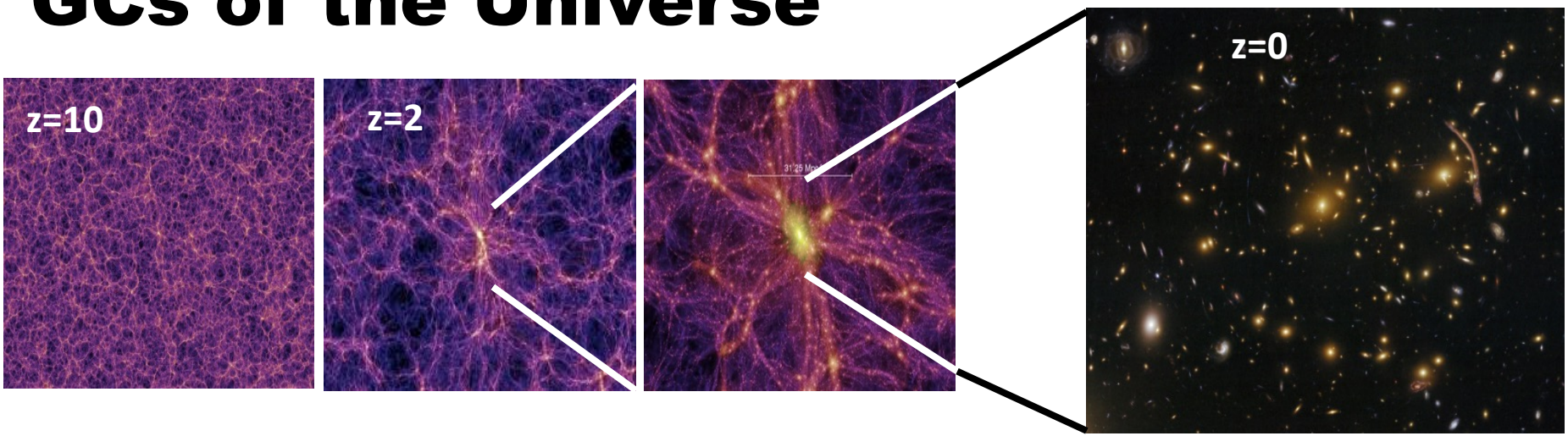
Characterising the most massive GCs of the Universe



What is a Galaxy Cluster?

An **optical (VIS+IR) observer** would say that GCs are **accumulations of galaxies**

An **X-ray/radio astronomer**: a **gas accumulation**

For a **theoretical physicist** : a **DM halo**

Multiwavelength analysis is needed

GCs are the youngest and more massive structures in the Universe, which contain the majority of the DM and where cosmic and galaxy evolution become emphasised

What am I working on?

1. Characterization of the massive clusters a z=0.25-0.5
2. Exploring the nature of clusters with cool-core

1) Why massive clusters (at z=0.25-0.5) are so important?

- There is only about 100 clusters with M_{200}~10^{15} Msun in z=0.25-0.5
- Massive clusters are important key in the LSS evolution.
- As the most massive structures, they show strong lensing efects. So, they can be used to investigate SF at high-z
- Explore the Mdyn/Mx (also Mdyn/Msz) at high mass regime.

