Groups and clusters in the 3XMM/SDSS Stripe 82 zone

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Outline

- The 3XMM/SDSS Stripe 82 group and cluster survey

- The group/cluster catalogue

- X-ray properties

- Optical properties
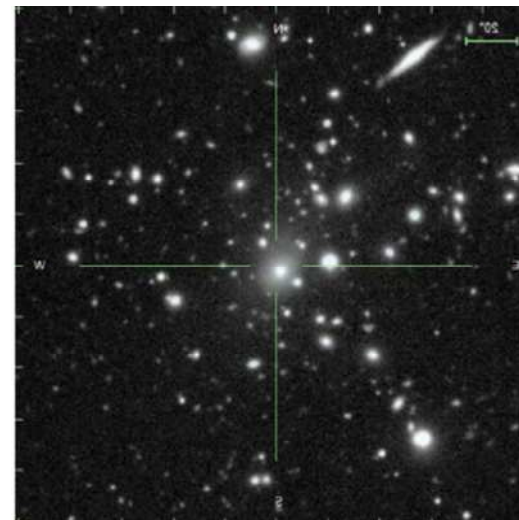
- Discovery of two merging clusters

The SDSS Stripe 82 survey

- Equatorial zone: -50°<RA<60° and |DEC|≤1.25
- Coverage 270 deg^2
- 13×10^6 galaxies with photo-z and 10^5 galaxies with zspec
- 50% completeness at r=23.5

SDSS DR12 image
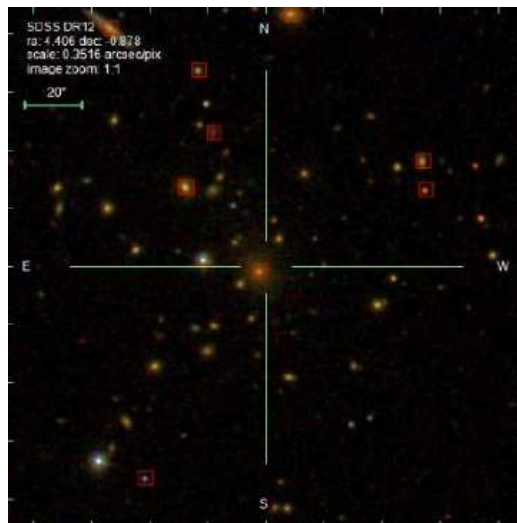
Stripe 82 image

Systematic search for clusters in the Stripe 82 region with AMACFI:
Durret et al. 2015, A&A 578, 79
Catalogue now being improved by Florian Sarron

X-ray cluster candidates in the Stripe 82 region

Systematic search for diffuse extended X-ray sources in XMM-Newton archive in the SDSS Stripe 82 zone

