A2029 a relaxed cluster in a chaotic ambient - analysis of the dynamic and photometric properties of the galaxies

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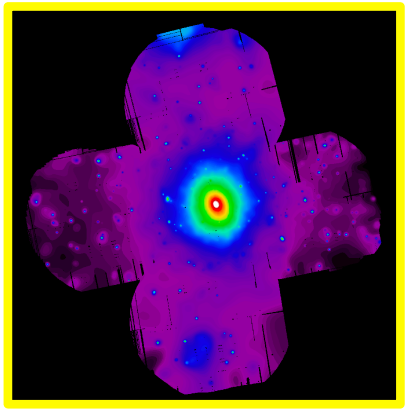
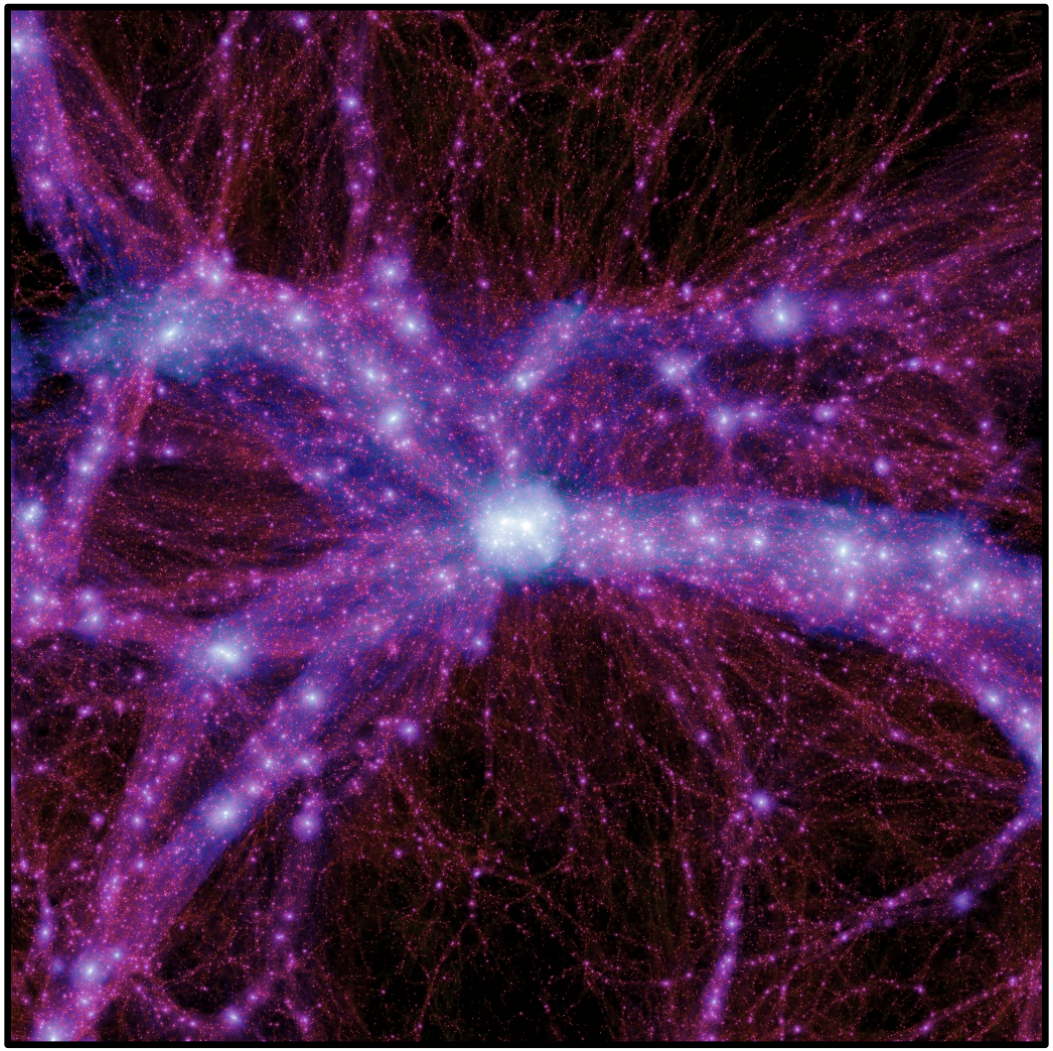
S. De Grandi,S. Molendi, F. Gastaldello, M. Rossetti, S. Ghizzardi - (Italy-MI)



Scientific background

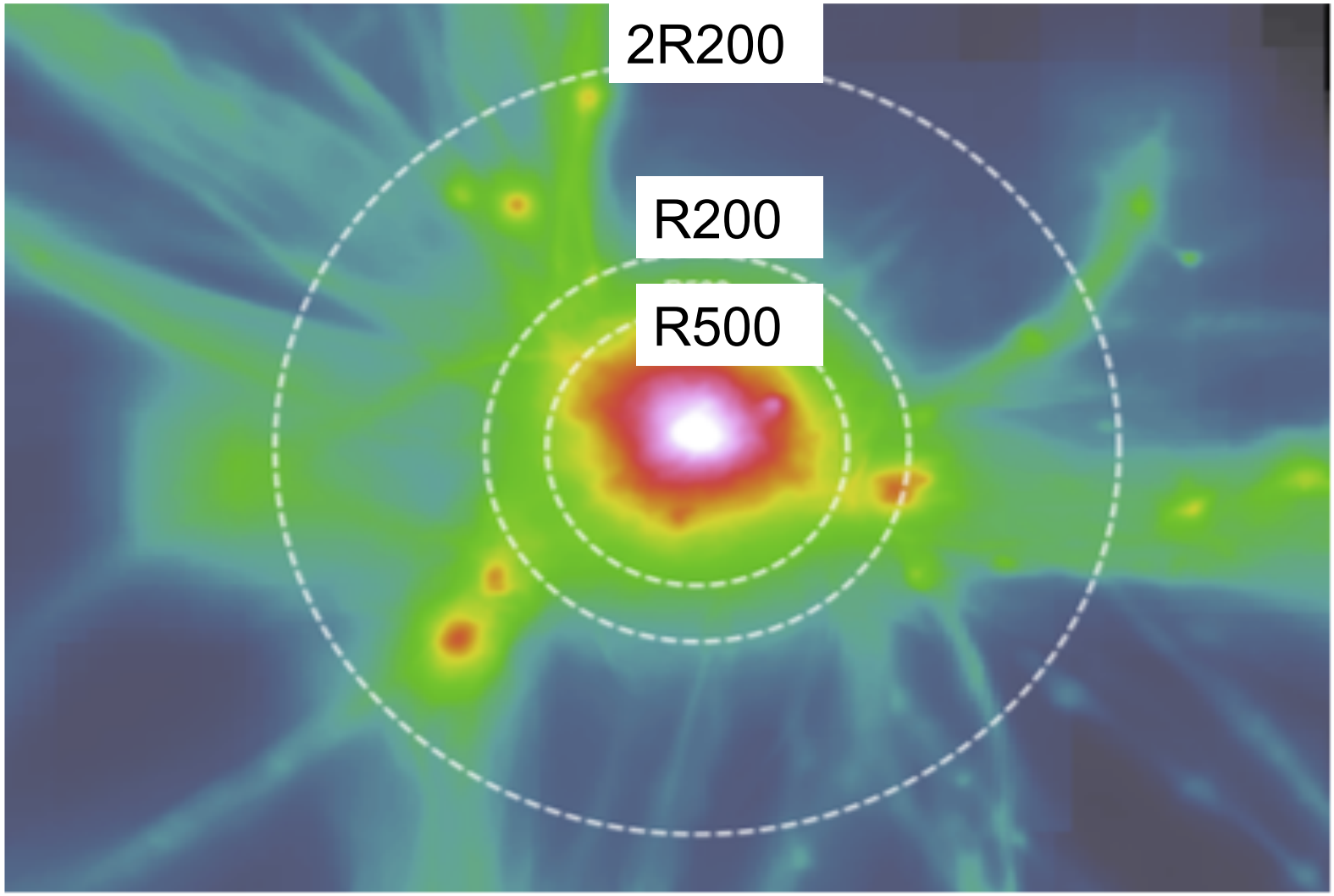
The baryonic matter flows along the gravitational potential well of the dark matter filaments towards the connecting nodes, where galaxy clusters are thus formed (e.g., Springel et al. 2005).

While major mergers of galaxy clusters carry a lot of mass but are rare, most of the cluster mass (~**80%**) accumulates through accretion of **small structures (galaxies and galaxy groups)**



Scientific background

Simulated projected gas density map

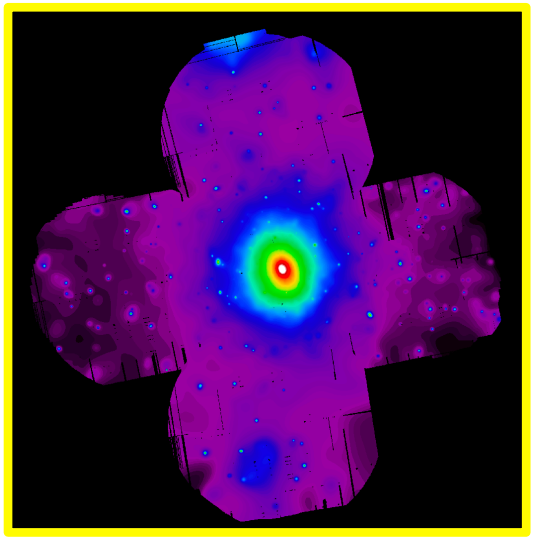


X-COP

The XMM Cluster Cutskirts Project (PI D. Eckert, VLP 1.2Ms)

Targets are the outer regions of a sample of **13 massive clusters:** $M_{500} > 3 \times 10^{14}\ M_{\odot}$ **@ z<0.1**

