A Statistical Investigation into Galaxy Cluster Radiative Process Correlations

by

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A Thesis Submitted in Partial Fulfillment of the
Requirements for the Degree of

BACHELOR OF SCIENCE (HONOURS)

in the Department of Physics and Astronomy

A Statistical Investigation into Galaxy Cluster Radiative Process Correlations

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Ben Fredebo Rasmussen

Supervisory Committee

Dr. J. Willis, Supervisor
(Department of Physics and Astronomy)

Dr. G. Steeves, Departmental Member
(Department of Physics and Astronomy)

ABSTRACT

This is where the abstract will go.

Contents

List of Tables

List of Figures

ACKNOWLEDGEMENTS

DEDICATION

My cat... for now.

Chapter 1

Introduction

Room for introduction here.

1.1 Introduction Introduction

This is where the introduction to chapter one will go.

1.2 Background

This is where the background will go.

1.3 The Data (This Could Potentially be Chapter 2)

1.3.1 Meet the Members

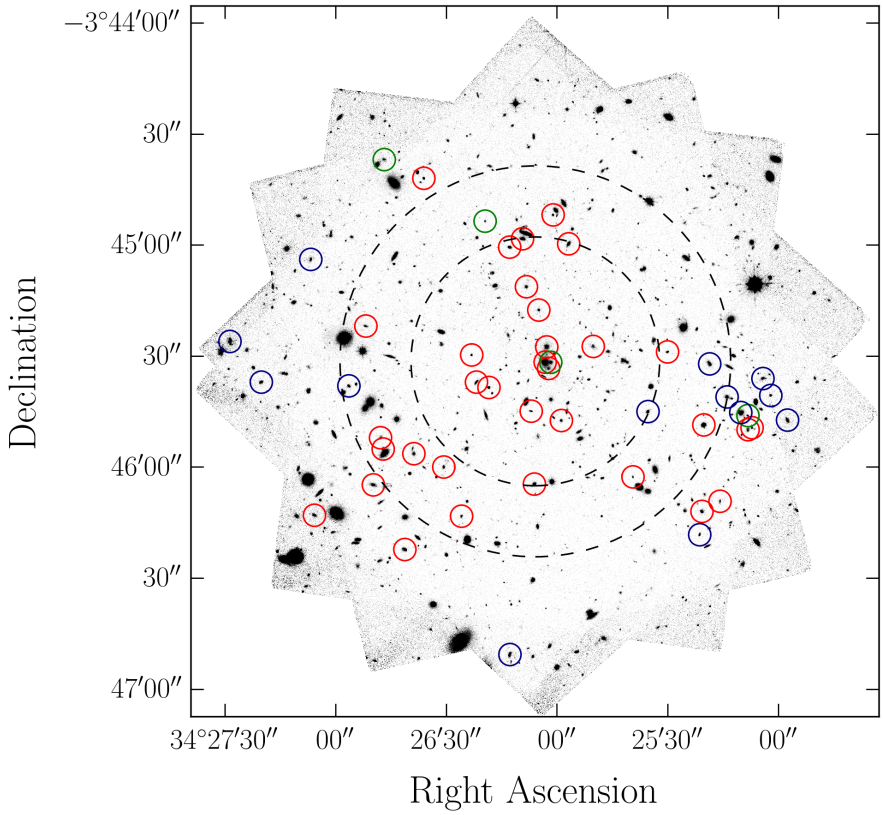

Figure 1.1: Image of the Cluster with Highlighted Members

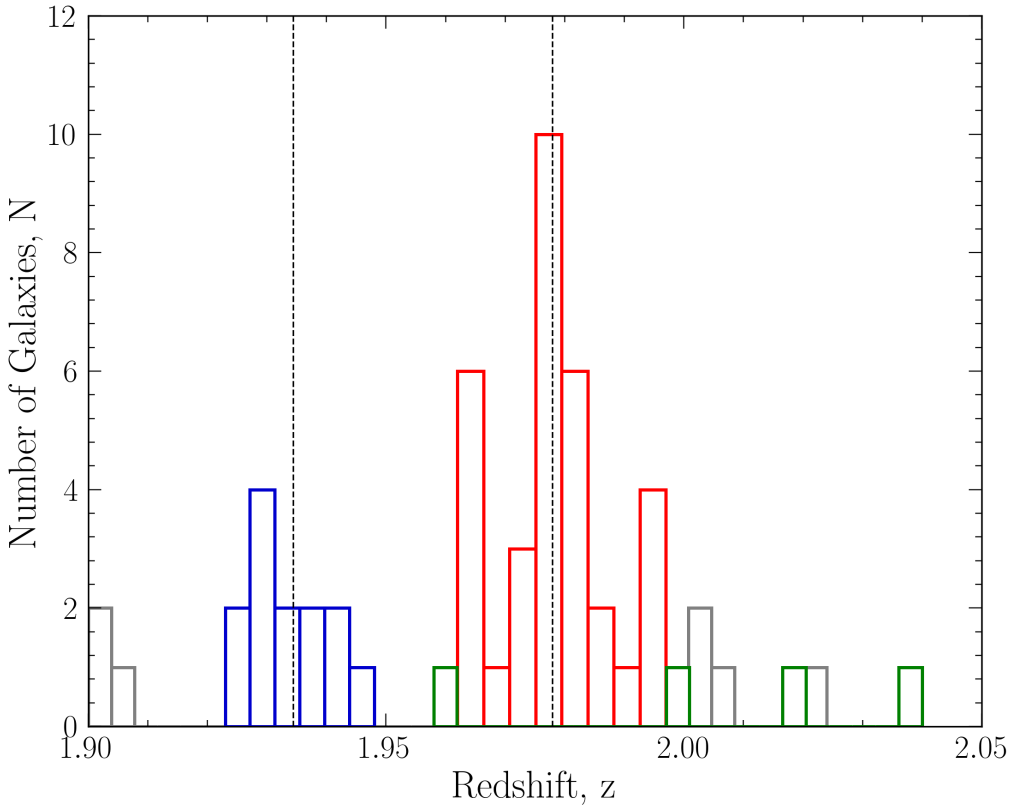

Figure 1.2: Redshift Histogram

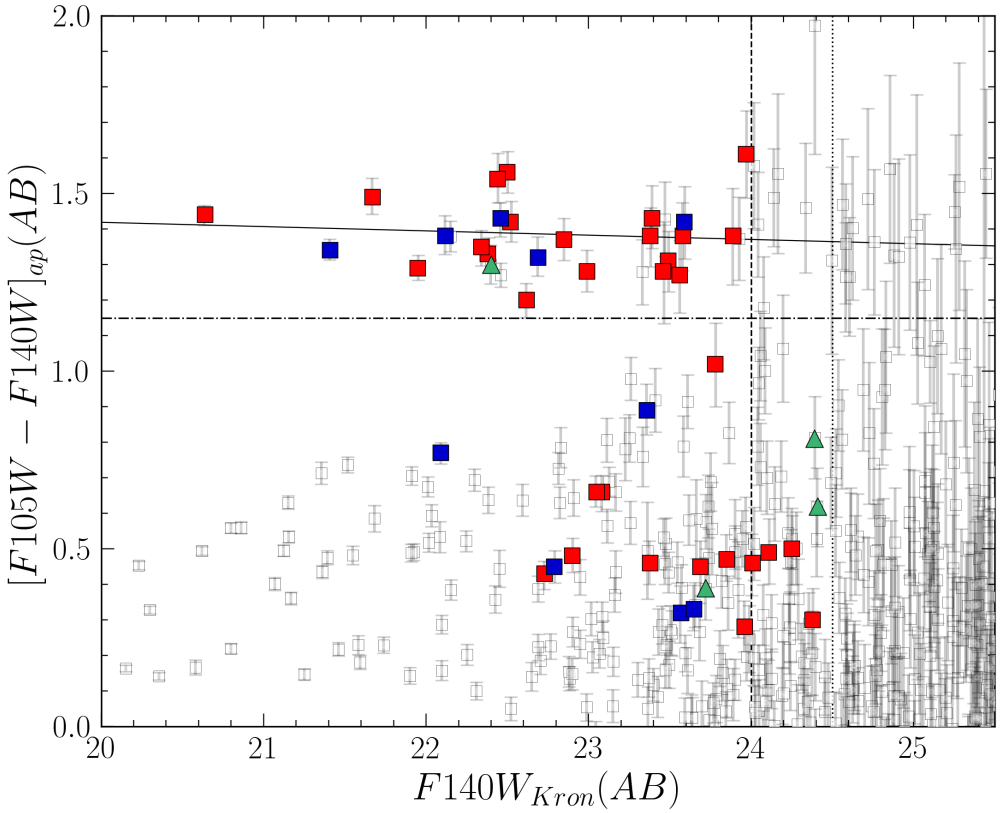

Figure 1.3: Colour Magnitude Diagram (Insert More Here)

