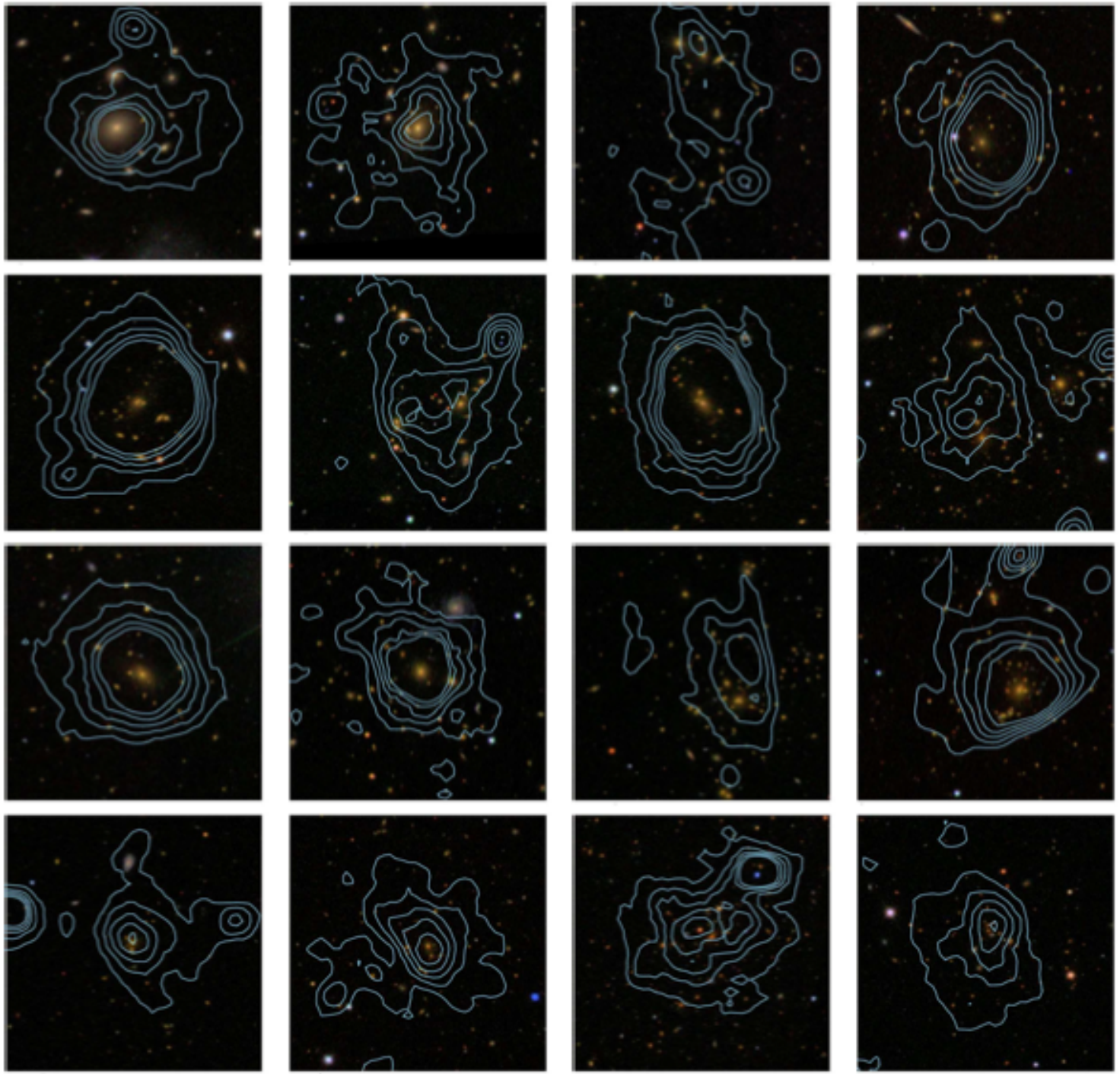
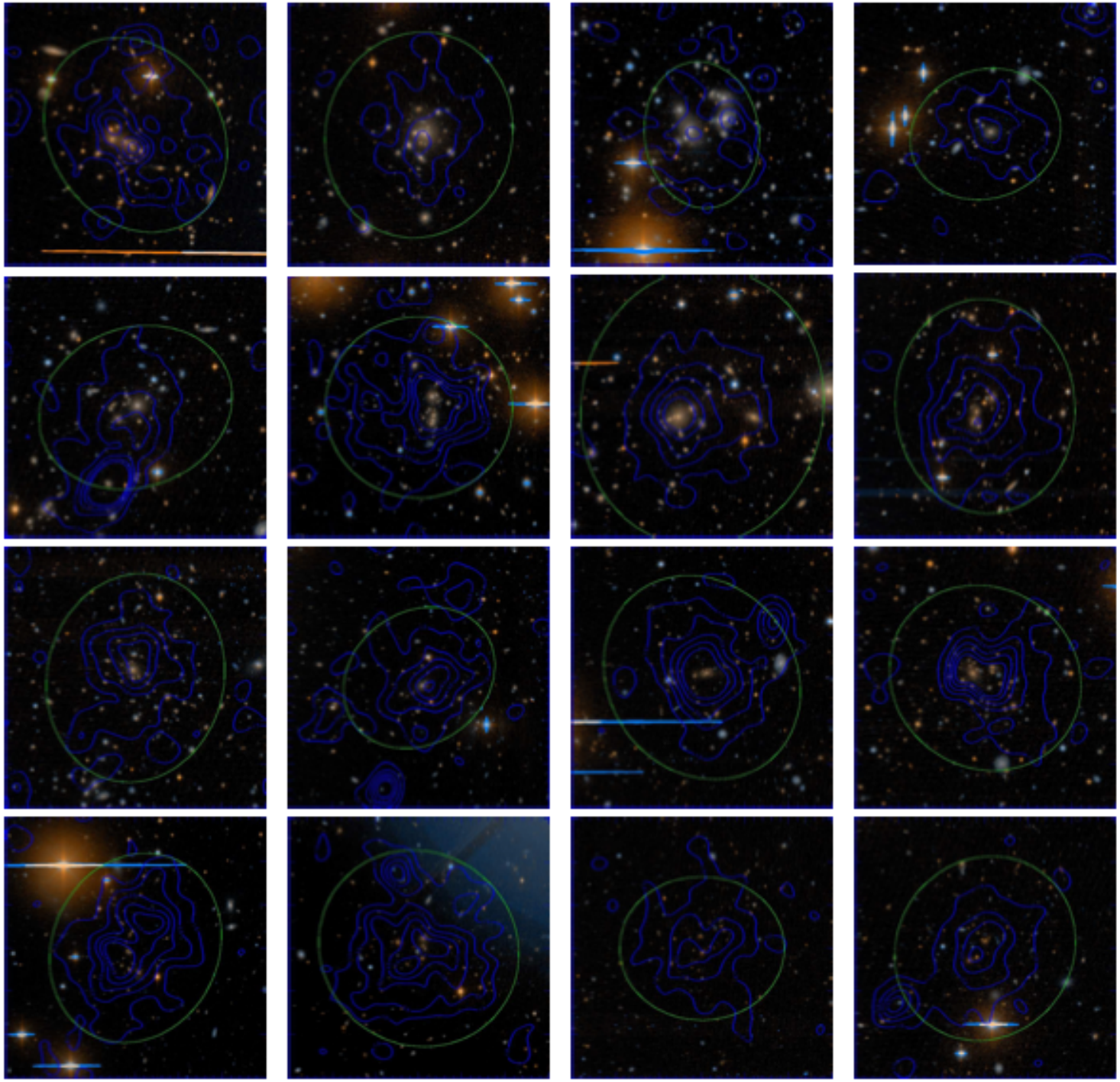
The XMM Cluster Survey First Data Release

Kathy Romer, Nicola Mehrtens, Ed Lloyd-Davies
(University of Sussex)
on behalf of the XCS collaboration





All the images will be available via www.xcs-home.org

XMMXCS J132830.2+470357.2	178	0.38	SDSS	4.1	1.4	4.3	
XMMXCS J132958.9+241124.6	126	0.17	LRG	2.3	1.0	2.1	
XMMXCS J133107.1-015837.4	162	0.20	LRG	2.5	0.7	1.6	
XMMXCS J133254.8+503153.1	2596	0.28	Lit	6.1	0.5	0.5	RBS 1283
XMMXCS J133439.5+504327.1	280	0.24	SDSS				MaxBCG J203.66157+50.72443
XMMXCS J133457.7+375020.3	690	0.38	Lit	8.3	5.0	12.2	NSCS J133503+374945
XMMXCS J133505.3+502336.3	688	0.09	LRG	1.1	0.1	0.1	
XMMXCS J133511.5-232917.2	669	0.10	NXS	1.2	0.2	0.3	
XMMXCS J133514.1+374905.8	294	0.60	Lit	4.1	0.7	0.9	MJM98 034
XMMXCS J133559.1+375400.8	101	0.25	LRG	1.7	1.6	7.3	
XMMXCS J133605.0+514531.2	1006	0.53	SDSS	1.2	0.2	0.4	
XMMXCS J133909.2+481152.7	172	0.41	LRG	1.2	0.2	0.4	
XMMXCS J134124.3-010204.0	229	0.29	LRG	2.2	0.6	2.7	MaxBCG J205.35590-01.04186
XMMXCS J134139.3+001733.9	214	0.44	SDSS	2.1	0.5	0.6	BPG2004 J134139.1+001739.3
XMMXCS J134305.1-000056.8	1338	0.55	SDSS	4.1	0.7	0.9	BPG2004 J134304.8-000056.3
XMMXCS J134326.9+554648.3	209	0.07	LRG	1.1	0.3	0.2	400d J1343+5546
XMMXCS J134645.9+264625.7	259	0.43	LRG				
XMMXCS J134825.6+580015.8	637	0.13	LRG	1.1	0.1	0.3	
XMMXCS J134851.8+600942.5	188	0.44	SDSS	1.9	0.2	0.4	
XMMXCS J134949.7+270605.3	145	0.42	LRG	1.6	0.4	0.8	
XMMXCS J135358.8+335003.1	553	0.47	LRG	2.5	0.4	0.4	NSCS J135400+335023
XMMXCS J135449.3+691738.6	549	0.21	Lit	2.7	0.7	0.8	RX J1354.8+6917
XMMXCS J135541.9+182545.4	236	0.28	SDSS	1.5	0.5	0.7	

(this column is embargoed at the moment)

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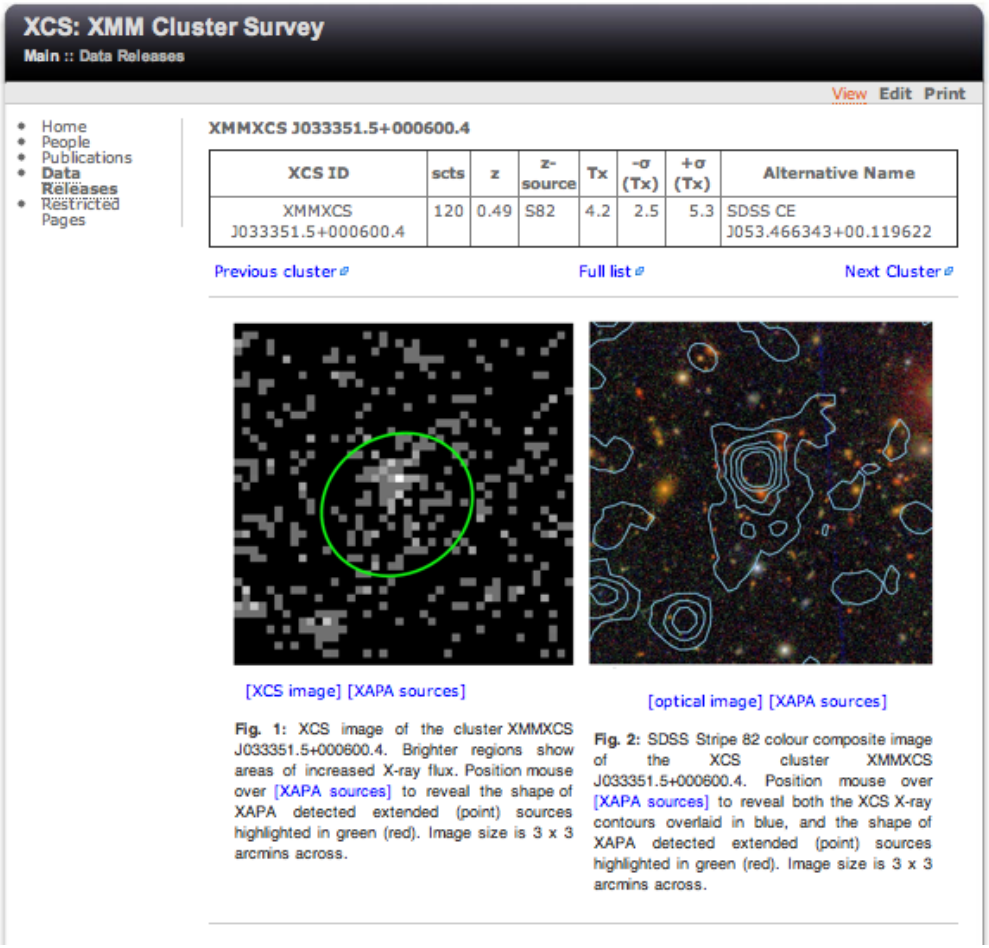

XCS: XMM Cluster Survey

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XMMXCS J033351.5+000600.4

XCS ID	scts	z	z-source	Tx	-σ (Tx)	+σ (Tx)	Alternative Name
XMMXCS J033351.5+000600.4	120	0.49	S82	4.2	2.5	5.3	SDSS CE J053.466343+00.119622

Previous cluster Full list Next Cluster

[XCS image] [XAPA sources]

Fig. 1: XCS image of the cluster XMMXCS J033351.5+000600.4. Brighter regions show areas of increased X-ray flux. Position mouse over [XAPA sources] to reveal the shape of XAPA detected extended (point) sources highlighted in green (red). Image size is 3 x 3 arcmins across.

[optical image] [XAPA sources]

Fig. 2: SDSS Stripe 82 colour composite image of the XCS cluster XMMXCS J033351.5+000600.4. Position mouse over [XAPA sources] to reveal both the XCS X-ray contours overlaid in blue, and the shape of XAPA detected extended (point) sources highlighted in green (red). Image size is 3 x 3 arcmins across.

