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

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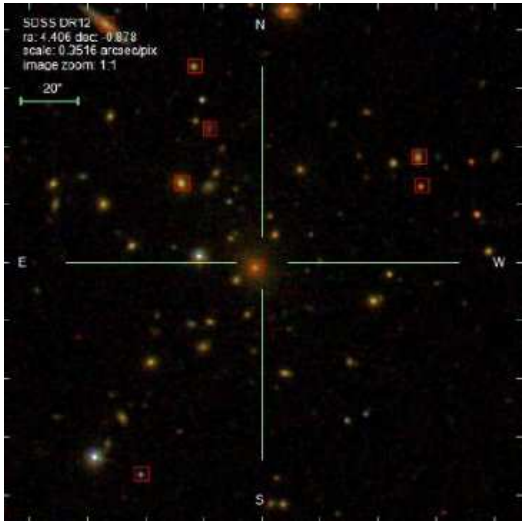
Outline

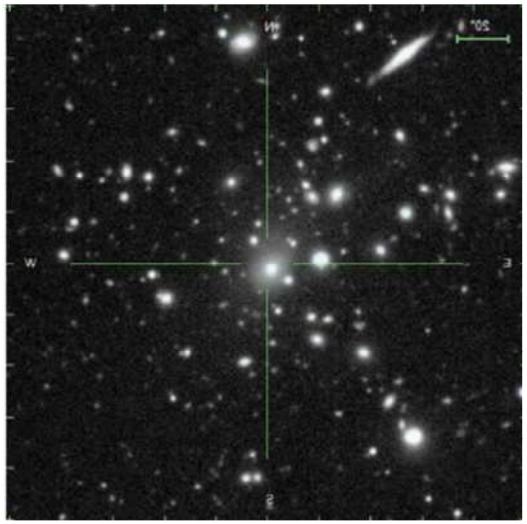
- The 3XMM/SDSS Stripe 82 group and cluster survey
- The group/cluster catalogue
- X-ray properties
- Optical properties
- Discovery of two merging clusters

The SDSS Stripe 82 survey

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

DR12 image





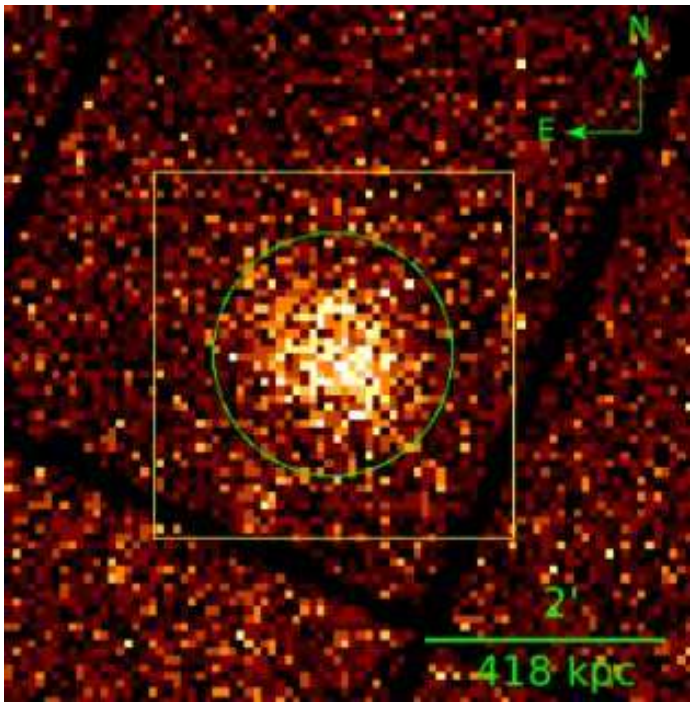
Stripe 82 image

Systematic search for clusters in the Stripe 82 region:
Durret et al. 2015, A&A 578, 79
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