1.3.2 What about the Xrays

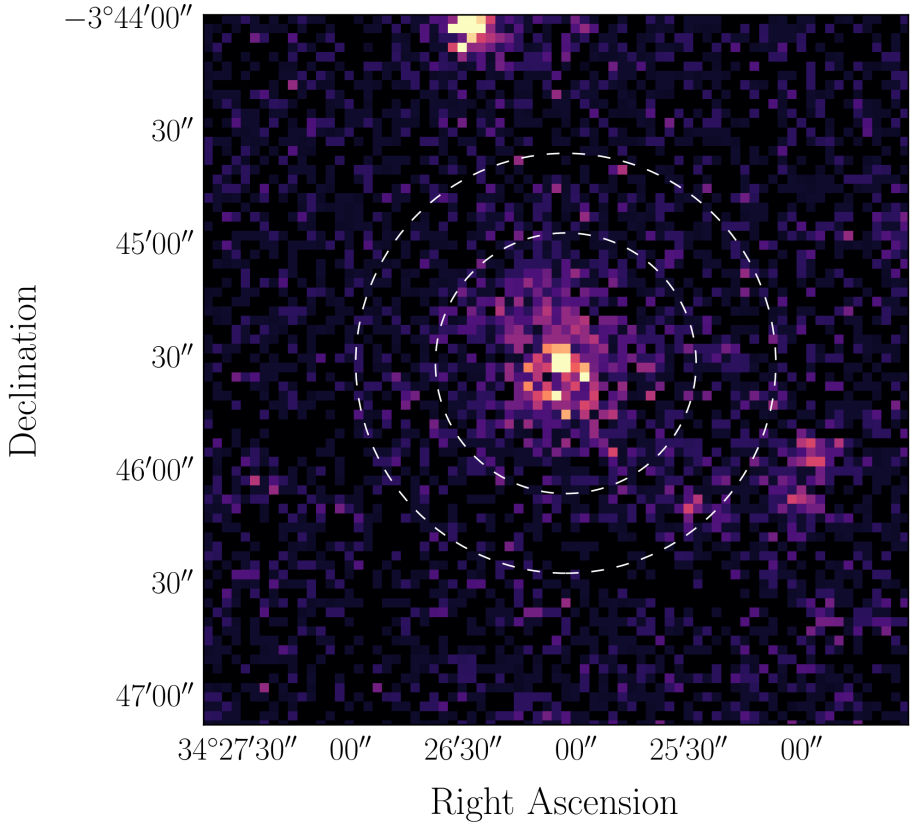

Figure 1.4: Image of the Raw Xray Image

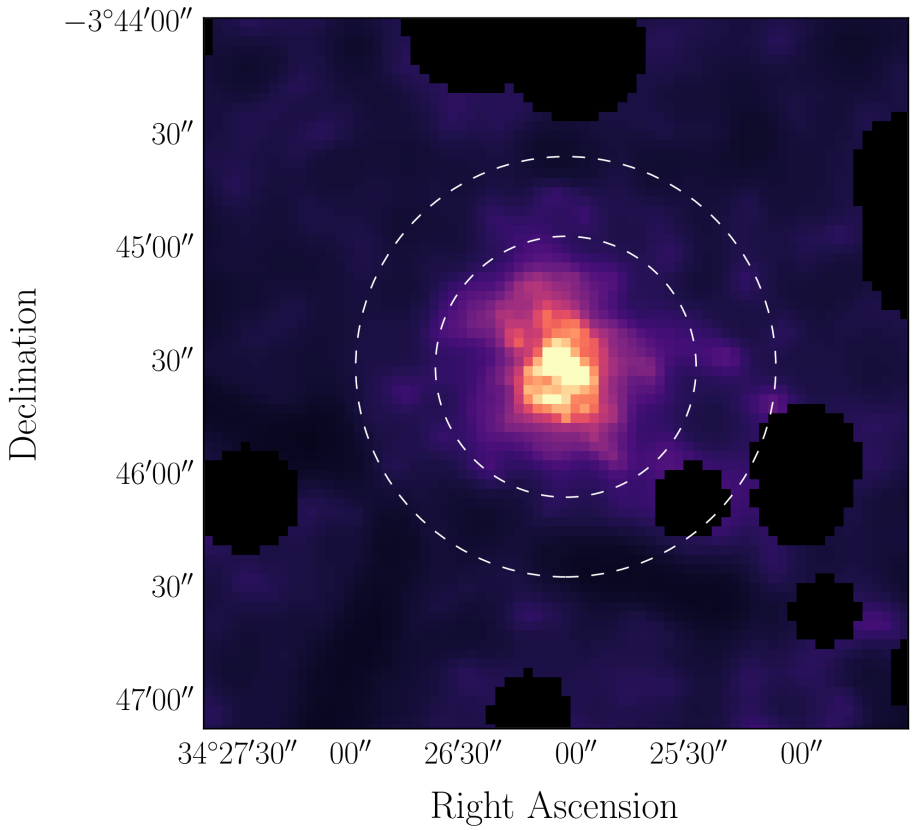

Figure 1.5: Image of Adaptively Smoothed Xray Image

1.4 Motivation of the Work

Highlight problem to be solved and any claims made by the author (me).

1.4.1 Importance of Claims in Context

Implications of contributions etc.

1.5 Agenda

Highlight the narrative structure of the document here.

Chapter 2

What is the Problem? (Could also be the setup to the project, about the data, fluxes etc.)

In-depth motivation for the work here. Background of the problem/project.

Could push the above into the intro chapter and leave this for the preliminary work.

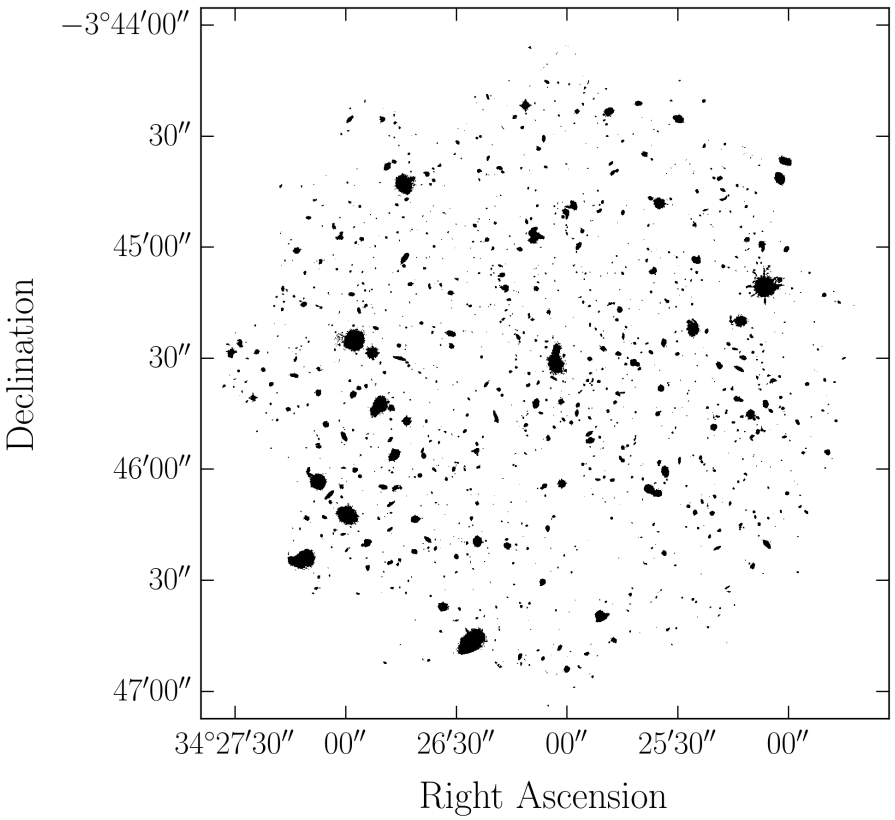

Figure 2.1: Segmentation Map of Image (Will likely not include)

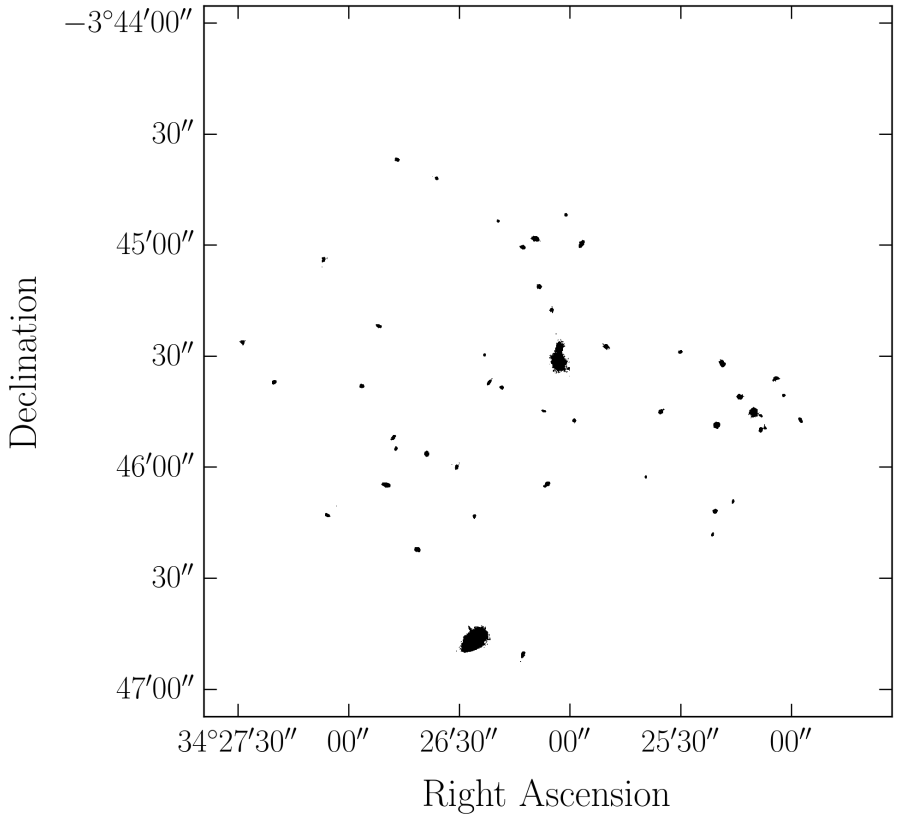

Figure 2.2: Segmentation Map of Members (Will likely not include)

