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Novel B -decay signatures of light scalars at high energy facilities

In this talk, we will discuss the phenomenology of light scalars of masses m_1 and m_2 coupling to heavy flavour-violating vector bosons of mass $m_V \sim \text{TeV}$. This scenario is particularly motivated, as the scalar-vector coupling arises naturally in non-minimal composite Higgs models and the vector boson is a prime candidate to solve the apparent anomalies observed in tests of lepton flavour universality.

For $m_{1,2} \sim \text{few GeV}$, the model triggers rare B -meson decays such as $B_s^0 \rightarrow 3\mu^+3\mu^-$, $B^0 \rightarrow 3\mu^+3\mu^-$, $B^+ \rightarrow K^+3\mu^+3\mu^-$ and $B_s^0 \rightarrow K^{0*}3\mu^+3\mu^-$. None of these signals has been studied experimentally. Therefore, we will discuss dedicated analyses to test these channels at the LHCb, obtaining current and future limits on the corresponding branching ratios.

For $m_{1,2} \gg \mathcal{O}(1) \text{ GeV}$, the scalars arise instead in the decay of the vector mediator, which can be produced in pp collisions at the LHC. In this regime, we will show that modified versions of current multiplepton and multitau searches can probe a wide region of the parameter space of this scenario.

Altogether, the potential of the searches we propose outperform other constraints such as those from meson mixing.

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