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The Beam Dump eXperiment at Jefferson Lab

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The Beam Dump Experiment (BDX) at Jefferson Laboratory (JLAB) is electron-beam thick-target experiment to search for Light Dark Matter (LDM) particles in the MeV-GeV mass range. BDX will exploit the high-intensity 10.6 GeV e beam from CEBAF accelerator impinging on the beam dump of experimental Hall-A, collecting up to 10^22 electrons-on-target in a few years time. Any LDM particles produced by the interaction of the primary e beam with the beam dump will be detected by measuring their scattering inside a detector, which is to be installed in a dedicated underground facility, located 20 m downstream. The space between the beam dump and the detector will be filled with heavy shielding to suppress the high-energy component of the beam-related backgrounds. The BDX detector consists of electromagnetic calorimeter (ECAL) made of a matrix of inorganic scintillating crystals, surrounded by a hermetic veto system. The expected signature for the LDM interaction in the ECAL is an O(100 MeV) electromagnetic shower with no activity in the surrounding active veto counters.

After an intense phase of R&D studies and simulations with on-site background measurements conducted to validate the corresponding results, the BDX proposal received full approval by the 2019 JLab Program Advisory Committee. The collaboration is actively working on the design of the new experimental facility for housing the experiment.

A small-scale version of the full experiment, BDX-MINI, has been built and operated with a lower energy beam, where the existing soil between the beam dump and the detector provided adequate shielding from known particles produced in the beam dump. The BDX-mini detector, installed in a well located 22 m downstream of the Hall-A beam dump, consisted of a PbWO electromagnetic calorimeter, surrounded by a layer of tungsten shielding and two hermetic plastic scintillator veto systems. Despite the small interaction volume, the large accumulated charge of 2.2 EOT allowed for the BDX-mini measurement to set competitive exclusion limits on the LDM parameters space, comparable to those reported by larger-scale efforts.

In this talk, after a brief introduction to the LDM physics case, we will present an overview of BDX, discussing the main items of the R&D and design phase of the experiment. We will then show the results obtained from the BDX-mini experiment, focusing on few key aspects of the associated experimental campaign and data analysis effort

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