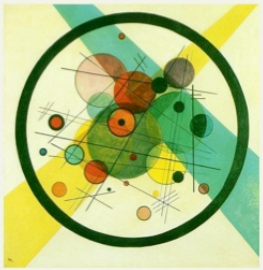

© Kandinsky

X
X
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The ultimate XMM extragalactic survey

die Kunst über in der Wissenschaft

Galaxy clusters in the XXL survey: First results

F. Pacaud

University of Bonn

on behalf of the XXL collaboration

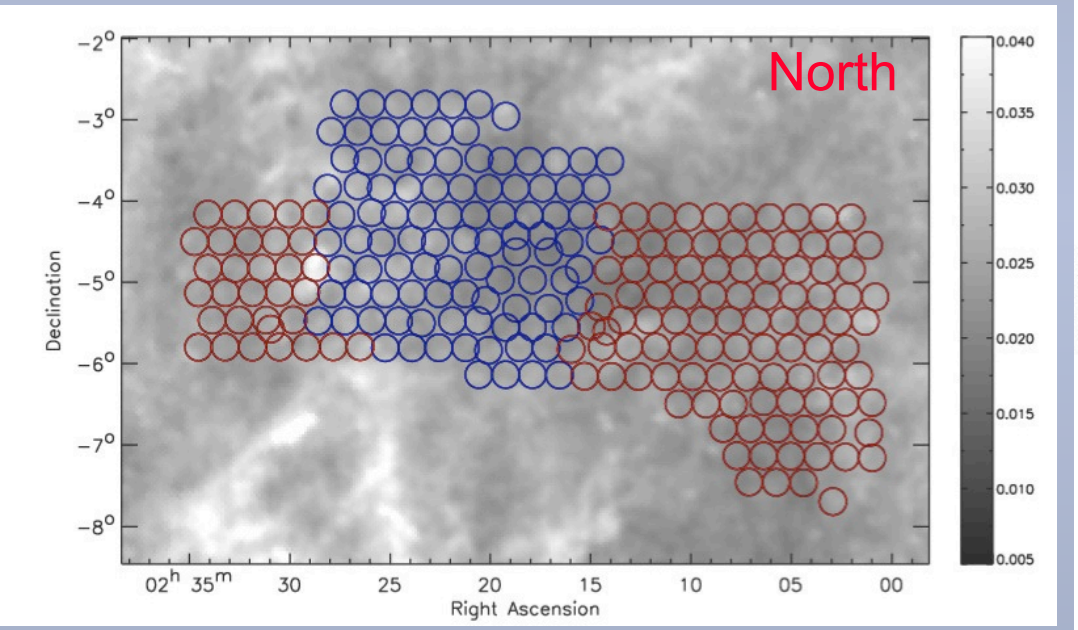
(main French contributors: *M. Pierre*, C. Adami, C. Benoist, S. Maurogordato)

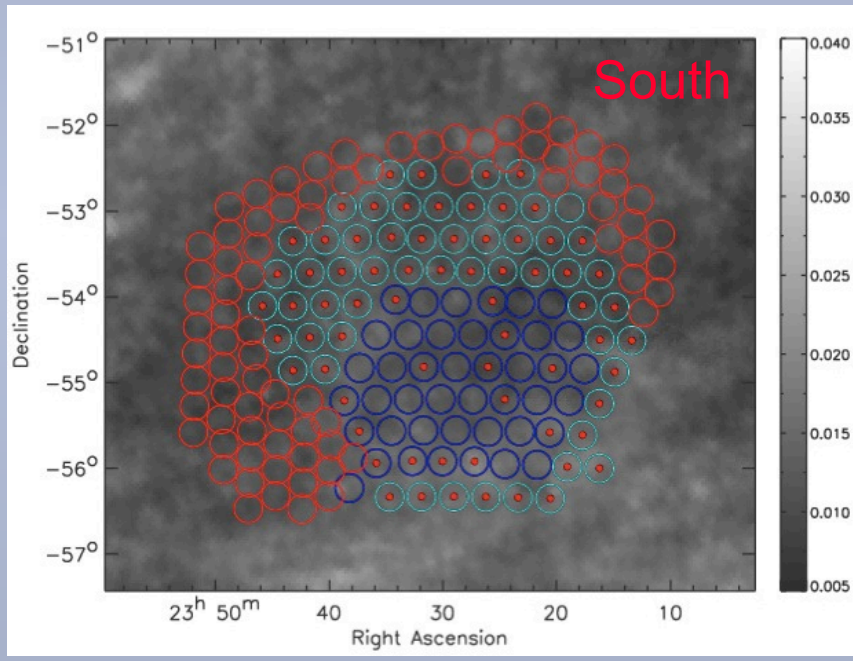
(thanks to PNCG for suporting them financially)

The XXL Survey

XMM survey based on a 2.9Ms VLP by M. Pierre (CEA/SAp)

- 2x25 deg^2 at high galactic latitude
- 10ks XMM exposure time (~6Ms in total)
- ~ 500 galaxy clusters and groups and 25000 AGNs





Rationale:

dark energy EoS with cluster counts and ξ (+ Planck CMB)

ξ improves constraints on w_0/w_a by a factor 2 (Pierre, Pacaud et al. 2011)

Paper I: Pierre, Pacaud, et al. (A&A in press)

Associated multi-λ projects

- **Equatorial field (LSS) 25 deg^2**
  - CFHTLS, HSC — optical
  - VISTA/VIDEO — NIR survey 4.5 deg^2
  - UKIDSS — NIR 9 deg^2
  - WIRCAM — shallow K survey
  - Spizter — MIR
  - Herschel-*spire* — FIR 9 deg^2
  - ACTpol deep — SZ survey
  - CARMA, AMiBA — SZ follow-up

Southern field (BCS) 25 deg^2

BCS, DEcam	optical
VISTA/VHS	NIR
Spitzer/SSDF	MIR
Herschel-*spire*	FIR
ACT, SPTpol	SZ
ATCA	Radio (1.4GHz)

- **Optical spectroscopy**
  - ESO large program (VLT/FORS2 + NTT/EFOSC2) for cluster follow-up
  - Anglo-Australian Telescope/2DF survey of X-ray sources in the south
  - Access to spectra from the GAMA / VIPERS surveys
  - Smaller individual proposals:
    - William Herschel Telescope,
    - Large Binocular Telescope, …

More information on the XXL associated datasets wiki : http://lenssearch.pbworks.com

Paper I: Pierre, Pacaud, et al. (A&A in press)

XXL 1st result release

15 papers submitted

(12 to be published in A&A special feature)

1 The XXL Survey
Pierre, Pacaud, et al.

2 The Bright Cluster Sample
Pacaud, Clerc, Giles, et al.

3 Luminosity –Temperature Relation
Giles, Maughan, Pacaud et al.

4 The Mass-Temperature Relation
Lieu, Smith, Giles et al.

5 Detection of the SZ effect at z=1.9
Mantz, Abdulla, Carlstrom, et al.

6 The 1000 Brightest Point Sources
Fotopoulou, Pacaud, Paltani, et al.

7 A Supercluster at z=0.43
Pompei, Adami, Eckert, et al.

8 Intracluster light in a z=0.53 Cluster
Adami, Pompei, Sadibekova, et al.

9 Radio Analysis of the Supercluster
Baran, Smolcic, Milakovic, et al.

10 Mass-K band luminosity relation
Ziparo, Smith, Mulroy, et al.

11 ATCA Continuum Observations
Smolcic, Delhaize, Huynh, et al.

12 Frequency of AGNs in Superclusters
Koulouridis, Poggianti, Altieri, et al.

13 The Baryon Content of Clusters
Eckert, Ettori, Coupon, et al.

14 AAOmega redshifts for XXL-S
Lidman, Ardila, Owers, et al.

15 BCG Growth in XXL Clusters
Lavoie, Willis, Démoclès, et al.

XXL 1st result release

12 papers accepted (so far)

arXiv + press release yesterday

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Pierre, Pacaud, et al.