- 74 XMM observations

- Surveyed area: 11 deg^2
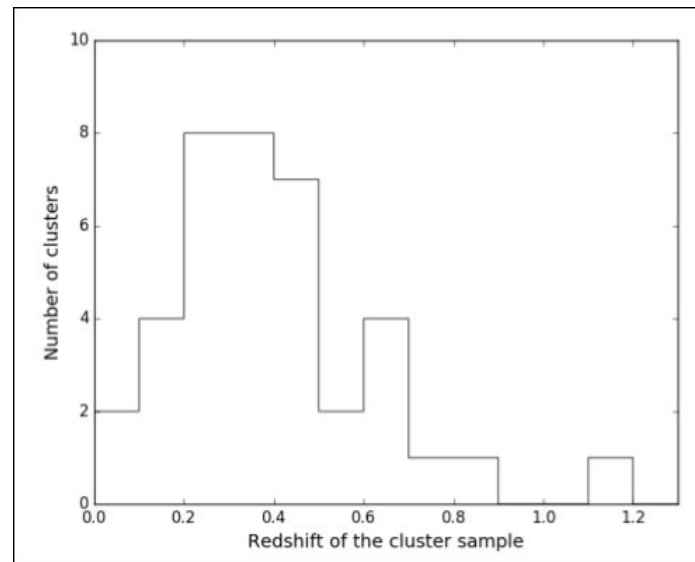
- 120 extended detections, <u>94 cluster candidates</u>
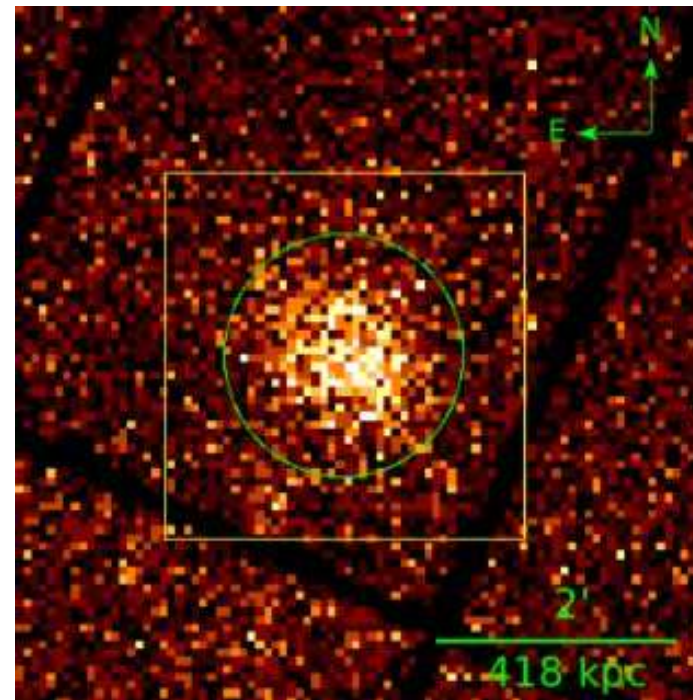
3XMM J001737.3-005240
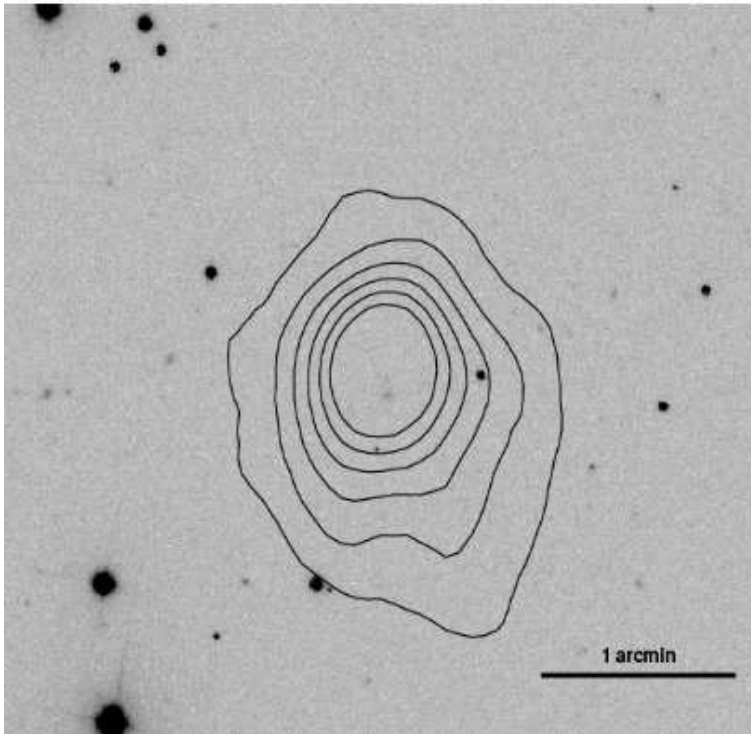(z_{spec} = 0.2141)

The sample with redshifts

- 51 groups or clusters with spectroscopic redshifts + 3 with photometric redshifts
- 1/3 of them are new systems in X-rays
- $0.05 < z < 1.2$
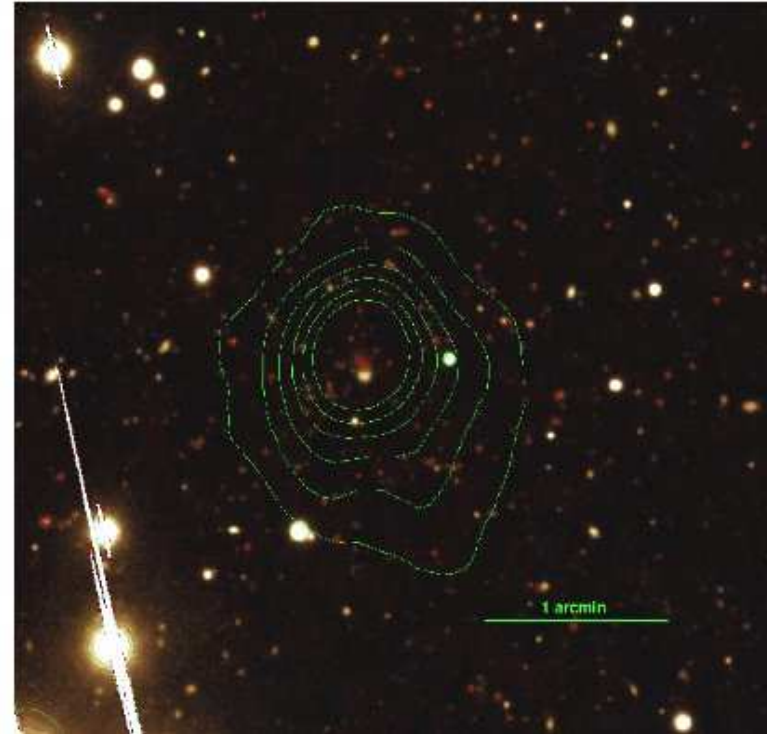- 7 clusters at $z \geq 0.6$

