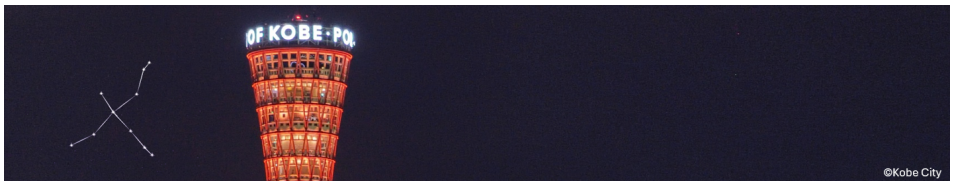

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Diffusion deconvolution method and fiducialization for the CYGNO experiment

Tuesday, 24 February 2026 16:24 (1 minute)

CYGNO is an international collaboration working on the development of a directional detector whose main goal is the direct detection of rare events, such as Dark Matter (DM) in the mass range below a few tens of GeV/c2, by means of a gaseous detector. It exploits the expected directional anisotropy of the DM candidates by measuring the orientation of the track, in addition to the energy released in the active medium. It will consist in a Time Projection Chamber (TPC) filled with a He:CF4 gas mixture equipped with an amplification stage composed of a triple Gas Electron Multiplier (GEM) structure. Given the scintillating

properties of the gas, the readout is optical, based on sCMOS cameras and fast photomultiplier tubes whose combination permits to extract the 3D information on the recoil topology from the TPC detector. In gaseous TPCs, the electron diffusion during drift and amplification spoils the intrinsic 3D information provided by TPC detectors, extremely valuable for directional detectors. A variety of deconvolutional methods can restore most of the details of the track topology, but require extremely detailed knowledge of all the diffusion phenomena. We will show the studies and characterization of the effective diffusion processes performed with a CYGNO prototype exploiting a muon-tagging system. In addition, we will show the use of a MultiWienernet for the deconvolution of the 2D camera images to restore the track topology and improve tracking. Moreover, as the diffusion along the drift direction directly depends on the drift distance, we trained the network to also return the absolute drift position of the deconvolved tracks, achieving a precision of the order of a few centimeters. This is crucial as in low energy searches the absolute determination of the position can help fiducialize the detector and reduce background.

Presenter: DHO, Giorgio (INFN - LNF)

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