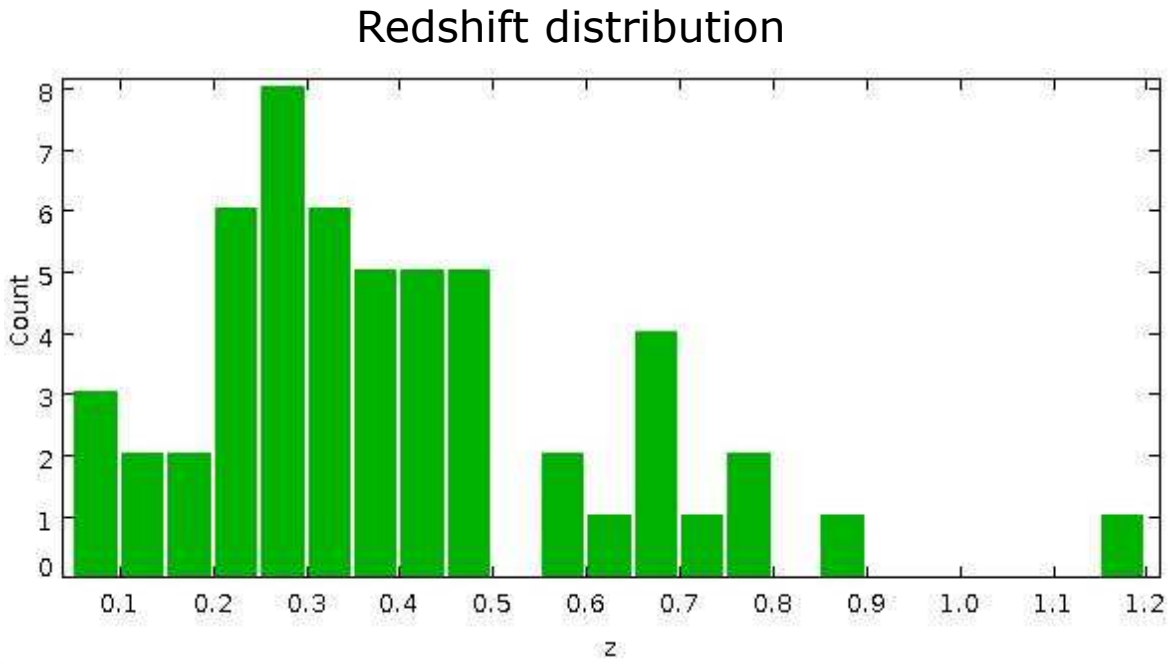
- 74 XMM observations
- Surveyed area: 11 deg^2
- 120 extended detections, <u>94 cluster candidates</u>



3XMM J001737.3-005240
(z_{spec} = 0.2141)

