A Possible Way to Unify Four Types of Interactions: Gravitational, Electromagnetic, Nuclear and Electroweak Interactions by using a Hydrodynamic Analogy

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Abstract: *A principle of equivalence and a unique particle are used for a possible unification of four types of interaction. For gravity, the hydrodynamic analog consists of the interaction of two sources, giving attraction for both emission and absorption. For electromagnetics, sources and vortices are used together with the formula Biot-Savart- Laplace. For nuclear forces, the HD equivalent of pi-mesons (Yukawa) is given. As electroweak interaction, the beta decay for neutron and proton via their quark structure is considered. The unique connecting particle used is called HD-graviton, a photon-like particle having the wave length of the Universe radius at a certain age of the Universe.*

Key Words: *HD-graviton, vortex- mass, recycled mass, quark interaction*

1. INTRODUCTION

The main forces acting in the Universe are related to the gravity and electric forces. Whilst the particle motion affects only quantitatively the gravity, the electric charges in motion create new phenomena like the magnetic field. An interesting thing is that light - the primary energy at the creation of the Universe - can be afterwards interpreted as an electromagnetic wave. According to our model of a Universe which is structured by division [1], the substance appeared from radiant energy under the form of neutrons, by a phenomenon of resonance. The electric charge has appeared afterwards from the neutron decay in the form of protons and electrons. This resonance required no gauge intervention. Another source of electric charge was the electron-positron pair production from high energy photon collisions. The electric interaction is a basic force for atom existence starting with the atom of Hydrogen (H_2). As regards the atom nuclei (example, the Helium nucleus) new aspects came into being - so called strong interaction responsible for the nucleus stability. A big number of particles was discovered related to electromagnetic, strong and weak interaction. Efforts are done to add to the three forces (strong and weak interactions and electromagnetic interaction) the force of gravity to obtain the so-called theory of everything.

A PRINCIPLE OF EQUIVALENCE CAN BE FORMULATED: FOR ANY TYPE OF FORCE (GRAVITY, COULOMB, LORENZ, YUKAWA, ETC…) THERE EXISTS AN EQUIVALENT HYDRODYNAMIC FORCE. A UNIQUE PARTICLE CALLED HD-GRAVITON IS USED. THIS IS A PHOTON-LIKE PARTICLE HAVING THE WAVE LENGTH OF THE ORDER OF THE UNIVERSE RADIUS. THE FORMULA BIOT-SAVART-LAPLACE IS USED FOR THE ANALOGY BETWEEN VORTICES AND ELECTRIC CURRENTS.

2. GRAVITATIONAL AND COULOMB FORCES BY USING A HYDRODYNAMIC ANALOGY

2.1 The case of gravity force F_N and its hydrodynamic analog $\mathrm{F_{HD}}$ is presented in Ref. [1; 2; 4], together with the definition of HD-gravitons and their field in Universe.

2.2 The Hydrodynamic Analog in Case of Coulomb Forces is considered in Ref. [4]. The corresponding analog is obtained using the so-called “vortex mass”. The applications for Hydrogen and Helium nuclei are given. The problem of the Helium nucleus stability is discussed.

3. THE ELECTROMAGNETIC (LORENZ) INTERACTION IS HOWEVER RECONSIDERED BELOW IN ORDER TO TAKE BETTER INTO ACCOUNT THE ELECTRIC CHARGE VELOCITY

The formula of Lorenz interaction for a moving charged particle in magnetic field is [5]:

$$\vec{F}_{Lor} = q\vec{V}_q \times \vec{B}, \tag{1}$$

where $q, \vec{V}_q, \vec{B}$ are the charge, the particle velocity and the magnetic field.

The electrical field was already unified (Coulomb force). Now, one has to find a hydrodynamic analog for the Lorenz force.

