DESY THEORY WORKSHOP

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Inverse Hierarchy MFV Quark Dipole

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We present a new minimal flavor violation (MFV) scenario in which the up-type quark dipole coupling matrices C_{uV}^{ij}, $V = W$ or B, are not only diagonal in the mass eigenbasis but also have the eigenvalues that are inversely proportional to the quark masses. Namely, C_{uV}^{11} is the largest Wilson coefficient in the three families. We analyze several aspects of this 'inverse hierarchy MFV quark dipole' model. In the infrared regime, we compare the flavor changing bounds of $K^0 - \bar{K}^0$ oscillation and exotic decays of the charged mesons π^+, K^+, B^+. Due to the GIM cancellation and the helicity suppression, these bounds are loose for the first generation quark and require $|C_{uV}^{11}| < \mathcal{O}(10)\text{GeV}^{-2}$. In the ultraviolet(UV) theories, the quark dipole operators are induced by the heavy states in the loops. Consequently, the quark masses receive sizable radiative corrections, leading to the light quarks' naturalness problem. In our framework, we provide a type of UV model in which the loop corrections to the mass cancel each other out. As a key part of our phenomenological study, we simulate the $\bar{p}p \to Wh/Zh \to \gamma\gamma\ell\nu/\ell\ell$ process at the FCC-hh collider. Our simulation shows that the high luminosity precision, $\sqrt{s} = 100\text{TeV}$, $\mathcal{L} = 30$ ab^{-1}, sets the C_{uV} upper bounds in the ballpark of $5 \times 10^{-3}\text{TeV}^{-2}$ which is almost two orders of magnitude stronger than the existing bounds obtained from LHC dilepton Drell-Yann channel analysis.

Summary

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