SPIDERS : XMM/ROSAT clusters follow-up

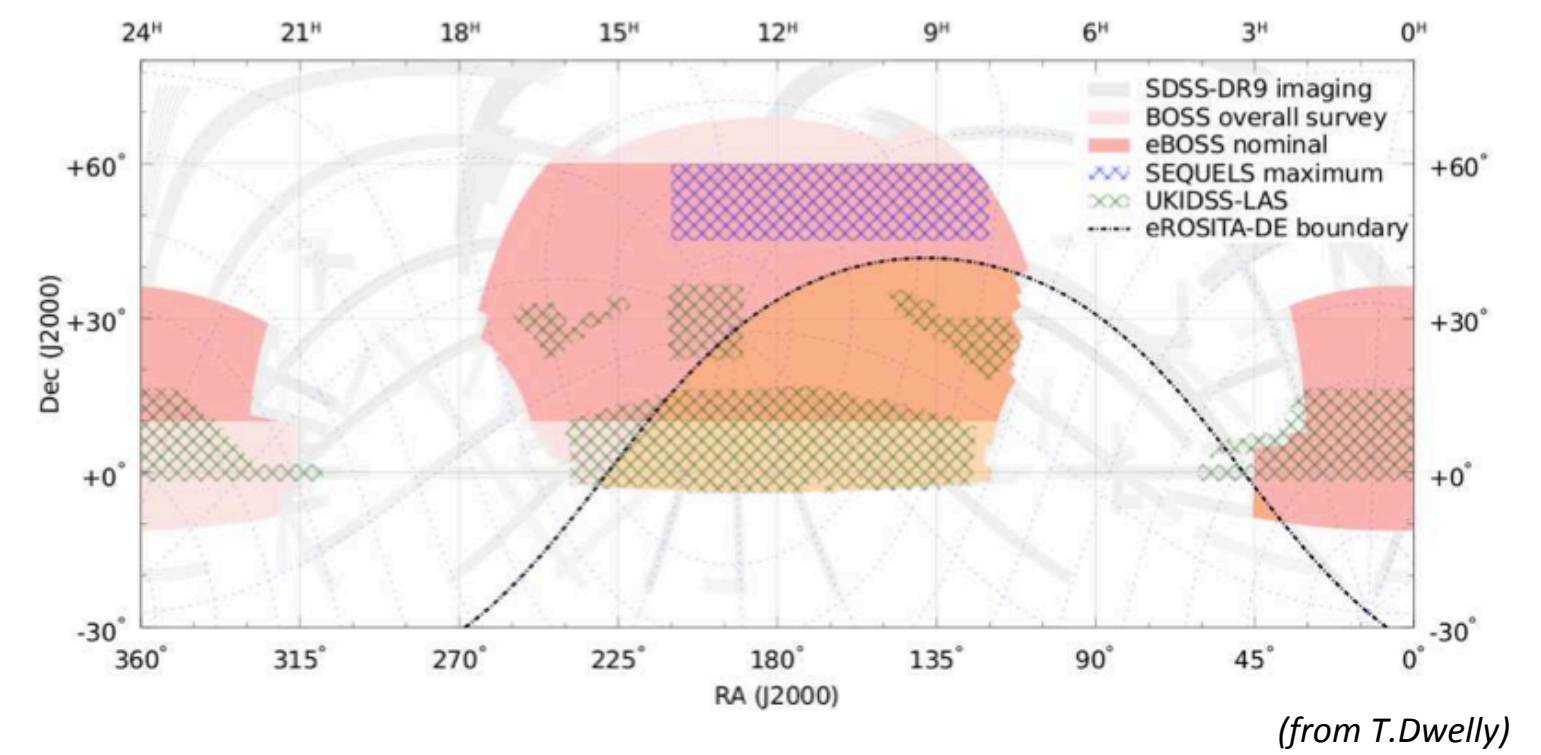
Nicolas Clerc (MPE)

A.Merloni, A.Finoguenov, J.Ridl, T.Dwelly, A.Georgakakis, M.Mirkazemi, K.Nandra, M.Salvato, K.Dawson, J-P.Kneib, H-J.Seo, J.Tinker, A.Meza, J.Brownstein, Y.-Y. Zhang, E. Rozo, E. Rykoff

eROSITA consortium meeting – Potsdam
16.9.2014

SPIDERS

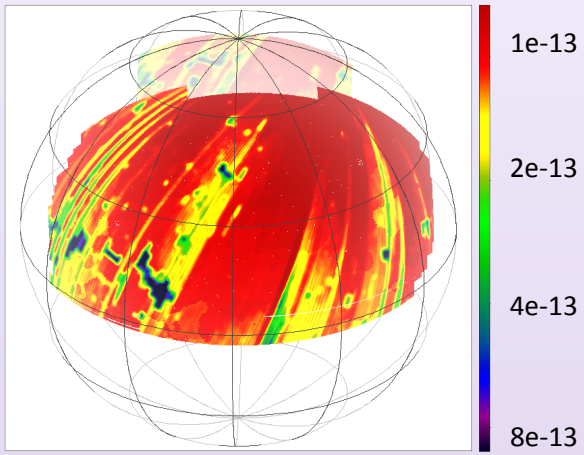
- Spectroscopic Idenditifcation of eRosita sources (SDSS-IV)
- *Tier 0* (before launch): follow-up of RASS/XMM sources (>5000 deg2)
- *Tier1+2*: eRASS:2+4 depths (750+1500 deg2)



(from T.Dwelly)

Pre-eRosita: CODEX (RASS+RedMapper)

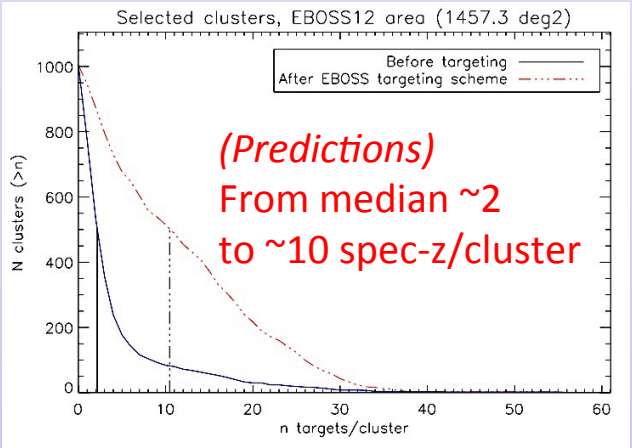
RASS-faint sensitivity ergs/s/cm^2



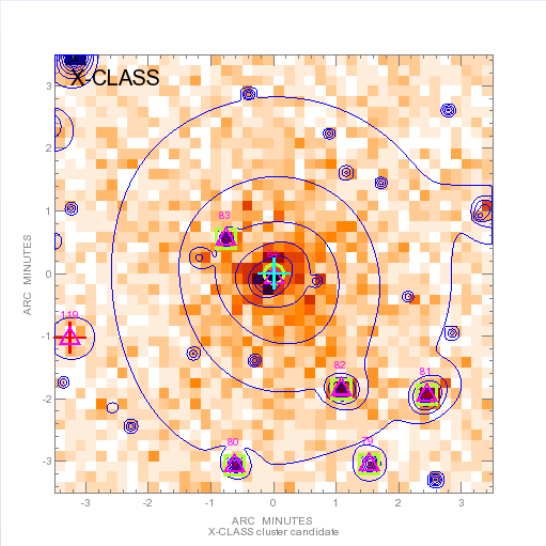
SDSS ugriz+RedMapper

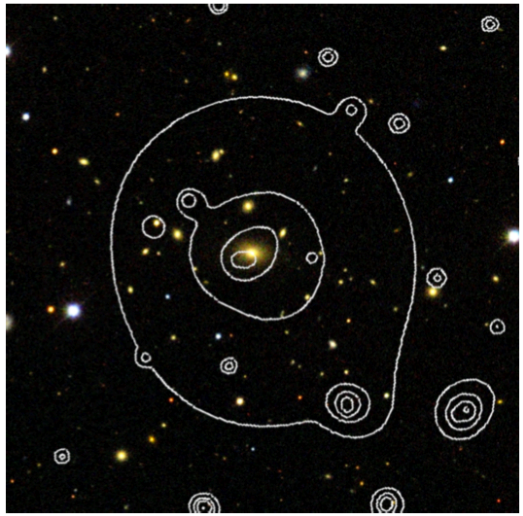
Goal: secure spectroscopic confirmation of 75% CODEX clusters (=4,500) + statistical velocity dispersion for massive subsamples

- $0.1<z<0.6$
- $0.8/deg^2$ (richness>10)
- Median mass ~4.10^{14} M_{sol}
- Optimized selection of targets
  - $17<i(2")<21.2$
  - Red-sequence prioritization
  - Cluster richness penalty



Pre-eRosita: RM-XCLASS (XCLASS+RedMapper)