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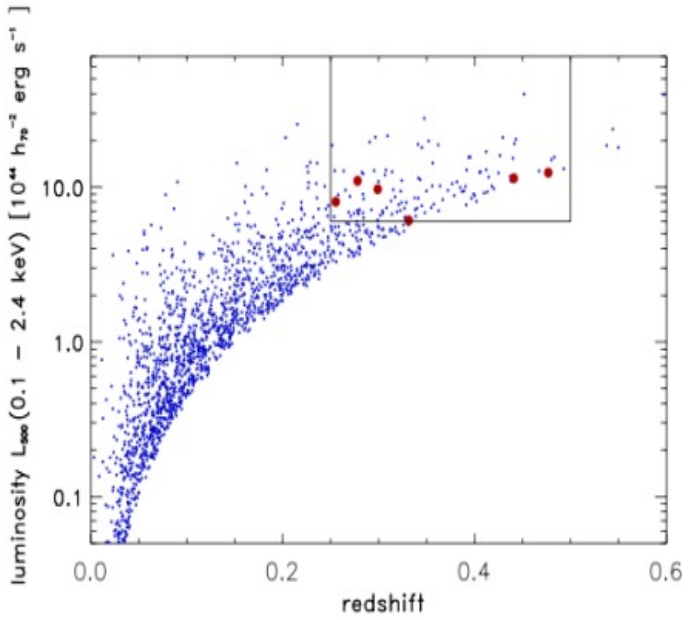
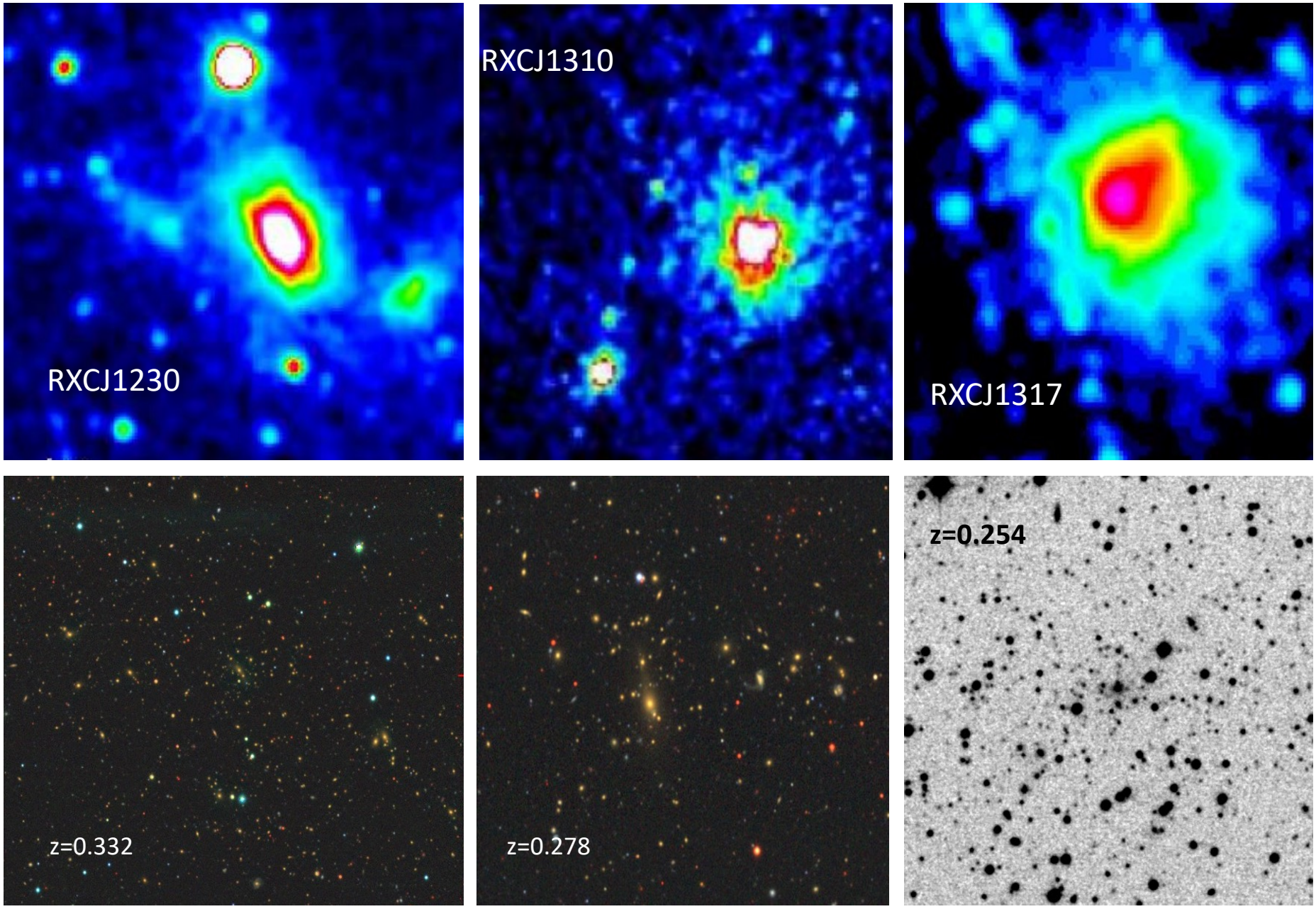
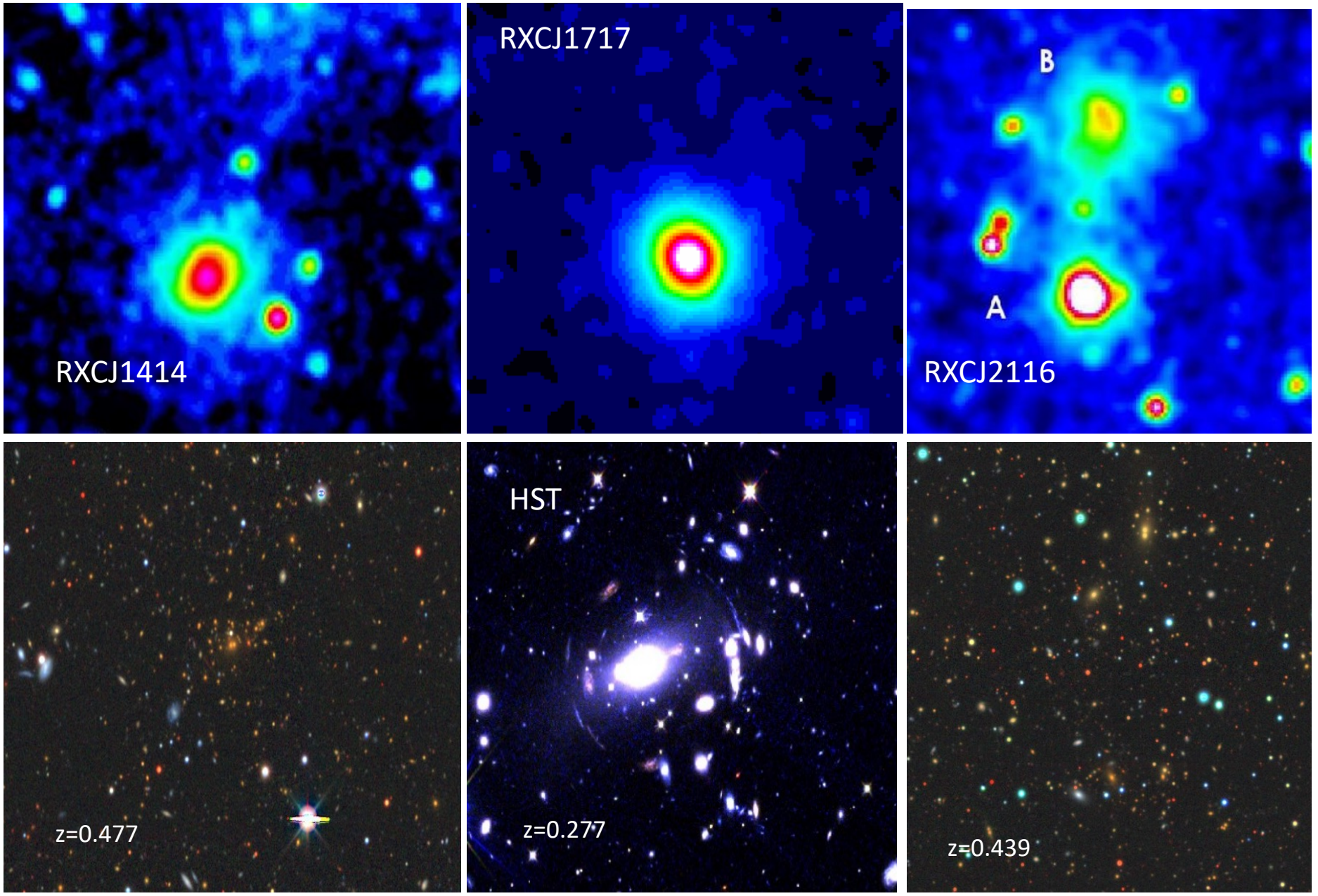