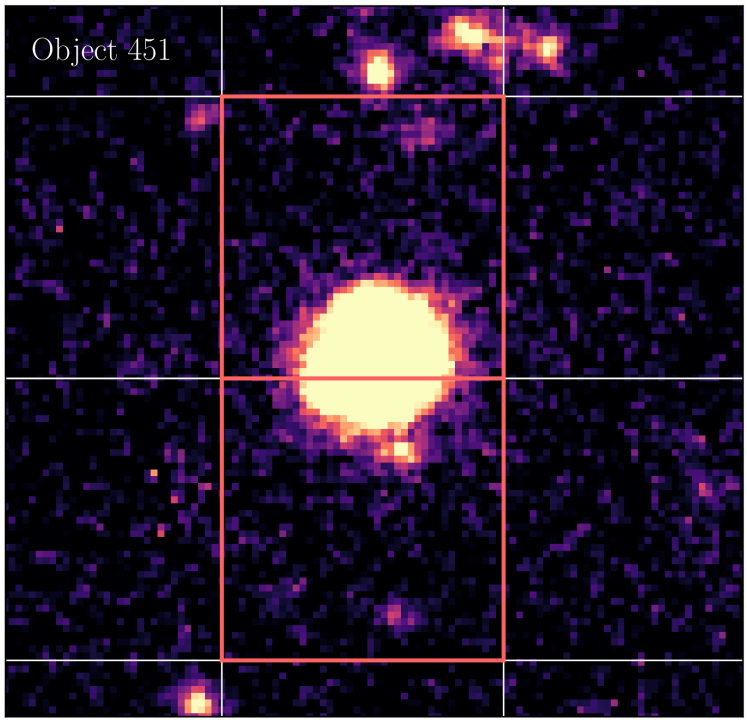

Figure 2.3: Manual Flux Determination example for object 451

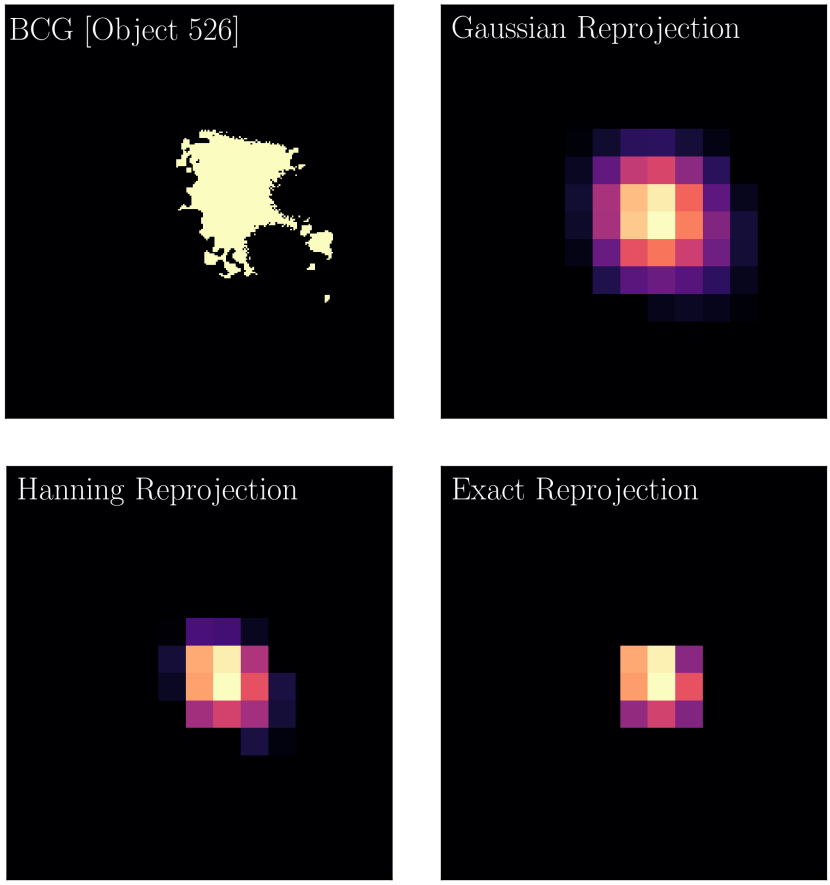

Figure 2.4: BCG Galaxy projected to xray image frame

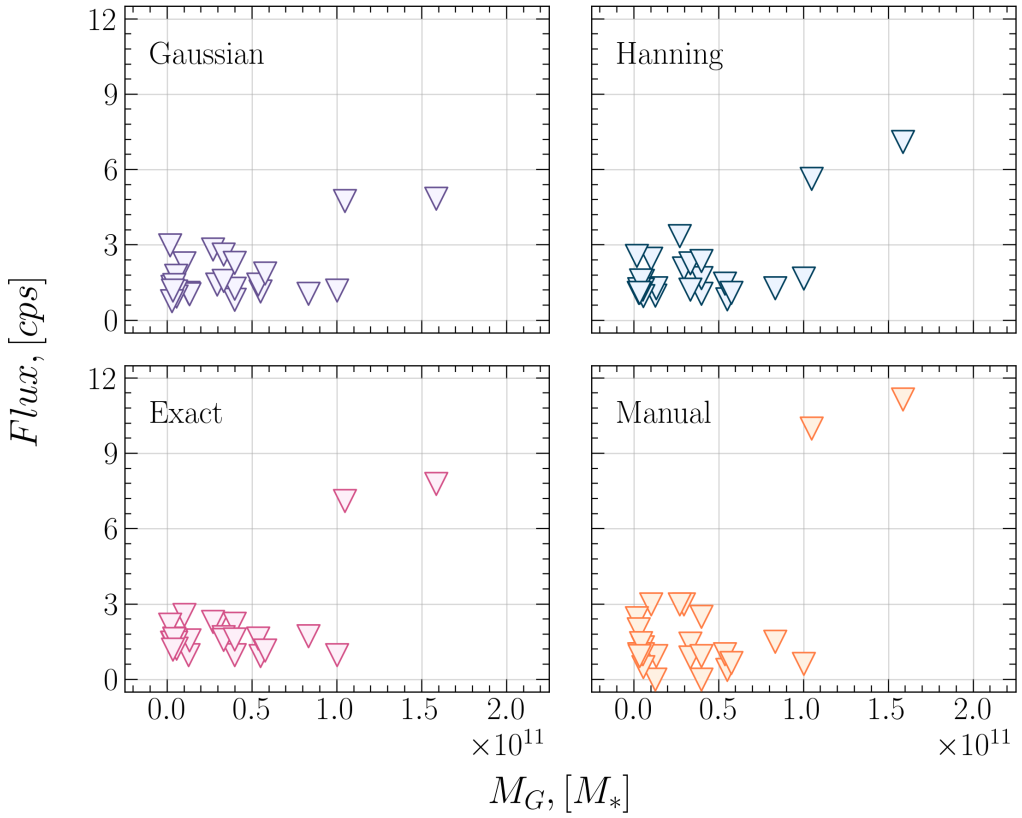

Figure 2.5: Plot of flux vs. mass for the four methods of obtaining flux values

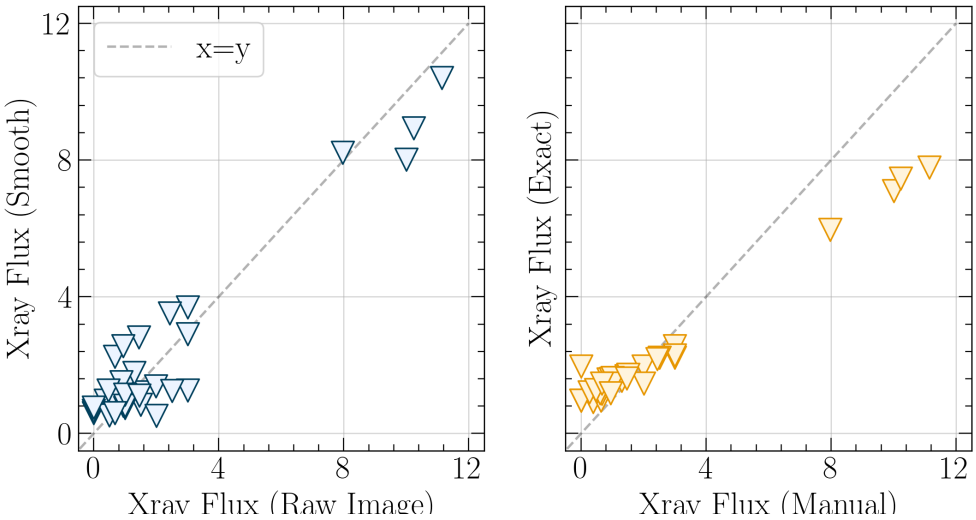

Figure 2.6: Comparison of important selected flux methods (and smooth vs. raw)

Chapter 3

Linear Correlation Techniques

Stuff about the first few weeks of the project.

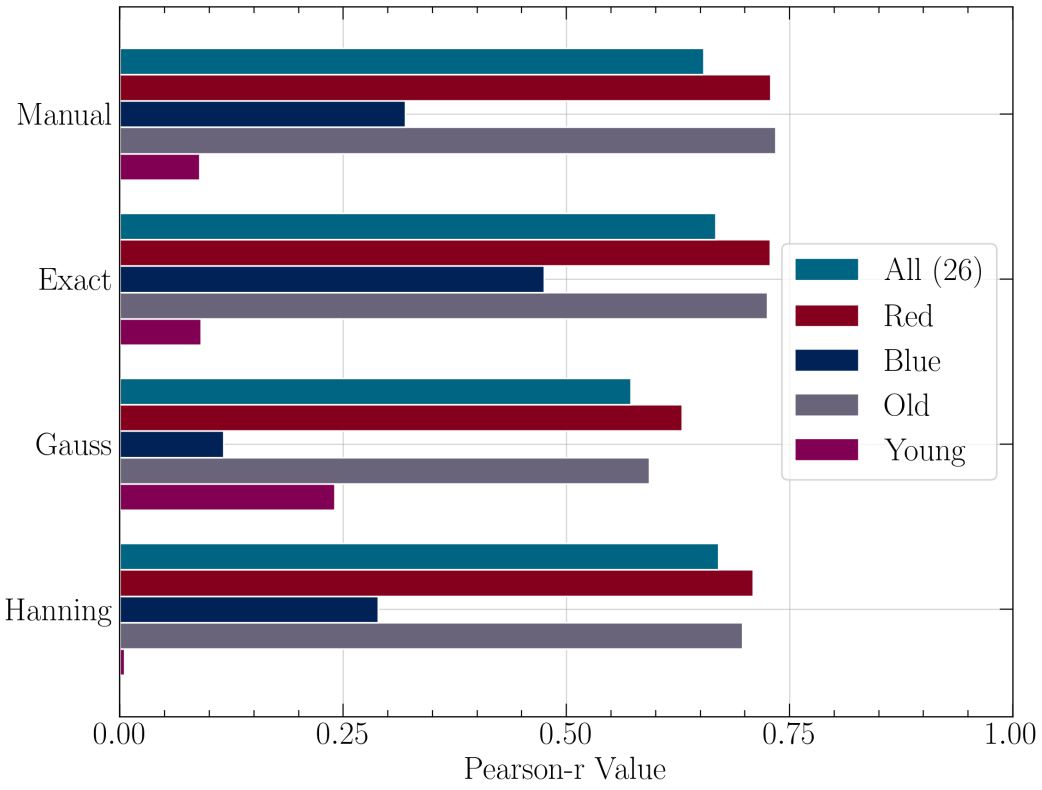

Figure 3.1: Pearson r for each subsample (so far) and the four major methods used. USeful to compare statistical behaviour for each method and choosing one.

