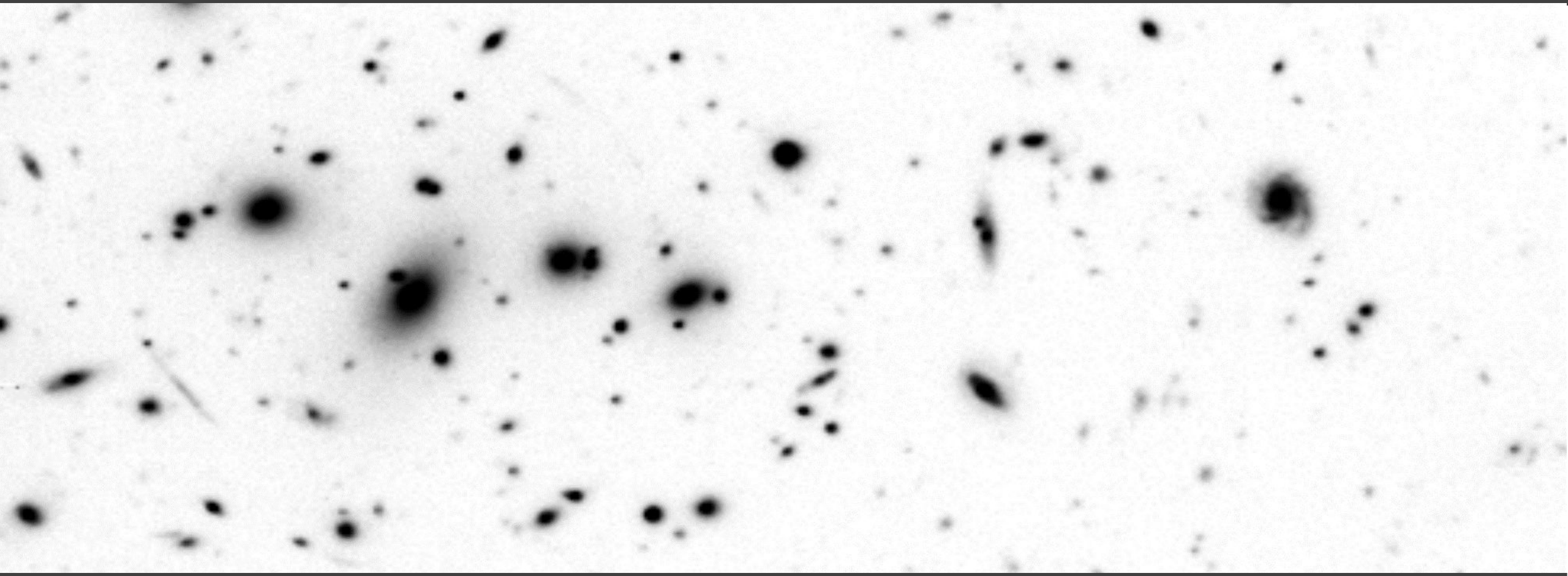
The Discovery and Properties of a Newly Discovered Compact Lensing Cluster CLIO at z = 0.42: A unique JWST target



Alex Griffiths
University of Nottingham

Introduction

The CLIO cluster will be a target for the 110 hour JWST ‘Webb Medium-Deep field’ GTO program. This talk will discus;

- Target selection
- Follow up observations
- Spectral analysis
- Cluster properties
- Intracluster light
- Initial Lensing models

Target Selection

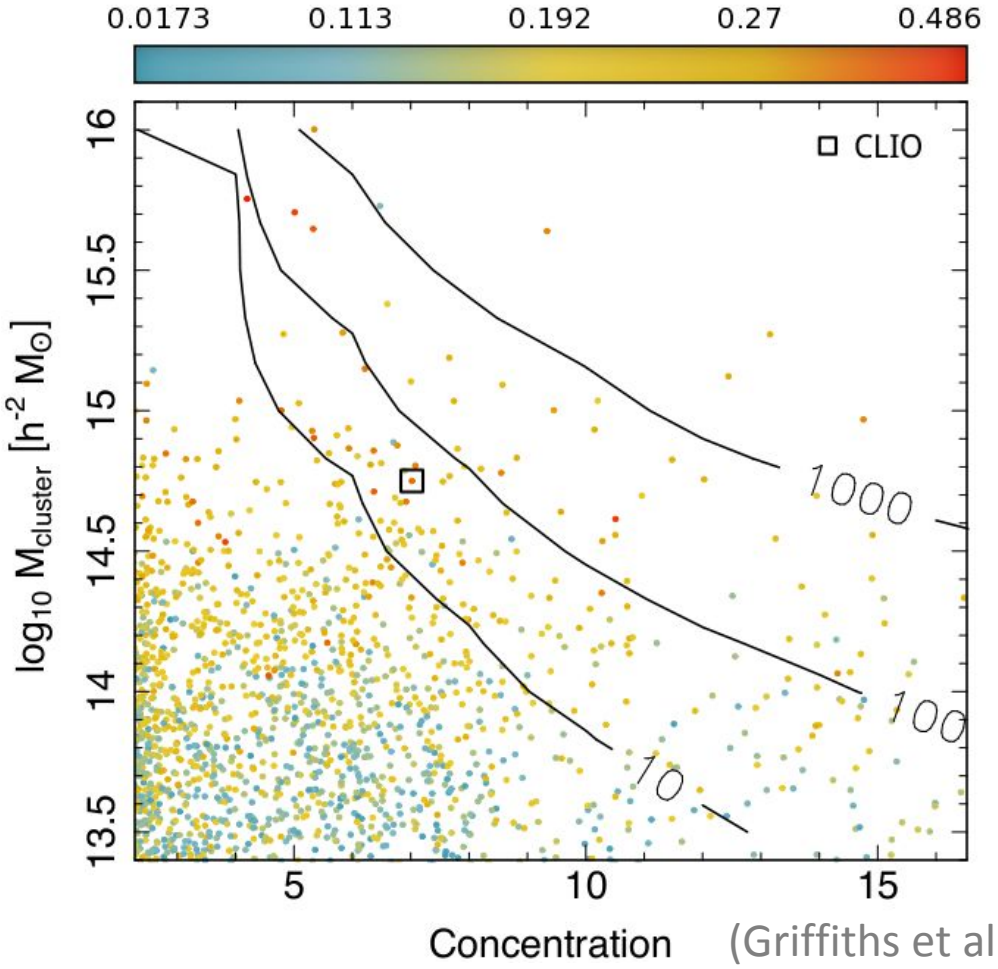
Webb Medium-Deep Field (WMDF) GTO program

Initial selection from the GAMA Galaxy Group Catalogue (G^3C v8)

