PHENIICS doctoral school PhD thesis subject 2017

Laboratory / research team

(LLR) Laboratoire Leprince-Ringuet, École polytechnique / HARPO

Title

High-performance γ-ray astronomy and polarimetry in the MeV-GeV energy range with a Time Projection Chamber (TPC).

Study of the performances of a flight module. AGN polarimetry.

Overview of the research:

Current γ-ray telescopes suffer from a gap in sensitivity between 1 and 100 MeV. Besides, linear polarization has never been measured in that energy range, and would be a strong tool to understanding particle acceleration and γ-ray emission phenomena in objects such as active galactic nuclei (AGN).

We are developing a new detector concept for high-resolution and high-sensitivity γ-ray astronomy in the e^+e^- pair-creation regime, the first with sensitivity to polarization. We have built a time projection chamber (TPC) demonstrator that we have characterized in a fully polarized γ-ray beam from 1.7 to 74 MeV [SPIE2016 9905-95, arXiv:1606.09417].

Thesis project

The **M2 internship** student will contribute to the analysis of these data and to their publication.

The **Ph. D** student will participate in the design of a flight model. From the analysis of geant4-simulated data of the interactions of γ-rays (signal) and cosmic-rays (background) in the detector, he/she will design, simulate and optimize a trigger algorithm based on the real-time multiplicity signal provided by the AGET chip developed and recently validated at CEA.

The performance for astrophysical observations will be evaluated for the study of γ-ray blazars. By measuring their polarization, it will be possible to determine whether their emission is due to leptonic or to hadronic processes [eg., Ap.J. 774, 18 (2013)], a long-standing question in blazar astrophysics.

Master and doctoral school

- M2 **High-Energy Physics**, or
  M2 **Astronomy or Astrophysics and Space Engineering**

- PHENIICS doctoral school – Université Paris-Saclay

Foreseen PhD grant funding

CNES / CNRS, 50/50.

Local team

Gamma-astronomy group (Stephen FEGAN, 01 6933 5558, sfegan @ llr.in2p3.fr)

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links : http://llr.in2p3.fr/~dbernard/polar/harpo-t-p.html