Uncovering the Nature of Hidden Neutron Star Interiors

Start Date: Spring 2026

Application Deadline: July 20th, 2025

Interview Date: Beginning of August 2025

Royal Holloway, University of London is inviting applications for a fully funded PhD position in the Astronomy Group that will focus on uncovering covering the physics of neutron star interiors.

Project Overview

Formed in the supernova explosions of massive stars, neutron stars are compact remnants that exhibit extreme gravity, ultra-high densities, fast rotation, and strong magnetic fields. Such conditions cannot be recreated on Earth, making neutron stars fantastic cosmic laboratories to study matter in extreme environments. In particular, to compare astronomical observations of neutron stars with theoretical predictions and learn about the matter hidden from direct view inside these compact objects, we can describe their interiors as multiple interacting fluids. However, building realistic three-dimensional models has been challenging to date due to the many physical mechanisms affecting the neutron star interior and a lack of numerical tools to accurately solve the corresponding mathematical equations. Recent advances in computational fluid dynamics (such as the Python-based framework Dedalus) have finally put this within reach and will enable us to make accurate predictions of the evolution of the neutron star fluid interior for the first time.

Royal Holloway's neutron star theory group plays a leading role in uncovering the nature of these compact objects by exploring cutting-edge cross-disciplinary science that combines different disciplines (astronomy, condensed-matter physics, nuclear physics, fluid dynamics, and computer science) and different research techniques (theoretical modelling, numerical simulations, data analysis, and machine learning).

We invite applicants to apply for a competitively funded position in our group. The successful applicant will undertake a project at the interface of astronomy and fluid dynamics. Specifically, they will investigate physics across a variety of scales such as superfluid vortex dynamics to better understand the evolution of the fluid neutron star interior. The project will combine theoretical and numerical modelling with astronomical data analysis and scientific software development. The

successful candidate will also have the opportunity to join a vibrant network of international collaborators and explore other applications of fluid dynamics across different areas of astrophysics.

Eligibility

We welcome applications from all qualified applicants with home student status, i.e., UK and Irish nationals as well as foreign nationals with settled status. However, applications are particularly encouraged from traditionally underrepresented groups in science. The Department of Physics at Royal Holloway holds an Athena SWAN silver award, and the University is an Institute of Physics Project Juno Champion. The award demonstrates that actions have been taken to address gender equality at all levels and to foster a more inclusive and equitable working environment.

How to Apply

Applications need to be submitted through our application portal. For further information on this post please reach out to Dr. Vanessa Graber at Vanessa.Graber@rhul.ac.uk.

Further Information

Visit our website to learn more about research degree (PhD) opportunities in the Physics Department at Royal Holloway, University of London.