Combination of high mass and concentration

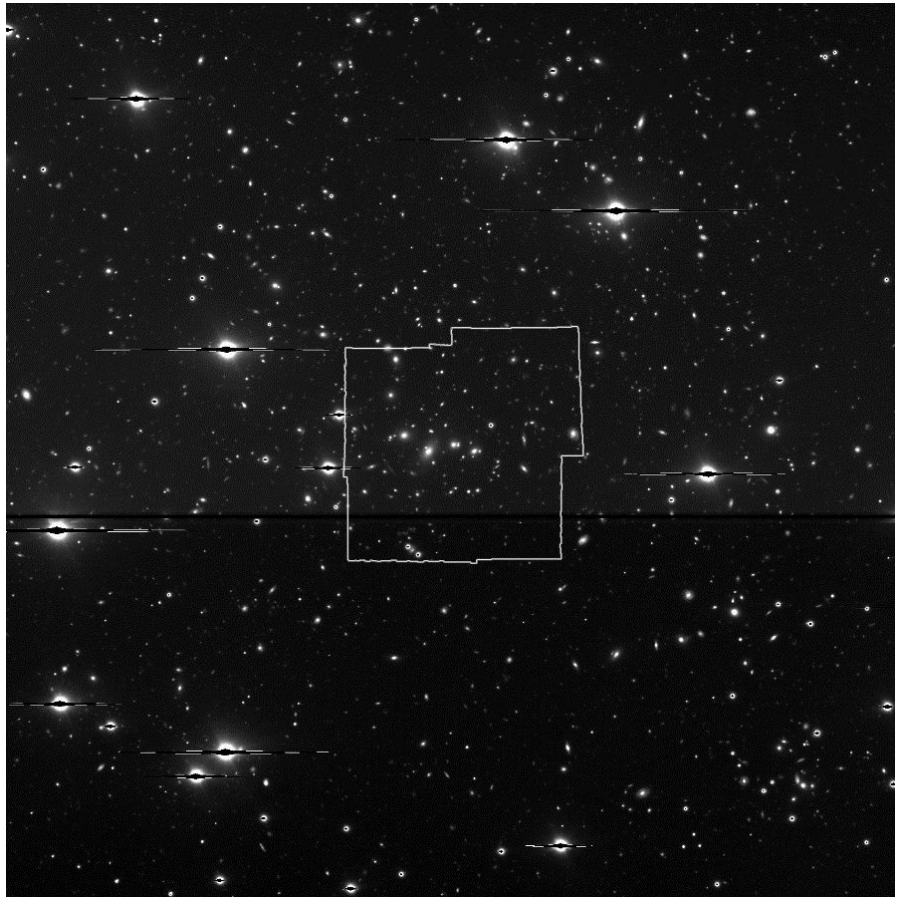
Lensing arcs detected in ground based imaging

- $M = 5.62 \times 10^{14}\ M_{\odot}$
- Concentration: 6.3
- z = 0.42



(Griffiths et al. 2018)

Observations



ESO/VLT FORS2 G and R Band

4.25 x 4.25 arcmin

10 x 600s and 12 x 580s exposures

ESO/VLT MUSE Integral Field Spectroscopy

1.8 x 1.8 arcmin

14 x 900s exposure

IRAC Channel 1 and 2 (3.6 and 4.5 µm)

5.2 x 5.2 arcmin

120 x 100s exposure

Spectral Analysis:
Object Detection

MUSE Line Emission Tracker (MUSELET)

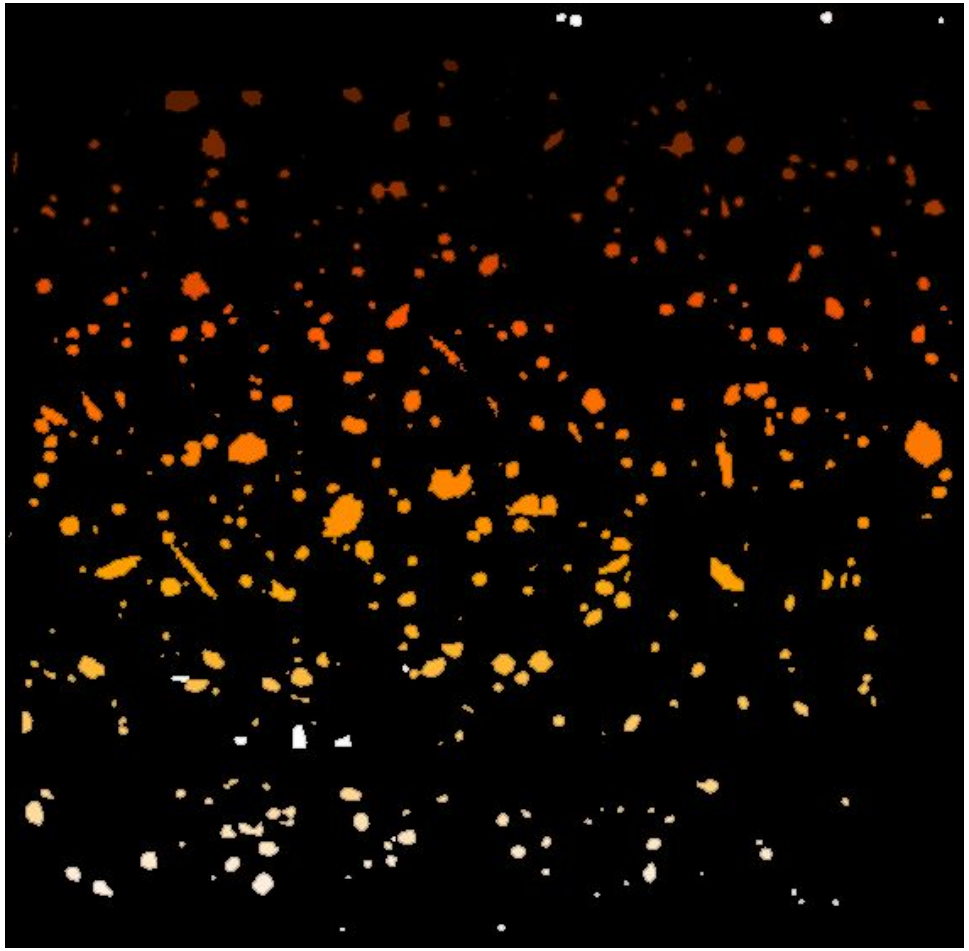
105 Emission line Sources

44 redshifts

Manual Extraction

Object detection via SExtractor in FORS2 R band image (406 objects total)

Extract 1D weighted spectra from MUSE datacube



Spectral Analysis:
Manual and Automatic Redshifting Software (MARZ)

Customised with high redshift spectral templates from:

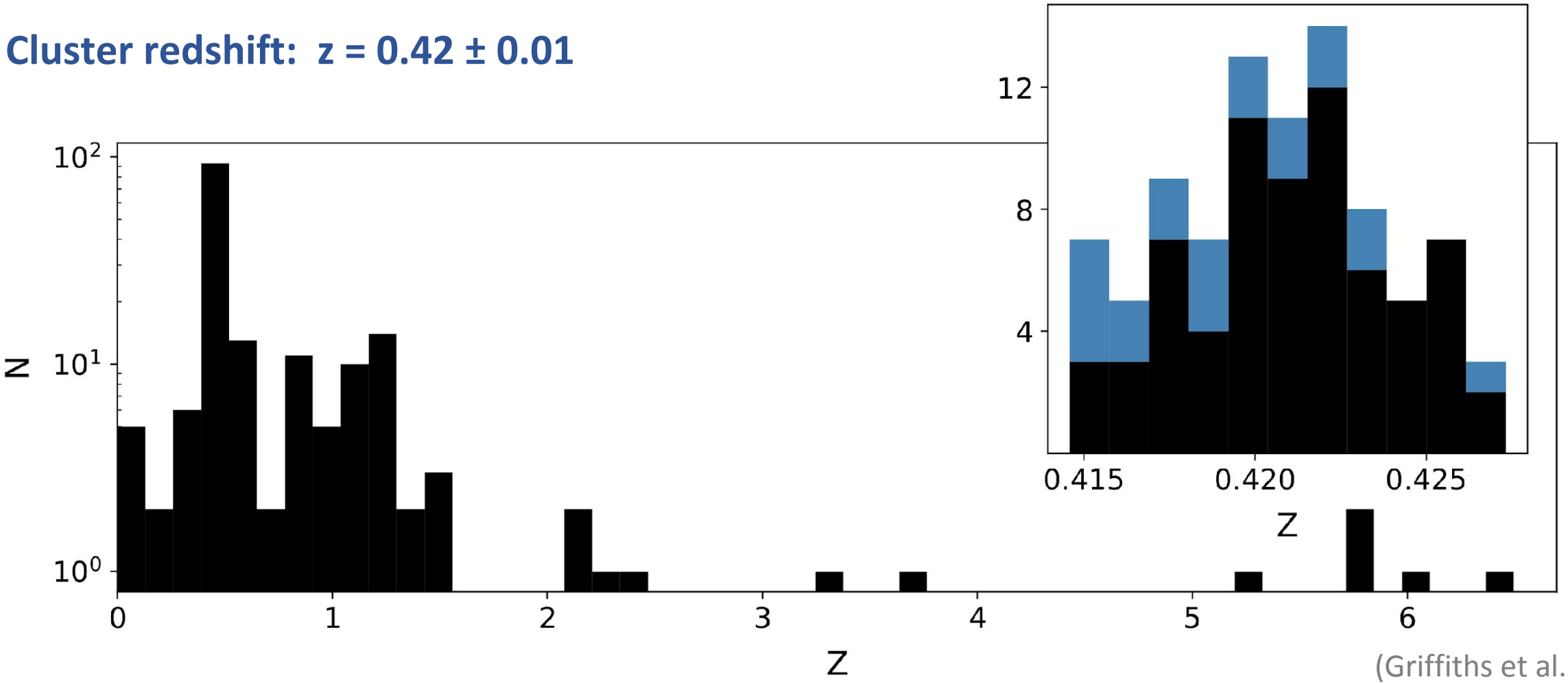
- zCosmos (Lilly et al. 2009)
- VIMOS-VLT Deep Survey (VVDS; Le Fevre et al. 2013)
- UDSz (ESO Large Programme 180.A-0776, PI: Almaini, Bradshaw et al. 2013; McLure et al. 2013, private communication)

