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Detecting Solar neutrinos with the CYGNO gas TPC

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The CYGNO project aims to develop a gaseous high-precision Time Projection Chamber with an optical readout for directional Dark Matter searches and solar neutrino spectroscopy. CYGNO incorporates innovative features, such as the utilization of a He-CF4 scintillating gas mixture, and an optical readout made by PMTs and scientific CMOS (sCMOS) cameras.
Directional Dark Matter (DM) detectors, as high precision gaseous TPCs, are not only able to discriminate solar neutrinos interacting through Coherent Elastic Neutrino-Nucleus Scattering (CEvS) from a DM signal, but with a TPC, it is possible to well identify the signal induced by solar neutrinos from the Sun by reconstructing the electron recoil initial direction. The angular distribution of these ER will show a peak in the opposite direction of the Sun (produced by neutrinos) over a flat background component.

In this talk, with particular focus on the studies on the CYGNO/INITIUM response to low energy electron recoils (ER), as measured on data with the LIME prototype (50 L active volume), we will illustrate the MC simulation of ER sCMOS images, and the comparison between these and real data acquired with the detector exposed to multiple X-ray sources.

We will demonstrate the robust data/MC agreement achieved, and we will furthermore discuss the expected ER angular resolution as evaluated on the MC simulation of LIME data and how this was additionally validated with a smaller prototype data.

We will then discuss how, starting from this realistic detector performances and a GEANT4 simulation of the expected backgrounds for a CYGNO-like 30 m3 detector, we demonstrated how an observation of pp neutrinos is feasible in a reasonable amount of time

Finally, we will illustrate the capability to pose constraints on Non-Standard neutrinos Interactions (NSI), demonstrating how already at a very reduced scale the proposed approach can start to be competitive with Borexino.

Collaboration you are representing

CYGNO collaboration

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