Addendum

Relation for the Light Absorption in the Presence of Gravitation Field

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Abstract

We argue for the validity of relation for electromagnetic wave electric field derived by us earlier. It includes an imaginary part responsible for the absorption induced by gravitation field of spherically symmetric mass.

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In a previous paper [1], the author has shown that a change, due to the action of a gravitation field of spherically symmetric mass, in the refractive index of "polarizable vacuum" (abbreviated as PV; see the terms adopted in [2]) should unambiguously lead to consideration of absorption of electromagnetic wave energy by the PV. This conclusion has been based on the fact that refraction is related to absorption at some frequencies ω_0, through the known *H.Kramers* and *R.Kroning* relations. In other words, a real part of high-frequency dielectric permittivity (or the refractive index) should approach unity, when the absorption of light is absent at these resonant frequencies ω_0.

The relation for the electric field of electromagnetic wave suggested in [1] for weak field approach looks as follows:

$$E^{(\omega)} = D^{(\omega)} - \\ -\left(4\sqrt{\beta M}\sqrt{|g|} \pm i4\sqrt{\beta M}\sqrt{|g|}\right)D^{(\omega)} \qquad (1)$$

where $\beta = G/c_0^4$, G is the gravitation constant and c_0 the speed of light in vacuum. In this relation, the imaginary part of the dielectric impermeability has been introduced without a proper reasoning and the form of the term $i4\sqrt{\beta M}\sqrt{|g|}$ has not been argued. The latter has just followed from the assumption that the imaginary part of dielectric impermeability should vary under the action of gravitation field in the same way as its real part. In the present report, we intend to show that the above assumption is indeed true.

Let us consider a relation for the optical-frequency electric field of the PV under the action of gravitation field of spherically symmetric mass M,

$$E_i^{\omega} = (1 - 4\sqrt{GM/c_0^4}(g^{1/2}) - \\ -7\left(\sqrt{GM/c_0^4}\right)^2 g + ...)D_j^{\omega}, \qquad (2)$$

or a corresponding relation for the optical-frequency impermeability,

$$B_{ij} = 1 - 4\sqrt{GM/c_0^4}(g^{1/2}) - \\ -7\left(\sqrt{GM/c_0^4}\right)^2 g + ... \qquad (3)$$

Here g means the strength of the gravitation field and G the gravitation constant. Let us now consider a purely mathematical operation, changing a sign of the gravitation field (formally speaking, this would have implied replacing a usual “attractive” field with a “repulsing” one). Then Eqs. (2) and (3) might be rewritten as

$$E_i^{\omega} = (1 - i4\sqrt{GM/c_0^4}\,|g|^{1/2} + +7\left(\sqrt{GM/c_0^4}\right)^2 |g| + ...)D_j^{\omega}, \quad (4)$$

$$B_{ij} = 1 - i4\sqrt{GM/c_0^4}\,|g|^{1/2} + +7\left(\sqrt{GM/c_0^4}\right)^2 |g| + ... \quad (5)$$

One can see that the imaginary parts in Eqs. (4) and (5) (i.e., the second terms in their r.h.s.), which appear after extracting the square root from the negative parameter *g*, have just the same form as written earlier in [1] (see Eq. (1) of the present work). As a result, mathematical expression of the absorption dependent upon the gravitation field should not depend on the sign of g and the term $i4\sqrt{\beta M}\sqrt{|g|}$ should be correct in both cases of signs mentioned above.

Hence, we have proved the validity of the relation (1). On the other hand, the third terms in the r.h.s. of Eqs. (4) and (5) become positive at the operation of changing sign of the gravitation field and passing to a “repulsing” one, thus leading to decrease in the refractive index below unity, as well as increase in the light velocity above c_0.

References

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