Finite Unification: Theory, Models and Predictions

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Abstract

All-loop Finite Unified Theories (FUTs) are very interesting $N = 1$ supersymmetric Grand Unified Theories (GUTs) realising an old field theory dream, and moreover have a remarkable predictive power due to the required reduction of couplings. The reduction of the dimensionless couplings in $N = 1$ GUTs is achieved by searching for renormalization group invariant (RGI) relations among them holding beyond the unification scale. Finiteness results from the fact that there exist RGI relations among dimensional couplings that guarantee the vanishing of all beta-functions in certain $N = 1$ GUTs even to all orders. Furthermore developments in the soft supersymmetry breaking sector of $N = 1$ GUTs and FUTs lead to exact RGI relations, i.e. reduction of couplings, in this dimensionful sector of the theory, too. Based on the above theoretical framework phenomenologically consistent FUTs have been constructed. Here we review FUT models based on the $SU(5)$ and $SU(3)^3$ gauge groups and their predictions. Of particular interest is the Higgs mass prediction of the models which is expected to be tested at the LHC.

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