PHD PROJECT DESCRIPTION (DR ROSALIND SKELTON)

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How galaxies form and evolve is arguably one of the most important open questions of modern astronomy. Galaxy evolution is driven by the interplay of gas accretion, star formation and feedback from supernovae and AGN, along with galaxy and halo mergers that form larger and larger structures over time. It is still not clear what sets the efficiency of star formation and what causes star formation to cease in some galaxies, producing a bimodal galaxy population.

Clusters of galaxies are particularly interesting environments from which to learn about the processes involved in galaxy formation. Star formation is typically suppressed in cluster galaxies and interactions are common. The history of merging events leaves various signatures: companion galaxies with disturbed morphologies; faint dwarf galaxies orbiting more massive galaxies; tidal streams; younger stellar populations in the outer regions of galaxy halos; and, in galaxy clusters, a diffuse intra-cluster light formed from the repeated stripping of infalling galaxies. The faint outskirts of massive galaxies provide a record of past merger events, and thus ultimately the evolution and transformation of galaxies.

Recently a new class of unusually dark galaxies known as Ultra Diffuse Galaxies (UDGs) were discovered in the Coma cluster (van Dokkum et al. 2015), with deep follow-up finding significant numbers of them (> 800, Koda et al. 2015). A handful of UDGs have also been found in other clusters and groups. UDGs have very low stellar masses, but sizes comparable to the Milky Way. Although similar in appearance to dwarf spheroidal galaxies, they seem to have more in common with much larger galaxies. To survive in the strong tidal fields of clusters they must contain significant amounts of dark matter. They are particularly interesting as examples of extremely inefficient galaxy formation, having formed very few stars for the size of their halos. It is essential to build up larger samples of UDGs in different environments to understand their properties, how common they are and where they are found, to develop a picture of how they formed. While fascinating in their own right, understanding the formation of these unusual galaxies has much larger implications for our understanding of the processes that quench star formation in all galaxies.

Public data from the IAC Stripe 82 Legacy Project (Fliri & Trujillo 2016) will be used to identify UDGs in clusters covering a broad mass and redshift range. The results will be used to constrain the evolution of the number density of UDGs, their spatial distribution and properties. The statistics from this large sample will be complemented by in depth studies of individual groups and clusters, using deep imaging data of four clusters and the Sculptor group from the KMTNet telescope. The student will be responsible for developing a data reduction pipeline to process the images, using existing code as a starting point. We will search the images for UDGs, faint tidal features and the ICL, comparing the different environments to each other.