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The LIME gaseous TPC prototype for the CYGNO experiment

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The CYGNO experiment aims at the development of a large gaseous TPC with GEM-based amplification and an optical readout for the directional detection of rare events such as Dark Matter and solar neutrino interactions. The 3D reconstruction of electronic and nuclear recoils is made possible by the combined use of high-granularity sCMOS cameras and PMTs. This technique provides an accurate measurement of the energy with a O(keV) threshold and good sensitivity to the directionality of the events.
In order to demonstrate the scalability of this design, many prototypes were built and tested, the largest of which is the 50 L active volume LIME, with 4 PMTs and a single sCMOS imaging a 33×33 cm2 area. The detector is operated at atmospheric pressure with a He:CF4 mixture in 60/40 proportion. LIME was installed underground at LNGS in February 2022, and it will be soon commissioned.
We will show the results on the performance of LIME, which was tested overground at LNF with different radioactive X-ray sources. The detector's stability, particle identification capability, energy response and energy resolution were studied. A comparison between actual data and Monte Carlo simulations is also ongoing for the characterization of the detector's response. The radioactive instrinsic and environmental background expected at LNGS was simulated, and it will be shown together with the perspectives on the upcoming data taking, including the spectral measurement of the neutron flux underground. LIME will serve as a demonstrator of this technique, which finds applications not only in Dark Matter direct detection, but also in the study of the Migdal effect, and in X-ray polarimetry.

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