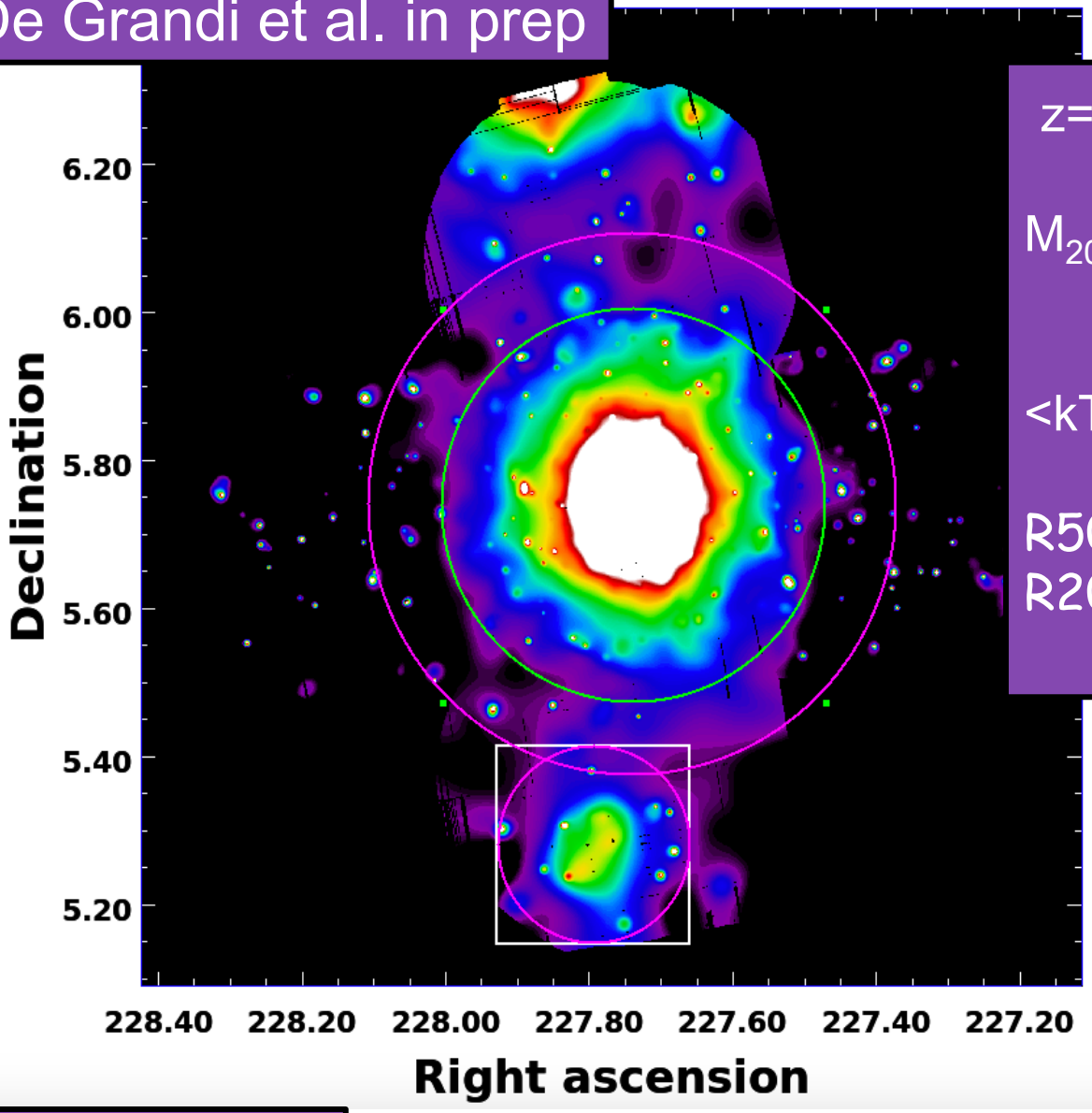
A2029



A2029 is @ z=0.077
$M_{200} \approx 1 \times 10^{15}\ M_{\odot}$ (Walker+12)
<kT> = 7.5 keV

A2029

De Grandi et al. in prep



z= 0.077

M_{200} ~ 1x10^{15} $M_{\odot}$
(Walker+12)

<kT> = 7.5 keV

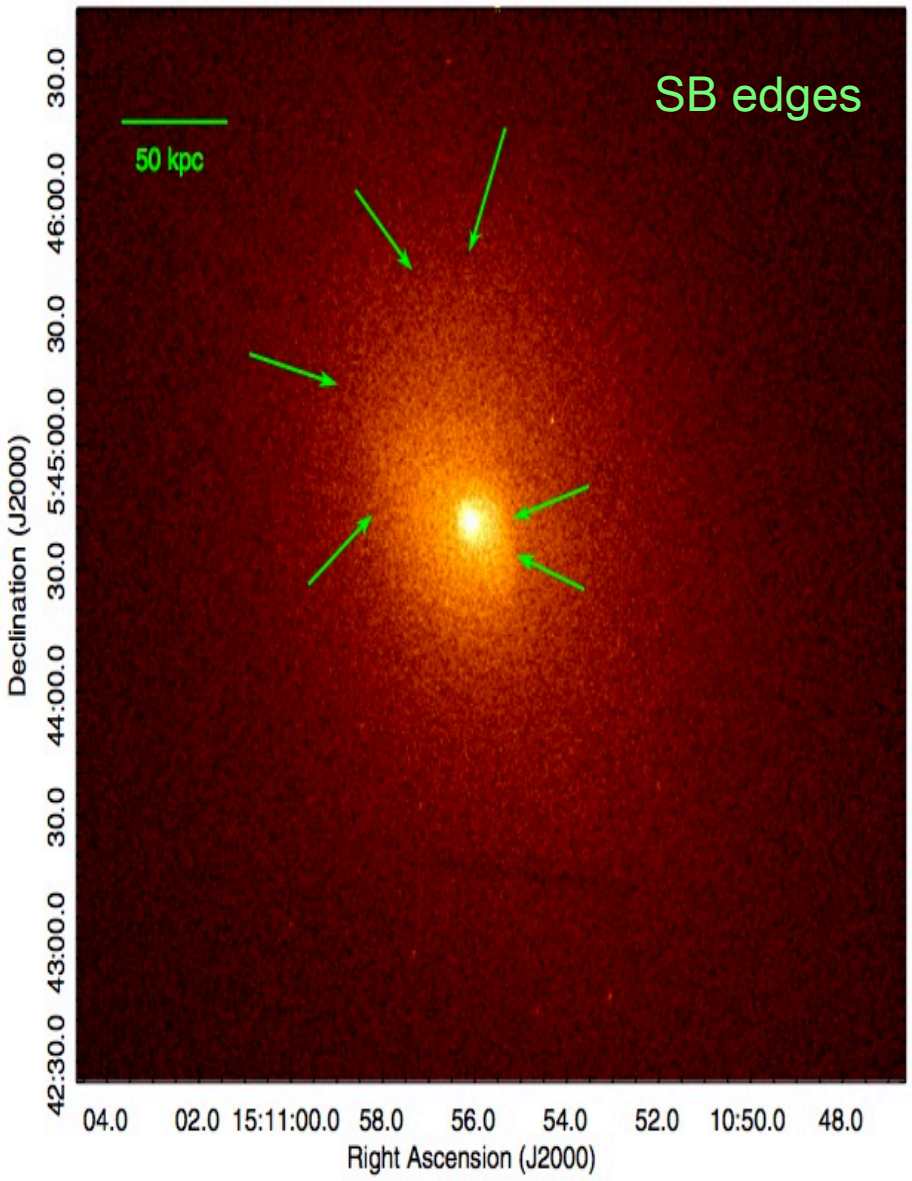
R500 ~ 1474 kpc (green)
R200 ~ 1945 kpc (magenta)

XMM (>300 ks)

A2029

De Grandi et al. in prep

Chandra SB image

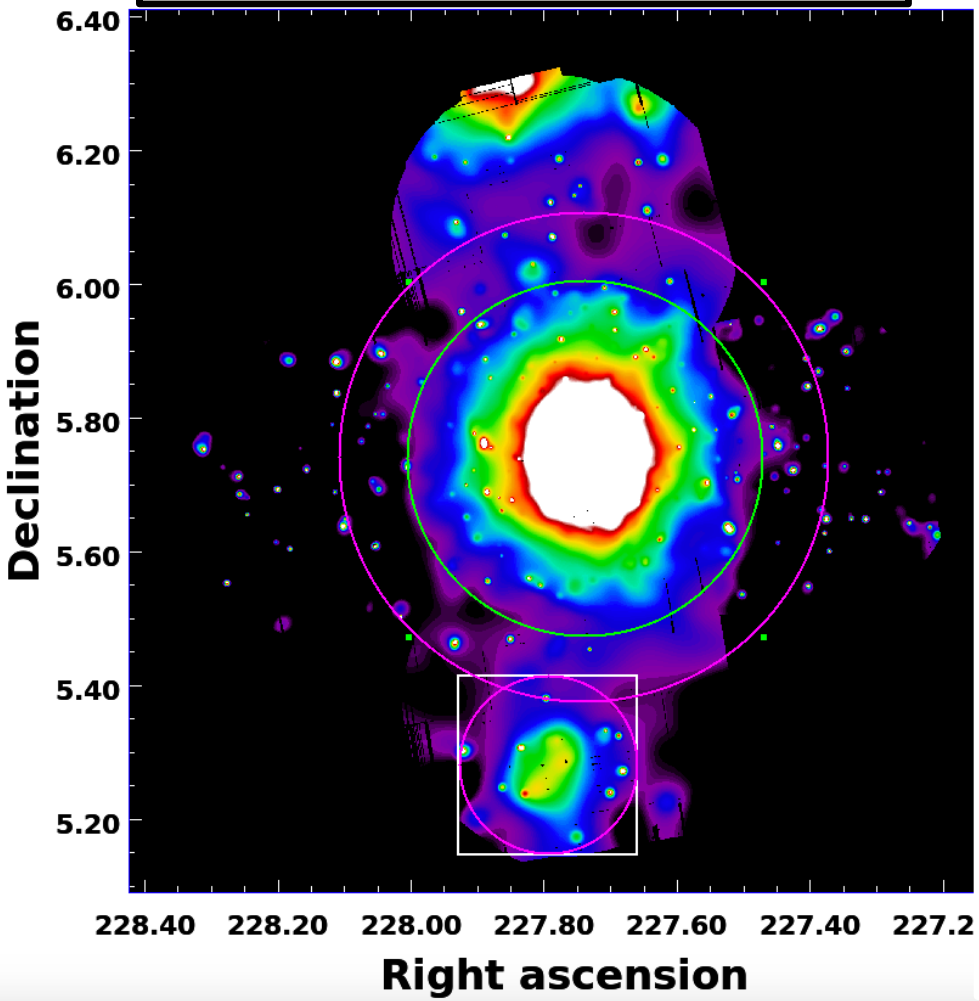


Chandra data show a sloshing spiral extending radially from the cluster core outward to ~400 kpc

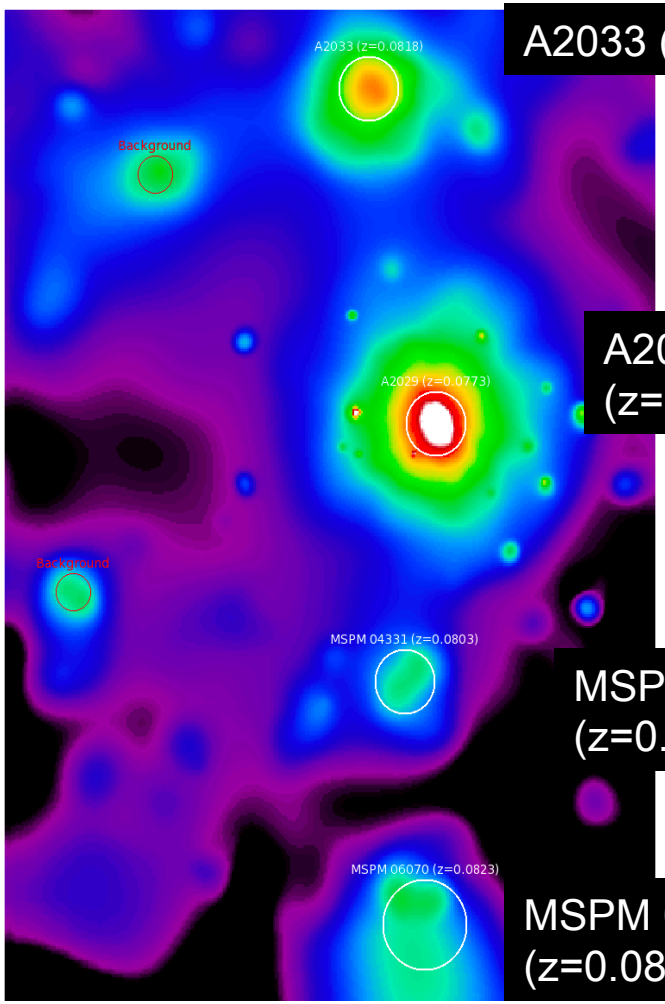
Gas sloshing occurs in cool core clusters that have been disturbed by an off-axis merger with a sub-cluster or group (Paterno-Mahler et al. 2013)

