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Hypothetical ether viscosity as explanation of Galactic spectra redshift and gravitational interaction

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Abstract

Modification of Maxwell's equations by small nonlinear term interpreted as ether viscosity can explain both the redshift of distant Galaxies spectra and gravitational forces. Hypothetical viscosity laser action of matter can be a source of quasi-standing gravitational wave of $\lambda_g \approx 3.5$ kilopersec wavelength, which could explain still not well understood spiral arm thickness in our Galaxy equal to about $\lambda_g/2$.

1. Introduction

It is well known, that equations of electrodynamics show great similarities with equations of theory of liquids and aerodynamics. Taking theses similarities as a starting point, it is suggested that some nonlinearities already well-known in liquids and gases when applied to the theory of electromagnetic waves are able to supply explanation of Galactic spectra redshift and gravitational interactions.

2. Nonlinearities in equations of aerodynamics applied to equations of electrodynamics

Two basic mechanisms contributing nonlinear terms to liquid and gas flow equations are known [3]:

I. Viscosity and friction losses.
II. Dispersion in sound velocity in waves of large amplitude.

Mathematical descriptions of both cases are given in Appendix I and II respectively.

*) IBJ - Instytut Badań Jądrowych (Institute of Nuclear Research), actual name: NCBJ – National Center for Nuclear Research, Świerk, Poland

The Maxwell equations are frequently written in the form:

$$\Box\varphi = \left(\nabla^2 - \frac{1}{c_0^2} \frac{\partial^2}{\partial t^2} \right) \varphi = -4\pi\rho \tag{2.1}$$

with: φ - electromagnetic scalar potential which, as suggested in [1] *) is proportional to energy density or to hypothetical ether pressure un incremental volume dV, φ [V] – in MKSI units, φ [m^2] – in LT units [1] **), c_0 – velocity of light in space of low energy density, ρ - charge density.

The expression for vector potential $\vec{A} = \rho\vec{V}$ is similar and will not be considered here.

It can be shown (Appendix III), that in the case of viscous flow, equation (2.1) takes the form (with assumption $\rho = 0$):

$$\frac{\partial^2 \varphi}{\partial t^2} = \left(c_0^2 + a\frac{\partial}{\partial t} \right) \nabla^2 \varphi \tag{2.2}$$

where $a = \frac{4}{3}\nu_k$, ν_k - kinematic viscosity factor, which can be written as

$$\left(\nabla^2 - \frac{1}{c_0^2}\frac{\partial^2}{\partial t^2} - \frac{4}{3}\frac{\nu_k}{c_0^2}\frac{\partial}{\partial t} \right) \varphi = 0 \,. \tag{2.3}$$

Equation (2.3) is identical to relativistic Klein-Gordon equation (Appendix IV) and it becomes natural to assume that the term $\frac{4}{3}\frac{\nu_k}{c_0^2}\frac{\partial}{\partial t}$ describes steady, continuous rest energy loss due to viscosity losses.

Of course it is hardly believable, that any "friction" in the case of electromagnetic waves could be converted into something like "heat". But it is rather possible, that viscosity losses will be emitted into space as an additional "noise", that is electromagnetic radiation which may be expected to be of extremely large wavelength.

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*) **) In [1], the possibility of existence of absolute time as well as possibility of expressing all physical quantities in LT (length, time) system of units is examined. In LT systems of units we have:

energy = (length)^5 (1.1)

charge = (length)^3 (1.2)

mass = (length)^3×(time)^2 (1.3)

The present system of units of electrodynamics consisting of h, c, l (Planck's constant, velocity of light, length) seems to be insufficient due to possible nonlinearities of h in volumes of high energy density [2].

3. Determination of the value of viscosity factor of vacuum (or ether) assuming its relation to the Galactic redshift

The observed redshift of distant Galaxies spectra is interpreted in several ways, mostly as Galaxies escape [4], or as a consequence of space geometry [6]. Assuming the validity of Bellert's law [6], which is a modified Hubble's law:

$$\Delta f = -kDf_0 \tag{3.1}$$

where: Δf – redshift (reduction of frequency) of quantum emitted with initioal frequency f_0 due to path over distance D, $k = \frac{1}{c_0 T}$, c_0 – velocity of light, $T = (1.3 \pm 0.6) \cdot 10^{10}$ years.