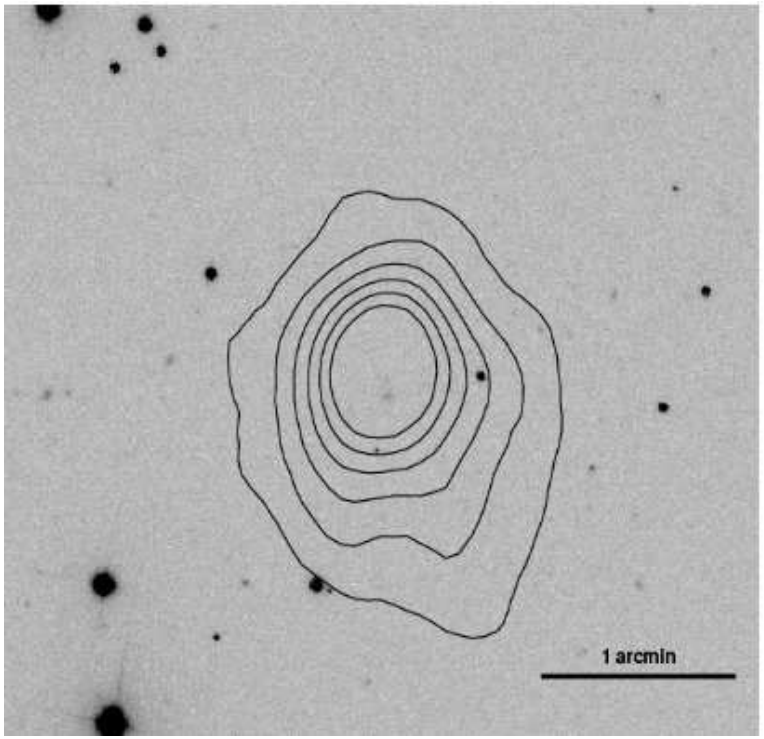
The sample with redshifts

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

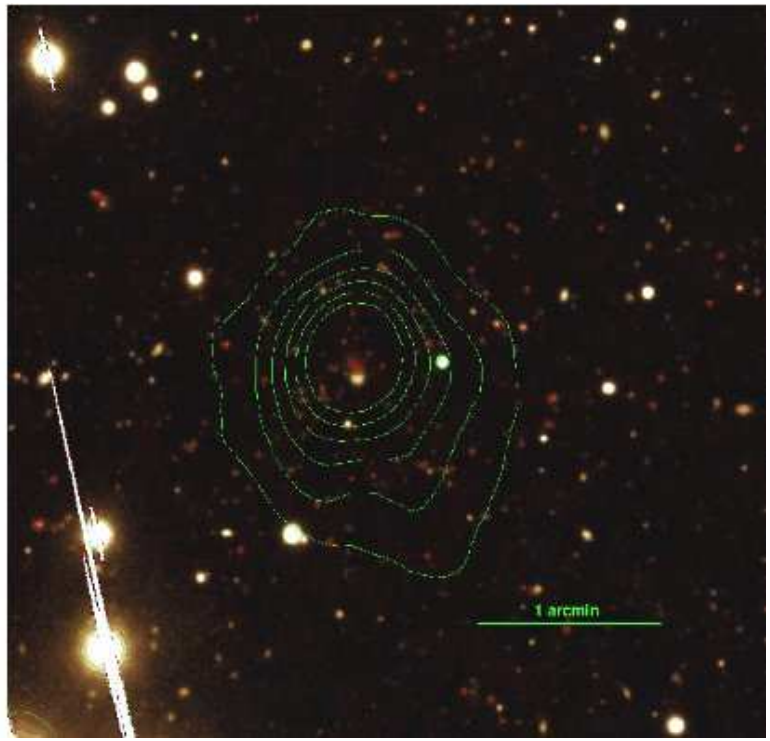


The most distant cluster (z>0.8)

2XMM J083026+524133

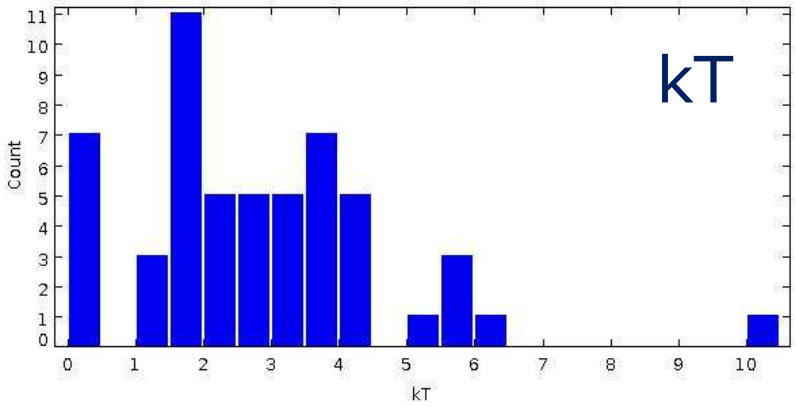


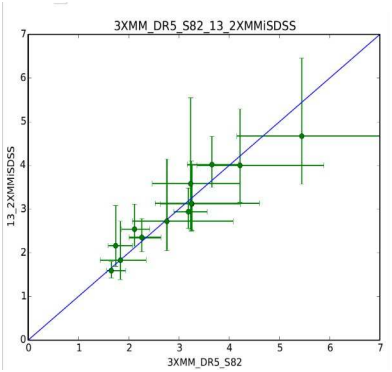
Large binocular telescope image
+ X-ray contours



