Progetto di ricerca (Research project)

The activity of the postdoc will be carried out within the project "Globular clusters in cosmological simulations and in lensed fields: from their birth to the present epoch", which has been funded in the framework of PRIN (Progetti di ricerca di rilevante interesse nazionale) – Call 2022. In this project, following up on a state-of-the-art, existing set of high-resolution cosmological N-body and hydrodynamcial simulations, we aim to design a new model of a Milky-Way halo with unprecedented features. The new simulations will have sub-parsec resolution down to redshift z~2 and will be among the first in a fully cosmological framework including the feedback of individual stars. At later epochs, the evolution of the simulated system will be followed by means of a cosmological, pure N-body simulation, which will be adequate for a realistic description of the dynamical evolution of its sub-systems, in particular the globular clusters (GCs) while yielding a more computationally efficient approach. We will compare the structural properties of the simulated clusters (i.e. magnitudes, density and sizes) with a wealth of multiwavelength observational data of the ancestors of present-day GCs in lensed fields. We will create lensed mock images of the simulated objects, a process that will be key for a reliable comparison between our high-level, proprietary data and simulations. We will study the chemical abundance pattern and the kinematical properties of the simulated clusters and compare them with local GCs. Our project, which involves a wide range of theoretical and observational expertise, is strategically important for training young researchers in highly competitive fields, which will dominate the scientific scope of present and future observing facilities.

Piano di attività (Activity plan)

The postdoc will work at DIFA, in collaboration with researchers of the DIFA and INAF-OAS Bologna research units of the PRIN 2022 project "Globular clusters in cosmological simulations and in lensed fields: from their birth to the present epoch". The activity of the postdoc will be focused on the study of the dynamical evolution of the GCs during phases of their lifetime in which they have lost essentially all their gas and can thus be modelled as purely stellar systems.
The evolution of such objects is driven by a combination of internal (such as two-body relaxation and mass segregation) and environmental (tidal interactions within a cosmological context) processes. Defining the best strategy to model these processes will be an essential part of the postdoc activity. The final goal is producing a low-redshift ($z<2$), state-of-the-art cosmological N-body simulation zoomed-in onto a Milky-Way like halo with resolution high enough to include and resolve GCs.
As a preparatory study toward the realization of such simulation, the postdoc will design, carry out and analyse idealized simulations of individual GCs, featuring time-dependent tidal effects calibrated on existing self-consistent cosmological N-body simulations.
Finally, in the first months of activity the postdoc will be also involved, in collaboration with other members of the two research units, in setting up the initial conditions and of the high-redshift ($z>2$) cosmological simulations and in their analysis, focusing on the collisionless component (dark matter and stars).