Implications of the de Broglie – Maxwell Equation

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ABSTRACT: One has explained the doubts connected with "mass-less charge solutions" and "mass-less bosons with spin" on the ground of the de Broglie – Maxwell equation.
Next, one has stated that the topological charge is equivalent to the mass as every other charge.
Then, the subtleties, connected with an existence or non-existence of the rest mass of photon, have been discussed.
One has mentioned the states with the negative norm, which are discussed in next works.

1. In the work [1] the de Broglie – Maxwell equation

   $$m = \alpha\, |Q|$$

   has been deduced.
   But in the Kaluza – Klein theory one might obtain a mass-less charged solution. So, we would have a discrepancy. But it is only an illusion, because the mass is the sum of all masses arising from all interactions.
   The Kaluza – Klein theory unifies gravitation with electromagnetism.
   So,

   $$M = m_{gr} + m_{el-magn} = 0$$

   and

   $$m + \alpha|Q| = 0$$

   So:

   $$m = -\alpha\, |Q|$$

   The "discrepancy" is cancelled.

2. The mass-less bosons with the spin 2 [2] must however have the mass, because the spin is the charge in the sense of the Dirac equation.

We have:

$$m = \alpha\,|s|$$

because $m = \alpha\,|Q|$ and $Q = s$.

The fact that the spin is a vector doesn't disturb, because there is an absolute value in the de Broglie – Maxwell equation.

Moreover, so as earlier:

$$M = m_{gr} + m_{el-magn}$$

and $m_{el-magn} = m$, $M = 0$,

so

$$m_{gr} = -m_{el-magn} = -\alpha|s| \ .$$

3. We have the formula [3]:

$$k^2 M_2 = e^{\Phi_0/2}\, Q_2$$

M_2 - mass for a unit of the length of the string.

It is the full analogy with the formula $= \alpha|Q|$.

The authors of this formula didn't realize an importance of it. So, the topological charge behaves like each other charge. In this work the Noether charge appears.

4. A mass-less relativistic string [4] is described by the formula:

$$m_{gr} = -\left(\sum_i m_i\right)$$

i - number of the interaction

By allowing additional degrees of freedom in the quantum mechanics we are able to quantize the string in the Lorentz covariant manner for any value of D and any mass for the first excited state [4]. In this scheme the full Fock space contains negative norm states, what shouldn't be rejected automatically.

5. Mass of photon $M_{ph} = 0$, but the gravitational mass and spin must exist. Moreover, we have the de Broglie – Maxwell formula $m = \alpha|\bar{s}|$.

So we have:

$$M = m_{gr} + \alpha|\bar{s}| = 0$$

so

$$m_{gr} = -\alpha|\bar{s}|$$

There are three possibilities:

1) $\alpha = 0$, because zero is an equally good number as each other
2) $\alpha \neq 0$ and there exists rest mass of photon different (although minimal) than zero – it is supported by the conception that the scattering cross section on photon is different than zero [5].
3) $m_{gr} = \frac{h\nu}{c^2}$ and α is a linear function of ν .

The second possibility suggests that the velocity of light isn't equal to the limit velocity, but infinitesimally smaller than it. It doesn't shake Relativity, simply the limit velocity and the velocity of light may be a bit different.
Verification which of these three cases is realized in Nature belongs to experimenters, but if $m_{0photon} = 0$ we will never know it because the measurement is always connected with a certain experimental error.
If $m_{0photon}$ is infinitesimally different than zero then v_{ph} is infinitesimally smaller than c ($v_{ph} < c$). In such a situation the real mass particle may move with the velocity
$v \in (v_{photon}, c)$.
Then we observe the Cherenkov effect, analogically as in crystals, where the velocity of a particle may be bigger than $v_{ph} = \frac{c}{n}$ and smaller than c.
We can observe the Cherenkov effect, when the particle crosses the velocity of light even without crossing the limit velocity, although at crossing the limit velocity the Cherenkov effect can be observed too.

References:

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