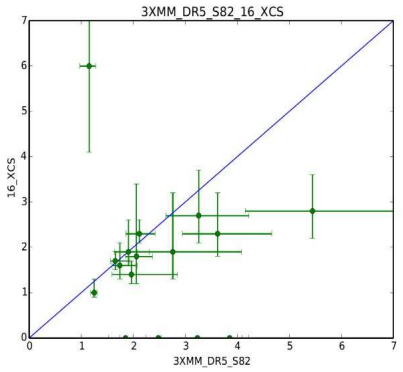
R and z band S82 image
+ X-ray contours

X-ray properties

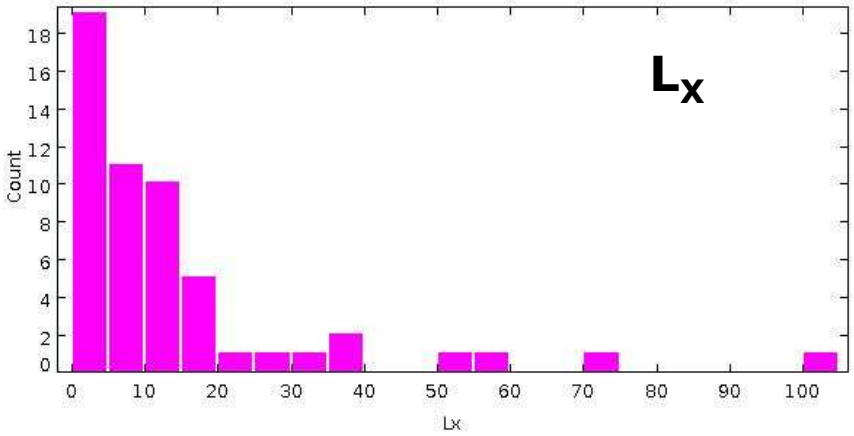




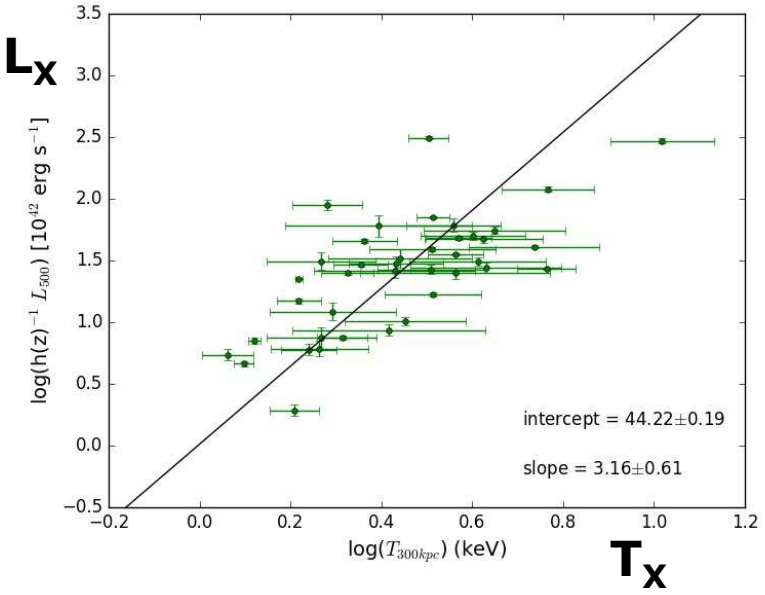
Comparison with 2XMMiSDSS

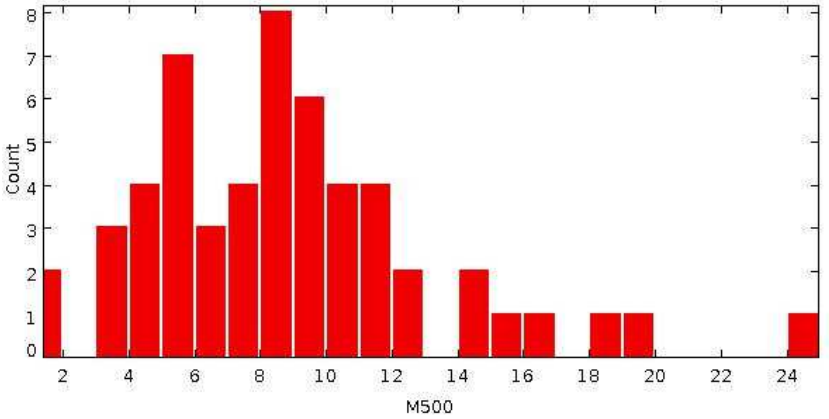


Comparison with XCS



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





Takey et al. 2017, in prep.

Cluster masses within r_{500} (10^{13} M_0)

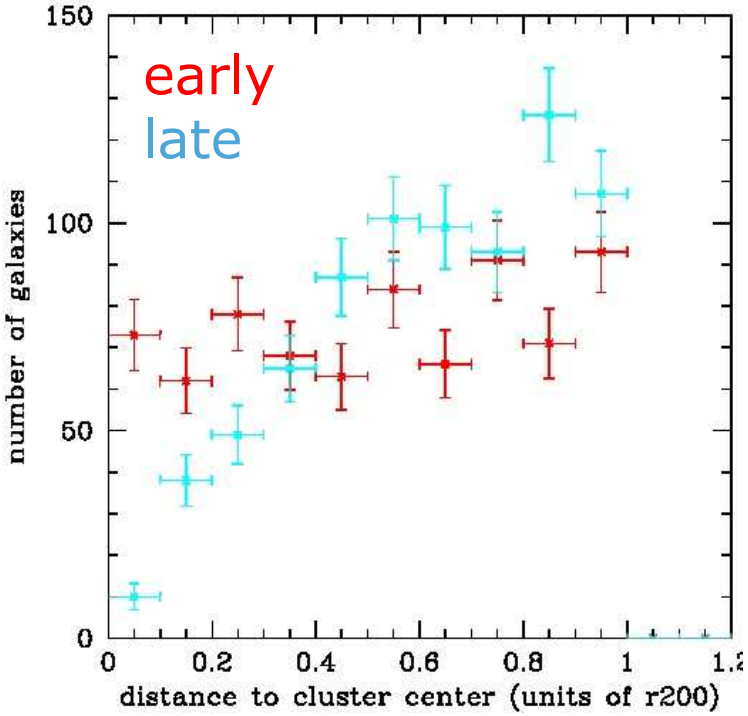
Optical properties of clusters: morphological segregation

