# The Hector Clusters: Overview.
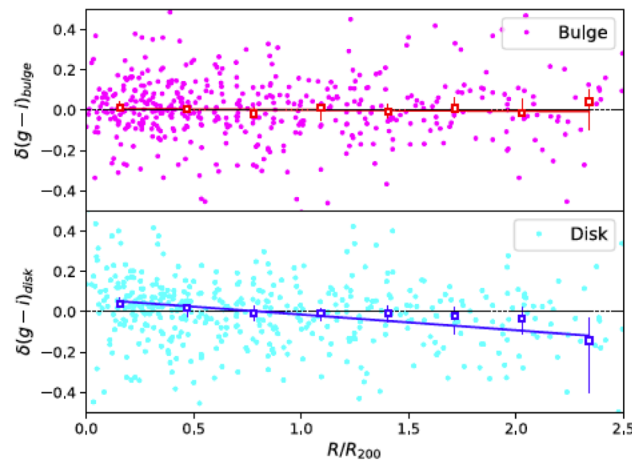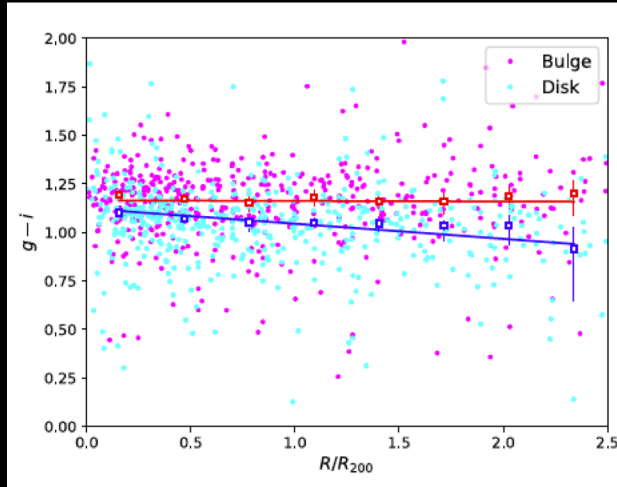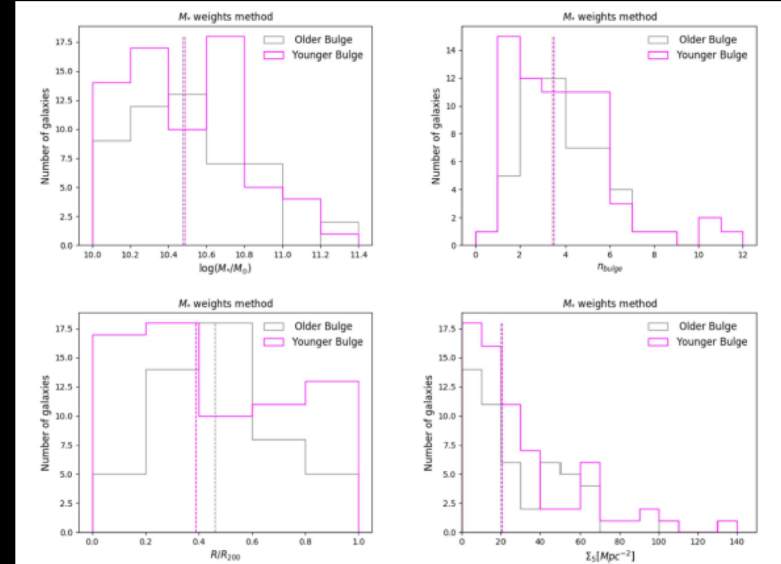## Matt Owers