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Pacaud, Clerc, Giles, et al.

3 Luminosity –Temperature Relation
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XXL 1st result release

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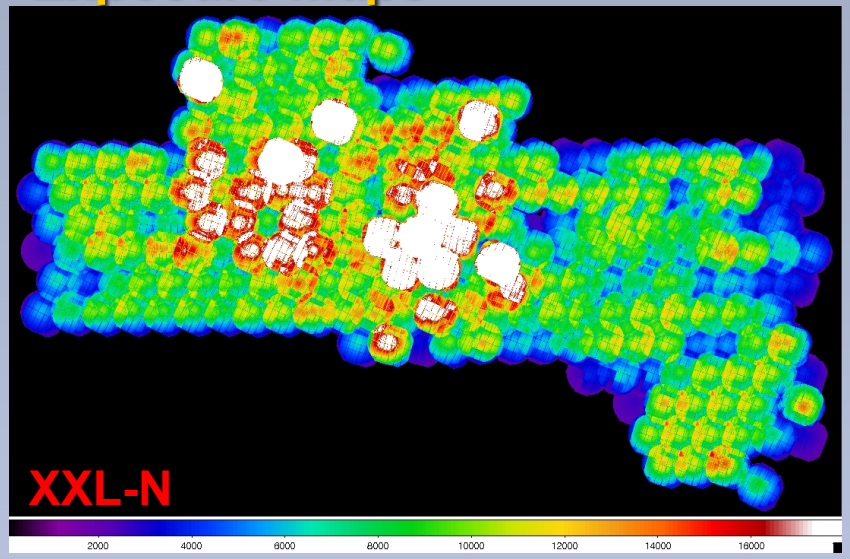
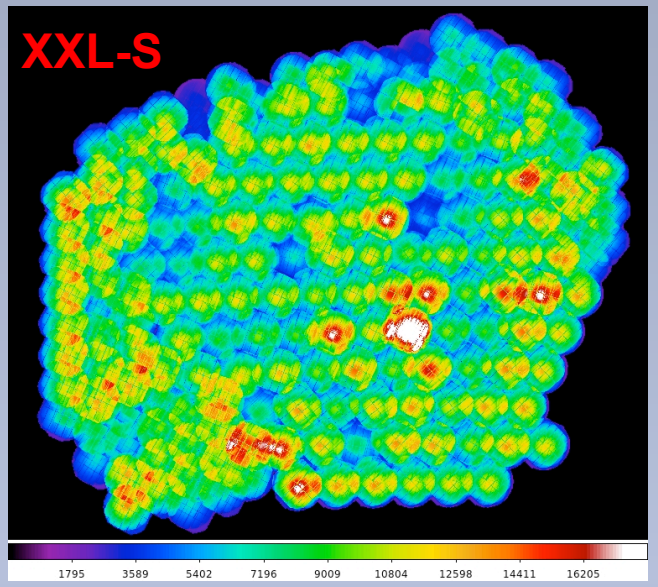
Lavoie, Willis, Démoclès, et al.

