Herschel's View of Coma

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A tale of two samples

1 Introduction

Clusters & Superclusters are the biggest structures in the universe and as a consequence of hierarchal formation a product of a cold dark matter dominated universe, are both the largest and latest to form. It is key to understand how these environments affect the evolution of the galaxies in them.

The Coma cluster and supercluster are one of our nearby examples of this large scale structures. This proximately has caused Coma to be the focus of many high spatial resolution surveys over a wide range of wavelengths. The focus of our work is to use data from the Herschel Space Telescope (PACS & SPIRE) to study Coma galaxies at far-infrared and sub-mm wavelengths (100, 160, 250, 350, and 500u) at an unprecedented resolution. The data can be used to measure both the temperature and mass of the cold interstellar medium.

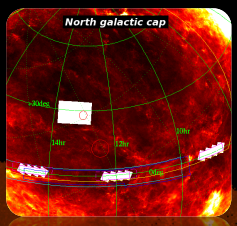
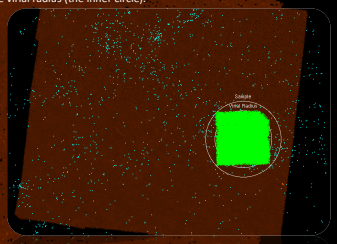


Figure 1 – The H-ATLAS fields – the NGP is the large rectangle at the top of the picture. The red circle over it is centered on the coma cluster.

2 Data - Herschel-ATLAS

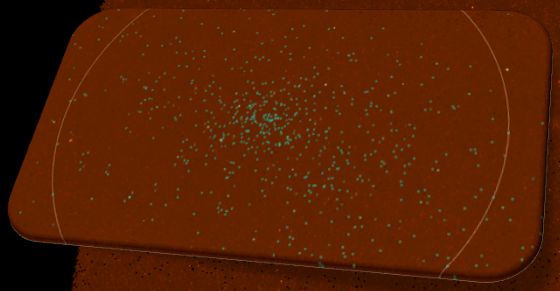
The Herschel-ATLAS is a large area survey in the sub mm, that is covering 550 square degrees of sky. The data that we are using for this project is the NGP, which is a 10° x 15° area of sky as shown in figure 1.

Figure 2 – NGP map at 250μm with an overlay of our proposed catalogue (cyan) and the GMP catalogue (green), this is the benchmark optically selected catalogues of coma, it clearly covers the area in a comparatively higher density of sources but lacks the radial coverage past or even up to the virial radius (the inner circle).



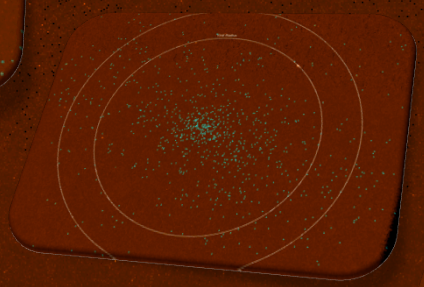
3 Current Catalogues

Many catalogues define a small angular area, at most up to the virial radius of the cluster and search to a very faint magnitude limit and then define membership based on morphology. There have been some that have been defined only by redshift however these surveys have only sampled out to half the viral radius. No single good catalogue exists for our purposes so we are creating one.



4 The origins of our catalogue and sample

The SDSS has covered the area with its spectroscopic survey. It has redshifts for 99% of galaxies brighter than 17th magnitude. Making it Ideal four the origin of our optical catalogue.



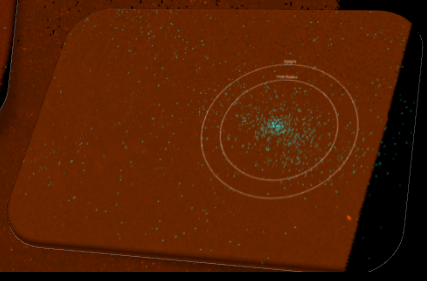


Figure 3 – a progressive 3 stage zoom into the coma cluster at 250μm. The circles drawn are at 1.5° and 2° from the centre and signify the virial radius of the cluster and our defining radius of the cluster.

Defining the samples

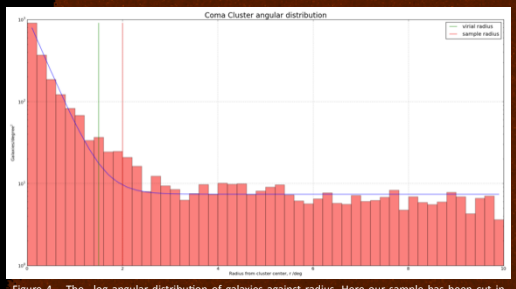


Figure 4 – The log angular distribution of galaxies against radius. Here our sample has been cut in velocity space so that only galaxies between 4215km/s and 9750km/s are included. The two lines mark the virial radius and the sample radius.

5 – Samples

We define the centre of the cluster by the peak x-ray emission. Figure 4 shows clearly that out to ~ 2° or 3° there is a density that is above the average background. We have fitted an exponential to the graph with a constant fit to the background level. Then after defining 2° as a conservative cut we have fitted a Gaussian function to a slice in velocity, we define the cluster μ ± 3σ in velocity space, where the velocity dispersion, σ = 922km/s and the mean μ = 6983km/s. Figure 5 clearly shows that this is a reasonable assumption as there are clear low-density regions beyond these cuts. Figure 6 shows the extent of the super cluster filament in velocity/radial space.

So our samples are defined as follows :

1. The Cluster between 4215 and 9750 km/s velocity, and r < 2°
2 .The Super cluster sample as anything in the 3σ ± mean velocity range that falls on the ngp field.

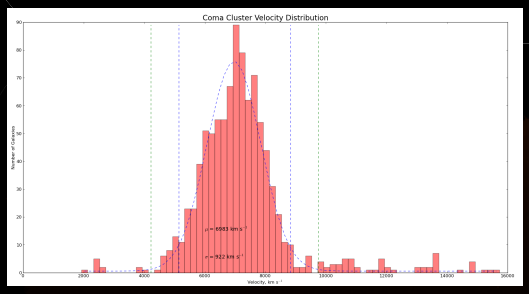


Figure 5 – The velocity distribution of galaxies with a 2° cut in radius, fitted with a Gaussian. The two lines show 2&3σ velocity dispersions, of 1844km/s and 2766 km/s.

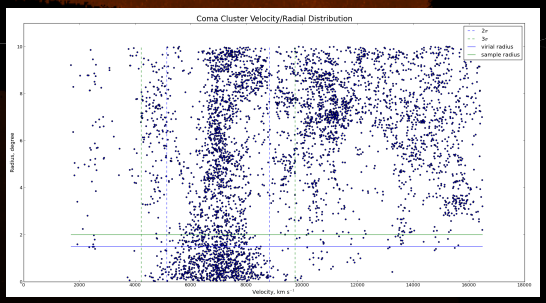


Figure 6 – This shows each galaxy's location in velocity and radial distance from the x-ray center, we can clearly see the "finger of God" effect in velocity space. The horizontal lines show the virial and sample radii, and the vertical show 2&3σ velocity dispersions.

6 Future

This is part of a larger project to study the properties of nearby galaxy clusters. The Herschel Virgo Cluster Survey (HeViCS), and the Herschel Fornex Cluster Survey (HeFoCS), and will be using equivalent methods for direct comparison with two different cluster environments as well as with the supercluster sample aforementioned.