Contribution ID: **31**   Type: **not specified**

Flavor puzzle in three Higgs-doublet models: Insights from BGL and lessons from flavor data

Thursday 3 July 2025 14:30 (20 minutes)

We study a variant of the 3HDM, referred to as the BGL-3HDM, incorporating a $U(1)_1 \times U(1)_2$ symmetry, which can distinguish the primary sources of mass for different fermion generations. In the version considered here, the Yukawa matrices in the down-quark and charged lepton sectors are diagonal, thereby eliminating tree-level FCNCs in these sectors. FCNCs mediated by neutral nonstandard Higgses are confined to the up-quark sector only. No new BSM parameters are introduced by the Yukawa sector of the model, making it as economical as the NFC versions of 3HDM with a $U(1)_1 \times U(1)_2$ symmetry in terms of the number of free parameters. However, even in the down-quark and in the charged lepton sectors, flavor diagonal but nonuniversal Higgs couplings set this model apart from the NFC versions of the 3HDM.

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Session Classification: Parallel session II