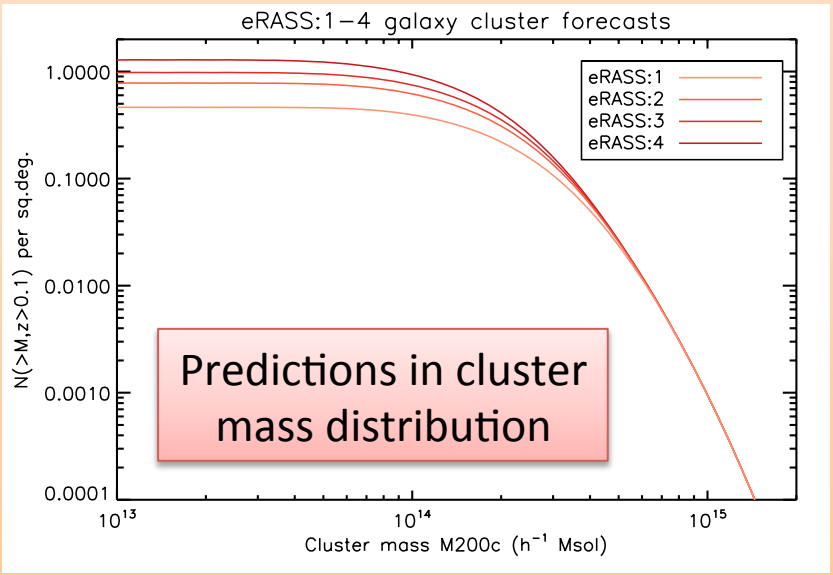
- XMM archive "C1" clusters correlated to RedMapper catalogue *(Sadibekova+14)*
- Few clusters (~200 in eBOSS footprint)

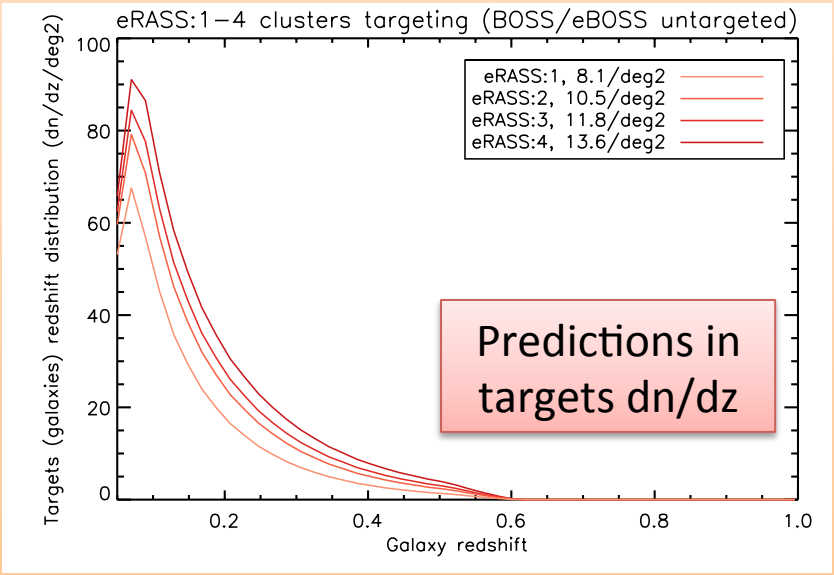
- XMM data <u>closer</u> to eRosita (e.g. PSF)
- Lower mass regime (good for scaling relations)
- X-rays ensure they are clusters → no bound on richness
- Sky sparse: higher prioritization

eRosita era

Goal: spectro-z of 90% z<0.6 clusters (→ L_X, mass…) *and* statistical velocity dispersion for massive subsamples

- 0.1<*z*<0.6
- Good X-ray positions/extent/flux
- 1.5 cluster/deg^2 (eRASS:4)
- Median mass ~10^{14} M_{sol}
- Target BCG in distant clusters





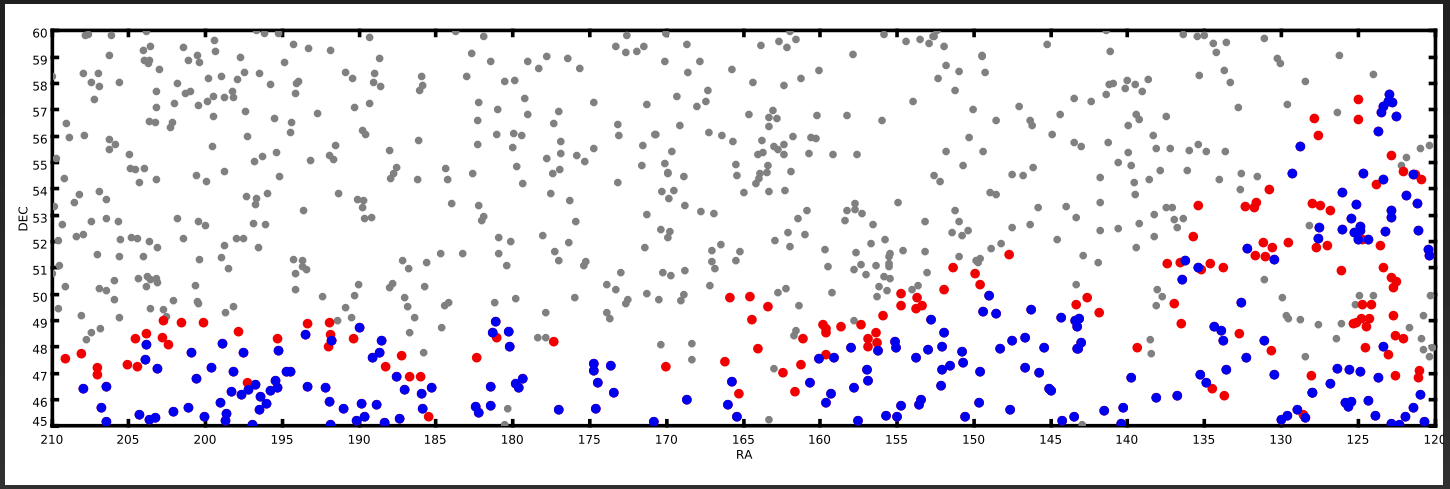
Analysis steps

1. Cluster database: collect data per cluster
2. Automated membership assessment
3. Interactive membership assessment
4. Redshift/V_{disp}, uncertainty estimates
5. Catalogue production
6. Science

SEQUELS as a pilot

- Targeting similar to SPIDERS except
  - *i*(fiber2) < 21 instead of 21.2
  - RM richness > 3 instead of 10

- SEQUELS program (through Aug. 2014):
  - 66 good SEQUELS plates covering 320 deg2
  - 351 CODEX clusters ; 223 fully observed
  - 8 XCLASS clusters ; fully observed



SEQUELS area

- All CODEX
- Fully obs (223)
- Partial obs (128)

