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A possible alternative mechanism to SUSY: conservative extensions of the Poincaré group

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Apart from the nonvanishing neutrino masses, state of the art experimental results in particle physics do not show direct evidence for Beyond Standard Model scenarios. This leaves us puzzled concerning the relation of the electromagnetic, weak, strong, and eventually of the gravitational interactions. On a theoretical basis, the local (extended) SUSY is considered to be a rather well-founded candidate for such unification mechanism, but it is still not seen experimentally. Therefore, a search for alternative mechanisms to SUSY is well motivated. In this contribution it is pointed out that even without the QFT context of the Coleman-Mandula theorem, already the group theoretical possibilities for nontrivial extensions of the Poincaré group are rather limited. These limited possibilities, however, do exist: these allow, in turn, for (extended) super-Poincaré group to exist. It shall be pointed out that also a less exotic alternative to (extended) super-Poincaré group is possible to construct. Namely, it is shown that there exists a unified group containing the usual Poincaré symmetries, the usual compact internal (gauge) symmetries, at the price of allowing in addition a normal subgroup of nilpotent internal (gauge) symmetries. The proposed mechanism uses a similar group theoretical backdoor to the Coleman-Mandula theorem as the (extended) super-Poincaré group does. It is, however, less exotic in the sense that it preserves also the vector bundle structure of fundamental fields over a four dimensional Lorentz signature spacetime manifold – i.e. it conserves a behavior so characteristic to gauge theories. Hence, we named these the conservative extensions of the Poincaré group. A theory having such symmetries can basically be considered as an ordinary gauge theory with some nilpotent internal symmetries besides the usual compact ones. However, the nilpotent symmetries make it possible to have a unified, i.e. non direct product structure for the group. Due to the normalness of the subgroup of nilpotent internal symmetries, introduction of new elementary particle species can eventually be avoided, while keeping the most important features of (extended) SUSY, and a maximal resemblance to an ordinary gauge theory can be maintained at the same time. These results were published in: JPhysA50(2017)115401.

Parallel Session

Alternatives to Supersymmetry

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