Light Dark Matter Experiment

Introduction

LDMX aims to decisively test a variety of dark matter scenarios (including thermal origin scenarios) in the sub-GeV mass range, and to provide strong sensitivity to any other dark sector physics that couples to electrons below the GeV-scale. One area of concentration is on light hidden sector (or "dark sector") dark matter in the mass range of 0.5 MeV to 0.5 GeV, roughly in the mass range of familiar matter such as electrons and protons. In this mass range, dark matter can be a thermal relic provided it interacts with the Standard Model through GeV-scale vector or scalar mediated forces.

The LDMX experiment proposes a high-statistics search for low-mass dark matter using an electron beam fixed-target missing momentum technique, scattering incoming electrons in a tungsten target to produce dark matter via “dark bremsstrahlung”. The clear signature of dark matter production is established by individually tagging incoming beam-energy electrons and unambiguously associating them with low energy, moderate transverse-momentum recoils and establishing the absence of a forward going photon. The primary backgrounds are traditional bremsstrahlung processes with photo-nuclear reactions occurring in the target or forward calorimeter. Therefore, the experiment requires; (a) low-mass tracking in a magnetic field that provides high-purity tagging for incoming electrons and clean, efficient reconstruction and momentum measurement of recoils; (b) a high-speed, granular calorimeter with MIP sensitivity and the ability to reject rare photo-nuclear reactions; and (c) a sensitive neutral hadron veto system to reject reactions the channel energy into pure neutron or neutral Kaon final states. The LDMX concept proposes to meet these challenges by leveraging technology under development for the HL-LHC and experience from the HPS experiment.

Currently, LDMX is in a design study phase, with collaborators developing and optimizing a full conceptual detector design. The beamlines under current consideration are the recently proposed S30XL transfer line that would supply SLAC's End Station A with 4-8 GeV electrons, Jefferson Lab's 11 GeV CEBAF, and 4-16 GeV electrons from an electron beam facility proposed at CERN.

Key Public Documents

- LDMX Design Study Paper (Aug 14, 2018)
- One page summary of LDMX science and detector
- Publications and Presentations

Collaborating Institutions

Caltech
Fermilab
Lunds Universitet
University of Minnesota
UCSB University of California Santa Barbara
Carnegie Mellon University
SLAC National Accelerator Laboratory
Stanford University
Texas Tech University
University of Virginia

Contacts

Co-spokespersons: Torsten AKESSON (torsten.akesson [at] hep.lu.se) and Timothy Knight NELSON (tknelson [at] slac.stanford.edu)

Reviews

LDMX Reviews (access required)