Analysis steps

1. **Cluster database: collect data per cluster**
2. Automated membership assessment
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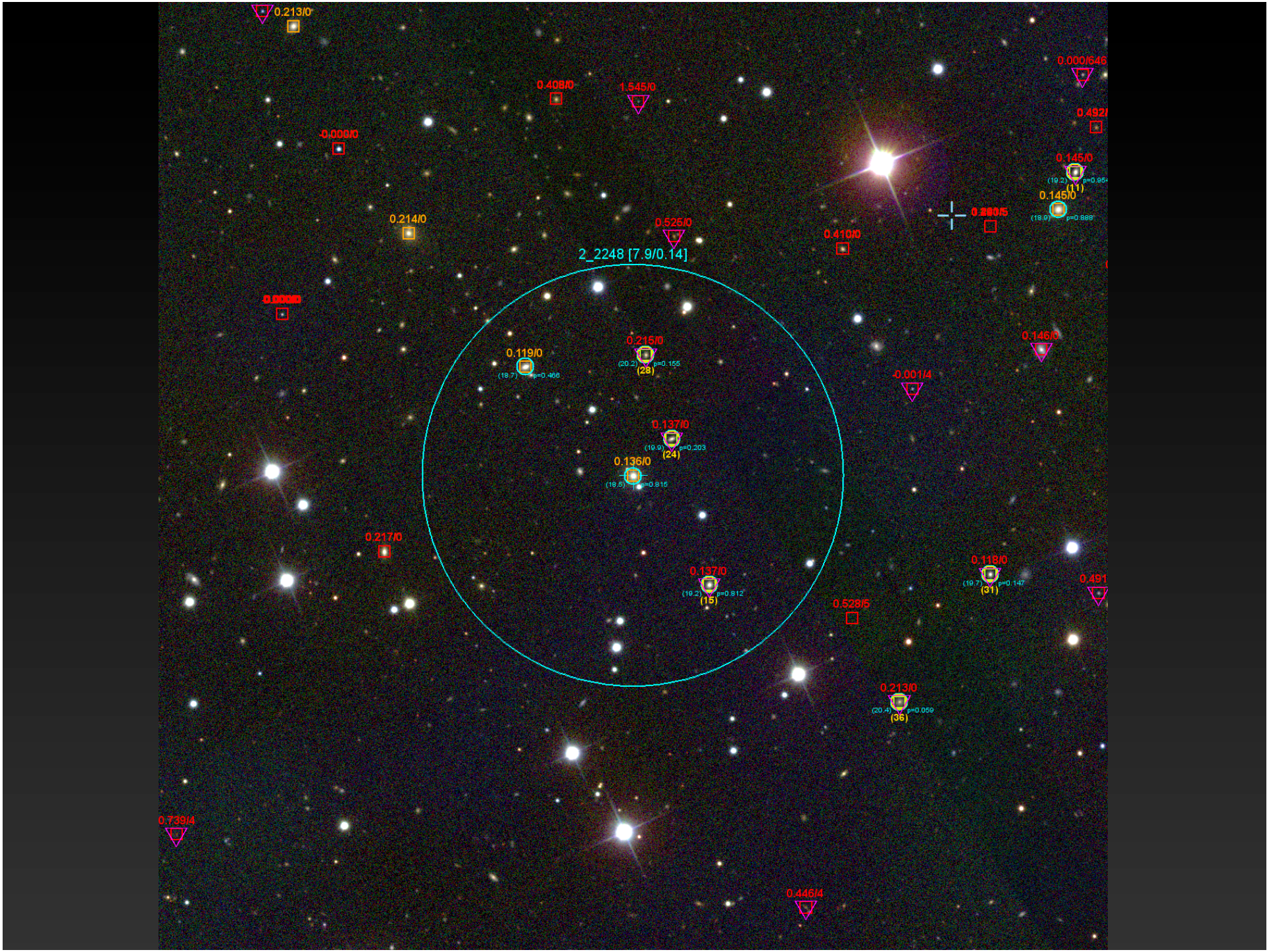
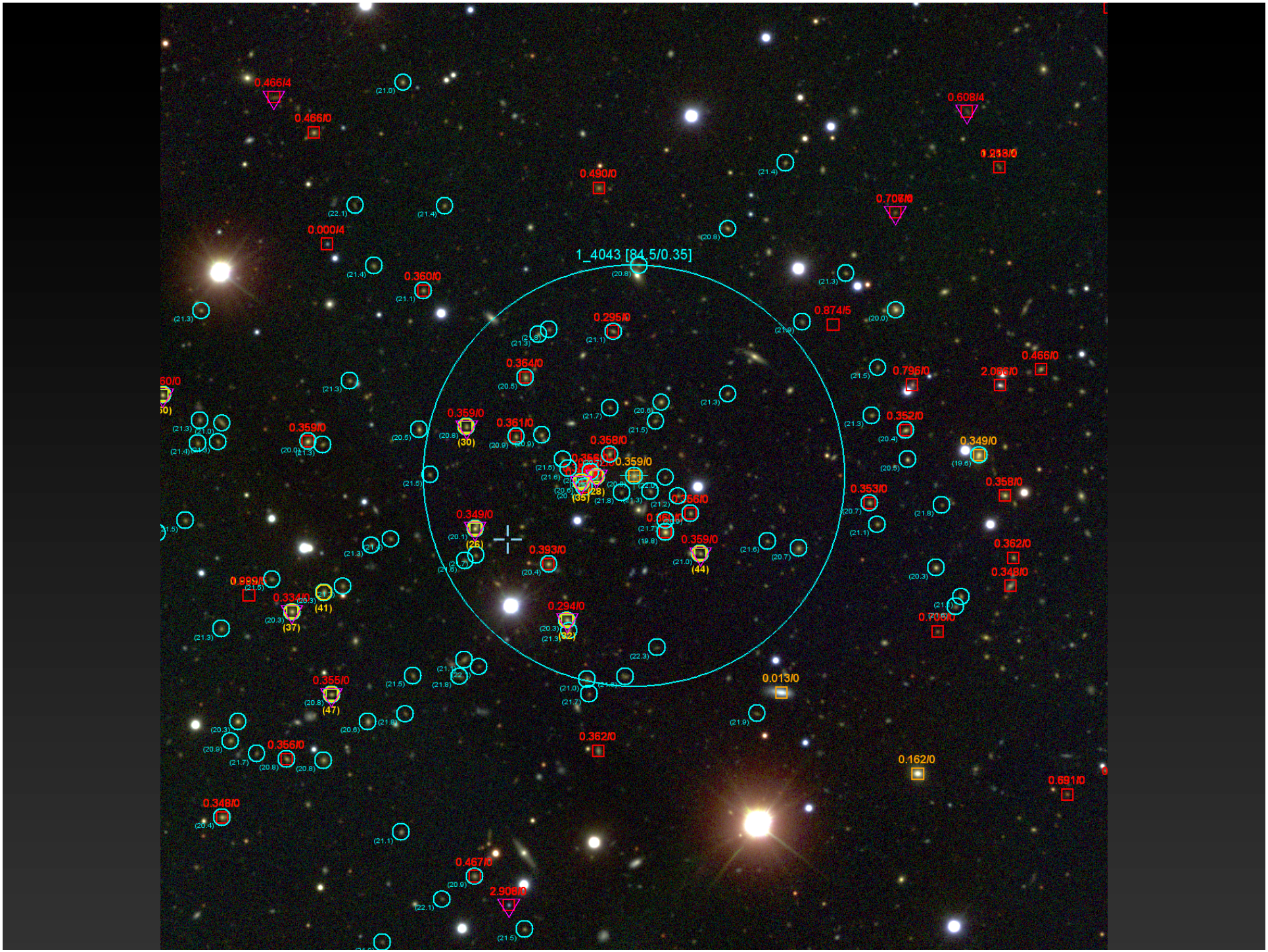
6. Science


0.213/0
0.408/0
1.545/0
0.000/646
0.492/
-0.000/0
0.145/0
(19.2)
(11)
p=0.964
0.145/0
(19.9)
p=0.888
0.214/0
0.525/0
0.410/0
2_2248 [7.9/0.14]
0.146/0
0.119/0
(18.7)
p=0.466
0.215/0
(20.2)
p=0.155
(28)
-0.001/4
0.137/0
(19.9)
p=0.203
(24)
0.136/0
(18.8)
p=0.815
0.217/0
0.118/0
(19.7)
p=0.147
(31)
0.491
0.137/0
(19.2)
p=0.812
(15)
0.528/5
0.213/0
(20.4)
p=0.059
(36)
0.739/4
0.446/4


1_4043 [84.5/0.35]
0.466/4
0.466/0
0.608/4
0.490/0
0.000/4
0.360/0
0.295/0
0.874/5
0.364/0
0.796/0
0.466/0
0.359/0
0.361/0
0.352/0
0.358/0
0.359/0
0.349/0
0.353/0
0.358/0
0.349/0
0.393/0
0.359/0
0.362/0
0.348/0
0.999/0
0.334/0
0.294/0
0.355/0
0.013/0
0.362/0
0.356/0
0.162/0
0.691/0
0.348/0
0.467/0
2.906/0

Summary SEQUELS/CODEX 2014-07-21 – Cluster 2_2248

Summary SEQUELS/CODE...

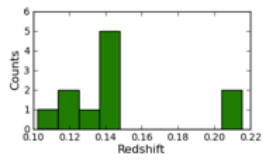
www.mpe.mpg.de/~nclerc/SEQUELS/2014-07-21/2_2248_info.html

Les plus visités | Gmail – Boîte de r... | Google.de | SAO/NASA ADS C... | XMM L3S Databas... | ARCHIVE L4S Dat... | XMM XXL Databa... | XMM-LSS/XXL | Experiment speci...

Summary SEQUELS/CODEX -- Run=2014-07-21

Cluster ID: 2_2248

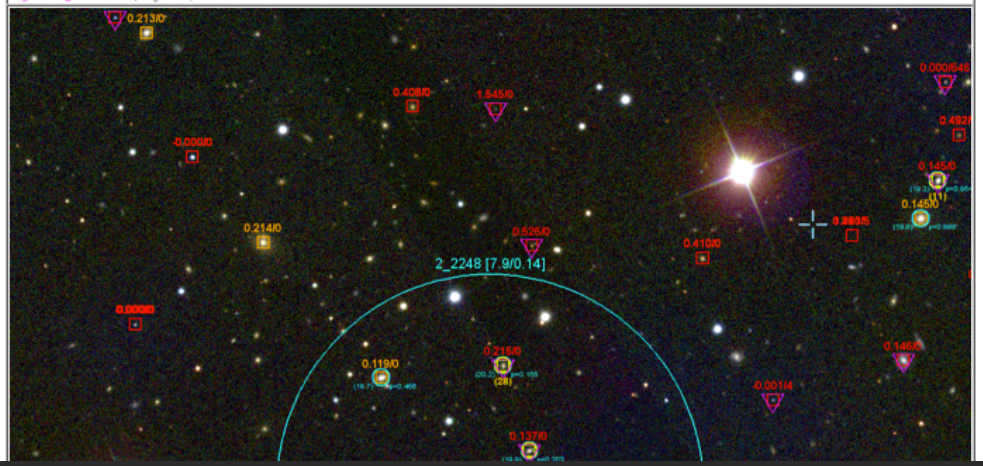
Nicolas Clerc, MPE

Cluster info	Targeting info	Rough z dist of RM members
CODEX ID: 2_2248 **RA:** 122.804, **Dec:** 52.868 **LAMBDA:** 6.2 **Z_LAMBDA:** 0.14 +/- 0.01 *"Optimized" quantities* **RA_OPT:** 122.888, **Dec_OPT:** 52.827 **LAMBDA_OPT:** 7.9	RM members: **11** - submitted: 7 - tiled: 7 With z: **11/11** - from SEQUELS: 7/11 - ZWARNING=0: 11/11	

