The four-dimensional spacetime with the mass density

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Until the early twentieth century, the three-dimensional space and one-dimensional time were considered separate beings. In 1908, German mathematician H. Minkowski connected together space and time into single idea, creating the four-dimensional spacetime [1].

The idea of the spacetime enjoyed success in the *Special Relativity* and the *General Relativity* (GR), correctly describing a range of physical phenomena.

We propose extension of this idea by the connection the four-dimensional spacetime and *the mass density* into **the single idea**, creating a new mathematical structure: *the four-dimensional spacetime with the mass density* [2].

This idea is mathematically defined as follows

$$\rho_{\mu\nu}^{bare} \overset{def}{=} \rho^{bare} \cdot \eta_{\mu\nu} = \mathrm{diag}(\rho^{bare}, -\rho^{bare}, -\rho^{bare}, -\rho^{bare}) \tag{1}$$

where: $\rho_{\mu\nu}^{bare}$ *is the bare mass density tensor,* $\eta_{\mu\nu}$ is *the Minkowski tensor*, $\mu, \nu = 0, 1, 2, 3$.

Under influence outer gravitational field the bare mass density becomes *the effective mass density*. The metric of the four-dimensional spacetime with *the effective mass density tensor* $\rho_{\mu\nu}(x)$ is defined as

$$ds^2\left(\rho_{\mu\nu}(x)\right) \overset{def}{=} \frac{\rho_{\mu\nu}(x)}{\rho^{bare}} \cdot dx^{\mu} dx^{\nu} \tag{2}$$

where: $\rho_{\mu\nu}(x)$ is the symmetric and position dependent.

This is an alternative attempt to describe gravitational phenomena, using a new idea of *the massification of spacetime*.

This a new idea provides the following benefits:

1. During any change in state of motion of the body appears the inertia, which source is the spacetime with the effective mass density.
2. The inertia becomes an intrinsic property of the massification of spacetime.
3. The magnitude of the inertia of any body is determined by massification of the spacetime.
4. Inertial forces, appearing in the non-inertial frames of reference, there are no longer fictitious forces.

5. In the gravitational field clocks and roots indicate the different time and length, than in the absence of the field. This difference results from the change of the effective mass density in a gravitational field.

The idea of the massification of spacetime, although a very attractive, requires experimental confirmation. Predicted the annual relative change of the fluctuation in the effective mass as resulting from ellipticity of the orbit for the Earth, is equal to 6.6×10^{-10} .

GR does not predicts a such fluctuations.

Reference

1. Minkowski H., *Raum und Zeit,* Physikalische Zeitschrift, **10**, 1909, p. 104 –111. English translation *Space and Time: Minkowski's Papers on Relativity*, ed. V. Petkov, Minkowski Institute Press, Montréal – Québec, 2012.
2. Kubiak M. J., http://vixra.org/abs/1703.0206 , March 2017.