Post-doctoral position in neutron stars astrophysics

Application deadline: March 31st, 2026

The Institute for Research in Astrophysics and Planetology (IRAP) in Toulouse, France invites applications for a postdoctoral position to work on neutron star modelling and observations funded by the French National Research Agency (Agence Nationale de la Recherche) through the DENSeR project.

Context

Neutron stars, the dense remnants of the core-collapse of massive stars, are unique laboratories to study the strong force in physics. With the densities attained inside neutron stars (beyond the density of atomic nuclei), astrophysicists can study the composition and behaviour of stable states of dense matter and constrain nuclear physics theory. This also opens up the possibility of exploring strange or exotic states of matter, which may only exist inside neutron stars. To do so requires measuring their masses and radii, the macroscopic properties that are linked to the interior pressure and density of neutron stars via an equation of state. One promising method to do so arose from the analysis of the X-ray pulse profile of millisecond pulsars obtained from the NICER X-ray telescope. By exploiting the effects of general relativity on the trajectory of photons leaving the NS surface, one can determine the neutron star compactness (and therefore the mass and radius) from the modelling of the X-ray pulse profile. However, current measurements have relied on a number of assumptions that can potentially bias the inferred masses and radii. Several avenues are being studied to improve the reliability of these measurements, in particular those made with the software X-PSI (X-ray Pulse and Simulation and Inference, ...).

Activities

The successful candidate will be leading some work packages of the ANR DENSeR, notably regarding the modelling of the neutron star surface emission regions to compare to X-ray observational data. The optimisation of the existing models (in X-PSI) will be necessary, as well as the inclusion of GPU and/or Machine Learning capabilities for the simulation and inference. These improvements of the neutron star surface emission modelling will be quantified with actual data (from the NICER telescope) and with simulated data from upcoming instruments (such as NewAthena). Part of this work will be done in collaboration with researchers at the University of Amsterdam and at the University of Helsinki (Finland).

Some time for the successful candidate's own research should also be possible. The research interests of the group include neutron stars, X-ray binaries, Ultra Luminous X-ray sources (ULXs), gamma-ray bursts and merging compact objects, including massive black hole binaries.

Profile

The applicant should have a PhD in Astrophysics (or closely related fields), ideally with experience in X-ray and/or neutron star astrophysics. The ability to work collaboratively and within an interdisciplinary framework will be a crucial element in the application assessment. A very good level of written and spoken English is expected as this work will be done in the context of an international collaboration. The applicants should have knowledge of Python programming, and knowledge of C/C++ (or Cython) would be advantageous. Additionally, some experience with the modelling of neutron stars, or GPU, or Machine Learning could be appreciated.

Position description

The position is for a full-time commitment, with an initial contract for one year, renewable once, and with a negotiable start date in October 2026.

Compensation will be commensurate with experience, with gross monthly salary ranging between €2800 and €3900. The position includes full access to the French healthcare and welfare system (medical and dental, sick leave, parental leave, family allowances for children, pension and unemployment benefits).

Additional funding for conferences, collaboration, and personal equipment is available through the DENSeR project or other sources of funding at IRAP.

The IRAP offices are part of a Restricted Area Regime (ZRR — Zone à Régime Restrictif). After the selection procedure, this access authorisation (to be granted by the competent authorities) will be required to establish the work contract.

Application procedure

Applicants should deposit a single PDF file by the deadline of March 31st, on the following webpage: **https://sdrive.cnrs.fr/s/iSda6xDoR28KHPi**

The application file should include, in order:

- A brief cover letter (1 page)
- A curriculum vitae (maximum 2 pages)
- A list of publications, conference presentations, etc. (no page limit)
- A personal and research statement (see details below)

The **personal and research statement** should present the applicant's research experience, research interests, and outline their motivation to work with us at IRAP. The maximum is 4 pages, but shorter statements (1-2 pages) will be assessed depending on the level of experience of the applicant.

Reference letters

In order to not burden reference letter writers with an excessive load, we only ask, at this stage, for names, positions, email addresses and telephone numbers of three referees/colleagues who have agreed to write reference letters. These will only be requested from short-listed candidates.

Inquiries should be addressed to Sébastien Guillot (sebastien.guillot1@utoulouse.fr).