9x9 arcmin SDSS *gri* image centered on RA_OPT/DEC_OPT with targeting info

Legend:
Cyan large circle: 2 arcmin radius around RA_OPT/DEC_OPT with name and [LAMBDA_OPT/Z_lambda]
Blue cross: RA_DEC position.
Cyan circles: all RM members in the area and *fiber2mag_i* and *pzprobability*
Gold circles: SEQUELS submitted targets and (priority) (1=SPIDERS_RASS_AGN)

Orange boxes: specObj-DR11 sources [all SDSS+BOSS in DR11] (Z/ZWARNING)
Red boxes: spAll sources [latest BOSS data] (Z/ZWARNING)
Green boxes: EBOSS_TARGET0 bit 21 (SPIDERS_RASS_CLUS)
Magenta triangles: tiled sources (will get a fiber)



Summary SEQUELS/CODEX 2014-07-21 - N. Clerc

Summary SEQUELS/CODE...

www.mpe.mpg.de/~nclerc/SEQUELS/2014-07-21/

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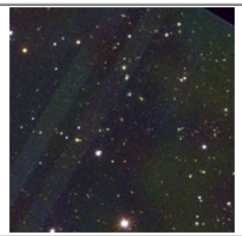
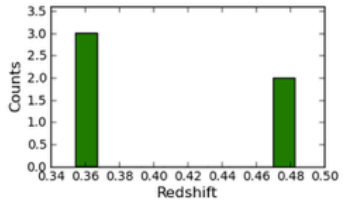
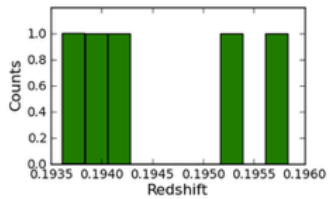
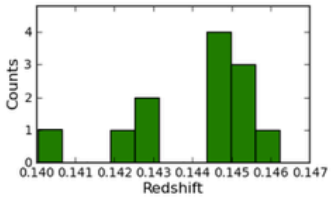
Summary SEQUELS/CODEX -- Run=2014-07-21

Nicolas Clerc, MPE

Link to FITS file with digested data: cluster_statistics_2014-07-21.fits
Link to PS file with analysis plots: allzspecplots_2014-07-21.ps

#	CODEX ID	SDSS *gri* mosaic (9'x9')	Targeting info	RM members z dist
1	1_4239		RM members: **26** - submitted: 2 - tiled: 2 With z: 5/**26** - from SEQUELS: 2/5	
2	1_4473		RM members: **8** - submitted: 7 - tiled: 4 With z: 5/**8** - from SEQUELS: 4/5	
3	1_4375		RM members: **19** - submitted: 12 - tiled: 12 With z: 12/**19** - from SEQUELS: 8/12	

