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CYGNO: an optically readout TPC for Dark Matter and neutrinos study

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The CYGNO experiment is developing a high-precision gaseous Time Projection Chamber for directional dark matter search and solar neutrino spectroscopy, to be installed at the Gran Sasso National Laboratories (LNGS). To achieve this goal, the collaboration is realising a TPC operating at atmospheric pressure, in which the secondary scintillation of a triple-GEM stack is acquired by a system consisting of Active Pixel Sensors based on sCMOS technology, with more than 4 million pixels each, and fast photo-multipliers.
This technology provides information such as the released energy and its spatial profile, 3D direction and 3D position that makes it possible to reconstruct and identify the ionisation produced in the gas by electronic or nuclear recoils with energies down to a few keV.
The use of a mixture based on He and CF4 allows excellent energy transfer from possible WIMPs of mass around GeV, making it the ideal target for possible light WIMPs of masses in the GeV range being also sensitive to the spin-dependent coupling thanks to fluorine.
In this presentation we will describe the operation of our 50-litre prototype (LIME) in the underground laboratories of the Gran Sasso, which represents the largest prototype developed by CYGNO to date, focusing in particular on studies relating to the identification of low-energy nuclear power.
In addition, we will show the design of the demonstrator of approximately half a cubic metre that will be installed in LNGS Hall F in 2025, and the physics potential that a future O(30 m3) experiment could bring.
Finally, we discuss some of the R&D carried out to maximise CYGNO's potential, including the study of hydrogen-based mixtures and the recent achievement of atmospheric pressure negative ion drift operation with optical readout, carried out in synergy with the ERC's INITIUM project.

Collaboration

CYGNO

Role of Submitter

I am the presenter

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