This page will go live once the paper is on astro-ph.

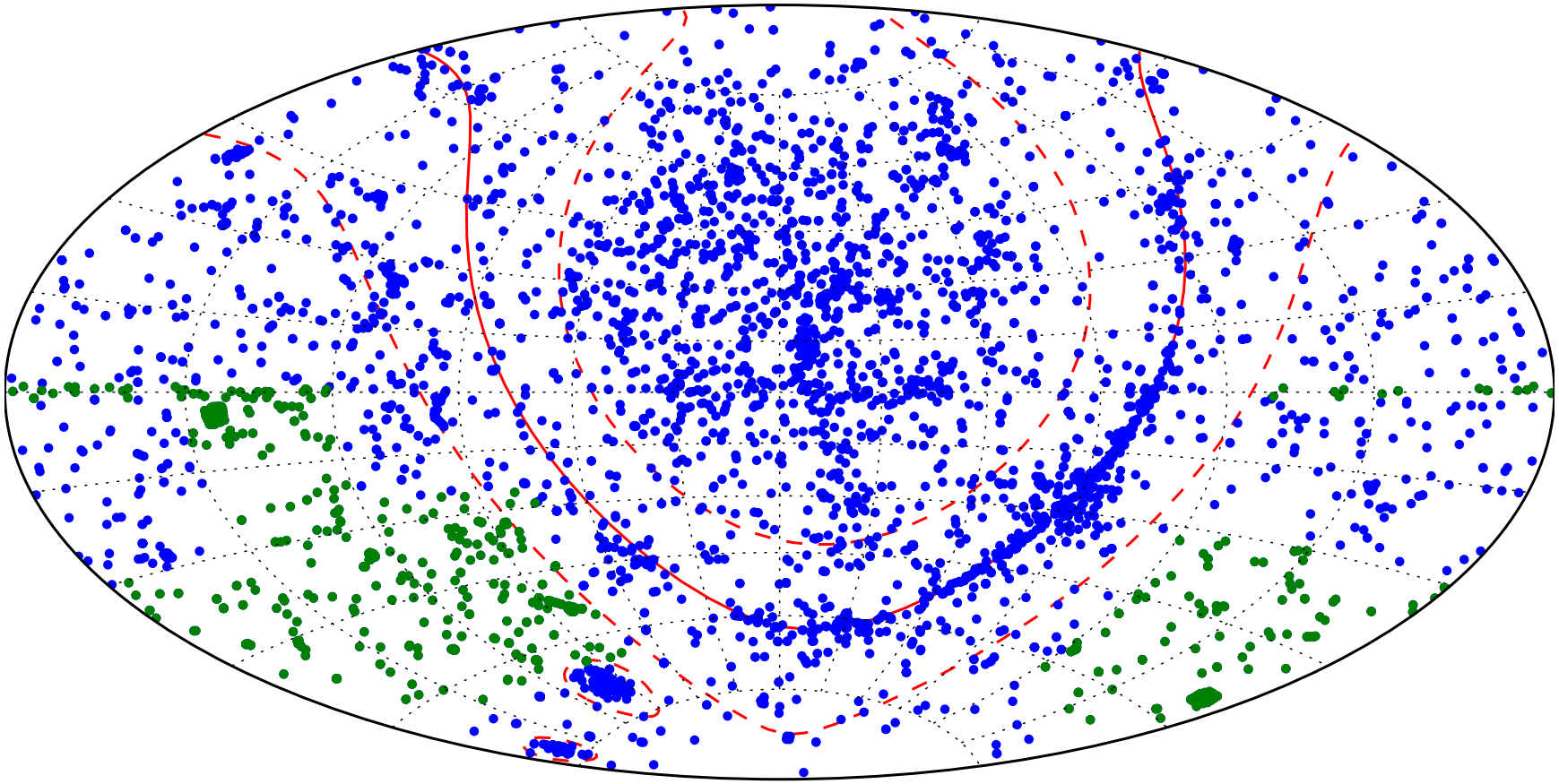
Overview

- Development of the first data release (DR1)
- Properties of the DR1 sample
- Applications of the DR1 sample and XCS pipelines

Development of DR1

There are ~6000 observations in the XMM archive

~400 sq.deg (*non-overlapping*) for cluster searching

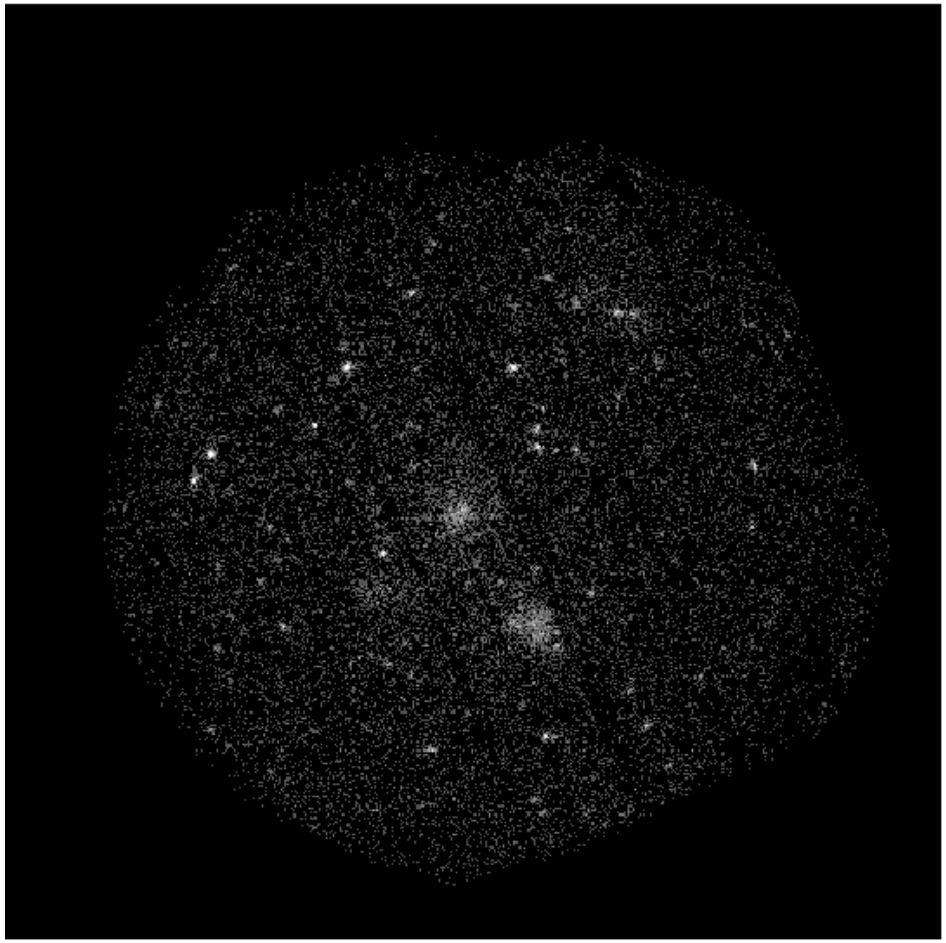


Green dots represent observations in the DES footprint.

Regions within red dashed lines are excluded from the cluster sample.

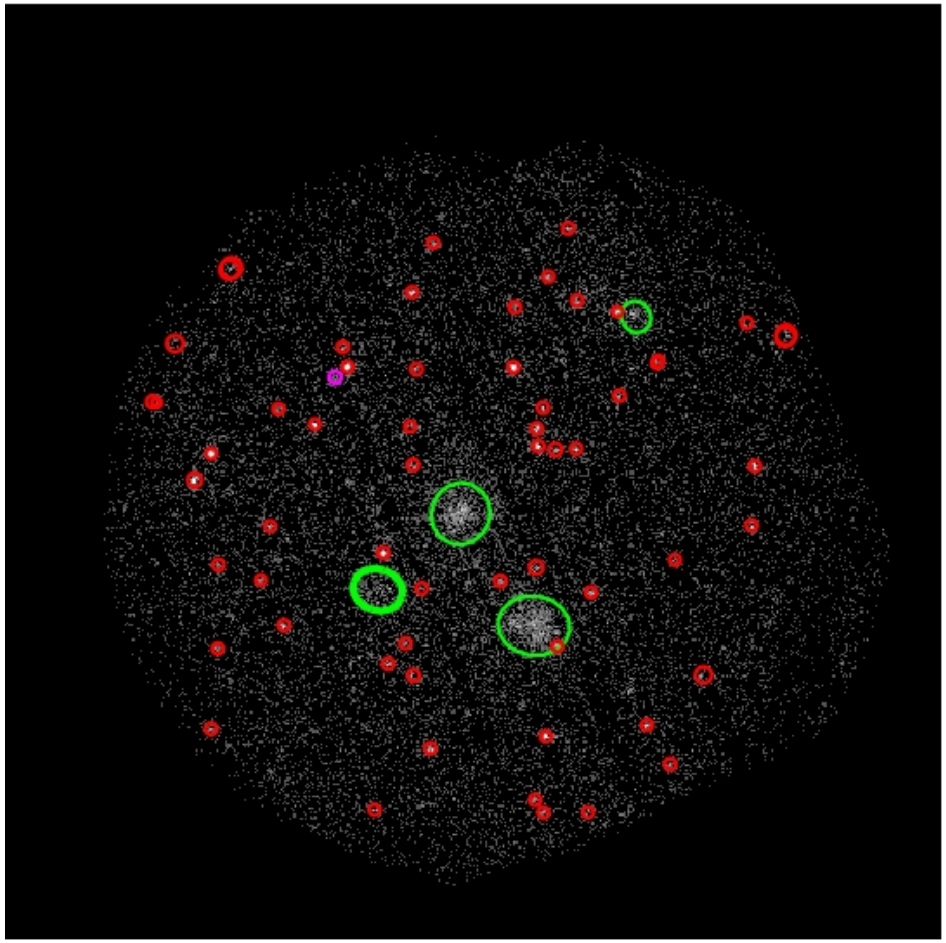
Development of DR1

Download the raw data; make images.



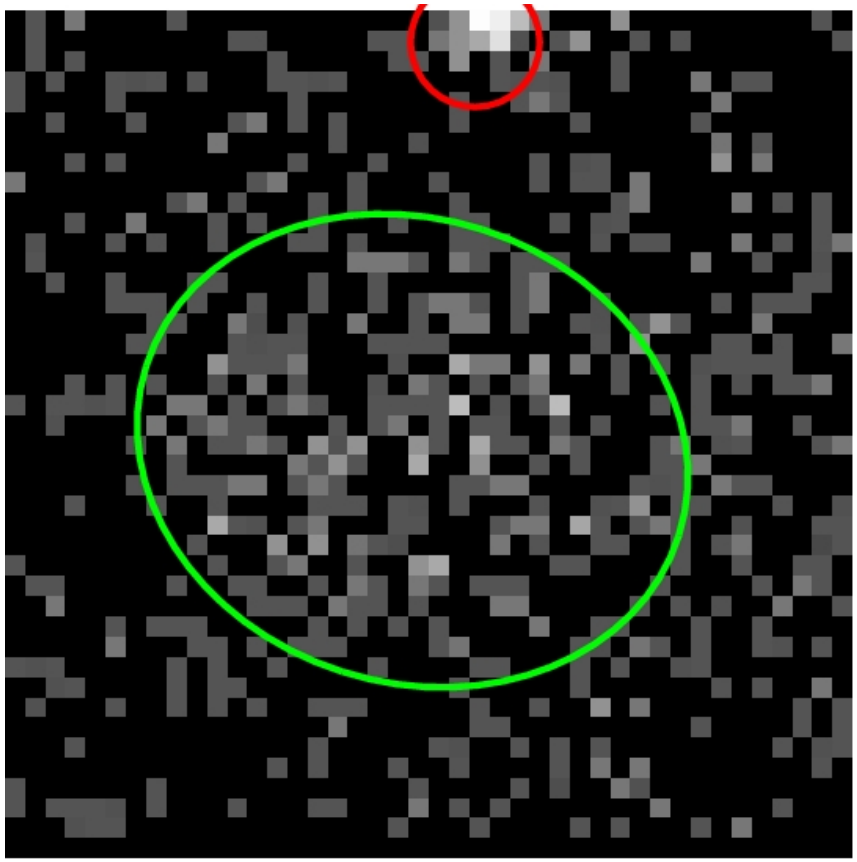
Development of DR1

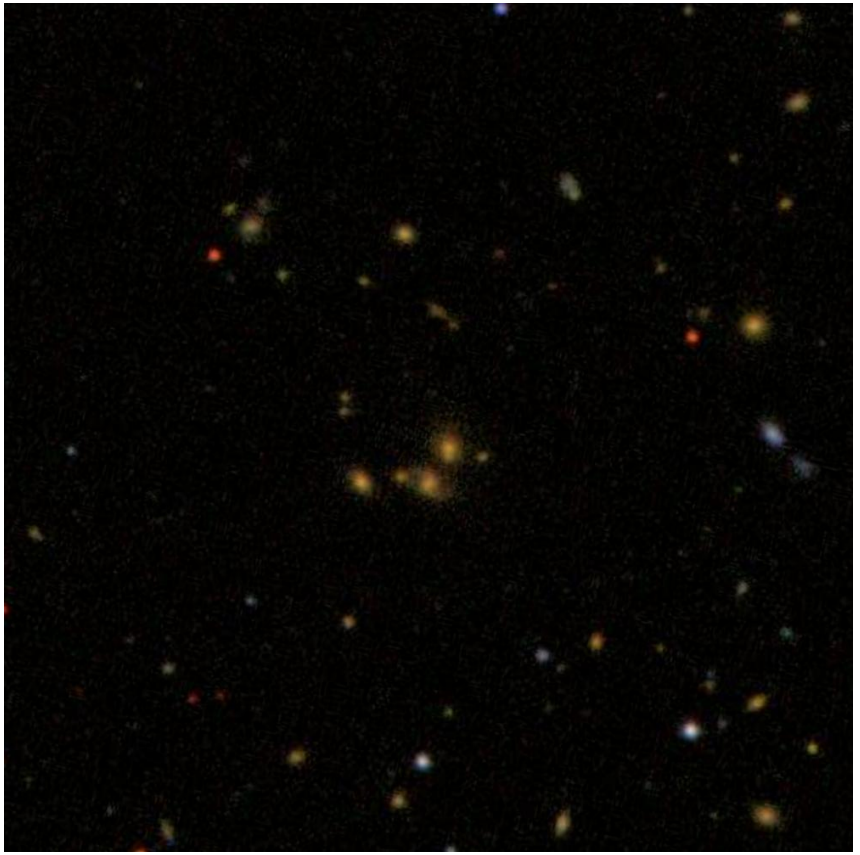
Find the sources; figure out which are extended.