Analysis steps

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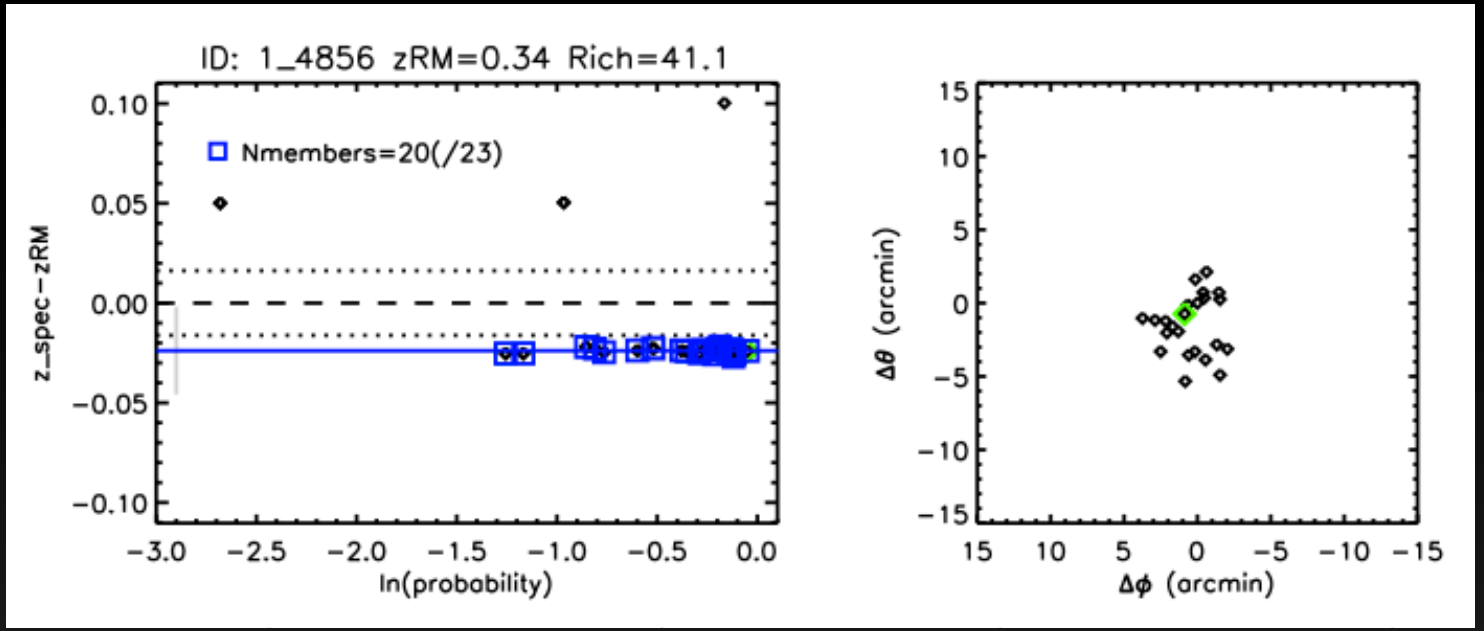
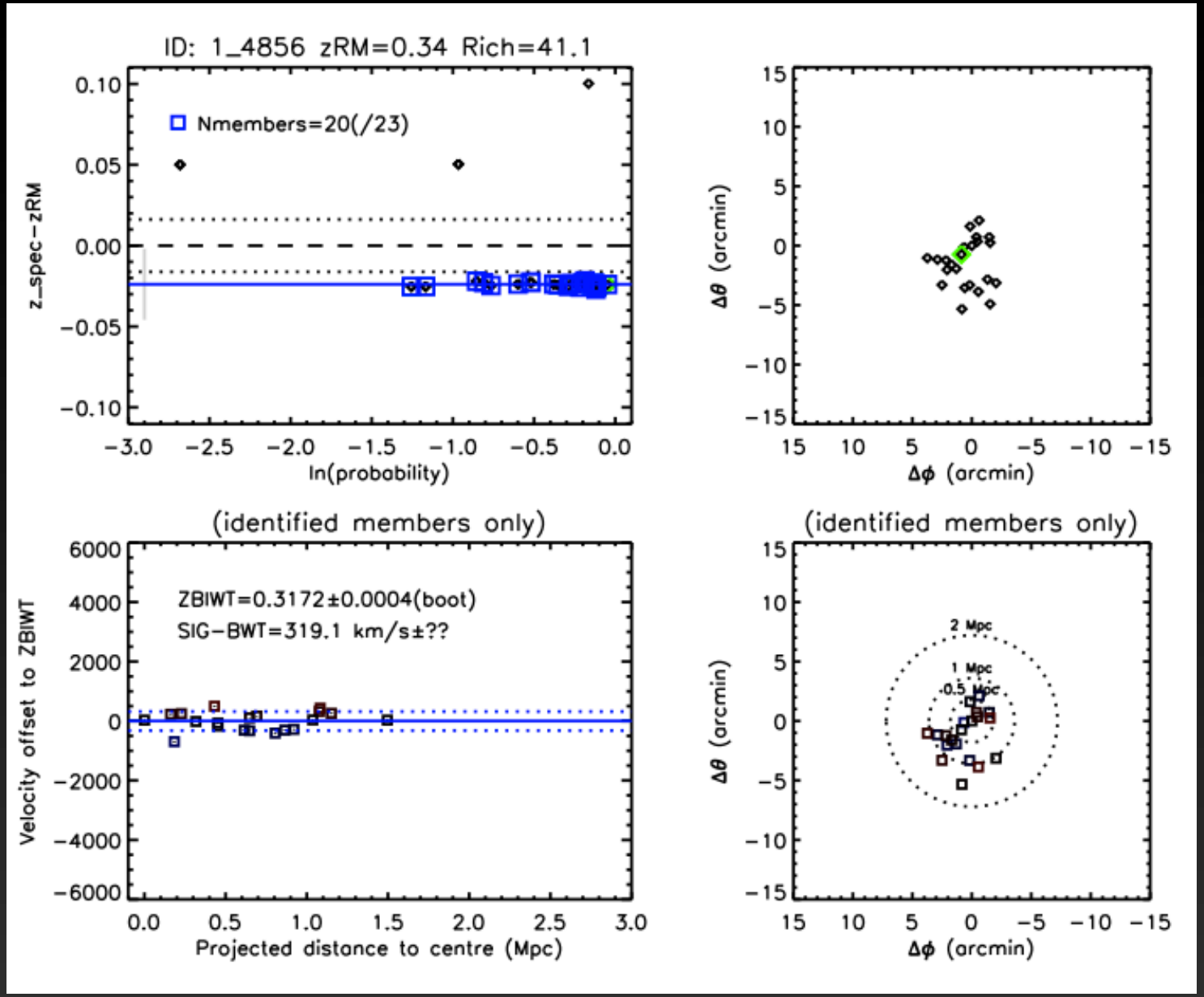
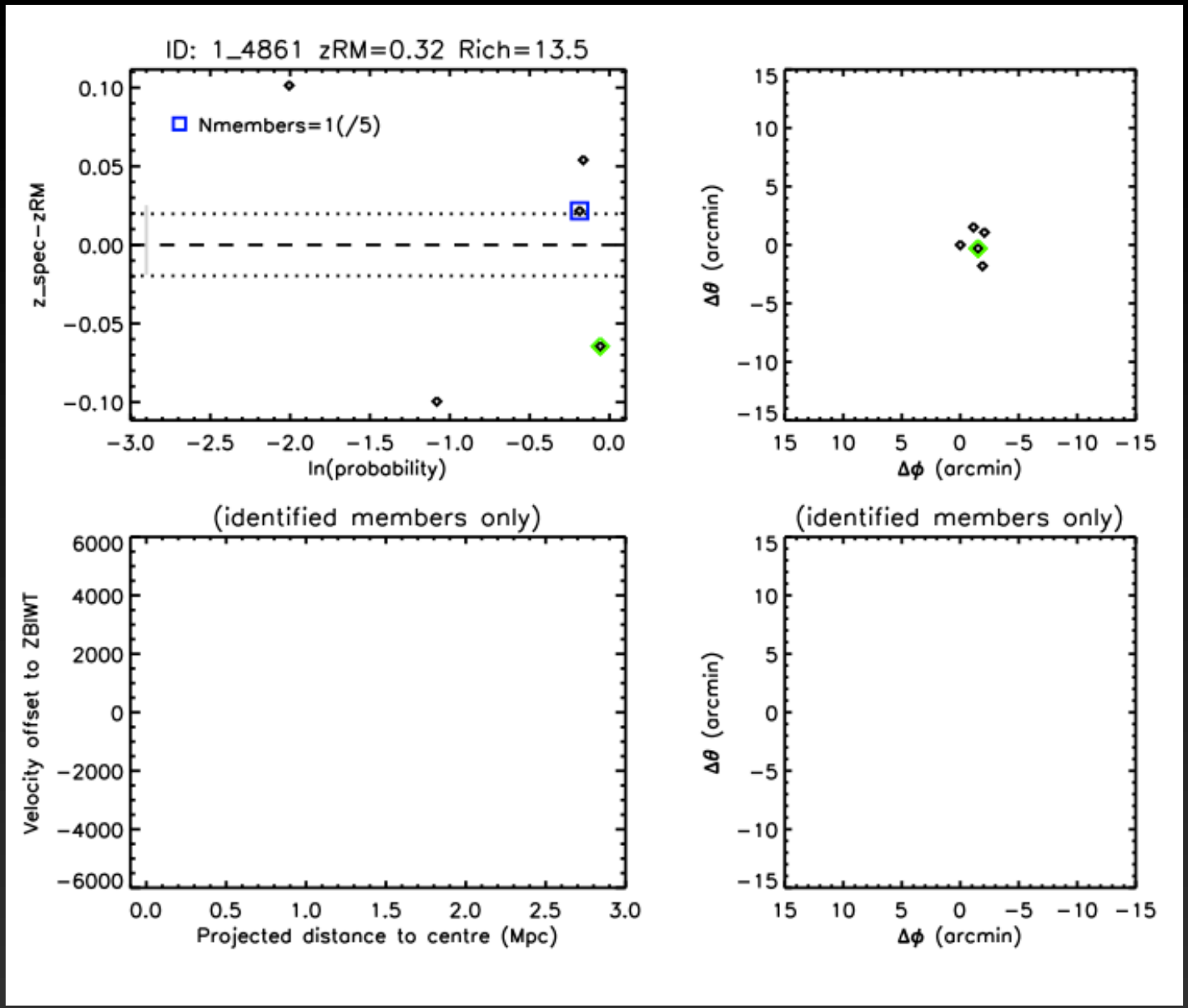
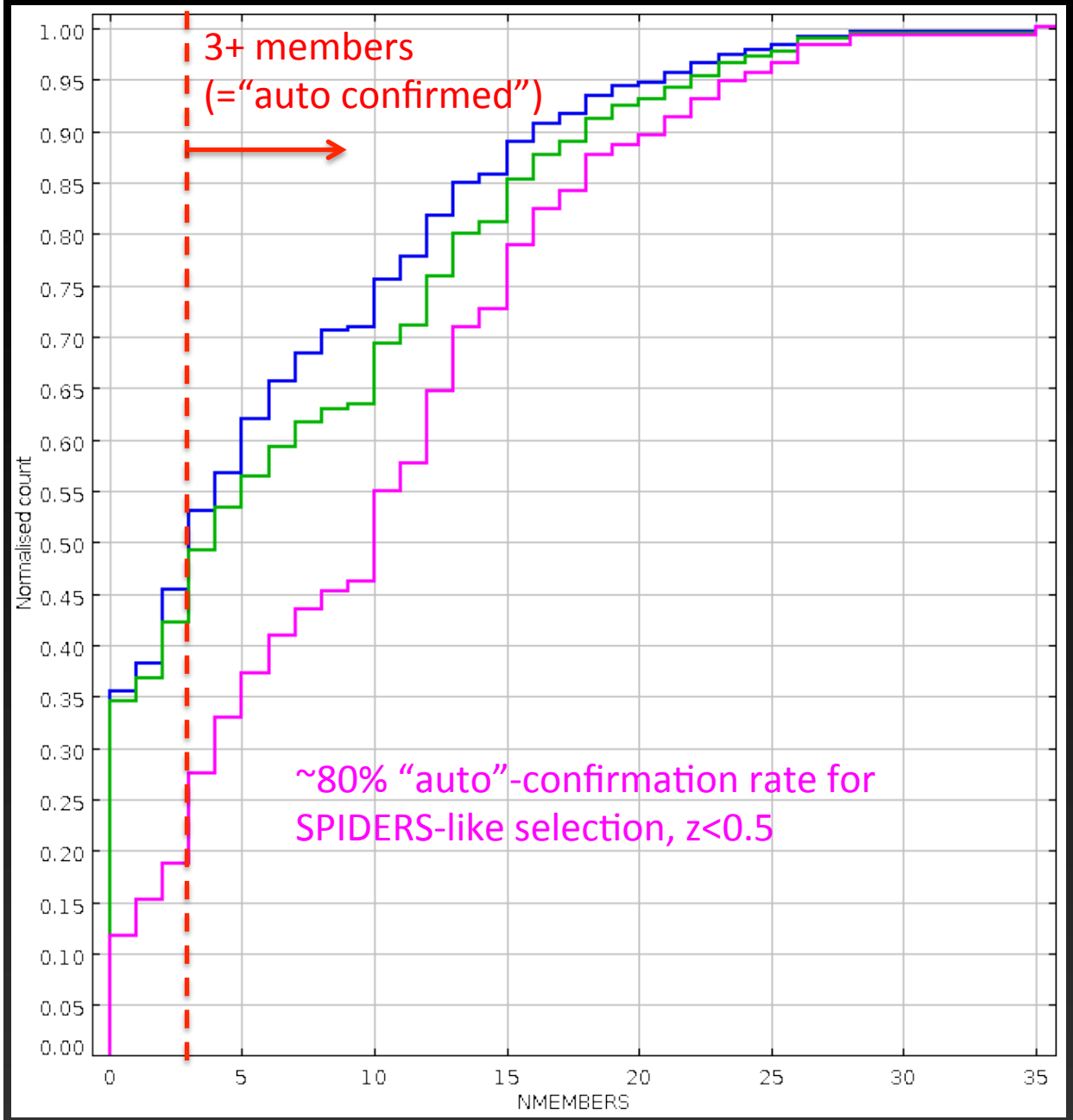

ID: 1_4856 zRM=0.34 Rich=41.1
Nmembers=20(/23)
z_spec−zRM
ln(probability)
Δθ (arcmin)
Δϕ (arcmin)


ID: 1_4856 zRM=0.34 Rich=41.1
Nmembers=20(/23)
z_spec−zRM
ln(probability)
Δθ (arcmin)
Δφ (arcmin)
(identified members only)
ZBIWT=0.3172±0.0004(boot)
SIG−BWT=319.1 km/s±??
Velocity offset to ZBIWT
Projected distance to centre (Mpc)
2 Mpc
1 Mpc
0.5 Mpc


