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Gauge gravitation theory. Gravity as a Higgs field

Classical gravitation theory on a world manifold X is formulated as gauge theory on natural bundles over X which admit general covariant transformations as the canonical functorial lift of diffeomorphisms of their base X. This is metric-affine gravitation theory where a metric gravitational field is treated as a classical Higgs field responsible for the reduction of a structure group of natural bundles to a Lorentz group. The underlying physical reason of this reduction is both the geometric Equivalence principle and the existence of Dirac spinor fields. Herewith, a structure Lorentz group always is reducible to its maximal compact subgroup of spatial rotations that provides a world manifold X with an associated space-time structure. The physical nature of gravity as a Higgs field is characterized by the fact that, given different gravitational fields, the representations of holonomic coframes $\{dx^\mu\}$ on a world manifold X by Dirac's γ-matrices acting on Dirac spinor fields are non-equivalent, and consequently the Dirac operators in the presence of different gravitational fields fails to be equivalent, too. To solve this problem, we describe Dirac spinor fields in terms of a composite spinor bundle $S \to \Sigma \to X$ over a fibre bundle of pseudo-Riemannian metrics Σ. A key point is that $S \to X$ is a natural bundle which admits general covariant transformations. As a result, we obtain a total Lagrangian of a metric-affine gravity and spinor fields, whose gauge invariance under general covariant transformations implies an energy-momentum conservation law.