

Optimising recoil imaging detectors for extraterrestrial particles

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The experimental search for WIMP-like dark matter remains inconclusive. As these experiments grow in size and more of the available parameter space is investigated and excluded, it is necessary to plan ahead to circumvent the looming neutrino fog, which constitutes a near-irreducible background for an experiment sensitive to only recoil energy.

The direction of the incoming flux of dark matter is unique, hence it provides a smoking-gun signal to unambiguously claim discovery. Accessing this information would then make it possible to discern between dark matter and other sources.

To accurately determine the origin of an incoming particle, a directional detector must be capable of resolving the spatial dimensions of the ionisation tracks, for example micro-pattern gas detectors (MPGDs), which can be used as the readouts for gas time projection chamber (TPC)-based experiments such as CYGNUS.

It is, then, vital to carefully consider how the sensitivity will depend on the geometry, location, alignment and orientation of the experiment. Our aim is to analyse these parameters for different sources of particles, ultimately devising a set of clear guidelines to maximise the performance of any 3D recoil imaging detector.

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