Postdoctoral Research Position for the MANTIS project at LPP

Multi-scale simulations of particle acceleration in solar flares and eruptive events

Laboratory of Plasma Physics (LPP), France

Applications are now open
Application deadline: September 30th, 2026
Starting date: Flexible, between November 2026 and April 2027

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The **Laboratory of Plasma Physics (LPP)** is seeking a highly motivated postdoctoral researcher to investigate the acceleration of energetic particles during solar flares and eruptive events using a new generation of multi-scale numerical code.

Understanding how magnetic energy is transferred into energetic particle acceleration remains one of the major challenges of solar and astrophysical plasma physics. Despite decades of observations and theoretical work, the physical mechanisms responsible for accelerating electrons and ions to relativistic energies during eruptive events are still incompletely understood.

To address this challenge, the successful candidate will exploit and contribute to the development of an innovative numerical framework that bridges magnetohydrodynamic (MHD) and kinetic (PIC) plasma descriptions. Unlike traditional approaches that treat fluid and kinetic processes separately, this new-generation simulation tool enables the self-consistent investigation of energy release across multiple spatial and temporal scales, opening exciting opportunities for studying particle acceleration in realistic solar environments.

This position offers an exciting opportunity to contribute to both the development of advanced computational methods and to our understanding of the physical processes involved in particle acceleration during solar eruptions.

Research objectives

This post-doctoral project focuses on understanding how energetic particles are accelerated during solar flares and eruptions.

This project is part of the MANTIS project for which we are developing a newly multi-scale code designed to bridge the gap between global coronal dynamics and kinetic particle physics. Unlike traditional test-particle approaches that assume prescribed electromagnetic fields, this new multi-scale code relies on the coupling of global MHD models, using the ARMS code (DeVore 1991), describing the evolving magnetic structure of the solar corona and solar wind; and a fully kinetic Particle-in-Cell (PIC) code that resolves particle kinetics. This enables to develop simulations that capture the dynamical interaction between evolving magnetic structures and the particle populations, in a much more realistic description of energetic particle acceleration. The successful

candidate will contribute to the development of highly scalable numerical tools capable of modelling coupled fluid-kinetic plasma systems and investigate fundamental questions at the frontier of heliophysics.

The successful candidates will work closely with researcher and computational scientist developing this unique multi-scale simulation capability and will contribute to expand its scientific applications. She/He will design and perform state-of-the-art HPC simulations using the newly developed multi-scale MHD-PIC code to model particle acceleration during solar flares and eruptive events. The analysis will focus on investigating :

- particle acceleration mechanism developing at small scales during solar flares and coronal mass ejections
- magnetic reconnection and energy conversion at small scales
- transport of energetic particles through reconnecting magnetic fields
- comparison of numerical results (particle trajectories and impact sites) with observations from current space missions by developing post-processing tools to create synthetic observables.
- Investigating the potential significance of feedback between kinetic particle populations and global plasma evolution;

A particular emphasis will be placed on understanding how particles are accelerated by implementing and testing several physical mechanisms and initialisation state. While the multi-scale code is developed by our computational scientist, the successful candidate will develop post-processing routines to create synthetic observables (X-rays EUV and radio signatures) that can be compared with observations. This is critical step to constrain the model by comparing the results with the observations.

The post-doctoral researcher will benefit from the team time allocation grant at the French National high-performance computers (e.g. Jean Zay @ IDRIS, ADASTRA @ CINES) in order to carry the numerical simulations that requires require state-of-the-art high-performance computing resources.

Within the MANTIS project, provisions have been made for the acquisition of computers to carry the work, to fund regular travels to international workshops and conferences where we expect the post-doctoral researcher to present his/her research work from the project.

The research work will be published in peer-reviewed scientific journals and presented at national and international conferences.

Research Activities

The main expected activities include:

- Conducting innovative scientific research on particles acceleration during solar flare and eruptions.
- Performing numerical simulations using HPC facilities
- Contributing to the development of the multi-scale MHD-PIC code.
- Developing post-processing tools to analyse the simulations results
- Collaborating with the MANTIS project team and with the international community, in particular to initiate collaboration related to the project.
- Disseminating research activities and results through team and project meetings, seminars, scientific articles, and conference presentations.
- There may be opportunities to supervise master students.

The Laboratory of Plasma Physics

The Laboratory of Plasma Physics is one of Europe's leading laboratories dedicated to plasma physics and space sciences. It brings together researchers studying plasmas across an exceptional diversity of environments, from laboratory experiments to the Sun, planetary magnetospheres, and the heliosphere. Expertise spans observations, numerical simulations, theory, laboratory plasma experiments, and the development of instrumentation for international space missions.

The LPP is implanted within the Paris-Saclay scientific campus (Palaiseau, France), and within Sorbonne University (Paris, France) LPP benefits from one of Europe's most dynamic research ecosystems including internationally renowned universities and research organizations (CNRS, École Polytechnique, Institut Polytechnique de Paris, Institut d'Astrophyisque Spatiale (IAS), CEA, and ONERA) It offers a vibrant scientific atmosphere with regular seminars, workshops, international visitors, and extensive interdisciplinary collaborations.

The LPP solar physics team is based at Sorbonne University (Paris).

The salary depends on the experience of the candidate. French salaries already include employer-funded health insurance contributions so no additional cost should be added on the income.

The Paris region offers an exceptional combination of scientific excellence and quality of life. Beyond its world-famous cultural heritage, museums, music, and gastronomy, the region provides: a vibrant international scientific community; excellent public transportation; extensive parks and natural areas;

Candidate profile

Applications are encouraged from early-career researchers seeking a postdoctoral appointment, women and minorities are especially encouraged to apply. Due to requirements of the funding contract, applicants from an EU Member state, Norway, Switzerland or United Kingdom will not need pre-approval by the French government.

The candidate should have:

- A PhD in plasma or solar physics, astronomy, astrophysics, and/or a related field.
- A publication record in peer-reviewed journals is essential.
- Advanced knowledge in solar physics, plasma physics, solar energetic particles, plasma simulations (MHD and/or PIC), magnetic reconnection, high-performance computing. Full expertise in all these fields is not required, but willingness to learn across the project's topics is essential.
- Advanced knowledge in scientific programming (C/C++, Fortran, Python, or similar) is required
- English proficiency at C1 level or higher.
- Strong scientific communication skills (oral and written).
- Proven ability to work collaboratively and as part of a team.

Applicants from both numerical and observational backgrounds interested in connecting simulations with space observations. Enthusiasm, scientific curiosity, and the ability to work collaboratively are valued as highly as prior experience with the specific numerical methods.

Application

Applications are **open now** and will be reviewed starting **September 1st, 2026** until the position is filled.

Applicants should submit by email to sophie.masson@lpp.polytechnique.fr

- a curriculum vitae;
- a publication list;
- a statement of research interests (1–2 pages);
- contact information for two or three referees.

The anticipated starting date is **flexible between November 2026 and April 2027**, depending on the candidate's availability.

As part of its recruitment process, the École Polytechnique (and LPP) is committed to reviewing all applications without any form of discrimination. École Polytechnique is a diverse institution that is committed to preserving and strengthening this diversity.