ID: 1_4861 zRM=0.32 Rich=13.5
Nmembers=1(/5)
z_spec−zRM
ln(probability)
Δθ (arcmin)
Δφ (arcmin)
(identified members only)
Velocity offset to ZBIWT
Projected distance to centre (Mpc)
(identified members only)
Δθ (arcmin)
Δφ (arcmin)



SEQUELS/CODEX:
← Fractional number of clusters with less than *N* spectro-members

- fully observed sample [223]
- fully obs., λ>10 [169]
- fully obs., λ>10, z_{phot}<0.5 [113]

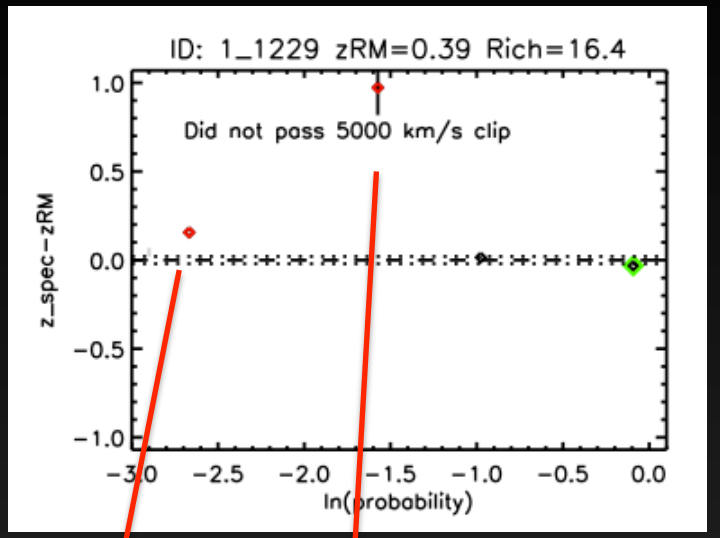
N.B.: z_{phot}>0.5 clusters take only 4% of the SPIDERS cluster fiber budget

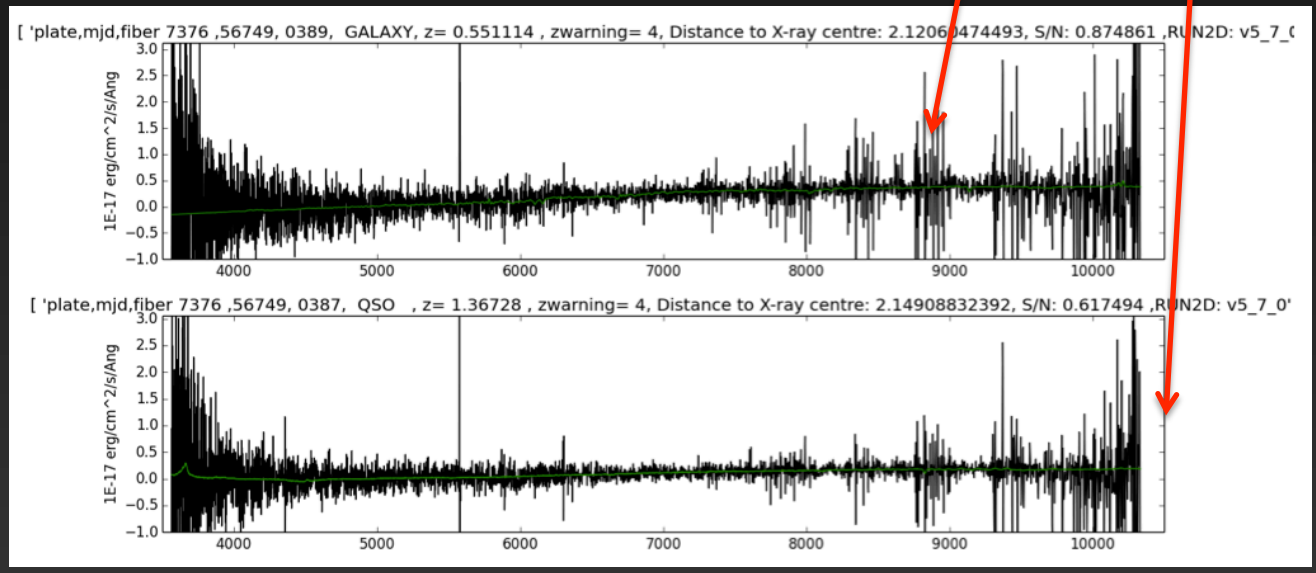
Analysis steps

1. Cluster database: collect data per cluster
2. Automated membership assessment
3. **Interactive membership assessment**
4. Redshift/V_{disp}, uncertainty estimates
5. Catalogue production
6. Science

Recovering individual *z*

- Spectra visual inspection
- New fit with priors?
- Add non-RedMapper spectra

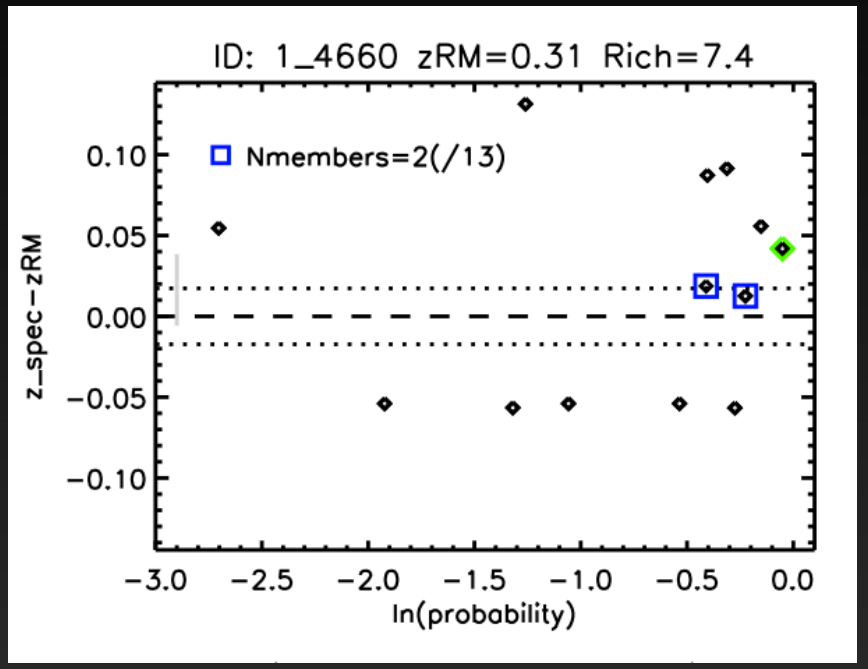




Membership "priors"

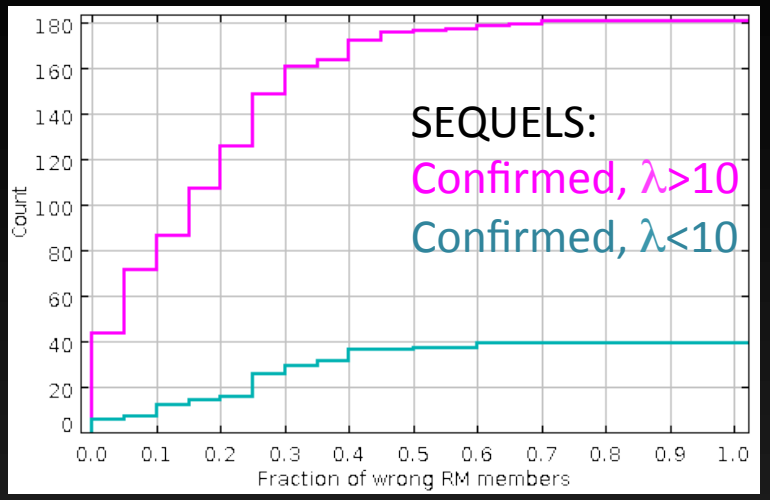
First guess for iterative 3σ-clipping:

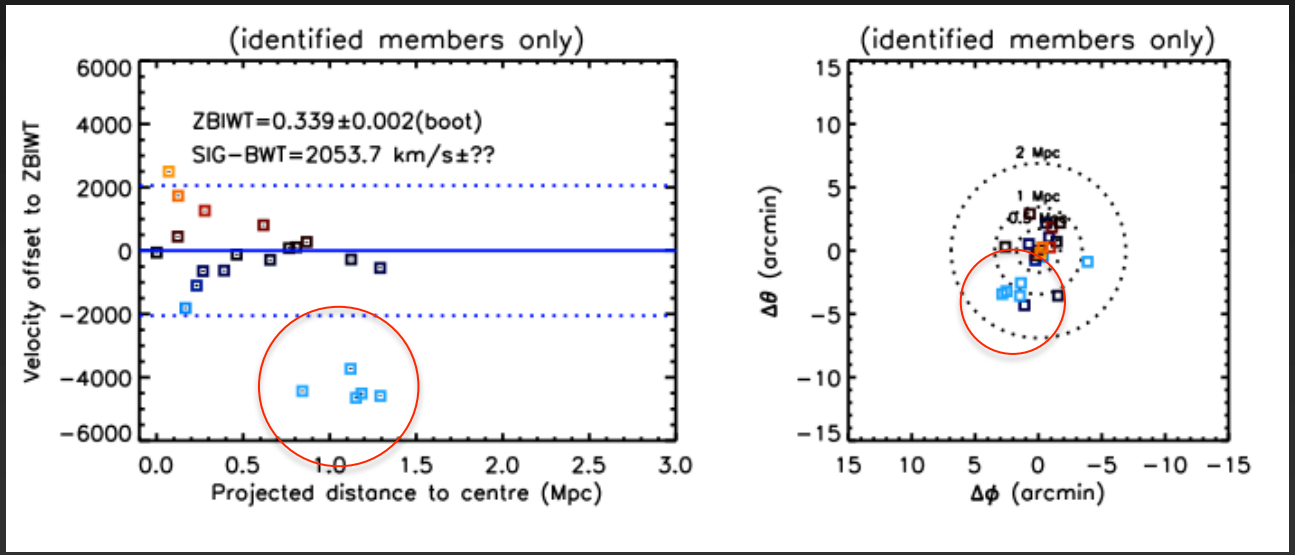
- Average? (current)
- RM photo-z ± Δz?
- *f*(*probability, magnitude, distance*) of available z_{spec}?
- 1st clipping amplitude (current: ±5000 km/s)



Refinement

- Substructure flagging
- Re-run RedMapper using all spec-z





Analysis steps

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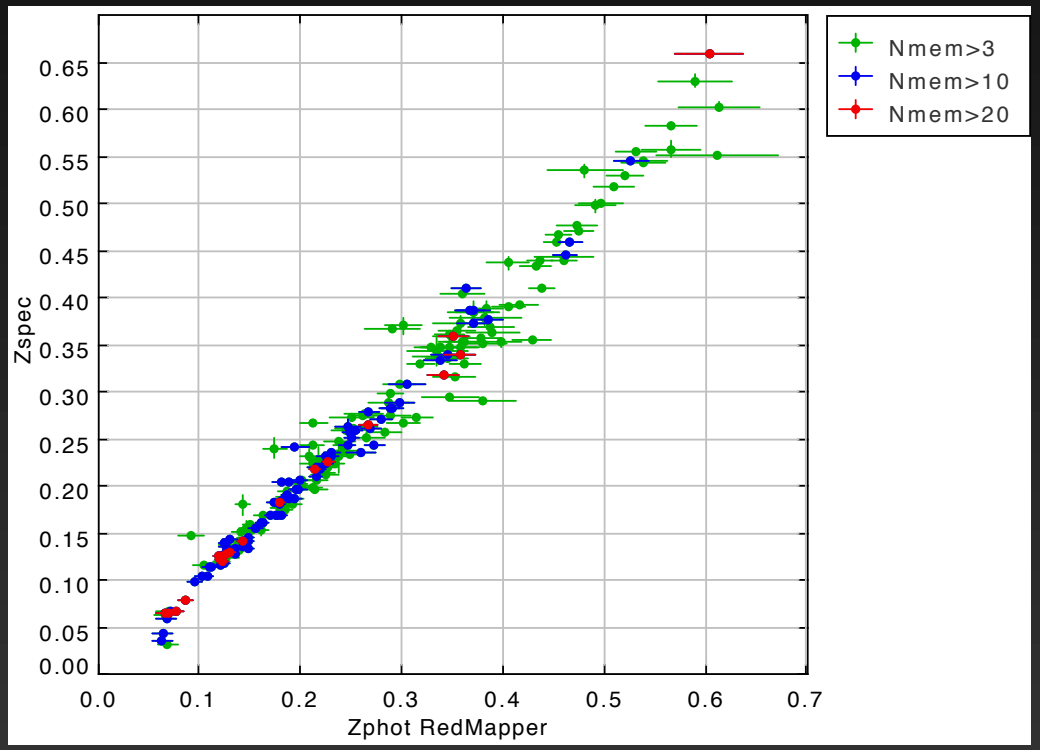
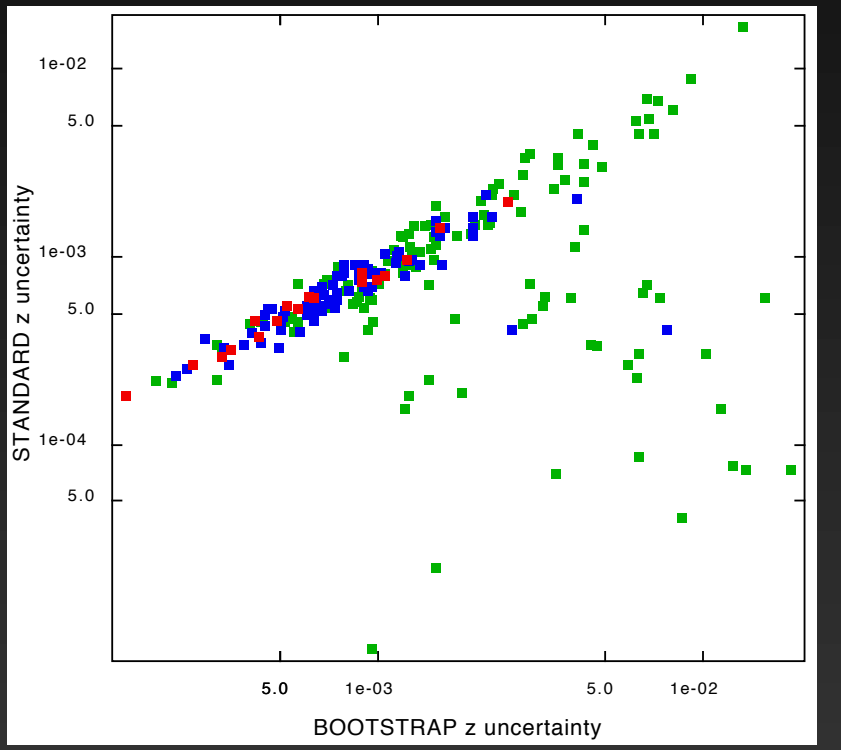
5. Catalogue production
6. Science

Cluster Redshifts

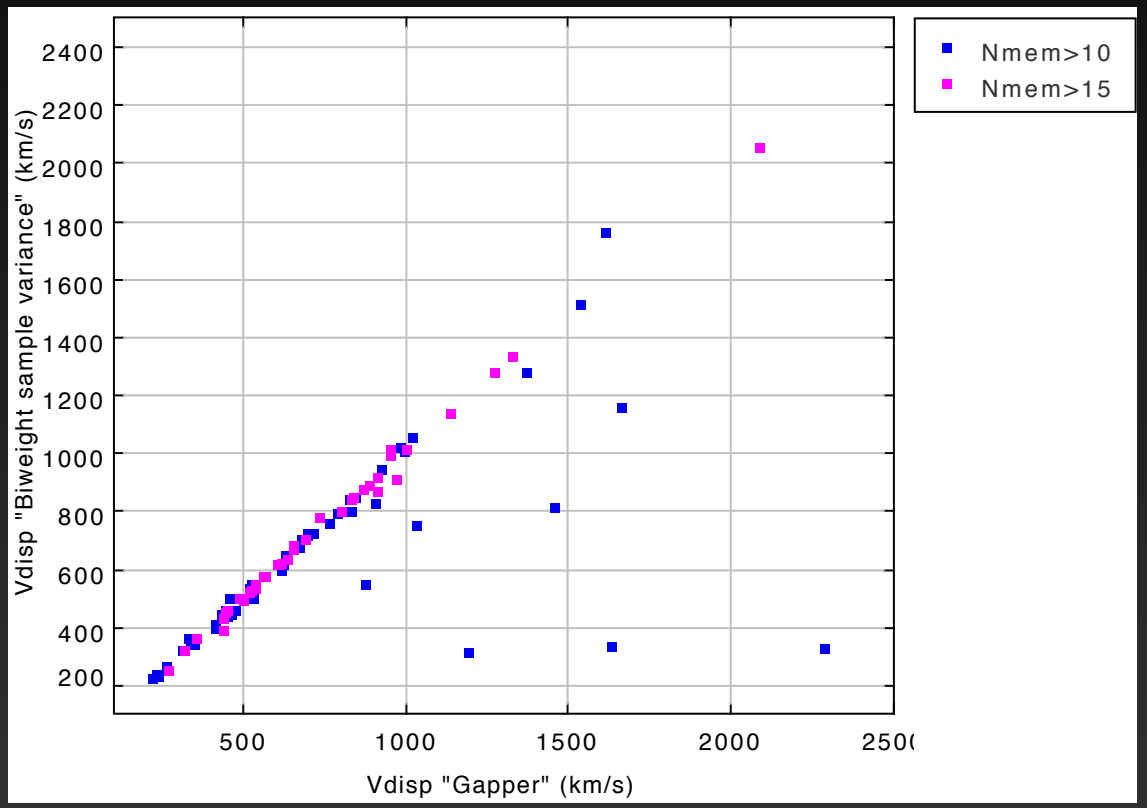
- Bi-weight estimate (Beers+90, ROSTAT)
- “Bootstrap” and “standard” uncertainties





