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Probing MeV-scale Scalar Bosons in association with TeV-scale Vectorlike Fermions in U(1)T3R at the LHC

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Abstract

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 semileptonically ($\chi_t \rightarrow W + b \rightarrow l \nu b$), 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} .

Primary authors: GURROLA, Alfredo (Vanderbilt University (US)); KAMON, Teruki (Texas A & M University (US)); DUTTA, Bhaskar (Texas A&M University); JULSON, Dale Adam (Vanderbilt University (US)); KUMAR, Jason

Presenter: JULSON, Dale Adam (Vanderbilt University (US))

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