MACQUARIE University

# Why clusters again?

- Interesting results from SAMI:
  - Barsanti+21a, 21b see evidence for changes in disk colour with R/R200, but low numbers and smaller radius in SAMI.
  - Around 50% of S0 population have bulges that are younger than disks, but no strong correlation with environment.
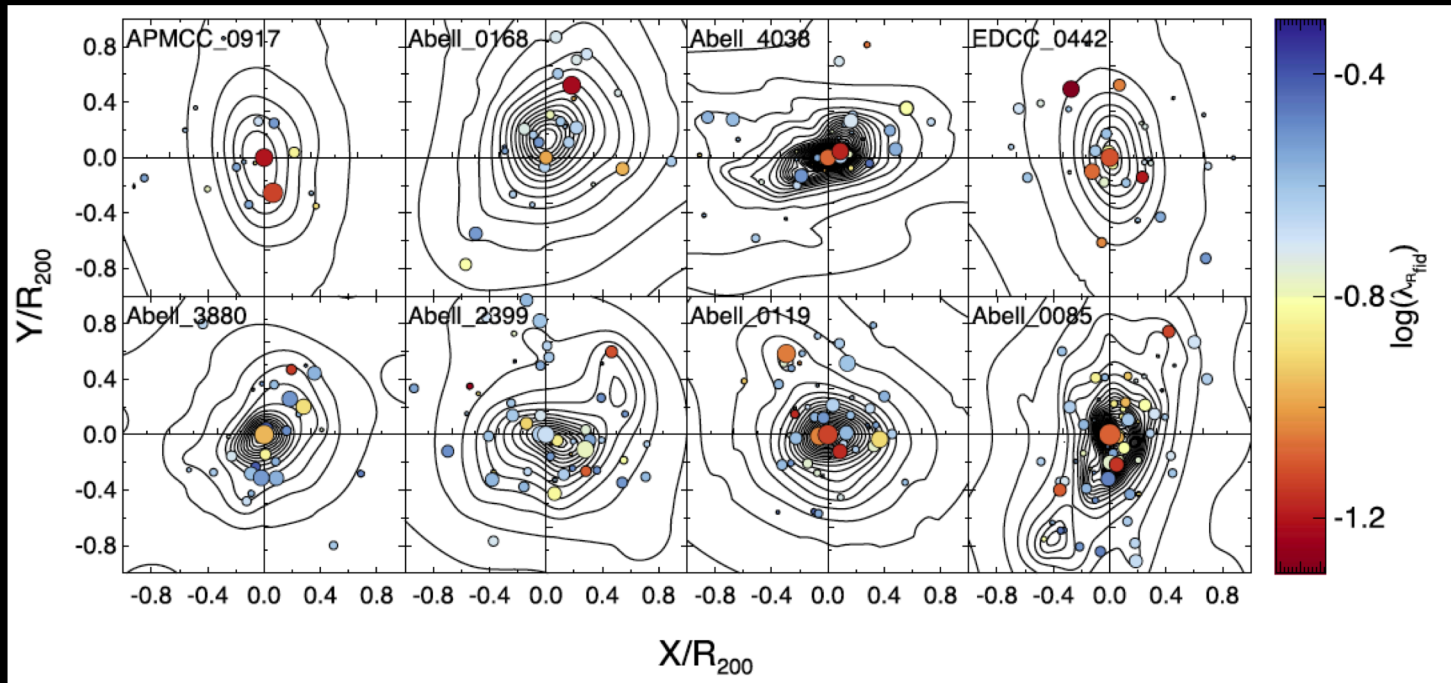
# Why clusters again?

- Interesting results from SAMI:
  - Ram-pressure stripped galaxies (Owers+2019)
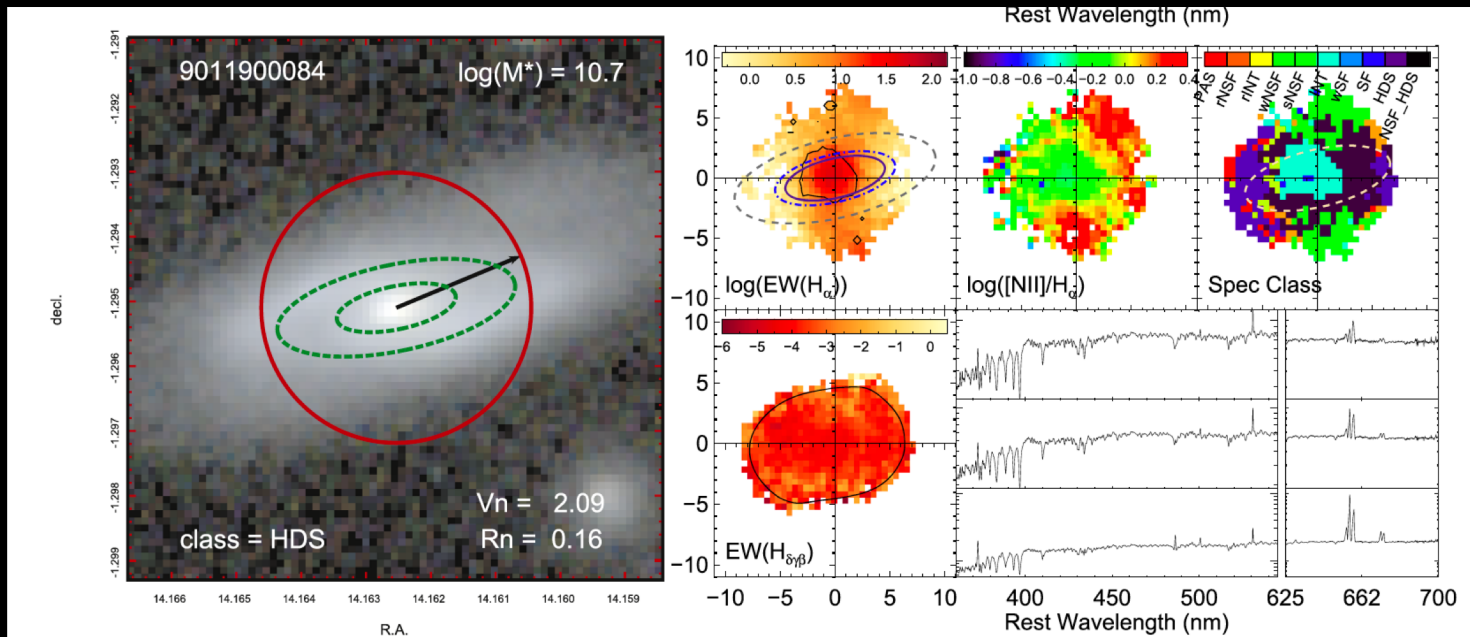


