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The CYGNO experiment, a directional detector for direct Dark Matter searches

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We are going to present the CYGNO/INITIUM project, an experiment that emerges as a new approach for directional Dark Matter searches using a gaseous TPC with the purpose of detecting low mass (0.5-50 GeV) WIMPs and performing solar neutrino spectroscopy. This project distinguishes itself by the use of He:CF₄, a low-density gas mixture sensitive to both spin dependent and independent interactions, at atmospheric pressure and with optical readout. The final objective of the CYGNO/INITIUM project is to install a $O(1)$ m³ demonstrator at the Laboratori Nazionali del Grand Sasso (LNGS) by 2024-2026. This will act as a demonstrator of the technology, performance, and scalability of the project.

The signal formation in our detector starts with a particle interaction inside the gas volume which is followed by the ionization of the gas and drift of the newly generated electrons. The amplification plane is composed by a stack of three Gas Electron Multipliers (GEMs), where the primary electrons are amplified. The readout is carried out through the combined use of a scientific CMOS camera and PMTs which record the light produced at the amplification stage due to excitation (and posterior de-excitation) of the gas molecules that occur during the electron avalanche process. By merging the information of the two-dimensional projection (X-Y) obtained with a sCMOS camera and the light time profile (dZ) reconstructed using the PMT signal, it is possible to perform a 3D reconstruction of the ionizing events. The high granularity and fast sensors also provide a detailed reconstruction of the energy deposition over a path length which enables topology, directional and head-to-tail recognition.

We will demonstrate the latest results concerning energy resolution, particle identification, and 3D tracking capabilities obtained with our latest 50 L prototype, LIME, recently installed underground. We will also discuss our most recent R&D progresses carried out with a smaller prototype focused on the improvement of the light production and experimental technique.

Collaboration name

CYGNO/INITIUM

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