Development of DR1

Check if the extended sources are clusters using optical data





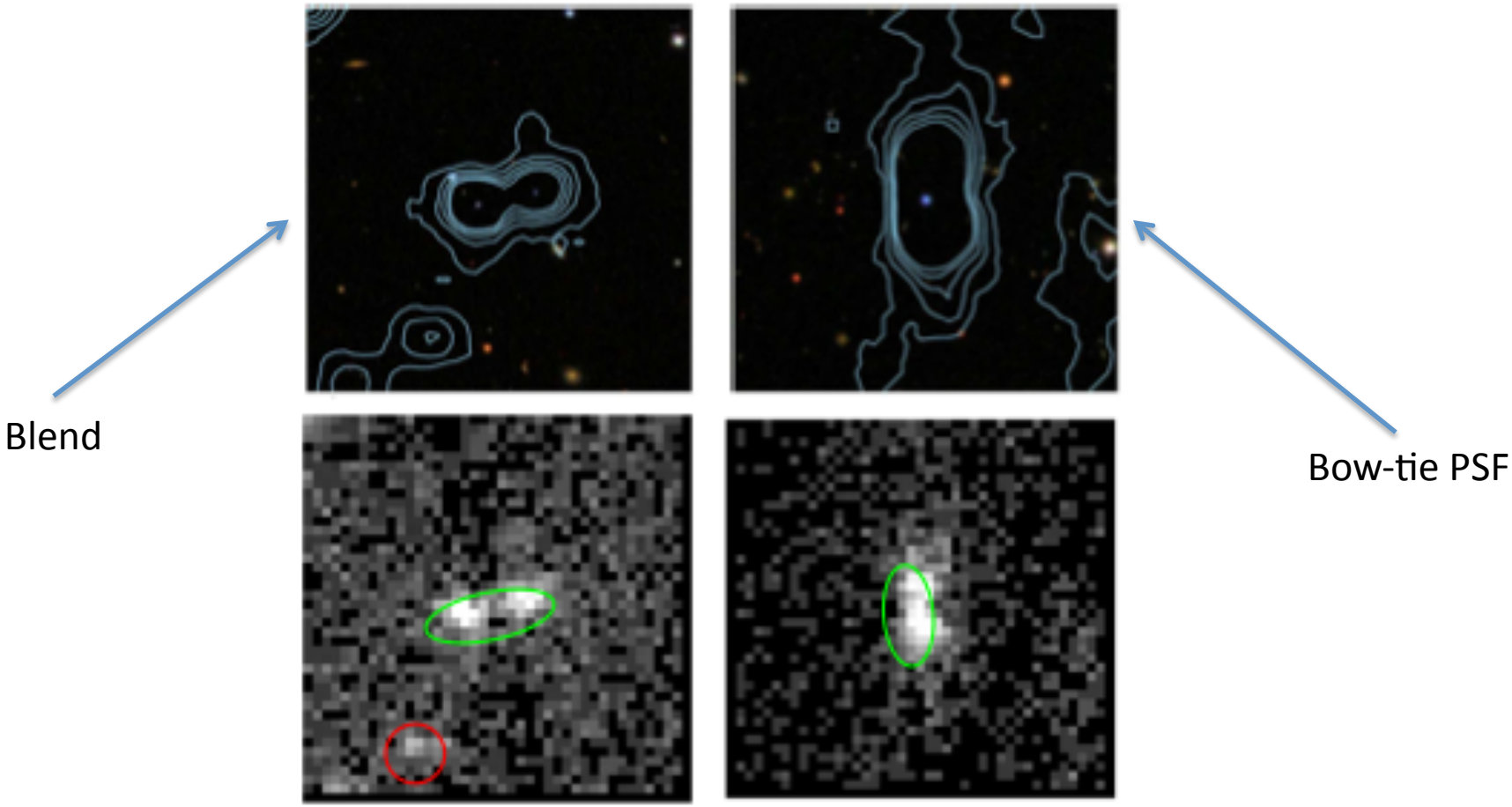
Development of DR1

Summary of optical identifications (505 identified so far)

- Eye-ball programme (similar to *Galaxy-Zoo*) for candidates with imaging from:
  - SDSS-DR7
  - Stripe 82 (SDSS co-add region)
  - The NOAO-XCS Survey (NXS)
- Plus detailed checks of the literature
  - when XCS re-detects known clusters, with published redshifts, outside the areas above

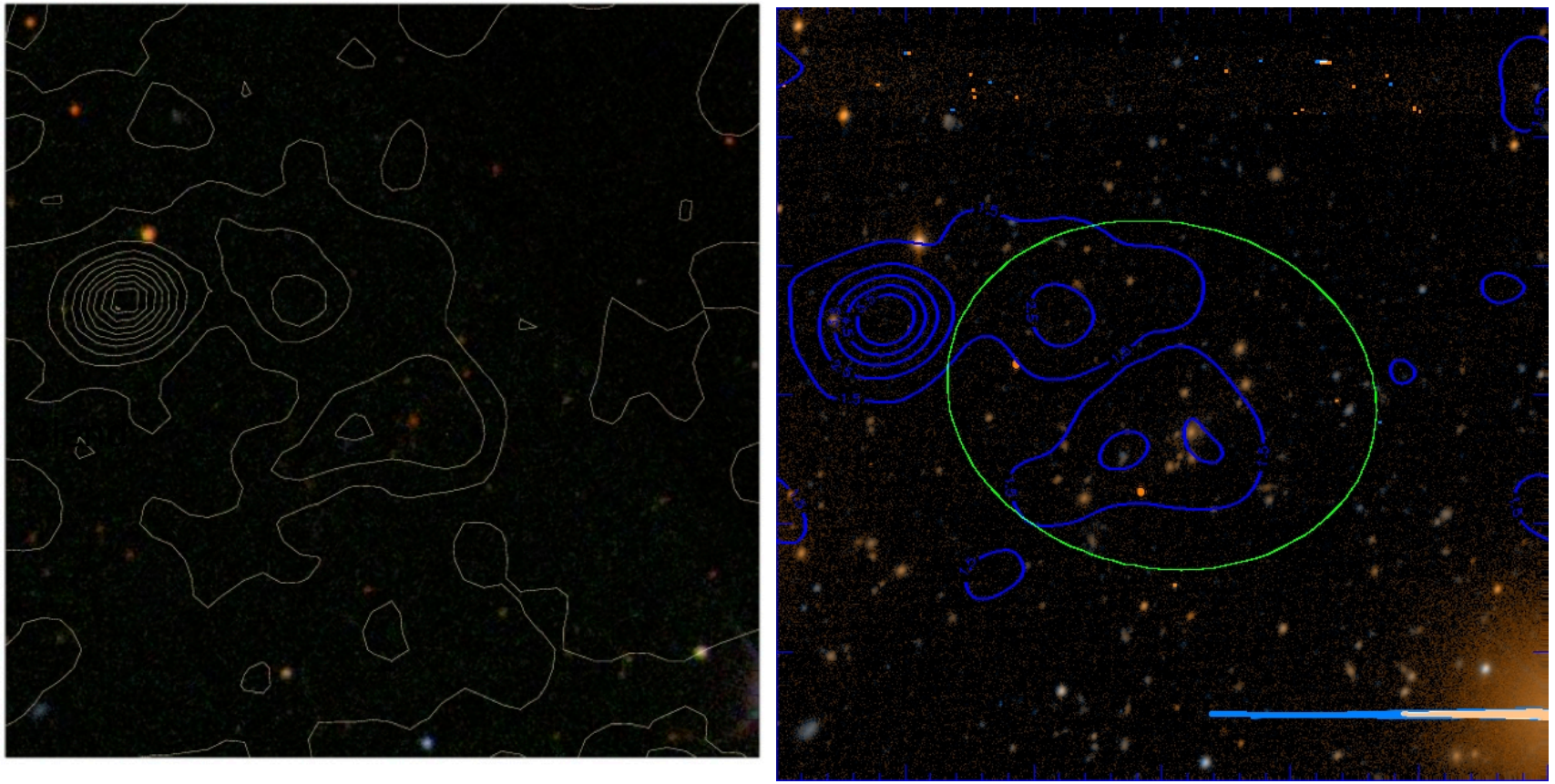
Development of DR1

The DR1 *Zoo* work allows us to reduce the eye-ball element in future.



Development of DR1

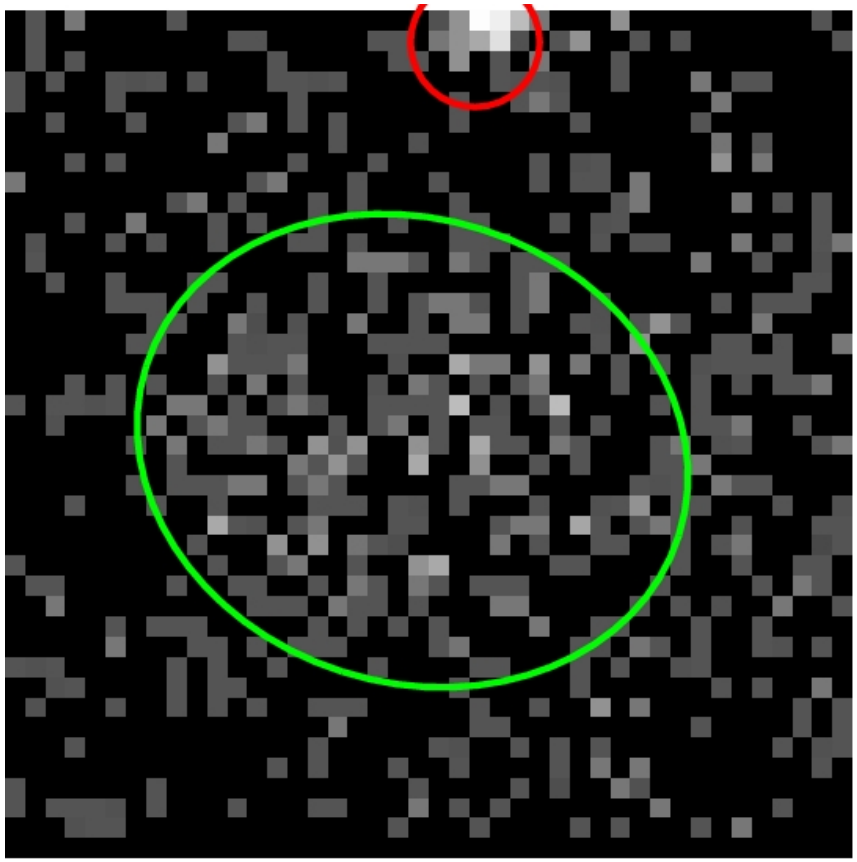
*Zoo w*ork has also shown the importance of deep imaging

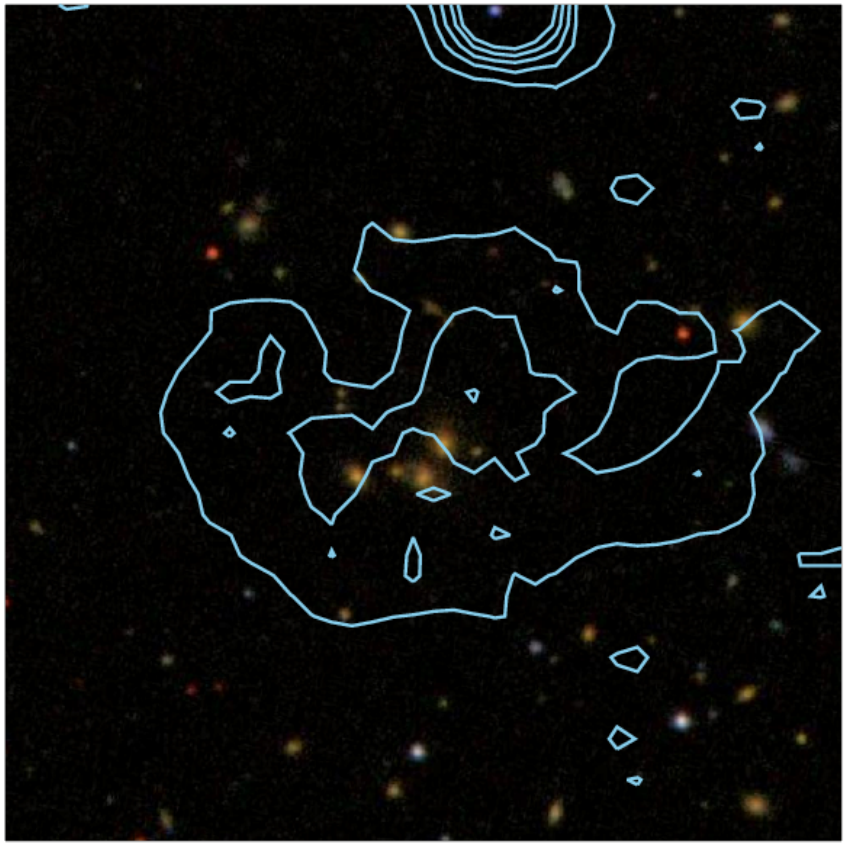


Cluster at z=0.52 in SDSS (left) and in NXS (right)

Development of DR1

Measure redshifts, temperatures and luminosities





Development of DR1

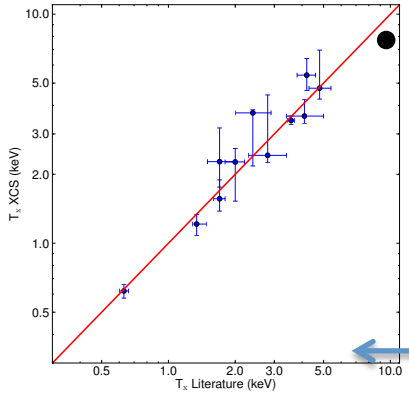
Summary of redshift follow-up of DR1 clusters (463 z's so far)

- Spectroscopic redshifts (139)
  - From our own work
  - From SDSS
  - From the literature
- Photometric (CMR) redshifts (324*)
  - From the NXS
  - From SDSS-DR7
  - From Stripe 82

