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The CYGNO Experiment

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The detection of ultra-rare events as the interaction of galactic dark matter (DM) candidate particles or of neutrinos originated from the Sun requires the development of innovative detection techniques. In particular future experiments for direct DM detection requires to extend their sensitivity to masses well below 10 GeV.

The Cygno collaboration plans to build and operate at LNGS a cubic meter demonstrator of a gaseous time projection chamber (TPC), equipped with an optical readout and using a He:CF₄ mixture kept at atmospheric pressure. The presence of low Z atoms allows to reach a competitive sensitivity to DM masses in the GeV range while the presence of fluorine can be used to set limits on a spin-dependent DM interaction cross-section.

The Cygno TPC is equipped with a Gas Electron Multipliers (GEM) amplification stage of the primary ionisation electrons. Light is produced from the GEM while scientific CMOS cameras and fast photodetectors are combined to obtaining a three-dimensional reconstruction of the tracks either due to nuclear or to electron recoils.

The design and the sensitivity of the demonstrator based on advanced Monte Carlo simulations of the radioactivity of the materials and of the LNGS cavern are reported. Pattern recognition algorithms are used to evaluate the identification capability of nuclear recoils against electronic recoils and studied in data from small scale prototypes. Energy measurement and also sensitivity to the source directionality are also evaluated. Therefore, a Cygno TPC would also be able to detect electron recoils originated by solar neutrinos interactions.

The Cygno collaboration plans to demonstrated the scalability of such detector concept to reach a target mass large enough to significantly extend our knowledge about DM nature and solar neutrinos.

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