Chemical evolution of galaxies with Adaptive Optics assisted observations

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Chemical abundances provide a fossil record of a galaxy's star-forming history.
The metal content of a galaxy is regulated by complex interactions between physical processes occurring on different spatial and time scales: heavy elements produced in stars enrich the interstellar medium (ISM), while infall of pristine gas from the intergalactic medium and outflows due to AGNs and Supernovae could dilute the ISM, triggering at the same time new star formation episodes. These processes impact the global baryon cycle and thus affect other physical quantities strictly related to the history of chemical enrichment in galaxies like stellar mass and star formation rate. In fact, relationships between these parameters and gas phase metallicity (e.g. the Mass-Metallicity relation, MZR [1]) have been observed both in the local Universe and at higher redshifts, finding evidences of a cosmic evolution [2][3]. Studying the main features of the MZR, e.g. its slope, asymptotic value and scatter, could provide crucial observational constraints for galaxy evolution models.

To extend the investigation to higher redshifts ($z > 1.5$), spatially resolved near-IR imaging and spectroscopy are required, in order to properly resolve galaxy substructures and take into account the fact that all the key diagnostic features are shifted into the near-IR region of the spectrum. This science case could in particular benefit from the implementation of Ground Layer Adaptive Optics (GLAO) techniques, which are aimed at correcting the optical turbulence introduced by the lowest region of the atmosphere over a large field of view. At the present time, the ARGOS system for the LUCI instrument on the Large Binocular Telescope (LBT)[4] represents one of the firsts laser guide stars GLAO facilities in the world available for ground based observatories.

My project is focused on defining a new method to obtain more robust calibrations of gas phase metallicity diagnostics in galaxies, based on stacked spectra of SDSS galaxies. We are going then to apply the new calibrated diagnostics to a variety of different cases, in particular to derive a new MZR in the local Universe and address its evolution at higher redshift. The sample will include also the first GLAO assisted observations of high-z galaxies performed with LUCI during the commissioning phase of the ARGOS system, to which I'm participating. We will also investigate the presence and properties of metallicity gradients in high redshift galaxies from a sample of gravitationally lensed objects observed with LUCI+ARGOS at LBT and KMOS at Very Large Telescope (VLT). The shape and steepness of abundance gradients may in fact help to discriminate among different scenarios of galaxy formation.

References

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