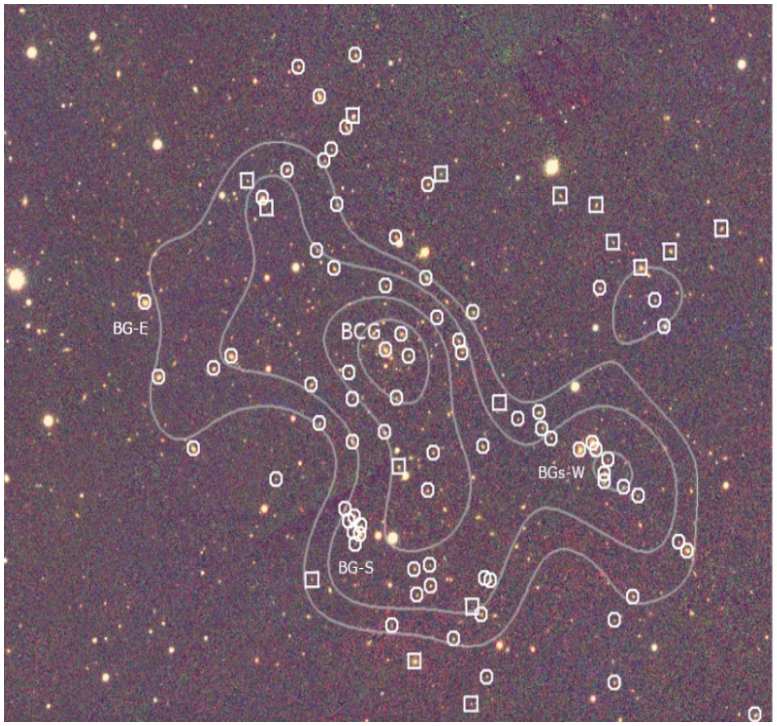
Figure 1: Distribution of the X-ray luminosity and redshift of the REFLEX and NORAS clusters. The six clusters studied with XMM-Newton are marked in red circles, which include the three proposed targets for HST.

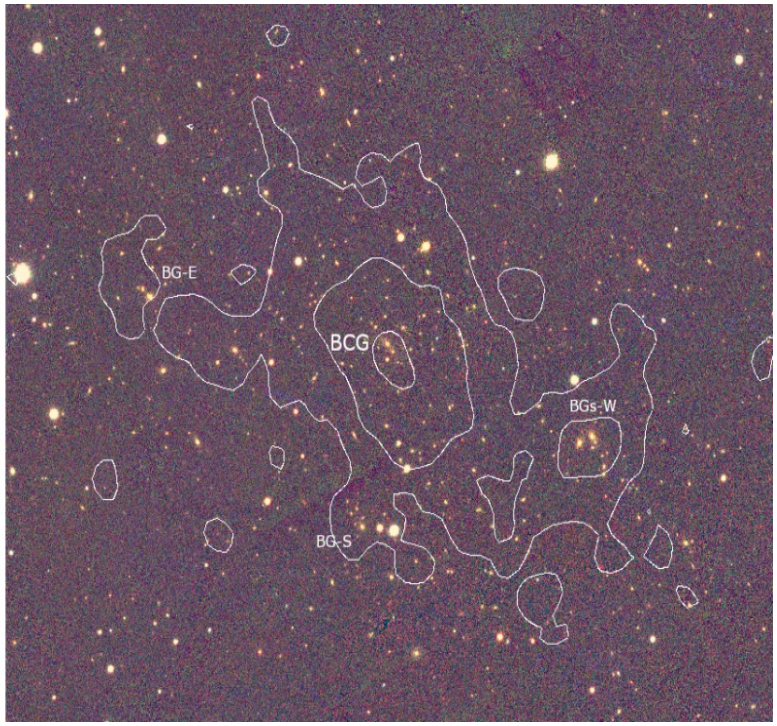
name	z
RXCJ1230.7+3439	0.3324
RXCJ1310.9+2157	0.2781
RXCJ1317.1-3821	0.2539
RXCJ1414.6+2703	0.4770
RXCJ1717.1+2931	0.2772
RXCJ2116.2-0309	0.4390

