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The CYGNO experiment

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Innovative experimental techniques are needed to further search for dark matter weakly interacting massive particles. The ultimate limit is represented by the ability to efficiently reconstruct and identify nuclear and electronic recoil events at the experimental energy threshold. Gaseous Time Projection Chambers (TPC) with optical readout are very promising candidates thanks to the 3D event reconstruction capability of the TPC technique and the high sensitivity and granularity of last generation scientific light sensors. The Cygno experiment is pursuing this technique by developing a TPC operated with He-CF4 gas mixture at atmospheric pressure equipped with a Gas Electron Multipliers (GEM) amplification stage where visible light is produced. The combined use of high-granularity sCMOS cameras and fast light sensors allows the reconstruction of the 3D direction of the tracks, offering good energy resolution and very high sensitivity in the few keV energy range, together with a very good particle identification useful for distinguishing nuclear recoils from electronic recoils. We present the design and the sensitivity of a demonstrator which is currently being installed underground at LNGS and will be operated already in 2022. The performances of the demonstrator are evaluated with advanced Monte Carlo simulation of the radioactivity of the materials and the LNGS cavern background together with calibrations against radioactive sources. We show that good energy and spatial resolution as well as discriminating power between nuclear and electronic recoils is achieved in the KeV energy range. The Cygno collaboration plans to demonstrate the scalability of such detector concepts to reach a target mass large enough to significantly extend our knowledge about DM nature and solar neutrinos.

In-person participation

Yes

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