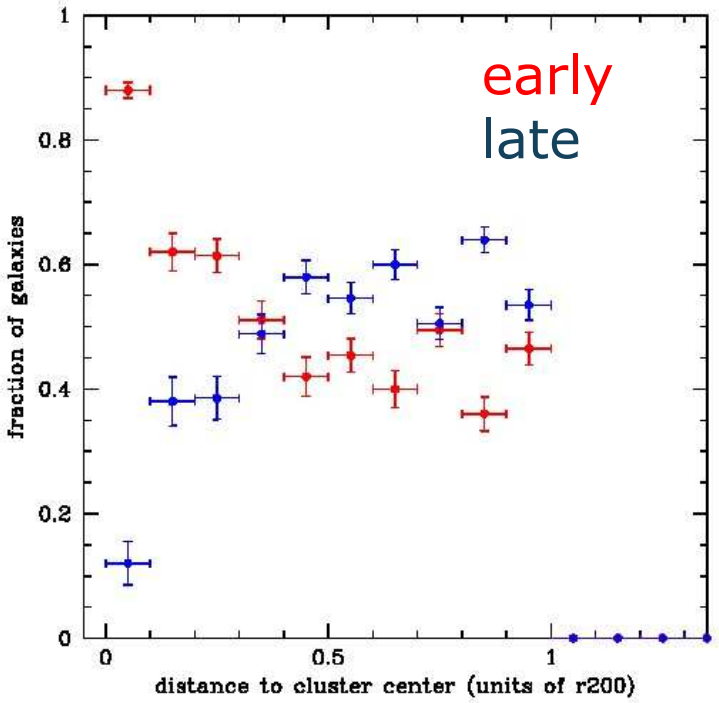
- Stripe 82 images retrieved from Fliri & Trujillo at http://www.iac.es/proyecto/stripe82/index.php
- 4 or 9 images combined to reach 1 Mpc radius
- Images analysed with SExtractor after modeling of the PSF ⟹ $flux_{spheroid}$ and $flux_{disk}$
- Classification as early type if

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

Results after stacking all the clusters:

- The number of early type galaxies stays roughly constant with radius while the number of late type galaxies strongly increases
- The fraction of early-type galaxies decreases and the fraction of late types increases with radius





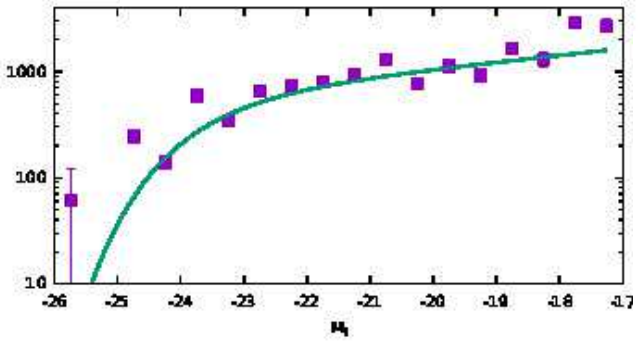
Galaxy luminosity functions (GLF)

Method:

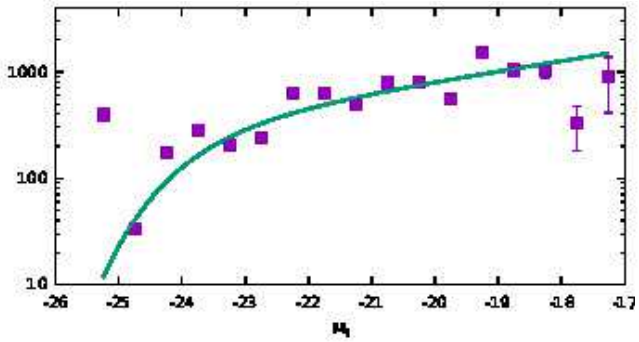
- Detections on rdeep image
- Galaxy-star separation
- Magnitude measurements in 5 bands (u, g, r, i, z) ⇒ 5 band galaxy catalogue
- Selection of galaxies along the red sequence for each cluster
- Same selection applied to COSMOS catalogue by Laigle to estimate the background
- Apply k-correction, estimate galaxy counts in absolute magnitude bins
- Fit of every GLF by a Schechter function