Accreting groups in A2029

R500 ~ 1474 kpc (green)
R200 ~ 1945 kpc (magenta)



ROSAT PSPC Pointed



A2033 (z=0.0818)

A2029 (z=0.0773)

MSPM 04331 (z=0.0803)

MSPM 06070 (z=0.0823)

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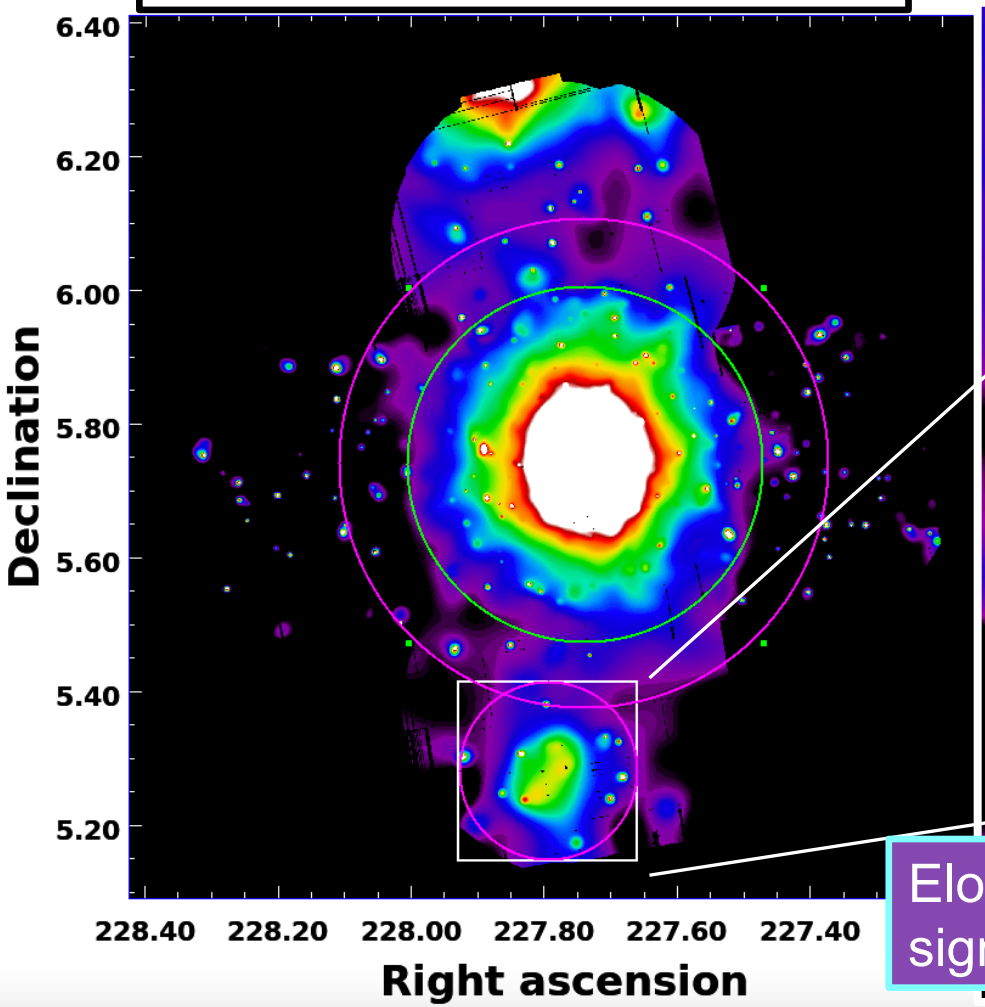
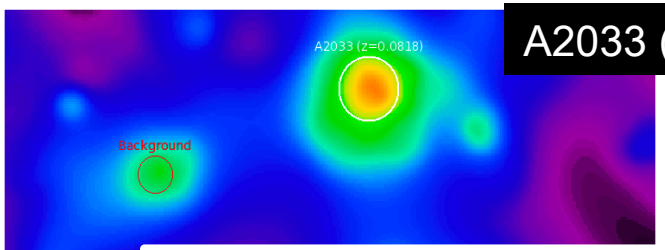
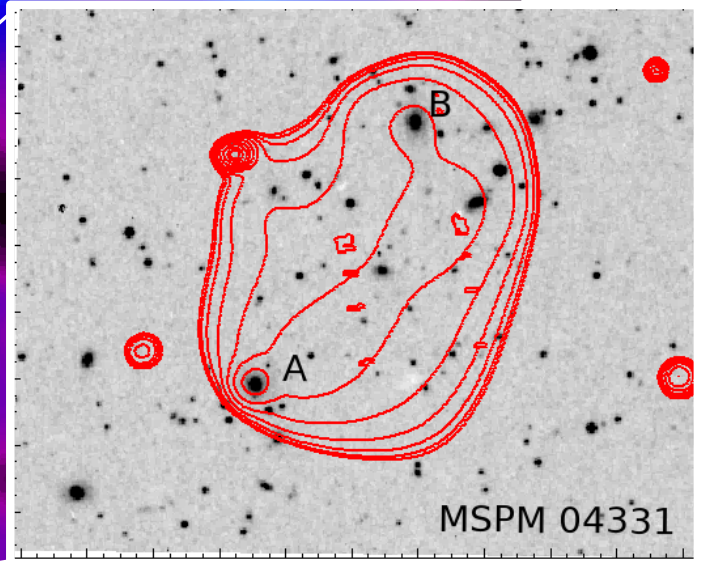




A2033 (z=0.0818)



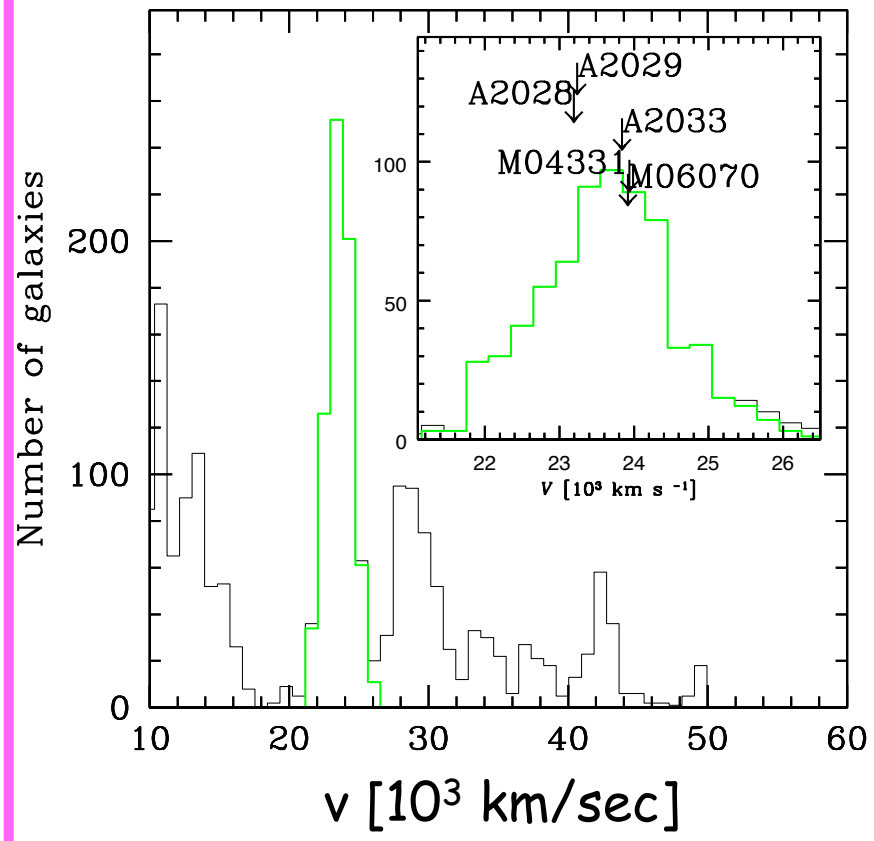
Elongated morphology, signs of interactions?

MSPM 06070 (z=0.0823)

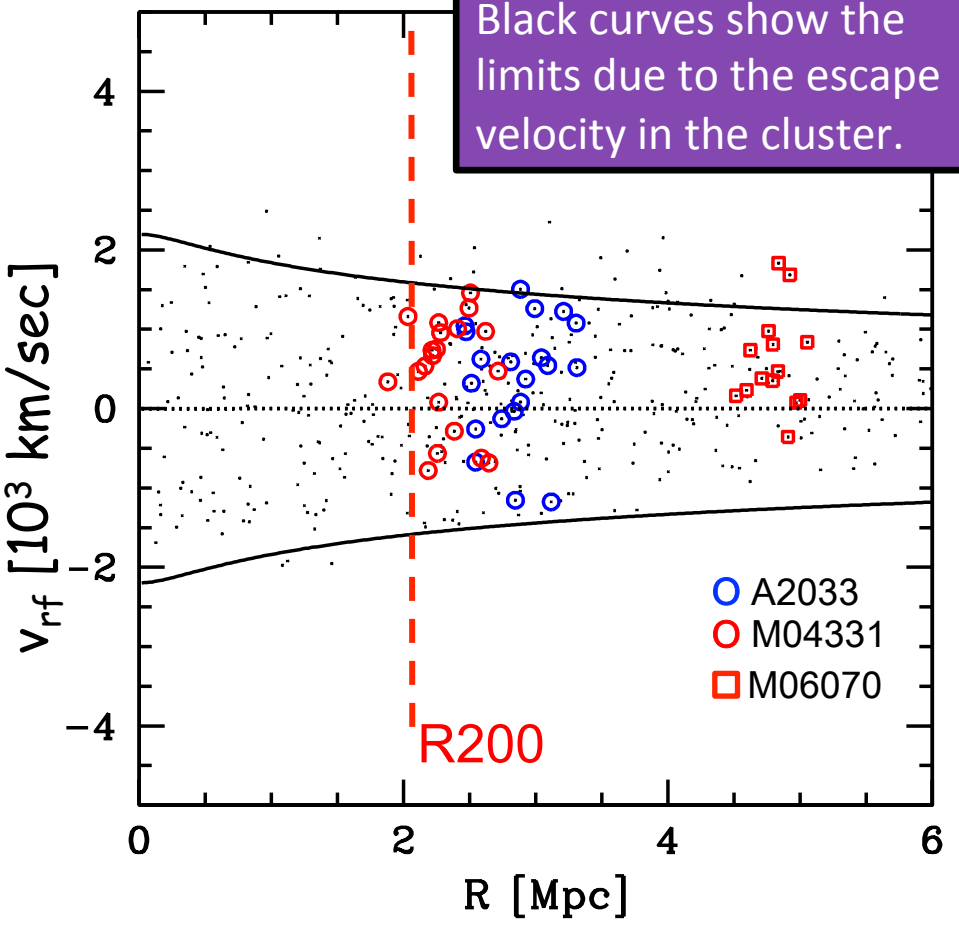
A2029

Rest-frame los velocity vs. projected distance from the center of A2029 of the spectroscopic 685 members of the cluster complex.

SDSS galaxy LOS velocities



Black curves show the limits due to the escape velocity in the cluster.



