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MIGDAL: Towards an unambiguous observation of the Migdal effect in nuclear scattering

Saturday, 9 July 2022 18:00 (20 minutes)

Despite the lack of experimental confirmation of the Migdal effect, several underground direct dark matter experiments are exploiting this rare atomic phenomenon to extend their sensitivity to light WIMP-like candidates. However, this effect is yet to be observed in nuclear scattering. The Migdal in Galactic Dark mAtter expLoration (MIGDAL) experiment aims to make the first unambiguous particle detector-based observation of the Migdal effect.

An Optical Time Projection Chamber (OTPC) will be used to image ionisation tracks originating from the same vertex, one belonging to a nuclear recoil and the other to an electron, which is the Migdal event signature. The nuclear recoils will be generated inside the detector's gaseous volume by the scattering of fast neutrons from intense DT and DD generators, allowing the effect to be explored across a wide range of nuclear recoil energies. The OTPC is outfitted with two glass-GEMs that enable high gain operation in a 50-Torr CF4-based gas mixture, as well as a photomultiplier tube and a fast low-noise CMOS camera to collect light from the initial ionisation and avalanche processes, respectively. A charge readout consisting of a 120 ITO strip anode is also included in the detector for timing information.

The MIGDAL OTPC configuration enables precise three-dimensional reconstruction of electron and nuclear recoil ionisation tracks and the use of low-pressure gas allows for the reconstruction of electron tracks down to 5 keV. The design of the experiment will be presented along with the results from end-to-end detailed simulations and estimates of signal and background yields, as well as the current status of activities at the Rutherford Appleton Laboratory's Neutron Irradiation Laboratory for Electronics (NILE), where the experiment will be hosted.

In-person participation

Yes

Primary authors: NIKOLOPOULOS, Konstantinos (University of Birmingham); KATSIOULAS, Ioannis (University of Birmingham)

Presenter: KATSIOULAS, Ioannis (University of Birmingham)

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