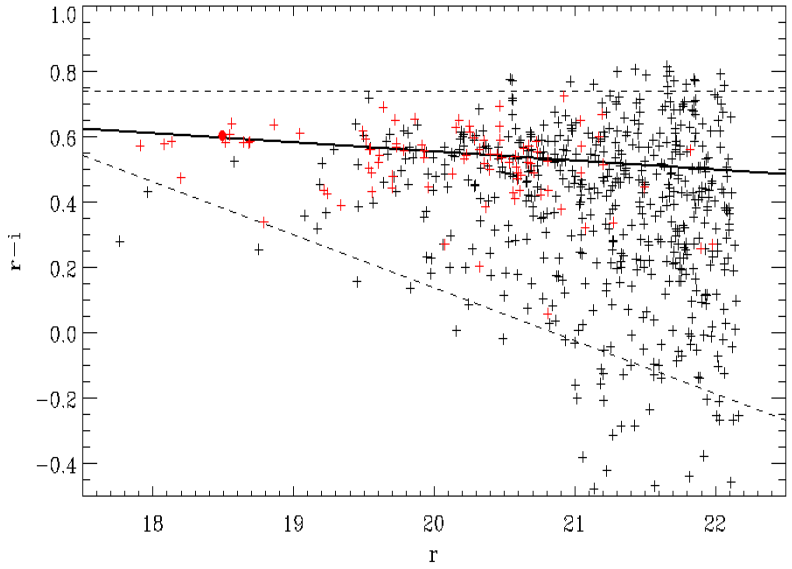

RXCJ1230
RXCJ1310
RXCJ1317
z=0.332
z=0.278
z=0.254

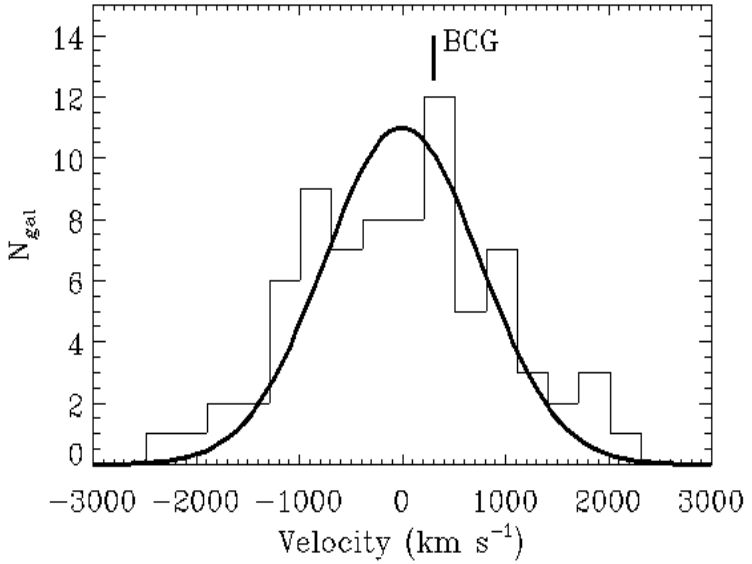

RXCJ1414
RXCJ1717
B
A
RXCJ2116
z=0.477
HST
z=0.277
z=0.439

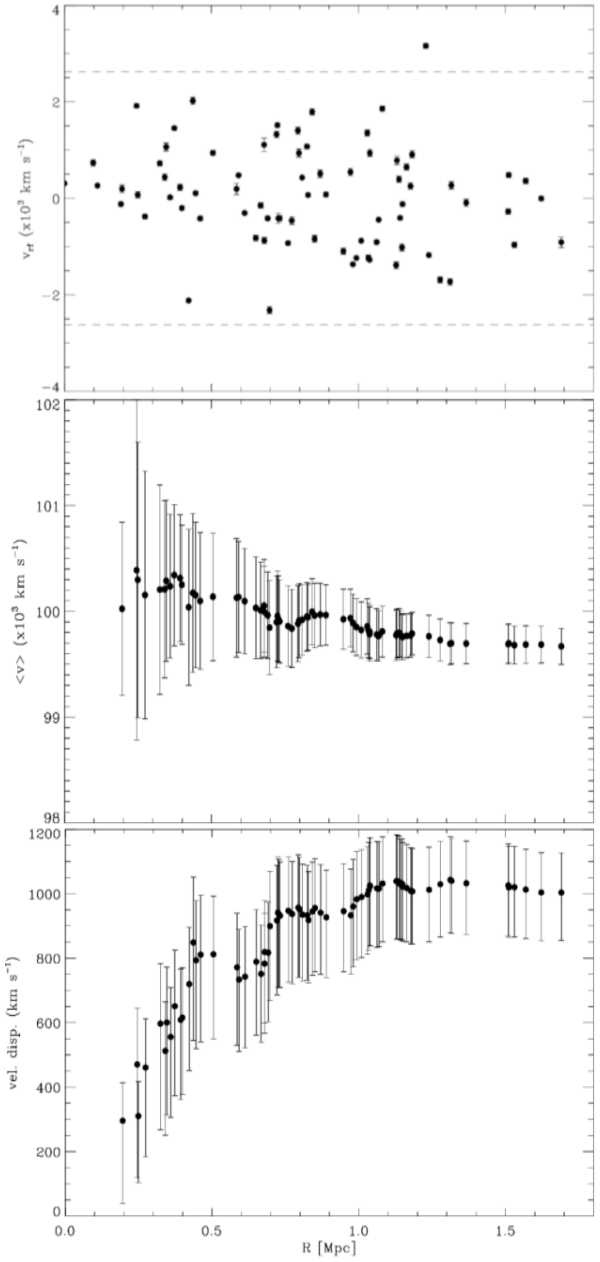
RXCJ1230
(z=0.33)

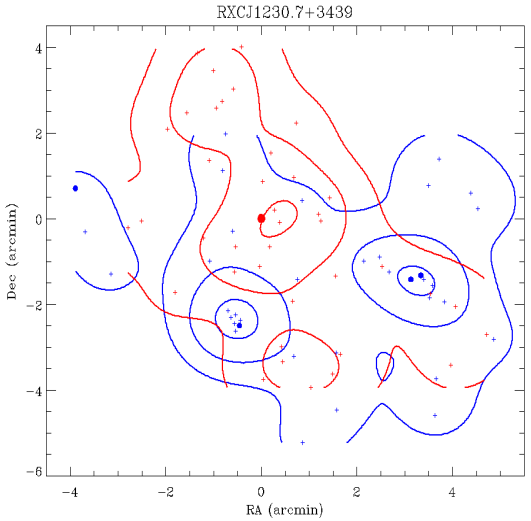


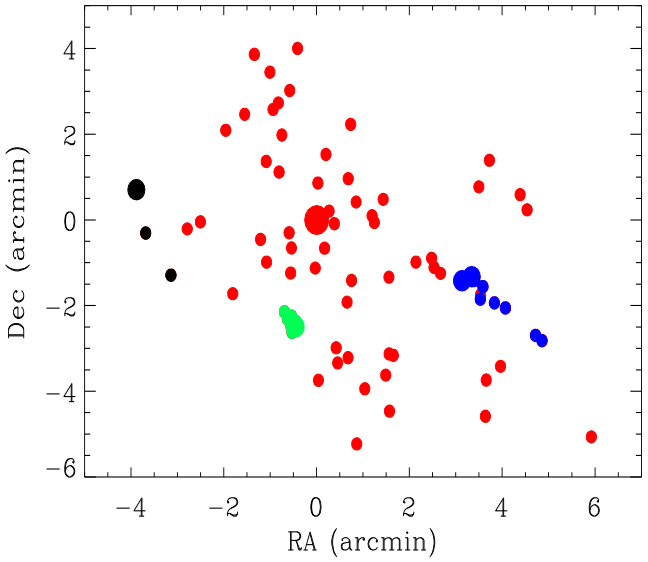












Structure	R.A. & Dec. (J2000) R.A.=12:*mm*:*ss.ss* Dec.=+34:′:″	N_{gal}	$\bar{v}$ (km s^{-1})	σ_v (km s^{-1})	r_{200} (h_{70}^{-1}Mpc)	M_{200} ($\times 10^{14}$ M$_\odot$)	M_{500} ($\times 10^{14}$ M$_\odot$)
Global	30:45.78 39:26.3	77	99658±161	1004^{+147}_{-122}	–	14.1 ± 3.8	9.0 ± 2.3
Centre	30:45.78 39:26.3	58	99967±161	999 ± 160	~ 1.8	9.0 ± 1.5	5.6 ± 1.0
South-West	30:30.55 38:01.4	9	98810±126	792 ± 230	~ 1.5	4.4 ± 3.3	2.7 ± 2.0
East	31:04.67 40:08.7	3	~ 99468	~ 500	~ 0.8	~ 1	~ 0.7
South	30:47.98 36:56.7	7	99090±192	< 300	< 0.5	–	–