Stripped at ~ pericentric passage. What happens after this?

# Why clusters again?

- ## Interesting results from SAMI:
  Slow rotators in groups (Fogarty+15, Brough+17)

# Why clusters again?
## Outskirts are key to many issues!

- Key questions related to galaxy evolution in clusters:

    (i) Do recent infallers become fully quenched following first passage of cluster core?

    (ii) Which cluster properties are important for galaxy transformation, e.g., mass, dynamical state etc?

    (iii) What is the relative importance of pre-processing in groups?

    (iv) Do we see slow-rotators in groups prior to infall?

    (v) …and many more

- 1-2$R_{200}$ region is key to understanding infalling and backsplash populations.

- Need to characterise local environment: isolated, pairs, groups.
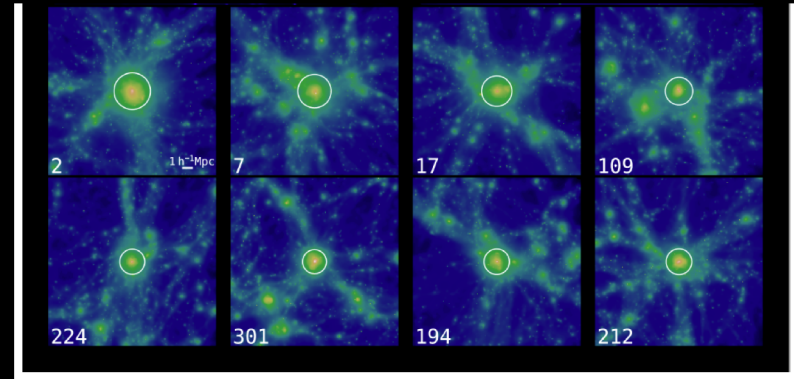


TheThreeHundred project: Arthur et al. (2017)
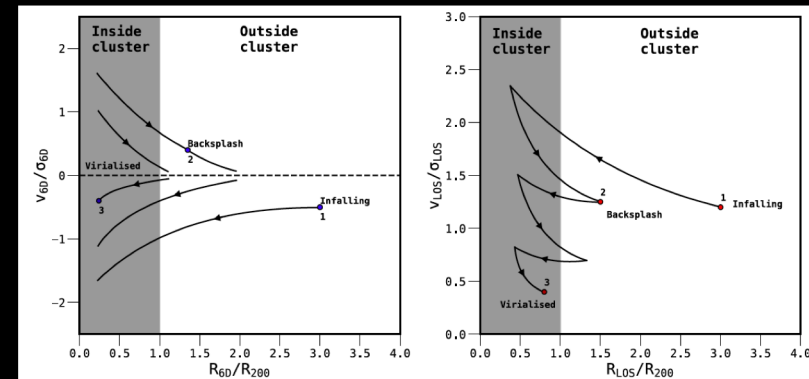
# Which clusters?

