

MiniBooNE-DM: a dark matter search in a proton beam dump

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In a dedicated run where protons from the Fermilab Booster were delivered directly to the steel beam dump of the Booster Neutrino Beamline, the MiniBooNE detector was used to search for the production of dark matter particles via vector-boson mediators, as predicted by vector portal models of dark matter. In the scenario that was considered, the interactions of the dark matter particles are mediated by a “dark photon” that kinetically mixes with the ordinary photon, and four parameters determine the physics: the dark matter mass, the mediator mass, the kinetic mixing parameter, and the dark sector coupling. The signal searched for was the elastic scattering of dark matter particles off nucleons in the detector mineral oil, with neutrinos being an irreducible background. Within the model considered, the results obtained provide the best limits on the dark matter annihilation parameter, in the dark matter mass range from 0.01 to 0.3 GeV, for a value of the dark sector coupling consistent with theoretical bounds. The result also excludes a vector mediator particle solution to the $g-2$ anomaly. Our analysis was motivated by the vector portal model, however, other low-mass dark matter models are also possible. In this talk we will review the experiment, the analysis methods, and present the results, which demonstrate that beam dump experiments provide a novel and promising approach to dark matter searches.

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