# Light refraction and gravitational redshift

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**Abstract.** The inductive-inertial phenomenon is the precondition of the E/M waves, while the spin oscillations of the electron cause the E/M formations. The photon is the autonomous motion of the E/M wave with constant photon length and the number of its fundamental E/M waves determines its wavelength. The light speed is determined as the transmission speed of the disturbance into the tense elastic-dynamic space. However, the light speed depends on the cohesive pressure that is proportional to the square of the distance from the Universe center and therefore it is a local constant in our region. The change of cohesive pressure in electric fields directly affects the change in the light speed, which can be attributed to photon refraction phenomena. The deviation of E/M waves in the dynamic fields occurs, of course, in the gravitational field as well. It is proved, the light has gravity only in the back half-space with result the gravitational redshift of the stars spectrum, while gravitational blueshift cannot happen, since there is no gravity in the front half-space of the E/M wave.

*Keywords*: Inductive phenomenon; photon length; cohesive pressure.

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## 1. The E/M waves as photons

By the unified theory of dynamic space,[1,2] the inductive-inertial phenomenon[3] of the accelerated electron and the inductive forces has been developed, which act on the electric units[2] of the dynamic space, forming the grouping units, namely the electric charges or forms of the electric field. So, a pressure difference[3] $\Delta P$ in front of and behind the electron is created and forces on pairs of vertical meridians[4] of the electron motion formation are accumulated as forces talantonion[5] $f_\tau$, which are released by a mechanism[6] that has been described.

Also, by the above theory, the constant length[4,6] of the photon

$$L = 3000m \Rightarrow L = 10^{58} L_0 \tag{1}$$

and the constant length of photon helix[4,6]

$$\pi L = \pi 3000m \Rightarrow \pi L = \pi L_0 10^{58} \tag{2}$$

are determined, where[2]

$$L_0 \approx 10^{-54} m \tag{3}$$

the quantum length of the electric dipole in our region. In the photon helix (Eq. 2), one or more forces talantonion[5]

$$f_\tau \approx 10^{26} N \tag{4}$$

are accumulated. The forces talantonion $f_\tau$, which are accumulated in the constant length of photon helix, determines the wavelength, the number of the fundamental E/M waves and the frequency of the photon. Therefore, all fundamental E/M waves, which are derived from the motion meridians[4] of the electron and have a constant photon length $L$, are the autonomous motion formation of E/M waves, the photons.

In Fig. 1 the first and the second E/M formations each contain half a force talantonion ($f_\tau/2$), which accumulates in the formation's spindle and composes its autonomous motion.