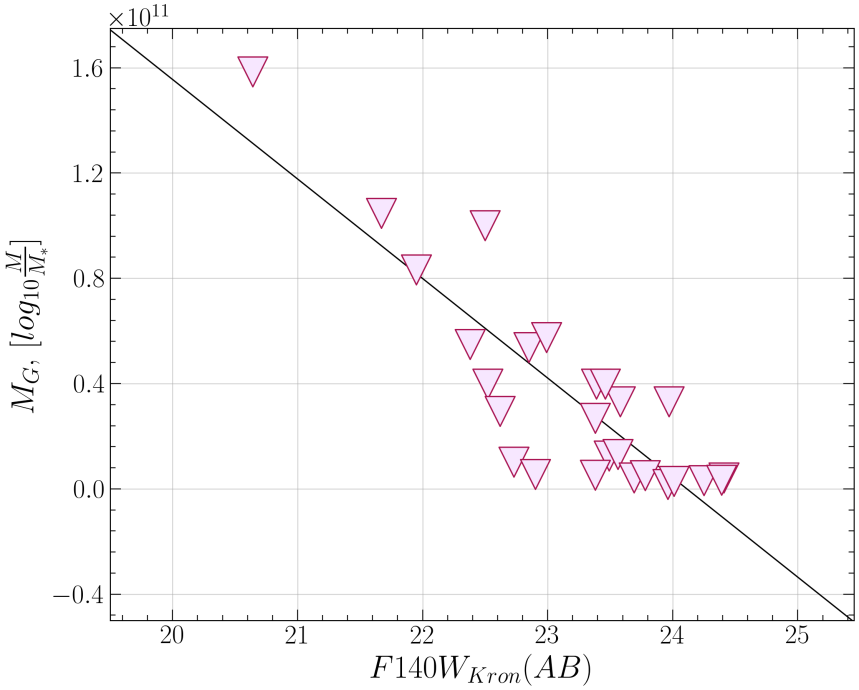

Figure 3.2: Linear Relation established from mass and magnitude for known masses (Trudeau et al)

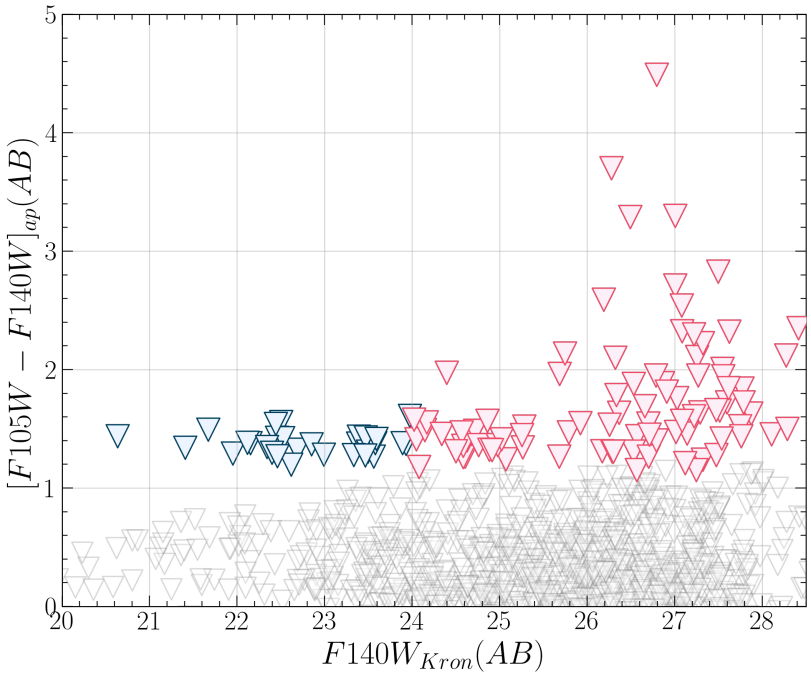

Figure 3.3: Colour magnitude diagram showing sample that will be examined for possible member extensions

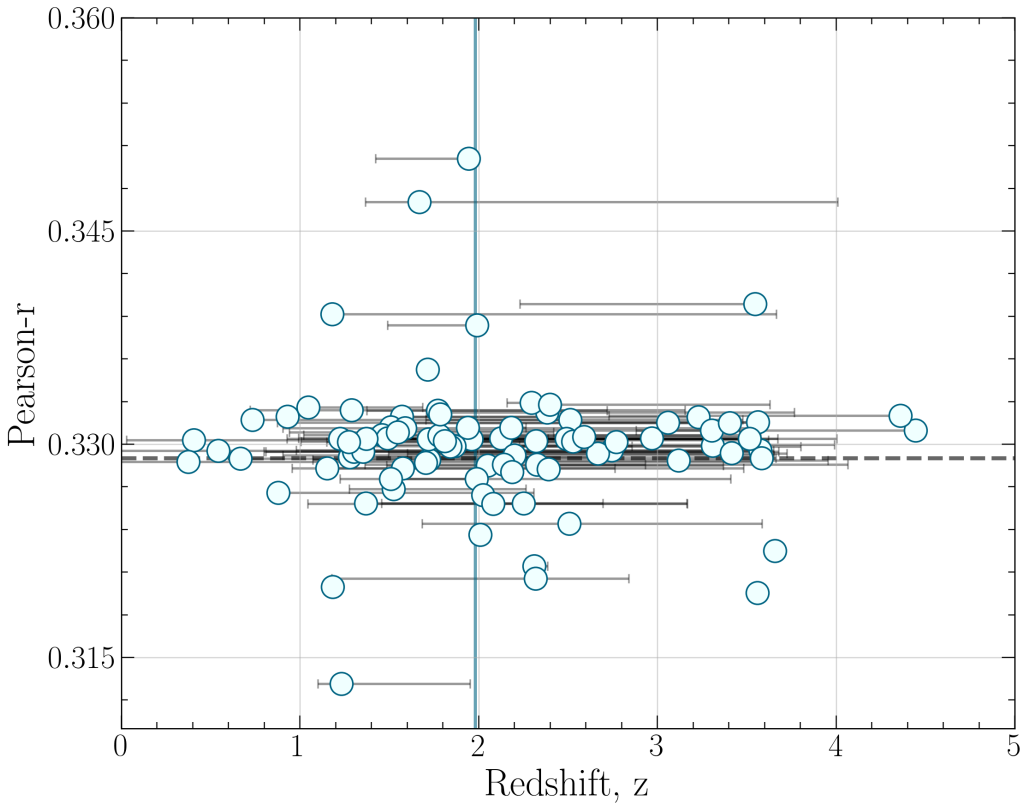

Figure 3.4: Bootstrap Pearson-r for each of the possible candidates as a function of redshift. Lines for z=1.98 and r=0.329 which is 68.5th percentile.

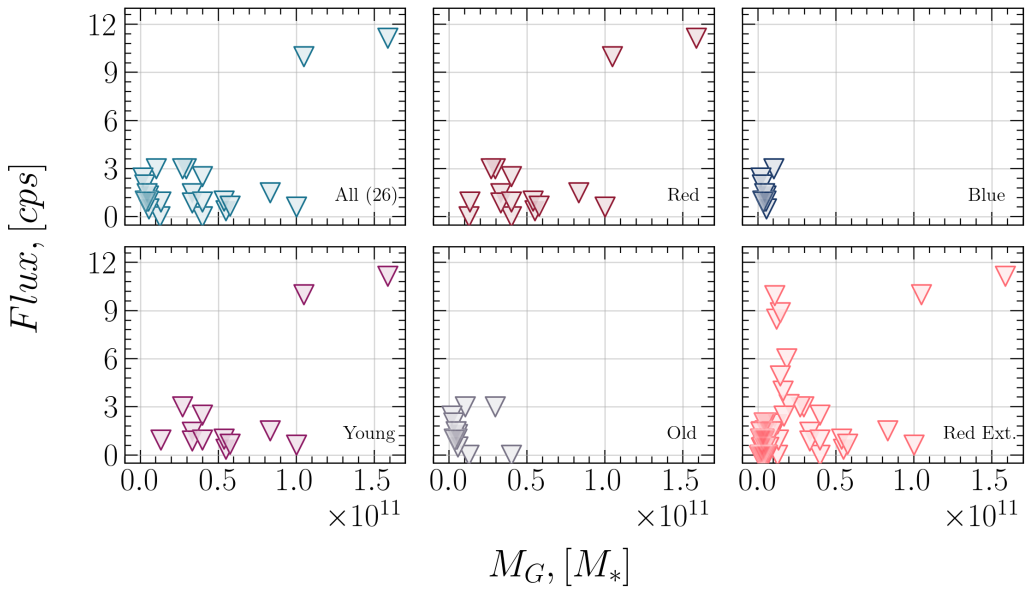

Figure 3.5: Xray flux as a function of galactic mass for all 6 sub samples

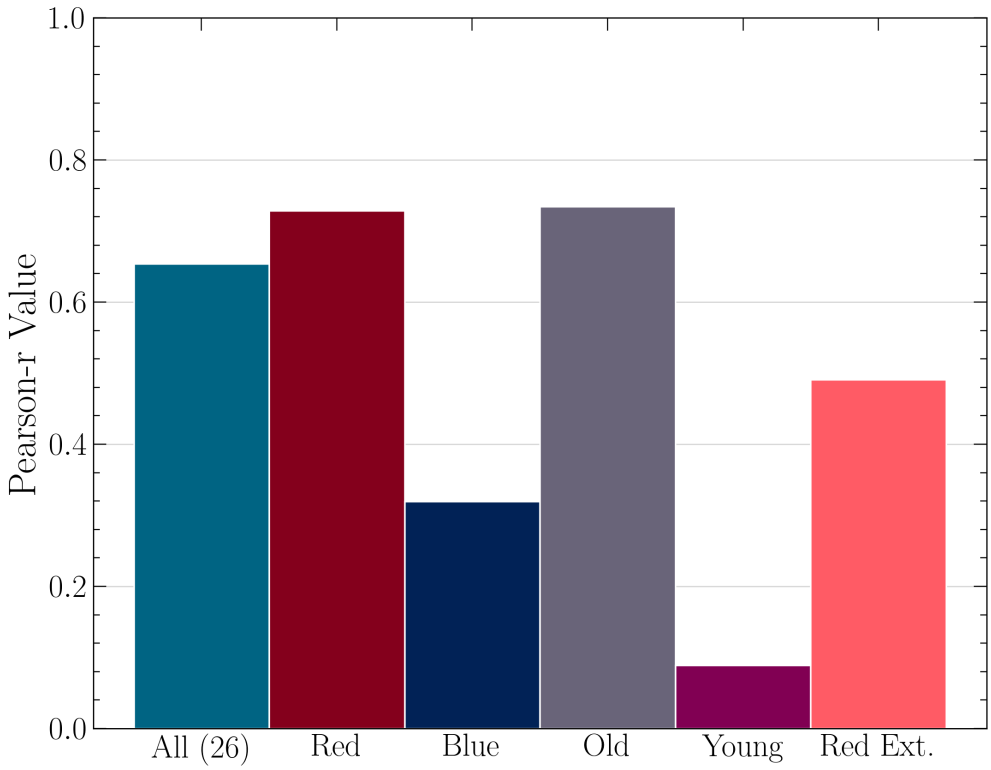

Figure 3.6: Pearson r coefficient for all 6 of the final samples.

