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Tri-hypercharge: a path to the origin of flavour

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I will discuss a tri-hypercharge (TH) extension of the Standard Model (SM) in which a separate gauged weak hypercharge is associated with each fermion family, avoiding the family repetition of the SM. If the SM Higgs doublet only carries third family hypercharge, then only third family renormalisable Yukawa couplings are allowed, explaining the hierarchical heaviness of their masses. I will motivate the addition of a second Higgs doublet as a natural explanation for the hierarchies between the fermion masses in the different charged sectors. Yukawa couplings for light fermion families are induced in the form of non-renormalisable operators provided by the high scale Higgs fields (hyperons) which break the TH group down to SM hypercharge, explaining fermion mass hierarchies and the smallness of CKM quark mixing. I will show that due to the TH gauge symmetry, the implementation of a seesaw mechanism naturally leads to a low scale seesaw, where the right-handed neutrinos may be as light as the TeV scale. Finally, I will motivate that the breaking of the TH group could be as low as the TeV scale, with implications for flavour-violating observables, LHC physics and electroweak precision observables related to low scale Z' bosons.

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