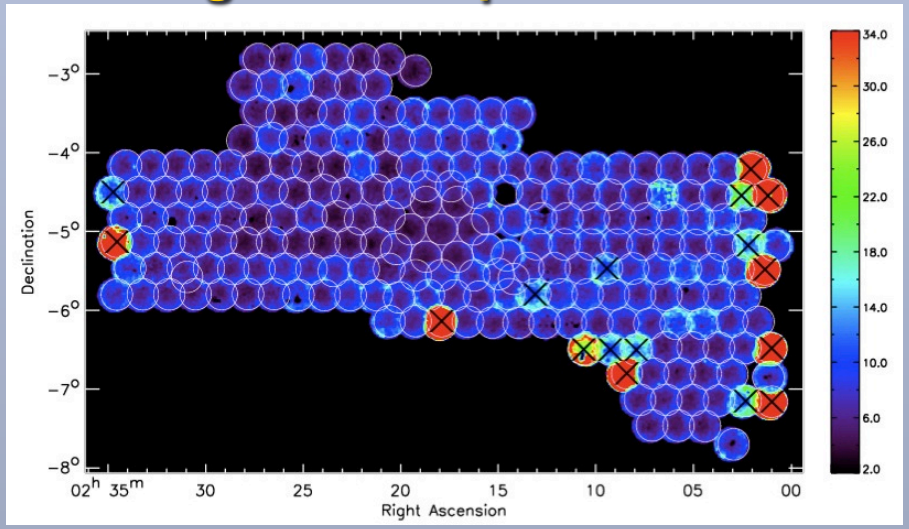
The XXL Survey: data quality

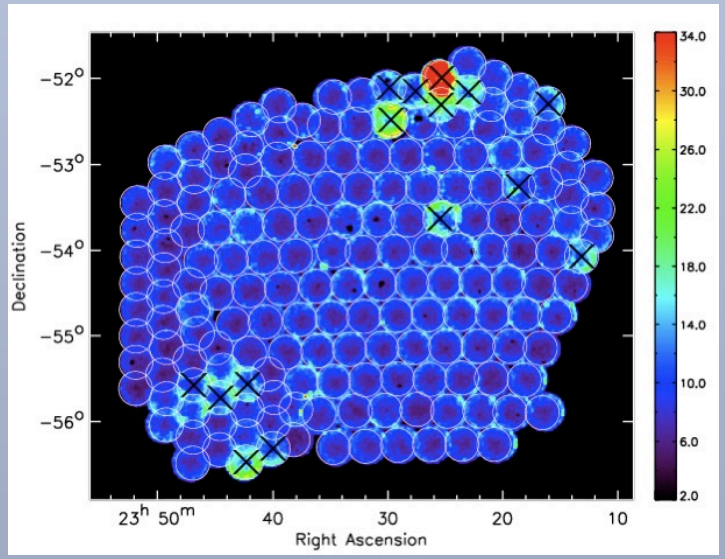
Exposure maps





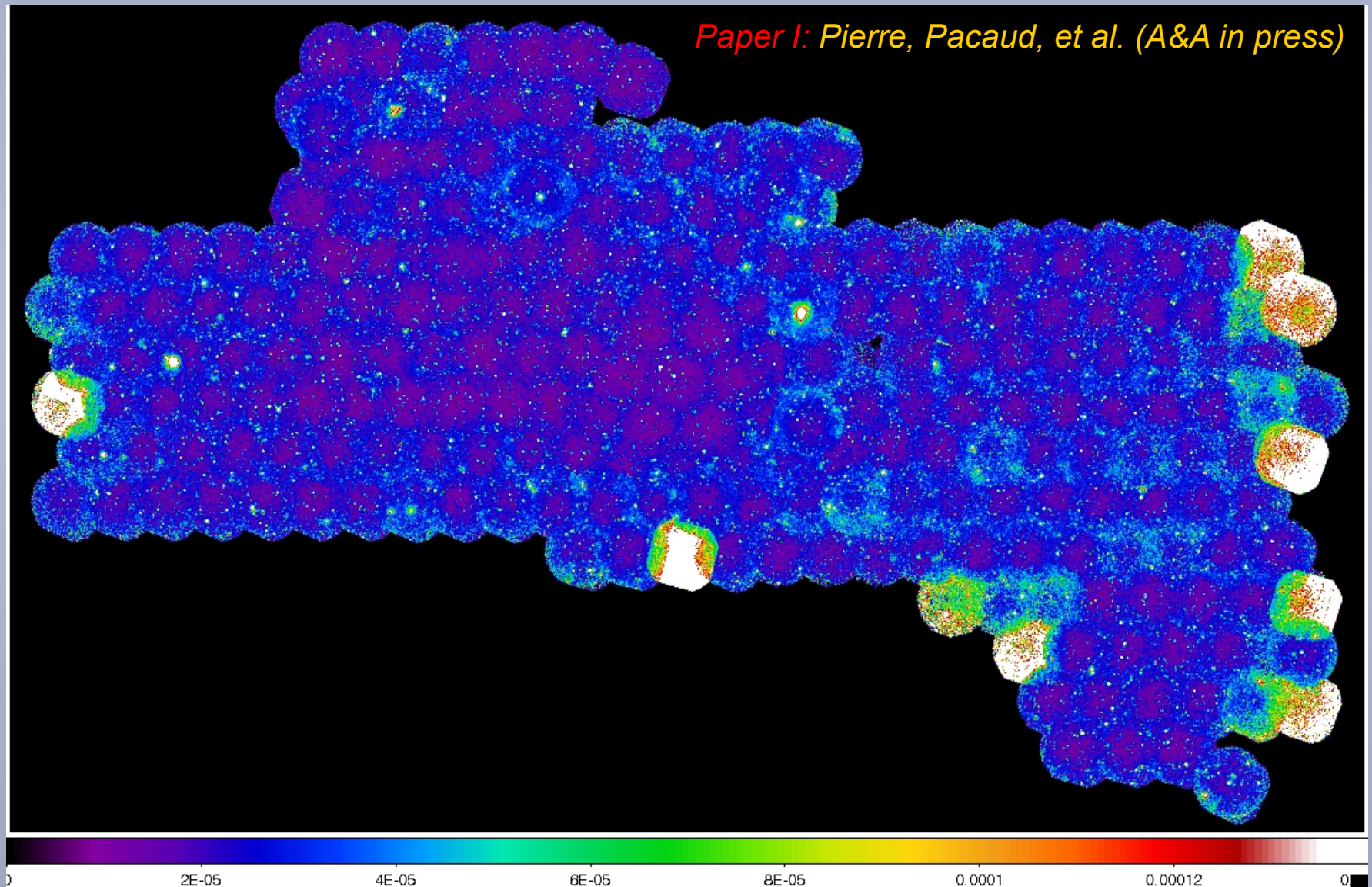
Background maps



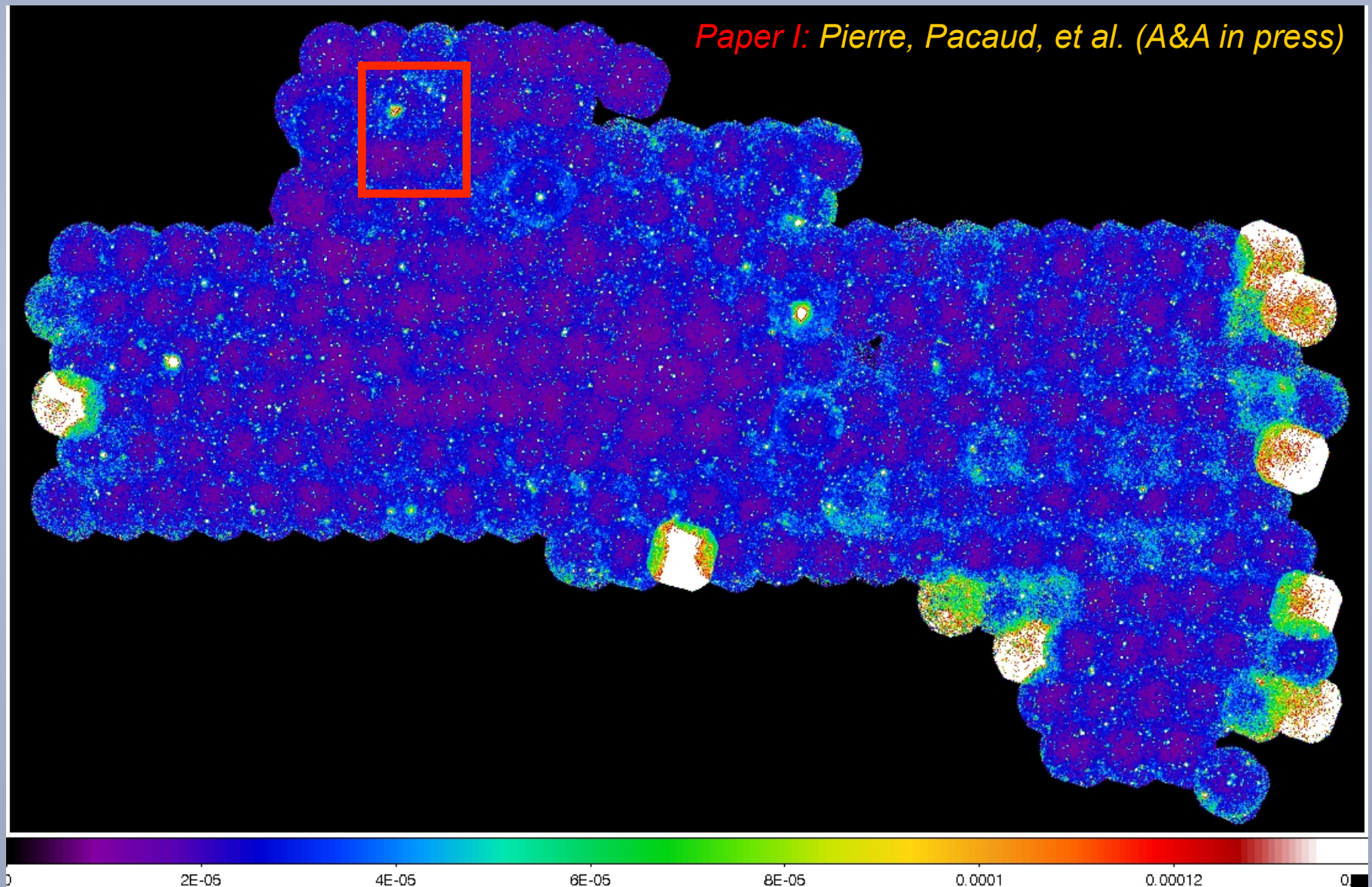


Paper I: Pierre, Pacaud, et al. (A&A in press)