Redshift distribution

The most distant cluster (z>0.8)
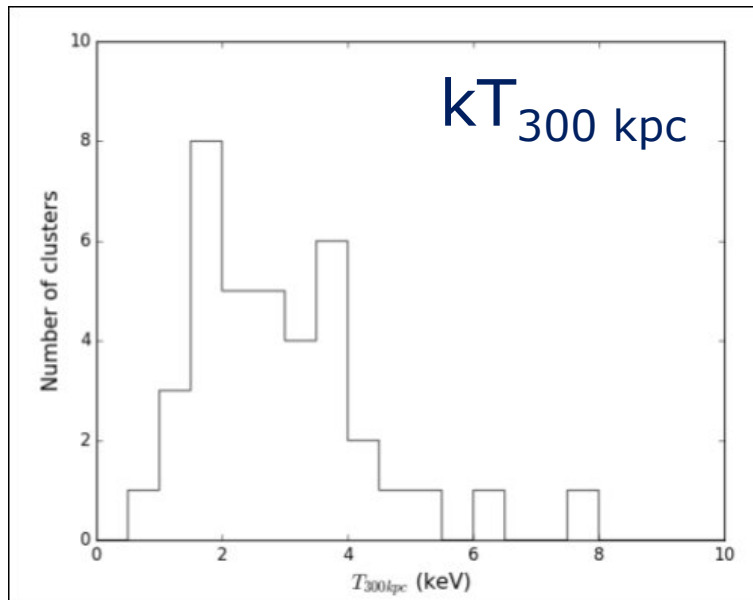## 2XMM J083026+524133

Large binocular telescope image
+ X-ray contours
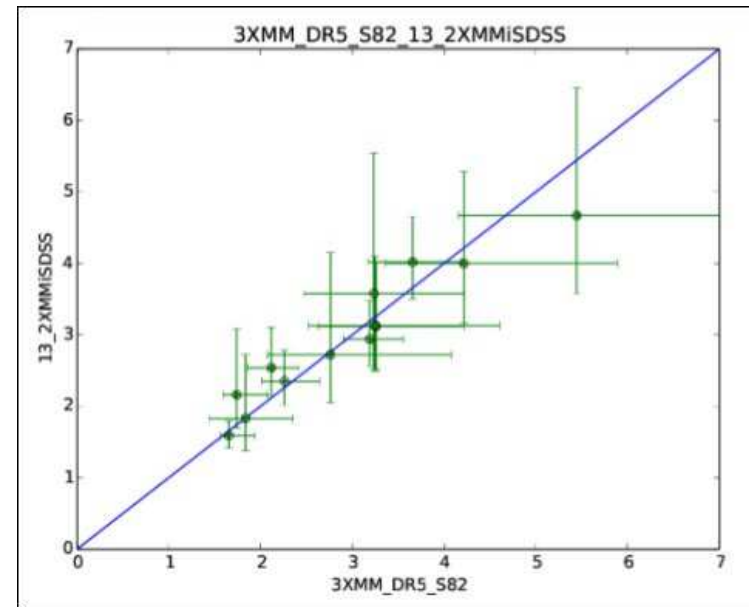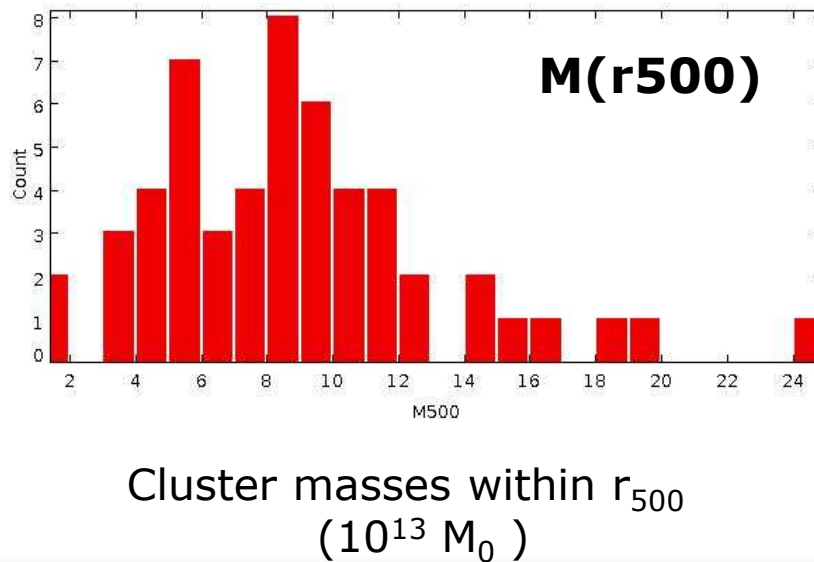
R and z band S82 image
+ X-ray contours

