Direction des Sciences de la Matière
IRFU
Service d'Astrophysique

Soutenance de thèse du Service d'Astrophysique

ENVIRONMENTAL EFFECTS ON GALAXY EVOLUTION AT HIGH REDSHIFT

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SAp

Lundi 12 septembre – 14h30 – Salle Galilée

The environment is a key regulator of the evolution of every physical system. Galaxies are not an exception, and they exhibit different behaviors and characteristics depending on the density of their surroundings. It is still unclear which physical processes induce these dependencies, although there are indications that key environmental imprints must have happened at early times. My thesis aims at identifying and analyzing such behaviors at an epoch when galaxies were still young and active, forming stars and growing their central black holes at high paces.

In particular, my work is focused on one of the most distant, X-ray detected galaxy clusters known so far, CL J1449+0856 at z=1.99. This cluster is the prototype of the most extreme environments that a galaxy can experience in its early times, and it represents the ideal laboratory to test the onset of environmental effects on galaxy evolution.

First, I will present the result of a Subaru/MOIRCS spectroscopic follow-up of a population of massive star-forming galaxies residing in this cluster and in the field. The properties of the H, N, and O nebular emission are different between the two samples, consistently with a lower metal content and a higher specific star formation rate in cluster galaxies than in the field. Physically, I will interpret these differences as stemming from the extra-accretion of metal-poor gas from the cluster environment or, if triggered by mergers, the galaxy surroundings.

In a second time, I will show the results of a Keck/LRIS narrowband imaging campaign, targeting the Lyman-alpha (Lya) transition at z=1.99. I will report the discovery of a huge reservoir of warm gas (10^4 K) in the cluster core, shining in Lya light and extended over 100 kpc. I will explore the physics of this nebula and identify two AGNs as the most plausible powering sources, with a possible contribution by dissipation of mechanical energy carried by galactic winds. Moreover, I will indicate galactic outflows as a source of gas supply to sustain the nebula against evaporation due to the interaction with the hot (10^7 K), X-ray emitting intracluster medium. Finally, I will show that the mechanical energy carried by outflows and injected into the surrounding medium is consistent with the predictions of state-of-the-art cosmological simulations that reproduce the thermodynamic properties of local clusters, providing an empirical estimate for a long-standing issue in galaxy cluster science.