Results for stacked clusters in three mass bins

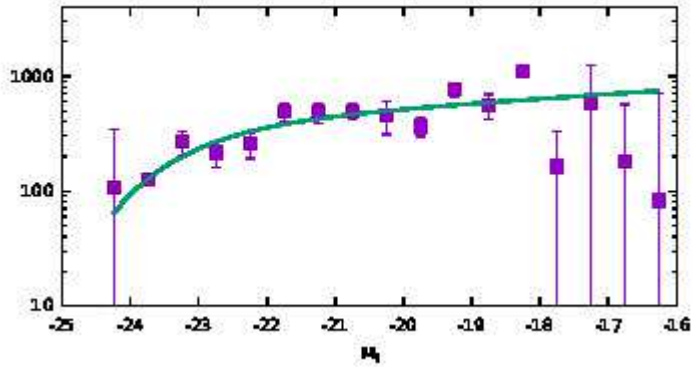
13 high mass clusters
$M > 10^{14} M_0$



16 medium mass clusters
$7\ 10^{13} \leq M \leq 10^{14} M_0$



17 low mass clusters
$M<7\ 10^{13} M_0$



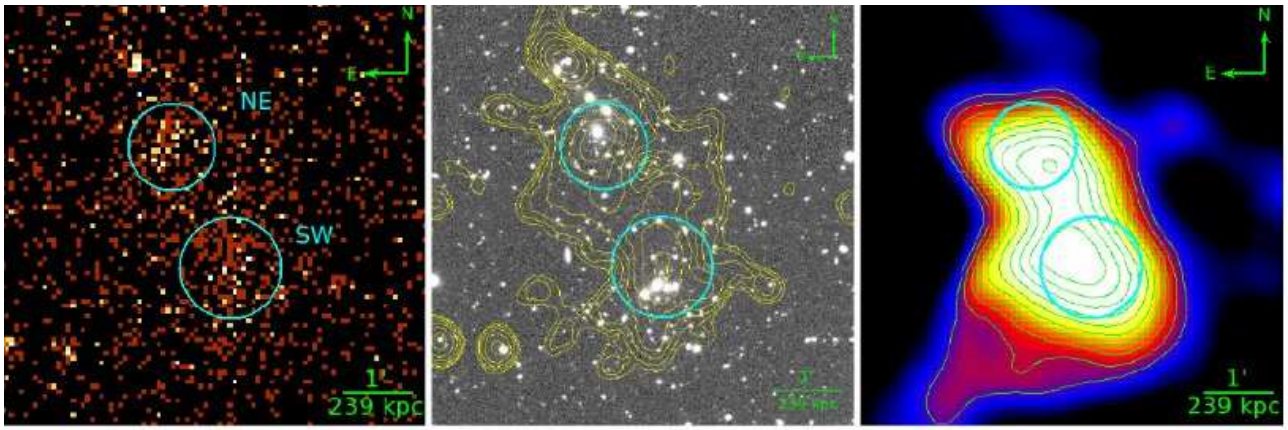
Schechter fit parameters in the four bands g, r, i, z

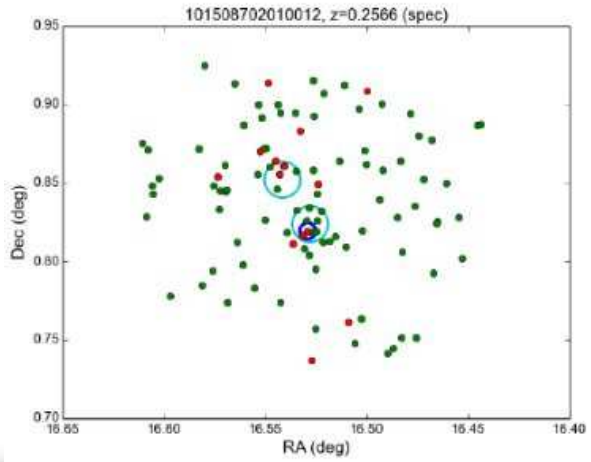
	Low mass ($M < 7\ 10^{13}$ $M_\odot$)	Medium mass ($7\ 10^{13} \leq M \leq 10^{14}$ $M_\odot$)	High mass ($M > 10^{14}$ $M_\odot$)
Φ_g	311 ± 36	260 ± 25	152 ± 19
M^*_g	-26.00 ± 0.17	-23.60 ± 0.12	-25.60 ± 0.19
α_g	-1.054 ± 0.038	-1.306 ± 0.017	-1.360 ± 0.016
Φ_r	178 ± 106	304 ± 15	413 ± 38
M^*_r	-25.02 ± 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