Each automatic fit checked and compared to MUSELET Results

(Hinton et al. 2016)

Spectral Analysis:
Cluster Membership

Cluster redshift: z = 0.42 ± 0.01



(Griffiths et al. 2018)

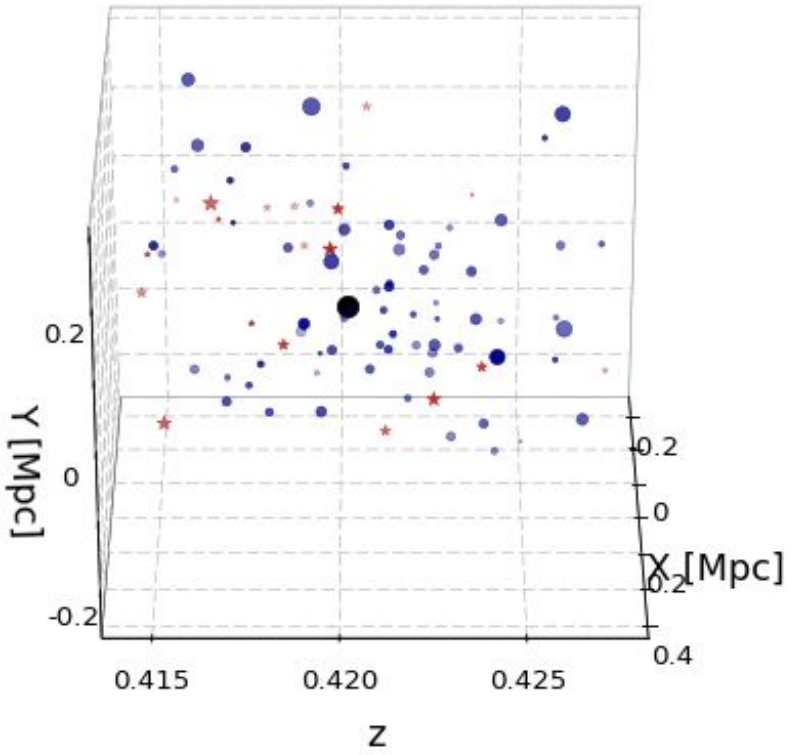
Spectral Analysis:
Results

184 Spectroscopic Redshifts:

- 7 Stars
- 13 foreground galaxies
- 89 cluster members
- 75 background galaxies (out to z = 6.49)

Additional Cluster Members

- Colour-Colour Selection
- 1σ of cluster members
- HSC photometric redshift (Tanaka et al. 2017)
- 198 candidates within 1 Mpc of cluster centre



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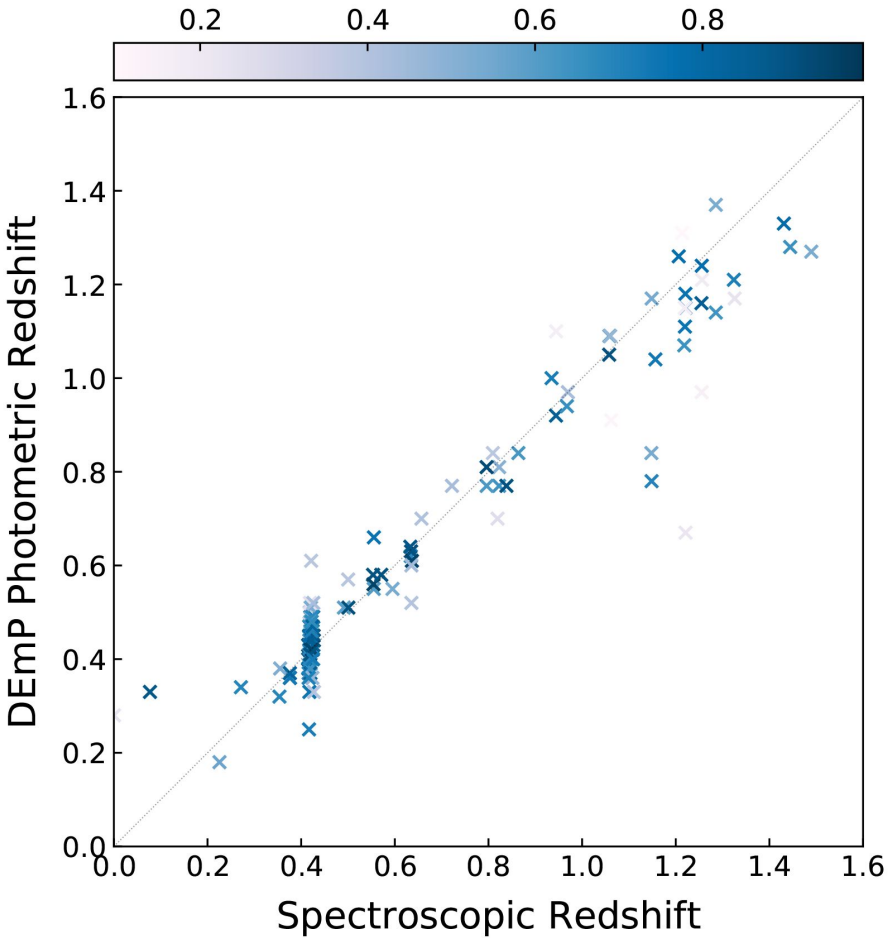


(Griffiths et al. 2018)

Cluster Properties

Using observations we update the cluster properties and measure the luminosity function

Velocity Dispersion:

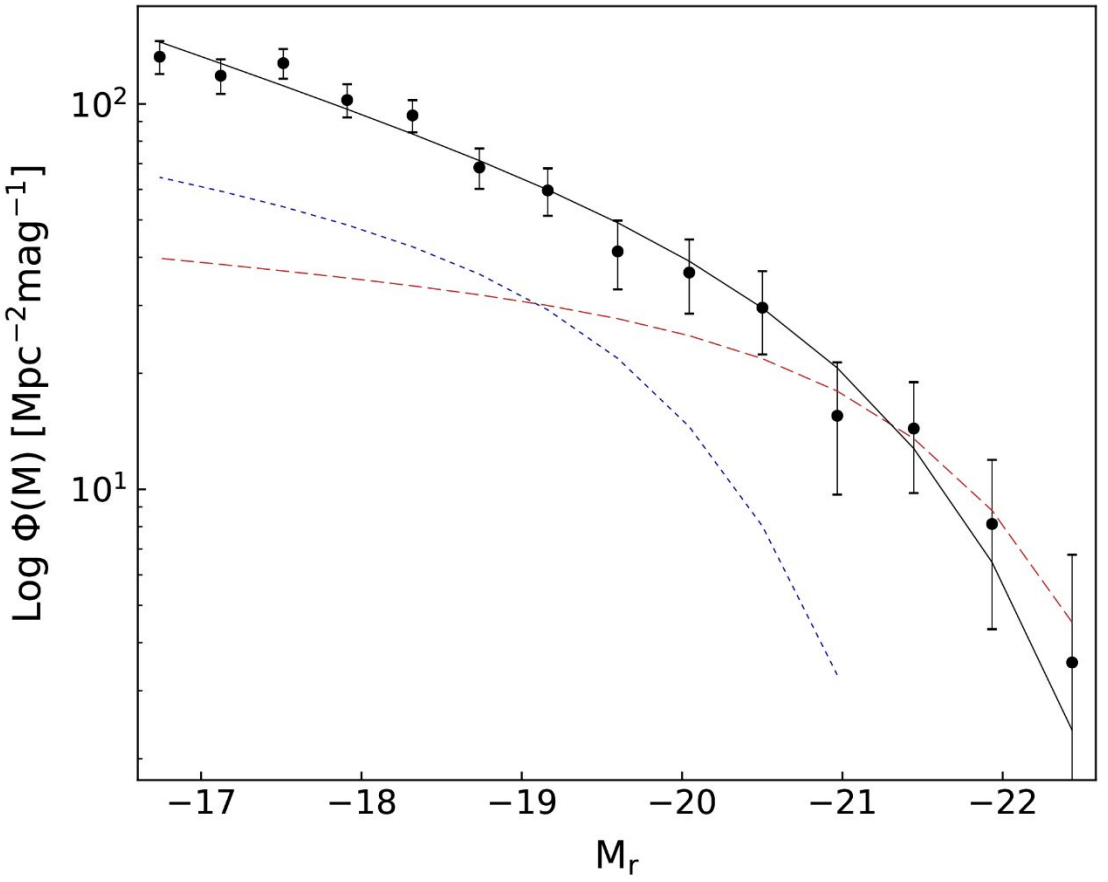
$\sigma = 633 \rightarrow (619 \pm 11)$ km s^{-1}

Concentration:

$C = 6.63 \rightarrow 7.61 \pm 0.43$

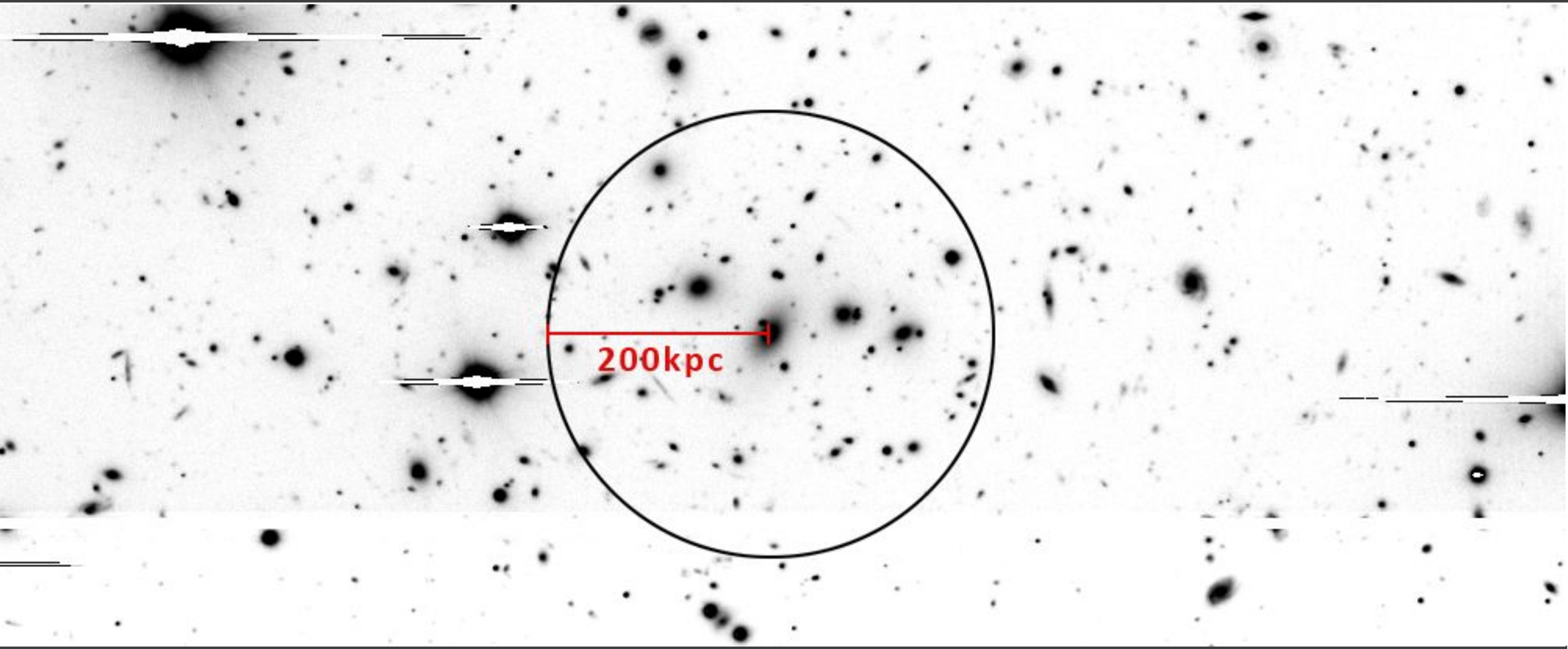
Mass:

$M_{200} = 5.16 \rightarrow (4.49 \pm 0.25) \times 10^{14} M_{\odot}$



(Griffiths et al. 2018)

Intracluster Light (ICL)