There is an obvious analogy between the pairs $I, \vec{B}$ from Electromagnetics and $\Gamma, \vec{V}$ from Hydrodynamics, via the Biot-Savart- Laplace formula:

$$\vec{B} = \frac{\mu_0 I}{4\pi}\int_{CI}\frac{\vec{r}\times d\vec{s}}{r^3}; \vec{V}_\Gamma = \frac{\Gamma}{4\pi}\int_{C\Gamma}\frac{\vec{r}\times d\vec{s}}{r^3}; \tag{2}$$

where $CI, C\Gamma$ are curves of current and of vortices, respectively.

3.1. Application to an electric charge moving in a magnetic field

In Fig. 1 the electric charge is moving on a circle of radius *a,* in a magnetic field of constant intensity $\vec{B}$ normal to the circle plane.

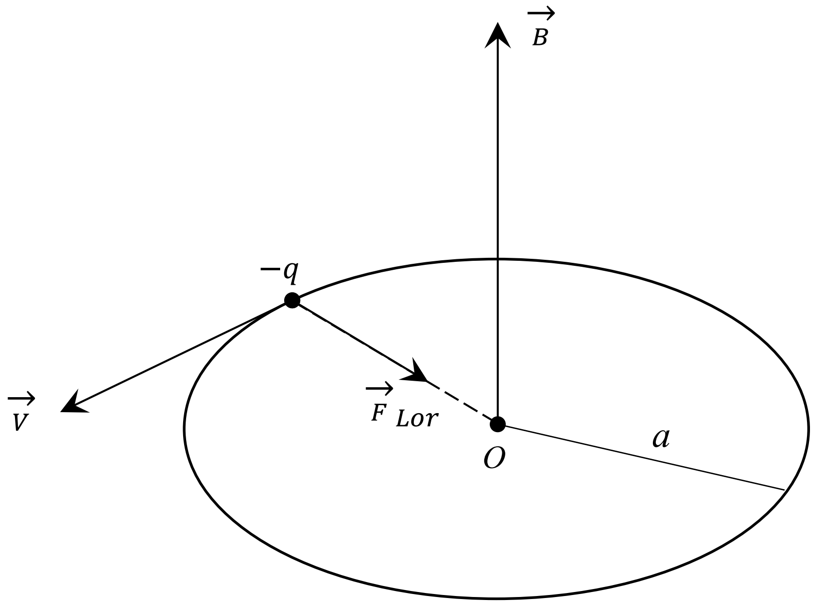

Fig. 1 - Electric charge q moving on circle
a – circle radius; $\vec{V}$- the velocity; $\vec{B}$- the magnetic field; $\vec{F}_{Lor}$- Lorentz force

By applying the formula (1) one obtains for the Lorenz force:

$$\vec{F}_{Lor} =- q\vec{V}_q \times \vec{B}; \quad \vec{B} = \frac{\mu_0 I}{4\pi}\int_{CI}\frac{\vec{r}\times d\vec{s}}{r^3} \tag{3}$$

$d\vec{s}$ being the oriented circuit element. $\vec{F}_{Lor}$ is directed to the circle center.

There are more possibilities to model a HD-force, $\vec{F}_{HD}$. The simplest one is to consider two infinite parallel vortices.

Another one is to consider two parallel circuits (Fig. 2). By replacing the magnetic intensity as a function of a current I_1 and introducing a current I_2 as in relation (14), one can make a comparison with the case of two circular circuits of intensities I_1, I_2 located in parallel planes (Fig. 2).