A2029

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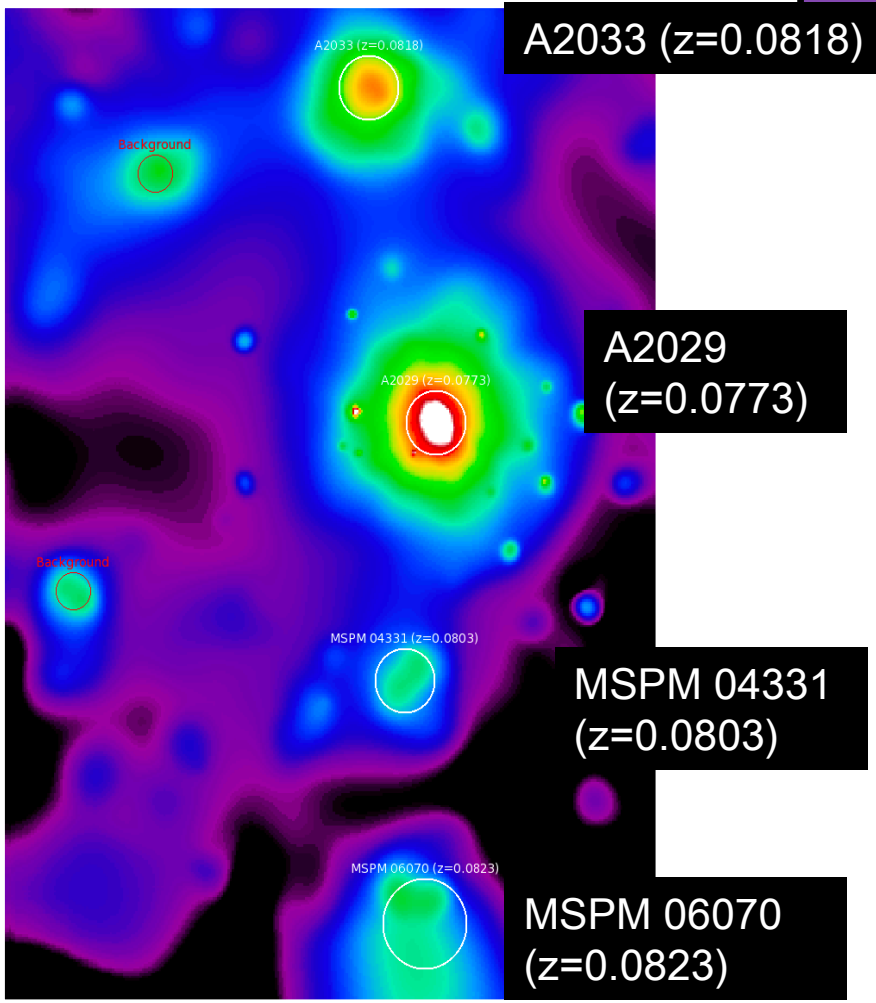
Rest-frame los velocity vs. projected distance om the center of A2029 of the spectroscopic 685 members of the cluster complex.



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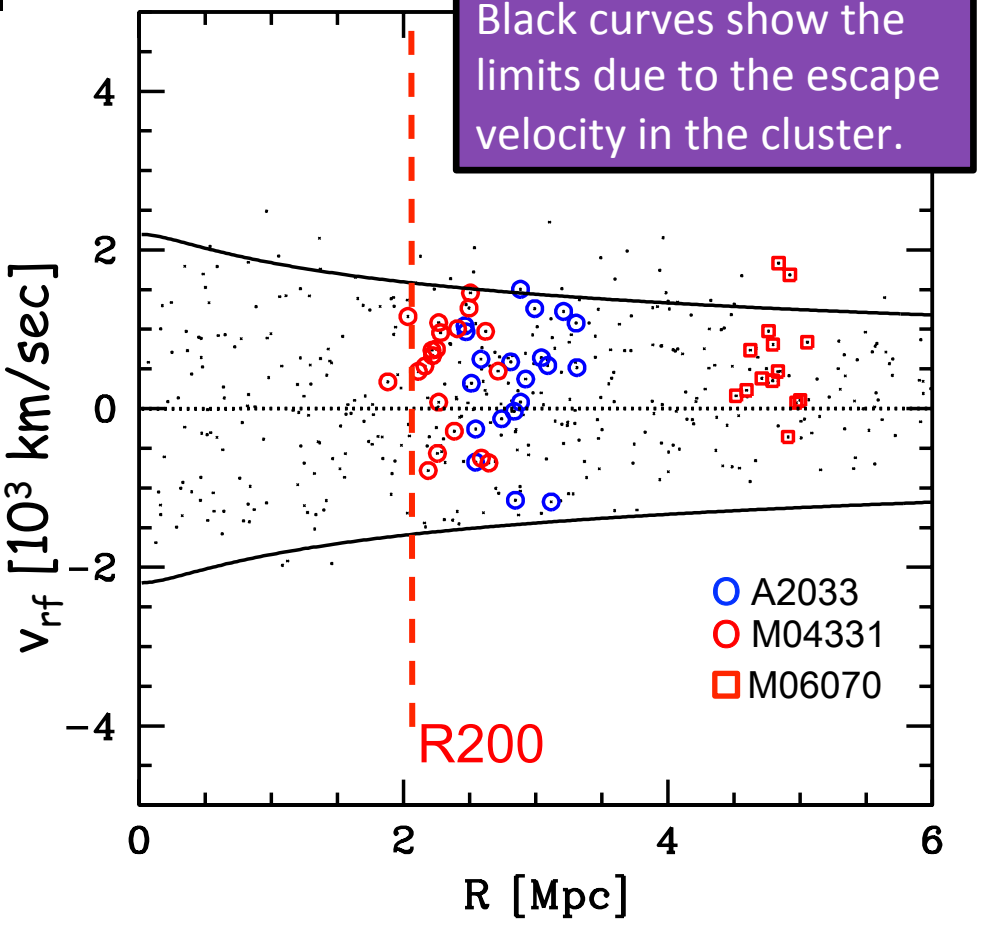
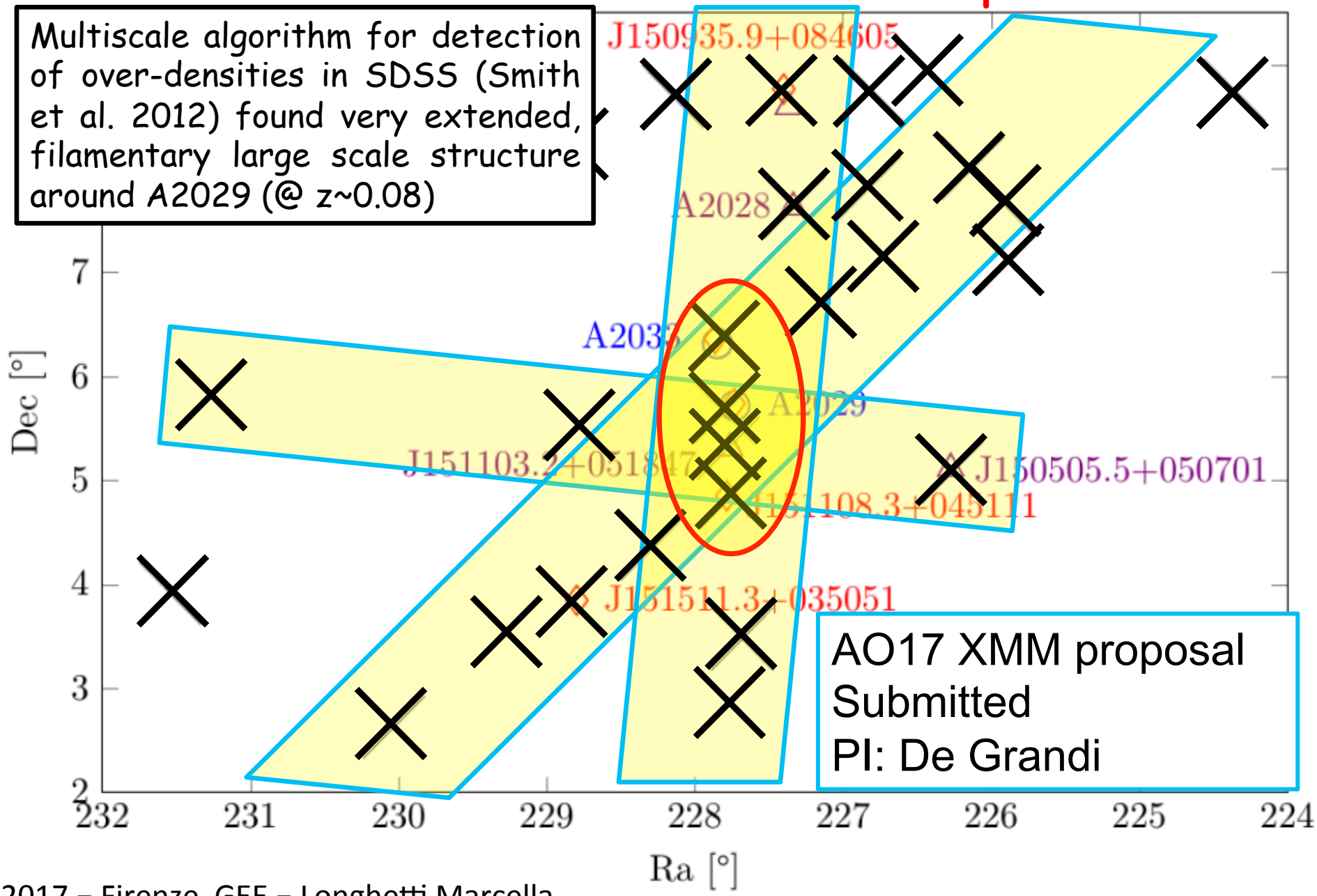