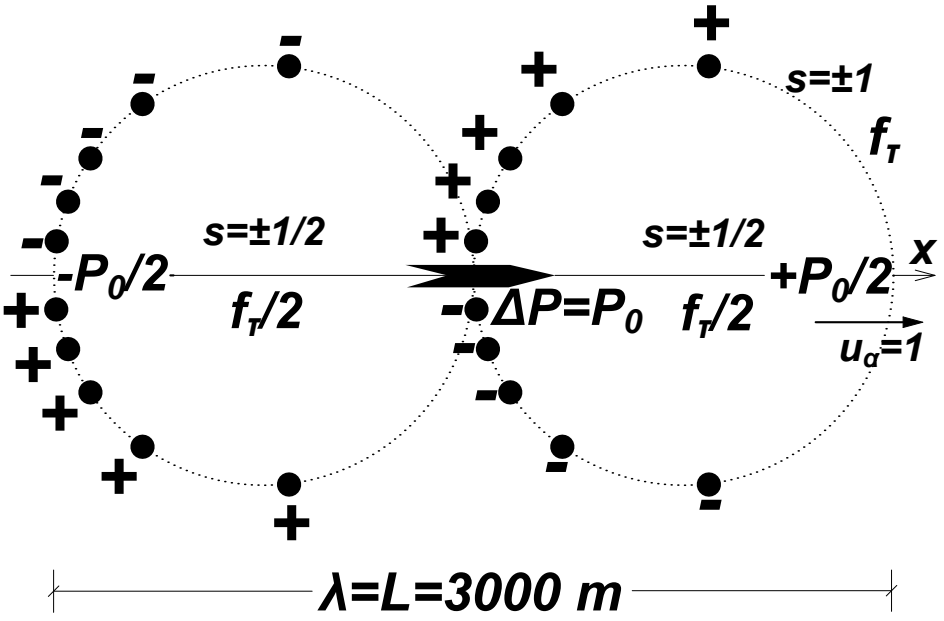


**Figure 1.** The two E/M formations compose the fundamental E/M wave[4] with a spin $s = +1/2 + 1/2 = +1$ or $s = -1/2 - 1/2 = -1$ and an accumulated force of one talantonion ($f_\tau = f_\tau/2 + f_\tau/2$) and a wavelength $\lambda = L = 3000$m

The fundamental E/M waves (Fig. 1), which constitute the photon, have interchangeable spin ($s = +1$ or $s = -1$). So, depending on the number of the fundamental E/M waves (even or odd), the photon spin becomes $s = 0$, $s = +1$ or $s = -1$.

## 2. The speed of light

The spherical deformation of space creates its dynamics,[1,2] based on the force[2] of the electric dipole

$$F = kL_0. \tag{5}$$

The force density[2] of space, due to Eq. 5, is

$$d_f = \frac{F}{V} = \frac{kL_0}{L_0^3} = \frac{k}{L_0^2} \Rightarrow d_f = \frac{k}{L_0^2} \tag{6}$$

and for the cohesive pressure[2] of space, due to Eq. 5, it is

$$P_0 = \frac{F}{L_0^2} = \frac{kL_0}{L_0^2} = \frac{k}{L_0} \Rightarrow P_0 = \frac{k}{L_0}. \tag{7}$$

So, Eq. 6, due to Eq. 7, becomes

$$d_f = \frac{k}{L_0^2} = \frac{P_0}{L_0} \Rightarrow d_f = \frac{P_0}{L_0}. \tag{8}$$

The mass density[2] of space is

$$d_m = \frac{m}{V} \tag{9}$$

where ‡

$$m = \frac{E}{C_0^2} = \frac{FL_0}{C_0^2} \Rightarrow m = \frac{FL_0}{C_0^2} \tag{10}$$

and $C_0$ the light speed, then, due to Eq. 10, Eq. 9 becomes

$$d_m = \frac{m}{V} = \frac{FL_0}{C_0^2 V} \Rightarrow d_m = \frac{FL_0}{C_0^2 V}. \tag{11}$$

So, for $d_f = F/V$ (Eq. 6), Eq. 11 becomes

$$d_m = d_f \frac{L_0}{C_0^2}. \tag{12}$$

We replace $d_f = P_0/L_0$ (Eq. 8) into Eq. 12 we have

$$d_m = d_f \frac{L_0}{C_0^2} = \frac{P_0}{C_0^2} \Rightarrow C_0 = \sqrt{\frac{P_0}{d_m}}. \tag{13}$$

Therefore, the light speed is determined as the transmission speed of the disturbance into the tense elastic-dynamic space. It becomes obvious, that the light speed (Eq. 13) depends on the cohesive pressure that is proportional to $x^2$ of the distance[2] from the Universe center and therefore it is not a Universal constant, but it is a local constant equal to $C_0 = 3 \cdot 10^8$m/sec in our region.

‡ $F_f^2 = F_0^2 + F_s^2$, where for the E/M wave applies $F_0 = 0$, therefore $F_f = F_s$, namely the final force $F_f$ of the formation is equal to the accumulated force $F_s$, where $F_f = E/L_0$ represents the energy of the E/M wave and $F_s = pC_0/L_0$ represents its momentum. Substituting in the above $F_f = F_s$ we have $E/L_0 = pC_0/L_0$, where $p = mC_0$ is the momentum of the formation, so $E = mC_0^2$.

