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Yukawa coupling unification in non-supersymmetric SO(10) GUT models with an intermediate scale

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We will discuss the possibility of unifying in a simple and economical manner the Yukawa couplings of third-generation fermions in a non-supersymmetric SO(10) model with an intermediate symmetry breaking, focusing on two possible patterns with intermediate Pati-Salam and minimal left-right groups. For this purpose, we start with a two Higgs doublet model at the electroweak scale and assume a minimal Yukawa sector at the high energy scales. We first enforce gauge coupling unification at the two-loop level by including the threshold corrections in the renormalization group running which are generated by the heavy fields that appear at the intermediate symmetry breaking scale. We then study the running of the Yukawa couplings of the top quark, bottom quark, and tau lepton at two loops in these two breaking schemes, when the appropriate matching conditions are imposed. We find that the unification of the third family Yukawa couplings can be achieved while retaining a viable spectrum, provided that the ratio of the vacuum expectation values of the two Higgs doublet fields is large, $\tan \beta \approx 60$.

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