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Status and Prospects of Light Dark Matter eXperiment

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An elegant explanation for the origin and observed abundance of dark matter in the Universe is the thermal freeze-out mechanism. Within this mechanism, possible masses for dark matter particle candidates are restricted approximately to the MeV - TeV range. The GeV-TeV mass range is being explored intensely by a variety of experiments searching for Weakly Interacting Massive Particles. The sub-GeV region occurs naturally in Hidden Sector dark matter models, but has been tested much less by experiments to date. Exploring this mass range is imperative as part of a comprehensive Dark Matter search programme, but requires new experimental approaches.

The freeze-out mechanism assumes a non-gravitational interaction between dark and ordinary matter, which necessarily implies a production mechanism for dark matter at accelerator experiments. Recent advancements in particle accelerators and detectors in combination with software developments like machine learning techniques open new possibilities to observe such processes.

The planned Light Dark Matter eXperiment (LDMX) is an electron-beam, fixed- target experiment that exploits these developments, enabling us to observe processes orders of magnitudes rarer than what is detectable today. The key to this is a multi-GeV beam providing a few electrons 46-million times per second, and a detector that monitors how each individual electron interacts in the target —for up to 10^{16} electrons. First beam for commissioning the experiment is expected in early 2024 at SLAC, Stanford, marking the starting point of a first data taking period of about one and a half years. A second phase with higher beam-energy and -intensity is foreseen soon thereafter.

This presentation will give an overview of the theoretical motivation and the different components of the LDMX detector concept, as well as the main experimental challenges and how they are addressed. It will further discuss projected sensitivities and possible future upgrades towards covering a large portion of the viable phase-space for sub-GeV thermal relic dark matter and other models.

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