We obtain

$$\Delta f = -8.13 \cdot 10^{27} f_0 D \quad [\mathrm{m}]. \tag{3.2}$$

In contrast to existing hypotheses let us assume, that redshift is caused solely by viscosity term from equation (2.3). Then energy lost over distance dx will equal to:

$$\Delta E = h\Delta f = -\frac{4}{3}\frac{m\nu_k}{\varphi}\frac{d\varphi}{dt} = -\frac{4}{3}\frac{mc\nu_k}{\varphi}\frac{d\varphi}{dx}, \tag{3.3}$$

$$dx = c_0 dt, \quad \varphi = -\frac{E}{q}, \quad m = E/c_0^2,$$

E – energy, q – charge, m – mass. After rearranging:

$$E = -\frac{4}{3}\frac{\nu_k}{c} E_0 \times D[\mathrm{m}] \tag{3.4}$$

or

$$\Delta f = -\frac{4}{3}\frac{\nu_k}{c} f_0 \times D[\mathrm{m}]. \tag{3.5}$$

Comparing (3.5) with (3.2) one can compute ether or vacuum kinematic viscosity factor ν_k:

$$\boxed{\nu_k = 1.83 \times 10^{18} \quad \frac{\mathrm{m}^2}{\mathrm{s}}} \tag{3.6}$$

4. Hypothesis on viscosity origin of gravitational interaction

Let us compare the gravitational linear energy density with losses due to viscosity. Two masses of 1 kg each placed 1 m from each other are attracted with gravitational force F_g:

$$F_g = G\frac{m_1 m_2}{r^2} = 6.673\times10^{-11}\,\text{N}\,, \tag{4.1}$$

$G = 6.673\times10^{11}\ \text{m/kgs}^2$ - gravitational constant, $m_1 = m_2 = 1$ kg, $r = 1$ m. Such force makes on length of 1 m the work equivalent to energy ΔE_g:

$$\Delta E_g = F_g \times 1\,\text{m} = 6.673\times10^{-11}\ \text{J}\,. \tag{4.2}$$

Rest energy of both masses equals:

$$E_g = 2\times1\,\text{kg}\times c_0^2 = 1.8\times10^{17}\ \text{J}\,. \tag{4.3}$$

Relative loss of energy:

$$\frac{\Delta E_g}{E_g} = 3.71\times10^{-28}\,. \tag{4.4}$$

Comparing (4.4) to (3.2) we have the relative loss for viscosity:

$$\frac{\Delta E}{E} = -8.13\times10^{-27}\,. \tag{4.5}$$

One can state, that there is a good agreement in order of magnitude between two values. This agreement can encourage us to state the following hypothesis: <u>Gravitation and redshift are caused by the same phenomenon, namely losses due to viscosity</u>.

It may be interesting to note, that in LT system of units both <u>viscosity kinematic factor ν_k and magnetic field H are measured in the same inits L^2T^{-1}</u>.

5. Energy losses due to viscosity for photons and particles

In conclusion we can underline once more, that each particle or photon loses constantly some energy due to viscosity losses. For energies not exceeding E_e (electron rest energy) the energy lost per second and per time interval t equals:

$$\Delta E = 2.44\times10^{-18} E_0 \times t\ \ [\text{s}] \tag{5.1}$$

where E_0 – energy of photon or rest energy of particle.

For $E_0 > E_e$, (3.2, 5.1) must be modified due to h – nonlinearity [2]. If we take equation (3.2) as a basic equation then, as shown in [2] for $E > E_e$, equations (3.2, 5.1) can be written as:

$$h\Delta f = -8.13\times10^{-27}\times hp/\eta/\,f_0\times D\ [\mathrm{m}] \qquad (3.2a)$$

or

$$\Delta E\!\!\diagup_{1\mathrm{m}} = -8.13\times10^{-27}\times p(\eta)E_0\times D\ [\mathrm{m}] \qquad (3.2b)$$

and

$$h\Delta f = -2.44\times10^{-18}h\times p(\eta)\,f_0\times t\ [\mathrm{s}] \qquad (5.1a)$$

or

$$\Delta E\!\!\diagup_{1\mathrm{s}} = -2.44\times10^{-18}\,p(\eta)E_0\times t\ [\mathrm{s}] \qquad (5.1b)$$

where: $p(\eta)=\eta\mathrm{ctgh}\eta$, $\eta = E_0/E_e -$ normalised energy, $E_e -$ rest energy of electron.

Equations (3.2a, b) and (3.7 a,b) are general, and in special case of $E_0 \ll E_e$ one has $\eta \ll 1$; $p(\eta)\approx 1$ and equations become identical to (3.2) and (3.7).

