A possible way of unification of the gravity (Newton) and electric (Coulomb) forces by using a hydrodynamic analogy

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DOI: 10.13111/2066-8201.2020.12.4.3

Received: 05 September 2020/ Accepted: 26 October 2020/ Published: December 2020

Abstract: *Although the gravity is the most important force acting on the Universe scale, on small scales the electrical interaction prevails. Indeed, the Coulomb force between two charged particles is very high as compared to the gravity force between the masses carrying electric charges. Therefore, a solution would be to connect the two forces by extending the hydrodynamic analogy successfully introduced in the author's previous works. These papers provide a model for gravity, an important conclusion being the dependence of the gravity coefficient in Newton formula on the age of the Universe. Unlike mass-energy, the total electric charge in the Universe is null. Therefore, we must consider limited regions of the Universe (example: atoms, nuclei) to express Coulomb's strong forces. In the following we take into consideration that any electric charge (electrons, protons, quarks etc.) is carried by a mass. Unlike the gravity force which is modeled by hydrodynamic sources on a global scale, Coulomb's force is modeled by an equivalent vortex mass on a local scale.*

Key Words: *electro-HD-graviton, vortex- mass, recycled mass, electric-gravity force ratio*

1. INTRODUCTION

The main forces acting in the Universe are related to the gravity and electric forces. Whilst the particle motion affects the gravity only quantitatively, the electric charges in motion create new phenomena like the magnetic field. An interesting thing is that light, the primary energy in 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 did not require any measurement 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). Regarding the nuclei of the atom (for example, the Helium nucleus) new aspects have emerged – the so-called strong interaction responsible for the nucleus stability. A big number

of particles was discovered related to electromagnetic, strong and weak interaction [2]. 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 *great unification*. Therefore, a unification of gravity and electric forces could help.

2. A CONNECTION BETWEEN THE NEWTON AND COULOMB FORCES BY USING A HYDRODYNAMIC ANALOGY

In our previous work [3] a model for the Newton gravity force was obtained by using a hydrodynamic analogy between the source interaction in an incompressible fluid and Newton gravity force. There is attraction for both two positive and two negative sources, which corresponds to the gravity force, which is attraction only, as well. The emitted/absorbed fluid is formed by **HD-gravitons**, which are photon-like particles having the wave length equal to the radius of Universe at the given age, t_U. In contradistinction, the Coulomb force [4; 5] is an attraction for electric charges of opposite sign and a rejection for charges of the same sign.

2.1 The case of gravity

Let us consider two point-like sources of mass rates $m_1^{'}, m_2^{'}$ in an incompressible fluid of the density ρ and volume rate Q. In this case the hydrodynamic force is [6]:

$$F_{HD} = \frac{m_1^{'} m_2^{'}}{4\pi\rho R_{12}^2};\ m^{'} = \rho Q, \tag{1}$$

R_{12} being the distance between source centers and $m^{'}$ the corresponding mass rate. By assuming [3] that any quantity of energy E or mass m can emit/absorb fluid, proportionally to the intensity θ_g, and equating the hydrodynamic force with the Newton force, we obtain the following relations:

$$E^{'} = \theta_g E;\quad m^{'} = \theta_g m;\quad F_N = f_N \frac{m_1 m_2}{R_{12}^2};\quad \theta_g^2 = 4\pi\rho f_N, \tag{2}$$

f_N being the universal coefficient of gravity. The emitted/absorbed fluid is formed from **HD-gravitons**, some photon-like particles, having the wave length equal to the radius of the Universe. By denoting E_{gU} the total energy of the fluid of HD-gravitons in Universe one writes the conservation equation:

$$\frac{dE_{gU}}{dt_U} = \theta_g\left(E_U - E_{gU}\right). \tag{3}$$

E_U is the total energy of the Universe and t_U the age of the Universe (t_U = 0 at BIG BANG, or better said, BIG FLASH). Further, by considering the average density of HD-gravitons in Universe, ρ_{gU}, for ρ in the relation (2), we obtain:

$$\begin{aligned} &\rho_{gU} = \frac{3E_{gU}}{4\pi R_U^3 c_V^2};\theta_g = \pm A(t_{UHD})X_g; X_g = \sqrt{\frac{E_{gU}}{E_U}}; t_{UHD} = 10^6 ys; \\ &A(t_{UHD}) = \frac{t_{UHD}}{2}\sqrt{\frac{3f_{Nref}E_U}{c_V^3}}:\frac{f_N(t_U)}{f_{Nref}} = \frac{t_{Uref}}{t_U}; t_{Uref} = t_{Uact} = 13.8E9ys. \end{aligned} \tag{4}$$

c_V, t_{UHD} are the speed of light in vacuum and an age of Universe, respectively, from where the hydrodynamic analogy can be applied. The variation of the coefficient f_N with the age of Universe [7] was also considered in relations (4). The "$\pm$" signs correspond to the emission and absorption of HD-gravitons, respectively. The subscript "ref" stands for "reference".
With θ_g given by (4), the differential equation (3) has the following analytical solution giving E_{gU} at various ages of the Universe and other necessary parameters:

$$\ln\left(\frac{1+X_g}{1-X_g}\frac{1-X_{gref}}{1+X_{gref}}\right) = \pm\frac{t_{UHD}}{2}\left[1-\left(\frac{t_{Uref}}{t_U}\right)^2\right]. \tag{5}$$

The above formulas allow to calculate the time evolution of the gravity force in Universe starting with t_{UHD} (after the neutron formation [1]). For example, **at the actual time**, t_{Uact}, **the Universe is in absorption**; on the other hand the energy E_{gU} can be interpreted as the black energy in Universe [8] as the HD-gravitons are very hard to detect. The Newton law should be extended to include the variation of the gravity coefficient and of masses with the age of the Universe [7].
By using expressions (4) and (5), one can calculate the time variation and the contribution ε_{12} to the creation of gravity in Universe in a time interval $(t_{U1}; t_{U2})$, for any mass *M:*

$$M(t_{U2}) = M(t_{U1})(1+\varepsilon_{12}); \varepsilon_{12} = \int_{t_{U1}}^{t_{U2}}\left[\left(-\theta_g(t_U)\right)\right]dt_U = -\theta_{gAV}(t_{U2}-t_{U1}) \tag{6}$$

The subscript *"AV"* stands for *"AVERAGE"*.

Only a fraction of the quantity ε_{12} denoted by β is associated to the mechanical energy conservation of the mass system.

As the gravity propagates at finite speed (c_V), one has $\beta_A \neq \beta_B$ for two bodies M_A, M_B. Because the mass M_B is distant from M_A we shall take $\beta_B = 0$ near the mass M_A. In general, one should have $\beta_{A,B} \in (0; 1)$.

Table 1 gives the fractions ε_{12} and β_A ($\beta_B = 0$) for Earth-Moon (mass M_A) rotating around the Sun (mass M_B) for an interval of time of 10^8 years. The actual energy of the HD-gravitons E_{gU} was taken $0.95E_U$ according to the total black energy (including black matter energy) [8].

Table 1. The Energy of HD-gravitons and the mass variations in 10^8 years ($\varepsilon_{12} = \varepsilon_{AV}; \beta_B = 0$)

t_U [years]	f_N [N.m^2/kg^2]	$\frac{E_{gUref}}{E_U}$	E_{gU}/E_U	$-\theta_g$ [s^{-1}]	$-\theta_{gAV}$ [s^{-1}]	ε_{AV}	$10^8\beta_A$
13.8·10^9	6.670·10^{-11}	0.95	0.95	2.7381·10^{-22}	2.712·10^{-22}	0.855·10^{-6}	5.3865
13.9·10^9	6.622·10^{-11}	0.95	0.95-0.427·10^{-7}	2.6863·10^{-22}			

2.2 The case of Coulomb force

Let's consider the electric charges q_l, q_2 attached to masses m_1, m_2. The Coulomb force F_C between the charges q_1, q_2 are [4; 5]:

$$F_C = \frac{-q_1 q_2}{4\pi\varepsilon_0 R_{12}^2}; \varepsilon_0 = 8.854.10^{-12}(A\,sec/V\,m). \tag{7}$$

ε_0 being the vacuum permittivity. Because the Universe is electrically neutral, the use of relation (7) is limited at a domain denoted by D_ω which will be specified in the following.