In addition, the E/M wave§ is a dynamic autonomous motion formation of accumulated evident forces and its timeless speed $u_a$ is calculated as follow:

The timeless speed[7] $u_a$ of a particle has been found equal to

$$u_a = \frac{u}{C_0} = \sqrt{\frac{\Delta P}{P_0}} = \frac{F_s}{F_f} = \frac{F_s}{\sqrt{F_0^2 + F_s^2}} = sin\omega, \tag{14}$$

where $F_0$ is the gravity force, $F_s$ the accumulated one of the particle, $\Delta P$ its motion arrow and $u$ its time speed. The gravity force $F_0$ does not accompany the E/M wave and so for

$$F_0 = 0 \tag{15}$$

the Eq. 14 becomes

$$u_a = \frac{F_s}{\sqrt{F_0^2 + F_s^2}} = \frac{F_s}{F_s} = 1 \Rightarrow u_a = 1, \tag{16}$$

namely equal to the constant timeless speed of light

$$u_a = \frac{u}{C_0} \Rightarrow u = C_0 \Rightarrow u_a = 1. \tag{17}$$

Also, the timeless speed $u_a$ of a particle is (Eq. 14)

$$u_a = \sqrt{\frac{\Delta P}{P_0}} \tag{18}$$

and for $u_a = 1$ it is

$$u_a = \sqrt{\frac{\Delta P}{P_0}} = 1 \Rightarrow \Delta P = P_0 \Rightarrow \Delta P = (\Delta P + \frac{P_0}{2}) - (\Delta P - \frac{P_0}{2}) = P_0, \tag{19}$$

i.e. equal to the pressure difference $\Delta P$ in front of and behind the E/M wave (Fig. 1).

## 3. Light refraction in electric fields

The positive charge of the proton causes the electrical induction of positive and negative units (Fig. 2), creating electric or quantitative deformation of the proximal dynamic space,[2] consisting of the repulsion of positive units and the attraction of negative ones. The result is the alteration of the background electric density $\rho_0$, which is the density of electric charge per length $(Cb/m)$ of equal number of positive and negative units.

The alteration of the background electric density $\rho_0$ consists of displacement of positive and negative units, during which an excess of positive charge and at the same time a lack of equal amount of negative charge is created, which weaken with distance. We define by $\rho(+)$ and $\rho(-)$ the equal relative densities of positive or negative units per length, so the absolute value of electric density is

$$\rho_a = \rho_0 + \rho(+) \Rightarrow \rho_a = \rho_0 + \rho(-). \tag{20}$$

§ In the E/M wave the whole huge cohesive pressure $P_0$ of space is installed as a pressure difference[11] $\Delta P = (P_0 + P_0/2) - (P_0 - P_0/2) = P_0$ and causes a change of volume $\Delta V$ at the proximal elastic space of the E/M wave, creating dynamic energy $\Delta V \cdot P_0/2$, that converts to kinetic energy $mC_0^2/2$ of the E/M wave. So, $\Delta V \cdot P_0/2 = mC_0^2/2$ and for $d_m = m/\Delta V$, it is $C_0^2 = P_0/d_m$ and $C_0 = (P_0/d_m)^{1/2}$.

The change of relative density $\rho$ of the electric field affects directly the cohesive pressure of proximal space, since it depends on the number of pairs of electrically opposite elementary units, which have remained in the electric field and caused from tensions ($F = kL_0$, Eq. 5) of the electric dipoles[2] between these electric units. Accordingly, the remaining cohesive pressure $P$ is proportional to these number of pairs of electrically opposite units, which have remained in the electric field. Therefore, if $\rho$ is the relative density at a position of the electric field, then the absolute electric density $\rho_0 - \rho$ is proportional to the number of the above pairs of units, the attractive forces of which create the remaining cohesive pressure $P$ at this position. Consequently, the cohesive pressures $P_0$ and $P$ are respectively proportional to $\rho_0$ and $\rho_0 - \rho$, that is

$$\frac{P}{P_0} = \frac{\rho_0 - \rho}{\rho_0} \Rightarrow P = P_0 \frac{\rho_0 - \rho}{\rho_0}, \tag{21}$$

where $\rho_0$ is the background density of the positive or negative units and $\rho$ is their reduction or increase.