Full physical interpretation of $p(\eta)$ factor is given in [2]. Here we can say, that the left hand side of (3.2) and (5.1) must be multiplied by non-modified value of Planck's constant, because Δf corresponds to very small energies $h\cdot\Delta f \ll E_0$, but the right hand side of (3.2) and (5.1) must be multiplied by modified Planck's constant $h' = h\cdot p(\eta)$ whenever $E_0 \ge E_e$.

6. Evaluation of the energy lost due to viscosity during one resonant period of proton

Protons are basic "building bricks" of Universe (from the mass point of view) so it is interesting to evaluate their loss of energy due to viscosity. During one period of proton resonant-state, which equals [2]:

$$T_p \cong 3\times\frac{E_e}{h} = \left(3.71\times10^{20}\,\mathrm{Hz}\right)^{-1} = 2.7\times10^{-21}\mathrm{s}\,. \qquad (6.1)$$

The loss of energy can be estimated from (4.4):

$$E_p = 3.71\times10^{-28}\times1836\times2.7\times10^{-21} = 1.82\times10^{-45}\,\mathrm{J} \qquad (6.2)$$

$p(\eta)\cong1836$.

7. Hypothesis of gravitations emitted due to viscosity losses

Let us now assume, that energy ΔE_p from (6.2) is the principal energy of gravitations emitted during one period of proton resonant-state. Then the wavelength of gravitons equals:

$$\lambda_g = \frac{hc}{\Delta E_p} = \frac{hc}{E_g} = 1.09\times 10^{20}\,\mathrm{m} = 3546\ \mathrm{parsec}\,. \tag{7.1}$$

The period of oscillation of gravitons equals:

$$T_g = \frac{\lambda_g}{c} = 3.63\times 10^{11}\,\mathrm{s} = 11511\ \mathrm{years}\,. \tag{7.2}$$

If the energy lost due to viscosity wouldn't be reabsorbed by proton from other sources of Galactic noise, then the life of proton would be:

$$E(t) = E_p \mathrm{e}^{-\lambda t} = E_p \mathrm{e}^{-2.44\times 10^{-18}\,p(\eta)\times t}\,, \tag{7.3}$$

$$E(t) = \frac{E_p}{e}\ \text{ for } t = \tau = \frac{1}{2.44\times 10^{-18}\,p(\eta)} = 7.08\times 10^{6}\ \text{years}\,. \tag{7.4}$$

Let us now make several remarks on the nature of gravitons:

1. Gravitons of various wavelength are emitted due to viscosity practically by all photons travelling with velocity c_0 as well as by particles. But protons and neutrons contain the highest percent of the whole energy of matter. Then it is reasonable to assume, that the wavelength given by (6.1) will predominate.
2. Wavelength λ_g is very large and the period of oscillation very long. It is then rather probable , that all oscillators within the distances comparable to the wavelength can make resonance, or a kind of laser action – it means that all protons will synchronise their radiation of viscosity losses to form gigantic standing wave of about 3.5 kiloparesc wavelength.

Let us compare this with our Galaxy (Fig. 1) [5]:

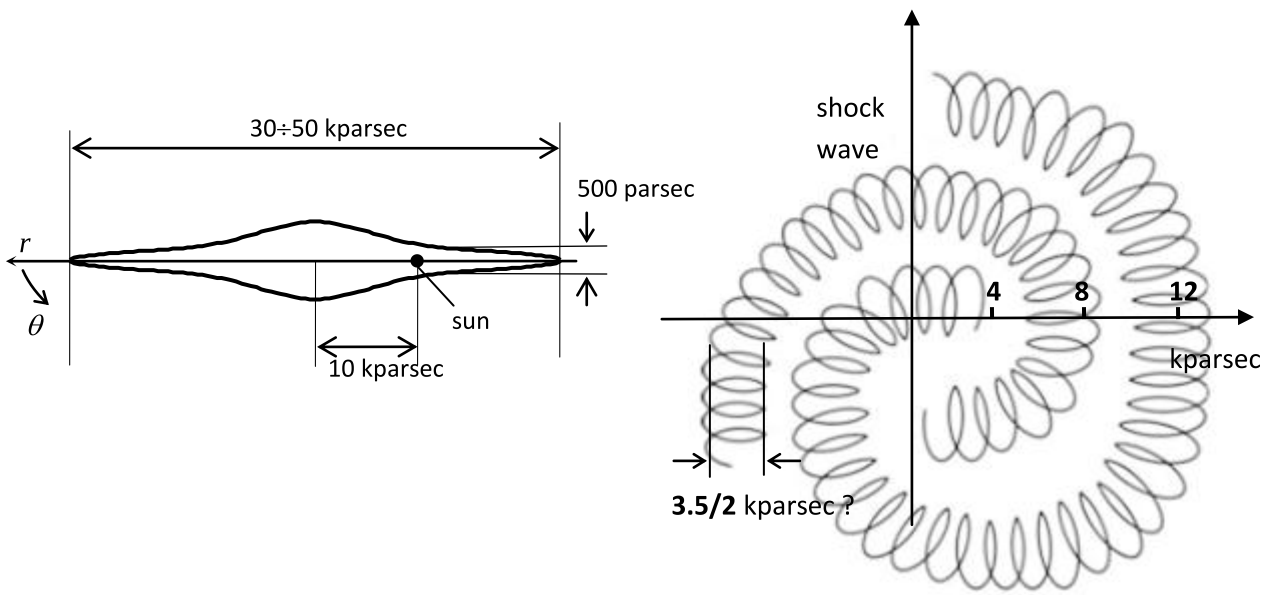

Fig.1

Whatever could be the correct equation of galactic spiral, the compressions of Milky Way seem to have thickness just corresponding to computed graviton standing waves. It implies immediately, that due to electromagnetic nature of gravitational standing waves the gravitational attraction within the region $\frac{1}{2}\lambda_g$ of standing wave probably corresponds to gravitational repulsion in regions, where the phase of standing wave is opposite. Such assumption would explain existence of vast empty spaces between the Milky-Way spirals, and the still puzzling spiral arm thickness (ref. [5], page 356).

Considering what was said above one is able to make the following hypotheses about the nature of gravitational interaction:

1. Gravitational forces are of electromagnetic nature.
2. Gravitons are emitted by all energetic objects due to viscosity of hypothetical ether. Proton and neutron gravitons of 3.5 kpc wavelength predominate and probably form a gigantic standing wave.
3. Isotropic radiation of gravitons gives the net zero repulsive force for sole object. When considering two objects (masses) within $\frac{1}{2}\lambda_g$ distance, then the force of attraction will appear as an effect of:
   - Possible reabsorption of gravitons between objects. Then radiation pressure of non-compensated external directions will press the objects together (force of attraction). This effect seems to be possible if energies of absorbed gravitons will be greater than these of reemitted gravitons.
   - Gigantic laser action of gravitons will cause the compression (force of attraction) of all objects within $\lambda_g/2$ region.
4. Newton's law $F \cong K\frac{m_1 m_2}{r^2}$ seems to be special case, valid only for $r \ll \lambda_g$. It is expected, that for $r \simeq \lambda_g/2$ they can change their sign (gravitational repulsion).
5. If we assume that gravitons are normal photons despite their extremely large wavelength, then we can expect spin 1 for gravitons. But quantum theory states gravitons should have spin 2. This is probably due to double resonant-state of proton in comparison to electron [2].

For spin 2 the hypothetical "radius" of point-like photon of energy E_g would be equal to:

$$r_g \cong 32\pi\sqrt{2\varepsilon_0 E_e/1\text{m}^3} \times \frac{E_e}{E_g} = 5.44\times10^{21}\text{m=177 kparsec}. \quad (7.5)$$

For spin ½ (it would be the same spin as that of protons which are the source of radiation) we would have the radius

$$r_g = 44.25\text{ kparsec}. \quad (7.6)$$

May be it is only an accidental case, that this last value is to our Galaxy diameter, If one would assume the model of pulsating Galaxy (as in the case of disc-shape electron [2]), then it would mean that Galaxy is in half a way of its expansion period.

Let us now estimate parameters of electrons graviton:

$$E_{ge} = 2.0\times10^{-31}\times1.31\times8.1\times10^{-21}\,\mathrm{Hz} = 2.12\times10^{51}\,, \tag{7.7}$$

$$\lambda_{ge} = \frac{hc}{E_{ge}} = 9.4\times10^{25}\,\mathrm{m}\,. \tag{7.8}$$

This wavelength is rather close to cosmological horizon, which we obtain when $p(\eta) = 1$ and which is equal to $1.23\times10^{26}\,\mathrm{m}$ [6].

Conclusions

It seems very likely that assumption of existence of electromagnetic viscosity with kinematic factor $\nu_k = 1.83\times10^{-18}\,\mathrm{m}^2/\mathrm{s}$ can explain nature of:

- galaxies spectra redshift
- gravitational interaction,
- width of Milky-Way arms constructing disc-spiral shape of our Galaxy.