$M_{tot} = 1.4 \pm 0.4 \cdot 10^{15}$ Msun

$\Delta v_{LOS,rf} = 870 \pm 153$ km/s

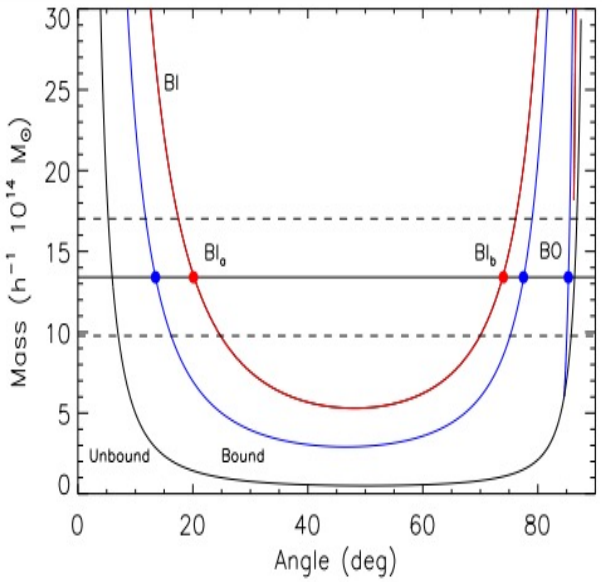
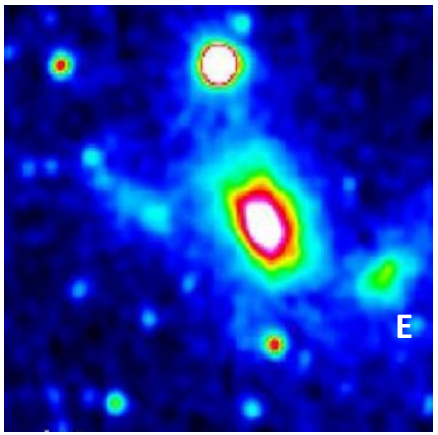


Fig. 8. Two-body model applied to the main cluster and south-west galaxy substructure (C-SW system). The black curve separates bound and unbound regions according to the Newtonian criterion. Solid curves represent the bound incoming (BI) and bound outgoing (BO) solutions. Blue and red curves denote the models for 706 and 1022 km s^{-1}, which represent the marginal relative velocity between main cluster and sub-structure, considering the corresponding uncertainties. The horizontal lines represents the observational values of the total mass of the C-SW system, with it uncertainty (dashed lines).

	<v> (km/s)	$M_{500,dyn}$ ($x10^{14}$ M_o)	$M_{500,X}$ ($x10^{14}$ M_o)	T_X (keV)
Main body	99970 ± 160	5.6 ± 1.0	3.7±0.4	4.7 ± 0.4
SW subcl.	98810 ± 160	2.7 ± 2.0	2.5±0.3	4.4 ± 0.6
E subcl.	-	~1.0	1.3±0.3	



Most likely angle: **α ~ 17°**

Mass ratio impact = **2:1**

Δv_{rf} = **3000 km/s** ; D_{rf} =**1** $\mathbf{h_{70}^{-1}}$ **Mpc**

Merging in about **3 Gyr**

This would explain the 1.5 keV excess in SW subcluster.

The dynamical state of RXCJ1230.7+3439: a multi-substructured merging galaxy cluster

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Received ; accepted

We ana
spectro
density

XMM-Newton study of six massive, X-ray luminous galaxy clusters systems in the redshift range z = 0.25 to 0.5

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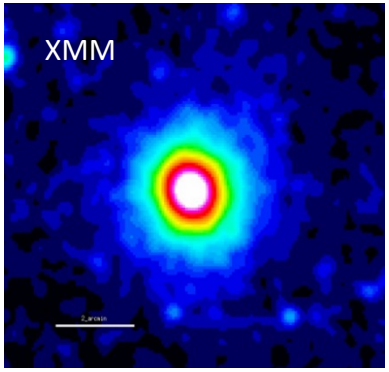
Submitted 25/2/22

ABSTRACT

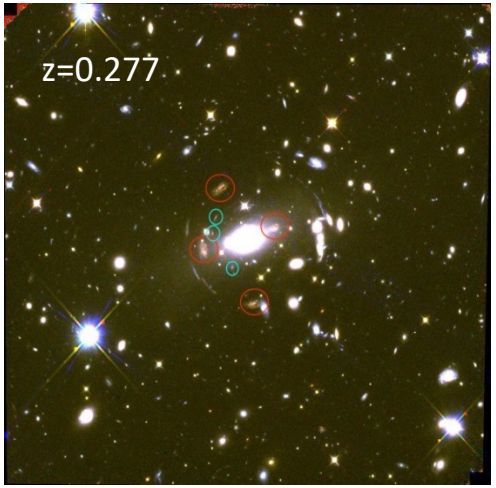
Massive galaxy clusters are interesting astrophysical and cosmological study objects, but are relatively rare. In the redshift range z = 0.25 to 0.5 which is, for example, a favourable region for gravitational lensing studies, about 100 such systems are known.

The lensing cluster J1717.1+2931

Aim: Use this cluster
As cosmological telescope to put constraint at the high-z (3<z<6.5) LF using Ly-α