- 11 clusters selected from OmegaWINGS survey (Moretti+2017), incl. 3 SAMI clusters with $M_{200} > 5 \times 10^{14} M_{\odot}$.

- Selection criteria: $\sigma > 650$km/s, dec < 5deg, $0.04 < z < 0.06$ and coverage with DES (grizY) and DeCaLs (grz).

**Table 4:** HECTOR clusters: Nine selected from OmegaWINGS with decl. < 5 deg, $0.04 < z < 0.06$ and $\sigma_{200} > 650$ km/s, plus the three most massive SAMI clusters.

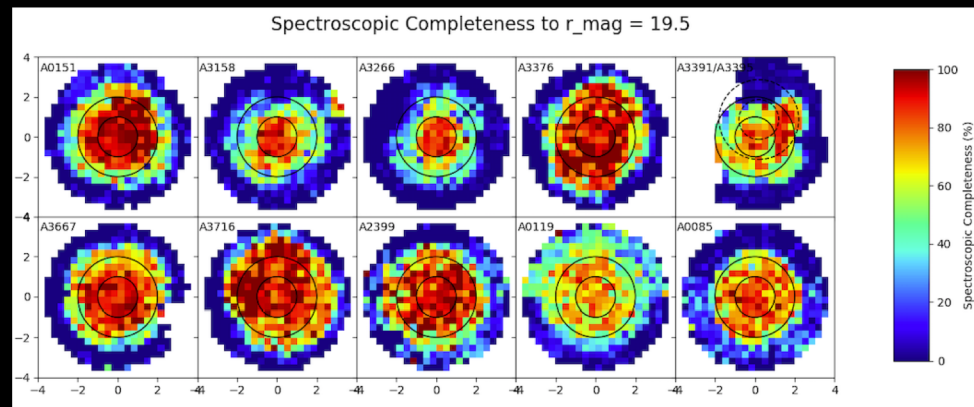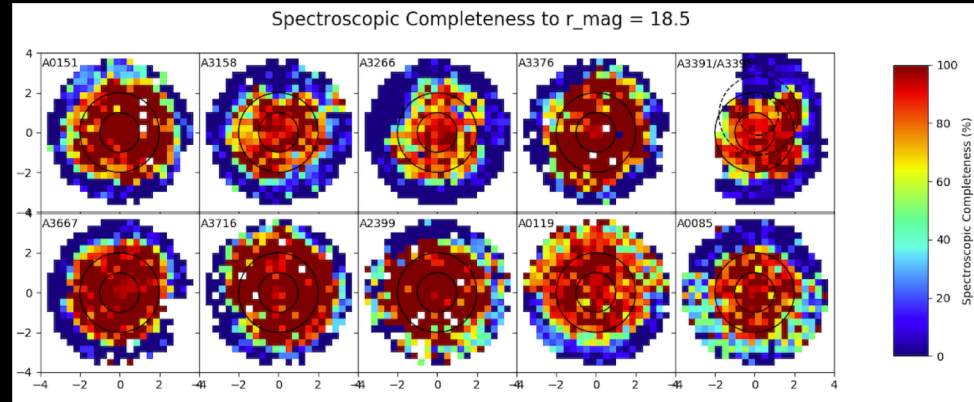| Cluster | R.A. | decl. | z | $\sigma_{200}$ | $N_{spec}$ $R < 2R_{200}$ | $N_{spec}$ $R < 2R_{200}$ and $|v_{pec}|/\sigma_{200} < 3.5$ |
|---------|------|-------|---|----------------|----------------|----------------------------|