X-ray properties: temperature

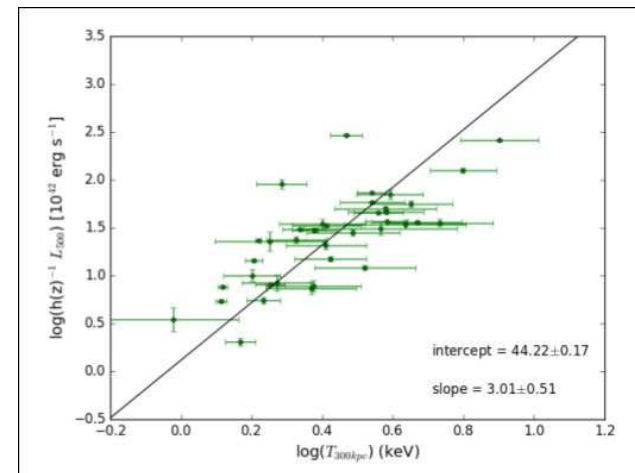38 clusters with $kT_{300\ kpc}$
error < 50%

kT: comparison with 2XMMiSDSS

L$_X$ (r500)

X-ray luminosities (10^{42} erg s^{-1})

M(r500)

Cluster masses within r$_{500}$
(10^{13} M$_0$)

L$_X$ (r500)

intercept = 44.22±0.17

slope = 3.01±0.51
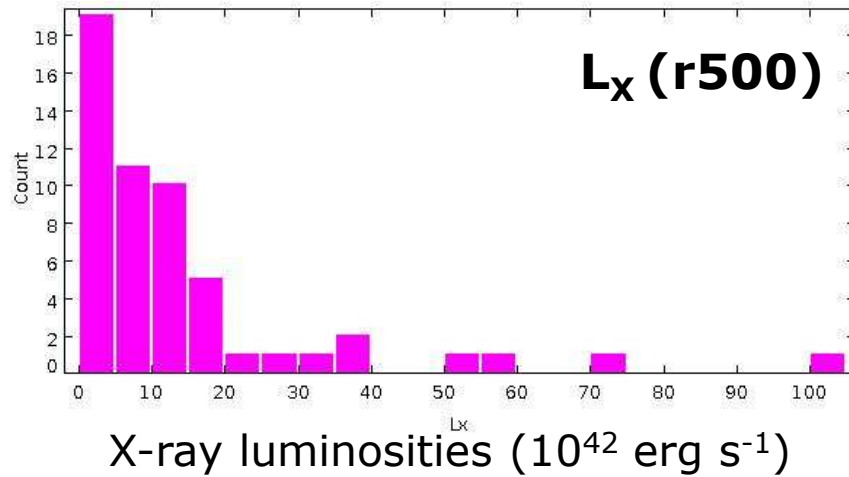
T$_X$ (300 kpc)

Takey et al. 2017, in prep.

