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Premetric telleparalel gravity and the geodesic principle.

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Premetric teleparallel gravity is a generalization of GR based on two field equations similar to Maxwell's equations of electrodynamics. In gravitational model, the scalar-valued 2-forms of electrodynamics are replaced by two vector-valued 2-forms. The energy-momentum 3-form of matter and gravity field serves as a source. A general linear constitutive relation between two basic fields provides a rich family of gravitational models. When this gravitational constitutive tensor is restricted to a metric-dependent expression with a special choice of dimensionless parameters, the standard GR in its teleparallel equivalent version is recovered. The energy-momentum current and the Lorentz-type force density expressions are defined for the whole family of models. They loss their invariant meaning only when the construction is restricted to GR itself. It is because of an additional local Lorentz transformation of frame field. We show that this gravitational Lorentz force yields the proper geodesic equation for the whole family of models (even including GR) when an additional mechanical linear constitutive relation between the velocity and the momentum of a point-wise particle is assumed. This fact solves the known dichotomy between geodesic and autoparallel trajectories in gravity models with a general connection.
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