Project Title: Radio feedback and the evolution of galaxies and their massive black holes

Project description:

Unravelling the evolution of galaxies and their central massive black holes, from the 'dark ages' to the variety of systems that we observe in the local Universe, remains a primary goal for observational and theoretical astrophysics. The main scenario is that, driven by gravity, dark matter halos merge into progressively larger structures. The baryons in the dark matter haloes cool radiatively into material from which stars form. The number of stars that could be formed in this process far exceeds that which is observed, so a source of energy is needed to heat the cold gas, thereby reducing star formation. An important feedback mechanism is "AGN feedback" invoked by current cosmological galaxy formation models. This feedback is due to jets from active galactic nuclei (AGN) injecting large amounts of energy and momentum into the surroundings of their host galaxies. The outcome of the evolution processes is that galaxies can have very different shapes, masses, sizes, stellar populations, gas content, metallicities and star formation histories. Also, a huge variety of active nuclei are observed, ranging from weak activity at the centres of some galaxies, to explosive events in quasars that produce luminous emission over the entire spectrum

Operating at frequencies from 10 to 240 MHz, LOFAR is the world's premier low frequency radio telescope. The LOFAR Surveys Key Science Project (PI Röttgering) is conducting a series of unique low-frequency radio surveys with a range of depth, area and frequency. WEAVE is a multi-object spectrograph facility for the William Herschel Telescope (WHT) and will be commissioned at the end of 2020. One of its major science projects is to generate more than 10^6 spectra of LOFAR selected radio sources.

With these massive data sets (factor 100-1000 larger than before), we shall address the following questions relevant to AGN feedback:

1. How is the impact of AGN feedback related to the characteristics of the AGN, their host galaxies and environments?

2. How does the effect of AGN feedback change during the build-up of galaxies?

3. How does the impact of the feedback change when radio sources grow from kiloparsec to megaparsec scales?

4. What is the relative importance of the main drivers for the differences between radio AGN e.g. black hole mass, environment, accretion rate, stage of development, orientation? How does this change with redshift and how does this relate to the build-up of massive black holes since z~6?

Supervisor: Prof. H.J.A. Rottgering

Selection criteria: Research qualities and astronomical background

Applications:

To apply for this vacancy, please send an email to rottgering@strw.leidenuniv.nl. Please ensure that you upload the following additional documents quoting the project title:

- Curriculum vitae;
- Bachelor's and master's transcripts;
- (Draft of) MSc thesis.

Deadline: June 1st 2021