Galaxy evolution in high-redshift galaxy clusters

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In the nearby Universe and up to intermediate redshifts, galaxy clusters have long been the poster child of the impact of the environment on the evolution of galaxies. As a most obvious example, they clearly and particularly dramatically show the ubiquitous, strong suppression of star formation typical of dense environments. Because of observational limitations, the physical processes determining environmental effects are studied in detail mostly at low redshifts. However, high-redshift clusters - even 10 billion years ago - already show environmental signatures on their galaxy populations, and the physical mechanisms that produce them are not necessarily - and actually not likely - the same acting at low redshifts. A proper understanding of galaxy evolution in the most massive structures thus requires a comprehensive investigation of environmental signatures up to high redshift, and their interpretation in terms of physical mechanisms properly accounting for the cosmological context where galaxies and clusters evolve.

This project combines observations from major facilities and state-of-the-art theoretical models to investigate environmental effects on distant cluster galaxies at z∼1-1.5. On the observational side it will focus specifically on public and proprietary observations from the GOGREEN survey (mean z∼1.2, Balogh et al. 2020) and the most distant clusters from the SPT-SZ survey (mean z∼1.5, Strazzullo et al. 2019). On the theoretical side it will exploit and compare semi-analytical models (GAEA, e.g., Hirschmann et al. 2016, Fontanot et al. 2020) and hydrodynamical simulations (Dianoga, e.g., Bassini et al. 2020, Borgani et al. 2022 in prep.; Magneticum, e.g., Hirschmann et al. 2014, Steinborn et al. 2015). Publicly available data and results from other recent simulations and models (e.g., IllustrisTNG, GALFORM, L-Galaxies) will also be investigated in comparison and combination with the in-house simulations.

The project will benefit from direct interaction with a group of local collaborators on this topic on both the observational and theoretical sides (including in particular G. De Lucia, M. Pannella, E. Rasia, A. Saro, V. Strazzullo), as well as from close connections with international collaborators.

The project can be adjusted to the PhD candidate's interests and expertise in terms of the relative weight of observational vs. theoretical work, and of the range of specific aspects to be investigated (star formation and quenching, morphological evolution, nuclear activity, evolution of galaxy properties across the virial volume, …).