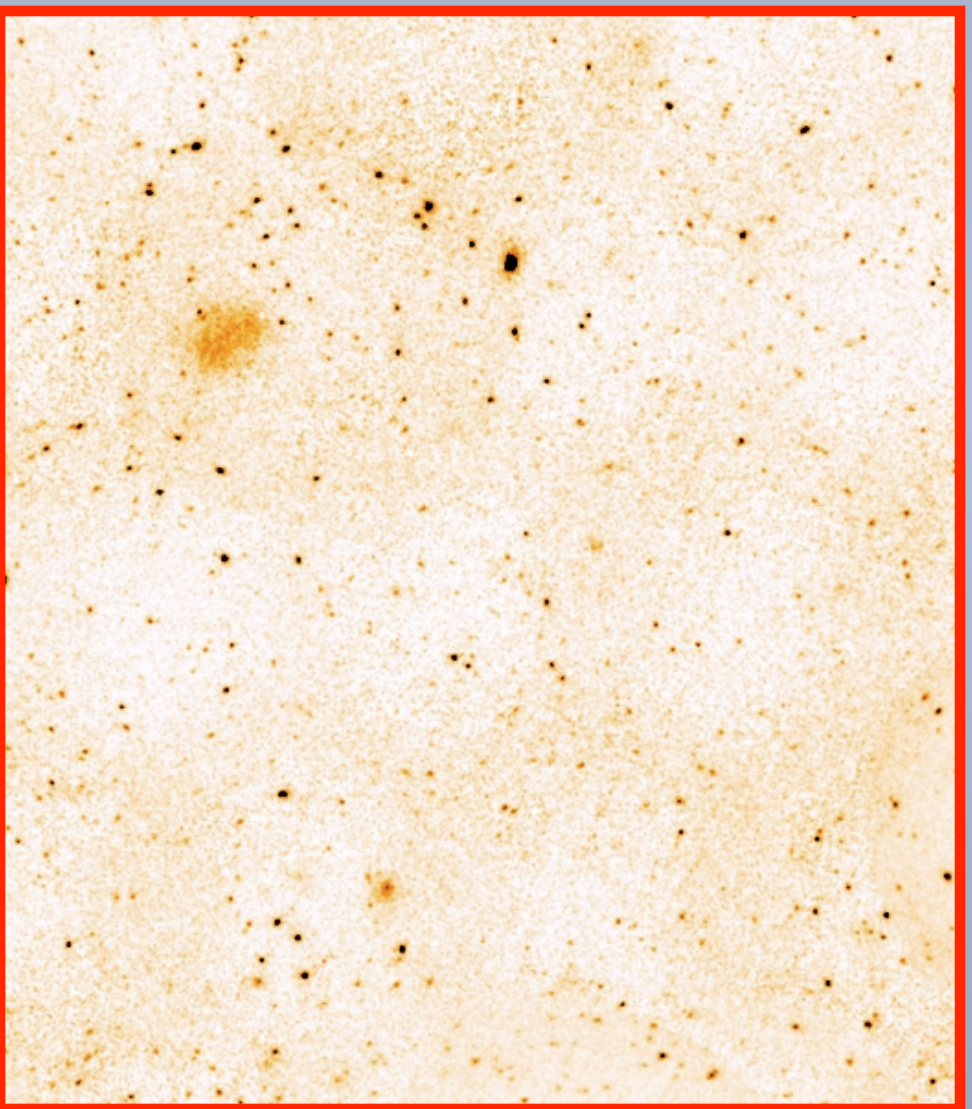
XXL observation status: northern count-rate map



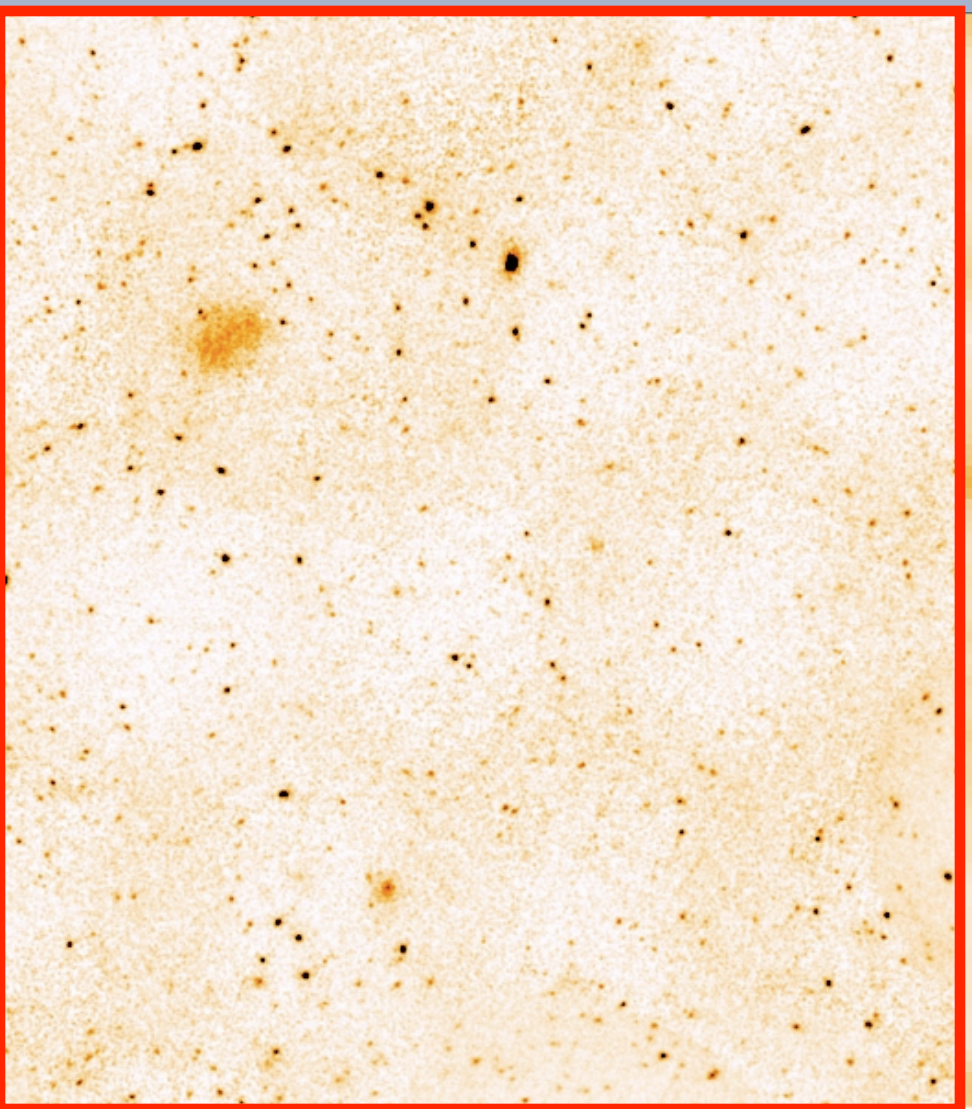
XXL observation status: northern count-rate map