Optical properties of clusters: morphological segregation

- Stripe 82 images retrieved from Fliri & Trujillo at http://www.iac.es/proyecto/stripe82/index.php

- 4 or 9 images combined to reach 1 Mpc radius

- Images analysed with SExtractor after modeling of the PSF ⟹ $flux_{spheroid}$ and $flux_{disk}$

- Classification as early type if

$$flux_{spheroid} / (flux_{spheroid} + flux_{disk}) \geq 0.35$$

**Results after stacking all the clusters:**

- The **fraction** of early type galaxies seems to decrease with cluster mass while the number of late type galaxies increases
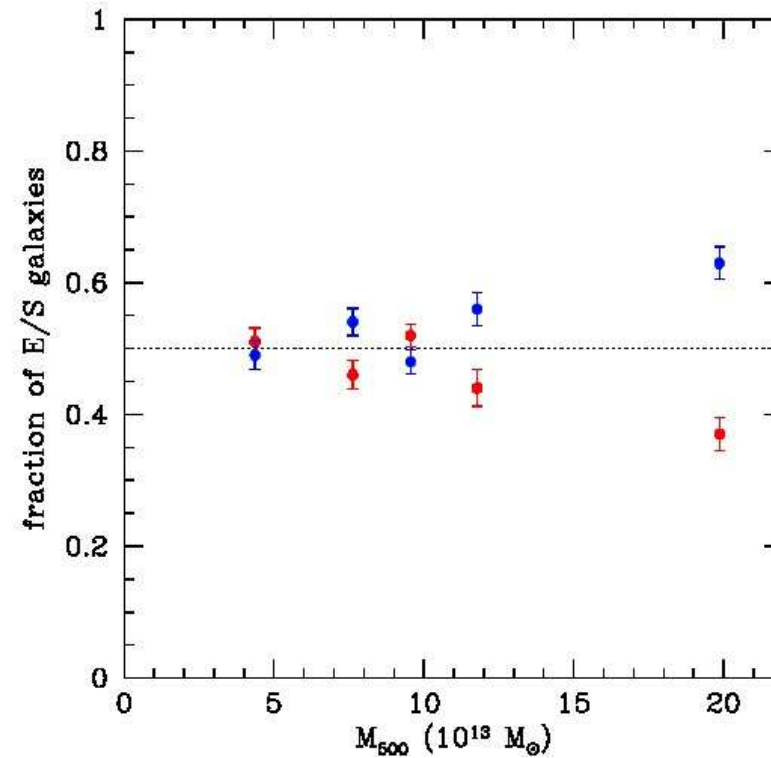
early type
late type

- The **number** of early type galaxies stays roughly constant with radius while the number of late type galaxies strongly increases with radius

- The **fraction** of early-type galaxies decreases and the fraction of late types increases with radius

early type
late type
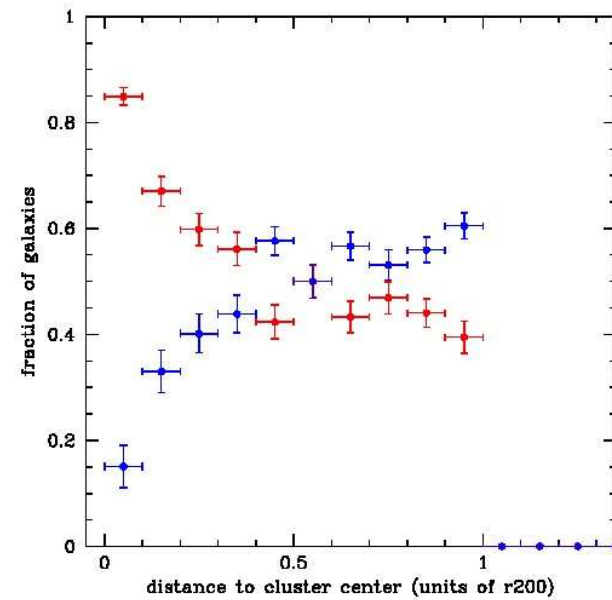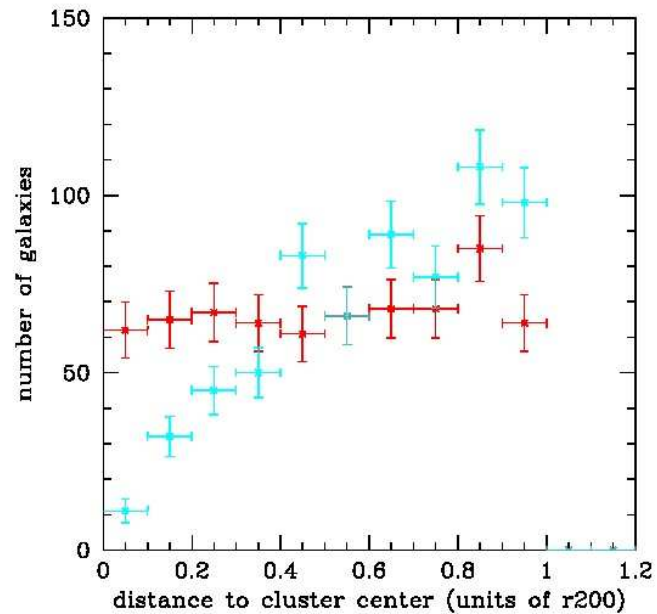
Galaxy luminosity functions (GLF)

