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Search for feebly interacting particles with the Lohengrin experiment at the ELSA accelerator

An interesting family of extensions to the Standard Model features new, light particles that interact only feebly with the SM sector. A prominent example are models that aim to explain dark matter with the existence of a dark sector. A feeble coupling between the dark sector and the SM is established by introducing a kinetic mixing term between the SM photon and a new massive vector portal, the dark photon, in the Lagrangian. In these models, dark photons can be produced in a process that is similar to SM bremsstrahlung by shooting a beam of electrons at a fixed target. The radiation of a dark photon would cause the incoming electron to lose a significant fraction of its energy in the process. The dark photon could escape the experiment undetected, provided that its mass is high enough to enable its decay into two dark matter particles. The Lohengrin experiment is an experiment that is to be set up at the ELSA accelerator in Bonn, exploiting the unique ability of the accelerator to produce extremely clean events at an exceedingly high rate. Lohengrin is projected to provide sensitivity to a dark sector with the mixing term as small as necessary to explain the relic amount of dark matter in the universe for scalar, Majorana and Pseudo-Dirac dark matter particles and dark photon masses of a few MeV and above, so far uncovered by existing experiments. The realization of the experiment requires the finalization of short-term silicon detector R&D to enable data taking at the necessary event rate. An AI-engine driven track trigger, in combination with a high rate-capable tracking detector and a reasonably sized set of fast calorimeters will enable the full physics potential of the experiment. This extends beyond light dark matter models to any models with one or more particles that couple feebly to the electron.

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