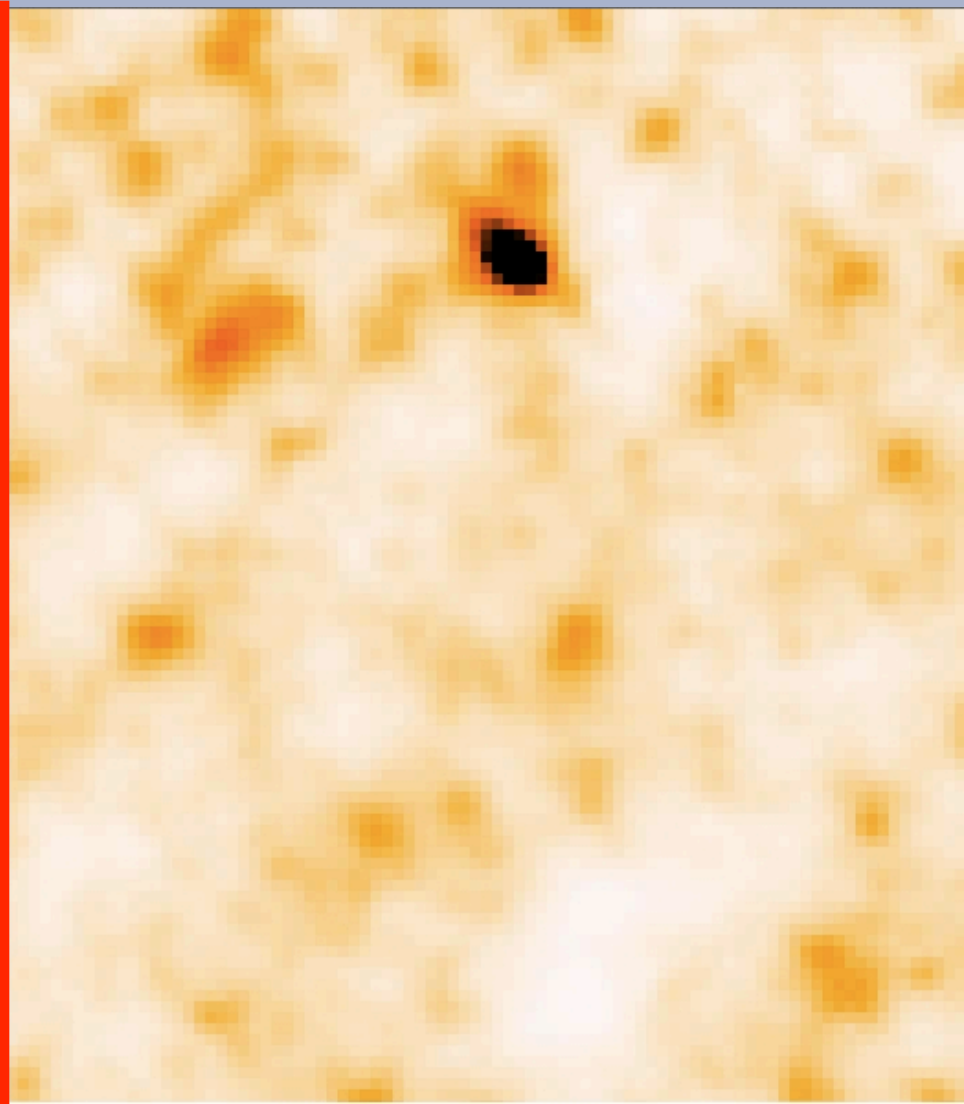


Zoom ~ 0.8 deg^2



Comparison with RASS

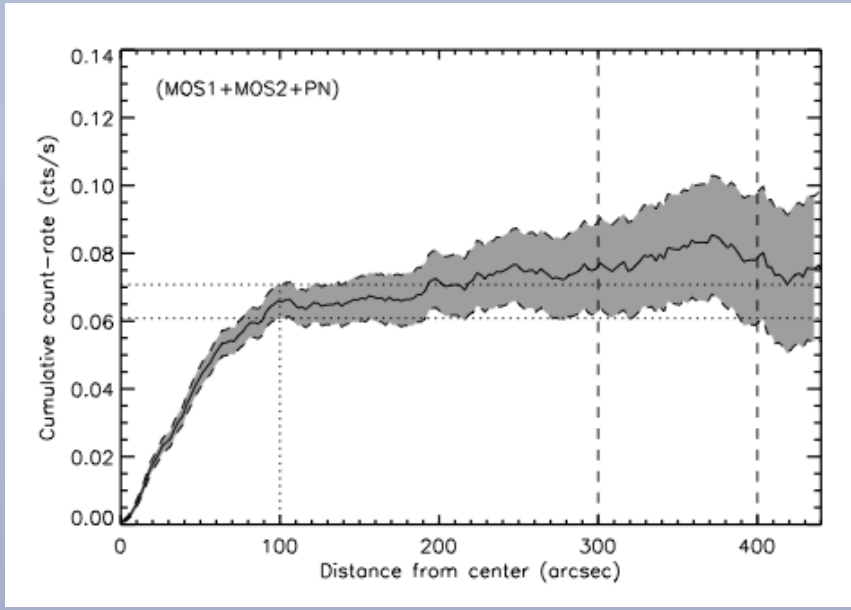




The Bright Cluster Sample: selection

⇒ 100 brightest galaxy clusters

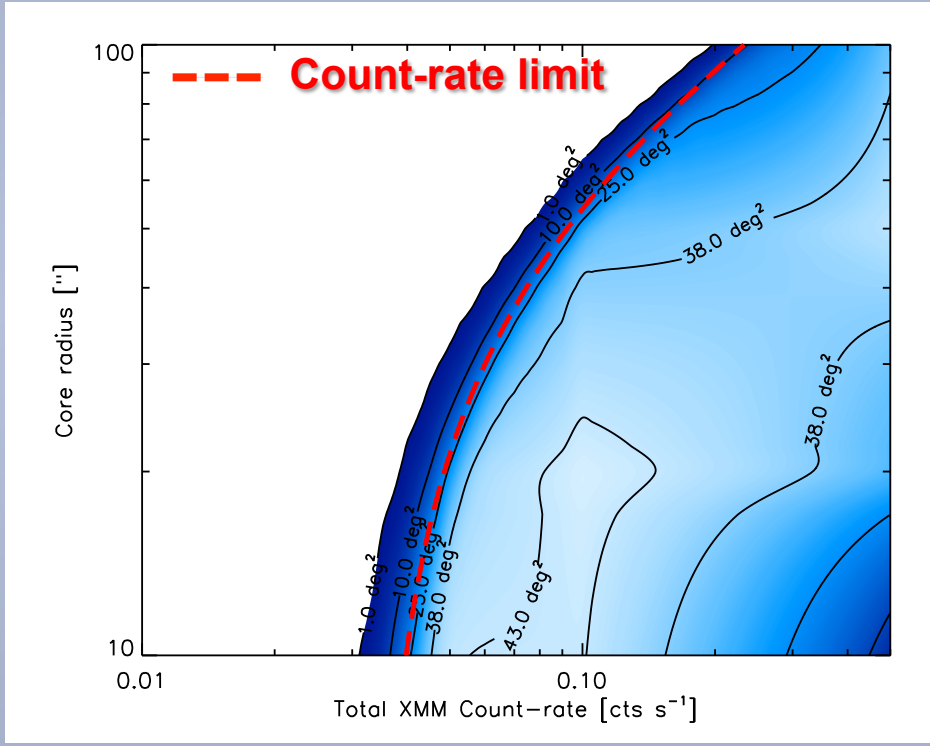
- Start from the pipeline extended source sample
- Perform growth curve analysis