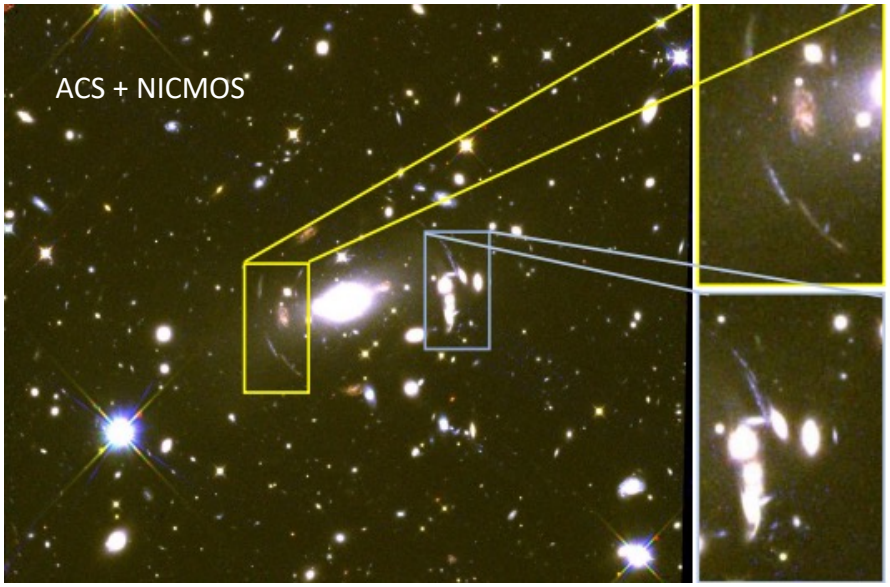


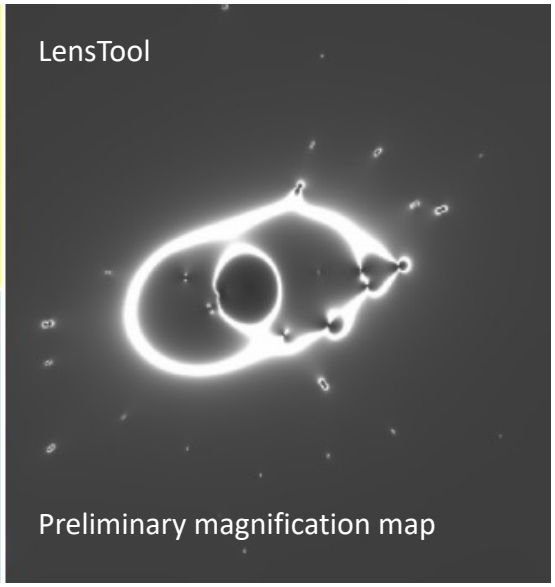
$M_{200,X} \sim 1.5 \cdot 10^{15} M_o$



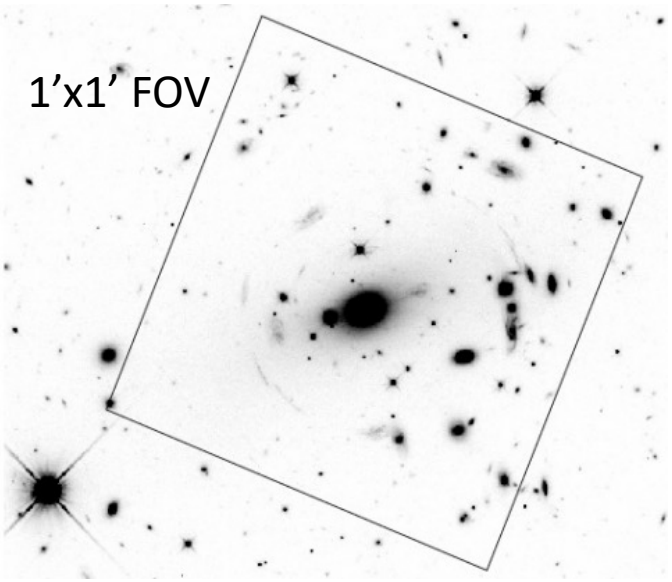
From F814W, F110W & F160W photometry:

Multiple image	z_{phot}
Red 1	0.57±0.08 (1.6)
Red 2	0.46±0.01 (1.6)
Red 3	0.32±0.04 (1.6)
Red 4	0.25±0.15 (1.6)
Blue 1	0.08±0.07 OII (z=1.2)
Blue 2	0.11±0.11 OII (z=1.2)
Blue 3	0.17±0.14 OII (z=1.2)





Arc ID	zphot
1	0.59±0.04
2	0.05±0.04
3	0.33±0.03
4	0.14±0.13
5	0.53±0.06
6	1.65±1.22
7	0.21±0.05
8	0.58±0.08



ESO MUSE/VLT proposal

- 24 pseudo slices
- 4x1h Texp
- m_z <22.4

High-z sources

Redshifts of multiple images, arcs and Lyα emitters

CAT OSIRIS/GTC proposal

- 90 gals, 60 members
- 2 masks (PA=0 and 90 deg)
- 2x2h Texp
- i<24

Cluster members

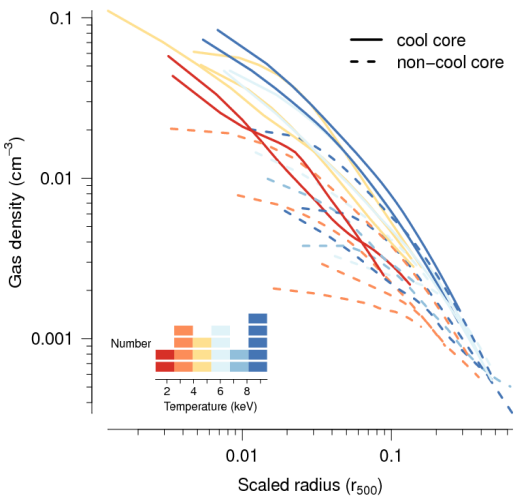
Determine the dynamical mass

- Obtain an accurate mass distribution and magnification map in this cluster
- Explore the high-z star-forming galaxies

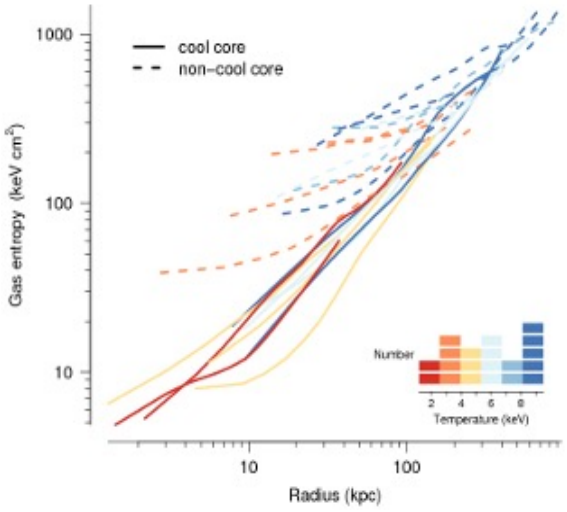
2) Nearby clusters with cool-core

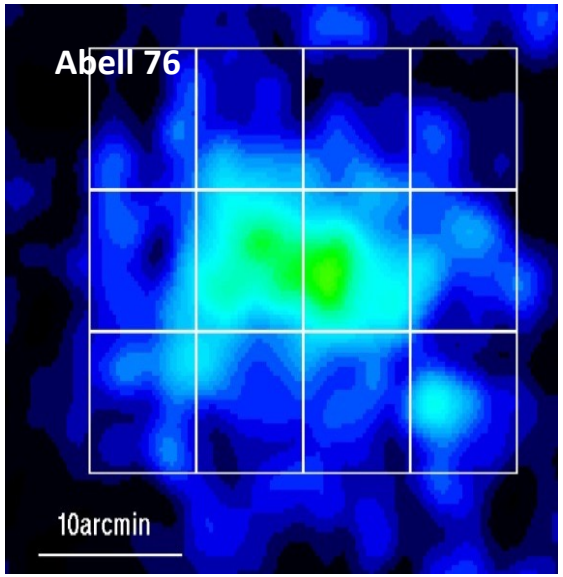
- What are these kind of clusters? Unveil the nature of these clusters
- Gas vs galaxy clump distribution
- Clarify the Mx-Mdyn scaling relation

