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Potential Signatures and Combined Constraints for First Generation Leptoquarks

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We present potential signatures and combined constraints for leptoquarks which couple to first generation fermions, considering both low energy precision observables and LHC direct searches. Including all ten leptoquark representations, five scalar and five vector ones, we study at the precision frontier the constraints from $K \rightarrow \pi\nu\nu$, $K \rightarrow \pi e^+e^-$, $K^0 - \bar{K}^0$ and $D^0 - \bar{D}^0$ mixing, as well as from experiments sensitive to parity-violating interactions (APV, QWEAK and COHERENT). We include LHC searches for s -channel single resonant production, pair production and Drell-Yan-like signatures of leptoquarks. Particular emphasis is placed on the recent CMS analysis of lepton flavour universality violation in non-resonant di-lepton pairs. The excess in electron events could be a hint at first generation leptoquarks, t -channel contributions from $\tilde{S}_1, S_2, S_3, \tilde{V}_1, V_2$ ($\kappa_2^{RL} \neq 0$) and V_3 can explain the excess without violating other bounds. Regarding the so-called “Cabibbo angle anomaly”, we observe that the present constraints are too restrictive to allow for a resolution via direct leptoquark contributions to super-allowed beta decays.

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