⇒ Flux limit of 3.10^{14} erg/s/cm^2 in a 1' aperture

Paper II: Pacaud, Clerc, et al. (A&A in press)

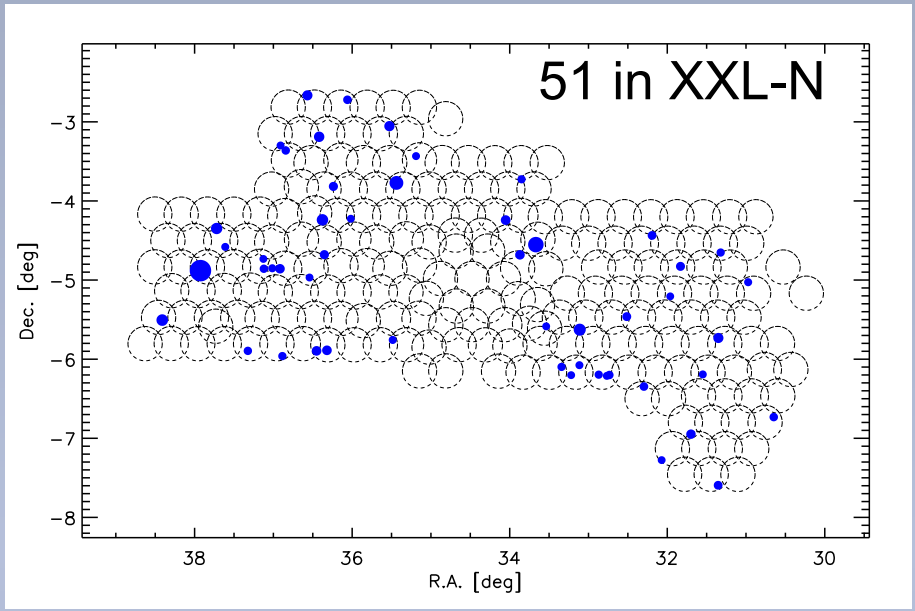
Selection function

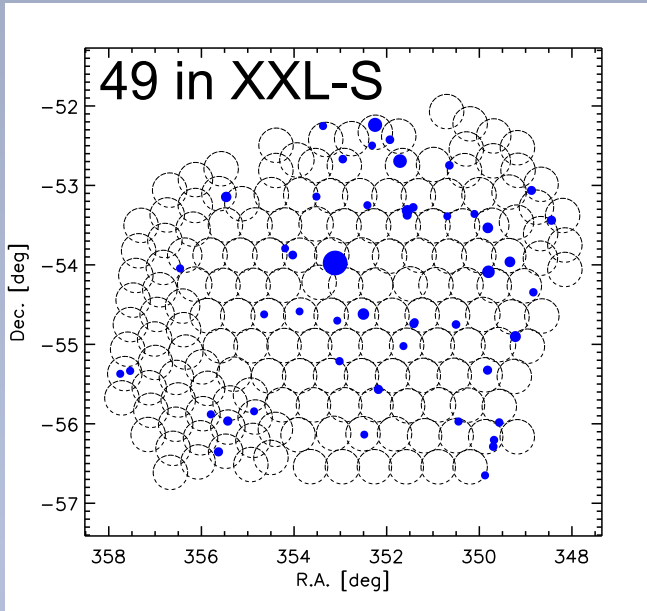


Includes:

- Pipeline selection
- Aperture flux cut
- Flux uncertainty

The Bright Cluster Sample: XXL-100-GC

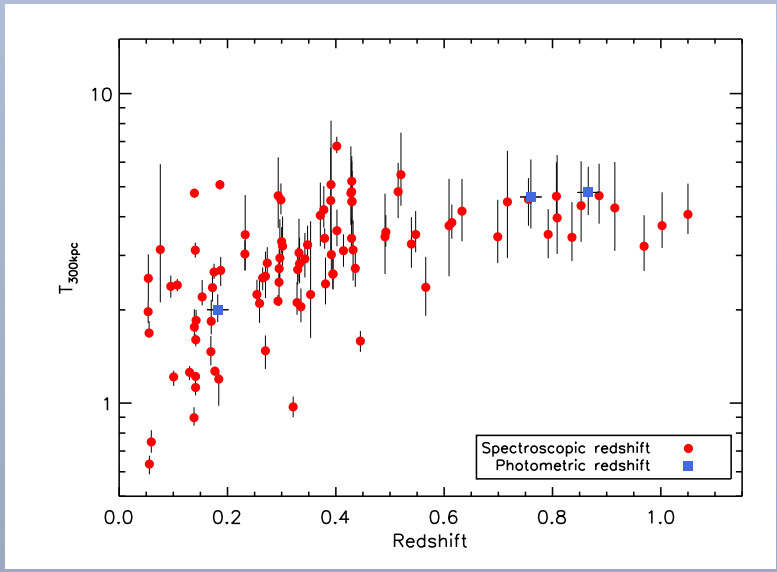




Paper II: Pacaud, Clerc, et al. (A&A in press)

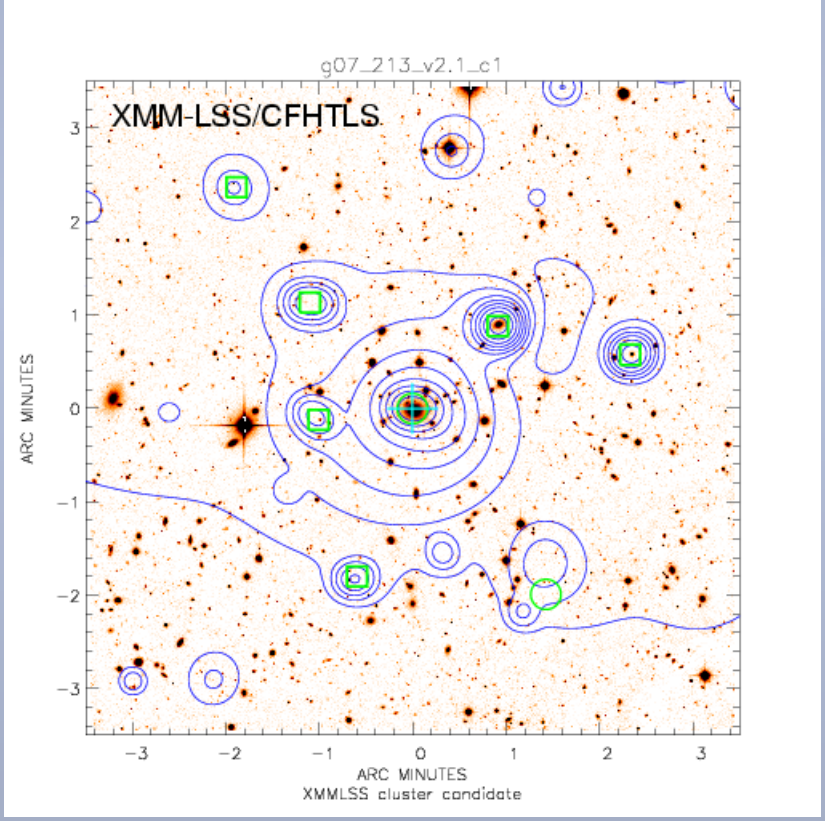
Available parameters :

- Spectroscopic z for 97/100
- T_{300kpc} for all from survey data
- L_{500} and M_{gas}

