Kinematic renormalization of energy in the gravity

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The Lagrangian in the theory of gravity in the affine frame (TGAF) [1] is

$$L_\gamma = \delta^{\mu\nu}_{ab} g^{bd} \gamma^a_{\mu c} \gamma^c_{\nu d}, \tag{1}$$

where $\delta^{\mu\nu}_{ab}$ is the alternator, $e_a = h^\mu_a \partial_\mu$ is the affine frame in the Riemann space, and $g_{ab} = e_a \cdot e_b$, γ^a_{bc} are coefficients of the torsion-free and metric-compatible affine connection in the affine frame e_a.

Under GL^g-transformations $e'_a = L^{a'}_a e_{a'}$ Lagrangian L_γ is transformed by the rule:

$$L_{\gamma'} = L_\gamma + \nabla_\sigma \Delta V^\sigma, \tag{2}$$

where $\Delta V^\sigma = \delta^{\sigma\nu}_{ab} g^{bd} \partial_\nu L^a_{c'} L^{c'}_d$. Transformation (2) is canonical transformation and don't changes the equations of motions – Einstein equations:

$$G^\mu_a \equiv -\nabla_\sigma B^{\mu\sigma}_a - t^\mu_a = \tau^\mu_a, \tag{3}$$

but changes energy-momentum tensor of the gravitational field t^μ_a and the superpotential $B^{\mu\sigma}_a$ of the complete energy-momentum tensor of the gravitational and matter fields $T^\mu_a = t^\mu_a + \tau^\mu_a$:

$$t'^\mu_a = t^\mu_a - \frac{1}{\sqrt{-g}} \partial_{h^a_\mu} (\sqrt{-g} \nabla_\sigma \Delta V^\sigma), \tag{4}$$

$$B'^{\mu\nu}_a = B^{\mu\nu}_a + \partial_{\partial_\nu h^a_\mu} \nabla_\sigma \Delta V^\sigma. \tag{5}$$

This changing permits to renormalize the complete energy by changing general reference frames.

References

[1] S. E. Samokhvalov. General reference frames and definition of energy in theory of gravity (in Ukrainian). *Math. Modelling.*, 2(35), 2016.