On the other hand, the Coulomb force does not depend on masses m_1, m_2; that is why one will consider the masses m_e, m_P of the electron and proton for negative and positive charges,

respectively. In order to adapt the source formula (1) to obtain the equality with the Coulomb force (attraction for sources of opposite signs) the "vortex equivalent mass rate", $m_V^{'}$ is introduced.

Indeed, a multiplication with $\sqrt{-1}$ gives a rotation with $\pi/2$ degrees of velocities. One writes:

$$m^{'} \to im_V^{'}; i = \sqrt{-1}; F_C = -\frac{m_{V1}^{'} m_{V2}^{'}}{4\pi\rho_\omega R_{12}^2} = -\frac{q_1 q_2}{4\pi\varepsilon_0 R_{12}^2}. \tag{8}$$

ρ_ω is the density of vortex-masses in the domain D_ω.

The interpretation of vortex type interaction is suggested by analogy with the case f the straight line sources and of the ring sources [6].

For example, in case of a circular source line, multiplying by $\sqrt{-1}$ the radial velocity will become tangent, giving a vortex line.

The masses wherefrom one re-circulates the HD- gravitons are the "vortex masses" m_V, given by:

$$m_V = m_{eP}\left|\frac{q}{q_e}\right|; m_{eP} = m_e if q < 0; m_{eP} = m_P if q > 0 \tag{9}$$

q_e is the charge of electron; m_e, m_P are the electron and proton masses, respectively.

Therefore, the mass m_V is the mass of all electrons or protons contributing to the charge q. For $|q| = 1C$, one obtains:$|q|/|q_e| = 1C/|q_e| = 6.242E18$.

The vortexes attributed to a charged body are considered spherical (very often the electrical charges are located near the body surface) and can be represented as rings formed of punct-like vortexes.

The vortex mass rate $m_V^{'}$ of HD-gravitons is given similarly to case of gravity (2) by:

$$m_V^{'} = \theta_V m_V (kg/sec), \tag{10}$$

θ_V (sec^{-1}) being the intensity of recycling.

From equalities (8) and (10) one obtains:

$$\theta_V^2 = \frac{\rho_\omega |q_e|^2}{m_P m_e \varepsilon_0}; \theta_V = \pm|q_e|\sqrt{\frac{\rho_\omega}{m_P m_e \varepsilon_0}}. \tag{11}$$

ρ_ω is the mass density in the extended domain D_ω where the two charges interact.

This extension takes into account that the charges influence propagates around with the speed of light $\boldsymbol{c_V}$, but the extension is limited by facts which are discussed in the following applications. The sign of θ_V is connected with the charge sign. The density ρ_ω is:

$$\rho_\omega = \frac{3(m_{Ve} + m_{VP})}{4\pi r_\omega^3}; r_\omega = K_\omega d; K_\omega > 1, D_\omega = \frac{4\pi}{3}(r_\omega)^3;\ (t_{rec})\frac{2\pi d}{c_{V\ min}} \tag{12}$$

d being the distance between the centers of vortex mass rates (Fig. 1) and K_ω a coefficient of amplification. $(t_{rec})_{min}$ is minimum recycle time necessary for a circle of radius d.
In the following, we give applications for the case of two charges (see Table 2).

