

Finding, confirming and studying the most distant (first) galaxies at $z > 7$ before JWST and E-ELT: a (very) wide-field approach

Supervisors: David Sobral (sobral@strw.leidenuniv.nl), José Afonso, Bahram Mobasher (UC Riverside)

Abstract: When did the first stars and galaxies form? Over the last decade, galaxies have been robustly identified out to $z \sim 7.2$, just ~ 700 Myr after the Big Bang, and a GRB has been confirmed at an even earlier epoch ($z \sim 8.2$). The refurbished HST/WFC3 has opened a window to even earlier epochs, allowing the selection of $z \sim 7-10$ very faint candidates. Despite the great progress, all $z > 7.3$ candidates are simply too faint to be spectroscopically confirmed, a consequence of them being found by very deep, very small-area surveys. A very effective approach towards overcoming the current limitations is to look for relatively luminous Ly α emitters at wavelengths which are easily accessible from the ground. The reasons are simple: it opens the possibility of targeting very large volumes required to find the most luminous sources at $z \sim 7-9$, but also because, by selection, it will find sources with relatively luminous Ly α emission, enabling the spectroscopic confirmation and detailed study of such distant sources for the first time. With the advent of near-infrared wide-field cameras, this can now be done very effectively, and our group has just completed by far the largest contiguous narrow-band near-infrared survey ($\sim 20\times$ larger than the previous largest one) for Ly α emitters at $z \sim 8.8$. The student will be able to work on both the follow-up of the current best candidates for the highest redshift galaxies, but also to participate in extending the survey to both lower luminosities, but also to even larger areas and different redshifts by using different telescopes/instruments. The results will allow for the most accurate determination of the evolution of the Ly α luminosity function up to $z \sim 9$, with extremely important consequences to studying the re-ionisation of the Universe.

The confirmation of even a single $z \sim 8.8$ Ly α emitter will allow for completely unprecedented science and follow-up observations, because any confirmed source will be bright enough to be studied by the largest telescopes/facilities available right now. This would be a fantastic opportunity to explore ALMA, Keck, the VLT(SINFONI/KMOS) and HST to unveil the nature of $z \sim 9$ galaxies, many years before the next generation of large telescopes allows this to be done for the much fainter sources.

Facilities: CFHT/WIRcam, VISTA/VIRCam), VLT/SINFONI