Thesis subject

Name of the laboratory: Laboratoire d'Astrophysique de Marseille

Thesis advisor: : Matthew M Pieri
Email and address: matthew.pieri@lam.fr
Tel: : +33-(0)4-91-05-69-87

Co-advisor: Stéphane Arnouts

Subject's title:

Gaseous galaxy environment and its role in galaxy formation

Subject description:

Understanding how galaxies form is one the major motivating factors that drive modern astrophysics and cosmology. The epoch around z=2 is of critical importance since this is the era where the Universe assembles most of its stars. The story of how the universe arrives at this star formation peak is the story of how galaxies acquire the gaseous fuel for star formation from large-scale collapse and how this acquisition is regulated by outflows caused by star formation. To tell this story, we must come to understand the properties of galactic environments on all scales, through the study of gas outside galaxies (the intergalactic medium, IGM). Within galaxies' gravitational sphere of influence is the interface between the intergalactic medium and the galaxy, known as the circumgalactic medium (CGM). In order to pick apart the voyage from IGM, to CGM, to galaxy and potentially back again we must develop the necessary tools to disentangle gas properties and build the datasets necessary. This means that we must reconstruct representative volumes of the cosmic web, and sample well all possible environments: nodes, filaments, sheets and voids.

The student will explore methods for tomographic mapping of the cosmic web using foreground absorption along the line of sight to bright background quasars and galaxies. The student will further classify and analyse the quasar absorption by galaxy proximityand placement within the cosmic web filament using Pieri's stacking methods, to draw inferences about galaxy formation.

Increasing source densities and the extension of wide-area galaxy surveys to beyond z>2 mean that activity in IGM tomography and the study of the CGM is growing rapidly. The student will work within the ANR supported projects WEAVEQSO-JPAS and HZ-3D-MAP and make use of quasar spectra from SDSS-IV (in hand), DESI (being acquired) and WEAVE-QSO

(will begin to arrive before the starting date). Furthermore, data of line-of-sight absorption towards galaxies for mapping and CGM sampling will grow rapidly via DESI ancillary programs, PFS and DESI-Ib during the doctorate program. Further galaxies for CGM studies will be provided by Over the next decade and beyond MOSAIC, DESI II, MSE and WLT will all exploit the methods developed in this program. LAM astronomers have key roles in these present and future projects.

Bibliography:

Japelj et al (2019), "Simulating MOS science on the ELT: Ly-alpha forest tomography" https://ui.adsabs.harvard.edu/abs/arXiv:1911.00021

Jin et al (2022) "The wide-field, multiplexed, spectroscopic facility WEAVE: Survey design, overview, and simulated implementation" https://arxiv.org/abs/2212.03981

Kraljic et al 2022 "Forecasts for WEAVE-QSO: 3D clustering and connectivity of critical points with Lyman-α tomography" https://ui.adsabs.harvard.edu/abs/2022MNRAS.514.1359K/abstract

Pieri et al (2014) "Probing the circumgalactic medium at high-redshift using composite BOSS spectra of strong Lyman α forest absorbers" https://ui.adsabs.harvard.edu/abs/2014MNRAS.441.1718P/abstract

Pieri et al (2016), "WEAVE-QSO: A Massive Intergalactic Medium Survey for the William Herschel Telescope" https://arxiv.org/abs/1611.09388

Ravoux et al (2020) "A tomographic map of the large-scale matter distribution using the eBOSS—Stripe 82 Lyα forest" https://ui.adsabs.harvard.edu/abs/2020JCAP...07..010R/abstract