

Towards a large gaseous TPC with optical readout: the CYGNO project

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The identification and discrimination of electronic and nuclear recoil events at low energy thresholds are significant challenges in contemporary dark matter direct detection experiments. Gaseous Time Projection Chambers (TPCs) with optical readout offer a promising and innovative solution in this context. As a result of the high granularity and sensitivity of advanced scientific CMOS (sCMOS) light sensors, this technique provides excellent energy and 3D position reconstruction capabilities. The CYGNO collaboration is pursuing this approach by developing a gaseous TPC that operates with a gas mixture of He and CF₄ at atmospheric pressure, equipped with a Gas Electron Multiplier (GEM) amplification stage. An event induced in such a detector results in the production of visible light, which is collected by sCMOS cameras and a set of fast photosensors. Recently, the 50 L LIME prototype was operated underground at the Laboratori Nazionali del Gran Sasso (LNGS) to evaluate the performance of the CYGNO methodology in a low-background environment and to refine the trigger and data acquisition systems for the future upgrades. This experience is a critical step towards the currently ongoing commissioning of CYGNO-04, a larger 0.4 m³ demonstrator of the CYGNO experiment.

Author: PIACENTINI, Stefano (Istituto Nazionale di Fisica Nucleare)

Presenter: PIACENTINI, Stefano (Istituto Nazionale di Fisica Nucleare)

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