*many of the 139 clusters with spec-z's also have photometric redshifts

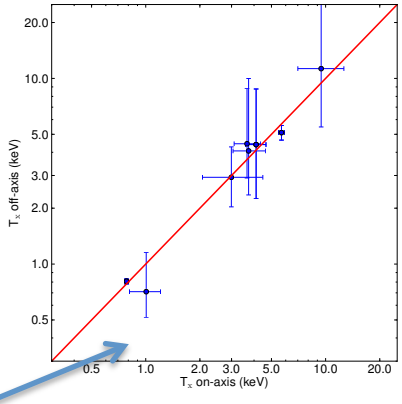
Development of DR1

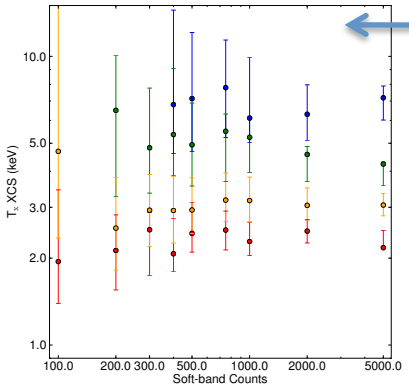
We have pipelines to measure T_x and L_x

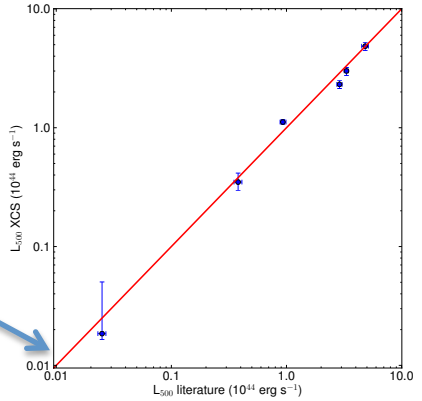


In Lloyd-Davies et al. (1010.6195) we showed that we can:

- Measure Tx with pipelines
- Measure Tx far off axis
- Measure Tx down to low counts
- Measure Lx with pipelines

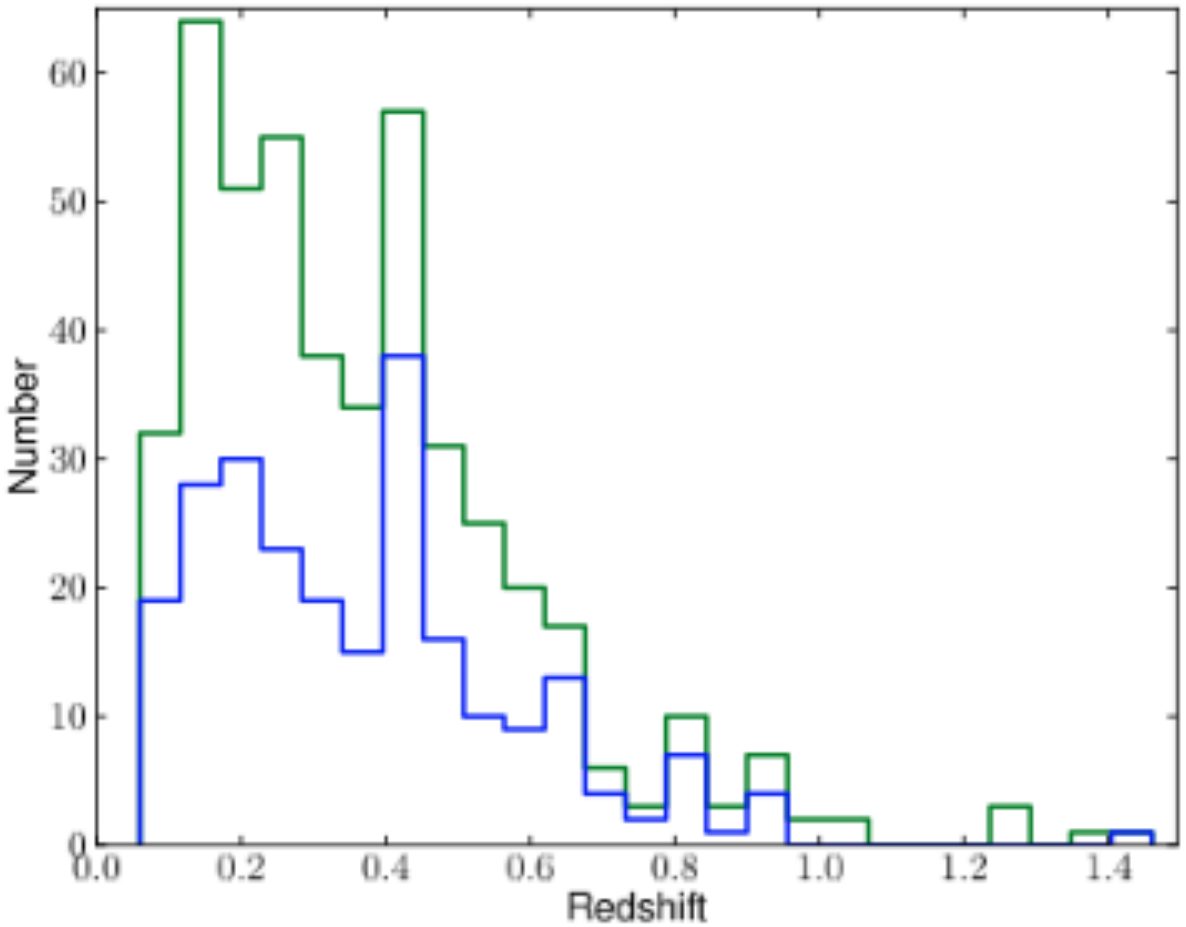






Properties of the DR1 sample

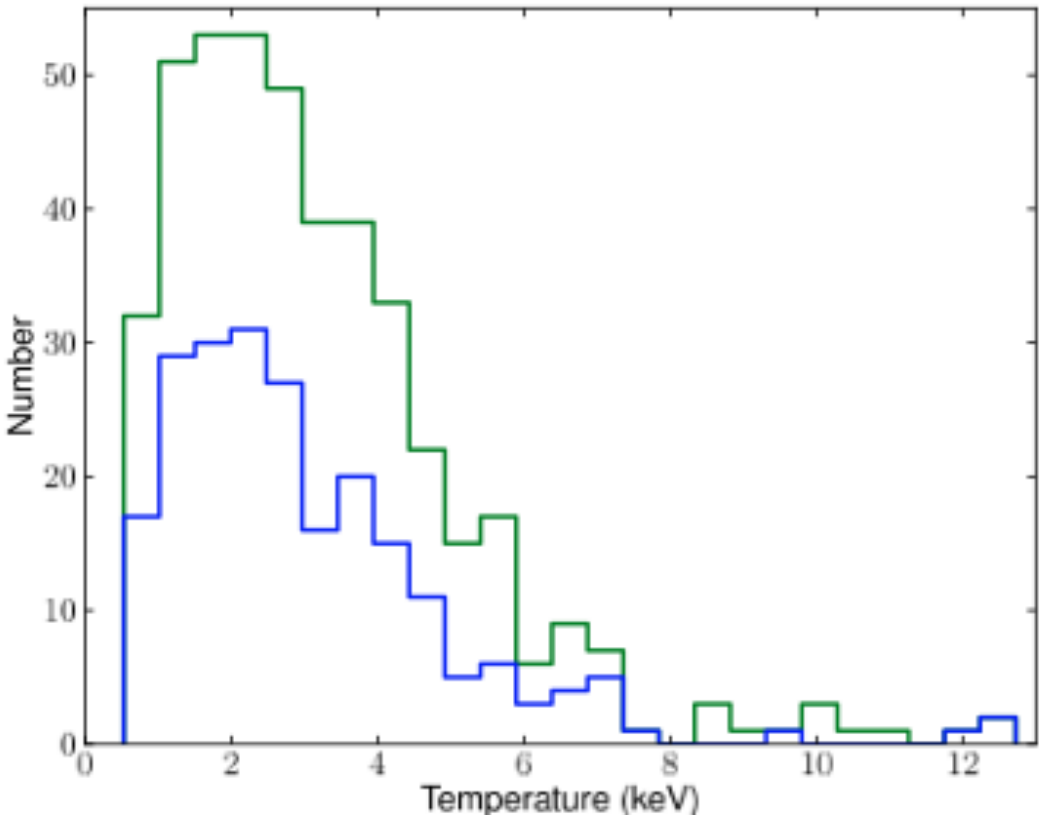
Summary of redshift follow-up of DR1 clusters (463 z's so far)



Blue are new to literature, Green is the full sample

Properties of the DR1 sample

Summary of DR1 temperature fitting (401 T_x so far)



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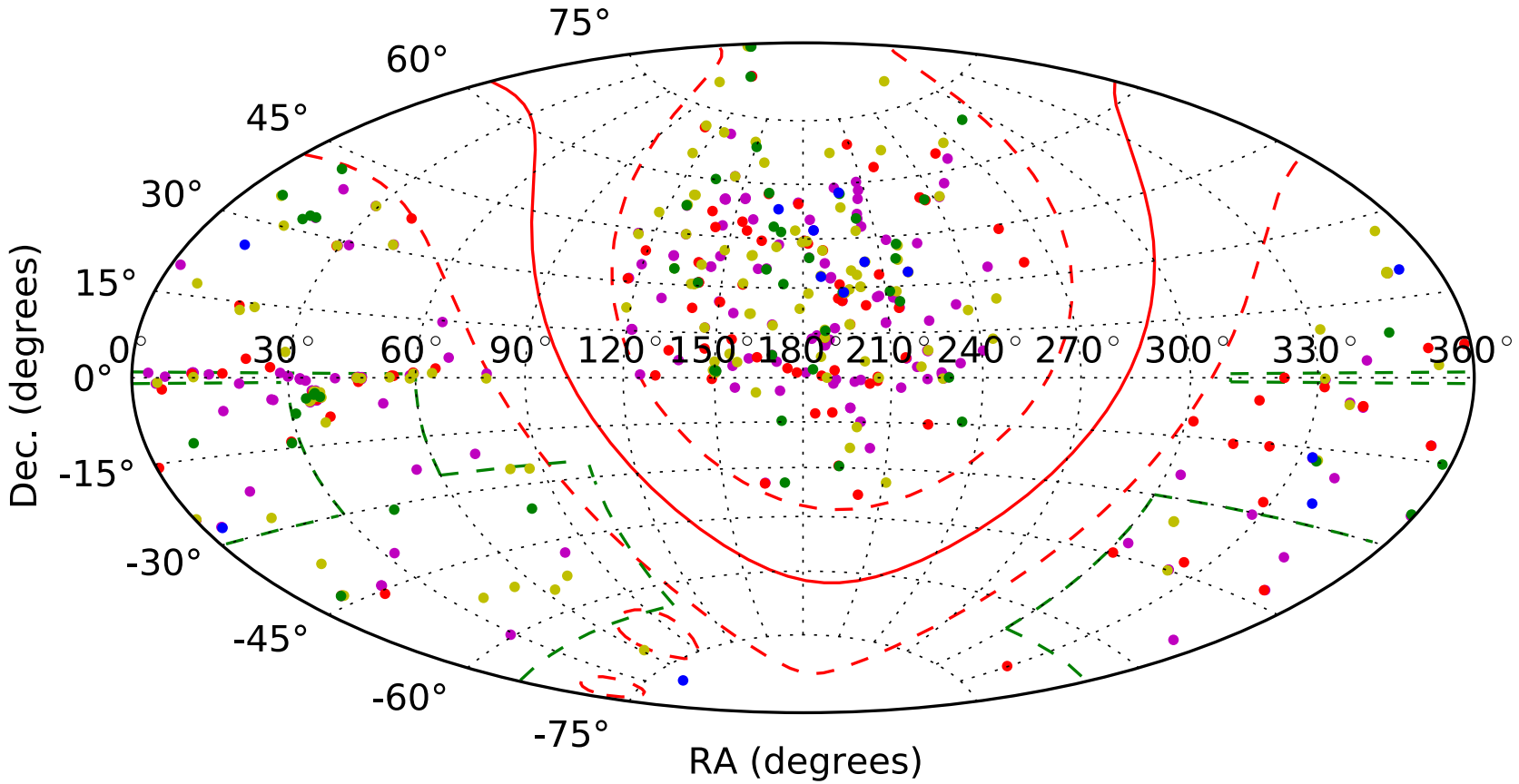
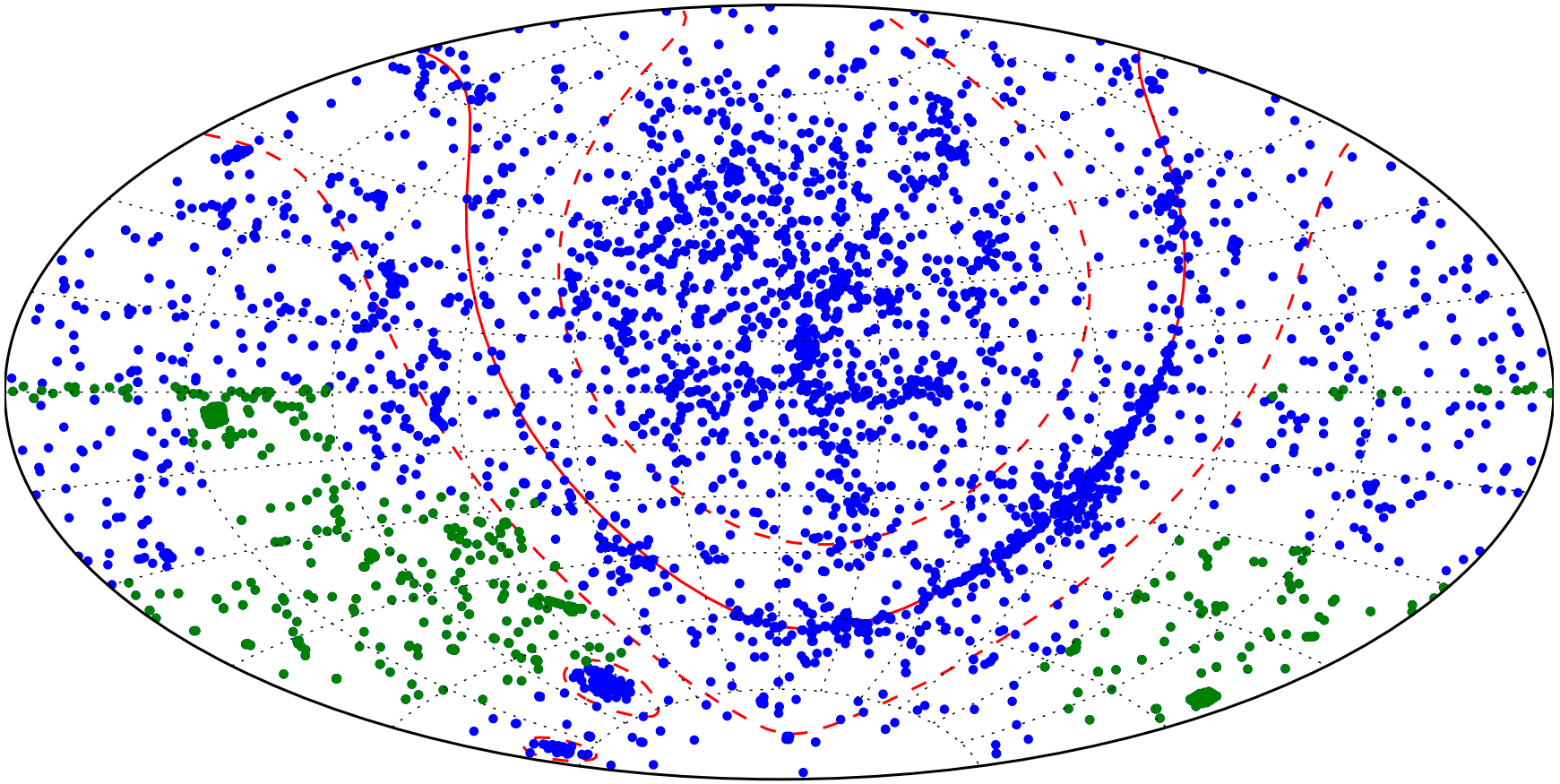
Properties of the DR1 sample