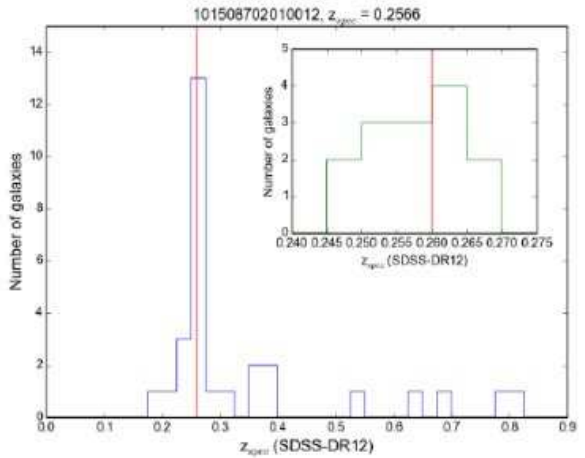
No obvious variation of Schechter parameters with cluster mass

Merging clusters

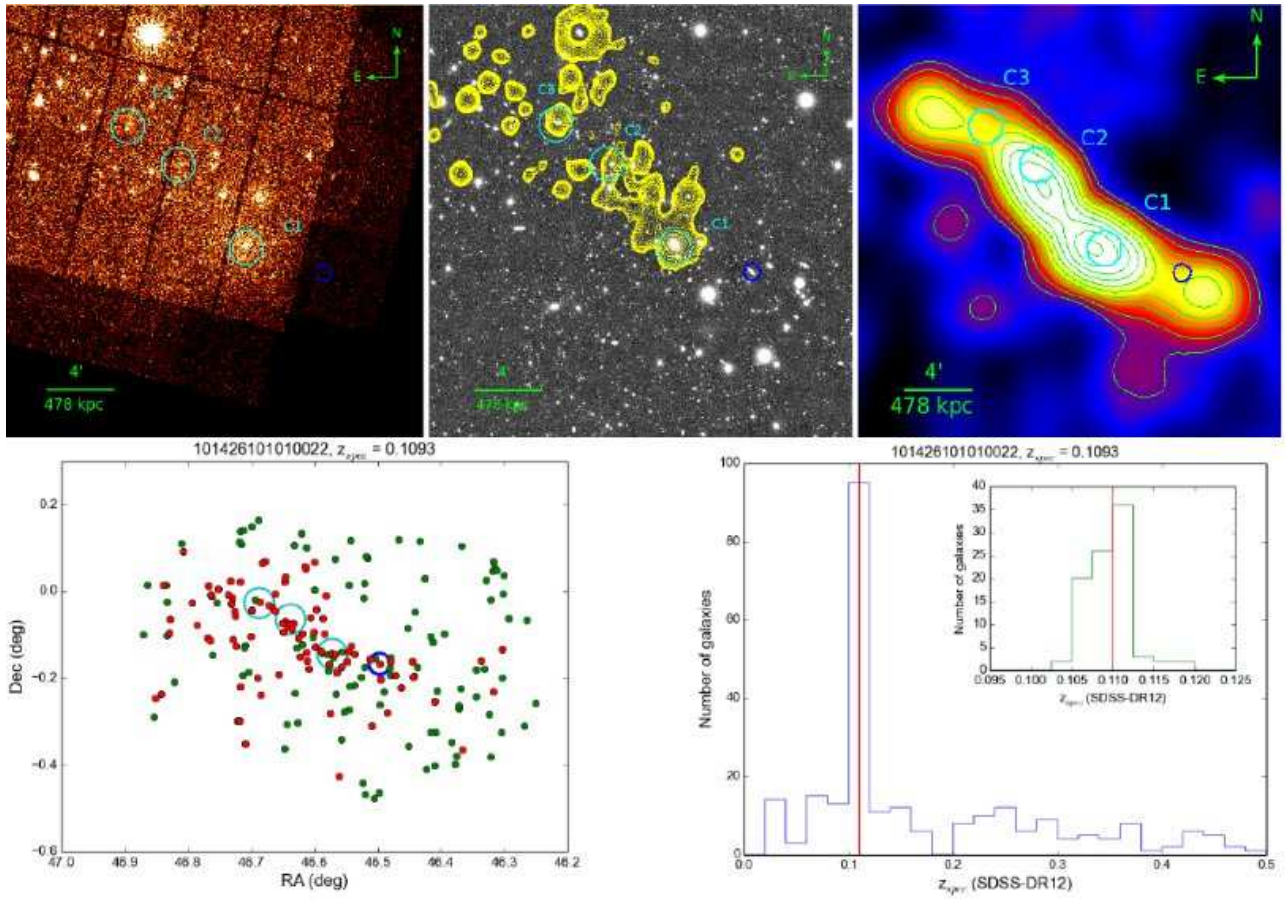
3XMM J010606.7+004925 (z=0.26)