Method:
- Detections on rdeep image
- Galaxy-star separation
- Compare mag. histogram of stars to Besançon model
- Magnitude measurements in 5 bands (u, g, r, i, z)
- → 5 band galaxy catalogue
- Selection of galaxies along the red sequence for each cluster
- Same selection applied to COSMOS catalogue by Laigle et al. (2016) to estimate the background
- Apply k-correction, estimate galaxy counts in absolute magnitude bins
- Fit of every GLF by a Schechter function
- Cluster stacks in mass and redshift bins
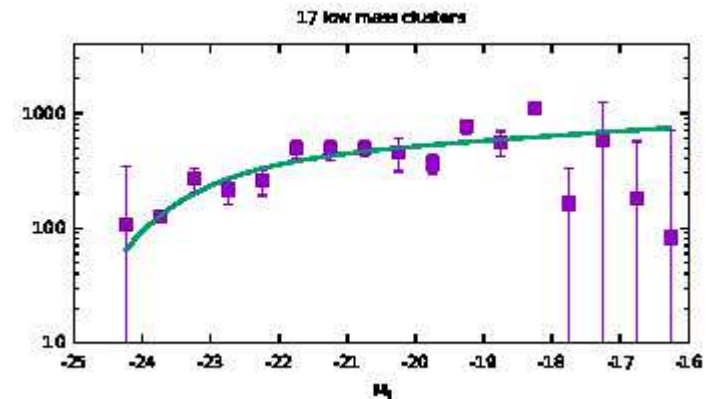
Results for stacked clusters in three mass bins

13 high mass clusters
$M > 10^{14} M_0$
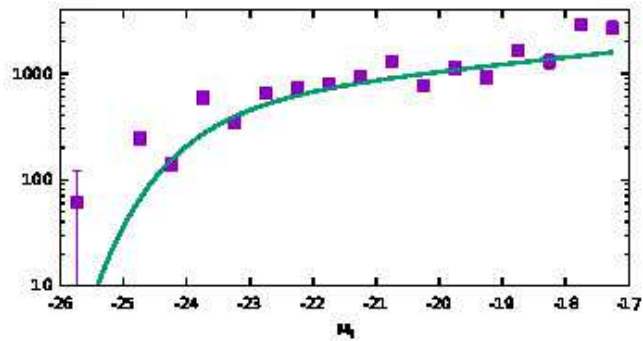
16 medium mass clusters
$7\ 10^{13} \leq M \leq 10^{14} M_0$
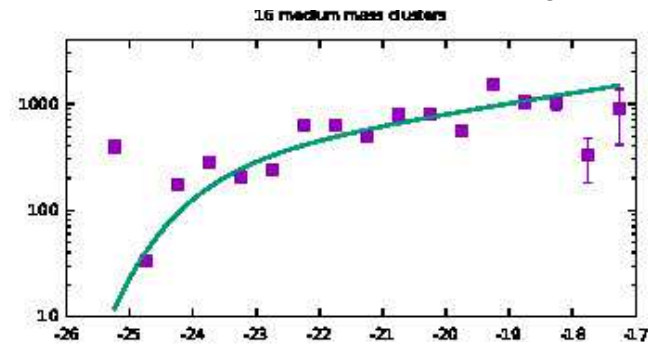
**17 low mass clusters**
$M < 7\ 10^{13} M_0$

