



Contribution ID: 79

Type: **not specified**

More on Fake GUT

Tuesday 26 July 2022 16:54 (18 minutes)

It is remarkable that the matter fields in the Standard Model (SM) are apparently unified into the $SU(5)$ representations. A straightforward explanation of this fact is to embed all the SM gauge groups into a simple group containing $SU(5)$, i.e., the grand unified theory (GUT). Recently, however, a new framework “fake GUT” has been proposed. In this new framework, the apparent matter unification can be explained by a chiral gauge group G , $G \supset SU(5)$. We emphasize that the SM matter fields are not necessarily embedded into the chiral representations to explain the apparent unification. In this paper, we discuss details of concrete realizations of the fake GUT model. We first study the model based on $SU(5) \times U(2)_H$, where $SU(3)_c$ in the SM is from $SU(5)$ while $SU(2)_L \times U(1)_Y$ are from the diagonal subgroups of $SU(5) \times U(2)_H$. We also extend this model to the one based on a semi-simple group, $SU(5) \times SU(3)_H$, so that $U(2)_H$ is embedded in $SU(3)_H$. We also show that this framework predicts rather different decay patterns of the proton, compared to the conventional GUT.

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Session Classification: Parallel Session C

Track Classification: Particle Physics