Radial velocity dispersions

- "Gapper" and "Biweight variance" agree well for N_{mem}>10
- Outliers: merging clusters or 2+ interlopers
- Uncertainties: work in progress (stacking, resampling, simulations…)



Analysis steps

1. Cluster database: collect data per cluster
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3. Interactive membership assessment
4. Redshift/V_{disp}, uncertainty estimates
5. **Catalogue production**
6. Science

Catalogue production

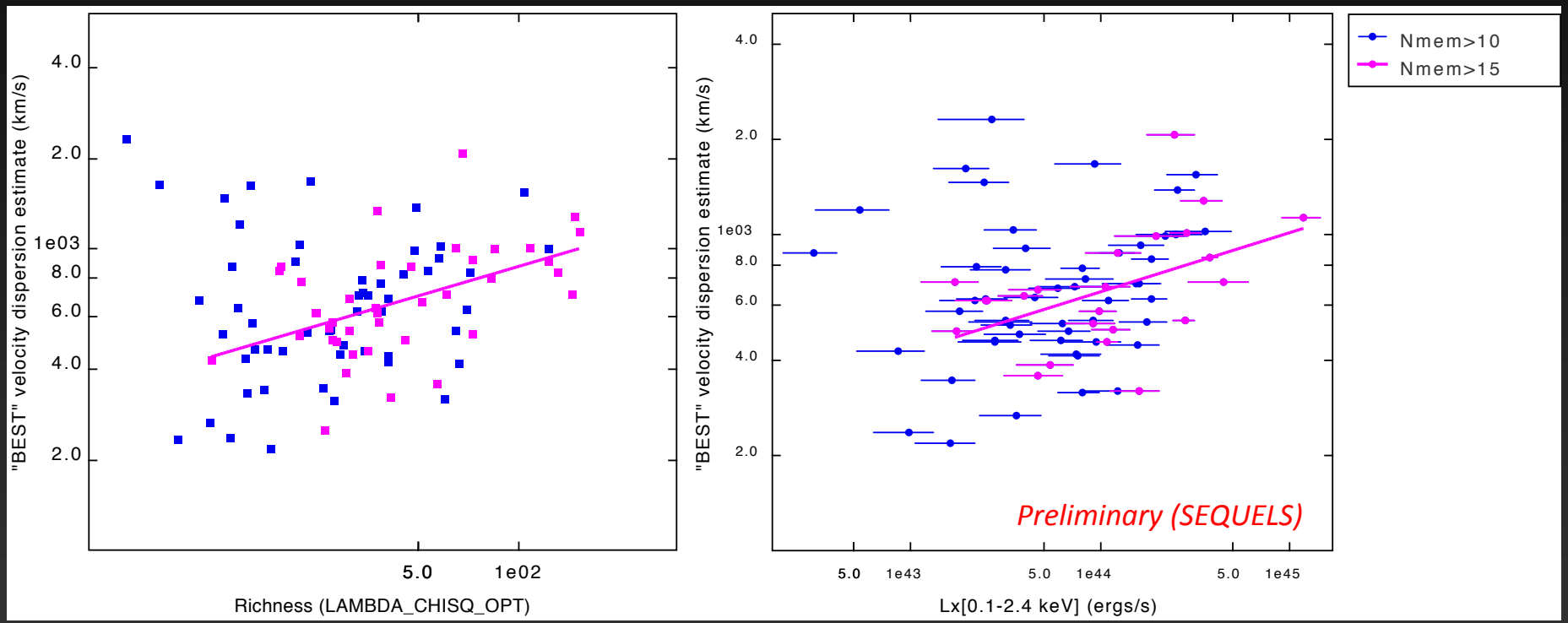
- Catalogue of X-ray/optical/spectroscopy
- Open items
  - Subsample? 20% of clusters require 80% manpower: are they really of interest?
  - Re-estimation of cluster parameters
    - X-rays (new redshifts)
    - Optical (refined red-sequence finder)
  - Interactive database (see pipeline session)

Analysis steps

1. Cluster database: collect data per cluster
2. Automated membership assessment
3. Interactive membership assessment
4. Redshift/V_{disp}, uncertainty estimates
5. Catalogue production
6. **Science**

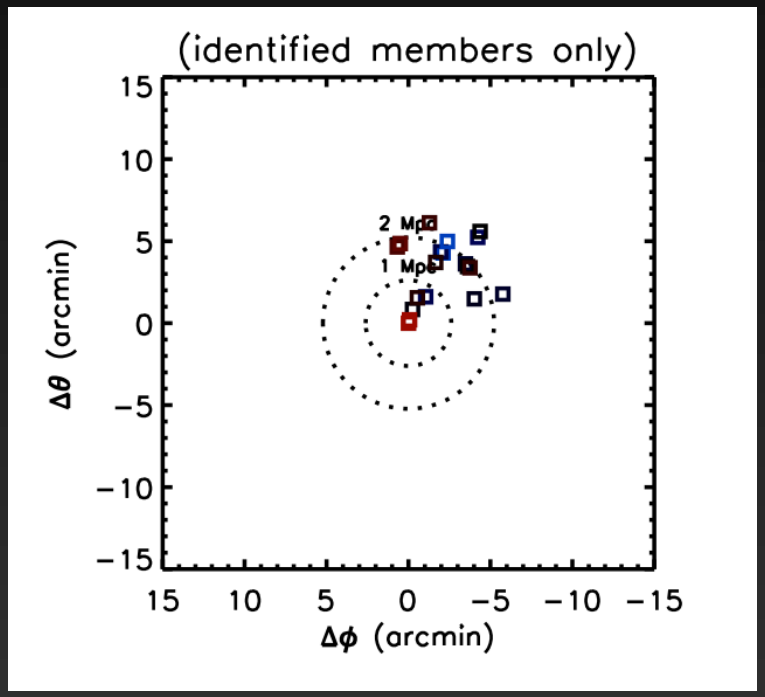
Science

- This first technical paper will discuss scaling relations
  - Consistency checks
  - Optical properties/X-ray properties/V_{disp}
  - How does it relate to mass estimates?



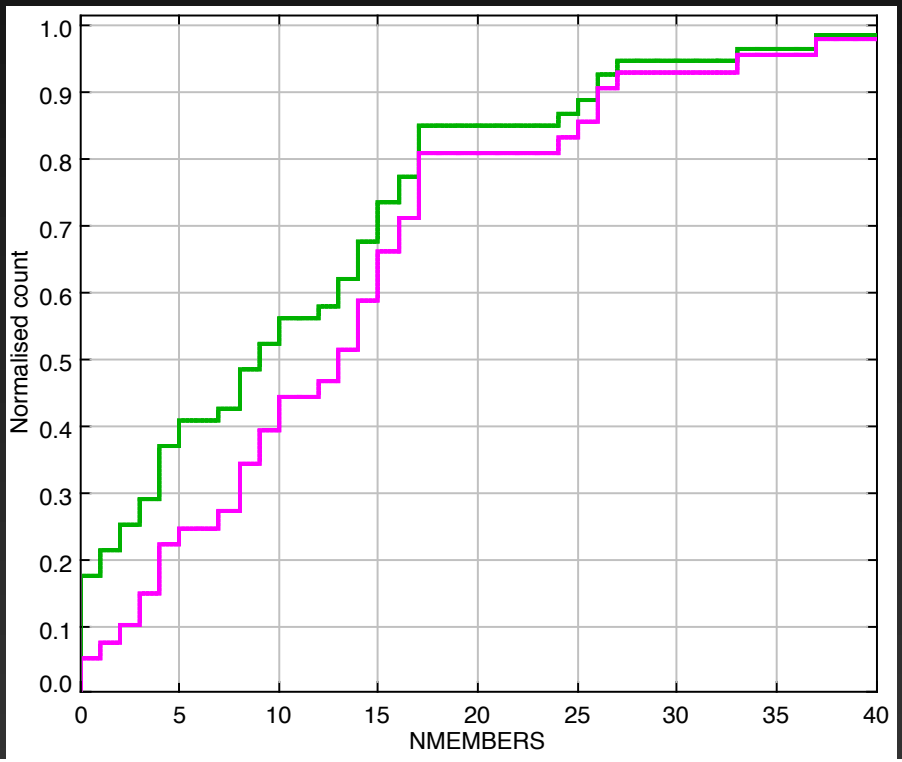
Science

- A sample of mergers?



First SPIDERS results

- As of Friday, 13 ‘good’ eBOSS plates observed
  - 72 CODEX clusters (λ>10) ; 52 “fully observed”
  - 8 RM-XCLASS clusters



SPIDERS/CODEX:
← Fractional number of clusters with less than *N* spectro-members

- fully obs., λ>10 [52]
- fully obs., λ>10, z_{phot}<0.5 [41]

eROSITA era expectations

- Needs work on the X-CLASS/RM sample (~200 clusters in eBOSS footprint)
- Improved red-sequence finder with X-ray priors (position/extent/…)
- Confirmation with BCG is more straightfoward