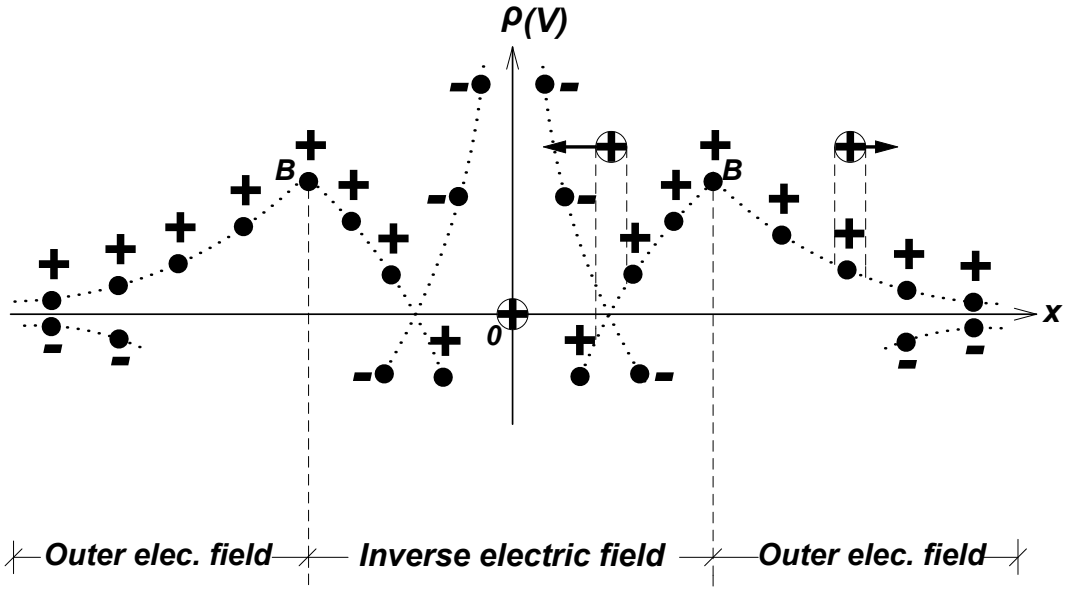


**Figure 2.** Inverse[8] (inner) and outer electric field of proton ($\rho = e/x$, $V = K\rho$, where $K$ is a ratio constant and B the potential barrier)

The speed of light was found $C_0 = \sqrt{P_0/d_m}$ (Eq. 13) and therefore the speed $C$ of light in the electric fields, with the cohesive pressure $P = P_0(\rho_0 - \rho)/\rho_0$ (Eq. 21), becomes

$$C = \sqrt{\frac{P}{d_m}} \Rightarrow C = C_0\sqrt{1 - \frac{\rho}{\rho_0}}. \tag{22}$$

So, the change of cohesive pressure in electric fields directly affects the change in the speed of light, which can be attributed to photon refraction phenomena. Refraction, as is known, is the deviation from the course of the photon's movement, when its speed changes during its passage from one optical medium to another.

However, the real cause of the refraction of light is the rotation of its E/M formation, due to a change in the accumulated forces from the presence of dynamic fields, which here are the electric fields of matter. For this purpose we will correspond the accumulated force $F_s$ of the moving particle with the accumulated force $F_s = F_f$ (Eq. 27) of the E/M wave.

So, the gravity pressure[9] in $A$ (Fig. 3) of a moving particle is

$$P_g = \frac{F_f}{4\pi R^2}, \tag{23}$$

where the final force is

$$F_f = nf' \tag{24}$$

and $R$ the distance from the particle center. However, the back cone is the tail of gravity of the moving particle. If a point is inside this cone, then it is attracted by both hemispheres, i.e. with double force $F_f$ and therefore its gravity pressure $P_c$ inside the back cone is $P_c = 2P_g$, so

$$P_c = 2P_g = \frac{F_f}{2\pi R^2} \Rightarrow P_c = \frac{F_f}{2\pi R^2}, \tag{25}$$

i.e. it is double that of the outer space.