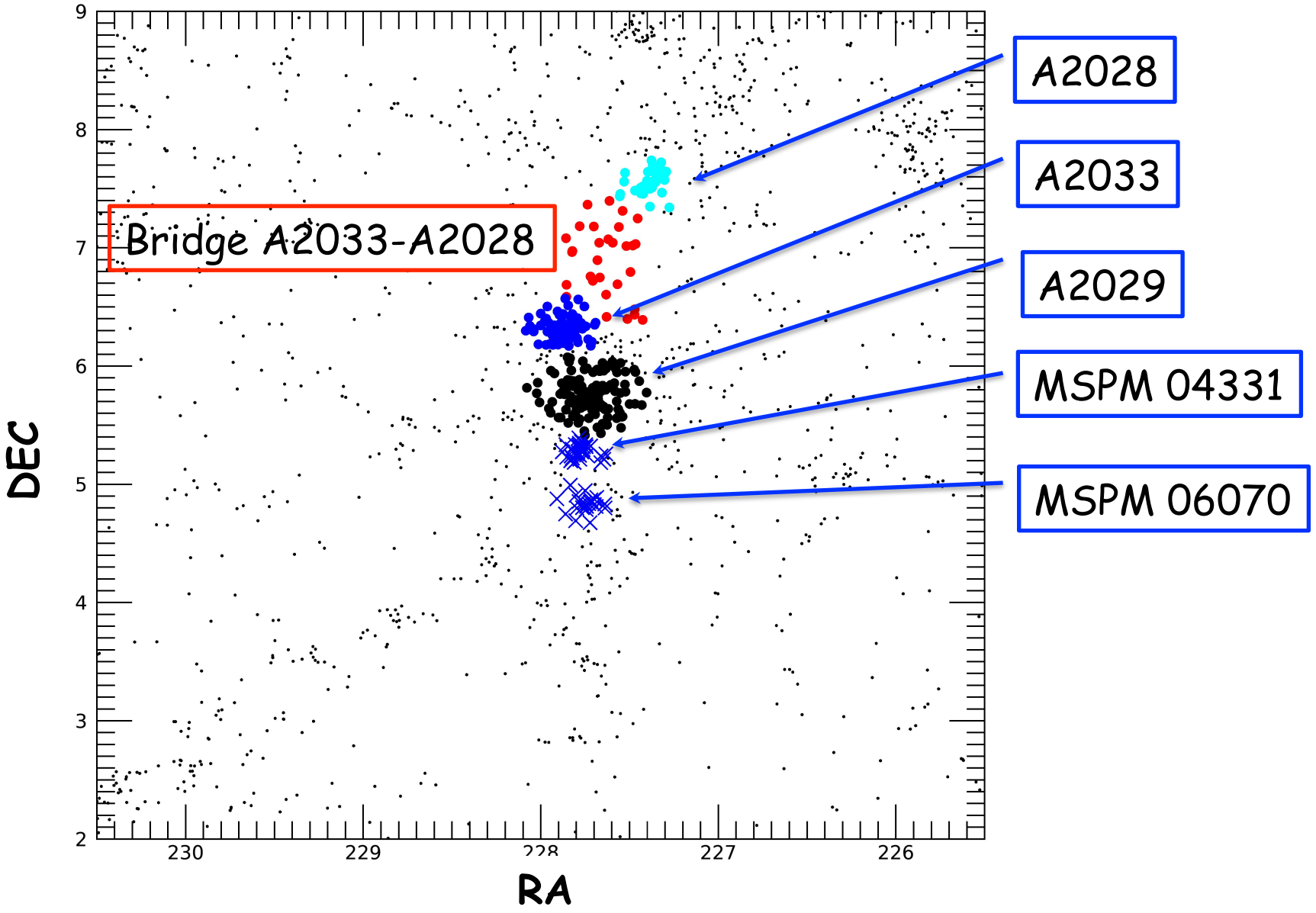
A2029 and its super-cluster

Multiscale algorithm for detection of over-densities in SDSS (Smith et al. 2012) found very extended, filamentary large scale structure around A2029 (@ z~0.08)



AO17 XMM proposal
Submitted
PI: De Grandi

A2029 and its super-cluster



SELECTION OF SAMPLEs FROM SDSS DR12

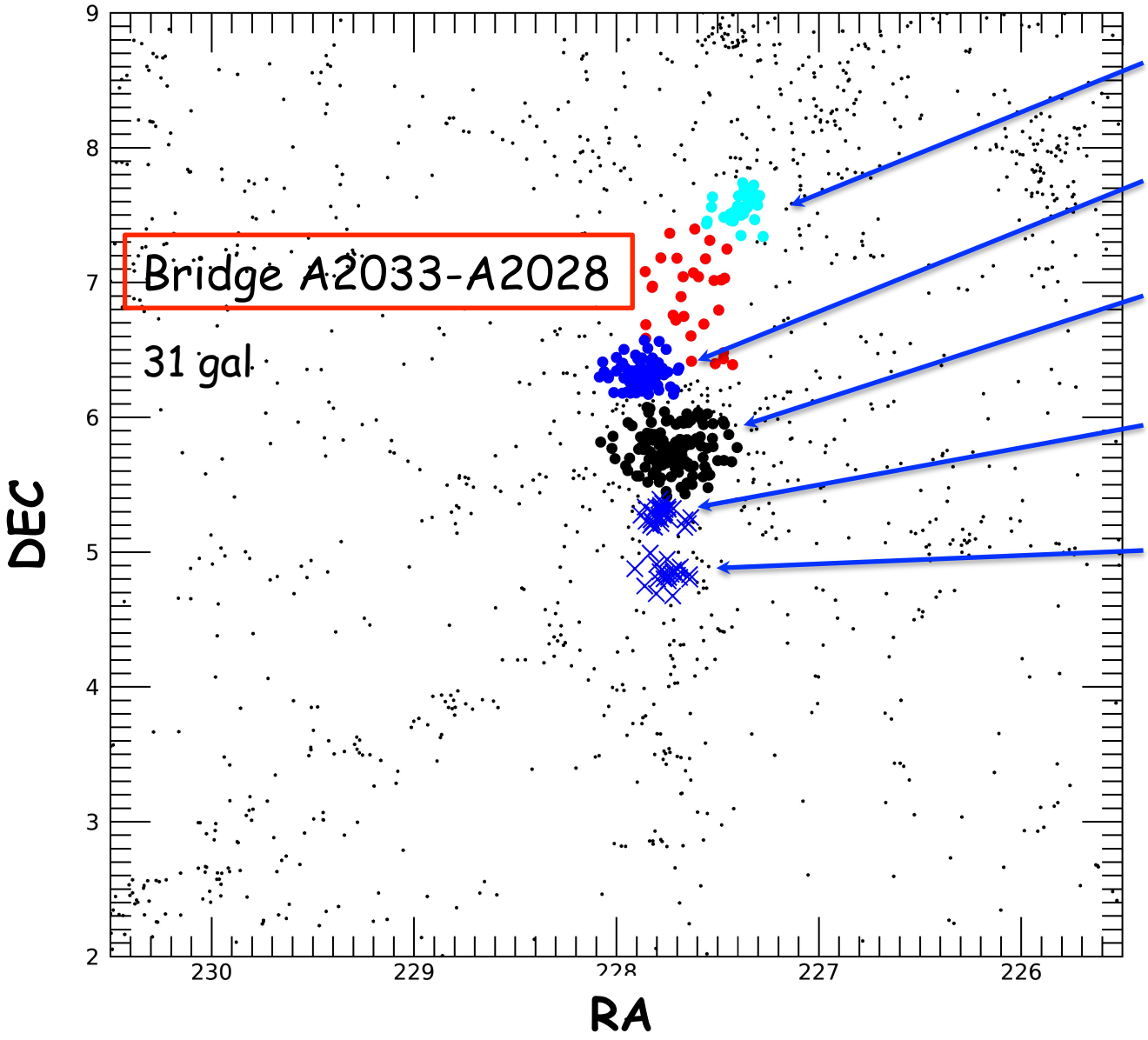
A2029 – A2028 – A2033

- z_{spec} within 0.06 – 0.09
- $err\_z_{spec}/z_{spec} < 0.5$
- **galaxy position – within R200 from the centres**

Bridge between A2033-A2028

- z_{spec} within 0.06 – 0.09
- $err\_z_{spec}/z_{spec} < 0.5$
- **galaxy position**
  - **outside R200 from the centres of all the clusters**
  - **RA and DEC in the bridge region**