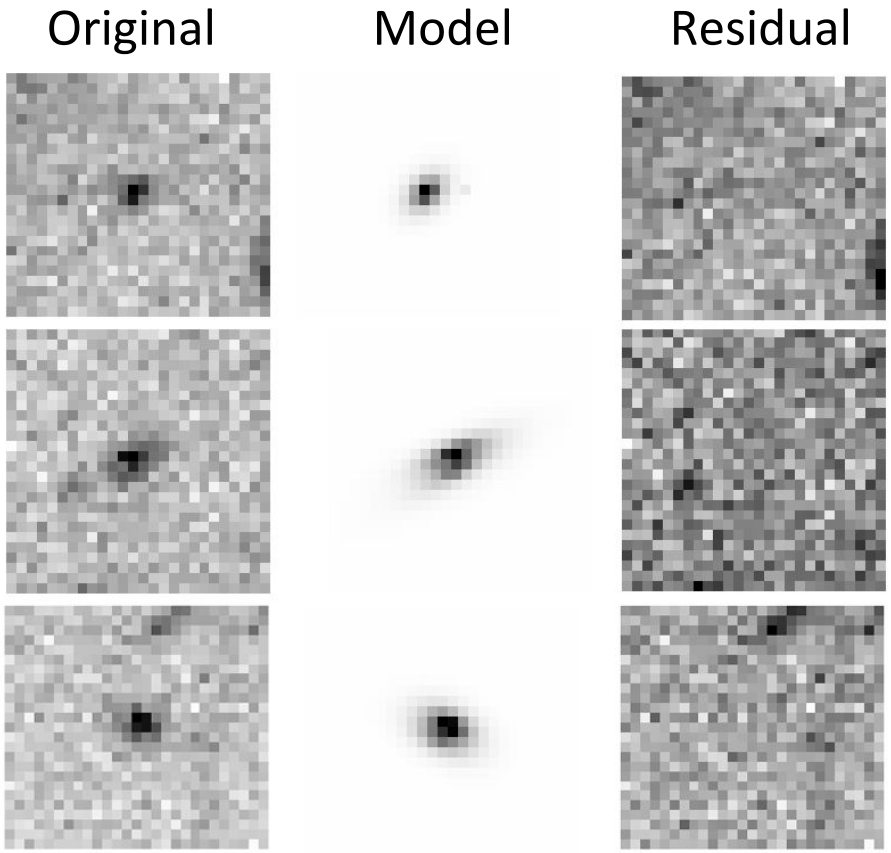
Intracluster Light (ICL):
Modelling

Initially mask stars and other sources of noise

Use SExtractor values of; x, y, R_e, PA and b/a as initial estimates

Work on postage stamp images using a combination of single, or multiple Sersic profiles and constant background

Create composite model from all sources to mask the full image



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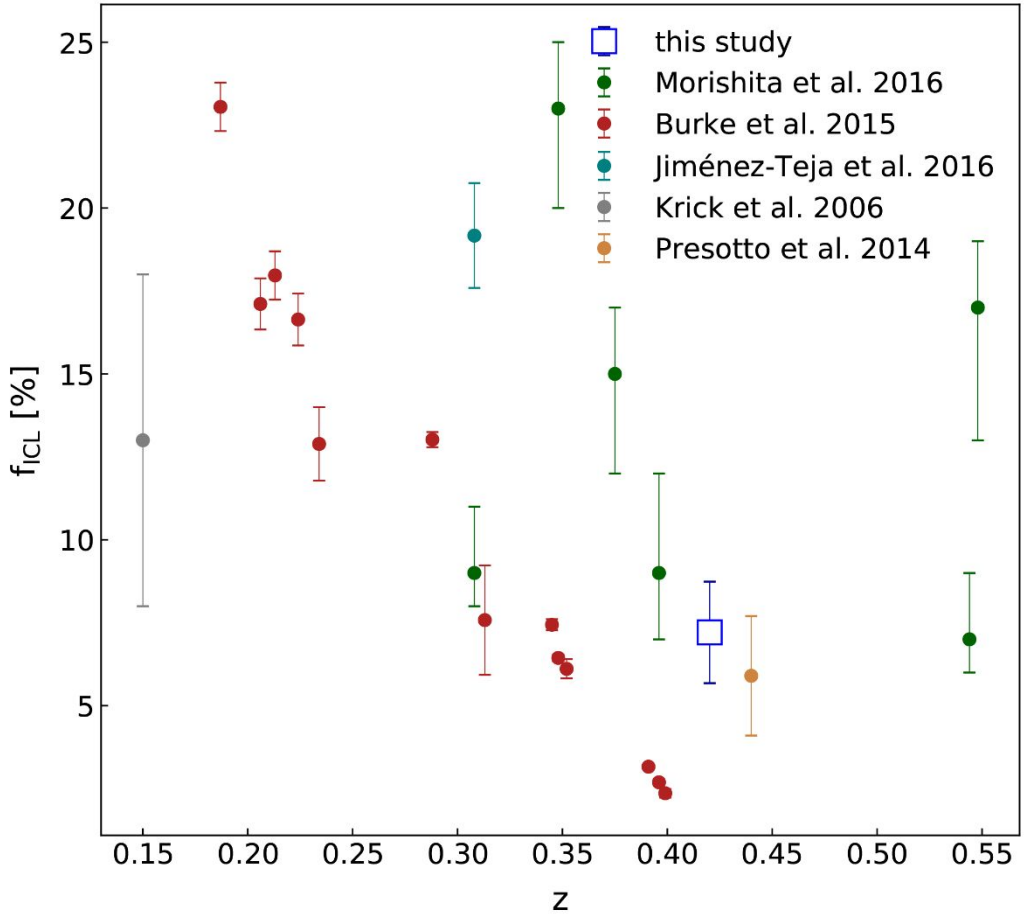
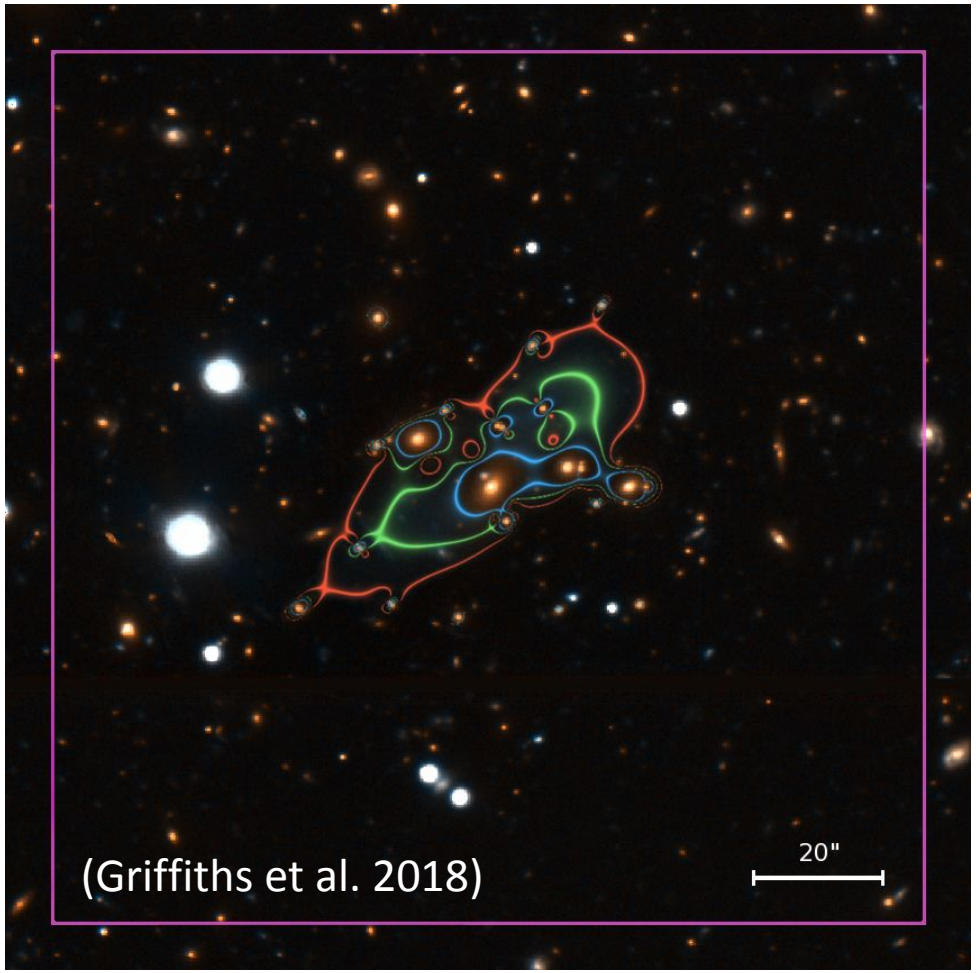


(Griffiths et al. 2018)