Summary of DR1 temperature fitting (401 T_x so far)



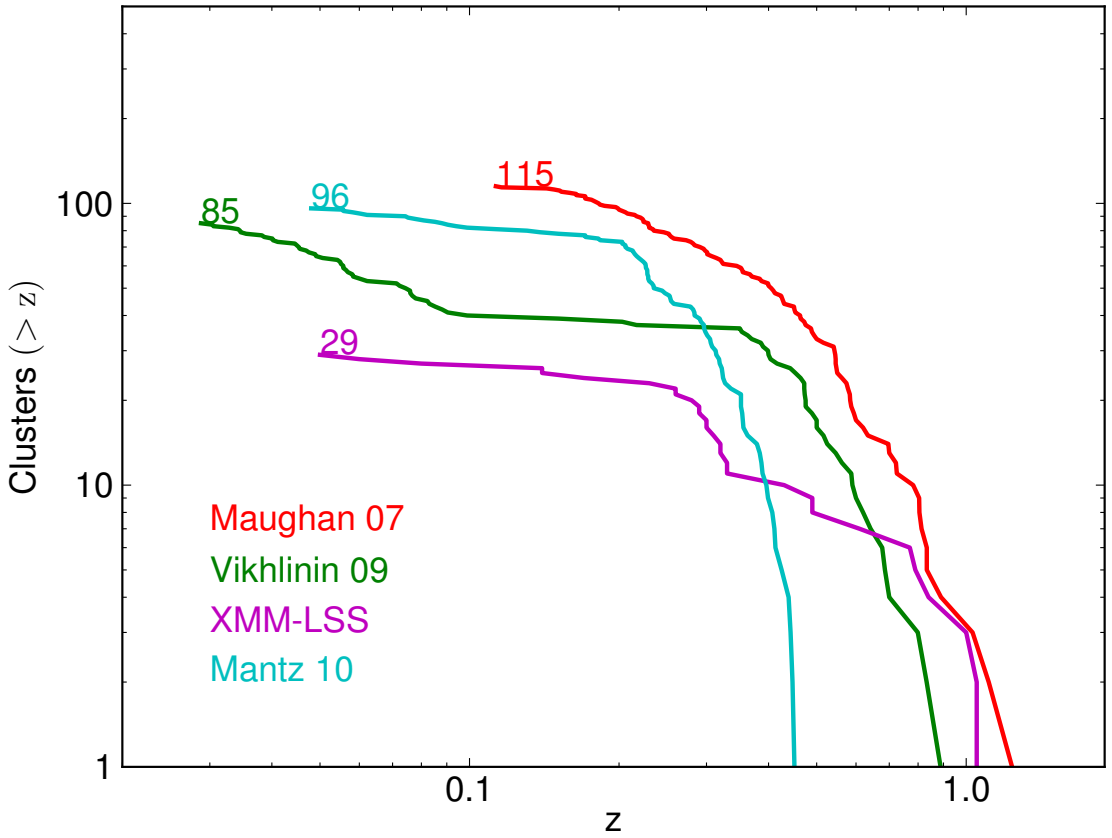
Properties of the DR1 sample

Much more could be done outside SDSS region



Properties of the DR1 sample

Comparison with some other Tx data releases



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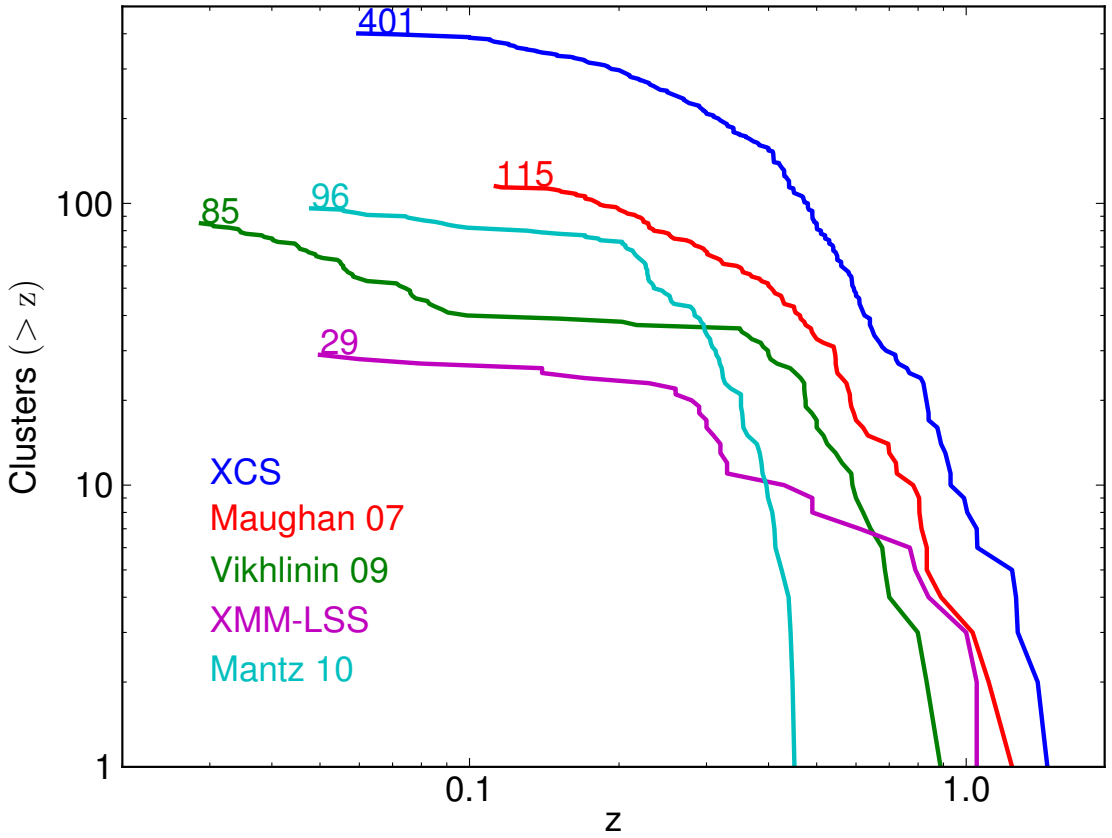

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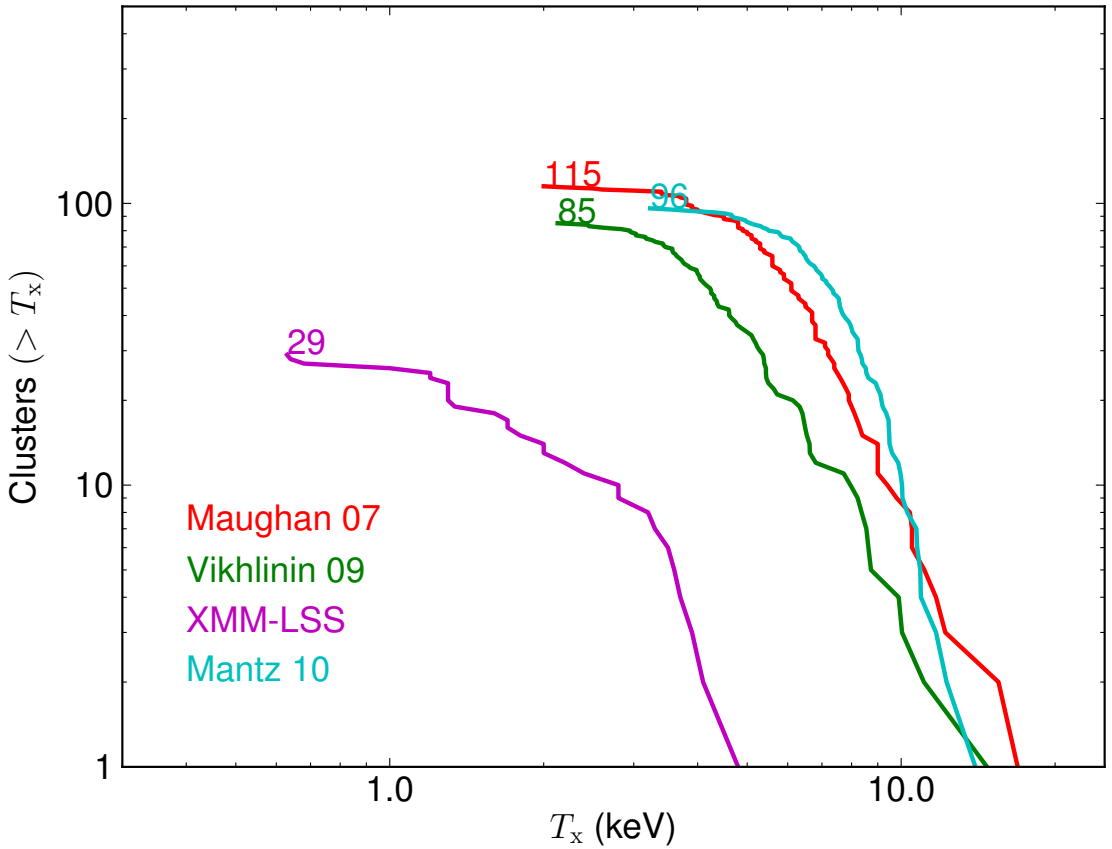

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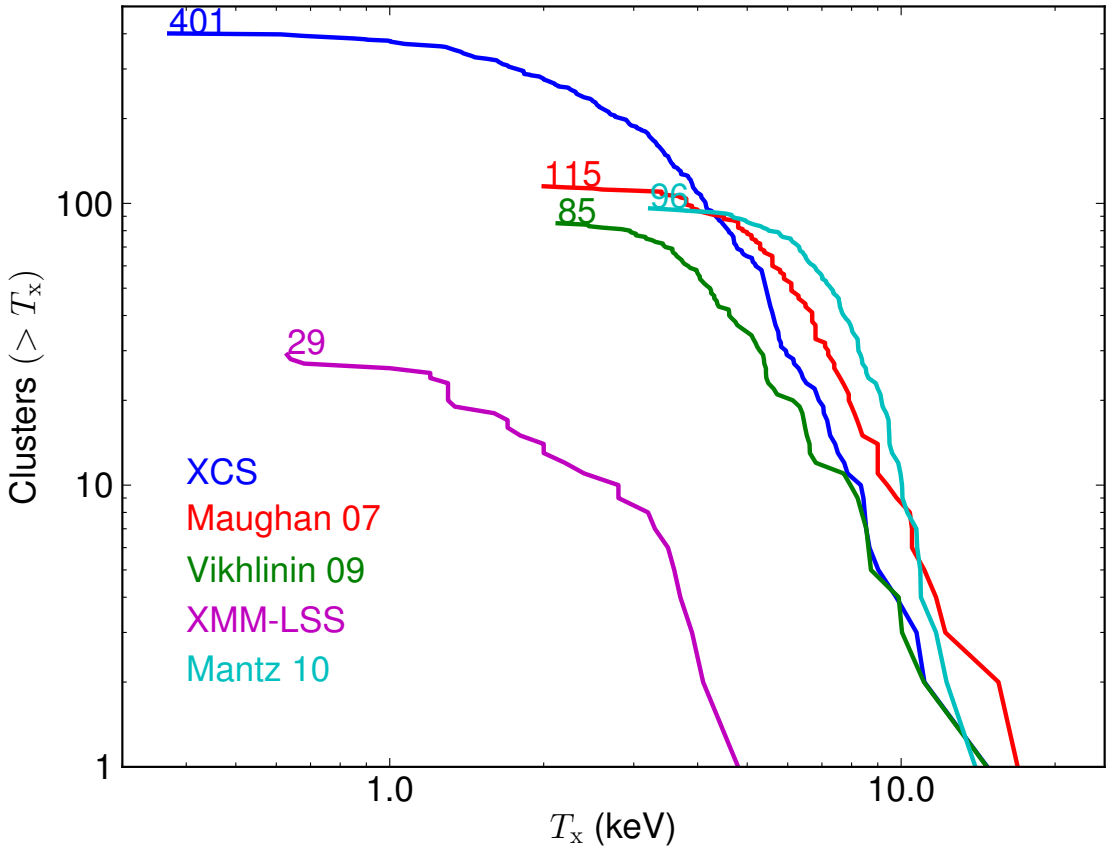

