



PhD position in “Data Intensive Astroparticle Physics”

Astroparticule et Cosmologie (APC)

Data Intelligence Institute of Paris (diiP)

ANNOUNCEMENT

The University of Paris calls for applications for a PhD position in Data Intensive Astroparticle Physics to work under the supervision of Prof. Yvonne Becherini through the funding of the “IdEx Chaire of Excellence”. The candidate will work on the connection between neutrino and gamma-ray astronomy through the analysis of real data and Monte Carlo simulations using advanced analysis methods in Machine/Deep Learning. The research project will benefit both from the Astroparticule et Cosmologie laboratory (APC) and from the Data Intelligence Institute of Paris (diiP) environments.

Subject field of the position: Physics with specialization in Data Intensive Astroparticle Physics
Placement: [University of Paris](#), [Astroparticule et Cosmologie laboratory \(APC\)](#) and [Data Intelligence Institute of Paris \(diiP\)](#)
Extent: 100%
Duration of appointment: 3 years
Research project title: Search for neutrino-gamma correlations in the high-energy extragalactic sky
Data access: [Fermi](#) data (public), [IceCube](#) alerts/event lists (public), [ANTARES/KM3NeT](#) event lists (private), [HESS](#) simulations and data (private)
Doctoral school: [STEP'UP \(Earth and Environment Science and Physics of the Universe in Paris\)](#)

CONTEXT OF THE RESEARCH PROJECT

Astroparticle physics is a sub-branch of Physics dealing with the understanding of the Universe through the detection of gamma rays, neutrinos, gravitational waves and cosmic rays. In this context, the origin of IceCube TeV-PeV cosmic neutrinos remains still unknown, and this project proposes an indirect and complementary approach to tackle the problem, focusing on the extragalactic field. The indirect approach in the quest for the cosmic neutrino origin consists in the search for spatial and temporal correlations between the detected cosmic neutrinos and known gamma-ray sources. This will be developed in two parallel research lines, here called the “Statistical Approach” and the “Follow-Up Approach”. The “Statistical Approach” will take advantage of public data continuously being collected by Fermi since 2008, public event lists provided by IceCube, and private access to the ANTARES and KM3NeT neutrino event lists, and is based on the search for correlations using catalogues and light curves through advanced procedures of Machine/Deep Learning. The “Follow-Up” approach is instead based on multi-messenger observations of the regions of the sky where a cosmic neutrino has been observed. The PhD student will work on both the “Statistical” and the “Follow-up” complementary aspects.

DESCRIPTION OF GROUP/LABORATORY/SUPERVISION

This PhD thesis will be supervised by Yvonne Becherini, Professor at the University of Paris, and will take place within the High-Energy Astrophysics (AHE) group of the AstroParticule and Cosmologie Laboratory and the Data Intelligence Institute of Paris (diiP). The APC is an ideal laboratory for carrying out such a research project, as the lab participates and therefore has access to the data of several VHE observatories. The diiP is the ideal research centre for knowledge exchange on data-intensive aspects. The PhD student will become a member of the HESS and of the ANTARES/KM3NeT collaborations.

PROPOSED WORK

- Search for neutrino-gamma correlations using the Fermi catalogues and the IceCube cosmic neutrinos using the “Statistical Approach”
- Analysis of public data from Fermi (catalogues and light curves) and IceCube neutrino lists using Machine/Deep learning

- Active participation in proposals for, and decisions on HESS observation campaigns
- Analysis of Fermi data and HESS data taken after neutrino alerts (“Follow-Up” Approach)
- Multi-wavelength and Multi-messenger analysis and source modelling
- Analysis based on Python programming
- Writing of scientific articles
- Oral presentations at national and international workshops/conferences

DUTIES

- Attend doctoral school courses for a total of 15 Academic credits, more information may be found at this address: <https://ed560.ed.univ-paris-diderot.fr/en/rules-for-training/>
- Work on the research subject proposed in this document
- Regularly presentations of intermediate research results to the supervisor
- Active participation in the HESS Collaboration, with responsibility to be undertaken on a technical aspect of data analysis and/or data calibration
- Work in close collaboration with the other project members in an interdisciplinary research environment as well as with domain experts
- Presentation and publishing of intermediate results in conference proceedings
- Presentation and publishing of more mature results in journal articles
- Preparation of the thesis manuscript
- Participation to the annual “Congrès des Doctorants”

TRAINING AND SKILLS REQUIRED

- Master in Astronomy and Astrophysics or Master in Astroparticle Physics
- Ability to work in a team
- Python programming
- Good command of English

ACQUIRED SKILLS

Several skills acquired and developed during this PhD thesis will be valuable and transferable to other fields: data analysis at different wavelengths, numerical simulations, data processing, data analysis, machine learning, writing of articles and of observation proposals, teamwork, oral presentations at national and international workshops and conferences.

ASSESSMENT CRITERIA

The selection of candidates is made with regard to the applicant’s ability to successfully complete and benefit from their studies at the graduate level. The assessment takes into account academic skills documented in scientific works, especially focused on the quality of the essays at the undergraduate level, any advanced work and other scientific or scholarly works. The assessment also takes into account breadth and composition of the undergraduate degree.

The successful candidate has excellent analytical and problem-solving skills, is a committed researcher with a drive for excellence. Prior research experience concerning the subject is a significant advantage. Excellent written and oral communication skills in English are essential to publish and present results at international conferences and in international journals. Advanced skills in computing are a key requirement as all activities are carried out in Linux/Unix environments and using the Python programming languages. Interpersonal skills and flexibility are of key importance since the work is done in a research group.

REQUIRED DOCUMENTS

Send a cover letter, a CV, links to the Master thesis and previous works, and contact information of two referees to yvonne.becherini@apc.in2p3.fr. Applications may be received until November the 7th, included. After the selection of the candidate, the doctoral school needs to endorse the nomination. The contract can start shortly after the PhD candidate has been nominated.