Lensing:
Modelling

- 14 potential multiple-image groups consisting of a total of 43 individual images. Non reliable enough to be used as constraints
- Models based on cluster member locations and lensing arcs
- Initial model using automated Light-Traces-Mass method (LTM; Zitrin et al. 2012)
- Complimentary modelling with Weak & Strong Lensing Analysis Package (WSLAP+; Diego et al. 2005, 2016)



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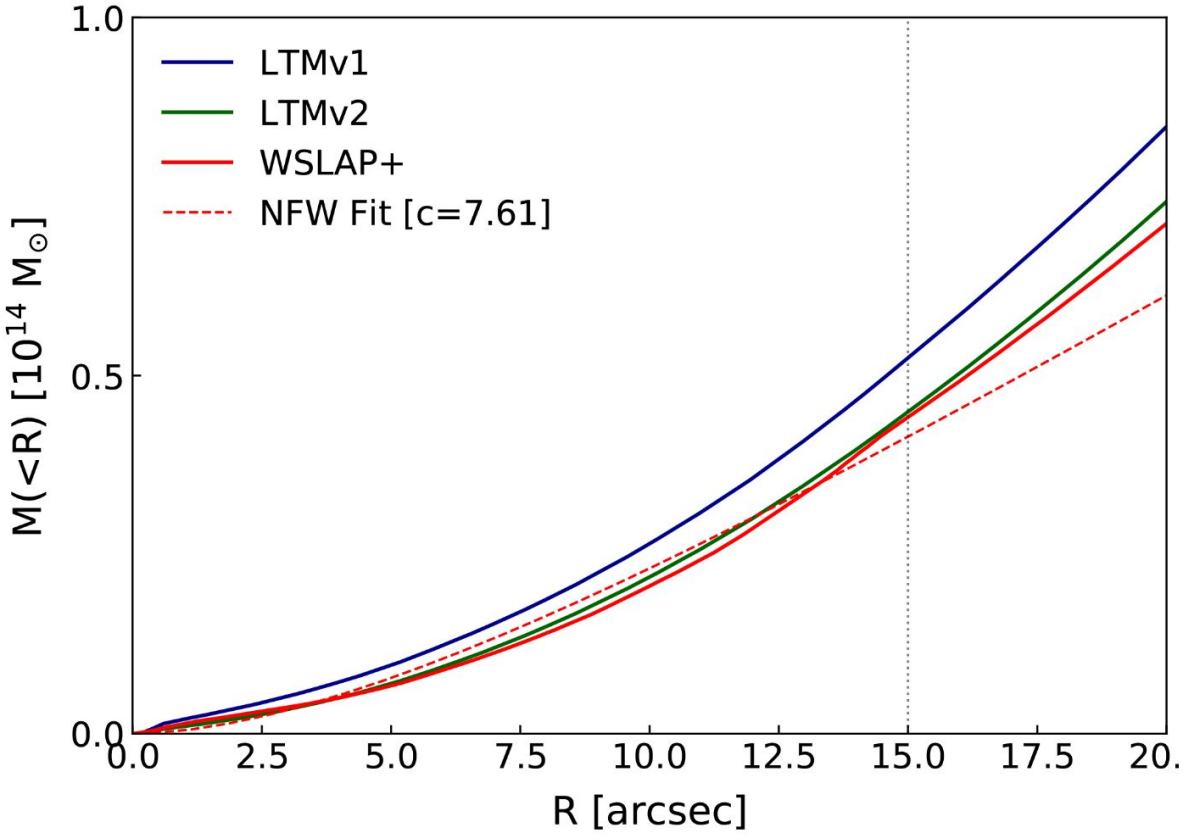

(Griffiths et al. 2018)

Summary

- Through spectral analysis of the MUSE datacube we find 184 spectroscopic redshifts with 89 cluster members and 75 background galaxies out to z = 6.49
- Find an initial mass estimate of $(4.49 \pm 0.25) \times 10^{14} M_{\odot}$
- More robust measure of cluster concentration at 7.61 ± 0.43
- Galaxy profile fitting provides an ICL Fraction $7.21 \pm 1.53\%$
- Need more data to further constrain lensing models
- The clusters high concentration and low ICL fraction makes it an interesting target for the JWST WMDF GTO program

Acknowledgement

PhD Supervisor

Christopher J. Conselice

Co-Authors / Collaborators

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Science & Technology Facilities Council

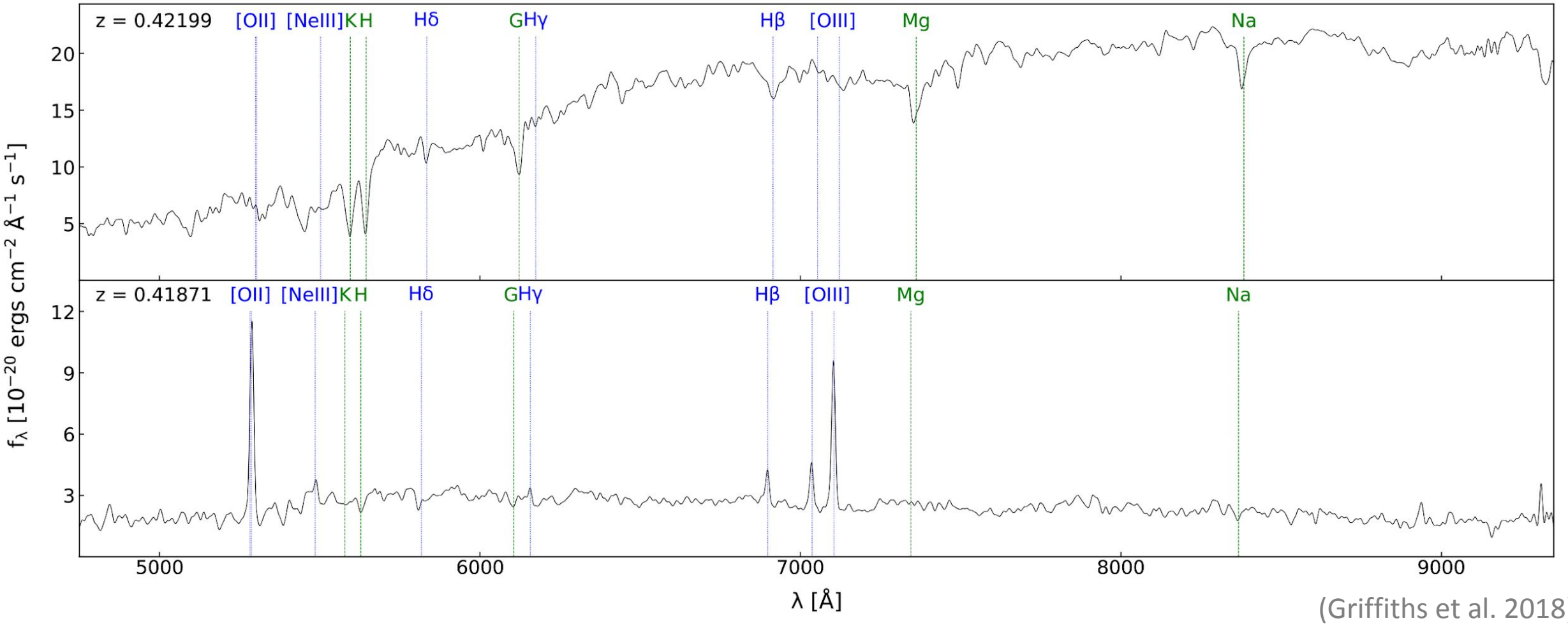
University of Nottingham
UK | CHINA | MALAYSIA

Questions

Any Questions?

