

Probing MeV-Range Scalar Bosons and TeV Range Vectorlike Fermions Associated with $U(1)_{T3R}$ at the LHC

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Recently, there has been great interest in beyond-the-Standard Model (BSM) physics involving new low-mass matter and mediator particles. One such model, $U(1)_{T3R}$, proposes a new $U(1)$ gauge symmetry under which only right-handed fermions of the standard model are charged, as well as the addition of new vector-like fermions (e.g., χ_t) and a new dark scalar particle (ϕ) whose vacuum expectation value breaks the $U(1)_{T3R}$ symmetry. For this work, we perform a feasibility study to explore the mass ranges for which these new particles can be probed at the LHC. We consider the interaction $pp \rightarrow \chi_t t \phi$ in which the top quark decays purely hadronically, the χ_t decays semi-leptonically ($\chi_t \rightarrow W + b$), and the ϕ decays to two photons. The proposed search is expected to achieve a discovery reach with signal significance greater than 5σ for χ_t masses up to 1.8 TeV and ϕ masses as low as 1 MeV, assuming an integrated luminosity of 3000 fb^{-1} .

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