Properties of the DR1 sample

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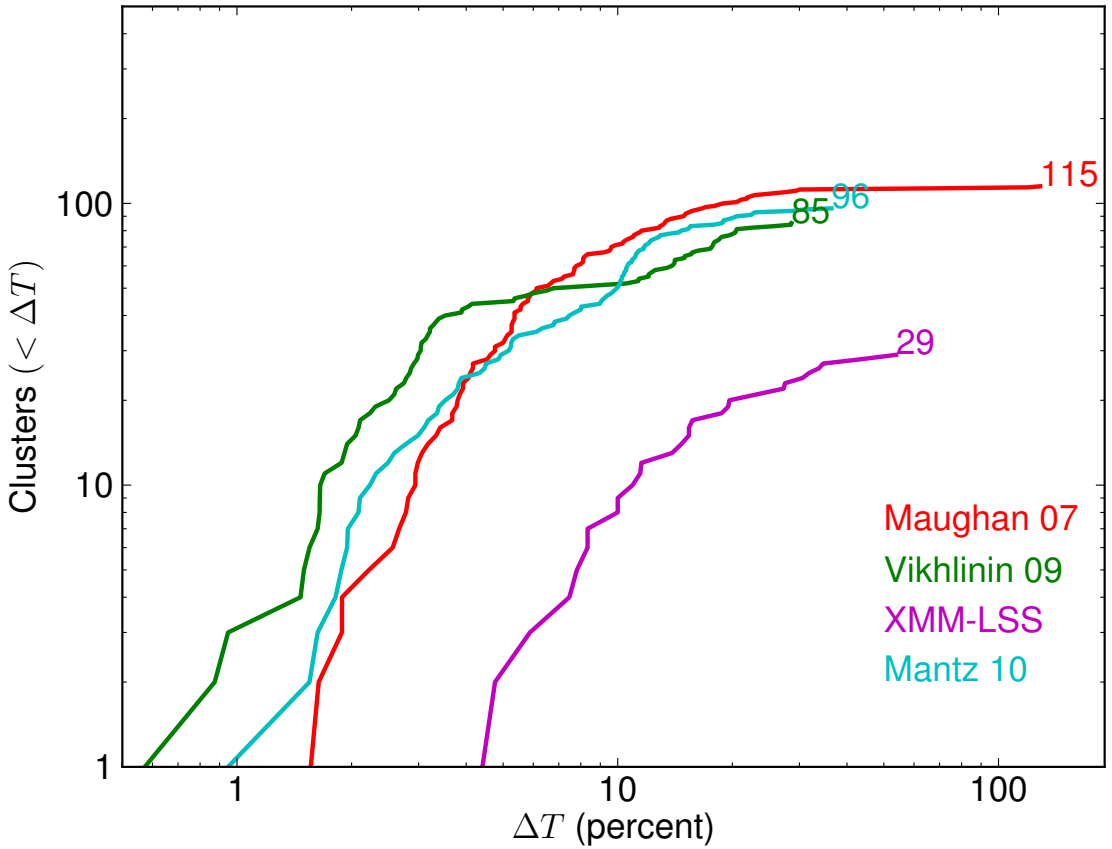

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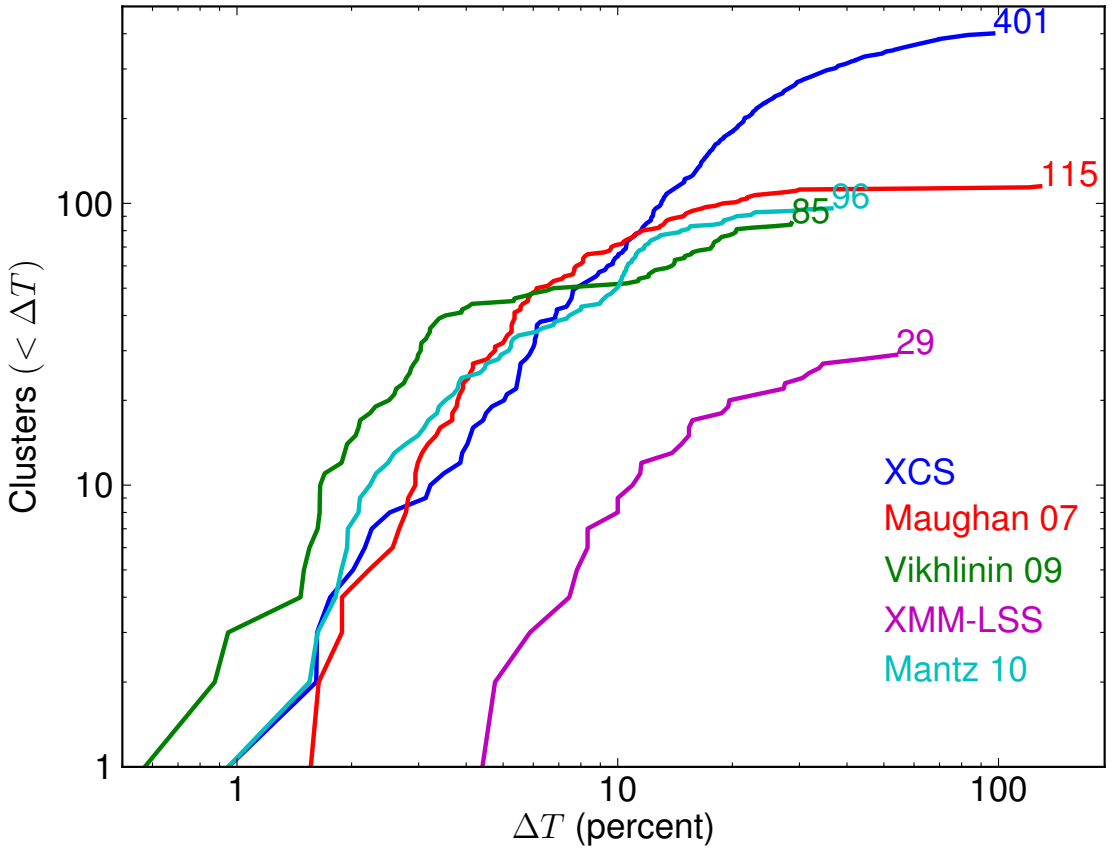
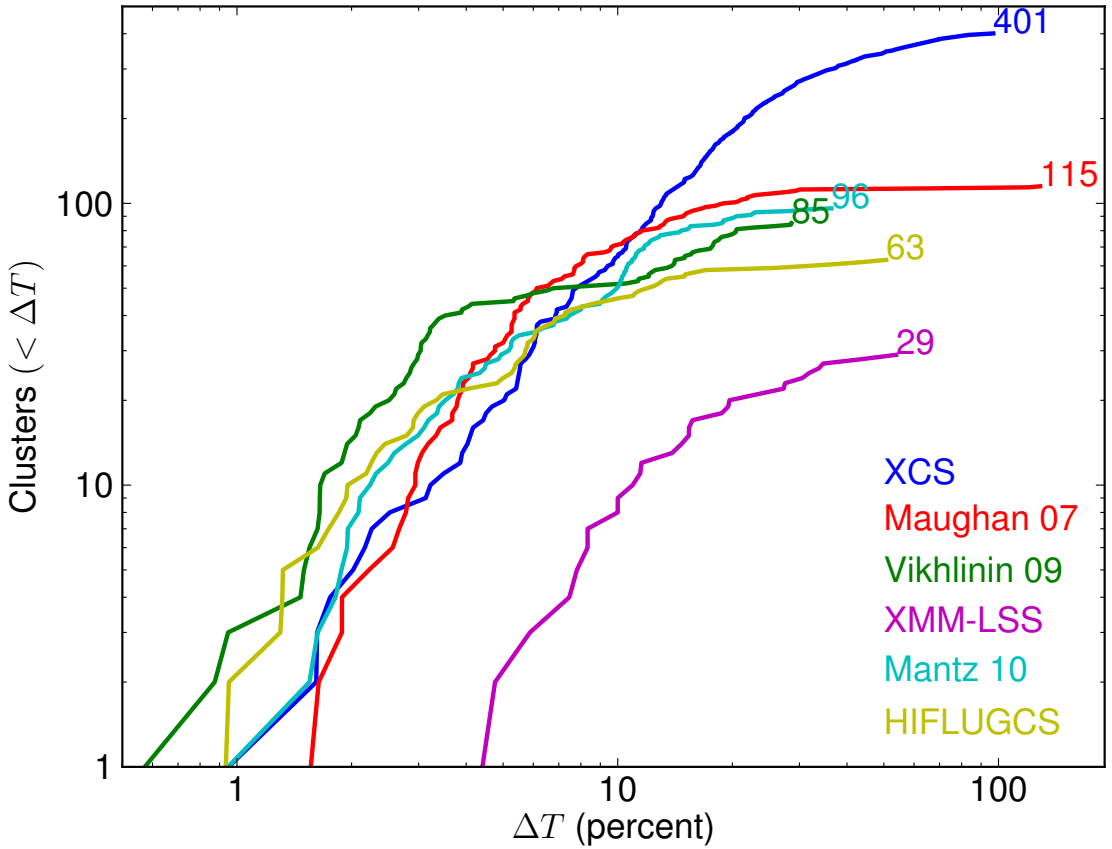


Properties of the DR1 sample

Comparison with some other Tx data releases



Overview

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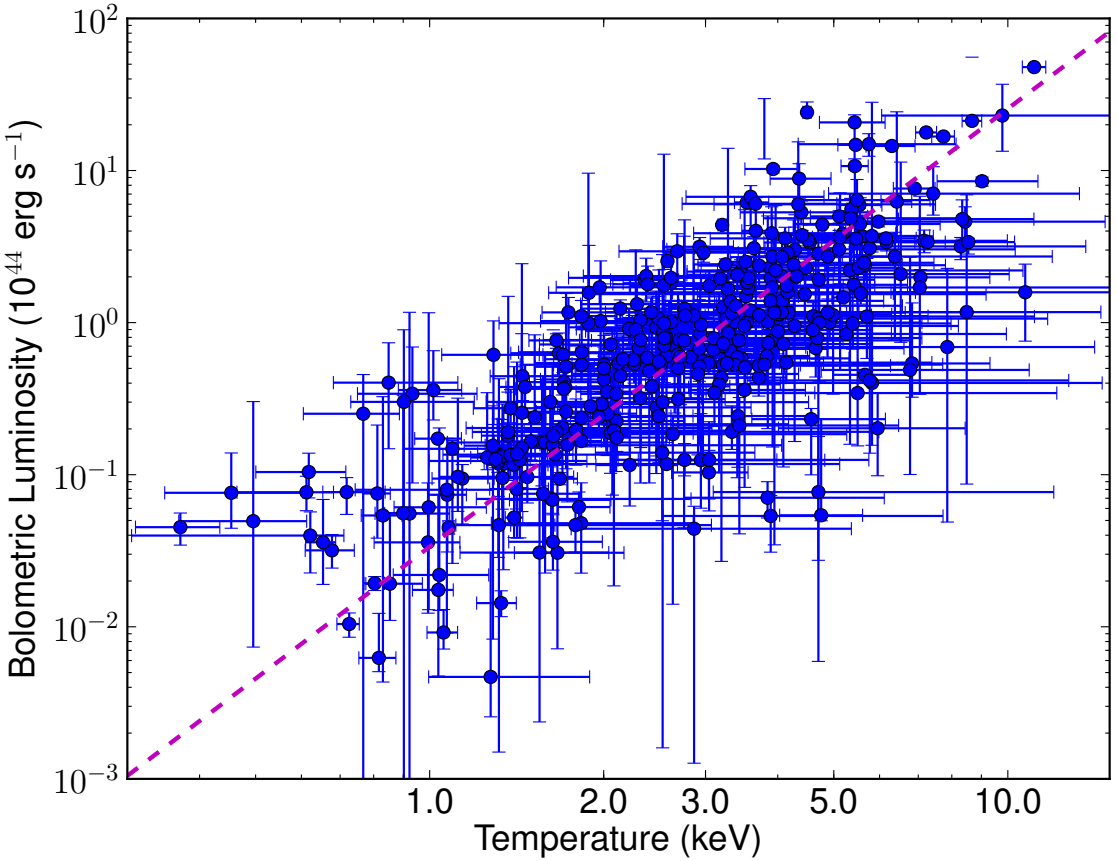
Overview

- Development of the first data release (DR1)
- Properties of the DR1 sample
- Applications of the DR1 sample and XCS pipelines
  - Only going to show 2 examples today (a preliminary L-T relation and some work on fossil groups).
  - XCS members are also actively working on optical scaling relations (Mehrtens); Planck overlap (Viana); and cosmology forecasting (Sahlen).