The magnetic field in the center of the circuit of intensity I_1, produced by the circuit of intensity I_2 is:

$$\vec{B}_{centre} = \frac{\mu_0 I_2 a^2 \vec{n}}{2(a^2+h^2)^{3/2}} \tag{4}$$

normal to the circle plane (unit vector $\vec{n}$).
The Lorenz force corresponding to (1) is:

$$\vec{F}_{Lor} = \frac{\mu_0 I_1 I_2 V_q \vec{\tau}_{Vq}}{2}\frac{a^3 V_q}{2(a^2+h^2)^{3/2}} \tag{5}$$

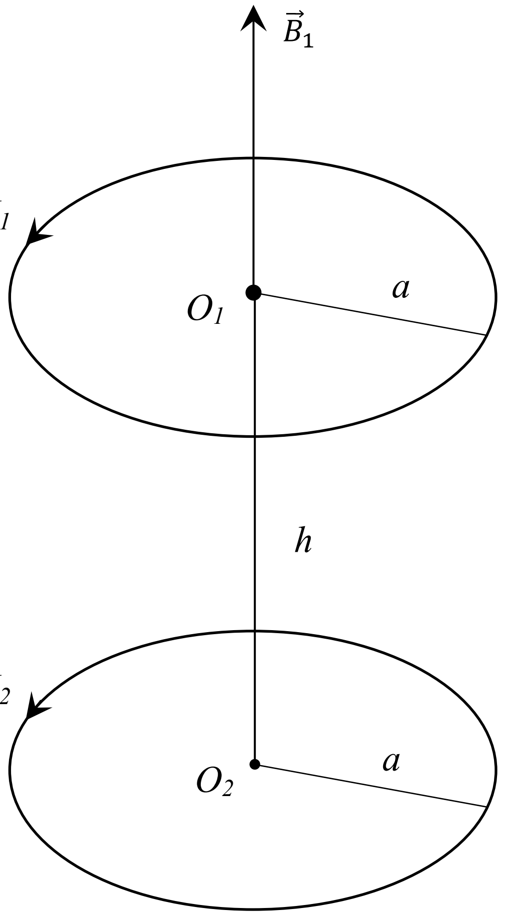

Fig. 2 - Two circular currents in parallel planes
I1, I2 – current intensities; *h* – plane distance; *a* – circles radii; $\vec{B}_1$- the magnetic field intensity induced by the current *I2*

$\vec{\tau}_{Vq}$ being the unit vector of velocity direction of the moving electric charge.

A similar calculation is done to obtain the HD-interaction for two vortex circles of intensities Γ_1, Γ_2, obtained from (16) by replacing *I* with Γ, and μ_0 with a fluid density ρ gives the equivalent HD-force:

$$\vec{F}_{HD} = \frac{\rho \Gamma_1 \Gamma_2}{2} \vec{n} \frac{a^3}{2(a^2 + h^2)^{3/2}} \tag{6}$$

$\vec{n}$ being the unit vector of direction normal to the circles plane.

By equating $\vec{F}_{Lor}$ from (5) and $\vec{F}_{HD}$ from (6), **in case of a constant charge velocity**, one obtains the necessary condition to find the HD correspondent for Lorenz force (in absolute value for scalars):

$$\mu_0 I_1 I_2 V_q = \rho \Gamma_1 \Gamma_2; \vec{n} = \vec{\tau}_{Vq} \tag{7}$$

i.e. the normal to plane circles must be directed after the electric charge velocity.

REMARK 1. In case of variable velocity of the moving electric charge, $\vec{V}_q$, the equality $\vec{F}_{Lor} = \vec{F}_{HD}$ can be obtained by using adapted forms of circuits in relations (2)

3.2 The case of two parallel circuits of infinite length

In order to estimate the HD-gravitons fluxes, one considers two parallel circuits I_1, I_2 of infinite length, at a distance *d*. For a length *l,* the Lorenz force is:

$$\vec{F}_{Lor} = \frac{\mu_0 I_1 I_2 V_q l\, \vec{\tau}_{V_q}}{2}, \tag{8}$$

where $\vec{\tau}_{Vq}$ is the unit vector oriented in the circuits' plane (attraction for intensities of different signs).

For comparison, one considers two parallel vortex lines of infinite length with the intensities Γ_1, Γ_2. The hydrodynamic force for a length *l,* is:

$$\vec{F}_{HD} = \frac{\rho \Gamma_1 \Gamma_2 l}{2} \vec{n}, \tag{9}$$

$\vec{F}_{HD}$ is contained in the circuits plane (attraction for intensities of different signs).

