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Explaining B-Anomalies with safe Z' extensions

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$U(1)'$ extensions of the SM with generation-dependent couplings to quarks and leptons are a popular explanation of anomalies in rare B-decays, such as the R_K and R_K^* observables. However, a critical issue with such models is often ignored – most configurations feature a Landau pole in the new gauge coupling that is well below the Planck scale. We present an ansatz that avoids such Landau poles, stabilises the Higgs potential and remains well-behaved and predictive up to the Planck scale. To these ends, we introduce three generations of vector-like standard model singlet fermions, an enlarged, flavourful scalar sector, and, possibly, right-handed neutrinos, all suitably charged under the $U(1)'$ gauge interaction. We identify several benchmark models consistent with theory as well as phenomenological constraints and their respective predictions of Wilson coefficients for a global $b \to s$ fit. We further investigate the complete two-loop running of gauge, Yukawa and quartic couplings up to the Planck scale to constrain low-energy parameters and map out the BSM critical surface. Moreover, some key phenomenological aspects are highlighted.

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