UCT MSc Project

A first look at a complete survey of molecular gas in the Coma cluster

Supervisor: Dr. Nikki Zabel (UCT), nikki@ast.uct.ac.za
Co-supervisor: Prof. D.J. Pisano (UCT)

Background:

The main difference between galaxy clusters and the isolated galaxies comprising the "field" is their relatively high number of passive galaxies. This suggests that the cluster environment is capable of "quenching" the star formation in galaxies on relatively short timescales. It is now well-known that the atomic gas in cluster galaxies can be strongly affected by environmental processes, eventually leading to the quenching of star formation. However, the situation is less clear for the more tightly bound and centrally located molecular gas, in which the star formation takes place. The Coma cluster is a very massive and dynamic nearby cluster. There is a wealth of data available for it, all of which show evidence of gas being removed from galaxies. This makes the Coma cluster ideal for studying the effects of environment on molecular gas.
The COCO (*CO* in the *Co*ma cluster) survey, carried out with the IRAM 30m telescope in the south of Spain, is the first complete survey of molecular gas in Coma cluster galaxies, traced by CO. The survey targeted 41 galaxies with evidence of ongoing star formation, and/or substantial HI or dust reservoirs. This sample is an important piece of the puzzle in the multi-wavelength study of the Coma cluster, as well as the study of molecular gas in nearby galaxy clusters.

Aims:

The goal of this project is to reduce and analyse the 30m single dish data of molecular gas in this complete sample of Coma galaxies. To this end, the student will have to write code to baseline the spectra, and fit the CO(1-0) (and CO(2-1)) lines in order to derive molecular gas masses. The resulting masses can be used to derive corresponding gas fractions and deficiencies (the lack of gas compared to field galaxies of similar masses), and study those in relation to environmental properties, such as the galaxies' positions in the cluster.
The wealth of available ancillary data (e.g. HI, Halpha, UV, dust) means that, if time permits, this project can be extended in whichever direction interests the student. Examples include a comparison between (or combination of) the molecular gas content in the Coma, Virgo, and Fornax clusters, studying molecular-to-atomic gas ratios, studying gas-to-dust ratios, or studying various scaling relations (such as the Kennicutt-Schmidt relation).
The data reduction will be done using GILDAS and/or a programming language of the student's choice (although Python is recommended).