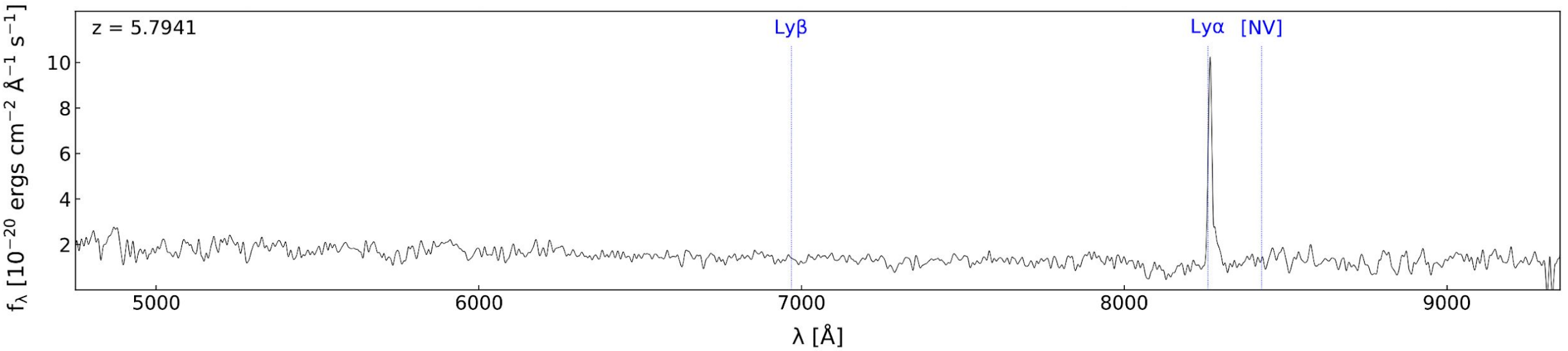
arXiv:1801.01140
2018MNRAS.475.2853G

Spectral Analysis:
Typical Cluster Member Example Spectra



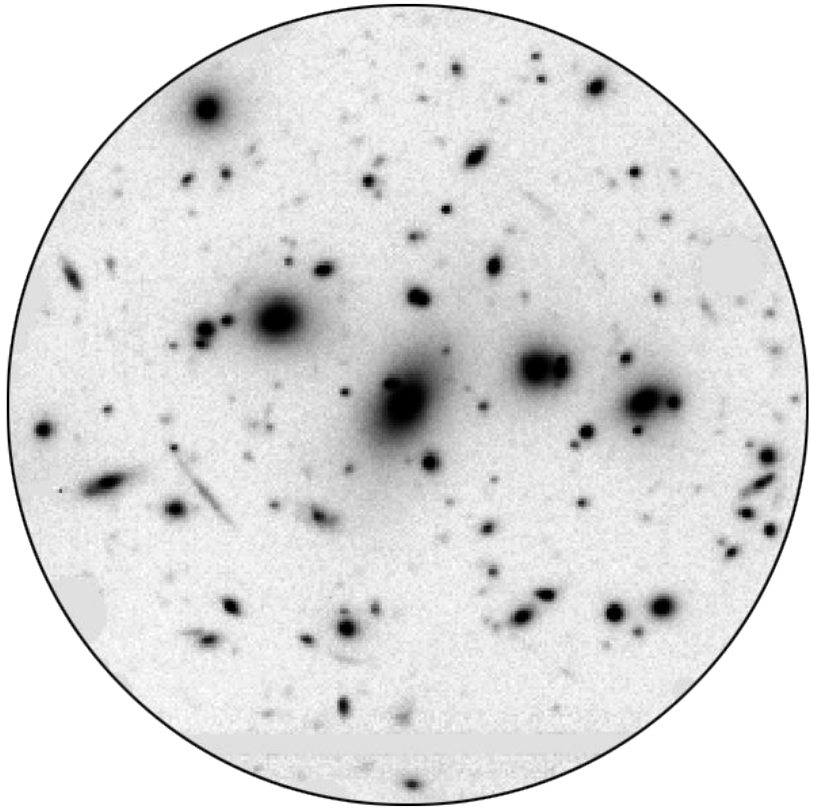
(Griffiths et al. 2018)

Spectral Analysis:
High Redshift Example Spectra

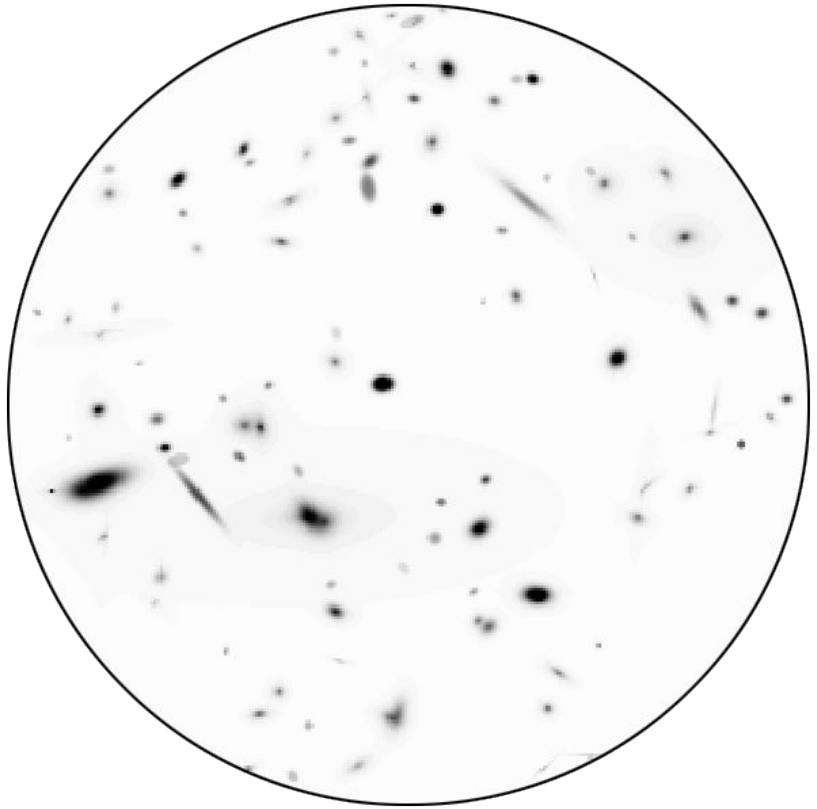


(Griffiths et al. 2018)

