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Classical gauge theories and gravity

It belongs to folklore that electromagnetic, electroweak, and strong interactions are understood as gauge theories. In contrast, the situation regarding gravitational interaction is often considered more complex. Since the 1960s, this complexity has led to extensive research on the question: Can gravity be understood as a gauge theory?

In this talk, we explore a framework for describing classical gauge theories developed by Andrzej Trautman in the 1970s. This framework utilizes the theory of Ehresmann connections on principal G-bundles. Within the framework, gravity can be understood as a classical gauge theory, where the metric tensor field is treated as a classical Higgs field. One significant advantage of this framework is that it enables the description of gravity and gauge theories of internal symmetries using the same mathematical formalism. This unification leads to a deeper understanding of the crucial geometrical differences between these two distinct classes of classical gauge theories, which have non-trivial physical implications.

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