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# Reconstruction and Particle Identification with CYGNO detector

*Wednesday 1 June 2022 17:19 (3 minutes)*

CYGNO is developing a gaseous Time Projection Chamber (TPC) for directional dark matter searches, to be hosted at Laboratori Nazionali del Gran Sasso (LNGS), Italy. CYGNO uses He:CF4 gas mixture at atmospheric pressure and relies on Gas Electron Multipliers (GEMs) stack for the charge amplification. Light is produced by the electrons avalanche thanks to the CF4 scintillation properties and is then optically read out by a high-resolution scientific CMOS Camera (sCMOS) and Photo-Multiplier Tubes (PMT). sCMOS are designed for low readout noise, uniformity, and linearity and are therefore capable to track particles down to O(keV) energies. These high-resolution images (2D event projection) are combined with the PMT signal (relative z coordinate information) to obtain 3D reconstruction, with the aim of particle identification and to determine track direction of arrival.
sCMOS images are well suited to be analyzed with Deep Learning techniques (using Convolutional Neural Networks (CNNs), Deep Neural Networks (DNNs)) because of their high granularity and low noise. We will present the CYGNO features and achieved experimental performance, and then focus on the MonteCarlo sCMOS images simulation, reconstruction performed with density-based algorithms (DBSCAN) and Geodesic Active Contour (GAC) clustering algorithm to identify and track particles. Using the morphological features in the track from the reconstructed data, Deep Leaning Models like Gradient Boosted Decision Trees (GBT), Random Forest Classifier (RFC), and Deep Neural Network (DNN) are employed to classify the tracks into different energy classes of Electron recoils and Nuclear Recoils. Future work focuses on the use of a CNN-based model for track reconstruction (instance segmentation) and classification.

## Main Topic

Image segmentation, object detection and classification

## Secondary Topic

Classification and regression

## Participation mode

In person

**Author:** PRAJAPATI, Atul (Gran Sasso Science Institute -INFN)

**Presenter:** PRAJAPATI, Atul (Gran Sasso Science Institute -INFN)

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