r_o^{\,4}/4r^2 = ½\,\sigma\,\gamma(r) \qquad (15a)$$

where $\gamma(r) = \sigma/2\pi r^2$. Now, following the structure of eq.(5), we determine the force due to the unbalanced collisions of the beam symmetrically opposite to the missing $\psi_2(r)$ (Fig.1)

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

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

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

the strong force $\Phi(r)$ equals $f(r)$ when $2 = ½\, N_c\, \gamma^2(r)$, that is when

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

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

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

This proves the strong force, working in the nucleus, is negligible (as well as the gravitational one, which equals everywhere 10^{-39} times the electric force) at distances greater than 10^{-10}m, where atomic and intermolecular electromagnetic forces largely predominate. For instance, at a distance of 0.53 Angstrom (Hydrogen atom) the force $\Phi(r)$ 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

$$d_n = (m/\delta_N)^{1/3} \approx 3.5\text{x}10^{-16}$$

δ_N being the nuclear density. On the other hand the strong force is roughly balanced by the electrical force when the distance between protons equals about d_n, showing the "chain" structure of the force holding the nuclei. Putting eq.(17) in the more suitable form

$$\Phi(r) = \sigma p_M (\sigma/2\pi r^2)^3 \qquad (17a)$$

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 balance becomes

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

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

The generation of the strong force is similar to the process generating the radiation pressure upon two reflecting spheres of little weight immersed in an isotropic 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. A first calculation shows this experiment appears to be realistic.

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 $M_n = 1.912\mu_B = 9.66\text{x}10^{-27}$ which generates the magnetic field $B_n = (\mu_o/4\pi)\,(M_n/r^3)$.

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

$$\Phi(r) = \sigma p_M (\sigma/2\pi r^2)^3 = m_o v_n^2/r_n\beta_n \qquad (18)$$

whereas the equation for proton is

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

where m_o/β_i denotes the relativistic mass of particle i, r is the distance and $r_n = xr$, $r_p = (1\text{-}x)r$ are the orbital radii of neutron and proton. Finally $v_n = \omega xr$, $v_p = \omega(1\text{-}x)r$ are the nucleon velocities.

Recalling that $v_n = v_p x/(1\text{-}x)$ and substituting the numerical quantities one gets, after putting $v^2 = c^2(1-\beta^2)$,

$$\Phi(r) = 1.836\text{x}10^{-90}/r^5 = m_o c^2 (1-\beta_n^2)/\beta_n x \qquad (18a)$$

$$1.836\text{x}10^{-90}/r^5 \pm 1.545\text{x}10^{-52} v_p/r^2 = m_o v_p^2/(1\text{-}x)\beta_p. \qquad (19a)$$

Since the magnetic force is considerably less than $\Phi(r)$, 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 will be to calculate the exact value of x, provided it is close to ½ required by perfect symmetry. An exact analysis shows that $(1\text{-}x)^2/x^2 = (1-\beta_p^2)/(1-\beta_n^2)$ and that 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

$$r^5 = 0.612\text{x}10^{-80}\,\beta / (1-\beta^2). \qquad (20)$$

To the aim of calculating the term $(1-\beta^2)$ to be put in eq(20) 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 and putting $\beta_p \cong 1$, one obtains

$$v_p \cong 2.34\text{x}10^{-32} / r^{5/2} \pm 2.31\text{x}10^{-26} / r^2 \qquad (21)$$

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

Then we calculate

$$v_p^2 \cong 5.475\text{x}10^{-64} / r^5 \pm 1.08\text{x}10^{-57} / r^{9/2}$$

which gives

$$1-\beta^2 \cong 0.612\text{x}10^{-80}/r^5 \pm 1.2\text{x}10^{-74}/r^{9/2}\ .$$

Substituting in eq(20) one has

$$\beta = 1 - 1.96\text{x}10^6\, r^{½}$$

and finally we obtain the orbit diameter

$$r = 1.55\text{x}10^{-16} \qquad (22)$$

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.

Although the adopted micro-quanta cross sections have not only undergo a process of re-normalisation, the obtained diameter of Deuterium is in accord with the known average distances between nucleons comprised in the atomic nuclei.

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, whereas in the outer orbits of heavier nuclei have an angular momentum equal to an increasing multiple of $\hbar$.

It has been shown that the relativistic centrifugal force

$$F_c = m_o v^2/\beta\, r$$

on a particle in circular motion depends on the interaction with the flux of micro-quanta [1]. The corresponding angular momentum is constant (due to the pure radial force) for each particular orbit. But it is 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 Hydrogen.

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

$$m_o\, v_n\, r_n = \hbar\ .$$

and substitute in the centrifugal force of eq(18)

$$m_o\, v_n^2 / r\Phi(r)_n = \hbar^2 / m_o\, r_n^3.$$

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

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

We assume coherently that

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

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

From the study about deuterium one may get the numerical value of the angular momentum

$$m_o \, v_n r_n \cong 1.025\text{x}10^{-35}$$

pertaining to a nucleon pair. A difference not very high from $\hbar$, but fundamental.

4- The asymmetry of the self-screening forces

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

$$\Psi_e(r) = \sigma_e \, p_M(\sigma_P/2\pi r^2)^3 \qquad (18a)$$

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

$$\Psi_p(r) = \sigma_p \, p_M(\sigma_e/2\pi r^2)^3 \qquad (18b)$$

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" self-screening force $\Psi_e(r)$, together with the electromagnetic one, binds the pair electron-proton to form a neutron. Being a short range force, $\Psi_e(r)$ is greater than the electric force acting in the neutron structure. The neutron-bound electron possesses high kinetic energy when the detachment from orbit originates the β^- decay. Due to the braking force of protons on the escaping β^- particles, the observed energy may be much lower than the electron orbital energy. The observed continuity of the energy spectrum of β^- particles may be principally due to the motion of the electron closely orbiting a proton. The continuity of the β^- energy spectrum was assumed as proof of the existence of neutrino, theoretically proposed to the aim of restoring the lack of energy in the β^- decay process. It is a matter of history that in 1933 at the Solvay's conference W. Pauli announced with some reluctance his hypothesis about the neutrino.
The existence of the weak force $\Psi_e(r)$, which implies an *additional* (unknown to current physics) loss of energy during the electron escaping, might require a re-examination of the reasons for neutrino proposal. A study of the β^- decay mechanism is in progress.
As a matter of fact the neutrino energy is not yet well established.
The generation of the strong and weak force from the paradigm of micro-quanta, which generates also the gravitational and inertial forces (four of the five fundamental forces), points out the opportunity of re-interpreting current methods of conceiving the nuclear forces between nucleons and other particles.

A note of historical character [Quoted from a scientific Encyclopaedia]

"*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 is evident."

This story shows a high analogical power as referred to the contemporary physics. The knowledge of the heliocentric theory would have greatly simplified the Ptolemy's work. In a certain sense, his story can help to solve our problems.

References

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

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

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

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

[5] J.C. Pearl, B.J. Conrath, et al., Icarus, vol.84, March 1990, p.12-28

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

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

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

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