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# Numerical analysis of SO(10) models with flavour symmetries

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We consider a supersymmetric $SO(10)$ Grand Unified Theory (GUT)
in which the fermion masses are generated by renormalizable Yukawa couplings. Consequently, the scalar multiplets under consideration belong to the irreps **10**,
$\overline{\mathbf{126}}$,
and **120** of $SO(10)$.
We perform a complete investigation of the possibilities
of imposing flavour symmetries in this scenario;
the purpose is to reduce the number of Yukawa coupling constants
in order to identify potentially predictive models. We have found that there are 14 inequivalent cases of Yukawa coupling matrices,
out of which 13 cases pertain to one-generator Abelian groups
and only one case has a two-generator symmetry group. Supersymmetry enters through the numerical examination of those cases,
in which we have used the charged-fermion masses evaluated at the GUT scale
through renormalization-group running
in the context of the Minimal Supersymmetric Standard Model.
However, the numerical analysis rules out almost all the cases,
leaving only a few viable ones which are compatible
with the data on the fermion masses and mixings.

In order to test the viability of each case
and to find adequate numerical values for its parameters,
we construct a minimization function $\chi^2$ which relates experimental data with the observables (masses and mixing parameters) to be fitted. The minimization of $\chi^2$ is a difficult task because (a) parameters differ by several orders of magnitude, and (b) the number of local minima is always large. For the numerical minimization we have employed the Differential Evolution algorithm. This is a stochastic algorithm
that exploits a population of potential solutions
in order to effectively probe the parameter space.
By modifying uncertainties in the $\chi^2$ function and diversely restricting parameter space we have been able to test
more local minima for each case, and to find the minima
closer to the global minimum.

**Primary author:** JURCIUKONIS, Darius (Vilnius University (LT))

**Co-authors:** Dr LAVOURA, Luis (CFTP, Instituto Superior Tecnico, Universidade de Lisboa); FERREIRA, Pedro (ISEL—Instituto Superior de Engenharia de Lisboa); Dr GRIMUS, Walter (University of Vienna, Faculty of Physics)

**Presenter:** JURCIUKONIS, Darius (Vilnius University (LT))

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