Ramona Augustin

"Characterising the Circum-Galactic Medium: Observations in Absorption and Simulations of Emission"
September 20 at 2pm.
Amphithéater LAM

The jury consists of the following members:

Prof. Dr. Lutz Wisotzki (AIP), examiner/reviewer
Prof. Dr. Lise Christensen (DARK), examiner/reviewer
Dr. Freeke van de Voort (MPA), examiner
Dr. Céline Péroux (ESO), supervisor
Dr. Palle Møller (ESO), co-supervisor
Dr. Bruno Milliard (LAM), co-supervisor

The defense will be followed by the traditional buffet.

Abstract:
Understanding the processes of gas flows in and out of galaxies is crucial in galaxy evolution studies. Yet, observations of the faint and diffuse Circum-Galactic Medium (CGM), where these processes take place, remain challenging. In this work, I explore different methods to observe, simulate and characterise the gas around galaxies in the CGM.
The most efficient approach to detect this faint and diffuse gas is in absorption towards bright background quasars. However, to investigate the CGM we need to also identify the galaxy counterpart and connect it to the absorption feature. In this context I identified and characterised counterparts to Damped Lyman-alpha Absorbers (DLAs) at z1 using highly spatially resolved Hubble Space Telescope (HST) observations. I used multiple broadband filters to measure the magnitude of the DLA counterpart galaxies. Using those magnitudes I determine their stellar masses by fitting their spectral energy distribution (SED). The galaxies are found to be generally less massive than the average galaxy population, but they follow the predicted trends in terms of star formation rate and metallicity. The high spatial resolution of the optical HST data also allows for a closer look at the morphology at those galaxies and reveals complex, unexpected structures.
While absorption lets us investigate very faint gas, it is usually limited to a single line of sight and we need observations in emission to map the CGM and gain information on its extent and clumpiness. To improve observing strategies of the CGM in emission, I make predictions from dedicated cosmological zoom-in simulations. In order to obtain flux maps of the CGM, I post-process cosmological hydrodynamical zoom-in simulations that were created with the adaptive mesh refinement (AMR) code RAMSES. I apply an emission model for the gas cells, calculated from CLOUDY photoionisation modelling. This combination allows to create mock IFU-like galaxy halo data cubes. I compare the mock data cubes to real galaxy observations and adjust them to reproduce the total luminosity and radial profiles of real galaxies.
The galaxy data cubes are next used as input to instrument models in order to prepare CGM observations. One intrument is FIREBall-2, a UV spectrograph aboard a balloon observing a narrow band around 2000 Å. It is optimised to detect faint gas in emission for CIV at z=0.3, Ly

at z=0.7 and OVI at z=1.0.
Using the simulated galaxy halos, I predict the observable SNR of those emission lines and find that FIREBall-2 is capable of detecting Ly
. The metal lines remain
challenging to observe with FIREBall-2. Based on this result, I select suitable targets and prepare observations and data analysis for FIREBall-2. The other instrument is HARMONI on the ELT, a visible and near-infrared IFU, for which I test whether it is suitable for CGM studies in terms of sensitivity, field-of-view, and wavelength coverage. I find HARMONI to be competitive for CGM studies as it is not only more than an order of magnitude more sensitive than current facilities, but it is also found to be capable of detecting faint CGM-like surface brightnesses within reasonable observation times.