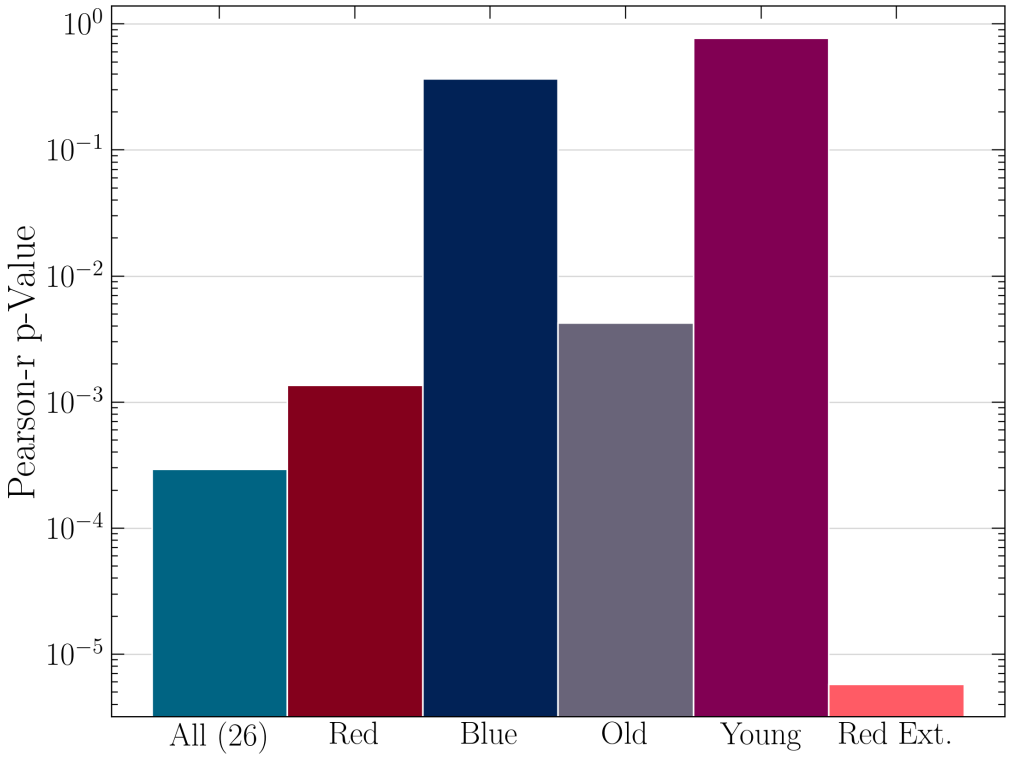

Figure 3.7: Pearson r coefficient *p-value* for all 6 of the final samples. Plotted logarithmically.

Chapter 4

Radial Correlation Techniques

All of the work from the second stage of the project.

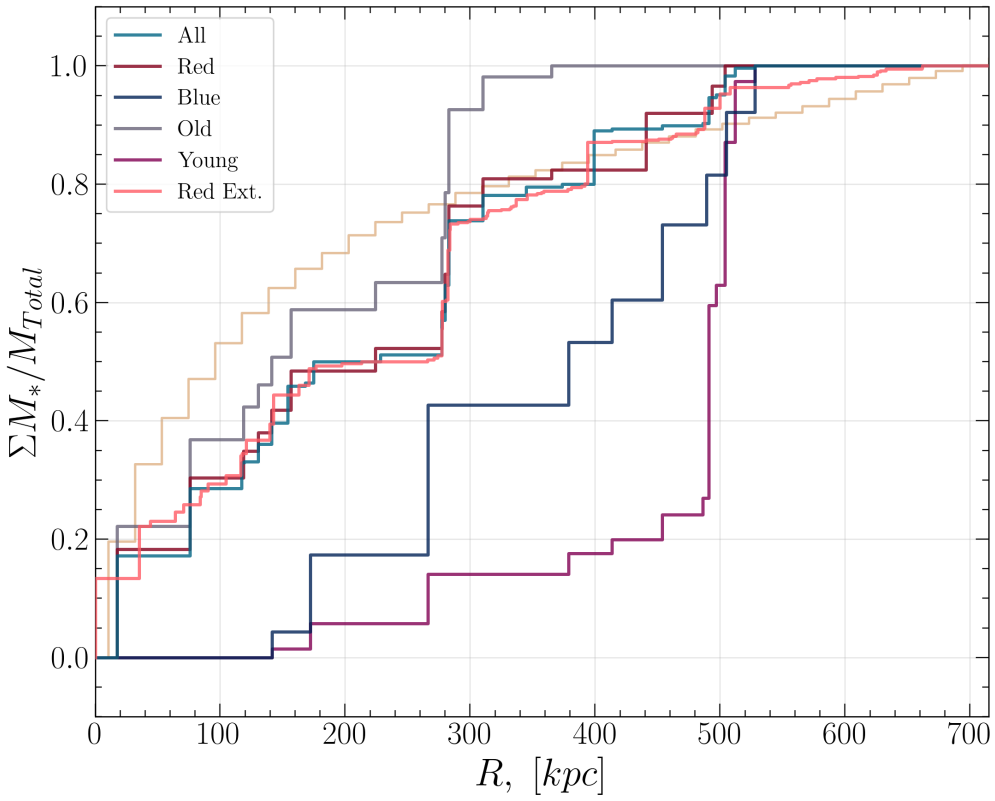

Figure 4.1: Cumulative radial mass distributions for each of the samples. Yellow is x-ray flux radial profile normalized to the red extension sample.

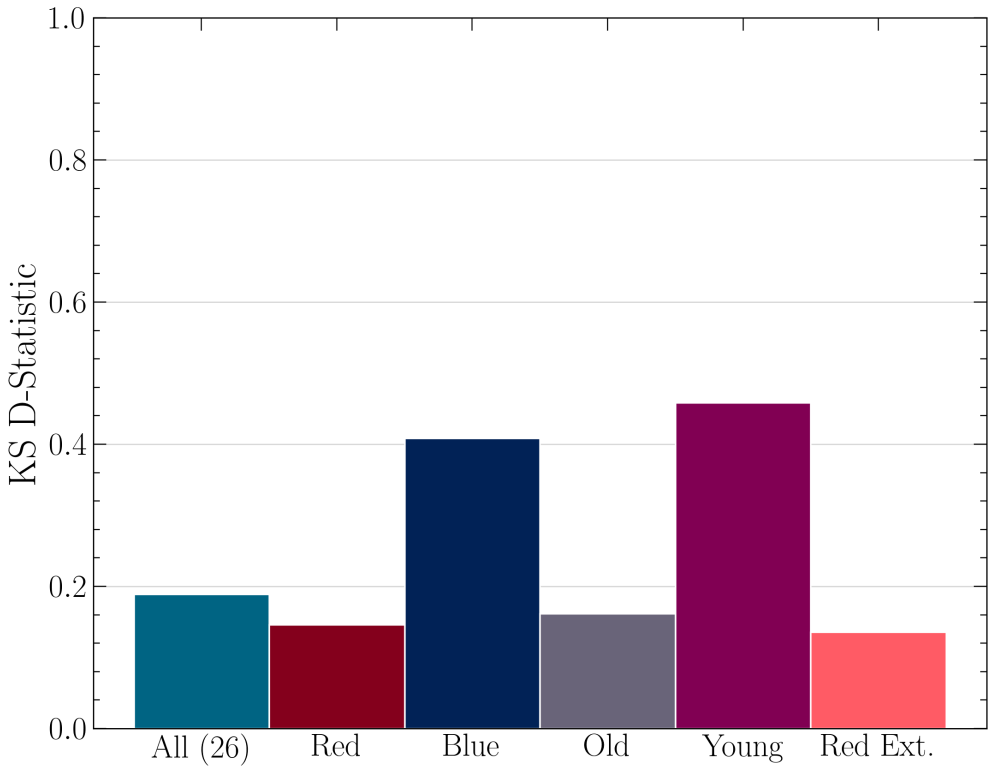

Figure 4.2: KS-Test D-statistic from the distributions in 4.1.

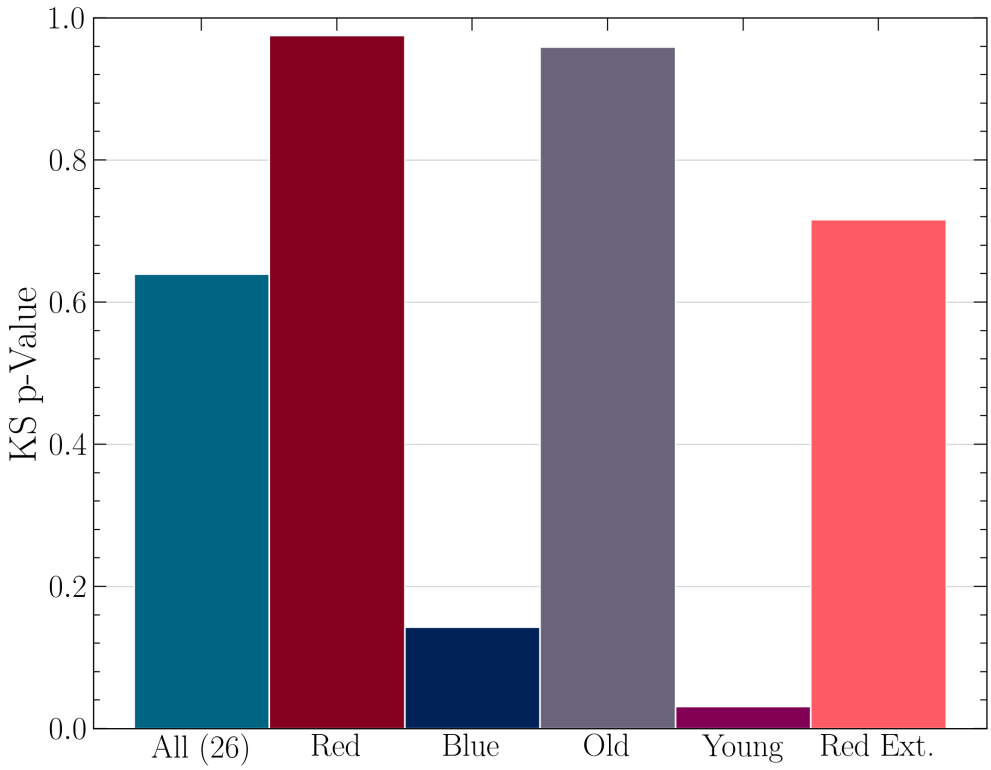

Figure 4.3: KS-Test p-value from the distributions in 4.1 corresponding to the critical values of the D-statistics from 4.3.

Chapter 5

Spatial Correlation Techniques

This is where the third part of the project will go.