Density ↑

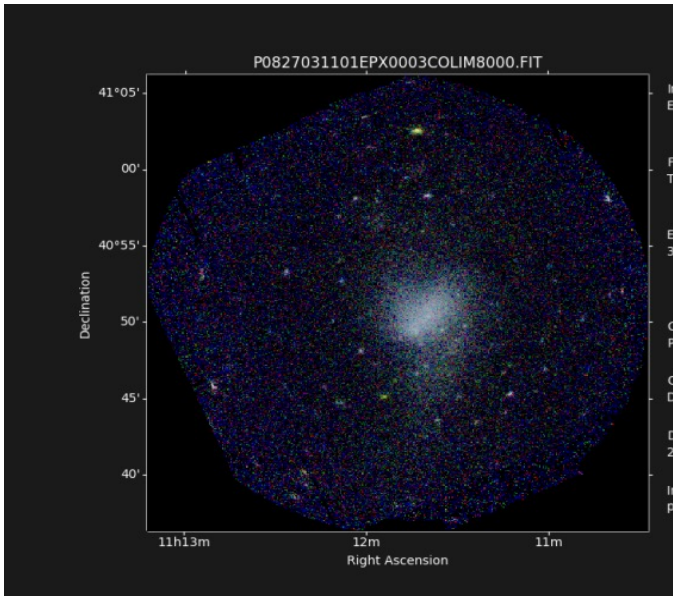


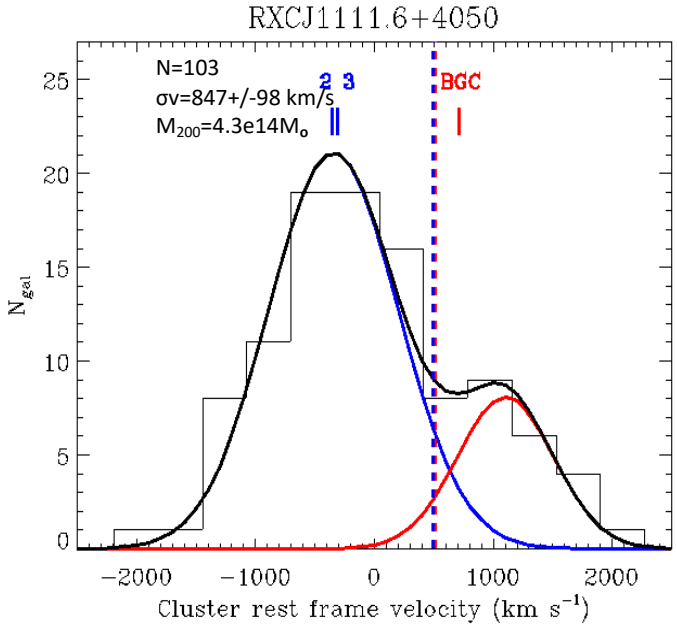
Entropy and Tx ↓

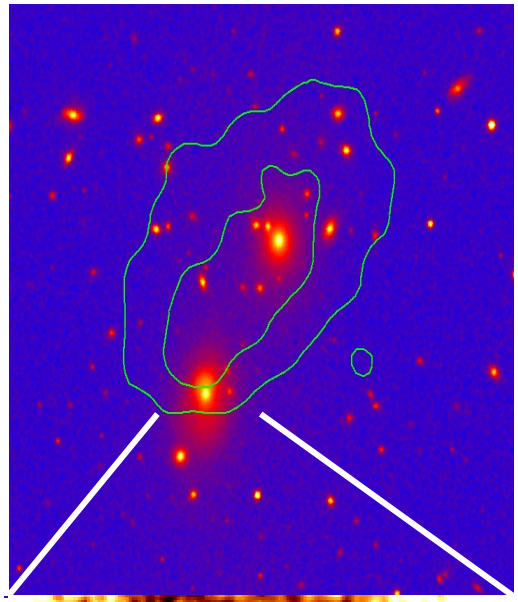


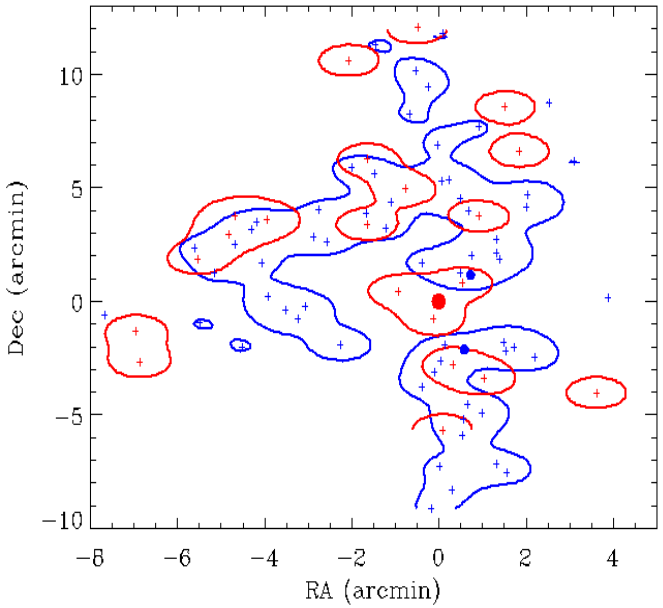


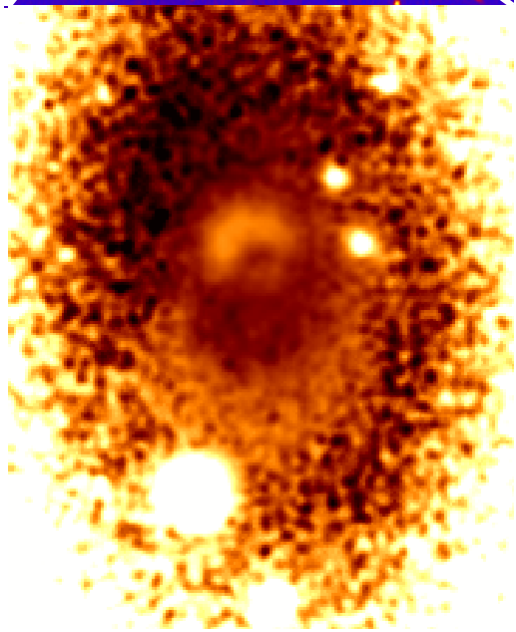
The nearby cluster J1111.6+4050 (z=0.076)