Schechter fit parameters in the four bands g, r, i, z

|	Low mass $(M < 7\ 10^{13}\ M_\odot)$	Medium mass $(7\ 10^{13} \leq M \leq 10^{14}\ M_\odot)$	High mass $(M > 10^{14}\ M_\odot)$
Φ_g	311 ± 36	260 ± 25	152 ± 19
M_g^*	-26.00 ± 0.17	-23.60 ± 0.12	-25.60 ± 0.19
α_g	-1.054 ± 0.038	-1.306 ± 0.017	-1.360 ± 0.016
Φ_r	178 ± 106	304 ± 15	413 ± 38
M_r^*	-25.02 ± 1.53	-24.19 ± 0.06	-24.47 ± 0.11
α_r	-1.243 ± 0.051	-1.285 ± 0.010	-1.212 ± 0.020
Φ_i	413 ± 94	363 ± 16	647 ± 36
M_i^*	-23.66 ± 0.23	-24.02 ± 0.04	-23.95 ± 0.06
α_i	-1.099 ± 0.055	-1.240 ± 0.011	-1.159 ± 0.015
Φ_z	377 ± 110	152 ± 19	968 ± 57
M_z^*	-23.95 ± 0.33	-25.60 ± 0.19	-23.86 ± 0.06
α_z	-1.121 ± 0.075	-1.360 ± 0.017	-1.056 ± 0.023