A2029 and its super-cluster



A2028 42 gal

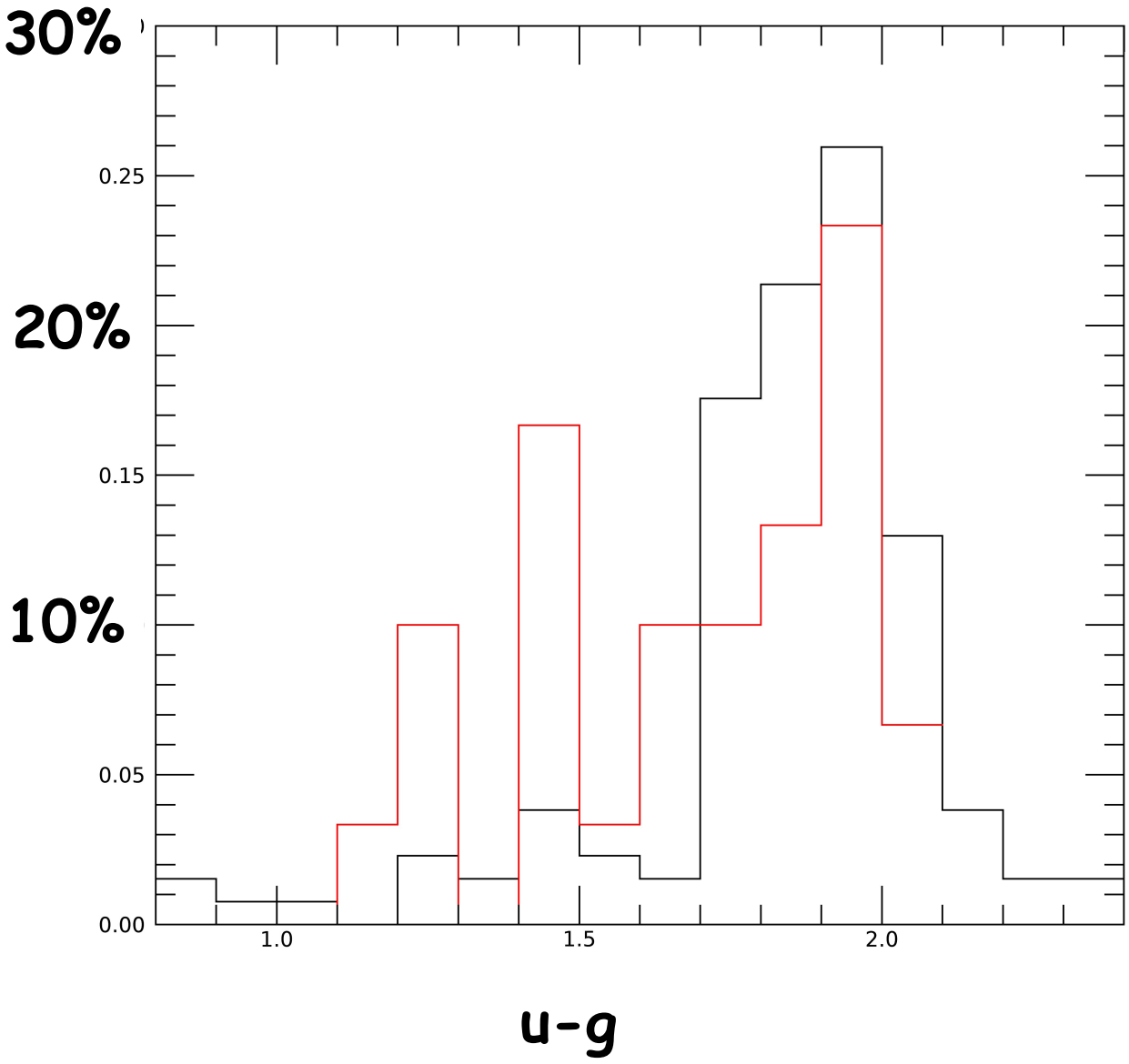
A2033 60 gal

A2029 131 gal

MSPM 04331 30 gal

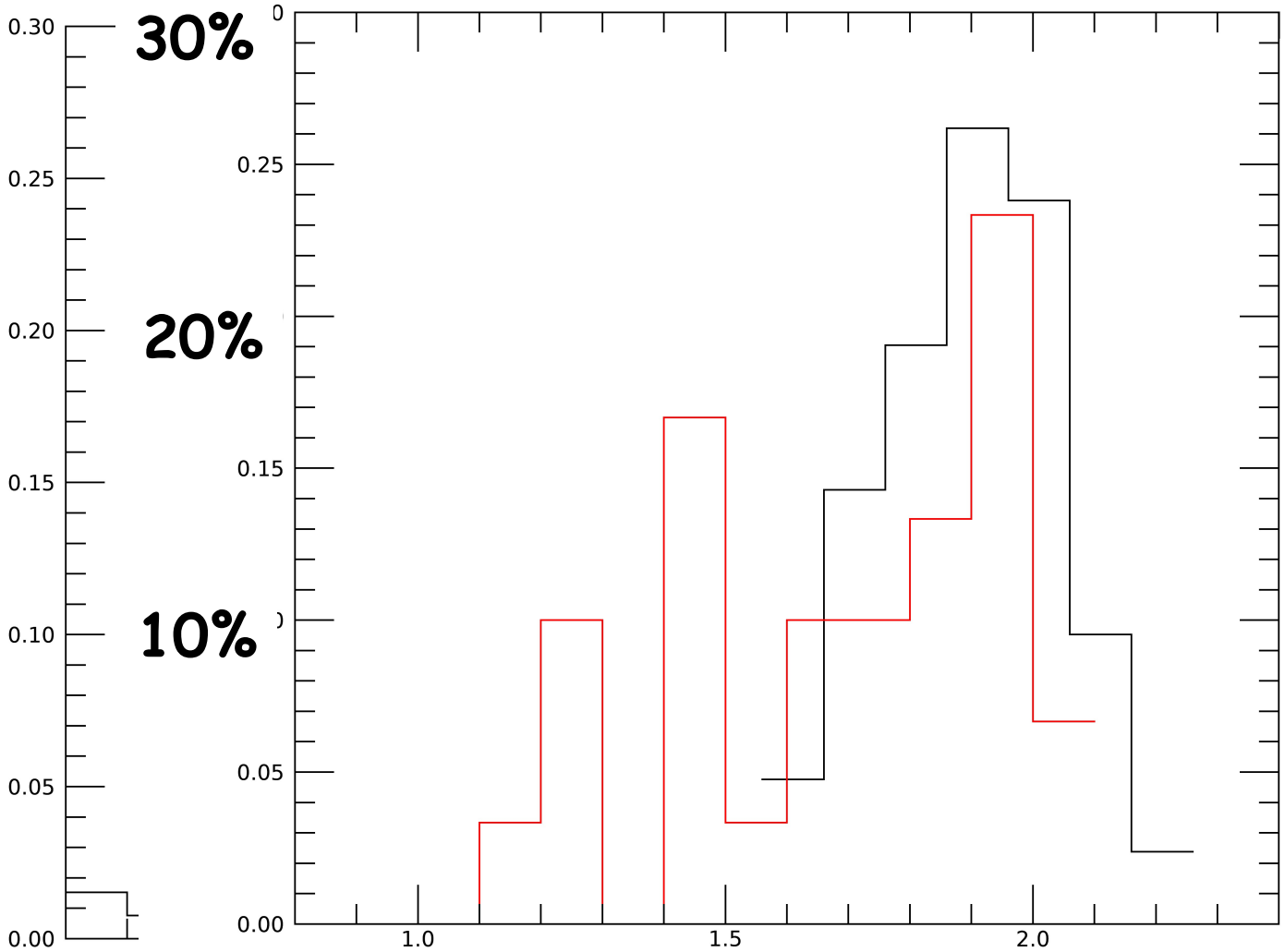
MSPM 06070 23 gal

A2029
Bridge A2028-A2033

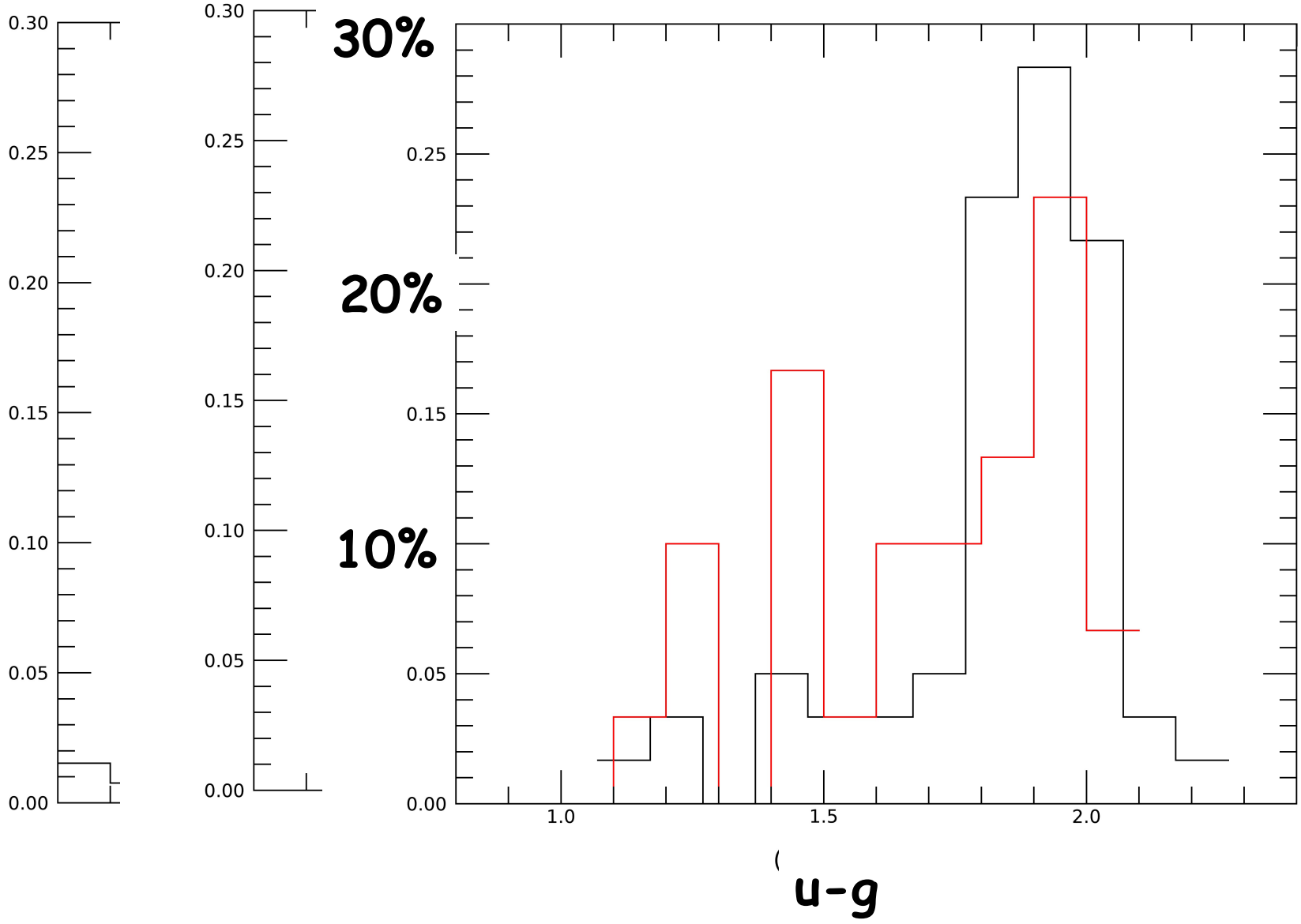