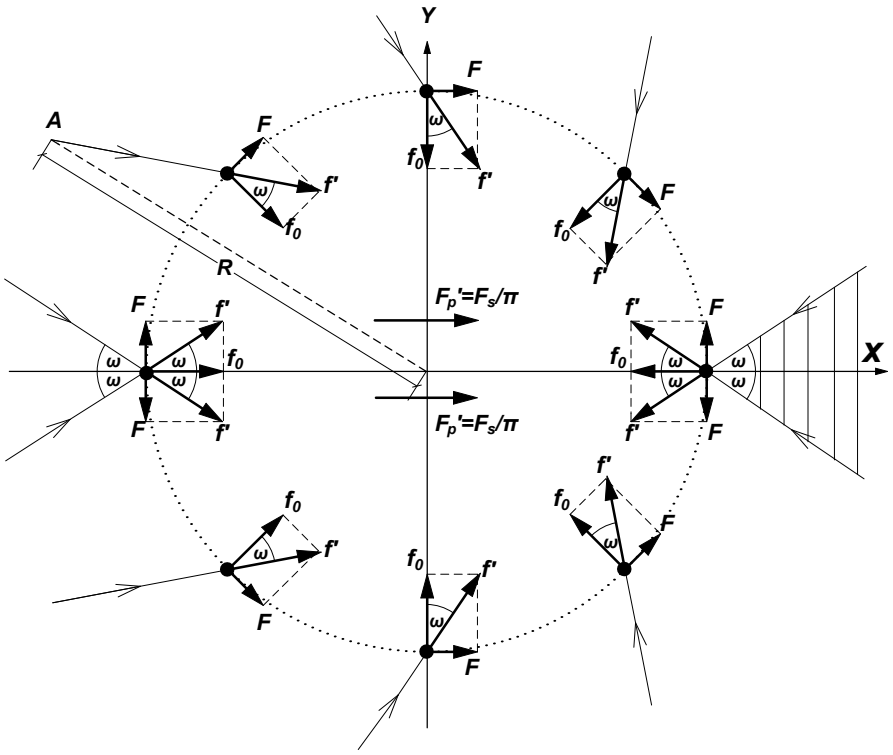


**Figure 3.** Gravitational field of moving particle ($sin\omega = F/f' = F_s/F_f$),

Additionally, it is[10]

$$F_f^2 = F_0^2 + F_s^2 \tag{26}$$

and for the E/M wave we have $F_0 = 0$ (Eq. 15), namely

$$F_f^2 = 0 + F_s^2 \Rightarrow F_s = F_f. \tag{27}$$

Also, due to Eq. 19, for the E/M wave it is

$$P_c = P_0 - \frac{P_0}{2} = \frac{P_0}{2} \Rightarrow P_c = \frac{P_0}{2} \tag{28}$$

and for

$$R = \frac{\lambda}{4}, \tag{29}$$

i.e. we consider point $A$ on the spindle of the E/M formation (Fig. 1), so due to Eqs 25, 27, 28 and 29 we have

$$\frac{P_0}{2} = \frac{F_s}{2\pi\lambda^2/16} \Rightarrow F_s = P_0\frac{\pi\lambda^2}{16}. \tag{30}$$