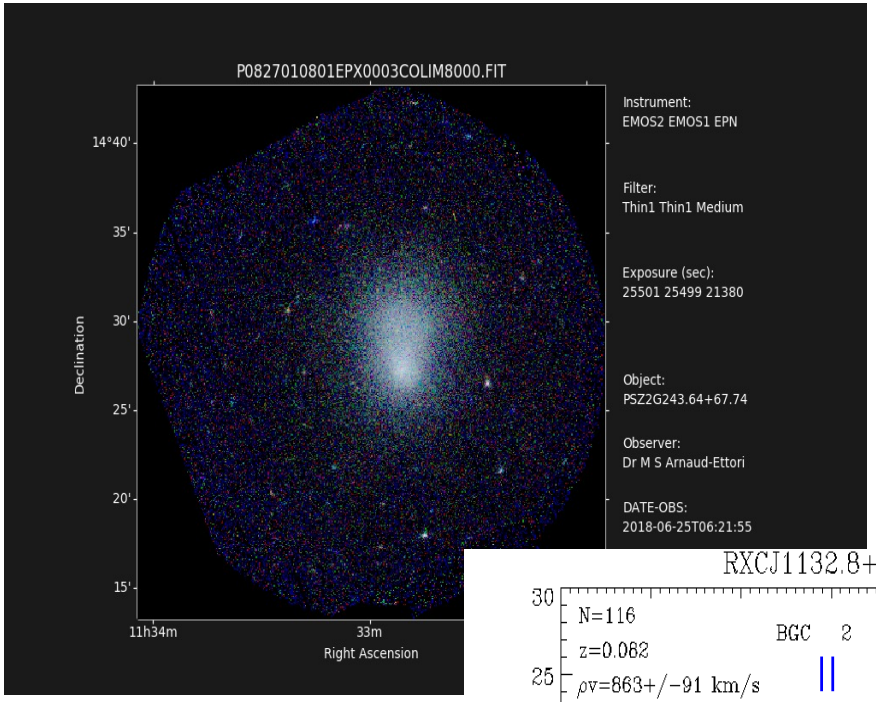


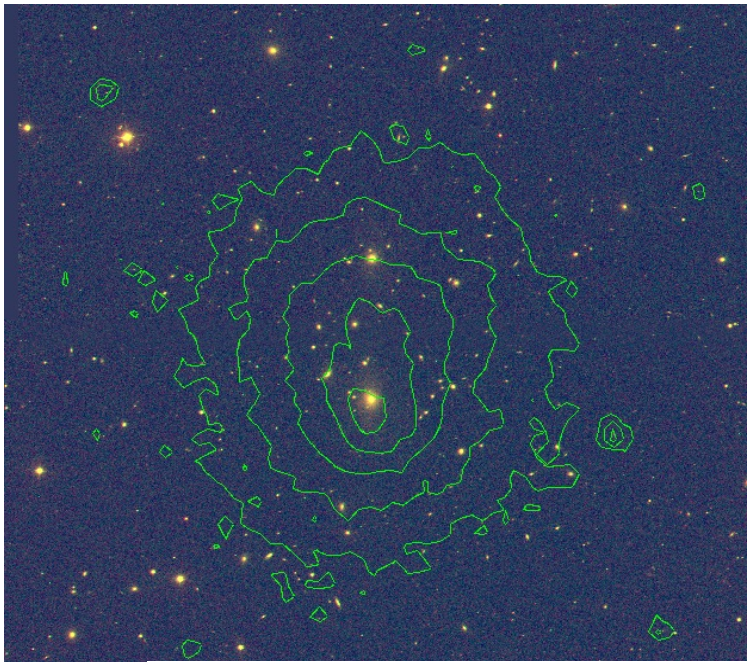


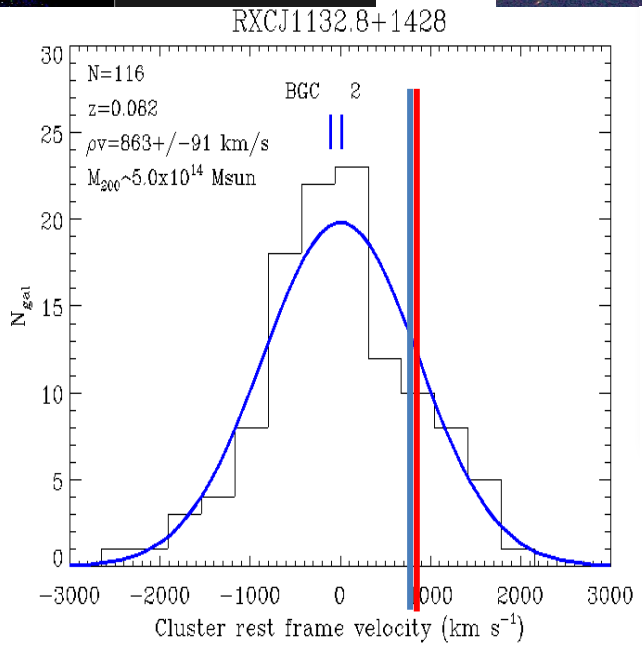


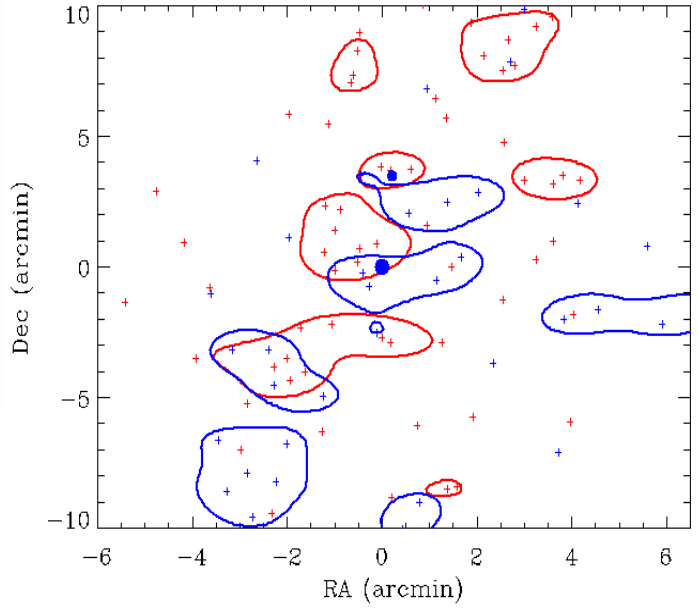


The nearby cluster J1132.8+1428 (z=0.082)









Conclusions

No conclusions yet!!
This is a work in progress.

My suspects …

- Even these massive clusters are not completely relaxed and show important mergers.
- They gravitational lensing effects. This offers an good opportunity to study the distribution of DM in clusters and use them as cosmological telescopes to explore the universe at high z.

- The connection between merger events and cool-core is not clear