“Radiative-transfer modelling of strongly-lensed supernovae”

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Source et détails sur le financement : ANR

Mots-clés : Supernovae ; Radiative Transfer ; Models ; LSST

Compétences nécessaires : Skills in programing and data analysis ; Knowledge in stellar evolution is a plus.

Sujet scientifique de la thèse :

Understanding supernovae (SNe) is essential because of their key role in cosmology, chemical enrichment, and galaxy evolution, yet the nature of their progenitors and explosion mechanisms remains uncertain. Progress is limited by the lack of very early-time observations, particularly in the rest-frame ultraviolet, where signatures of the progenitor star, its mass loss, and possible binary companion are strongest. Strongly lensed supernovae provide a unique solution: multiple, time-delayed images of the same explosion allow astronomers to predict and observe the SN at the moment of its next appearance, capturing its earliest evolution. In addition, gravitational magnification enables the study of high-redshift SNe whose rest-frame UV emission can be observed from the ground. The Vera Rubin Observatory is expected to discover over 100 strongly lensed SNe during the ten-year LSST survey. This three-year project aims to exploit these events to obtain the earliest rest-frame UV observations of supernovae ever achieved. By combining expertise in deep-learning classification, lensing and supernova modelling, LSST data access, and rapid follow-up observations, the project will place unprecedented constraints on the progenitors of all SN types shortly after explosion. The project is highly interdisciplinary, integrating machine learning, observations, and numerical simulations. Tasks will be shared between French and German partners. The PhD student at LAM will focus on radiative-transfer modelling, computing early-time synthetic spectra and light curves for various SN types using the CMFGEN code. These models, based on published explosion simulations (e.g. HESMA) and existing datasets, will be compared with observations of lensed SNe discovered by LSST. The resulting library of early-time synthetic spectra will be a valuable resource for the community. The PhD student will receive training in CMFGEN, carry out computations on local and extended computing facilities, and collaborate closely with German partners through regular visits, with the possibility of an extended stay at ESO. Full access to Rubin/LSST data will be provided.

Informations complémentaires :

Supervisors : Jean-Claude Bouret (LAM), research director • Stéphane Blondin (ESO/LAM), astronomer and senior researcher

Collaborators : In France: Raoul Cañameras (LAM), Luc Dessart (IAP) • In Germany: Stefan Taubenberger (TUM), Sherry Suyu (TUM/MPA)