Mass, Photons, Gravity

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Abstract

According to special relativity,

$$m^2 = E^2/c^4 - \mathbf{p}^2/c^2 \quad ,$$

$$\mathbf{p} = E\mathbf{v}/c^2 \quad ,$$

where m – the mass of a body – is a relativistic invariant, $\mathbf{v}$ – its velocity – is a three-vector, while $E, \mathbf{p}$ – its energy-momentum four-vector.

For a body at rest

$$m = E_0/c^2 \quad ,$$

where E_0 is the rest energy.

At the same time, according to many popular science books and articles,

$$m = E/c^2 \quad ,$$

$$\mathbf{p} = m\mathbf{v} \quad ,$$

while the so-called "rest mass" is introduced denoted by m_0.

The popular-science terminology is inconsistent and confusing. It suggests wrong explanations based on the notion of "photon mass", for such phenomena as gravitational redshift and deflection of light in a static gravitational field. Einstein's authority is often used to justify the misleading statement of "energy-mass equivalence".