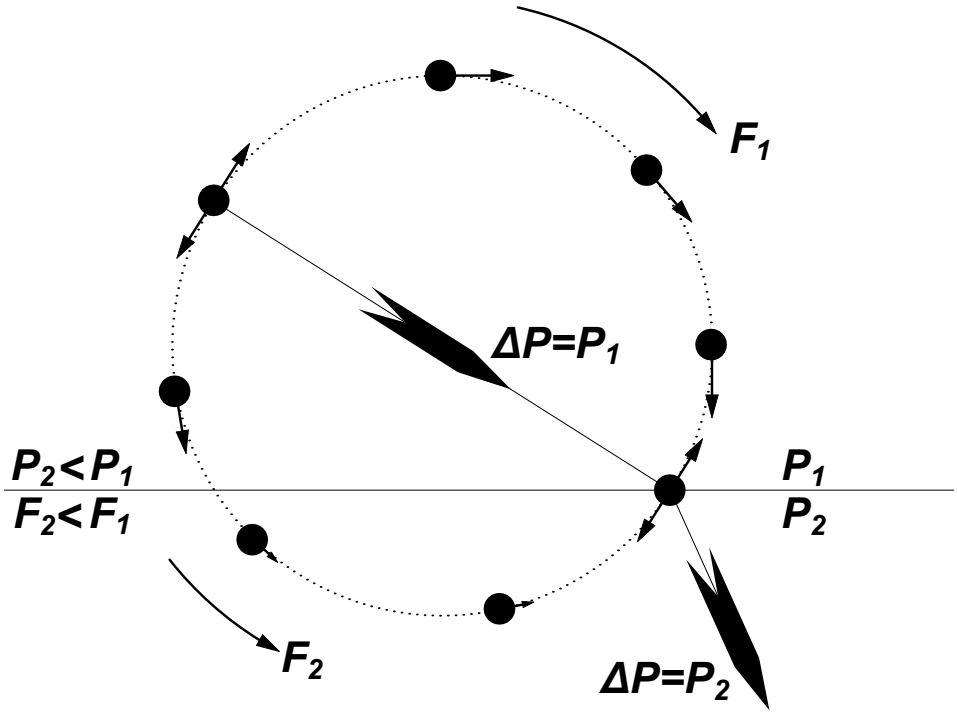


**Figure 4.** As the formation sinks into an optical medium of lower cohesive pressure ($P_2 < P_1$), the accumulated forces are reduced, resulting in its rotation and deflection ($F_2 < F_1$)

That is, the accumulated force $F_s$ (Eq. 30) is proportional to the cohesive pressure $P_0$ and vary according to its change in the dynamic fields. Therefore when the E/M formation (Fig. 4) moves into the proximal electric field, in which the cohesive pressure $P_0$ of the space is reduced to $P$ of the field and scale from $P_1$ to $P_2$, the accumulated forces decrease as the formation sinks to the lower pressure $P_2$.

On side impact, it has the effect of creating a force difference between the upper and lower hemispheres, which rotates and deflects the formation. However, this force difference is symmetrical during vertical incidence and thus no deflection is observed.

## 4. Proof of the refraction law

To prove the refraction law, we consider two homochromatic photons of length $L_1$ to move in cohesive pressure $P_1$ with a common front laterally towards the separating surface of different values (Eq. 21) $P_1$ and $P_2$ (Fig. 5), due to the different electric fields.