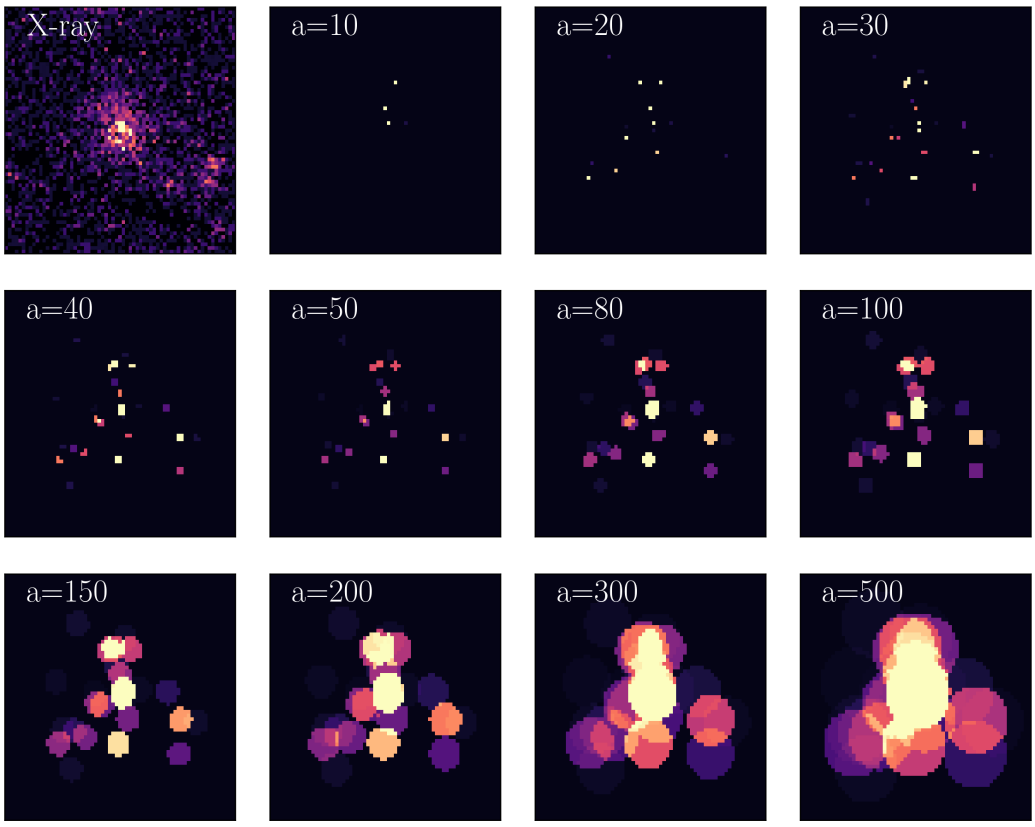

Figure 5.1: Spatial mass densities generated using a circular aperture with varying radii (in kpc). Sample shown here is the 26 member galaxies.

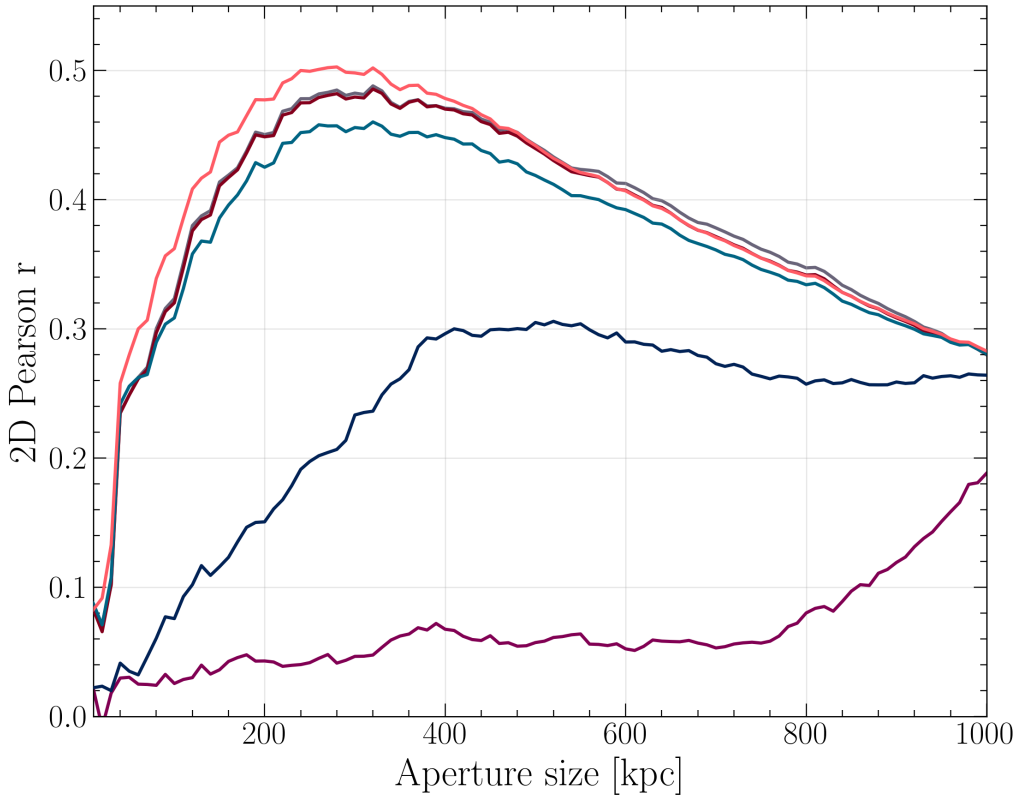

Figure 5.2: 2D Pearson r coefficient as a function of aperture size using a circular aperture with all 6 previously defined samples.

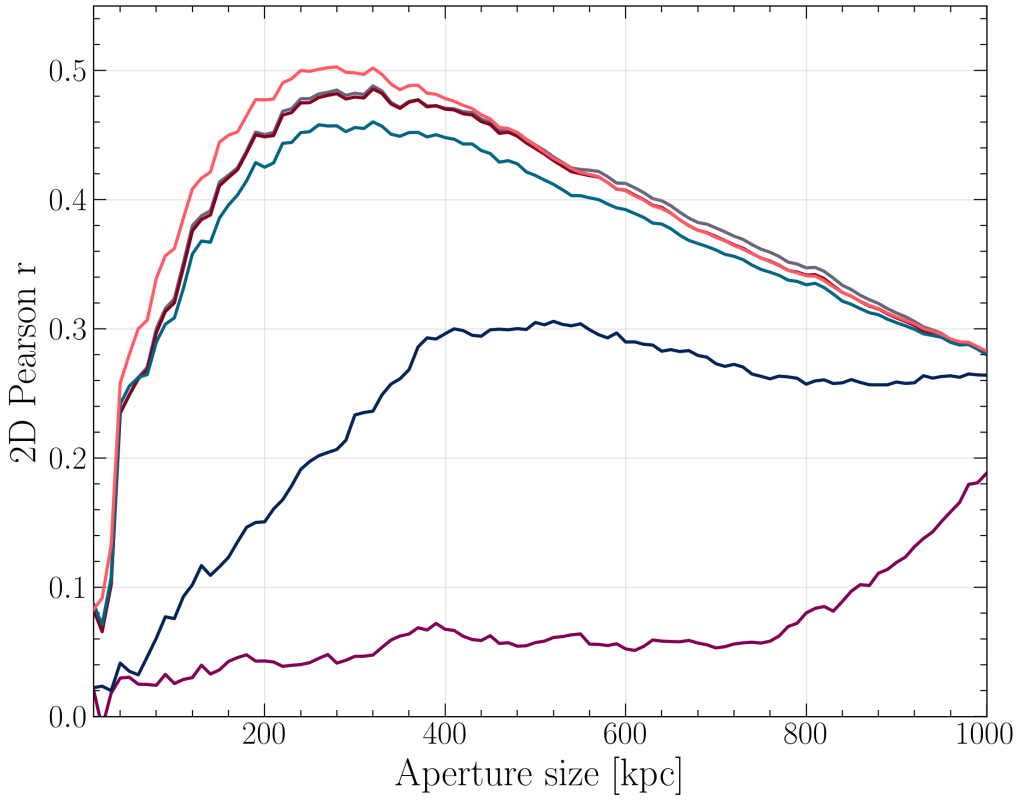

Figure 5.3: 2D Pearson r coefficient for a circular aperture of radius a=250 kpc. Corresponds to ≈ the maximum values from 5.2. Doesn't really add much here so will likely remove. For completeness it would be nice to have another 6 bar bar chart somewhere in this chapter.

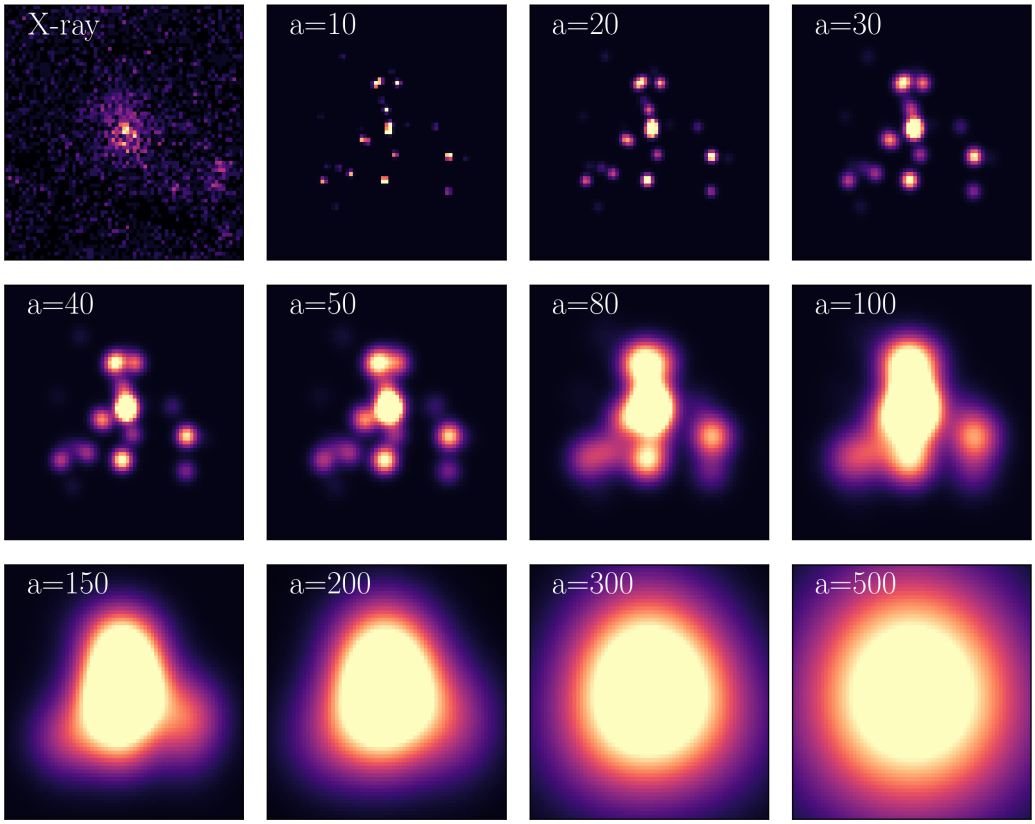

Figure 5.4: Spatial mass densities generated using a Gaussian aperture with varying a parameter (in kpc). Sample shown here is the 26 member galaxies.