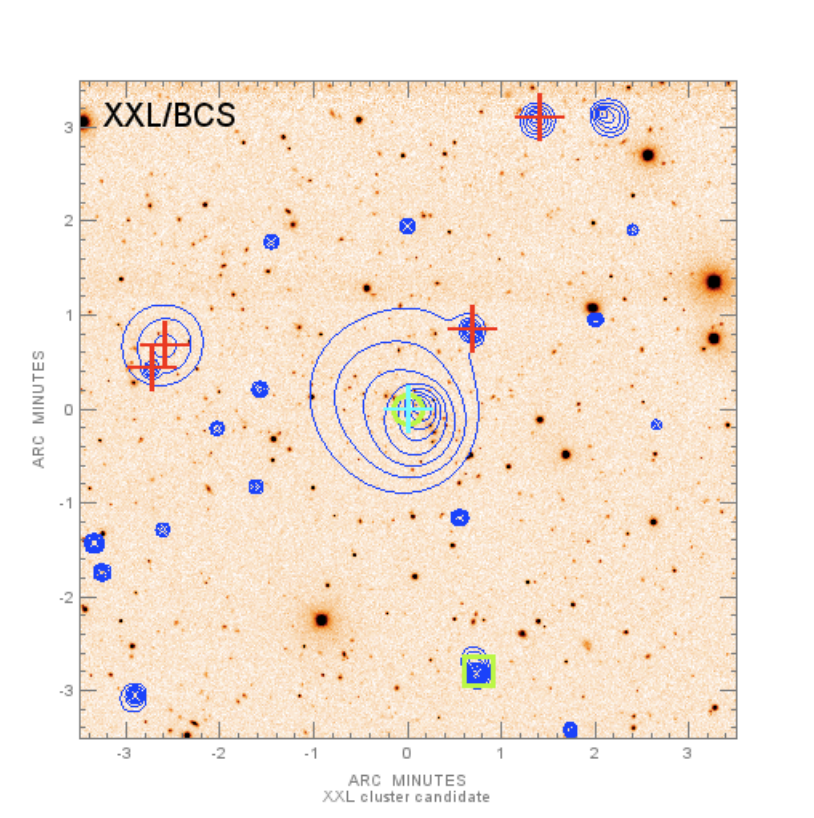


Example of XXL-100-GC clusters

XLSSC 025 at z=0.27

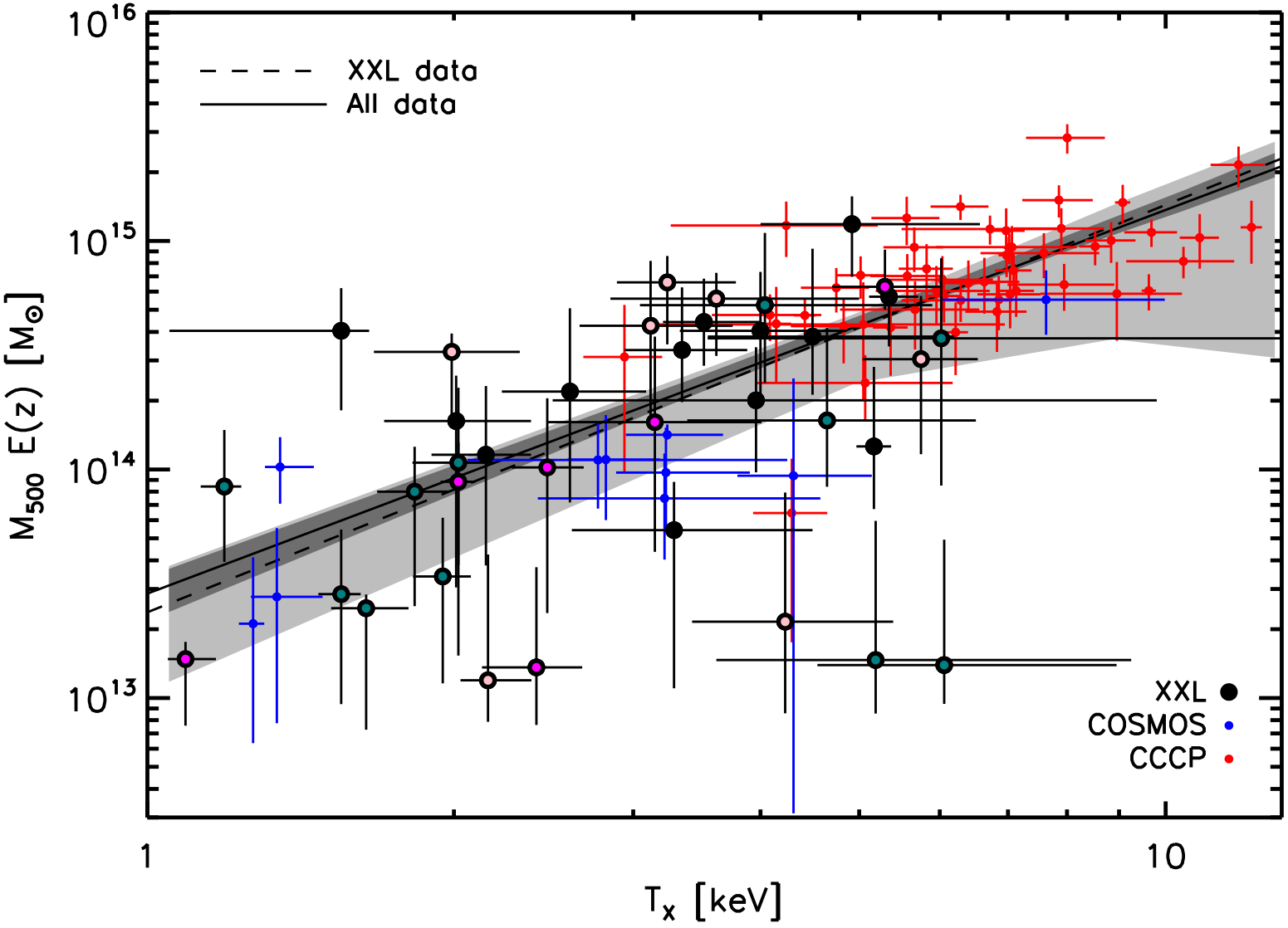


XLSSC 509 at z=0.63



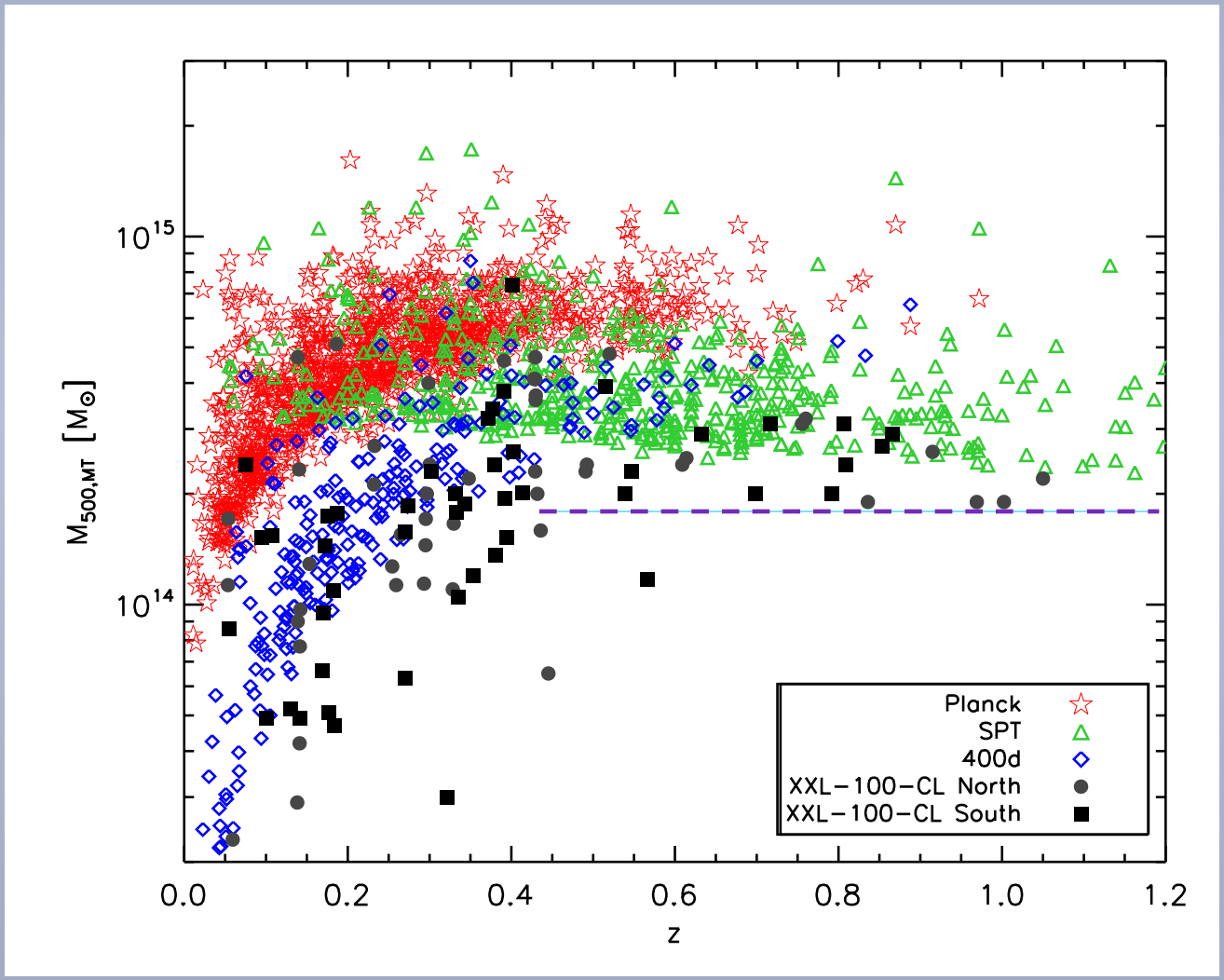
$M_{500,WL}$-T_{300kpc} relation

37 XXL-100 clusters at z<0.6 overlapping CFHTLens



Paper IV: Lieu, Smith et al. (A&A in press)

