

Probing light dark scalars with future laboratory experiments

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We investigate a dark sector containing a pair of light non-degenerate scalar particles, with masses in the MeV-GeV range, coupled to the visible sector through heavier mediators. The heaviest dark state is long-lived, and its decays offer new testable signals. We analyze the prospects for detection with the proposed beam-dump facility SHiP, and the proposed LHC experiments FASER and MATHUSLA. Moreover, we consider bounds from the beam-dump experiment CHARM and from colliders (LEP, LHC and BaBar). We present our results both in terms of an effective field theory, where the heavy mediators have been integrated out, and of a simplified model containing a vector boson mediator, which can be heavy $O(1)$ TeV, or light $O(10)$ GeV. We show that future experiments can test large portions of the parameter space currently unexplored, and that they are complementary to future High-Luminosity LHC searches.

Reference to paper (DOI or arXiv)

<https://arxiv.org/abs/2011.04735>

Your gender (free text)

Primary author(s) : TAOSO, Marco (INFN Torino)

Presenter(s) : TAOSO, Marco (INFN Torino)

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