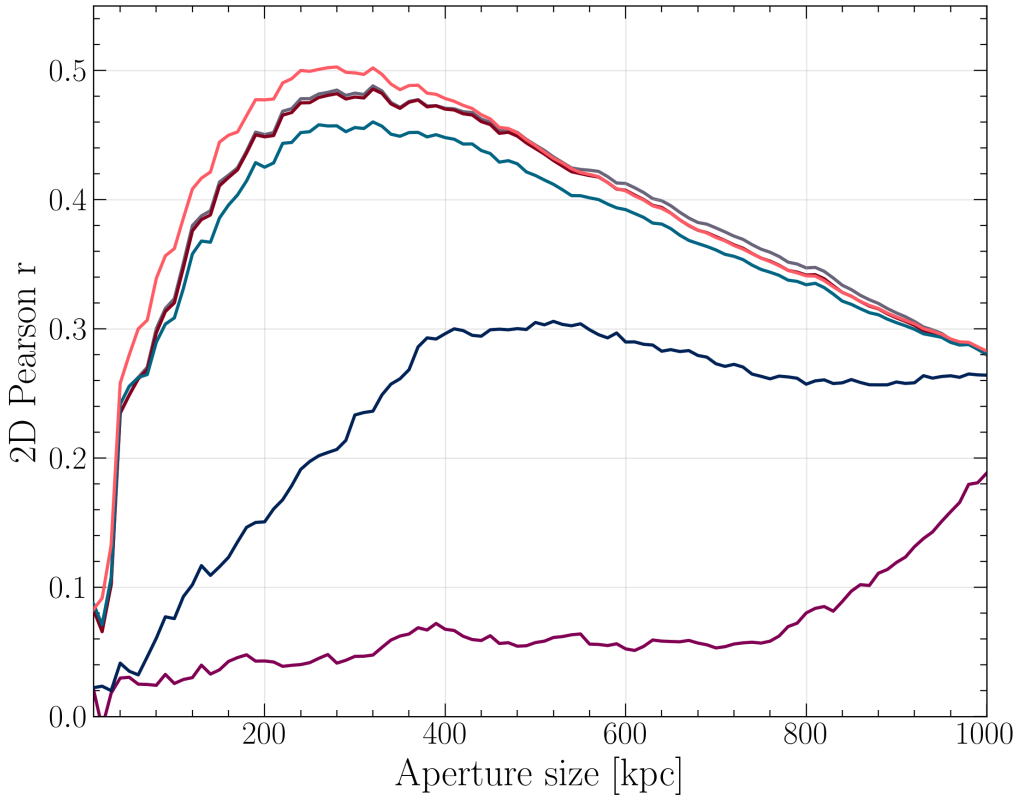

Figure 5.5: 2D Pearson r coefficient as a function of aperture size using a Gaussian aperture with all 6 previously defined samples.

Chapter 6

Analysis

This is where the big picture will hopefully become clear.

Chapter 7

Conclusions

This is where the conclusions from the work will go.

Appendix A

Additional Information

Additional info here like the data (especially the flux values from each technique). Tables, figures, etc that don't tell the narrative smoothly.

A.1 Plots to Further Understand the Spatial Densities

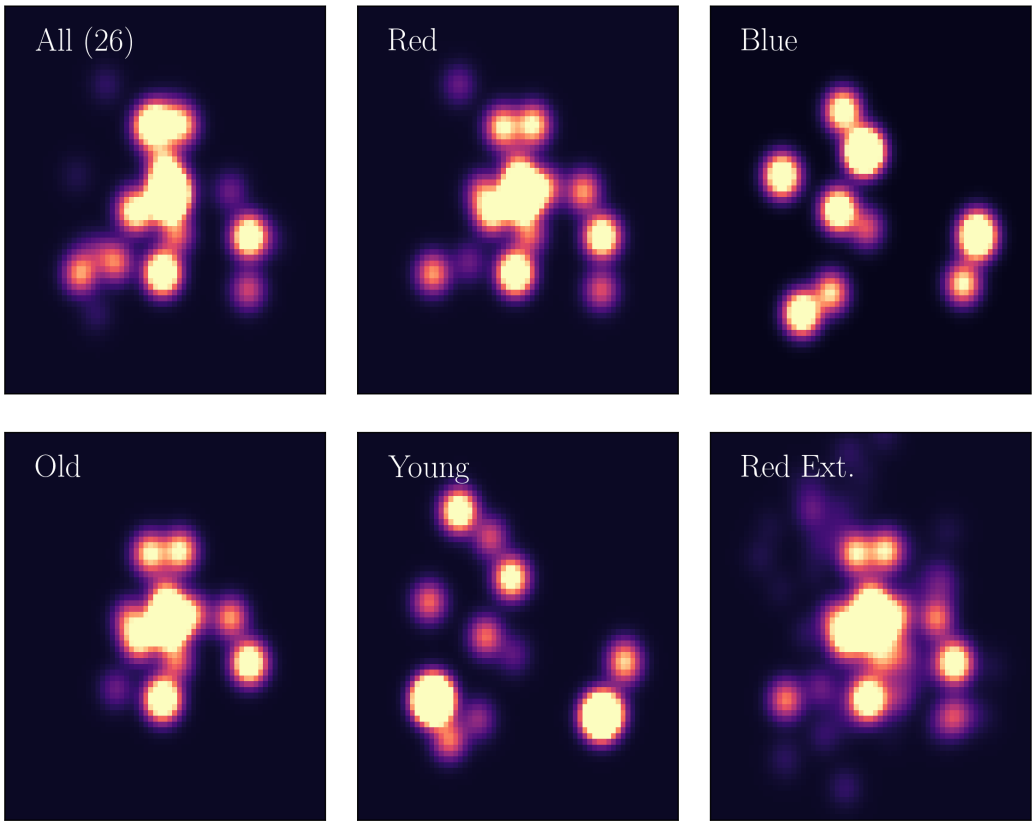

Figure A.1: Density maps for the 6 samples with a Gaussian aperture with a parameter a=50kpc.

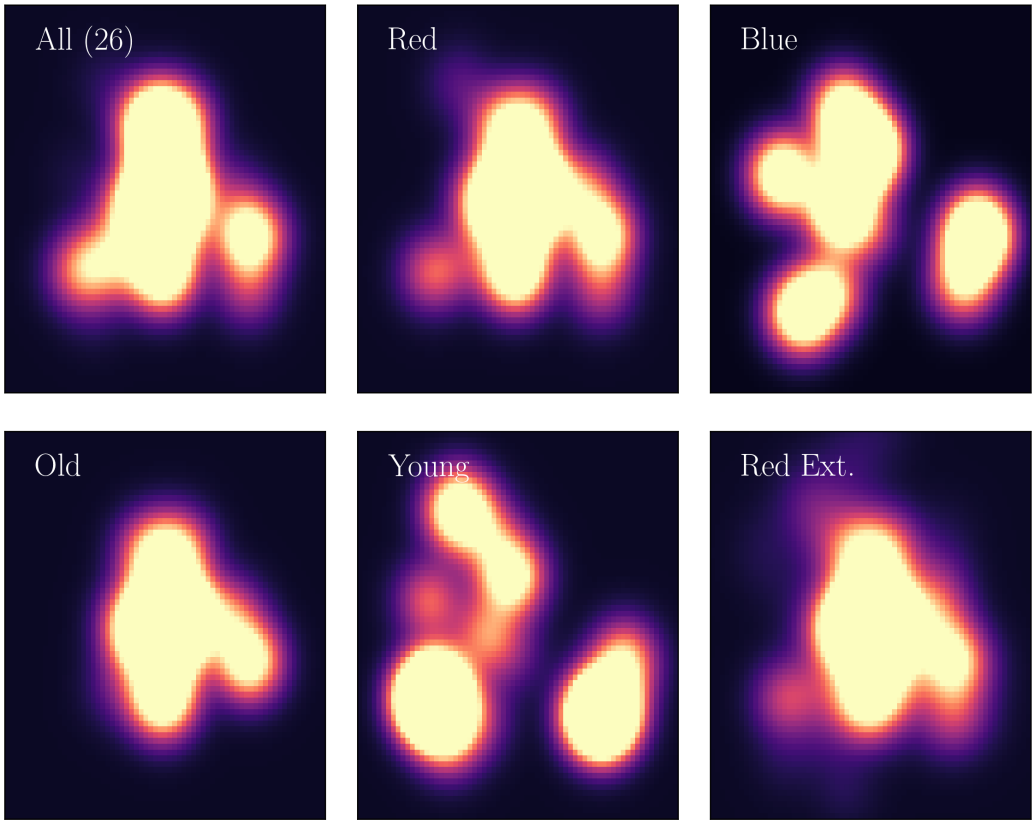

Figure A.2: Density maps for the 6 samples with a Gaussian aperture with a parameter a=100kpc.

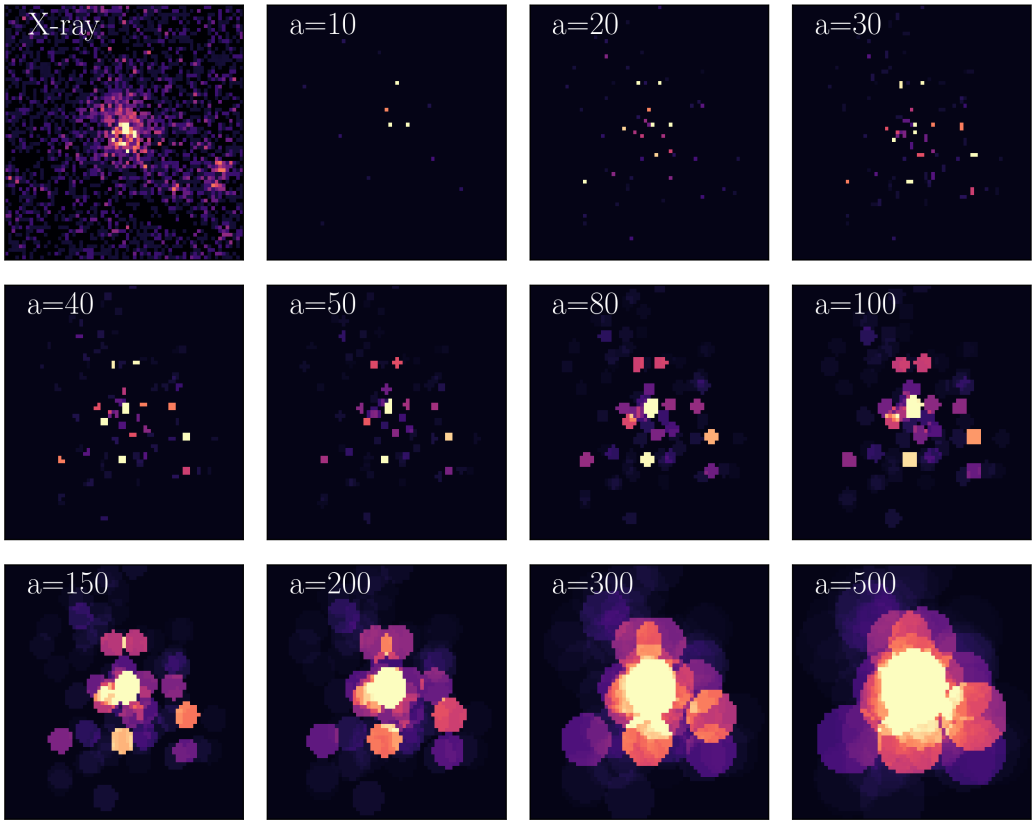

Figure A.3: Spatial mass densities generated using a circular aperture with varying radii (in kpc). Sample shown here is the red extended sample.