Appendixes

Nonlinearities in equations of aerodynamics applied to equations of electrodynamics

Appendix I. First mechanism is due to viscosity and friction losses

In the case of viscose flow the Euler equation is converted into Navier-Stokes equation:

$$\frac{d\vec{v}}{dt}-\frac{\nu_k}{3}\,\mathrm{grad}\left(\mathrm{div}\,\vec{v}\right)-\nu_k\nabla^2\vec{v}=-\frac{1}{\rho_m}\,\mathrm{grad}\,p+F \tag{I.1}$$

where: $\vec{v}$ - flow velocity, $\frac{d\vec{v}}{dt}=-\frac{\partial\vec{v}}{\partial t}+\vec{v}\,\mathrm{grad}\,\vec{v}$ - substantial derivative (in Euler coordinates), $\frac{\partial\vec{v}}{\partial t}$ - local derivative (in Lagrange coordinates), $\vec{v}\,\mathrm{grad}\,\vec{v}$ - convection derivative, ν_k - kinematic viscosity factor [m^2/s], ρ_m – mass density, F – potential of mass forces, p – pressure.

Critical discussion of Stokes equation can be found in [3] but we will accept its validity and assume that $\mathrm{grad}\left(\mathrm{div}\,\vec{v}\right)=0$ due to non-compressive flow.

Appendix II. Second mechanism causing nonlinearities is due to dispersion in sound velocity for waves of great amplitude

For small perturbations the group and phase velocities of sinusoidal wave are both equal to:

$$c=\sqrt{\frac{\partial p}{\partial\rho_m}}=c_0 \tag{II.1}$$

where ∂p - incremental change of pressure, $\partial\rho_m$ - incremental change of density. For gases and liquids the $p(\rho_m)$ characteristic is usually logarithmic. It can be linearised as in (II.1) only for small amplitudes of waves. For large amplitudes (II.1) should be replaced by [3]:

$$c_Z=c_0+\frac{\rho_m}{c_p}v\frac{\partial c_Z}{\partial\rho_m} \tag{II.2}$$

where c_0 – velocity of wave of small amplitude in medium being in rest and having parameters (p_0, ρ_{m0}, T_0) (T_0 – temperature), c_p – velocity of profile of perturbation in medium having parameters (p, ρ_m, T), c_Z – velocity of propagation of the state of perturbation, v – flow velocity.

For adiabatic propagation:

$$\frac{p}{p_0}=\left(\frac{\rho}{\rho_0}\right)^k=\left(\frac{T}{T_0}\right)^{\frac{k}{k-1}}, \tag{II.3}$$

$$\left(\frac{c}{c_0}\right)^2=\left(\frac{\rho_m}{\rho_{m0}}\right)^{k-1}=\left(\frac{p}{p_0}\right)^{\frac{k-1}{k}}=\frac{T}{T_0}. \tag{II.4}$$

For a plane wave the approximate equation of potential has the form

$$\frac{d^2\varphi}{dt^2}=c_0^2\frac{d^2\varphi}{dx^2}+(k-1)\frac{\partial\varphi}{\partial t}\frac{\partial^2\varphi}{\partial x^2}+2\frac{\partial^3\varphi}{\partial x^2\partial t}. \tag{II.5}$$

Appendix III.

In the case of plane wave (I.1) gives the equation of potential [3]:

$$\frac{\partial^2\varphi}{\partial t^2}=c_0^2\frac{d^2\varphi}{dx^2}+\frac{4}{3}\nu_k\frac{\partial^3 v}{\partial x^2\partial t}. \tag{III.1}$$

Comparing (II.5) and (III.1) it can be stated, that both these equations can be written as:

$$\frac{\partial^2\varphi}{\partial t^2}=\left(c_0^2+a\frac{\partial}{\partial t}\right)\nabla^2\varphi \tag{III.2}$$

with $a=\frac{4}{3}\nu_k$ for viscose flow, $a=k+1$ for large perturbation adiabatic flow.

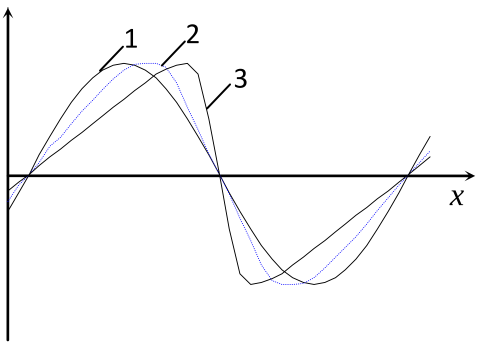

Fig. III.1 Wave of large amplitude changes its profile during propagation: 1. $\frac{x}{\lambda_0}=0$, 2. $\frac{x}{\lambda_0}=10$, 3. $\frac{x}{\lambda_0}=25$.

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