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Antiquanta Discovered

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Abstract Antiparticles are particles with negative energy for which time flows backward. A new consequence of this interpretation is the antiphoton existence which differs from the photon by the helicity sign. Its analogues are an antigraviton and antigluons (the antiquanta of the gravitational and nuclear fields).

Keywords: T-invariance, antiparticles, antiphoton, antiquanta.

Let us consider a tx -plane of Minkowski's space where a photon moves (in the direction of increasing x). For this, evidently, that time also increases (the positive direction of t -axis). As known, the Minkowski space is an R-invariant for electromagnetic phenomena occurring within it. Here R=PT is the relativistic reflection (4-inversion), P is the space reflection, and T is the inversion (sign change) of time. As a result of R-reflection, the directions of all axes are reversed, and it is found that the time for photon flows backward now. And this, as we know (see, e.g., [1-4]), is the antiparticle property (the known Stueckelberg-Feynman-Strel'tsov interpretation). Its factual consequence is the negative energy of antiparticles. There is an *antiphoton* before us!

Elucidate now another (observable) difference between the photon and antiphoton. Let the photon spin be directed along the momentum (the helicity $\lambda=+1$). After reflection, the momentum direction reverses but the spin direction (as an axial vector) does not change, i.e. the helicity changes ($\lambda=-1$). Thus, the distinctive observed difference of antiphoton (versus a photon) is the opposite sign of helicity. Just as an antineutrino is differed from a neutrino. The lepton charge of neutrino masks this fact that for massless particles the helicity sign is the distinctive indication of antiparticle from particle.

The same reasoning can be applied to the photon analogues: the graviton and the gluons (the quanta of gravitational and nuclear fields). As a result, after the discovery (more 70 years ago) of the first antiparticle - positron [5] we have the whole family of new antiparticles (*antiquanta*): the *antiphoton*, *antigraviton* and *antigluons* [6]. If the antigraviton differs from the graviton the helicity sign only, then the antigluons can be differed from the corresponding gluons by the opposite "color charge".

Now the urgent question arises how to distinguish the true quantum from the antiquantum. And in the first place, it concerns the photon and the antiphoton.

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