No obvious variation of Schechter parameters with cluster mass

Merging clusters

3XMM J010606.7+004925 (z=0.26)
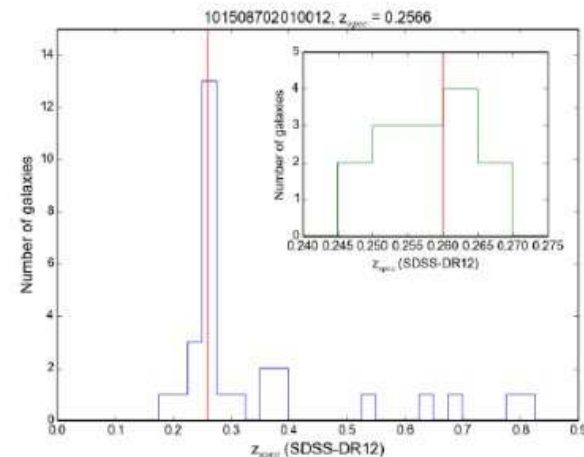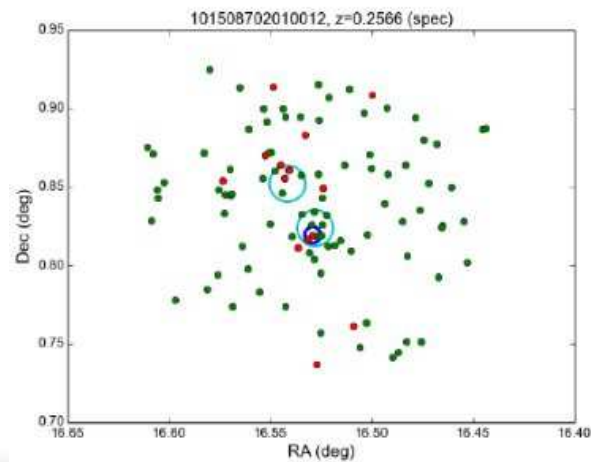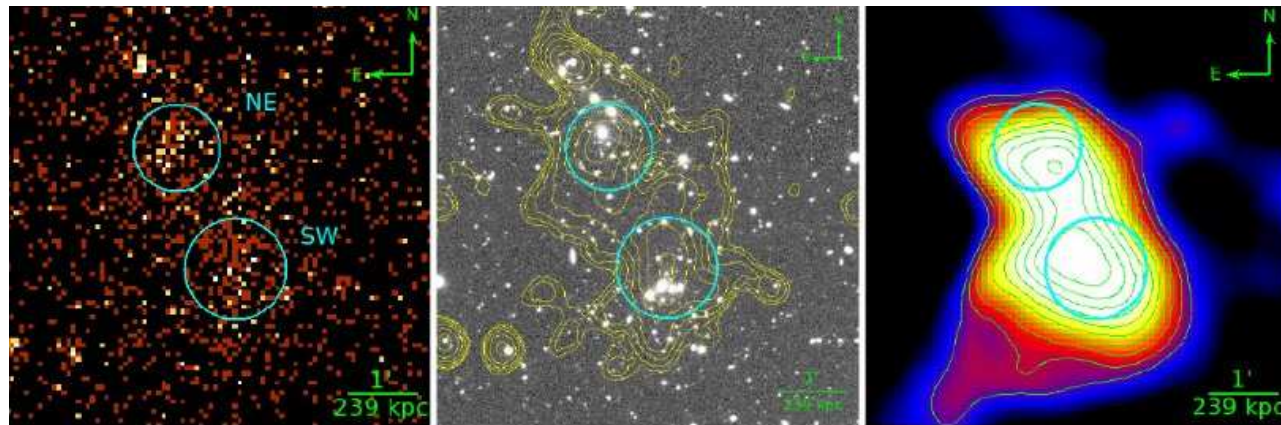
The multiple cluster Abell 412 (z=0.11)
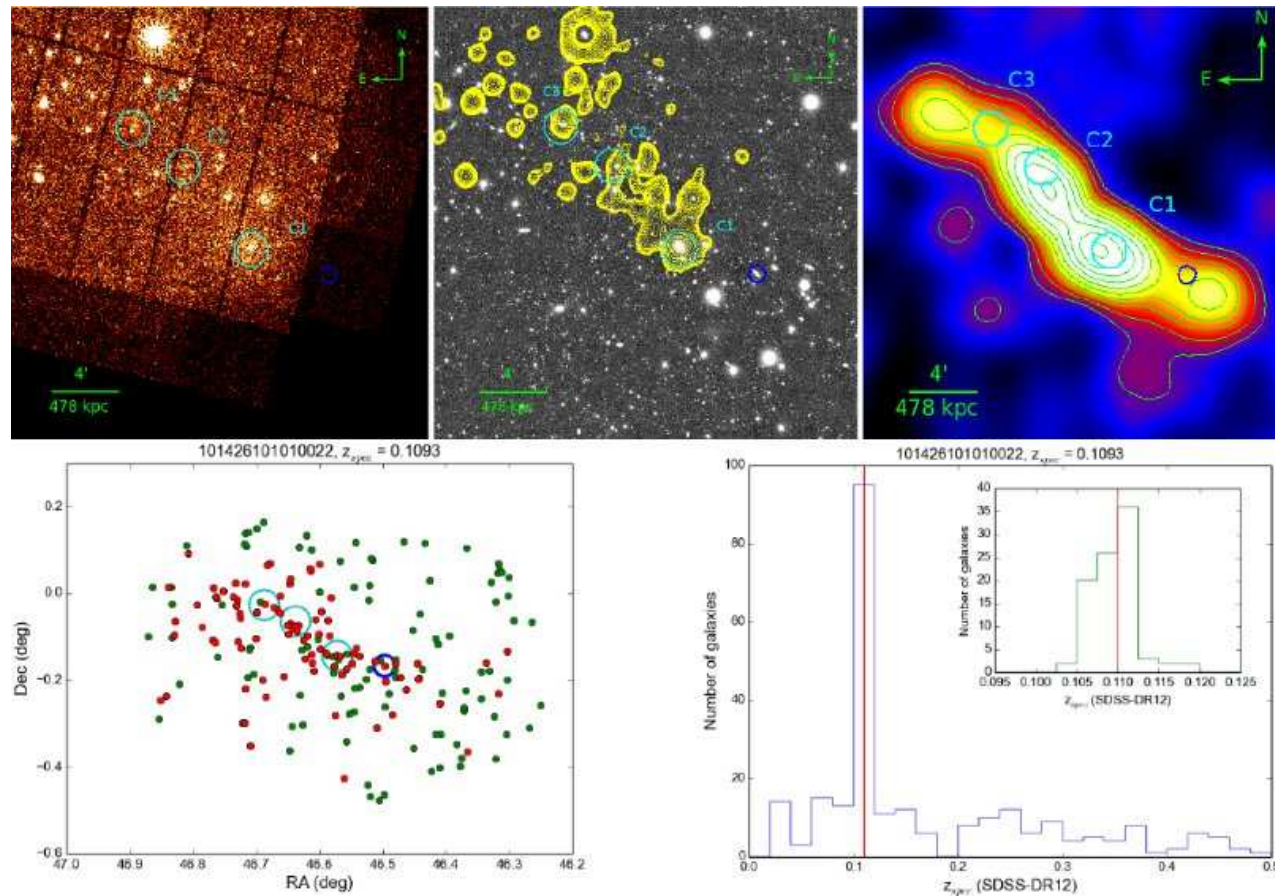
Takey, Durret, Ahmed, Ali 2016, A&A 594, 32

Conclusions and perspectives

- Make galaxy density maps for the whole sample to characterize galaxy distributions

- Study the optical properties of the Brightest Cluster Galaxies

- Redo systematic search for clusters in entire Stripe 82 photometric redshift catalogue

- Correlate with public Planck SZ catalogue