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Gravity is gauge? A unification perspective

The question of the extent to which gravity is a gauge theory can prove to be surprisingly complicated, considering constraint classes, internal and external symmetries, spacetime tangent structure, and connection versus metric variables. Furthermore, unifying gravity with the rest of the interactions provides even more conundrum, but also an arena for theory development. The premise for classical gravity unification in field theory is reviewed, with emphasis in form of a recently proposed Khronon Lorentz gauge theory of gravity, and with motivations in Cartan geometry, topological field theory, and pre(geo)metric ideas. Unification in particle physics has a well-motivated list of requirements, and rigorous limitations, e.g. by the Coleman-Mandula theorem among others. There are a multitude of ways to bypass this, but it will be argued that it seems also an inherently spacetime-geometric obstruction. Special attention will be brought to how to distinguish gravity and internal gauge theory, and how to approach a gravity-unified phase for theory development.

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