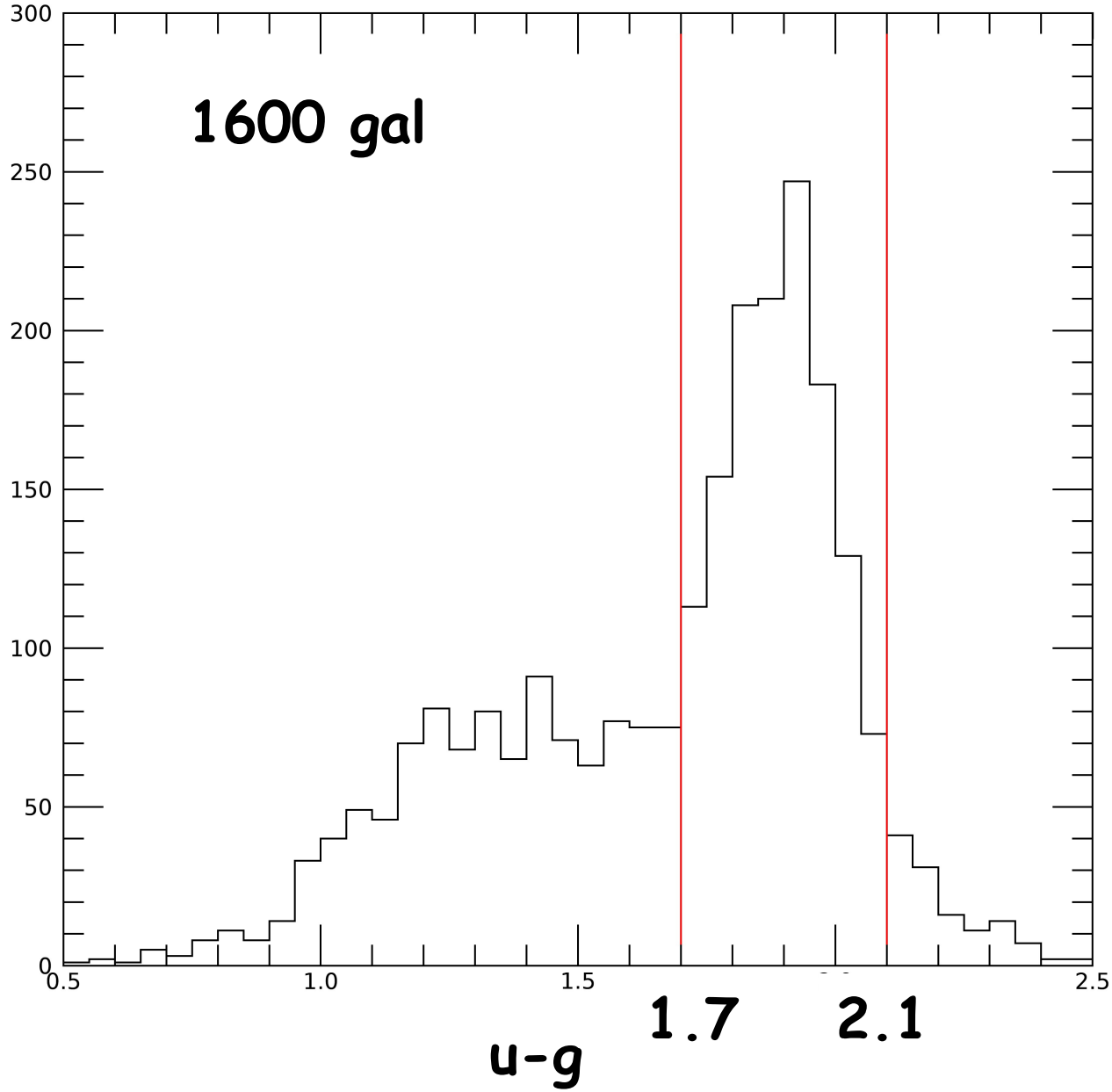
A2028

Bridge A2028-A2033



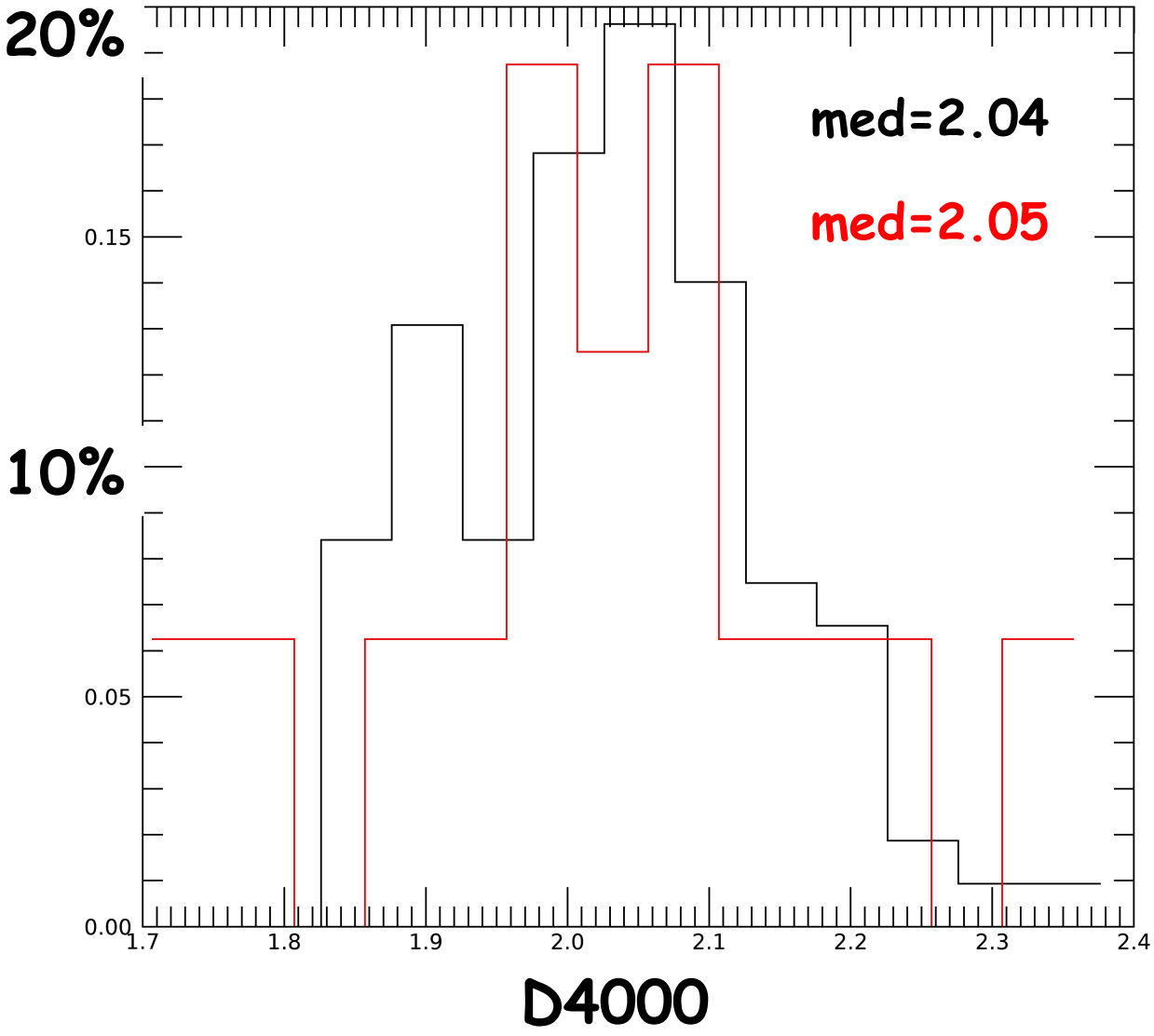
A2033
Bridge A2028-A2033




1600 gal
300
250
200
150
100
50
0
0.5
1.0
1.5
2.5
1.7
2.1
u-g

A2029

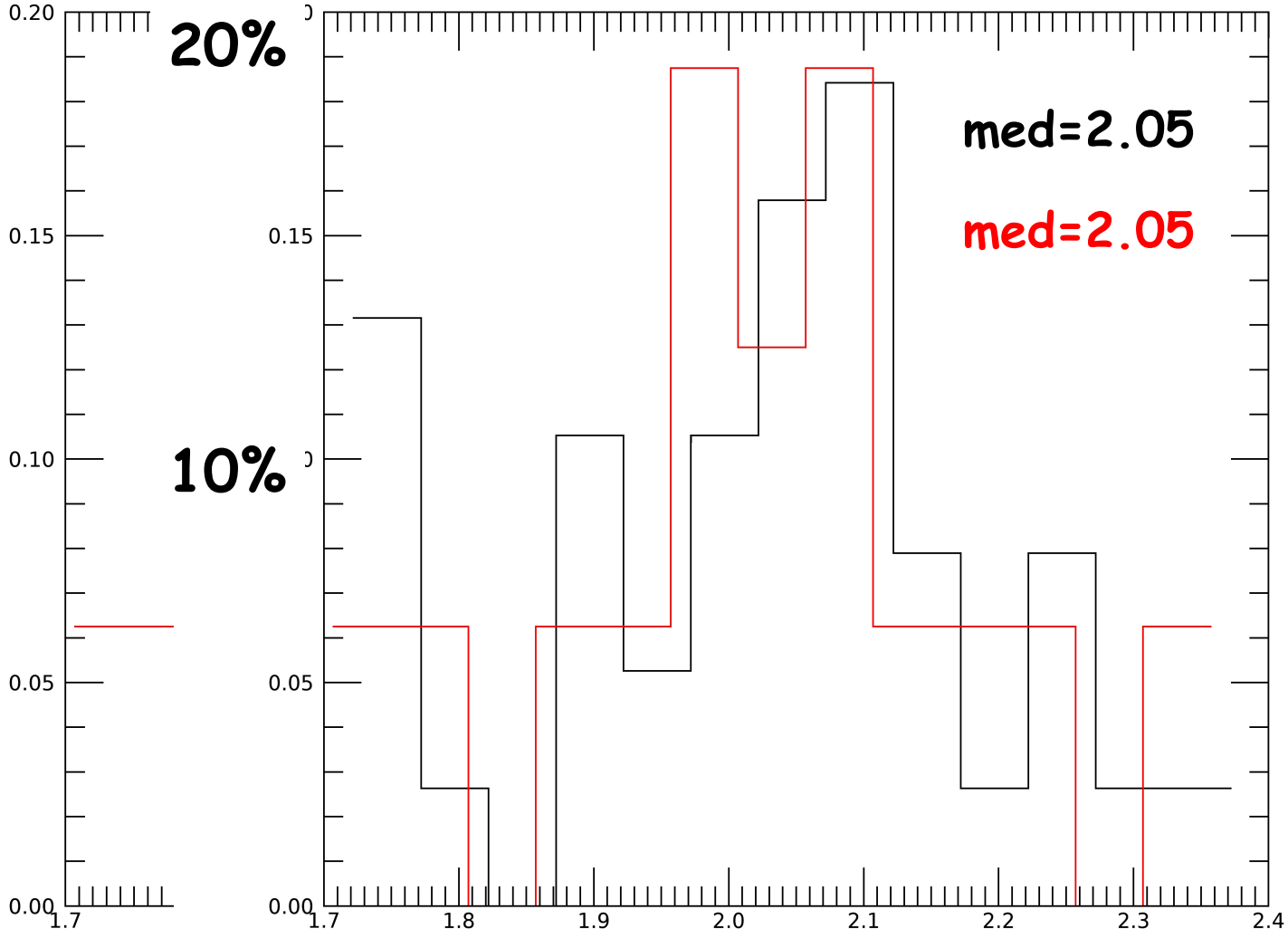
Bridge A2028-A2033



only red gal!