The same condition (7) is obtained for equality in case of the constant velocity of them moving charge.

4. A HYDRODYNEMIC ANALOG FOR YUKAWA FORCES

4.1 The standard description of the Yukawa model

In standard description one assumes that a particle (in particular, a meson of mass $m_{\pi 0} = 264 m_{el}$) is emitted by a proton and absorbed by the other. However, the mechanism is not that simple. We adopt a description in two phases:

a) two particles are emitted by the two protons in opposite sides (back);
b) two particles are absorbed from the outer field by the two protons from the front of them.

If one adopts a simple discrete application of the mechanical momentum, one writes:

$$\frac{m_{\pi 0} V_{\pi 0}}{\Delta t} = \frac{k q_P^2}{4\pi \varepsilon_0 d^2}, \tag{10}$$

where $V_{\pi 0}, q_P, \varepsilon_0, \Delta t$ are the average emission/absorption velocity of meson $\pi 0$, the proton charge, the vacuum permittivity and time interval, respectively. One takes:

$$\Delta t = \alpha V_{\pi 0 life}, 0 < \alpha < 1; V_{\pi 0 life} = 2E - 16\, sec., k = 137 \tag{11}$$

$V_{\pi 0 life}$ represents the meson $\pi 0$ life, and *k*=137 is a coefficient of stability for nucleus.

From the above relations, one obtains:

$$V_{\pi 0} = 5.908 \alpha \text{E4 m/sec} \tag{12}$$

For α =0.1, one obtains 5908m/sec.

4.2 The Hydrodynamic Analog for Yukawa Forces. Application for Helium

The particles emitting/absorbing HD-gravitons are the two protons. The HD analog, F_{HD}, for force is an attraction both for emission and absortion:

$$F_{HD} = \frac{M_1' M_2'}{4\pi \rho_{gN} d^2} = \frac{\theta_N^2 M_1 M_2}{4\pi \rho_{gN} d^2}, \tag{13}$$

$\theta_N, M_1, M_2, \rho_{gN}$ being the intensity of emission/ attraction, two masses and the density of the HD-graviton field inside the nucleus, respectively.
By equating the Coulomb and HD forces for two protons, one obtains:

$$\theta_N = \pm \frac{q_P}{m_P} \sqrt{\frac{k\rho_{g_N}}{\varepsilon_0}} \tag{14}$$

k being a coefficient of stability (k=137, Wikipedia)
The sign "+" stands for attraction and the sign " — -" stands for absorption, **the interaction being attraction in both cases**. The subscript "*N*" stands for nucleus.
In order to make an evaluation of ρ_{g_N}, the density of the HD-graviton field inside the nucleus of Helium, one calculates the density of matter inside this nucleus.
The radius of the nucleus of Helium is [10]:

$$\rho_{NHe} = 2.911E17\ kg/m^3; \rho_{gNHe} = \beta\rho_{NHe}; \beta << 1 \tag{15}$$

and the corresponding matter density:
One takes for the density of the HD-graviton field inside the Helium nucleus the value ρ_{gNHe}, with parameter β for evaluation. For β = $10^{-16} - 10^{-13}$, one obtains values similar to Coulomb case (see Table 2).

5. THE CASE OF ELECTROWEAK INTERACTION

For electroweak interactions one considers the beta decay for neutron and proton and the reaction electron-positron, under the forms.
The beta decay for neutron is:

$$n \rightarrow p^+ + e^- + \overline{\nu}_e \tag{16}$$

a proton, an electron and an antineutrino resulting from a neutron.
The beta decay for proton is:

$$p^+ + e^- + e^+ \rightarrow n + e^+ + \nu_e, \tag{17}$$

a pair electro-positron being necessary from a nucleus [10].
A pair electro-positron can be generated by HD-graviton emission having an energy of about 1MeV, giving first a γ_R ray:

$$\gamma_R \rightarrow e^- + e^+ \tag{18}$$

as the HD-gravitons are photons.

