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A possible way to unify the electrostatic (Coulomb) and nuclear (Yukawa) interactions by using a hydrodynamic analogy

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Abstract. In a previous paper [3] we have used the hydrodynamic analogy to give a model for gravity. A carrying particle named HD-graviton was introduced. In another paper [8], a hydrodynamic analog permitted to unify the theory to include the Coulomb force using so called "vortex masses" having as hydrodynamical correspondent the vortices. In this paper we will give a hydrodynamic interpretation to the YUKAWA (nuclear) interaction. We remember that the hydrodynamical analog for the electrical charges are the vortices.

Keywords: HD-graviton, vortex-mass, nuclear interaction.

1. Introduction

The main forces acting in the Universe are related to the gravity and electromagnetic forces. Whilst the particle motion affects only quantitatively the gravity, the electric charges in motion create new phenomena like the magnetic field. 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 means of 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 (H2). As regards the

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atom nuclei (example, the Helium nucleus) new aspects came into being - so called strong interaction responsible from the nucleus stability. Efforts are done to unify all the four interaction (gravitational, electromagnetic, nuclear or strong and weak interactions to obtain so called theory of everything. Therefore a unification of Coulomb and Yukawa forces could help.
A **principle of equivalence** can be formulated**: for any type of force 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.

2. A hydrodynamic analog for Coulomb forces

We first will shortly present the hydrodynamic analogy for Coulomb interaction. In our previous papers [1; 2] a hydrodynamic analogy for the gravity force was obtained. There is attraction both for two positive and two negative sources which corresponds to the gravity force producing only attraction as well. On the contrary, the Coulomb force [5; 6] is attraction for electric charges of opposite sign and repelling for charges of the same sign.

2.1 The case of Coulomb forces

This case was treated in [8]. One considers 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 is:

$$F_C = -\frac{q_1 q_2}{4\pi\varepsilon_0 R_{12}^2};\ \varepsilon_0 = 8.8541\cdot 10^{-12}\ \text{F/m} \tag{1}$$

ε_0 being the vacuum permittivity. Because the Universe is electrically neutral, using of relation (1) 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 considers the masses m_e , m_P of the electron and proton for negative and positive charges respectively.
In order to adapt the formula of source interaction to formula (1) to obtain the equality with the Coulomb force (attraction for sources of opposite signs) one introduces the "vortex equivalent mass rate", m'_V. Indeed a multiplication with $\sqrt{-1}$ gives a counterclockwise rotation with 90° of velocities. One writes:

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

ρ_ω is the density of vortex-mass rates in the domain D_ω. The interpretation of vortex type interaction is suggested by analogy with the case of the straight line sources and of the ring sources [8] where a line of sources is transformed in a vortex line via the multiplication with $\sqrt{-1}$. The vortices will re-circulate the HD-gravitons.

Because any electric charge is related to a mass m_V one writes:

$$m_V = m_{eP}\left|\frac{q}{q_e}\right|;\ m_{eP} = m_e\ if\ q<0;\ m_{eP} = m_P\ if\ q>0 \tag{3}$$

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:

$$|q|/|q_e| = 1\text{C}/|q_e| = 6.242\cdot 10^{18}.$$

The vortices 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 point-like vortices.

The vortex mass rate m'_V of HD-gravitons is given similarly to case of gravity by:

$$m'_V = \theta_V\, m_V\ \ (kg/\sec) \tag{4}$$

θ_V (s^{-1}) being the intensity of recycling. From equalities (2) and (3) one obtains:

$$\theta_V^2 = \frac{\rho_\omega\,|q_e|^2}{m_P m_e \varepsilon_0};\ \theta_V = \pm|q_e|\sqrt{\frac{\rho_\omega}{m_P m_e \varepsilon_0}}; \tag{5}$$

ρ_ω is the mass density of the HD-graviton field in the extended domain D_ω where the two charges interact. This extension takes into account the fact that the charges influence propagates around with the speed of light c_V but the extension is limited by the facts that are discussed in the applications. The sign of θ_V is connected with the charge sign. The density ρ_ω is:

$$\rho_{\omega H} = \frac{3\left(m_{Ve} + m_{Vp}\right)}{4\pi r_\omega^2};\ r_{\omega H} = K_{\omega H} d;\ K_{\omega H} > 1;\ D_\omega = \frac{4\pi}{3} r_\omega^2;\ \left(t_{rec}\right)_{\min} = \frac{2\pi d}{c_V}, \tag{6-a}$$

for Hydrogen and

$$\rho_{\omega He} = \frac{6\left(m_{Ve} + m_{Vp} + m_{Ne}\right)}{4\pi r_\omega^2};\ r_{\omega He} = K_{\omega He} d;\ K_{\omega He} > 1;\ \left(t_{rec}\right)_{\min} = \frac{2\pi d}{c_V}, \tag{6-b}$$

for Helium.