A2028

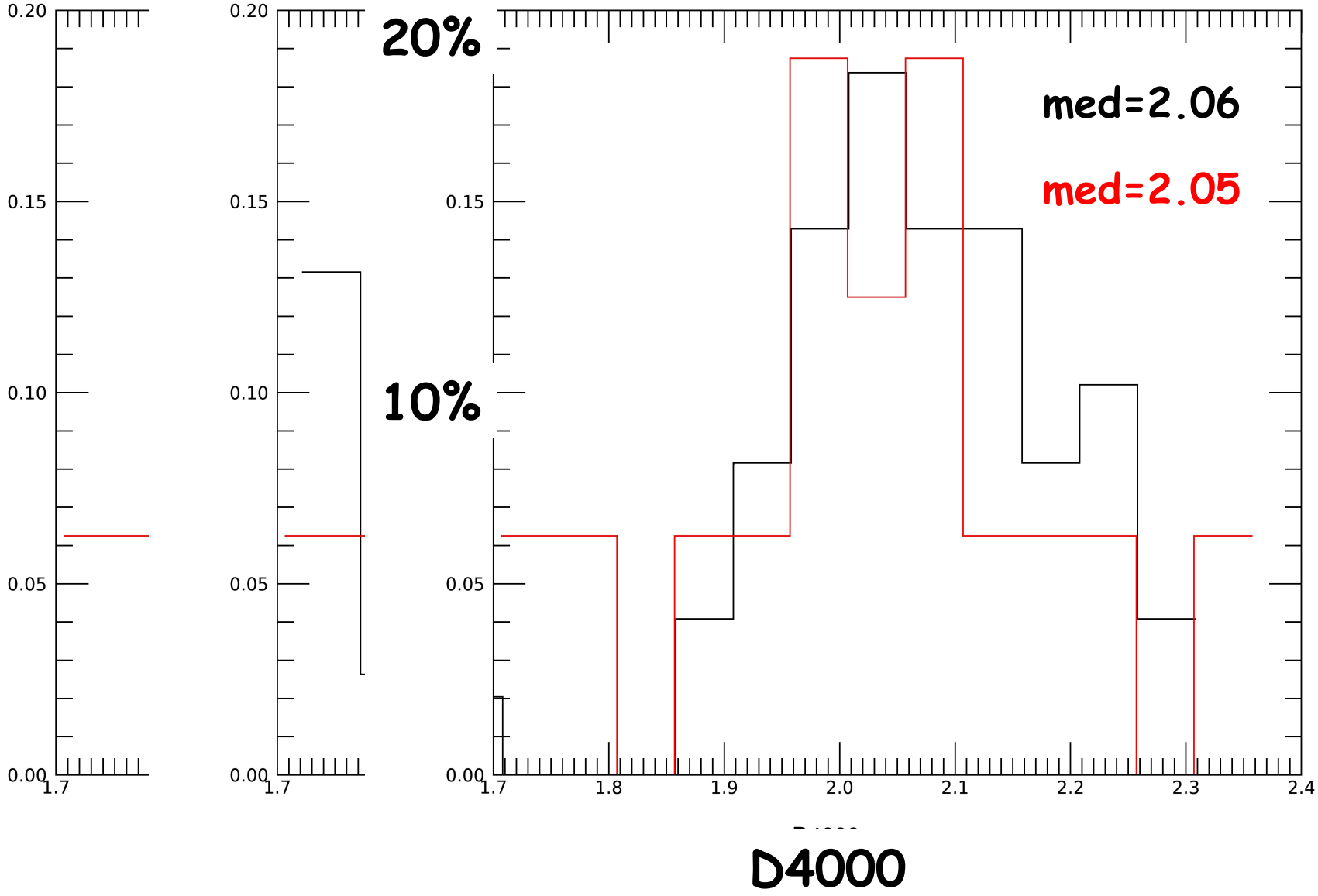
Bridge A2028-A2033

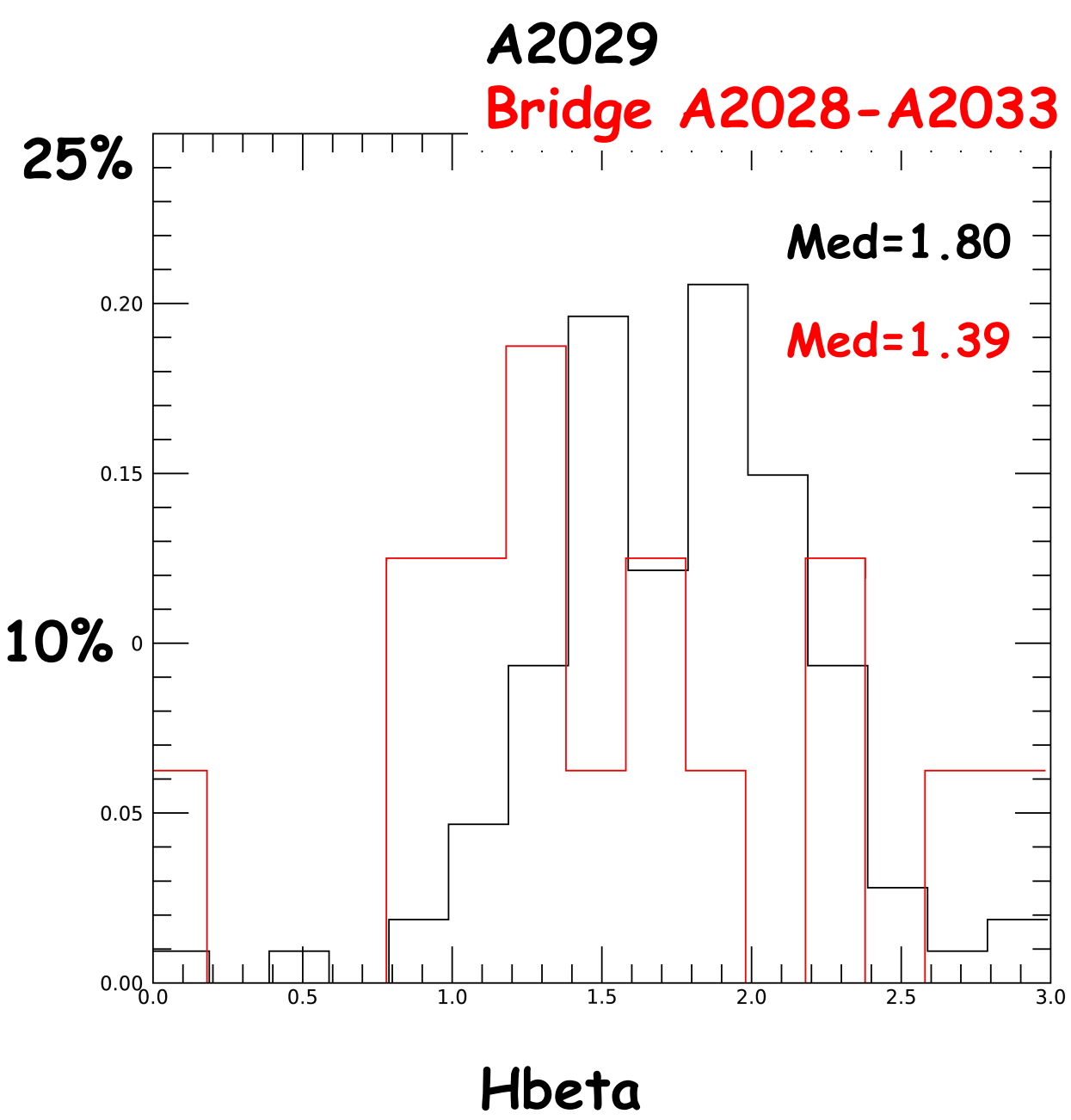


D4000

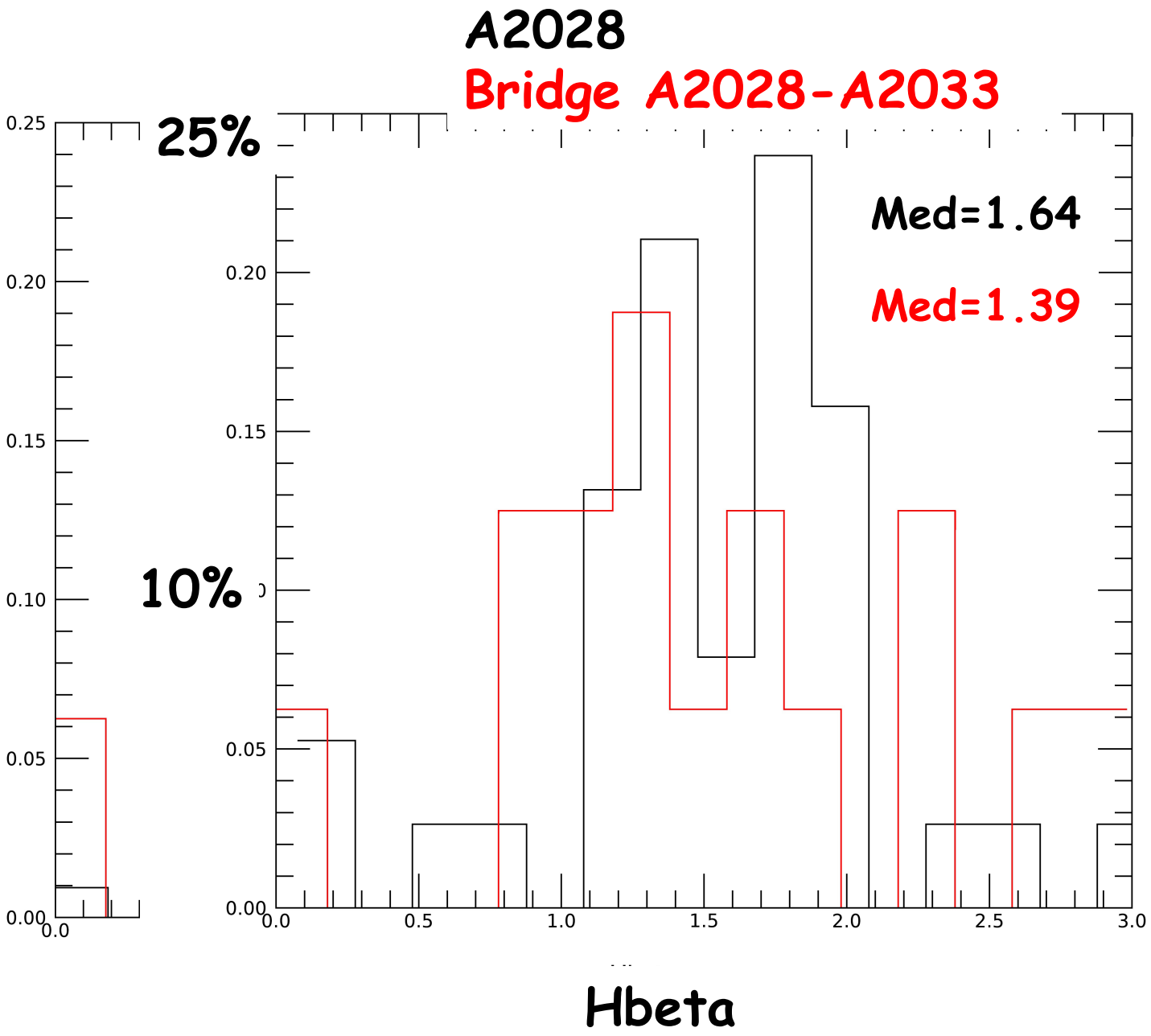
A2033

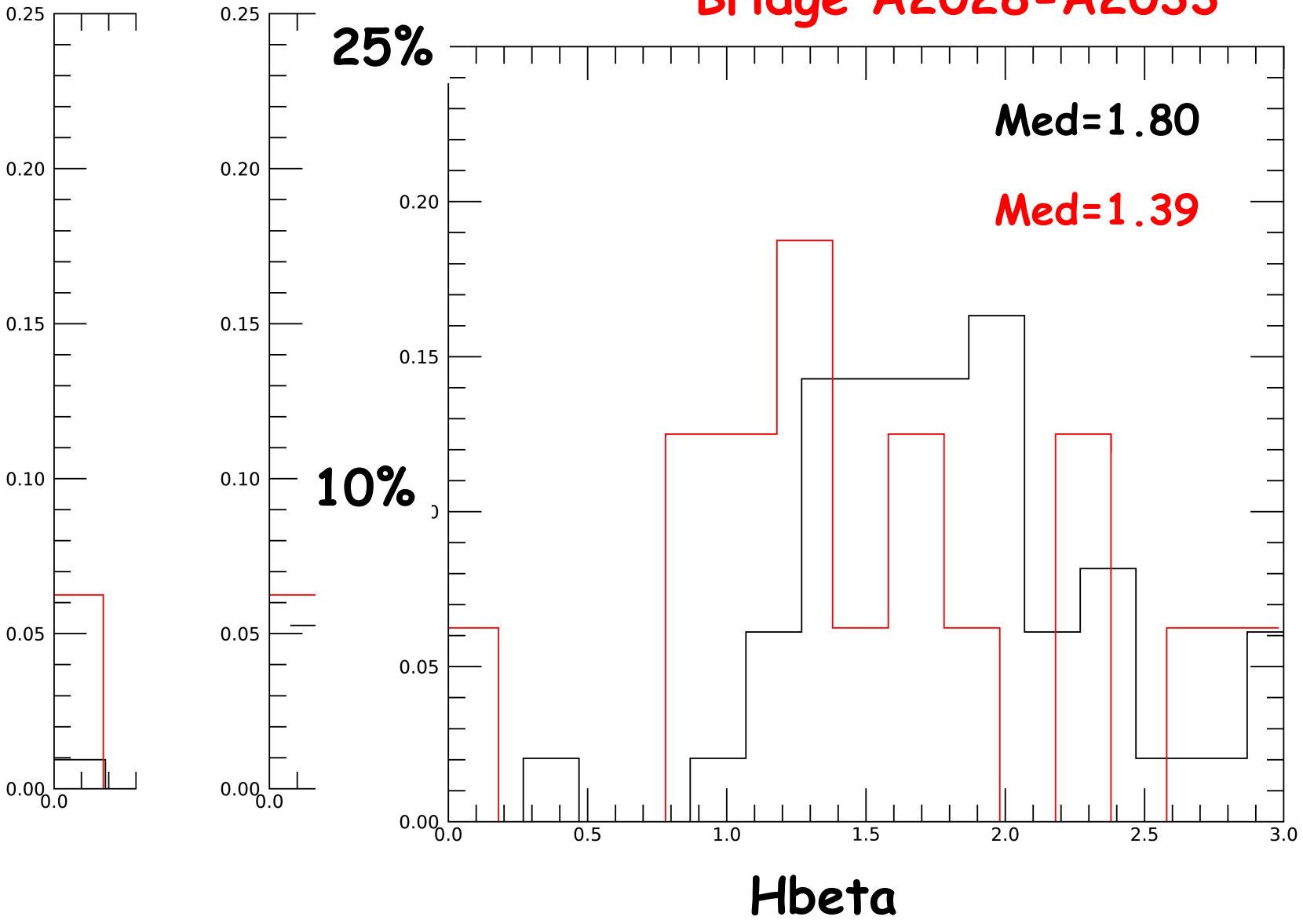
Bridge A2028-A2033




A2029
Bridge A2028-A2033
25%
10%
Med=1.80
Med=1.39
0.20
0.15
0
0.05
0.00
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Hbeta

only red gal!


A2028
Bridge A2028-A2033
25%
10%
Med=1.64
Med=1.39
Hbeta
0.25
0.20
0.15
0.10
0.05
0.00
0.0
0.5
1.0
1.5
2.0
2.5
3.0


A2033
Bridge A2028-A2033
25%
10%
Med=1.80
Med=1.39
Hbeta
0.25
0.20
0.15
0.10
0.05
0.00
0.0
0.5
1.0
1.5
2.0
2.5
3.0

SUMMARY

- Project to study:
  - the accretion mechanism of clusters
    AND
  - galaxy evolution along the filaments

- Need to explore regions at large radii (R>R200)

- A2029 promising candidate → massive, relaxed
  BUT
  signs of recent mergers **AND** many nearby small companions

- Red population in the bridge A2033-A2028 (**filaments?**) shows signs of recent (weak) SF event not present in the main structures

WORK IN PROGRESS!!

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THANKS!