Centre de Recherche Astrophysique de Lyon
UMR 5574

Master 1 Research internship offer
Academic year 2026 – 2027

Internship supervisor: Julia Shouse and Arghyadeep Basu
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Address/Workplace: CRAL **-** site Charles André : 9 avenue C. André, St Genis Laval

Hosting research team: GALPAC team

Internship title: Catching galaxies 'napping' in cosmological simulation

Summary of proposed work:

In the first billion years after the Big Bang, galaxies are not expected to form stars continuously. In particular, low-mass galaxies may alternate between short bursts of star formation and periods of greatly reduced activity, driven in part by stellar feedback. A galaxy observed during such a lull, sometimes described as "napping" or "mini-quenched", can show spectral features indicating a cessation of star formation, while retaining emission from stars formed during an earlier burst. JWST is now beginning to identify such galaxies in deep fields, providing a new test of models of early galaxy formation and feedback. However, because observations only provide indirect information about a galaxy's recent star-formation history, it is unclear how complete and reliable current observational criteria are.

The GALPAC team at CRAL has developed the SPHINX suite of radiation-hydrodynamical cosmological simulations (https://sphinx.univ-lyon1.fr), which model the formation of galaxies during the first billion years of the Universe. SPHINX contains thousands of resolved galaxies and reveals highly variable episodes of star formation. Importantly, the simulations provide the true star-formation histories of individual galaxies, allowing their physical evolution to be directly connected to observable signatures.

In this M1 project, the student will analyse SPHINX galaxies undergoing lulls in star formation and determine how well these systems can be recovered using observational diagnostics. Using mock JWST spectra and images, the student will apply commonly used criteria for identifying "napping" galaxies, based on some key features in their spectra and colours. By comparing these observationally selected galaxies with the galaxies identified directly from their simulated star-formation histories, the student will test how well these criteria work and whether their effectiveness changes with galaxy mass and redshift. During the project, the student will acquire extensive knowledge of front-line topics in extreme-redshift astronomy and gain experience with analysing large state-of-the-art cosmological simulations, using analysis tools developed by the GALPAC team.

Required skills: basic skills in Python, interest in astrophysics, comfortable working in English

Nature of the financial support for the internship: None

Potential for a follow-up as a PhD thesis: No