| A0151 | 17.1092 | -15.4092 | 0.05327 | 771 | 1573 | 380 |
| A3158 | 55.7704 | -53.6531 | 0.05947 | 948 | 1496 | 608 |
| A3266 | 67.7746 | -61.4436 | 0.05915 | 1095 | 1881 | 1079 |
| A3376 | 90.1529 | -40.0326 | 0.04652 | 756 | 960 | 391 |
| A3391 | 96.5859 | -53.6933 | 0.0514 | 1157 | 793 | 345 |
| A3395 | 96.88 | -54.4374 | 0.05103 | 1272 | 1696 | 631 |
| A3667 | 303.0917 | -56.8152 | 0.05528 | 1031 | 1901 | 913 |
| A3716 | 312.86 | -52.707 | 0.04599 | 753 | 1402 | 649 |
| A2399 | 329.372605 | -7.79692 | 0.058 | 690 | 1061 | 382 |
| A0119 | 14.06715 | -1.25537 | 0.0442 | 840 | 1975 | 609 |
| A0085 | 10.460211 | -9.303184 | 0.0549 | 1002 | 1862 | 637 |
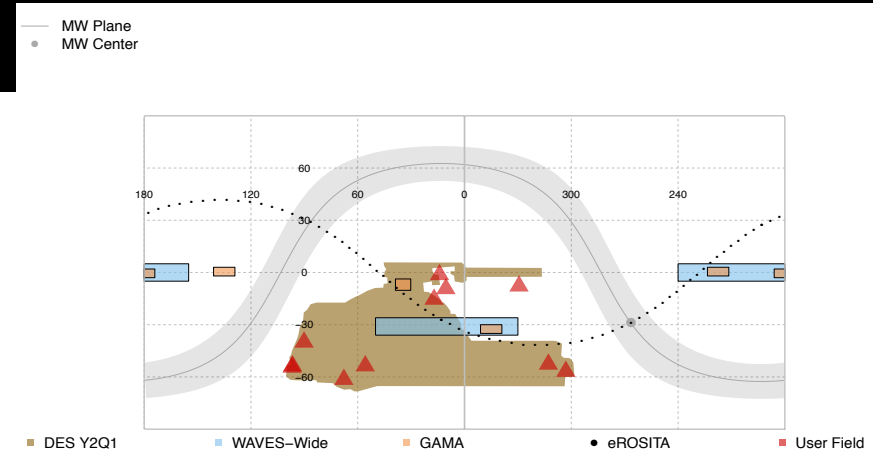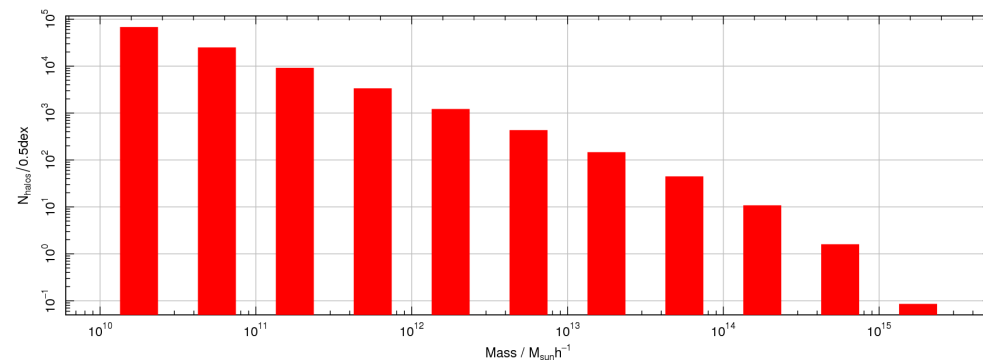
# What's been done so far?
## Photometry

