Master 2 Research internship offer
Academic year 2019 – 2020

Internship supervisor: Prénom NOM

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Address/Workplace [1]: CRAL **-** site Charles André : 9 avenue C. André, St Genis Laval

Hosting research team [1]: GALPAC

Internship title: Multiple stellar populations in the SPHINX simulations

Summary of proposed work:

Globular clusters (GCs) are massive tightly bound populations of stars orbiting galaxies. The stars found in these clusters are very old and appear to contain some of the oldest stars found in the Universe. Most of the oldest GCs are found to host not a single but multiple stellar populations, formed at multiple different epochs, and displaying very different metallicities. The formation of multiple stellar populations in GC remains a mystery. Several theories exist on this (see e.g. the review by Bastian & Lardo, 2018), but each of them seems to have shortcomings. The most mainstream model is probably the AGB scenario, where a new stellar population is fuelled with metals from AGB stars of the previous population combined with fresh gas accreted into the gravitational potential of the GC. However, simulations have so far had limited success in reproducing this scenario.

The GALPAC team at CRAL has developed the SPHINX suite of radiation-hydrodynamical simulations (https://sphinx.univ-lyon1.fr), designed to predict the formation of galaxies during the first billion years. These simulations are unique in their combination of a large sample of galaxies spanning a large range in mass and extremely high resolution, which gives us a unique opportunity to study massive GCs. In addition, the simulations include radiation feedback from young massive stars, which is likely an important factor in the early dispersion of gas in GC and shutdown in their star formation.

The idea for this master's project is to analyse SPHINX simulation outputs to look for massive GC and whether multiple stellar populations exist in those clusters, by studying their metallicities, masses, morphologies, and star formation histories.

During the project, the student will acquire extensive knowledge of front-line topics in extreme-redshift astronomy (theoretical and observational) and gain experience with analysing large state-of-the-art cosmological simulations, using and refining (Python/Fortran) analysis tools developed by the GALPAC team.

Nature of the financial support for the internship: Galpac team

Potential for a follow-up as a PhD thesis [1]: Yes, financed by the école doctorale

[1] Inscrire votre choix