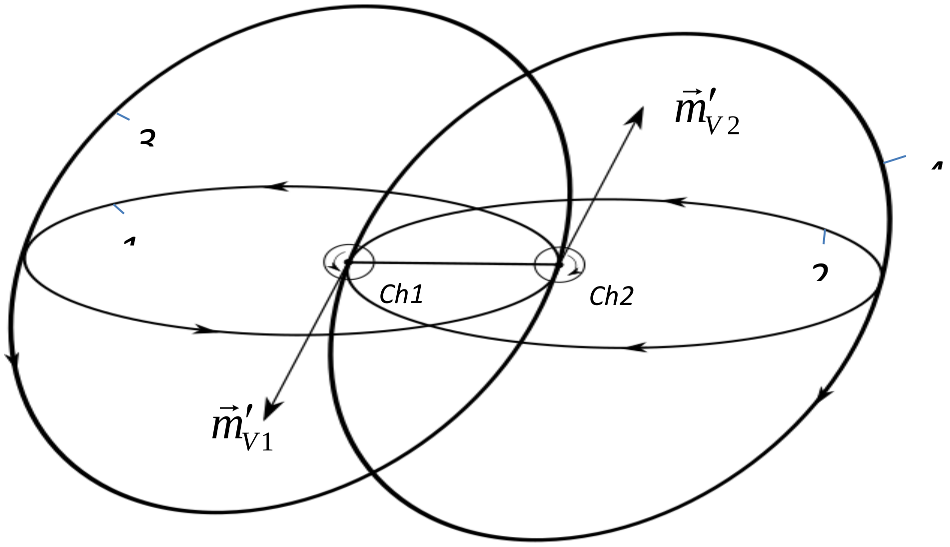

Fig. 1. The vortex mass-rates m'_{V1}, m'_{V2} interaction; *Ch 1;2*- electric charges of opposite signs; *1; 2; 3; 4* - vortex lines in two different planes passing through *Ch1*, *Ch2*

Table 1
The interaction parameters for H2 and He.(K_ω =10)

Case	$\theta_V \sec^{-1}$	r_ω ,*m*	$t_{\omega rec}$ [*sec*]	K_ω
Hydrogen atom	$\pm 6.726 \cdot 10^{9}$	$0.53 \cdot 10^{-12}$	$1.665 \cdot 10^{-20}$	1000
Helium atom	$\pm 6.268 \cdot 10^{6}$	$140 \cdot 10^{-12}$	$4.398 \cdot 10^{-18}$	1000

As one can see from Table 1, the intensity of the flux of HD-gravitons is much larger in case of electrical interaction as compared to the gravity.
Applications were done for Hydrogen and Helium atoms (see Table 2).

3. A hydrodynamic analog for Yukawa forces

3.1 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 directions (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:

$$\frac{m_{\pi 0}V_{\pi 0}}{\Delta t} = \frac{k q_P^2}{4\pi\varepsilon_0 d^2}, \qquad (7)$$

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

$$\Delta t = \alpha V_{\pi 0 life}, 0 < \alpha < 1;\ V_{\pi 0 life} = 2 \cdot 10^{-16} s,\ k = 137 \qquad (8)$$

$V_{\pi 0 life}$ being the meson π^0 life and k = 137 a factor of nucleus stability.

From (7) and (8), one obtains:

$$V_{\pi^0} = 5.908 \cdot 10^4 \alpha \qquad (9)$$

For α = 0.1, one obtains $V_{\pi^0} = 5908$ m/s.

3.2. The hydrodynamic analogy 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 absorption:

$$F_{HD} = \frac{M_1^{'}M_2^{'}}{4\pi\rho_{gN}d^2} = \frac{\theta_N^2 M_1 M_2}{4\pi\rho_{gN}d^2} \qquad (10)$$

$\theta_N, M_1, M_2, \rho_{gN}$ being the intensity of emission/attraction for nucleus, 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:

$$\theta_N = \pm \frac{q_P}{m_P}\sqrt{\frac{k\rho_{g_N}}{\varepsilon_0}} \qquad (11)$$

k being a coefficient of stability (k = 137).

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 calcculates the density of matter inside this nucleus.

The radius of the nucleus of Helium is [10]:

$$r_{NHe} = 1.2(4)^{1/3} = 1.905 \cdot 10^{-15}\text{m} \qquad (12)$$

and the corresponding matter density:

$$\rho_{NHe} = 2.911 \cdot 10^{17}\text{kg/m}^3;\ \rho_{gNHe} = \beta\rho_{NHe};\ \beta << 1 \qquad (13)$$

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 1).

4. Conclusions

A possible way to unify the Coulomb and Yukawa forces by using a hydrodynamic analogy was presented. It consists of introducing vortices (in case of Coulomb forces) and sources (in case of Yukawa forces) interacting in a fluid of photon-like particles called HD-gravitons. In case of sources, one has attraction for two sources both for emission and absorption.
In case of vortices, one has attraction for two vortices of opposite sense and repelling otherwise.
A principle of equivalence was 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.
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, which act at a global scale, the effect of vortices takes place at local scale in a domain containing the charged bodies. Examples of calculations for the atoms of Hydrogen and Helium are given [8].
For a comparison of the HD-graviton, intensity lines of HD sources and the principle of equivalence can be used. The result was that the HD-graviton intensity for vortices and spherical sources is of the same order of magnitude. In case of nuclear (Yukawa) interactions the HD-gravitons intensity is much larger as compared to the case of gravity forces [2; 4; 6] even if one considers the whole black energy formed of HD-gravitons. General data were takeh from [10]

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