The multiple cluster Abell 412 (z=0.11)



Takey, Durret, Ahmed, Ali 2016, A&A 594, 32

Conclusions and perspectives

- More detailed analysis in X-rays
- Galaxy density maps for the whole sample
- Study of the optical properties of the Brightest Cluster Galaxies (internship next spring)

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Astronomy & Astrophysics

The 3XMM/SDSS Stripe 82 Galaxy Cluster Survey

I. Cluster catalogue and discovery of two merging cluster candidates*

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ABSTRACT

We present a galaxy cluster survey based on *XMM-Newton* observations that are located in Stripe 82 of the Sloan Digital Sky Survey (SDSS). The survey covers an area of 11.25 deg^2. The X-ray cluster candidates were selected as serendipitously extended detected sources from the third *XMM-Newton* serendipitous source catalogue (3XMM-DR5). A cross-correlation of the candidate list that comprises 94 objects with recently published X-ray and optically selected cluster catalogues provided optical confirmations and redshift estimates for about half of the candidate sample. We present a catalogue of X-ray cluster candidates previously known in X-ray and/or optical bands from the matched catalogues or NED. The catalogue consists of 54 systems with redshift measurements in the range of 0.05–1.19 with a median of 0.36. Of these, 45 clusters have spectroscopic confirmations as stated in the matched catalogues. We spectroscopically confirmed another 6 clusters from the available spectroscopic redshifts in the SDSS-DR12. The cluster catalogue includes 17 newly X-ray discovered clusters, while the remainder were detected in previous *XMM-Newton* and/or ROSAT cluster surveys. Based on the available redshifts and fluxes given in the 3XMM-DR5 catalogue, we estimated the X-ray luminosities and masses for the cluster sample. We also present the list of the remaining X-ray cluster candidates (40 objects) that have no redshift information yet in the literature. Of these candidates, 25 sources are considered as distant cluster candidates beyond a redshift of 0.6. We also searched for galaxy cluster mergers in our cluster sample and found two strong candidates for newly discovered cluster mergers at redshifts of 0.11 and 0.26. The X-ray and optical properties of these systems are presented.

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Full length article

Spectral clustering for optical confirmation and redshift estimation of X-ray selected galaxy cluster candidates in the SDSS Stripe 82

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ABSTRACT

We develop a galaxy cluster finding algorithm based on spectral clustering technique to identify optical counterparts and estimate optical redshifts for X-ray selected cluster candidates.[1] As an application, we run our algorithm on a sample of X-ray cluster candidates selected from the third XMM-Newton serendipitous source catalog (3XMM-DR5) that are located in the Stripe 82 of the Sloan Digital Sky Survey (SDSS). Our method works on galaxies described in the color-magnitude feature space. We begin by examining 45 galaxy clusters with published spectroscopic redshifts in the range of 0.1–0.8 with a median of 0.36. As a result, we are able to identify their optical counterparts and estimate their photometric redshifts, which have a typical accuracy of 0.025 and agree with the published ones. Then, we investigate another 40 X-ray cluster candidates (from the same cluster survey) with no redshift information in the literature and found that 12 candidates are considered as galaxy clusters in the redshift range from 0.29 to 0.76 with a median of 0.57. These systems are newly discovered clusters in X-rays and optical data. Among them 7 clusters have spectroscopic redshifts for at least one member galaxy.