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A near-minimal leptoquark model for reconciling flavour anomalies and generating radiative neutrino masses

We introduce two scalar leptoquarks, the $\mathrm{SU}(2)_L$ isosinglet denoted $\phi \sim (\mathbf{3}, \mathbf{1}, -1/3)$ and the isotriplet $\varphi \sim (\mathbf{3}, \mathbf{3}, -1/3)$, to explain observed deviations from the standard model in semi-leptonic B-meson decays. We explore the regions of parameter space in which this model accommodates the persistent tensions in the decay observables $R_{D^{(*)}}$, $R_{K^{(*)}}$, and angular observables in $b \to s\mu\mu$ transitions. Additionally, we exploit the role of these exotics in existing models for one-loop neutrino mass generation derived from $\Delta L = 2$ effective operators. Introducing the vector-like quark $\chi \sim (\mathbf{3}, \mathbf{2}, -5/6)$ necessary for lepton-number violation, we consider the contribution of both leptoquarks to the generation of radiative neutrino mass. We find that constraints permit simultaneously accommodating the flavour anomalies while also explaining the relative smallness of neutrino mass without the need for cancellation between leptoquark contributions. A characteristic prediction of our model is a rate of muon–electron conversion in nuclei fixed by the anomalies in $b \to s\mu\mu$ and neutrino mass; the COMET experiment will thus test and potentially falsify our scenario. The model also predicts signatures that will be tested at the LHC and Belle II.

Primary authors: BIGARAN, Innes (The University of Melbourne); Prof. VOLKAS, Raymond; Mr GARGALIONIS, John

Presenter: BIGARAN, Innes (The University of Melbourne)