- Baseline photometry for redshift survey comes from DECaLs catalogues.

- Have retrieved DES grizY & SDSS ugriz images where available.

- Produced cutouts with matched astrometry, size and pixel scale.

- Used ProFound with rizY detection (r+z if no I, Y) to produce aperture-matched photometry.

- Produced i-band proxy using r & z photometry for all galaxies, as well as stellar mass proxy using g-$i_{fake}$ colour, $i_{fake}$ and redshift.
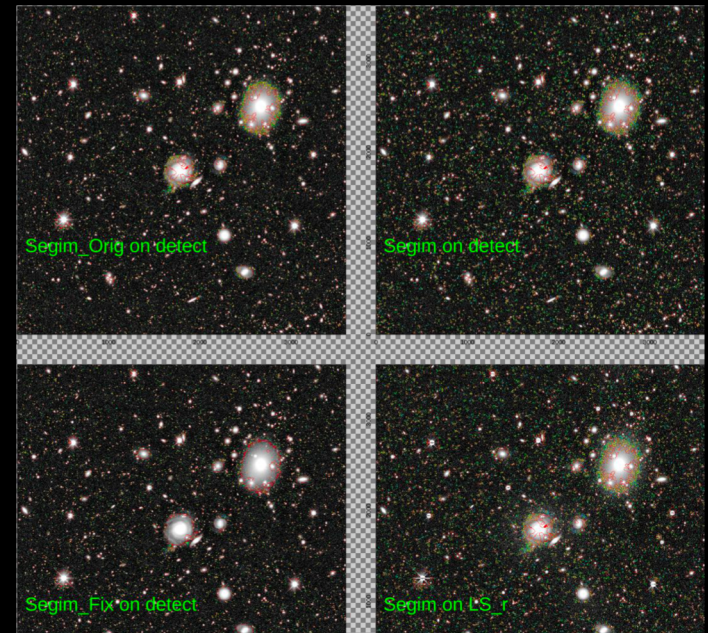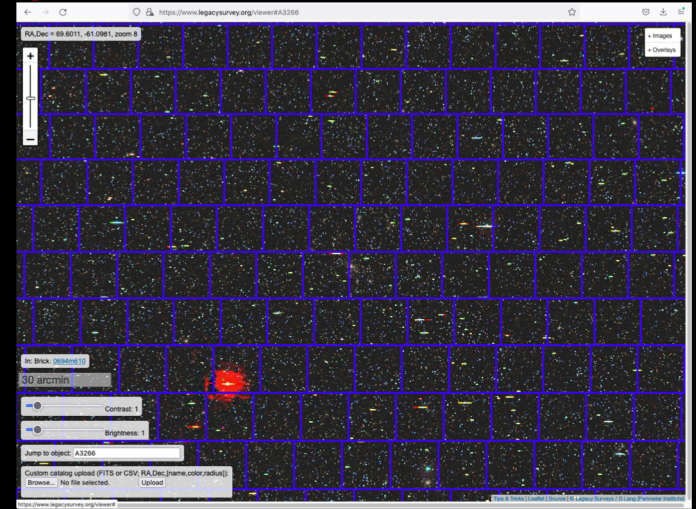
# What's been done so far?
## Redshifts

- Collated z's from other surveys & cross-matched with photo cats (SDSS, OmegaWINGS, WINGS, 2dFGRS, 6dFGS etc)

- Survey with 2dF/AAOmega, targeting gals without z's in the r< $3R_{200}$ regions to r=19.5mag.

- Reduced using SAMI-CRS pipeline, redshifts from autoz.

- Have ~31,000 redshifts within $3R_{200}$ of which 8700 have $|v_{pec}| < 3.5\sigma$.



Spectroscopic Completeness to r_mag = 18.5
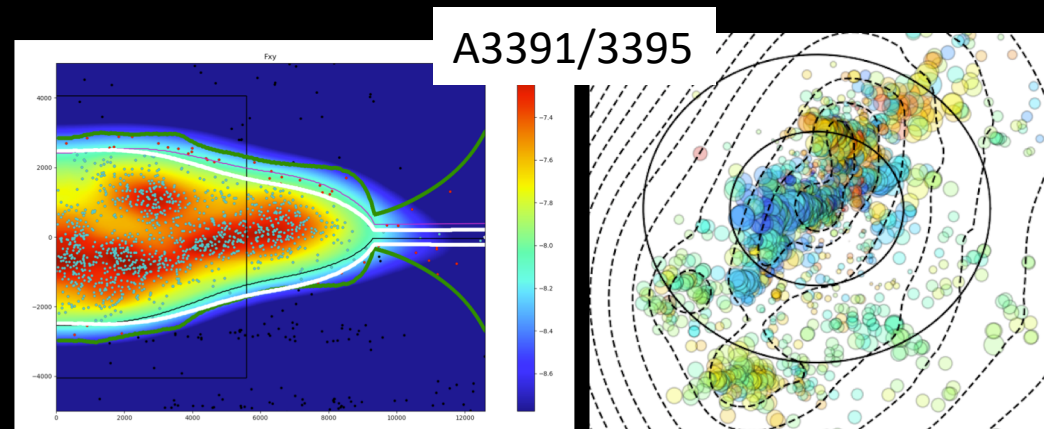


