DIFFUSE GAS EMISSION : FROM LARGE SCALE STRUCTURE TO GALAXY FORMATION

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Contexte et Description du projet:

Diffuse gas emission is one of the most promising probes of baryonic matter scaffolding the Universe along cosmological structures. Over the last decade, the advent of high-sensitivity integral-field spectroscopy has enabled the detection of diffuse line-emission tracing low-density gas in the circumgalactic medium (CGM) of galaxies and even beyond the virial radius of dark matter (DM) halos, up to the intergalactic medium (IGM). These observations have notably revealed that star-forming galaxies at high-redshift often exhibit extended emission of the Lyman-alpha (Lya) resonant line of hydrogen, and sometimes signatures of metal enrichment from e.g. MgII, SiII, FeII lines. At the scale of DM haloes, these observations provide new constraints on the complex baryon cycle in the CGM in which inflows of pristine gas accreted from the cosmic web co-exist with the material reprocessed by stellar feedback processes (supernovae, radiation pressure, etc). At megaparsec scales, they represent a unique probe of the matter distribution along large scale structures, which can help us tackle the role of environment in the formation of galaxies and decipher the history of cosmic reionization. Diffuse gas emission will be a key target of future surveys with forthcoming instruments such as VLT/BlueMUSE and WST, for which quantitative predictions from state-of-the-art simulations are badly needed.

We will use the radiative transfer code RASCAS to post-process cosmological radiation-hydrodynamics simulations in order to predict the observable signatures of the diffuse gas at various scales. RASCAS is designed to produce mock observations of resonant/non-resonant lines and stellar continuum emission, including the effect of dust attenuation. The overall goal of the project is to provide a theoretical framework to interpret existing and future observations of extended gas emission from CGM to IGM scales. The successful candidate will generate mock spectra, images and datacubes of various emission lines from zoom-in simulations of typical star-forming galaxies and the SPHINX cosmological simulations. They will investigate how the line properties are connected to the duty cycle of star formation, the presence of cool gas outflows, the escape of ionizing radiation, and metal enrichment of the CGM. A substantial part of the project will also be dedicated to the study of the Lya emission along large-scale structures outside DM haloes. A main goal will be to assess the observability of the cosmic web in the context of future instrument capabilities and explore how it can help constrain the matter distribution/clustering and the redshift evolution of the metagalactic UV background.

The project will be held within the GALPAC team at CRAL under the supervision of J. Blaizot (CRAL) and T. Garel (Observatory of Geneva). CRAL is a world leader in IFS instrumentation and in cosmological radiation-hydrodynamics simulations. The GALPAC team is a stimulating and friendly environment, with 9 PhD students, 4 postdocs, and 12 staff, sharing a strong expertise in observational and theoretical extragalactic astronomy. The successful applicant will also regularly visit the Observatory of Geneva.

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