INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: Laboratoire d'Annecy-le-Vieux de Physique Théorique, LAPTh
CNRS identification code: UMR5108
Internship director'surname: Calore
e-mail: calore@lapth.cnrs.fr Phone number: 0450091692
Web page:
Internship location: LAPTh, Annecy

Thesis possibility after internship: YES
Funding: YES If YES, which type of funding: ED Grenoble

Unravelling the emission of compact objects at the highest energies

Summary (half a page maximum)

Young and middle-aged pulsars are well-known emitters of gamma rays in the TeV range. Many of the unidentified sources detected by the Large High Altitude Air Shower Observatory (LHAASO), down to energies in the PeV range, appear to be associated with pulsars or pulsar wind nebulae. However, there is little evidence of TeV emission from millisecond pulsars (MSPs). While the GeV emission from MSPs comes mainly from curvature radiation, the TeV emission is more likely to be linked to secondary processes involving particles escaping from the magnetosphere.
The aim of this project is to explore theoretical models of the secondary TeV emission from MSPs. Using advanced simulations of pulsar particle emission, we will seek to understand how environmental conditions influence the final photon spectrum. The main objective is to estimate the cumulative TeV emission from Galactic MSPs and to identify unique spectral or morphological signatures that could guide future observational searches.
Tasks of this internship:
1. *Theoretical modelling*: Development of theoretical models of secondary emission in the TeV range by MSPs, taking into account radiative losses and environmental conditions.
2. *Numerical simulation*: Carrying out simulations of particle emission from MSPs, incorporating advanced models of pulsar emission.
3. *Sensitivity projections*: Evaluation of the detection potential of gamma-ray instruments currently in operation, in order to observe the TeV emission from MSPs.

The application of advanced statistical and machine learning based methods for point-source identification in simulated data will be explored during the possible, subsequent PhD.
This project is ideal for M2 students interested in high-energy astrophysics, theoretical modelling and data-driven research. You will have the opportunity to contribute to major astrophysical discoveries while developing valuable technical skills.
Environment:
You will be integrated into the LAPTh Astrophysics and Cosmology team, which includes several researchers, PhD students, post-docs and trainees. Frequent seminars and journal clubs are part of the life of the laboratory and will also give you an insight into the world of research. You will also collaborate with Dr. S. Manconi (LPTHE, Paris).

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: NO
Soft Matter and Biological Physics: NO
Quantum Physics: NO
Theoretical Physics: YES