DR1 and Pipeline Applications

An **initial** *L-T* relation (366 clusters, no selection function applied)



Dotted line shows the Arnaud &Evrard 1999 result

DR1 and Pipeline Applications

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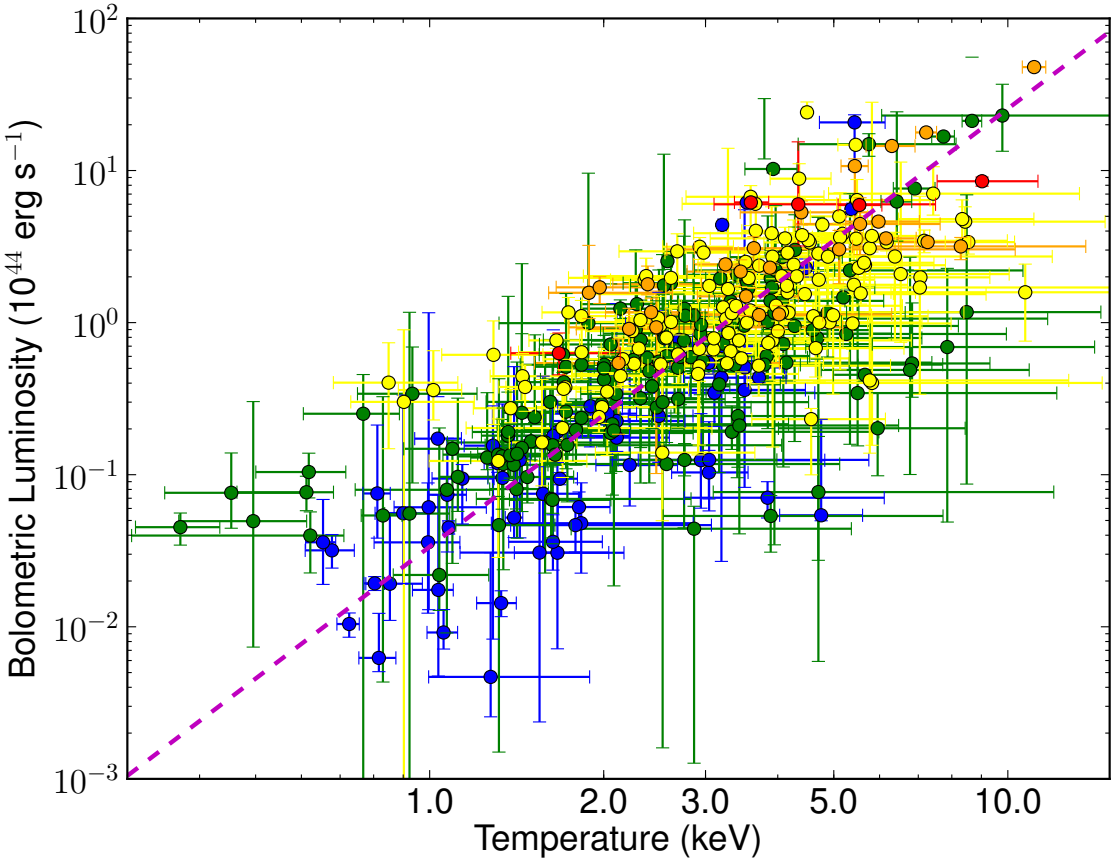
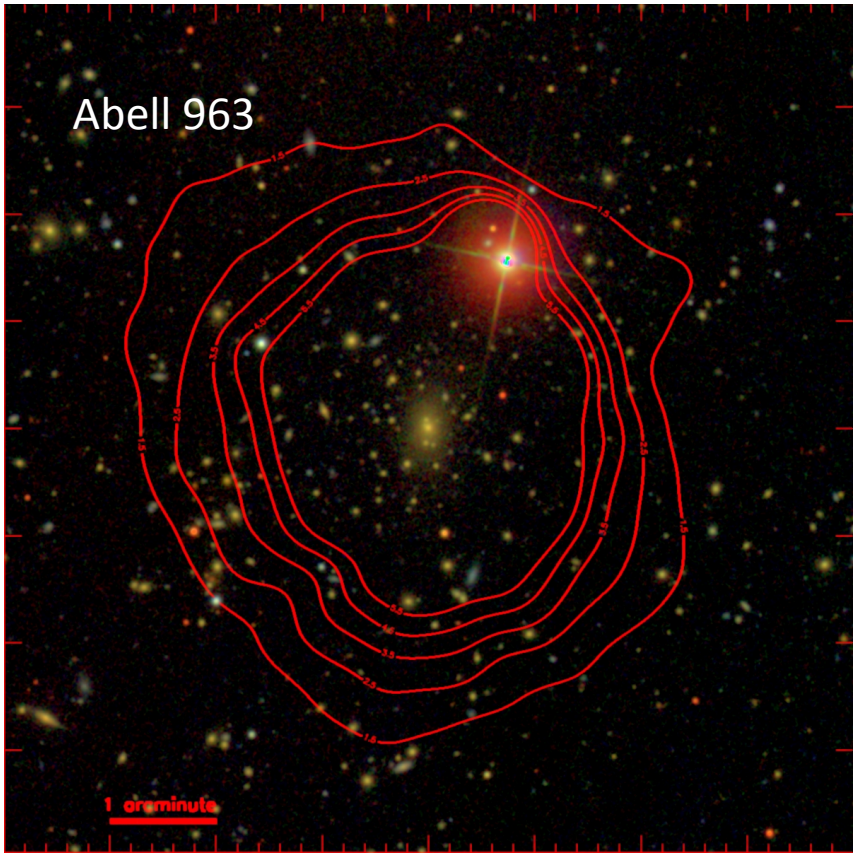


Colour coded by look back time (bins of 2 Gyr)

DR1 and Pipeline Applications

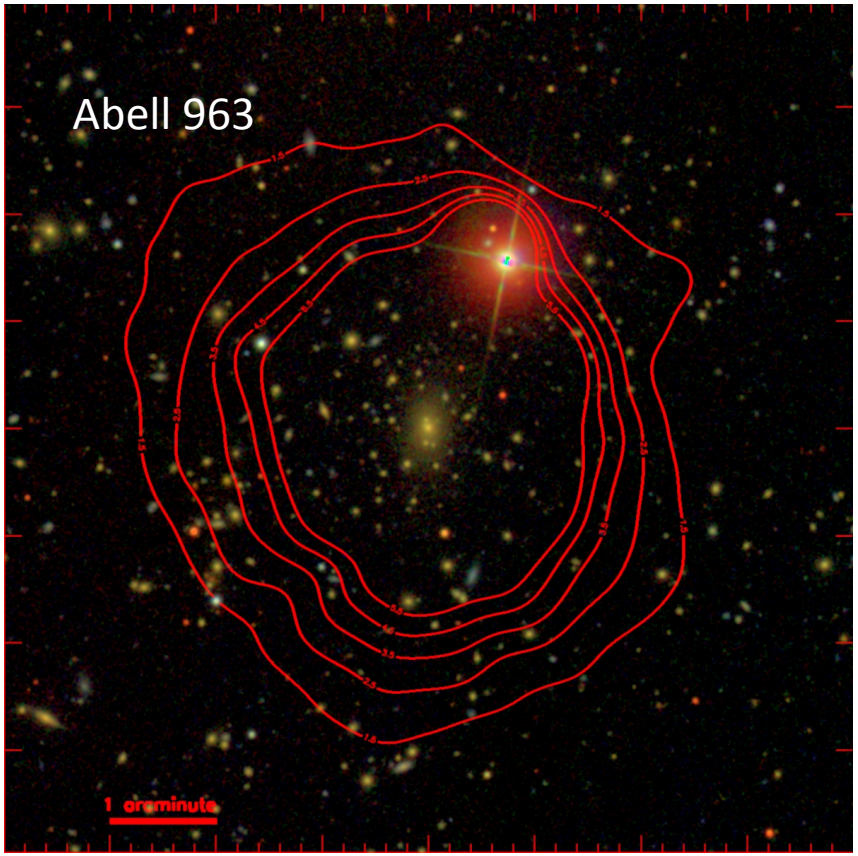
Automated search for X-ray fossil groups (14 in sample)
[Craig Harrison and Chris Miller]



- In this analysis, target clusters were used in addition to the serendipitous XCS clusters.
- This takes advantage of the fact that the post processing pipelines work just as well on axis as off.

DR1 and Pipeline Applications

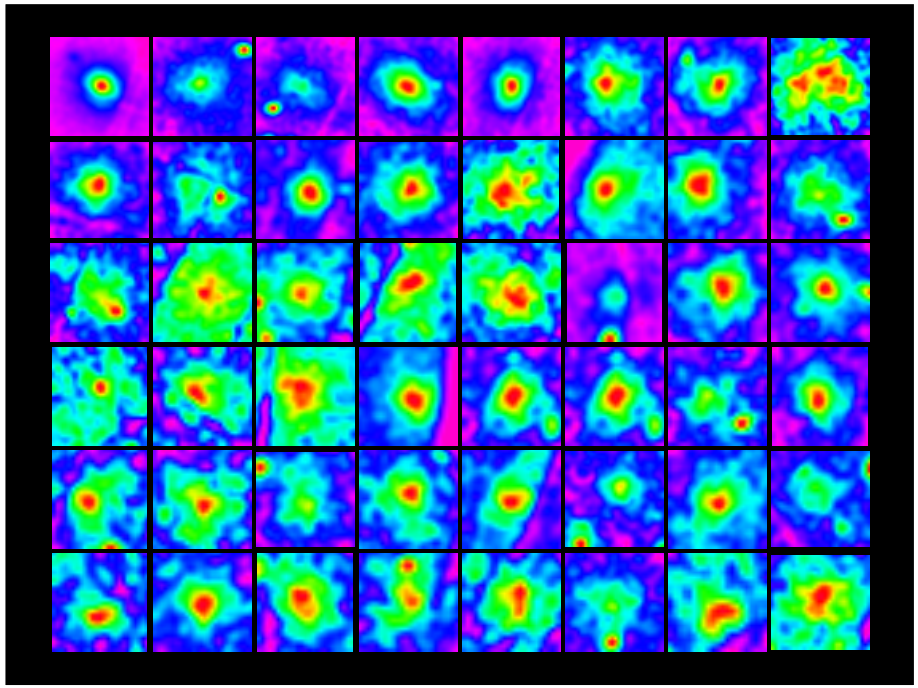
Automated search for X-ray fossil groups (14 in sample)
[Craig Harrison and Chris Miller]



- The most important discovery:
  - "Fossil group BCGs are the most massive stellar systems in the Universe"
- Which suggests that they:
  - "formed the bulk of their mass at very early epochs and grew via accretion"
- Also that there are "Fossil Clusters" too!

Conclusions

- There are a lot of clusters in the XMM archive.
- The first XCS data release contains 505 XMM clusters (401 with temperatures).
- Science applications so far:
  - X-ray scaling relations;
  - fossil groups;
  - Planck overlap;
  - BCG evolution;
  - optical scaling relations;
  - Cosmology
- We'd love it if you used XCS-DR1 for your cluster science too!



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- We'd love it if you used XCS-DR1 for your cluster science too!

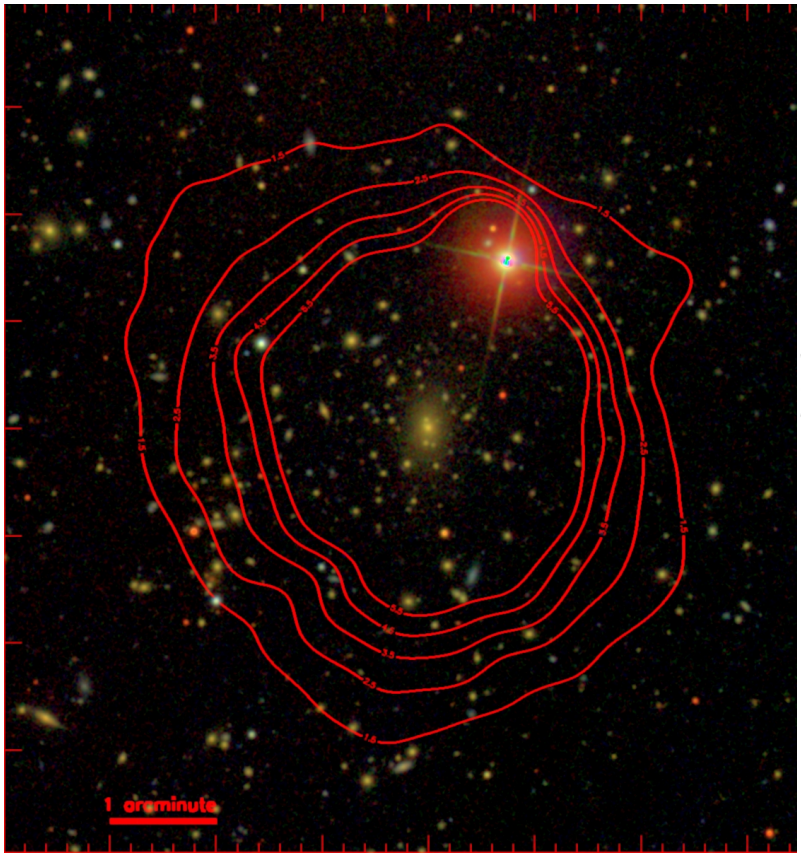
Some Final Notes

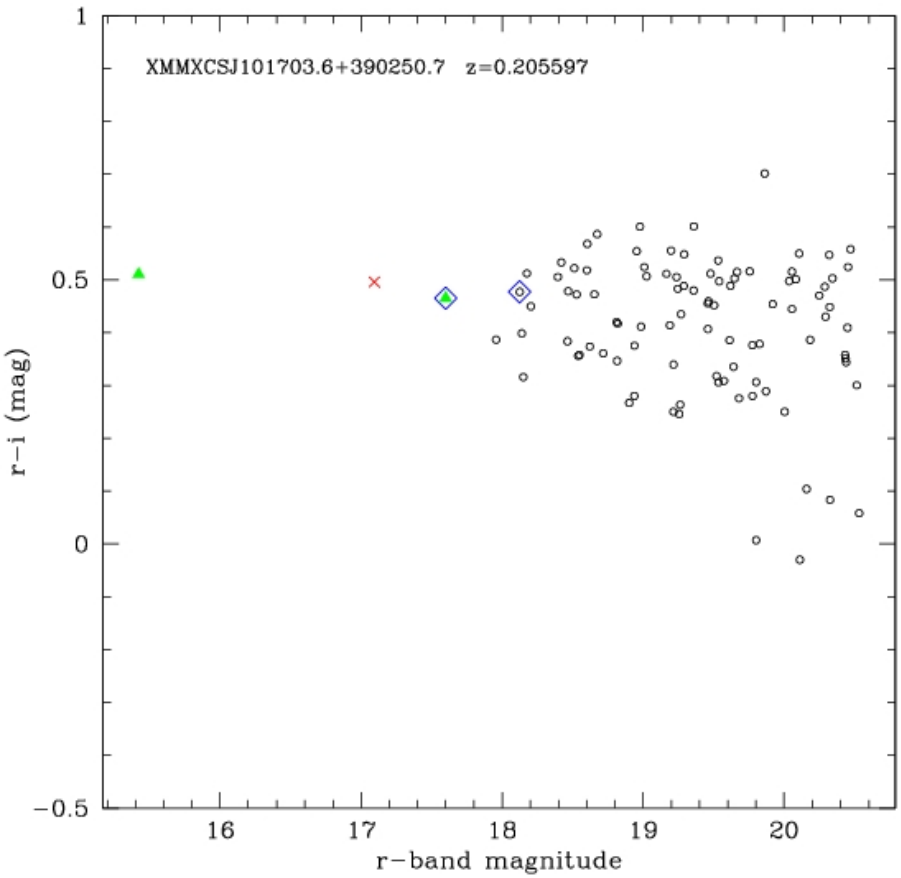
- For more detail refer to
  - www.xcs-home.org
  - Lloyd-Davies et al. (1010.6195);
  - Mehrtens et al. (to be sub.)
- If you've liked the data analysis, both lead authors are on the postdoc job market!
- I haven't mentioned selection functions, but those are an integral part of XCS
- **RAS Meeting Plug:** *The Scaling Relations of Galaxy Clusters* at JMU (Liverpool) on June 24th