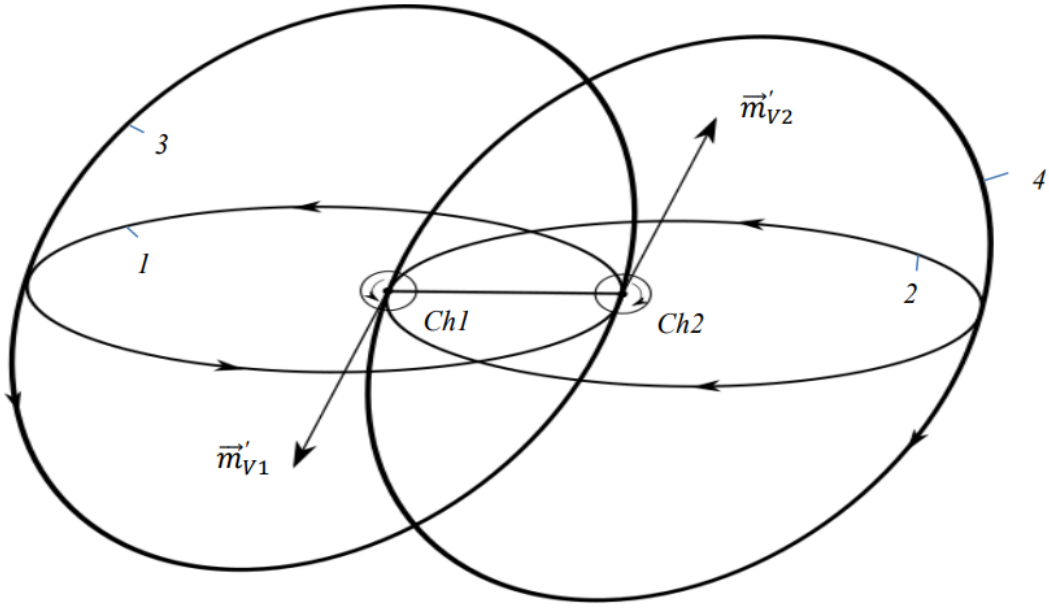

Fig. 1 - The vortex mass-rates m'_{V1}, m'_{V2} interaction; *Ch 1;2*- electric charges of opposite signs; *1; 2; 3; 4* - vortex lines in two different planes passing through *Ch1, Ch2*

2.2.1 Application to the atom of Hydrogen (H_2).

One considers the Hydrogen nucleus and the electron on the first orbit at the distance d = 5.292*E-11m*. One has:

$$|q_1| = |q_2| = |q_e| = 1.602E - 19C; m_{V1} = m_P; m_{V2} = m_e. \quad (13)$$

One takes K_ω = 10 ($K_\omega > 1$ for stability); the relative recycled mass, denoted by $\bar{m}$, has to be small enough i.e.:

$$\bar{m} = |\theta_{CN}|(t_{rec})_{min}. \quad (14)$$

In Table 2, the value obtained is $\bar{m} = 0.251E - 2$ for the H_2 atom. On the other hand, the mass of HD-gravitons in the selected domain D_ω obtained by using equation (10) is much smaller than the atom H_2 mass (about 10^{-24} times).

Remark. $\bar{m}$ is decreasing with $K_\omega^{3/2}$. ***Therefore the electric charge is responsible for the recycling of a very large quantity of HD- gravitons extracted and re-introduced from the very masses that carry it. Thus there is a dynamics between the vortex mass and the electric charge in order to create the Coulomb force.***

Table 2. The interaction parameters for *H2* and *He4*. ($\boldsymbol{K_\omega}$=10)

Case	θ_V, sec^{-1}	r_ω, m	$t_{\omega rec}, sec$	$\bar{m}$	K_ω
Hydrogen atom	$\pm$ 2.265*E15*	5.292*E-10*	1.108*E-18*	0.00251	10
Helium atom	$\pm$ 2.447*E20*	2.4.00 *E-14*	*5.027E-23*	0.0123	10

As one can see from Tables 1;2, the intensity of the flux of HD-gravitons is much higher in case of electrical interaction ($|\theta_V| >> |\theta_{gAV}|$).

