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On the origin of fermion masses and mixing from a unified description of flavour and gauge interactions

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We present a Grand Unified Theory where the usual E_6 gauge coupling unification is supplemented by a local $SU(2)_F \times U(1)_F$ family symmetry. We discuss its origin inspiring our model by an embedding into E_8 which can be seen as an unifying force. We argue that the presence of such a family symmetry has remarkable implications for both high-scale and low scale physics: First, while the usual 27^3 cubic interactions in the superpotential are forbidden, tree-level Yukawa terms are generated via dimension-four operators upon the breaking of E_6 down to its trinification maximal subgroup. Such a breaking will also induce sizable threshold corrections to the gauge couplings at the E_6 scale which modifies their running in such a way that it becomes possible to attain a low scale unification picture not far from the reach of a Future 100 TeV Circular Collider. On the other hand we demonstrate that the masses of leptons and first generation quarks are of radiative origin whereas second and third quark families are tree-level generated. This results in a CKM-mixing with the Cabibbo where deviations from unitarity are induced via mixing with down-type vector-like quarks as well as radiative corrections.

Primary authors: MORAIS, Antonio (University of Aveiro); PASECHNIK, Roman (Lund university); POROD, Werner Rudolf (Julius Maximilians Universitaet Wuerzburg (DE))

Presenter: MORAIS, Antonio (University of Aveiro)

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