These extra slides were not shown in the talk

DR1 and Pipeline Applications

Automated search for X-ray fossil groups (14 in sample)

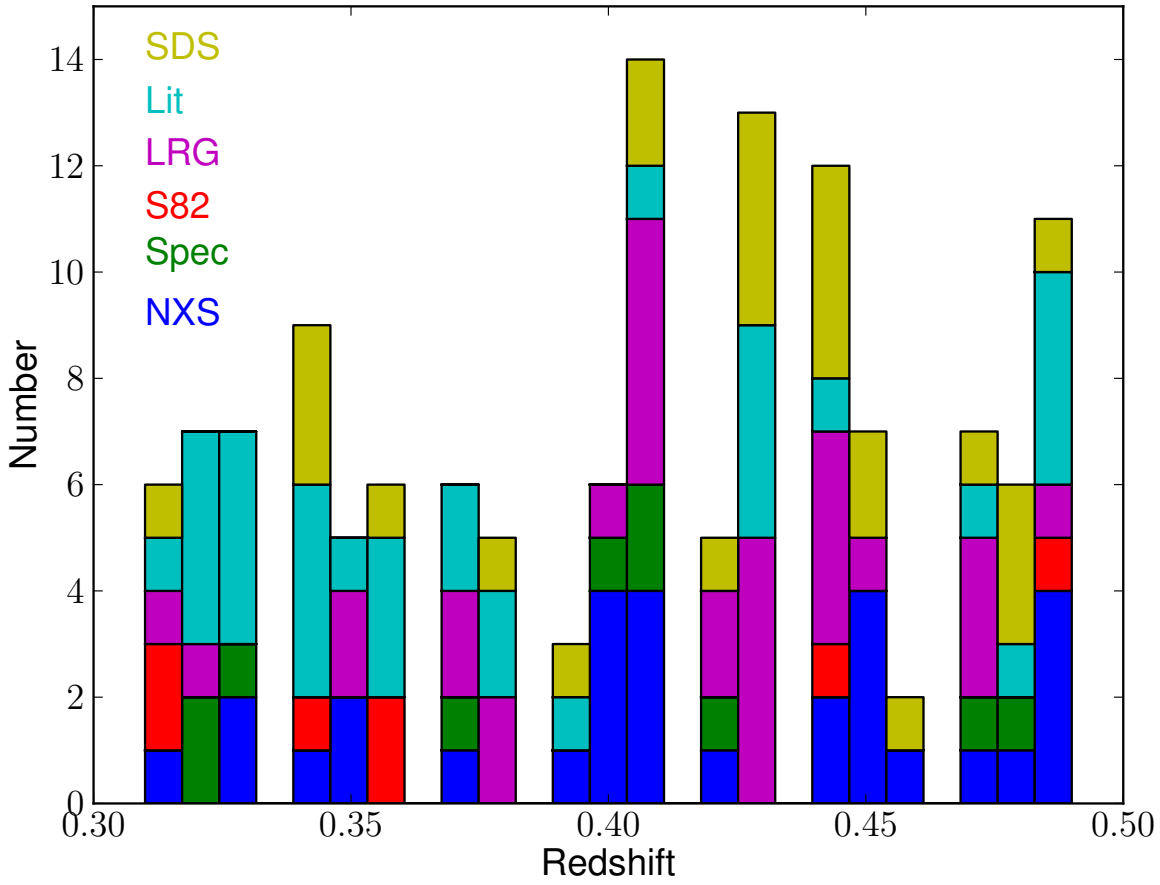




In this analysis, objects that were the intended XMM target are mixed with XCSDR1 (i.e. serendipitous) clusters (Craig Harrison and Chris Miller): the post processing pipelines work just as well on axis too!

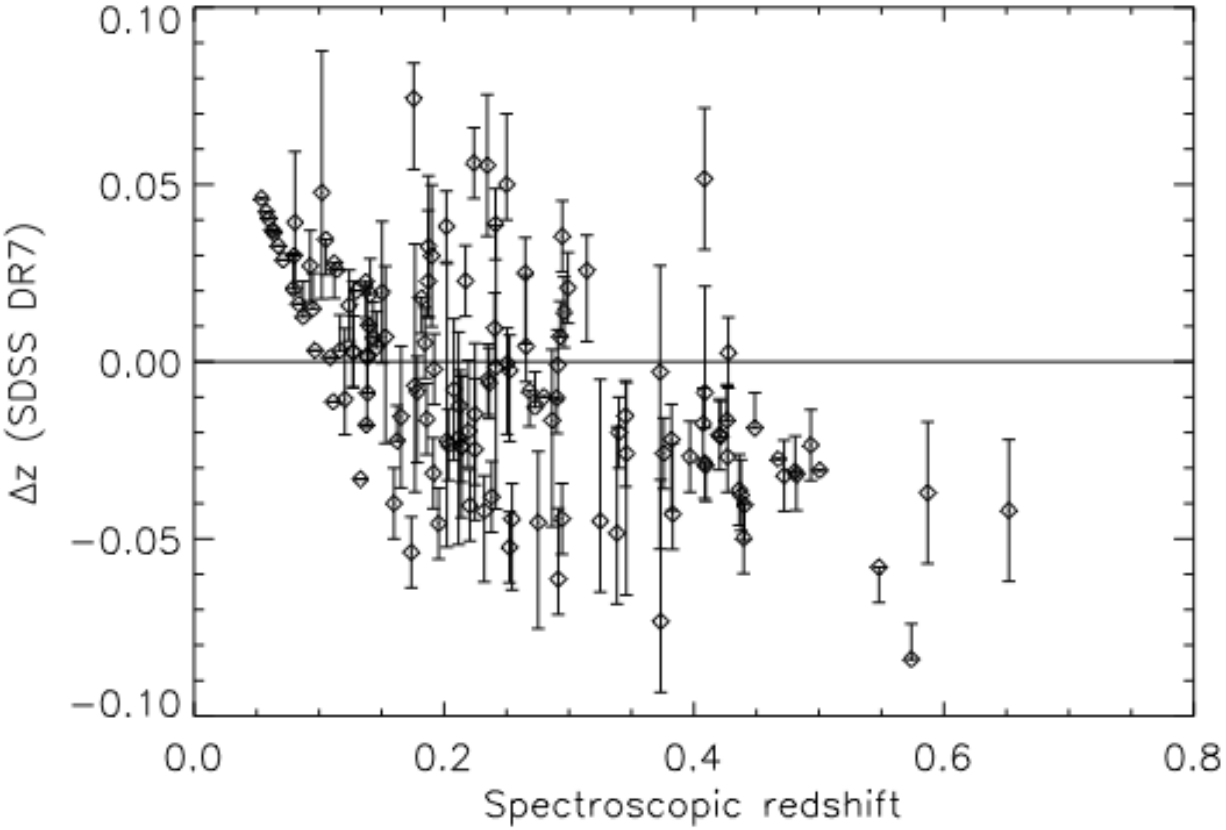
Properties of the DR1 sample

That peak at z=0.4 is not a concern.



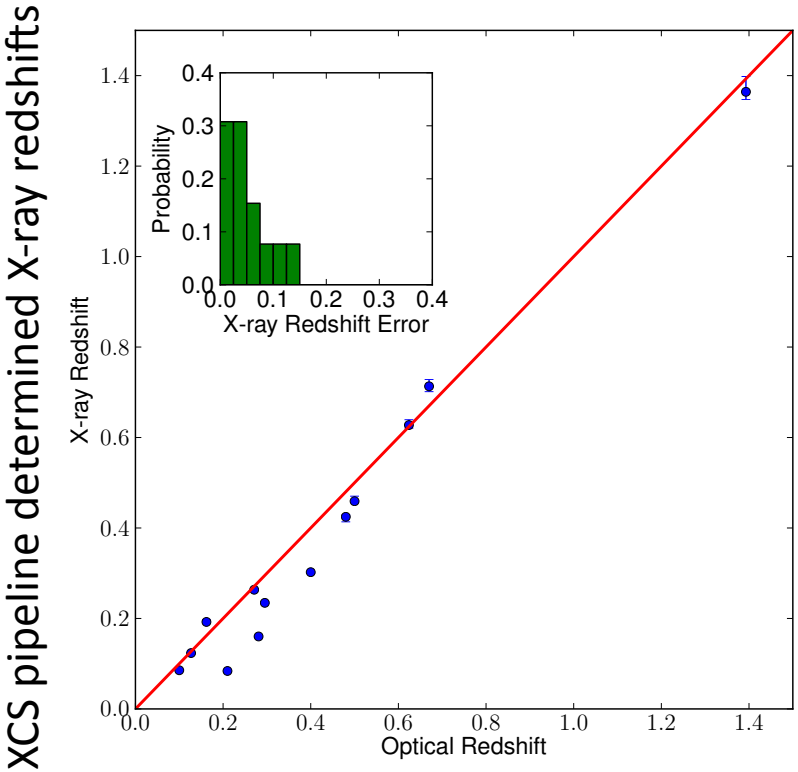
Development of DR1

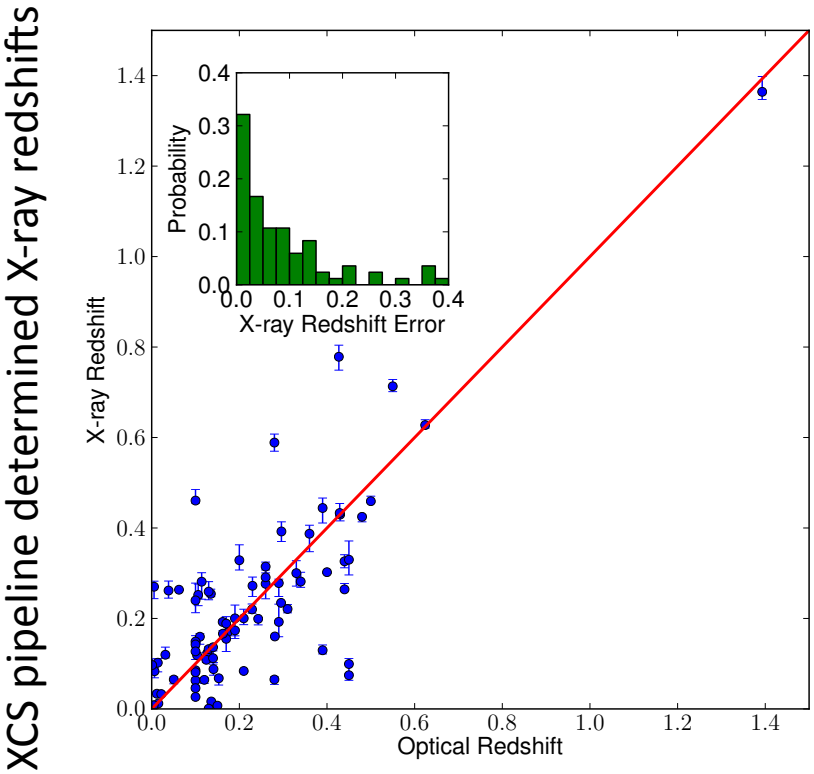
Measuring 1-colour CMR redshifts is OK



Development of DR1

Measuring X-ray redshifts is OK (sometimes!)

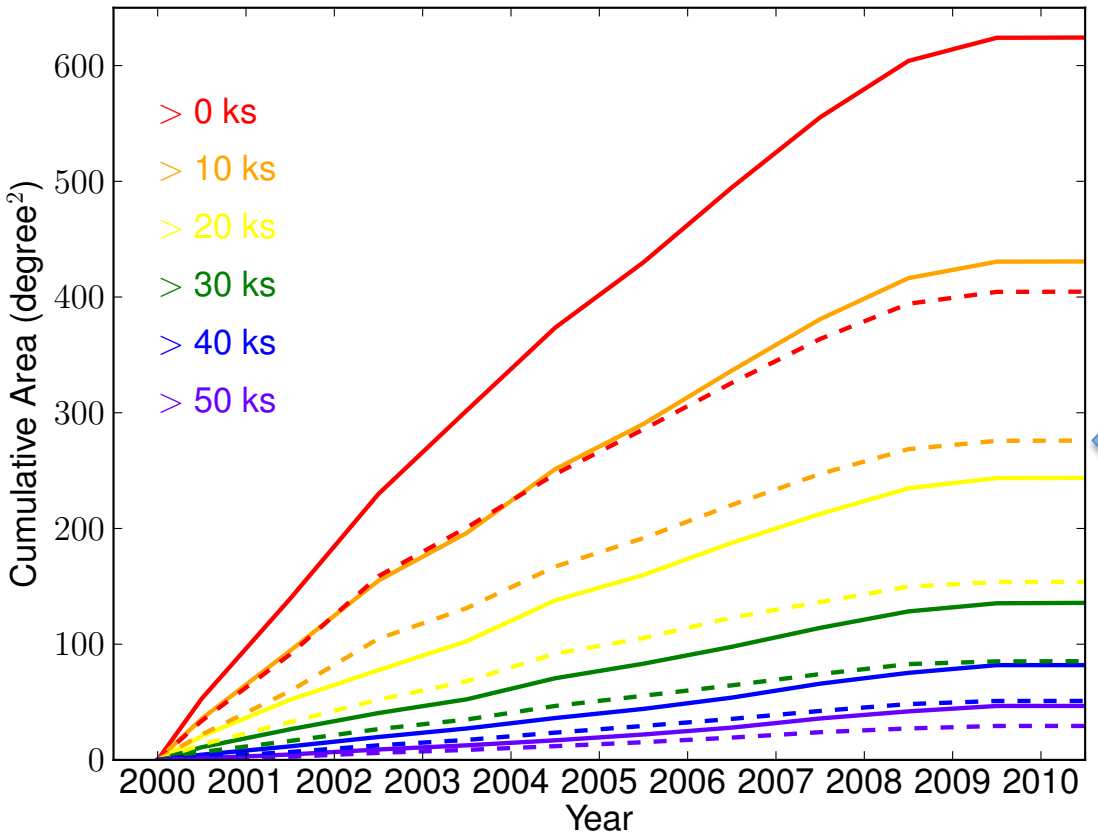




Spectroscopic Redshifts for the same clusters

Introduction to XCS

Archive covers a lot of *non-overlapping* area



280 deg^2 at 10ks

Solid is the whole area. **Dashed** refers to the area suitable for cluster searching