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S3 as a modular symmetry: consequences in the quark and Higgs sectors

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An open problem in the Standard Model relates to the origin of the mass hierarchy among fermions, and its mixing. Different alternatives have been proposed by adding extra symmetries that relate the three generations of fermions and by extending the Higgs sector. In particular, it has been shown that the S3 symmetry has given good results if two extra Higgs doublets are added to the Standard Model, giving a total of 3 Higgs doublets. The analysis of the scalar invariant potential of S3 was shown to be compatible with the known experimental results on Higgs physics, and to give interesting predictions that can be tested in the LHC pertaining the extra scalar bosons, besides providing one or more candidates to dark matter. However, when taking into account the minimization conditions of the Higgs potential, the resulting VCKM matrix exhibits a residual symmetry with zeros in some entries. Following the success of S3 with 3 Higgs doublets, an extension of the Standard Model is proposed by means of the same group, but obtained from a modular symmetry. A proper assignment of the quark and Higgs fields in S3 and their modular weights allows to write a mass matrix with texture zeroes. By evaluating the modular weights in their symmetric points, and using the results of the minimization of the scalar potential, a VCKM mixing matrix with no zero entries but few free parameters, can be constructed. A likelihood analysis from the theoretical expressions for the mixing matrix is then performed via a χ^2 analysis, giving very good agreement with experimental data. On the other hand, with an appropriate assignment of modular weights, the Higgs sector remains unchanged as compared to the usual S3-3H model, and thus the interesting results in this sector are maintained.

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