

DO WEBER'S EXPERIMENTS REVEAL THE PHOTON REST MASS?

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Weber's experiments [1 - 2] aimed at observing gravitational waves of frequency $\omega/2\pi = 1660$ Hz, which give pulsed flux values on the order of $1000 \text{ W/m}^2\text{Hz}$ [3], lead to significant difficulties in astrophysics, since the mechanisms that yield such a colossal radiation are unknown and the mass lost to radiation is too high [4]. In the present article we wish to call attention to the fact that an interpretation of Weber's experiment, where quartz converters of mechanical shear into electric voltage were used, are not unambiguous. It is possible to register in such an experiment longitudinal electromagnetic waves which exist if the rest mass of the photon differs from zero [5 - 10].

Longitudinal electromagnetic waves, like gravitational ones, pass without attenuation through metallic screens and through the earth's ionosphere. According to the best experimental laboratory and geophysical estimates

$$\Omega = m_\gamma c^2/h, \quad \Omega/2\pi \sim 0.5 \text{ Hz}, \quad (1)$$

and we shall use this value. The astrophysical estimates [10] are stronger.

The equations of electrodynamics with a rest mass lead to the following expression for the energy density [11, p. 34]:

$$8\pi W = F_{\alpha\alpha}^* F_{\alpha\alpha} + F_{\alpha\beta}^* F_{\alpha\beta} + \left(\frac{\Omega}{c}\right)^2 (A_\alpha^* A_\alpha + A_\alpha A_\alpha^*) = E^2 + 2\left(\frac{\Omega}{c}\right)^2 \phi^2, \quad (2)$$

$$\phi \sim |A_\alpha|,$$

where A_α is the vector potential \underline{A} , ϕ .

For longitudinal waves with $\omega \gg \Omega$, the main term is the last one - the main contribution to the energy density is made by the potential ϕ .

For the energy flux and for the electric field we have

$$S_\parallel = cW = \frac{c}{4\pi} \left(\frac{\Omega}{c}\right)^2 \phi^2; \quad E = \left(\frac{\Omega}{\omega}\right)^2 \nabla \phi = \left(\frac{\Omega}{\omega}\right)^2 \frac{\omega}{c} \phi. \quad (3)$$

The emf induced in the electric circuit is

$$\mathcal{E} = \int \mathbf{E} d\mathbf{s} = \mathbf{E}L = \mathbf{E}L \cos \theta,$$

where L is a certain effective antenna length, which depends strongly on the construction and wiring; as a rough estimate we put $L = 10$ cm - on the order of the dimensions of the pickups.

This value is most likely an underestimate, since at resonance in the input circuits (electrical or mechanical, it does not matter at low conversion losses), the emf increases by a factor Q , and in Weber's experiments $Q = 10^5$.

It follows from (3) that at equal electric fields

$$S_{\parallel} = \left(\frac{\omega}{\Omega}\right)^2 S_{\perp} > 10^7 S_{\perp}, \quad (4)$$

where S_{\perp} is the energy flux of the radial waves.

At a noise temperature 300°K , the threshold power is equal to 204 dB/W, which at an antenna area $\mathcal{L} = 10^{-2} \text{ m}^2$ leads to a threshold flux

$$\begin{aligned} S_{\perp} &= 10^{-18.4} \text{ W/m}^2\text{Hz} \\ S_{\parallel} &= 10^{-11} \text{ W/m}^2\text{Hz}, \end{aligned} \quad (5)$$

which is smaller by more than 10 orders of magnitude than the threshold flux of the gravitational waves in Weber's experiments.

Using astrophysical estimates and taking into account the factor Q^2 , the threshold energy flux turns out to be somewhat smaller than for gravitational waves.

Let us consider now the question of the reception diagram. In longitudinal waves $\vec{k} \parallel \vec{E}$, and therefore

$$\mathcal{L} \sim kL \sim \cos \theta,$$

where θ is the angle between the direction to the source and the vector L , which varies with the earth's rotation. The dependence coincides with the observed correlation between the frequency of the burst and sidereal time.

If the foregoing interpretation is correct, then 1) there is a time shift between the pulses of different frequencies and it is due to the dispersion in vacuum. If the source is the center of the galaxy, then the shift can be used to determine Ω . 2) There should be no pulses if capacitive pickups are used in a high-frequency bridge [12]. 3) The pulses can be registered without mechanical systems.

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