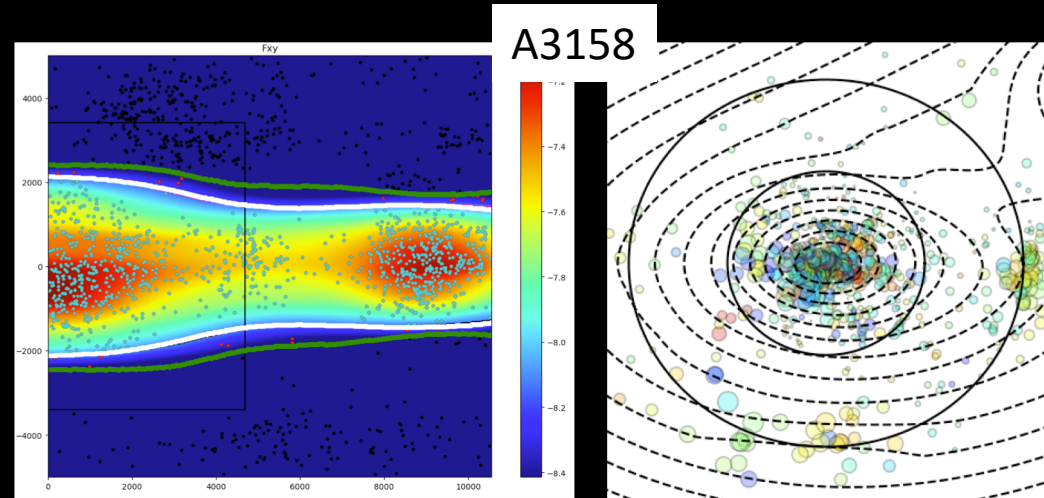Spectroscopic Completeness to r_mag = 19.5

# What's been done so far?
## Cluster membership

- Started writing code for caustics membership and substructure.

- Some complicated clusters – needs detailed substructure analysis to tease out membership.



A3158



A3391/3395

# What's been done so far?
## Substructure analysis

- New method to perform mixture modelling based on Tucker+(2020) approach.

- Uses NFW profile for spatial distribution of galaxies.

- Models projected velocity AFO radius by assuming spherical NFW profile.

- Incorporates odd selection function and spectroscopic completeness.

- Fits for M200, position, scale radius for main cluster and substructures, fraction of galaxies belonging to substructures.

- Uses results to assign probabilistic membership to subclusters.

A3391/3395
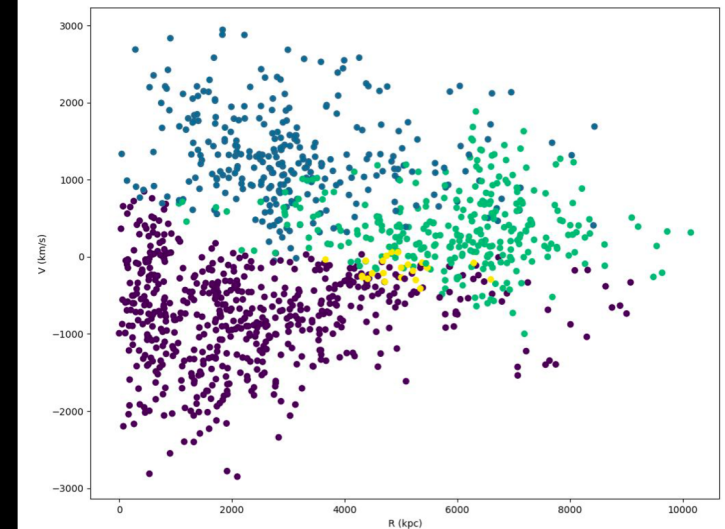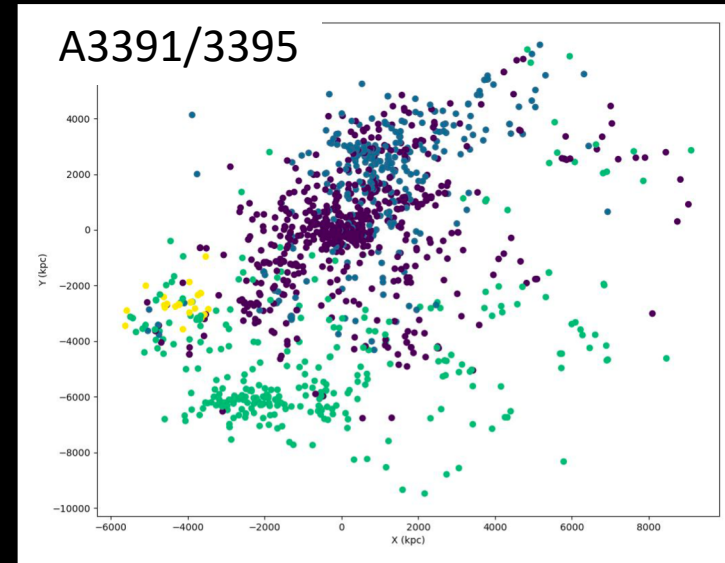
# What needs to be done?
## Clusters