5.1 A hydrodynamic analog for the neutron decay.

One writes the relation (16) in the form:

$$n + \gamma_R = n + e^- + e^+ \rightarrow p^+ + e^- + \overline{\nu}_e\ . \tag{19}$$

One takes into account that γ_R is a pack of HD-gravitons emitted by a mass in the domain of interaction (for example, a nucleus) and has the transformation (18) from collision with the neutron n.

The energy balance is supposed to be satisfied considering the kinetic energy as well. It is interesting to write the neutron decay by considering the quark structure.

Denoting by D, the down quark and by U, the up quark, one obtains relation [7] for the neutron decay:

$$UDD \to UUD + e^- + \overline{\nu}_e;\text{ therefore } D \to U;\ D + \gamma_R \to U + e^- + \overline{\nu}_e. \quad (20)$$

5.2 A hydrodynamic analog for the proton decay

One writes relation (17) in the form:

$$p^+ + \gamma_R \to p^+ + e^- + e^+ \to n + e^+ + \nu_e. \quad (21)$$

In this way one has found HD analogs for the three weak interactions, the necessary energies being of 1MeV order.

REMARK 2. In the unified electroweak interaction presented in [7], the particles $W^{\pm}, Z^0$, having the energies of 90 GeV order, are used. It is a huge energy in the context, having the energy of the order of 100 protons. Most likely, this energy **comes from the experiment (gauge interaction)** that mediates the transformation. This gauge effect is negligible in the case of other interactions (gravity, electric, even nuclear). Our HD-model is a “pure” model, without sensible gauge effects.

6. CONCLUSIONS

A possible way of unification of the gravity, electromagnetic forces, nuclear and electroweak forces by using a hydrodynamic analogy is presented. It consists of introducing sources and vortices interacting in a fluid of photon-like particles, called HD-gravitons. In the case of gravity, the uncharged masses act as sources in an incompressible fluid on the scale of the Universe, attracting two sources for both emission and absorption. This modifies the body masses while the whole Universe is filled of HD - gravitons of variable density in time. **An important consequence is the dependence of the coefficient of gravity and masses in Newton law on the age of Universe [4].**

A PRINCIPLE OF EQUIVALENCE was formulated: **FOR ANY TYPE OF FORCE (GRAVITY, COULOMB, LORENZ, YUKAWA, WEAK INTERACTIONS) THERE EXISTS AN EQUIVALENT HYDRODYNAMIC FORCE. A UNIQUE PARTICLE CALLED HD-GRAVITON IS USED TO CARRY THE INTERACTION. THIS IS A PHOTON-LIKE PARTICLE HAVING THE WAVE LENGTH OF THE ORDER OF THE UNIVERSE RADIUS.**

In case of Coulomb force, a similarity to vortex-mass interactions was used [8], the electric charges being responsible for the recycling of HD-gravitons taken mainly from the very masses which carry the charges, in large quantities. The connection with masses was obtained by considering the masses of electrons and protons giving the electric charges. Therefore an analogy between the electric charges and vortex-masses is suggested. Unlike the gravity sources, acting on a global scale, the effect of vortices takes place on a local level scale in a domain containing the charged bodies. Examples of calculations for the atoms of Hydrogen and Helium are given.

In case of Lorenz force, the current intensities are replaced with vortices. For a comparison of the HD-graviton intensity, lines of HD sources and the principle of equivalence were used. The result was that the HD-graviton intensity for vortices and spherical sources is of the same order of magnitude.

To simplify the use of the equivalence, equal intensities for the electric currents, vortices and source rates via geometrical averages can be used.
Three kinds of weak interactions were presented, using the transformation of the packs of HD-gravitons in pairs of electron-positron.

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