Quantum gravito-electromagnetism and dark matter: the role of the gravitational dipoles.

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Abstract.

The idea of quantization of the gravitational dipole may be applied to any matter, including photons. That makes the photon while having near-zero (negligible for gravitation) mass obligatory holding non-zero gravitational dipole h/c. Being polarized by the gravitational field those dipoles create illusion of the additional mass (dark matter). (Because the positive charges in the gravito-electromagnetism attract, not repel like in electromagnetism, dipole polarization makes the field stronger, not weaker). The dipoles may be indeed due to the presence of the undiscovered yet particles (and even from the hypothetical particles which interact only gravitationally), but evaluations shows that simple photons have concentration in the space enough to explain the accelerated rotations of galaxies.

Introduction.

In the recent publications the idea of quantization of the gravitational dipole was devised [1,2]. While for the first glance it seems very far from astrophysics and dark matter problem (because the gravitational dipole is so small, on the order of h/v, v is velocity of the particle - h/c for photons), it turned out that the modern observations of the absence of dark matter in ultra-diffuse galaxies and the unusual behavior of the mass-luminosity curve for binary stars hints onto the presence of the some sort of field, not dark matter as being composed from classical particles [2-4]. The formula was proposed for the gravity in the presence of such distortion in the gravitational field, formally similar to electrostatic one:

$$F=(\varepsilon_g/[4\pi\varepsilon_{go}])*m_1*m_2/r^2=\varepsilon_g*G*m_1*m_2/r^2 \quad (1)$$

Where ε_g would be gravito-electric permittivity of matter (space) similar to the value of ε in electromagnetism. It is in the numerator instead of denominator in the electromagnetism because the gravity is enhanced. Indeed, since the positive charges in gravity attract each other, not reject as in electromagnetism, the dipole will be oriented in such a way that it will enhance the field [5]. In [5] such particles were postulated but it was not clear where to find such matter. Indeed, for the enhancement of the gravity it would be necessary to have gravitational dipoles. But it turned out that the inevitability of the quantization of the gravitational dipole (strictly forbidden to be equal to zero) gives the necessary source for the enhancement of the gravity. Indeed, as it was speculated in [6] the gravitational dipole for photon is not zero and is at least h/c (h/2c in another quantization rule). Since the photons are abundant in the Universe, may be their presence will lead to the necessary enhancement of the gravity observed as dark matter?

Main part.

In the Solar system the total number of the photons irradiated by the Sun is 1*10exp(45) photons per second [7]. Let's assume the radius of solar system is one light hour (1*10exp(12) m). Since light should travel time of 3600 seconds to reach the boundary of the Solar system, in the Solar system simultaneously there are 3.6*10exp(48) photons. That would be (for 4*10exp(36) cubic meters) around 10exp(12) photons per cubic meter. The distance between photons thus around r_o=10exp(-4) meter. How to evaluate at least very approximately the influence of the dipoles (recalculate them into some kind of effective mass)?

In analogy with electrostatics the field created by the dipole (perfectly oriented) at the distance of r_o is according to the formula:

$$E_g=G*d_g/r_o^3 \quad (2)$$

Where d_g is gravitational dipole, E_g is the gravitational field.

And the field created by some mass at the same distance is:

$$E_g=G*m/r_o^2 \quad (3)$$

And from (2) and (3) the effective mass would be:

$$m=h/[c*r_o] \quad (4)$$

The effective dipole mass density would be $\rho_d=3m/(4\pi r_o^3)=3h/[4\pi c r_o^4]$=1.7*10exp(-26) kg/m^3. Since the ordinary mass is dominated by the Sun (2*10exp(30) kg) for the same volume of 4*10exp(36) cubic meters the density is 5*10exp(-7) kg/m^3 – inside the Solar system the effect is very small and all the gravitational effects are determined by the mass only.

For the Galaxy situation is the same: the mass density of Milky way is around 8*10exp(-20) kg/m^3, so inside the galaxy the influence of the dipoles is not really visible. But for the intergalactic space the mass density becomes much smaller [9] – only around 10exp(-29) g/cm^3 (10exp(-26) kg/m^3).

It means that at the edge of Galaxy provided the Galaxy is bright enough to have enough photons near the border the effective dipole mass density becomes comparable to the mass density of the intergalactic space. That border is exactly the place the mysterious dark matter appears (halo around the Galaxy). So the idea of the dipole origin of this mysterious substance is at least a little bit supported (it is necessary to remember that other particles with negligible mass should also contribute to the dipole effective mass, such as slow neutrinos and all other particles including possibly undiscovered yet).

If the Galaxy is ultra-diffuse the amount of light inside is obviously smaller and in this case the Galaxy rotation should be governed by the visible masses only, exactly as observed.

One more idea concerning the gravitational dipole of photons and neutrinos: they must be at least h/c but more generally Nh/c or h/c*(N+1/2) depending upon the quantization rule. Indeed, the De-Broglie wavelength for photon is λ, but the real photon is much larger than λ. The correlation length of star photon (say green one) is around 3 meters (typical fluorescence time is 10 ns and speed of light is 3*10exp(8), multiplication yields 3 m). It means that the photon is 3m/500 nm=6*10exp(6) times longer than λ and associated with λ gravitational dipole. If the value N is indeed 6*10exp(6) that makes instantly the gravitational dipoles of light very good candidates for "dark matter" – at this value of gravitational dipoles present the added gravity may be quite strong. Even if the number of photons in the intergalactic space is much smaller (say only 410 photons per cubic cm [10], 4*10exp(8) photons per cubic meter) if the gravitational dipole is 6*10exp(6) times stronger, the final value for the elementary gravitational dipole would be 2.4*10exp(15) per cubic meter, distance is just r_o=7*10exp(-6) m. It means that the effective dipole mass from formula (4) increases a lot and effective dipole mass density jumps 4 orders of magnitude, reaching 5*10exp(-22) kg/m^3. It is still very small for Solar system but large enough to mess with gravity at galaxy scale (around the same as normal matter) and definitely very strong for the intergalactic media (for cluster of galaxies the effect should be the strongest, which is indeed observed in dark matter observations).

The proposed speculation does not deny the possibility of discovery of dark matter (the undiscovered particles only weakly interacting with matter through strong and electro-weak forces) or "real dark matter" (interacts only gravitationally). However, it may turned out that very accurate accounting of simpler matter (light, neutrinos, other particles) will create the gravitational polarization (εg in formula (1)) large enough to explain all the anomalies in the rotation of the galaxies and galaxy clusters. It seems that the research in the direction outlined in [1] should be intensified to find how different is gravity from electromagnetism – only than it would be possible to start designing of some unifying theories for theory of everything.

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