- Fix ProFound segments
- Add in Galex/VISTA VHS/WISE data
- Complete redshift survey
- Bulge/disk/Sersic fits
- Detailed analysis of cluster dynamical states using Hector-CRS+X-ray data
- Decide on target selection (fraction of red-sequence, blue cloud, plus definition of RS & BC)
- CATID generation.
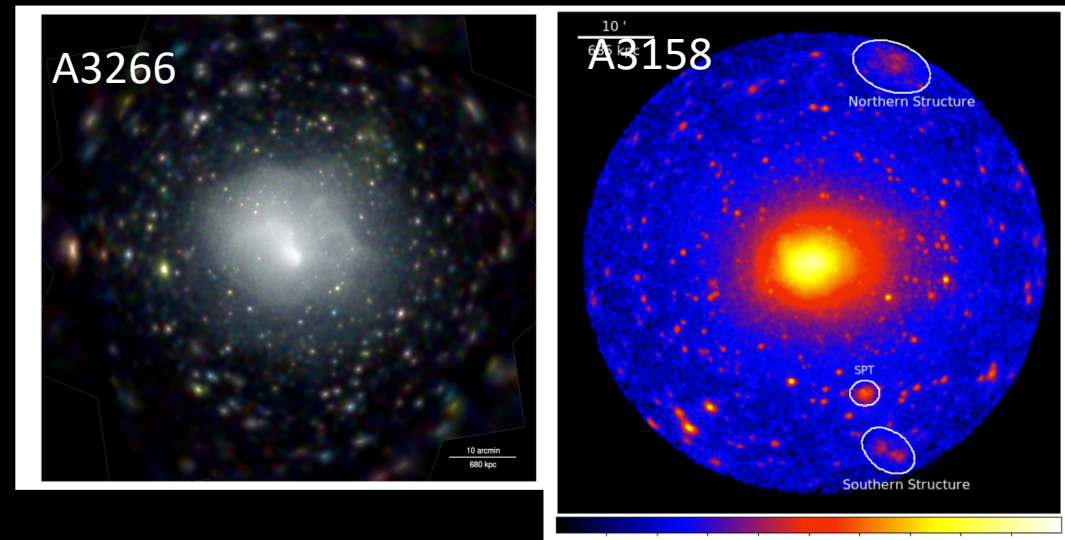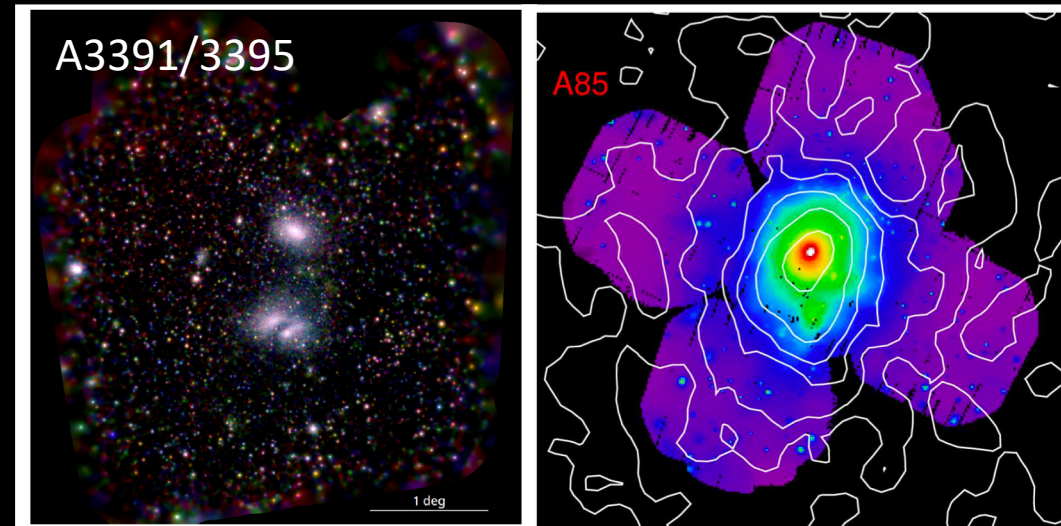
# What needs to be done?
# WAVES regions

- Environments in the WAVES regions:
  - Analyse 2PIGG–detected groups and clusters, consistent mass measurements between cluster and WAVES regions
  - Local density and other environment proxies
  - Filaments with DISPERSE?
  - eROSITA data?