2.2.2 Application to the nucleus of Helium.

Unlike the H_2 atom that represents a stable configuration other nuclei (for example, the *He* nucleus) consist of protons and neutrons. The protons are rejecting each other. Besides the binding energy due to the mass defect there exists a coupling particle according to Yukava theory [2]. There are several models of nuclei, for example the drop model and the model in layers (similar to atom models). Also, a lot of particles are possible some of them in connection with the experiments. First, we shall discuss the problem of nucleus stability.

The stability of He nucleus. Let us denote by d_P, E_Y the distance between protons and the energy of each of the two Yukava particles capable to maintain the *He* nucleus with a coefficient of stability denoted by K_S. One considers that the rejection of one particle by a proton and the absorption of the other by the second proton take place with the same velocity *v* given by momentum variation. The time interval Δt_Y is given by the uncertainty formula [4] together with the Gauss constraint [9]. By considering the Δt_Y time interval small enough to use finite differences in place of derivatives, one obtains the following equations:

$$E_Y = \frac{|q_e|}{4\pi d_P}\sqrt{K_S\frac{hc_{vac}}{\varepsilon_0\beta}}; \Delta t_Y = \frac{d_P}{|q_e|}\sqrt{\frac{\varepsilon_0\beta h}{K_S c_{vac}}}; \beta = \frac{v}{c_{vac}}; \beta \in (0;1). \tag{15}$$

Taking $d_P = 2.4E-15m$ (two proton radii) one obtains:

$$K_S = 274.192\beta^2; E_Y = 1.582\beta E-11J; \Delta t_Y = 6.667\beta^{-1}E-24sec, \tag{16}$$

depending on the emission/ absorption of the Yukava particle by the protons. Regarding parameter β, it cannot be equal to unity because the Yukava particle is a short lifetime one, whereas the photon is stable. However β should be pretty close to unity to obtain time intervals of the order $10^{-24}sec$. One notes the high value of the coefficient of stability, K_S.

The parameters of protons rejection. One has the distance between the centers of protons $d_P = 2.4E-15m$ and:

$$|q_1| = |q_2| = |q_e| = 1.602E-19C; m_{V1} = m_{V2} = m_P = 1.672E-27Kg; \tag{17}$$

$$(\theta_V)_{He} = \pm|q_e|\sqrt{\frac{6}{4\pi m_P r_\omega^3}}; \bar{m} = |(\theta_V)_{He}|(t_{rec})_{min}. \tag{18}$$

An analysis similar to the H_2 atom regarding the Coulomb force between the two protons of the *He* nucleus was done. The "vortex masses" are associated to protons only. Although there exist two neutrons this influences only the density of HD-gravitons related to the gravity. The numerical results for the parameters used to describe the electric interaction in hydrodynamic terms are given in Table 2.

3. CONCLUSIONS

A possible way of unification of the gravity (Newton) and electric (Coulomb) by using a hydrodynamic analogy was presented. ***It consists in introducing sources and vortexes interacting in a fluid of photon-like particles, called HD-gravitons.*** In case of gravity the uncharged masses act as sources in an incompressible fluid, on the Universe scale, giving attraction for two sources, both for emission and absorption. This modifies the body masses whilst the whole Universe is filled of HD - gravitons of variable density in time [8]. An

important consequence is ***the dependence of the coefficient of gravity and masses in Newton law on the age of Universe*** [7].

As regards the Coulomb force it is assimilated to ***vortex-mass interactions***, the electric charges being responsible for the recycling of HD-gravitons taken ***mainly from the very masses which carry the charges***, in large quantities. Therefore ***an analogy between the electric charges and vortex-masses is suggested.*** Unlike the gravity sources which act on the global scale, the effect of vortexes takes place on a local scale in a domain containing the charged bodies. Some examples of calculations for the atom of Hydrogen and for the nucleus of Helium are given.

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