Intracluster Light (ICL):
Modelling

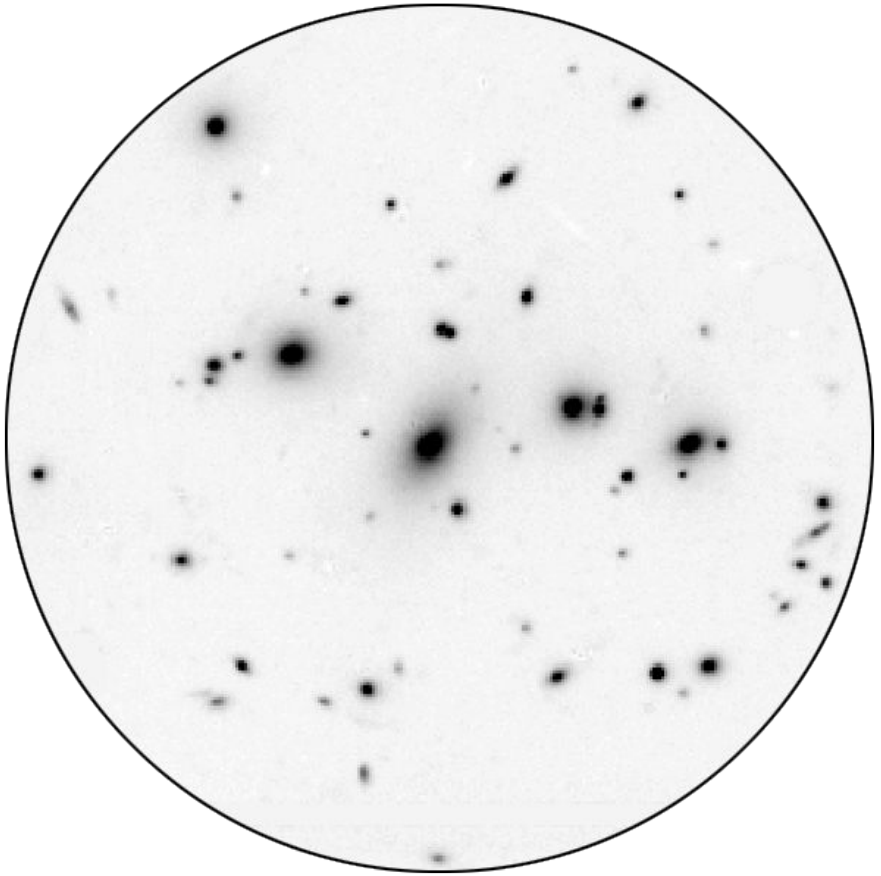


R Band Image



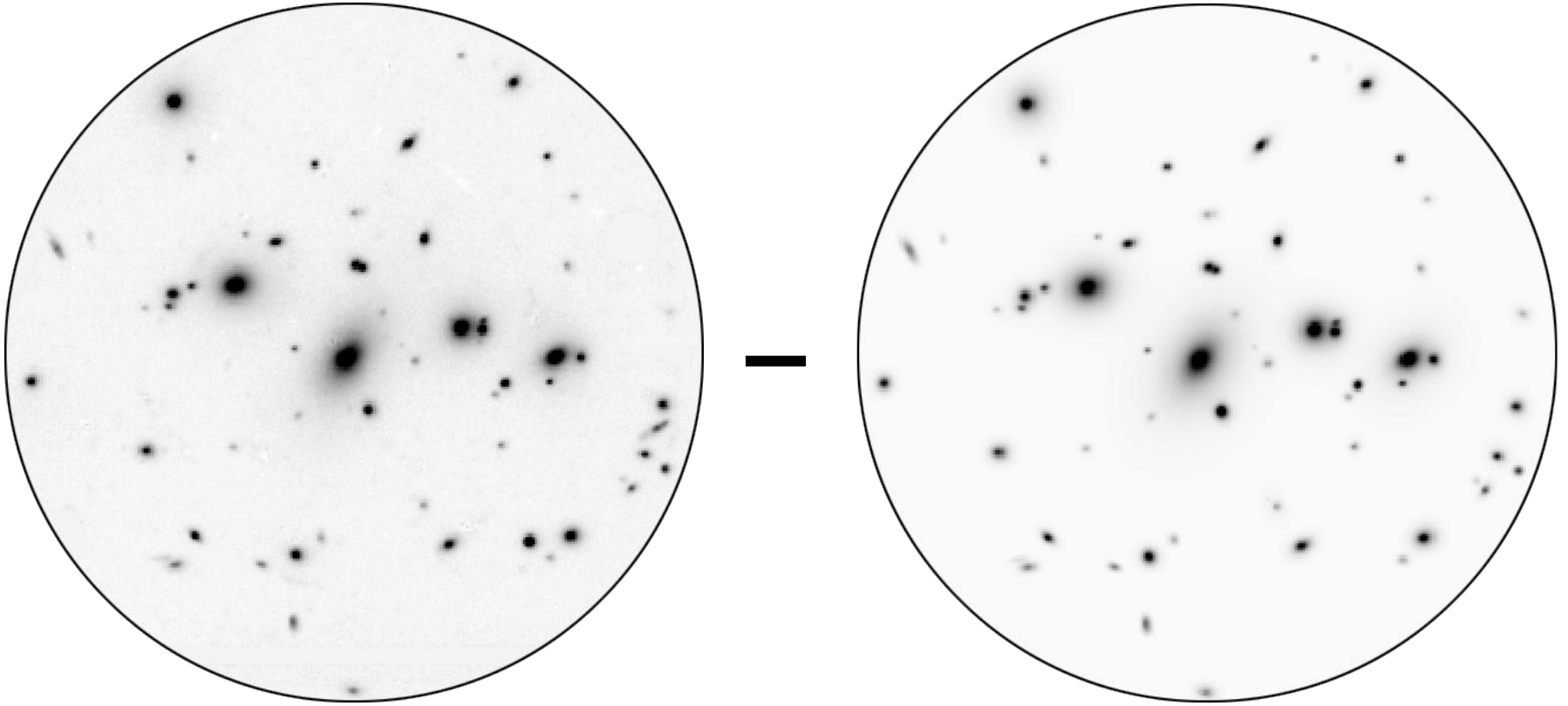
Composite background Model

Intracluster Light (ICL):
Modelling



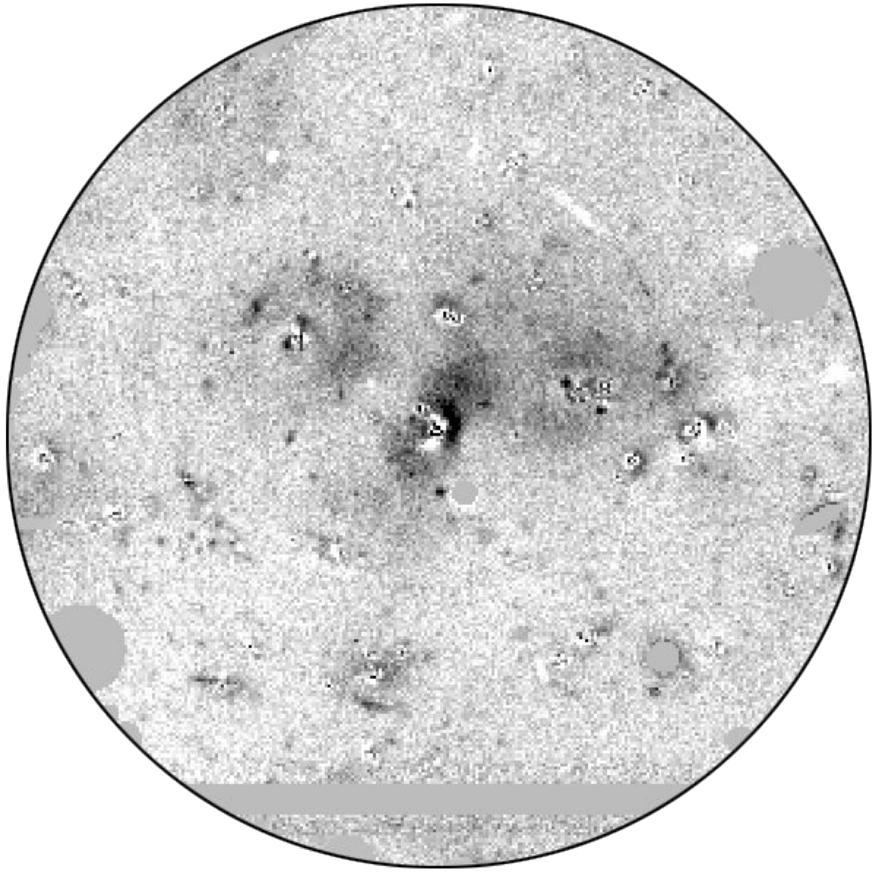
Background Subtracted Image (Cluster Only)

Intracluster Light (ICL):
Modelling



Background Subtracted Image **Cluster Member Model**

Intracluster Light (ICL):
Results



Cluster Subtracted Image (ICL Only)