The Gas Content of Galaxies in the Galaxy Cluster A2626

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Brief project description

Galaxy clusters are dense environments which influence the evolution of galaxies. Various processes take place in these environments which result in changes to galaxy morphologies, star-formation properties, and gas content. In particular, the neutral hydrogen, HI, in galaxies is an excellent tracer of these processes.

In this project, the student will investigate the average HI content of galaxies in different sub-structures in the nearby galaxy cluster Abell 2626 using in-hand MeerKAT data and optical spectroscopy and the HI stacking technique.

Abell 2626 (Legacy survey image)

Longer description

A key driver of galaxy evolution is the environment in which a galaxy is located. Dense environments like galaxy clusters influence galaxy properties (e.g. Dressler, 1980) due to the various physical interactions and processes that can take place between galaxies due to their gravitational influences on each other, as well as interactions between galaxies and the intra-group or intra-cluster medium. These processes can impact a galaxy's morphology, star formation properties, gas content, etc. Since the neutral hydrogen gas content of galaxies typically makes up a significant fraction of the overall baryonic mass of galaxies, as well as the fact that it usually extends further out spatially than the stellar component, it is a very useful tracer of interactions. Therefore studying the HI content of galaxies in galaxy clusters can provide important insights on environmentally-driven galaxy evolution processes.

Abell 2626 (A2626) is a relatively nearby (z=0.055), moderately massive ($M_{halo} \sim 5 \times 10^{14}\ M_{\odot}$) galaxy cluster. A study by Healy et al. (2021) using optical spectroscopy of the cluster has also revealed several sub-structures within the larger cluster environment. Furthermore, pilot 4k HI observations of the cluster with MeerKAT (Healy et al., 2021) have indicated high numbers of HI detections in the cluster.

The main aim of this project is to investigate the average gas content of galaxies in different substructures and locations inside A2626 as a means to study the evolutionary processes taking place in the cluster. This will be done by using the technique of HI stacking using the existing MeerKAT HI data we have in hand. In HI stacking, galaxy HI spectra are extracted from the radio data cube at the known positions of galaxies (from optical imaging), shifted to rest-frame (using each galaxy's redshift known from optical spectroscopy) and co-added. All the HI, imaging and

spectroscopic data needed for this project are in hand already. It is envisaged that a journal publication will result from this project.

The student will join a small international team working on various aspects of galaxy evolution in this cluster and will have access to the IDIA/ilifu cloud computing facilities where the A2626 HI data are stored and will be processed and analysed. Good python programming skills will be needed but can also be developed further during the project.

Useful readings:

Healy J., Willner S.P., Verheijen M.~A.~W., Blyth S.-L., 2021, AJ, 162, 193. doi:10.3847/1538-3881/ac0bc6

Healy J., Deb T., Verheijen M.A.W., Blyth S.-L., Serra P., Ramatsoku M., Vulcani B., 2021, A&A, 654, A173. doi:10.1051/0004-6361/202141377

Healy J., Blyth S.-L., Verheijen M.A.W., Hess K.~M., Serra P., van der Hulst J.~M., Jarrett T.~H., et al., 2021, A\&A, 650, A76. doi:10.1051/0004-6361/202038738

Healy J., Blyth S.-L., Elson E., van Driel W., Butcher Z., Schneider S., Lehnert M.~D., et al., 2019, MNRAS, 487, 4901. doi:10.1093/mnras/stz1555