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Dynamical Symmetry Breaking and Fermion Mass Hierarchy in the Scale-Invariant 3-3-1 Model

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We propose an extension of the Standard Model (SM) based on the $SU(3)_C \otimes SU(3)_L \otimes U(1)_X$ (3-3-1) gauge symmetry and scale invariance. Maintaining the main features of the so-called 3-3-1 models, such as the cancellation of gauge anomalies related to the number of chiral fermion generations, this model exhibits a very compact scalar sector. Only two scalar triplets and one singlet are necessary and sufficient to break the symmetries dynamically via the Coleman-Weinberg mechanism. With the introduction of an Abelian discrete symmetry and assuming a natural hierarchy among the vacuum expectation values of the neutral scalar fields, we show that all particles in the model can get phenomenologically consistent masses. In particular, most of the standard fermion masses are generated via a seesaw mechanism involving some extra heavy fermions introduced for consistency. This mechanism provides a partial solution for the fermion mass hierarchy problem in the SM. Furthermore, the simplicity of the scalar sector allows us to analytically find the conditions for the potential stability up to one-loop level and show how they can be easily satisfied. Some of the new particles, such as the scalars H , H^\pm and all the non-SM vector bosons, are predicted to get masses around the TeV scale and, therefore, could be produced at the high-luminosity LHC. Finally, we show that the model features a residual symmetry which leads to the stability of a heavy neutral particle; the latter is expected to show up in experiments as missing energy.

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