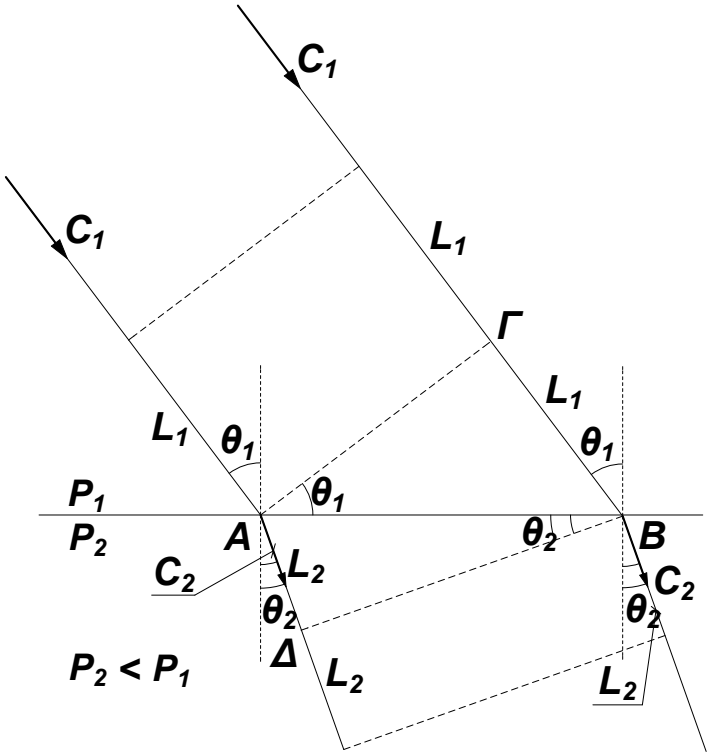


**Figure 5.** Proof of the refraction law

In the right triangle AΓB it is

$$sin\theta_1 = \frac{L_1}{(AB)} \tag{31}$$

and in AΔB it is

$$sin\theta_2 = \frac{L_2}{(AB)}, \tag{32}$$

so

$$\frac{sin\theta_1}{sin\theta_2} = \frac{L_1}{L_2}, \tag{33}$$

where $\theta_1$ is the angle of incidence and $\theta_2$ the angle of refraction, while $L_2$ is the length of the two photons, moving in cohesive pressure $P_2$, with the now reduced speed $C_2$ (Eq. 22) and the reduced wavelength $\lambda_2$. However, $L_1$ and $L_2$ are proportional to $\lambda_1$ and $\lambda_2$, which are proportional to $C_1$ and $C_2$, i.e.

$$\frac{L_1}{L_2} = \frac{C_1}{C_2}. \tag{34}$$

So, Eq. 33 is written

$$\frac{sin\theta_1}{sin\theta_2} = \frac{C_1}{C_2}, \tag{35}$$

which expresses the law of light refraction.

The phenomenon of light reflection is a symmetrical inversion of the movement, which in order to happen requires a reversal motion arrow $\Delta P$ of the E/M formation and this presupposes that the first motion arrow must be zeroed.

If we assume that in the front of the formation the cohesive pressure, due to the proximal electric field (near the atoms), is $P_1$ and in the back of its is $P_2$, then the pressure in front, due to Eq. 19, it will become

$$P_1 + \frac{P_1}{2} = \frac{3P_1}{2} \tag{36}$$

and in the back, due to Eq. 19, it will become

$$P_2 - \frac{P_2}{2} = \frac{P_2}{2}. \tag{37}$$

The motion arrow $\Delta P$ of E/M formation will then be

$$\Delta P = \frac{3P_1}{2} - \frac{P_2}{2} \tag{38}$$

and for $\Delta P = 0$ we have

$$\frac{3P_1}{2} - \frac{P_2}{2} = 0 \Rightarrow P_1 = \frac{P_2}{3}, \tag{39}$$

which constitutes the reflection condition.

These large decrease in the cohesive pressure appear in the strong electric fields of the matter. Specifically, in E/M formations of long wavelength this reflection condition ($P_1 = P_2/3$) is easier to happen, as e.g. in radio waves, whose reflection is favored than to the short wavelengths, which are penetrating.

Of course, the electric fields of matter does not change uniformly on the surface of a body. Thus, the incident photons contact different fields, where the reflection condition ($P_1 = P_2/3$) more or less is satisfied, so that total, partial reflection or even refraction occurs.

## 5. Gravitational redshift

The deviation of E/M waves in the dynamic fields occurs, of course, in the gravitational field as well. The dynamic energy of a photon on the star surface of mass $M$ and radius $r$ decreases equal to the kinetic energy of the photon

$$Fr = \frac{GMm}{r^2}r = \frac{GMm}{r} = f_k L_0 \Rightarrow \frac{GMm}{r} = f_k L_0, \tag{40}$$

where $f_k$ the kinetic force removed from the accumulated force $F_s = Lf_\tau/\lambda$ (Eq. 45) of the photon, $L_0$ the quantum length and $m$ the photon mass, which results from the mass[11] (Eq. 10) of the particle

