University of Victoria | Graduate Studies

Notice of the Final Oral Examination for the Degree of Master of Science

of

MALLORY THORP

BSc (University of Washington, 2017)

"Resolved Properties of Galaxy Mergers from the MaNGA Survey"

Department of Physics and Astronomy

Thursday, August 1, 2019
9:00 A.M.
Clearihue Building
Room B017

Supervisory Committee:
Dr. Sara Ellison, Department of Physics and Astronomy, University of Victoria (Supervisor)
Dr. Luc Simard, Department of Physics and Astronomy, UVic (Member)

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Abstract

The complex and diverse populations of galaxies observed today form hierarchically through past galactic mergers. Interactions between galaxies of similar masses will drastically alter the morphology, chemical composition, star-formation activity, and central black-hole accretion of their constituents. Though we can see the components and byproducts of galaxy mergers, these events endure over a timescale of hundreds of millions of years. Thus to understand the merging process from observations, astronomers are reliant on large spectroscopic surveys which will contain galaxy mergers at various stages of interaction, and those which have just experienced coalescence. Until recently, such surveys were limited to the global properties of each galaxy, constraining the global changes in chemical composition and star-formation activity, but overlooking how such changes vary across a galaxy. The advent of Integral Field Unit (IFU) spectroscopy surveys provides spatially resolved spectroscopic properties for thousands of galaxies for the first time. This thesis presents analysis of galaxy mergers from the Mapping Nearby Galaxies at Apache Point Observatory (MaNGA) IFU spectroscopy survey. Enhancements and deficits in star-formation rate ($\Delta\Sigma_{SFR}$) and metallicity (Δ O/H), as a result of the interaction, are determined for each spectral pixel (spaxel) based on well established relationships with stellar mass density. These offsets are then compressed into radial profiles to quantify how the effects of an interaction vary as a function of radius. A sample of 36 post-mergers are, on average, enhanced out to $\sim$2 effective radii, though individual galaxies can be enhanced or suppressed in the outskirts depending on the global star-formation rate of the galaxy. The metallicity is uniformly suppressed in post-merger galaxies, in concordance with the global SFR enhancement. A galaxy pairs sample is identified with cuts in the projected separation r_p, the line of sight velocity difference Δv, and the mass ratio μ of the interaction. I develop a method to deblend close galaxy pairs that are on the same IFU observation, and remove contribution from the companion galaxy in the radial profile. Radial profiles of $\Delta\Sigma_{SFR}$ and Δ O/H for the pairs sample, binned by r_p, confirm that central enhancements in SFR increase as separation decreases. Behaviour in the outskirts is more varied, and does not appear to correlate with r_p or the μ of the interaction. Δ O/H displays a similar issue, showing no clear correlation with separation or μ. Such ambiguity implies that multiple characteristics of the interaction and its components are required to predict the spatial changes in a galaxy merger. I propose projects that could shed

light on these ambiguities. The most recent release of MaNGA will double the sample size of mergers, possibly homogenizing r_p and μ bins that may be dominated by a particular population. An analysis of interacting galaxies that do not have μ measurements, but very small r_p's and highly disturbed morphologies, could provide understanding of the transition between the very end of an interaction and the state of the galaxy post-coalescence. I also propose a more complex analysis of the asymmetry of IFU spectroscopy data products, which until now have been simplified with radial profiles. Lastly, I emphasize the importance of follow up studies of the resolved molecular gas properties of merging galaxies to discern whether gas reservoir, depletion time, or both are driving the change in star-formation rate.