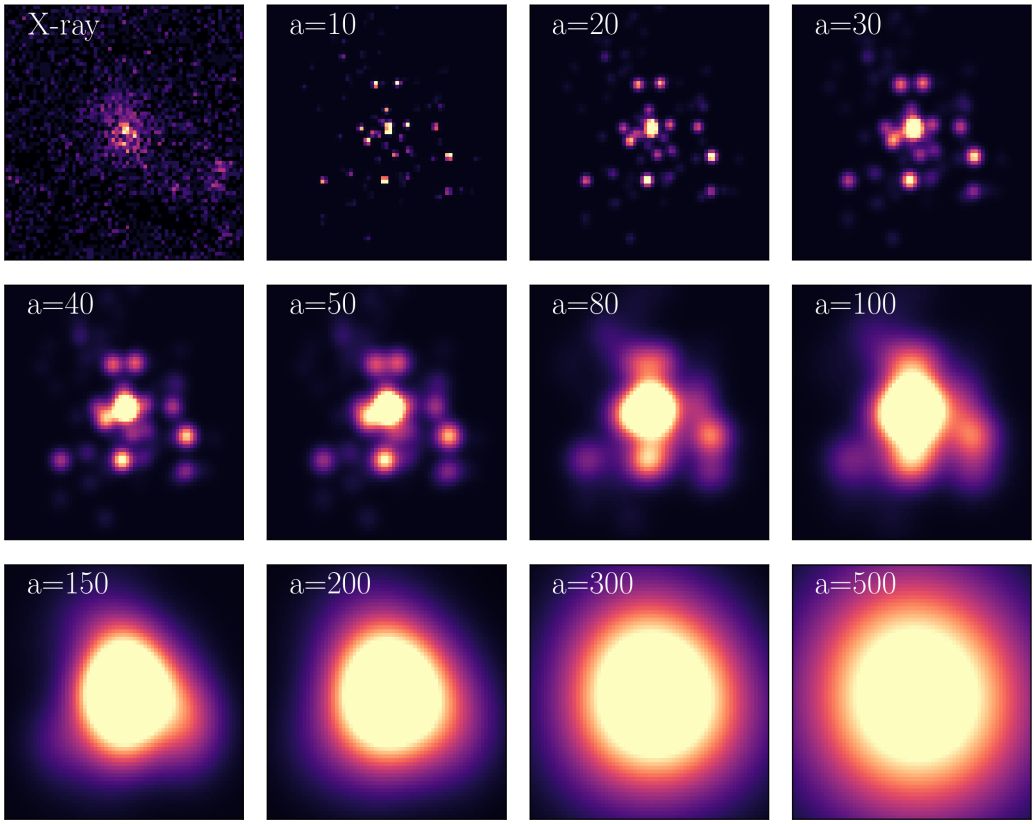

Figure A.4: Spatial mass densities generated using a Gaussian aperture with varying radii (in kpc). Sample shown here is the red extended sample.

A.2 Images that Didn't Make it in

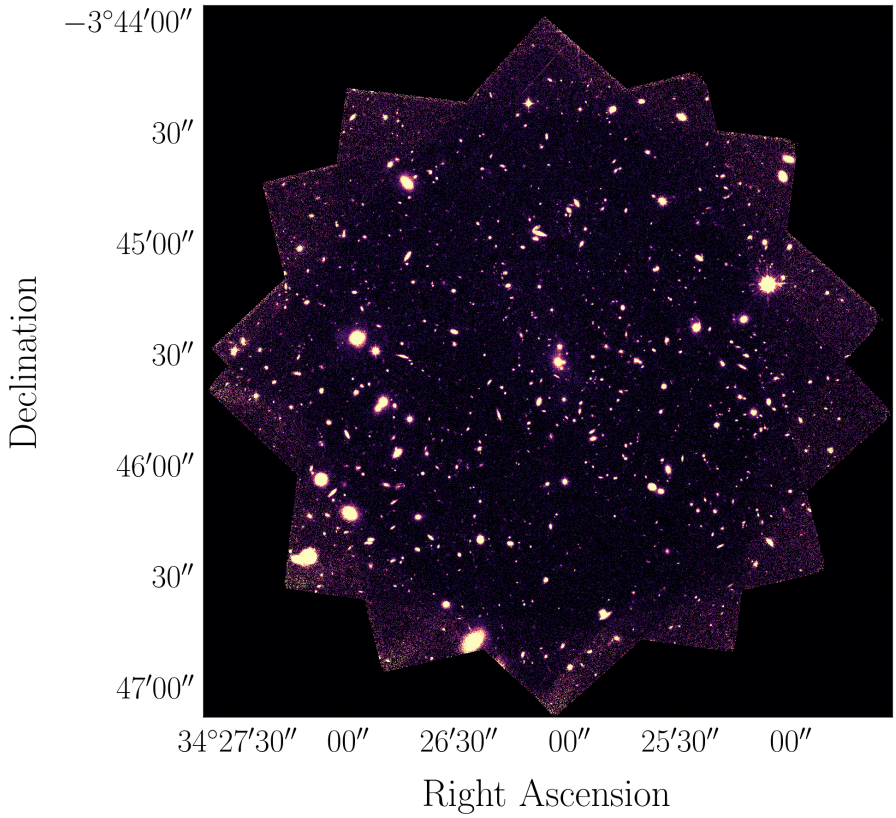

Figure A.5: Image of the Cluster

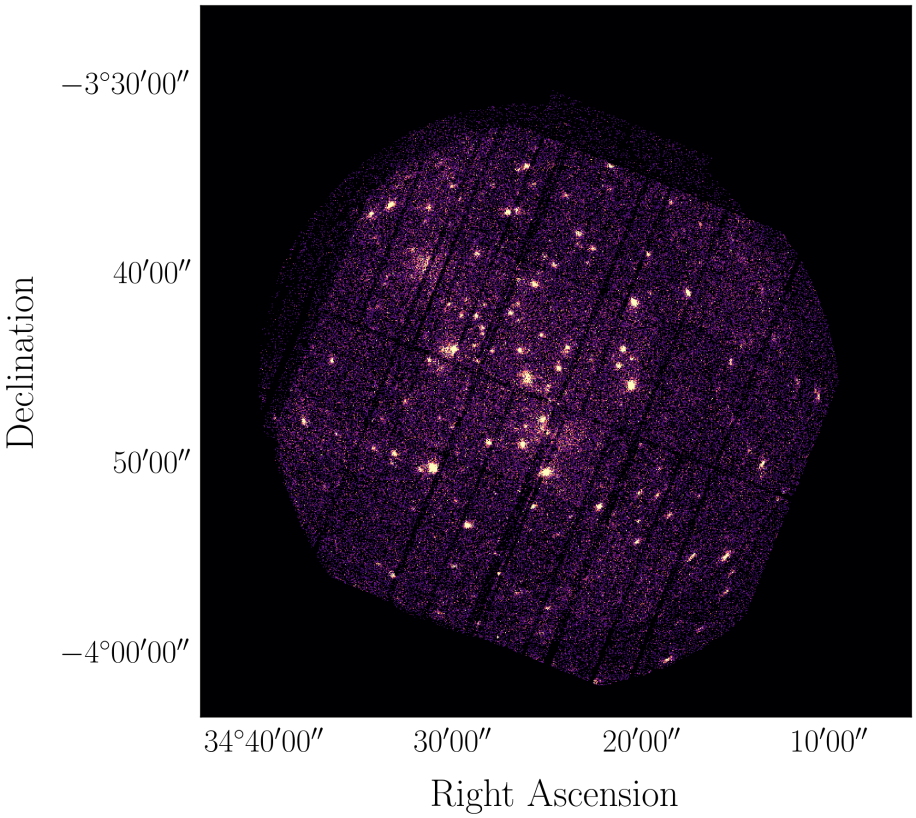

Figure A.6: Xray Image of the Cluster and Surrounding Region

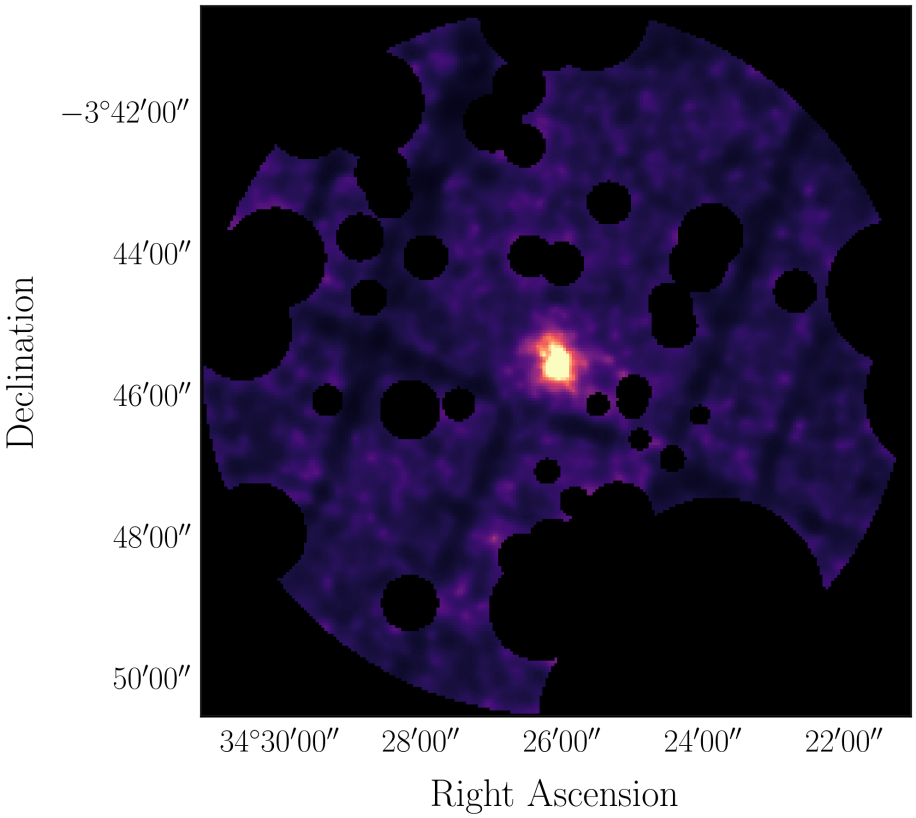

Figure A.7: Smoothed Xray Image of the Cluster and Surrounding Region

Bibliography