$$m_f = \frac{F_f L_0}{C_0^2}, \tag{41}$$

that for the photon is $F_f = F_k = F_s$ (Eq. 27). Hence, the photon mass is

$$m = \frac{F_s L_0}{C_0^2} \tag{42}$$

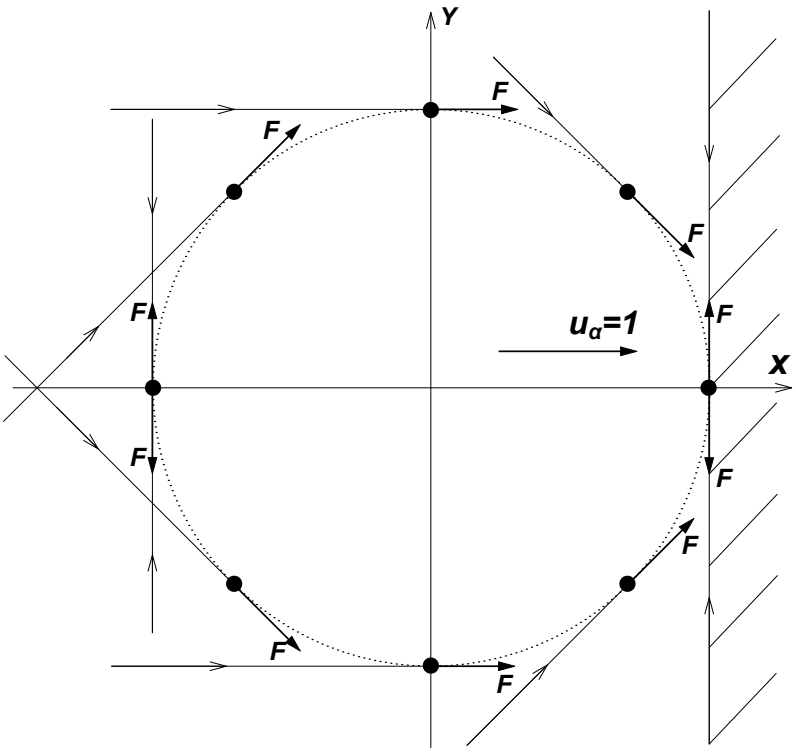


**Figure 6.** Gravity field of autonomous motion of E/M spindle-formation ($u_a = 1$ is the timeless speed of light)

Substituting Eq. 42 in Eq. 40 we have

$$\frac{GMm}{r} = f_k L_0 \Rightarrow \frac{GMF_s L_0/C_0^2}{r} = f_k L_0 \Rightarrow f_k = \frac{GMF_s}{rC_0^2}. \tag{43}$$

Then, the accumulated force of the photon, moving away from the star, decreases correspondingly with kinetic produced energy, i.e.

$$F_s' = F_s - f_k = F_s - \frac{GMF_s}{rC_0^2} \Rightarrow \frac{F_s'}{F_s} = 1 - \frac{GM}{rC_0^2}. \tag{44}$$

Additionally, the accumulated force of the photon is[12]

$$F_s = \frac{Lf_\tau}{\lambda} \Rightarrow F_s' = \frac{Lf_\tau}{\lambda'} \Rightarrow \frac{F_s'}{F_s} = \frac{\lambda}{\lambda'}, \tag{45}$$

i.e. inversely proportional to the wavelength and so Eq. 44 becomes

$$\frac{\lambda}{\lambda'} = \frac{F_s'}{F_s} = 1 - \frac{GM}{rC_0^2} \Rightarrow \frac{\lambda}{\lambda'} = 1 - \frac{GM}{rC_0^2}. \tag{46}$$

This formula proves the gravitational redshift observed in the stars spectrum.

It is noted that, in Fig. 3 angle $\omega$ expresses the timeless speed, i.e. $u_a = sin\omega$ (Eq. 14). So, for $\omega = 0$, it is $u_a = 0$, i.e. in the theoretically stationary particle, of course, there are no cones. For $u_a = 1$ (Eq. 16), namely the timeless speed of light, it is

$$u_a = 1 = sin\omega = sin90^0 \Rightarrow \omega = 90^0. \quad (47)$$

The formation is now the autonomous motion of the E/M wave, whereby the cone in front is the entire half-space without gravity, while the cone behind is widened with enhanced gravity (Fig. 6). Therefore, light has gravity only in the back half-space and proof of this is the gravitational redshift of the stars spectrum, while gravitational blueshift cannot happen, since there is no gravity in front of the half-space of the E/M wave.

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