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Global analysis and LHC study of a vector-like extension of the Standard Model with extra scalars

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We perform a global analysis of a vector-like extension of the Standard Model, which also features additional doublet and singlet scalars. The usual Yukawa interactions are forbidden in this setup by an extra U(1) global symmetry and the masses of the second and third family quarks and leptons are generated via the mixing with the vector-like sector. We identify three best-fit benchmark scenarios which satisfy the constraints imposed by the stability of the scalar potential, the perturbativity of the coupling constants, the measurement of the muon anomalous magnetic moment and the non-observation of the flavor violating tau decays. We show that dominant contributions to the muon $(g-2)$ originate in this model from the charged Higgs/neutral lepton one-loop diagrams, thus correcting an inaccurate statement than can be found in the literature. We also perform a detailed LHC analysis of the benchmark scenarios. We investigate the experimental constraints stemming from direct searches for vector-like quarks, vector-like leptons and exotic scalars. While we show that the model is not currently tested by any collider experiment, we point out that decays of a heavy Higgs boson into two tau leptons may offer a smoking gun signature for the model verification in upcoming runs at the LHC.

Primary authors: Dr CÁRCAMO HERNÁNDEZ, Antonio Enrique (Universidad Técnica Federico Santa María); RIZZO, Daniele (NCBJ); LEE, Huchan (The university of Southampton); Dr KOWALSKA, Kamila (National Centre for Nuclear Research)

Presenter: RIZZO, Daniele (NCBJ)

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