

**Remark Concerning the Gravitational Interaction of Matter and Anti-Matter.**

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A number of speculations have been made recently about the question whether the gravitational interaction of matter and anti-matter is different from that of matter with matter. More specifically it is argued that the gravitational interaction of matter and anti-matter may have the same magnitude as for matter with matter but being of opposite sign.

One can easily show that under the existence of a red-shift of light-rays in a gravitational field such an assumption leads to a violation of the law of energy-conservation.

The proof of this statement can be given by considering a simple cycling process.

A sufficient amount of energy say  $E_0$  may produce at a place in the gravitational field with the potential  $\Phi_0$  a particle-anti-particle pair. If the anti-particle shows an « anti-gravity » rather than an ordinary gravitational attraction the pair is weightless. It is therefore possible to lift the pair without work to another place in the gravitational field possessing the potential  $\Phi_1$ . Both particles shall be destructed at this place creating a photon. The photon is sent back to the place on the field where the potential is  $\Phi_0$ . It gains energy equal to  $\Delta E = [(\Phi_1 - \Phi_0)/c^2]E_0$ : The energy at the end of this cycling process is therefore

$$E_0 + \Delta E = E_0 \left( 1 + \frac{\Delta\Phi}{c^2} \right) > E_0,$$

a result which is in contradiction with the energy-conservation-law. This consideration is not confined to light-rays. An analogical situation is given if instead of light rays,  $\pi$ -mesons are produced as a result of the pair annihilation.

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