



Institut d'Astronomie et d'Astrophysique - ULB
Campus Plaine – CP 226, Boulevard du Triomphe
B-1050 Bruxelles – Belgique
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Post-doctorate fellowship in Astrophysics: “Study of the kilonova spectroscopy”

One of the major issues in modern astrophysics concerns the analysis and understanding of the present composition of the Universe and its various constituting objects. Nucleosynthesis models aim to explain the origin of the different nuclei observed in nature by identifying the possible processes able to synthesize them. Though the origin of most of the nuclides lighter than iron through the various hydrostatic and explosive burning stages in stars is now quite well understood, the synthesis of the heavy elements (i.e. heavier than iron) remains unexplained in many respects.

The rapid neutron-capture process, or r-process, is known to be of fundamental importance for explaining the origin of approximately half of elements heavier than iron observed in nature. Despite important efforts, the astrophysical site of the r-process remains unidentified. For this reason, the r-process has been considered as one of the top eleven questions in Physics and Astronomy by the USA national research council of the national academies. Supernovae have for long been envisioned as the dominant producer of r-process nuclei, but so far have failed to provide the right conditions for a successful nucleosynthesis. Recently, special attention has been paid to neutron star mergers following the confirmation by hydrodynamic simulations that a non-negligible amount of matter can be ejected and by nucleosynthesis calculations combined with the predicted astrophysical event rate that such events can account for the majority of r-material in our Galaxy. The recent observation of the gravitational wave signal GW170817 and its optical counterpart AT2017gfo in August 2017 has confirmed the efficient contribution of binary neutron star mergers to Galactic nucleosynthesis, though a great part of this observation still remains to be explained.

The present post-doctorate fellowship will focus on the analysis of the photospheric spectra of the kilonova AT2017gfo and the identification of transitions that are dominating and can help us to determine the composition of the ejecta. Different tools will be used for such an analysis, in particular simplified one-zone models as well as the 1D Monte Carlo radiative transfer spectral synthesis code TARDIS. In this approach, we plan to adopt element compositions from nuclear network calculations based on a realistic hydrodynamical simulation of a neutron star merger and recently updated atomic opacities.

The post-doctorate position is available at the Institut d'Astronomie et d'Astrophysique (IAA) of the Université Libre de Bruxelles (S. Goriely, S. Van Eck) and is funded for 3 years. Screening of applications begins immediately and continues until an outstanding candidate is selected. The position is to start as soon as possible.



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This project will be done in collaboration with the University of Mons (Belgium) who will provide newly calculated atomic data, the GSI research centre (Germany) who has a well-defined expertise in the field of hydrodynamic simulations of neutron star mergers and Queen's University of Belfast (UK) who is expert on spectra and radiative transfer modelling. The project is also part of the EOS (Excellence of Science) research project MANASLU in collaboration with the KU Leuven University and University of Mons.

Profile requested:

- The candidate must have a PhD in Physics with experience in spectra and radiation transfer modelling, preferentially for kilonovae or supernovae.
- The candidate must have programming skills and a strong interest in numerical simulations; knowledge of programming languages Fortran, C/C++ and Python is desirable.
- The applicant should have good organizational skills, a taste for interdisciplinary research, excellent scientific writing and presenting skills and be able to work independently.
- Working in our international team requires capacity of team work as well as good English language skills

Interested candidates should send their CV and request two referees to send their recommendation letter directly to S. Van Eck (sophie.van.eck@ulb.be) and S. Goriely (stephane.goriely@ulb.be)

Contacts:

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