DRAFT 1: section 1.4 - Thesis Outline

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1 General Thesis Outline

The main aim of this thesis is to demonstrate that the mechanical power of radio jets play a significant role in altering the morphology, kinematics and ionisation state of the multi-phase gaseous environment from the ISM to the CGM at the ∼100 kpc scale. To achieve this, I have obtained narrow-band imaging and spectra from IFU data acquired by the VLT/MUSE instrument. The spectral window of MUSE permits the detection of rest-UV lines at $z \gtrsim 2.9$ with which we trace the ionised gas within the gaseous haloes of the seven HzRGs in the sample. Additionally, comparisons of our measurements (in particular, column density ratios) to photoionisation models provide a constraint on the ionisation state of the gas. With data from ALMA, we trace molecular hydrogen, H_2, by way of the [CI](1-0) fine structure line. With this as a tracer, we aim to constrain the masses of molecular clouds within the host galaxy ISMs as well as within the extended halo or CGM. We also aim to determine H_2 kinematics relative to the jets. Overall, the purpose of this thesis is to provide observational constraints on radio-mode feedback operating within radio galaxies in the early Universe ($2.9 \lesssim z \lesssim 4.6$).

1.1 Chapter 2

In chapter 2, we explore the influence of radio-jets on the $<$ 1Mpc-scale environment density. With the use of a nearest neighbour pseudo-3D density measure, we quantify group scale environments of 2716 radio sources within a 100 deg^2 area of the Stripe 82 equatorial field. The radio-jet power is traced using 1.4 GHz luminosities ($L_{1.4\ \mathrm{GHz}}$) detected from the VLA in the CnB configuration. We test for correlations between the environment densities measured to the 2nd and 5th nearest neighbours and radio jet power for radio sources up to $z \sim 0.8$. This is achieved by comparing the environment density measures of radio-selected AGN to optical sources that are matched by $K-$band magnitudes and $(g - K)$ colour indices.
For this published paper, I developed the Python code required to obtain all of the main results. As the primary author, I was responsible for assembling the initial and follow-up drafts of the publication which included searching for relevant literature results to support or disprove our conclusions.

1.2 Chapter 3

Chapter 3 is a single-source paper. In it, we used MUSE data to explore the kinematics of ionised and neutral gas within the ISM and CGM of a $z = 2.92$ radio galaxy, MRC 0943-242. We do so by parametrising rest-UV lines detected around the nucleus in terms of their emission components which we fit using multivariate Gaussians. The resonant rest-UV lines permit us to quantify absorption and we fit these with composite Voigt and Gaussian functions. We compare the column densities obtained from Voigt profile fitting to predictions based on photoionisation

models with *Cloudy*. The aim of this is to determine the dominant ionising mechanism powering the metal-rich absorbers and determine their distance from the ionising source.
For this published paper, I reduced the data via a standard ESO pipeline - *Esorex* - for IFU data producing the final datacube that formed the dataset. I developed the Python code required to obtain all the results shown in the paper. I compiled literature results relevant to the topic and arranged it into the write-up that would be submitted to the journal for eventual publication.

1.3 Chapter 4

In chapter 4, we have taken ALMA [CI]^{3}P$_1$ - ^{3}P$_0$ line and continuum observations within a 4×4 arcec^2 field of view for seven radio galaxies between $2.9 \lesssim z \lesssim 4.6$. The [CI] line traces molecular hydrogen and thus we use it to constrain H_2 masses within and surrounding the host galaxies. The [CI] lines are also used to measure the kinematics of H_2 gas from their degree of line-broadening.
For this thesis chapter, I reduced and imaged the interferometric observations using the standard reduction pipeline - *Casa*. I developed the Python code required to obtain the results shown in the form of images and spectra. I assembled literature results to provide background for the research and worked on drafting write-up.