XXL-100-GC: Mass distribution



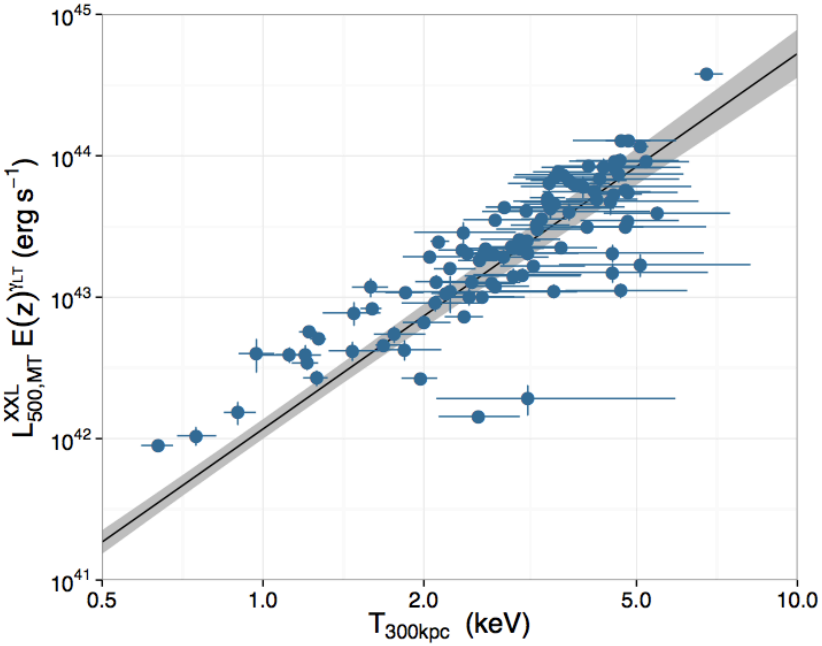
$M \geq 2 \times 10^{14} M_\odot$
$at\ z \geq 0.4$

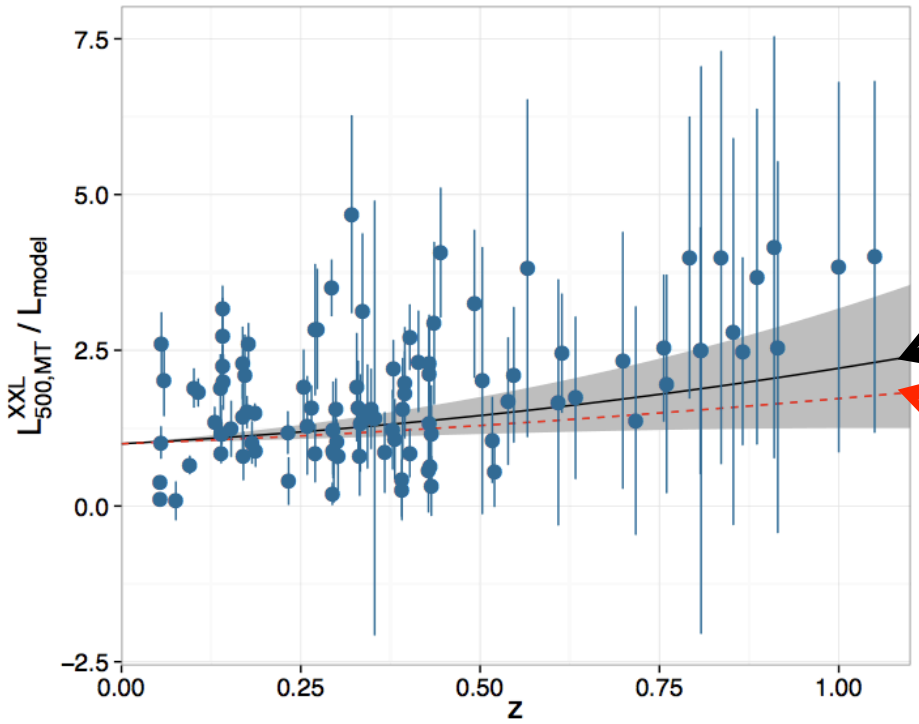
Paper II: Pacaud, Clerc, et al. (A&A in press)

L_{500}-T_{300kpc} relation

Self-consistent analysis:

- no local sample
- selection corrected
- Eddington bias corrected





Best fit

Self-similar

$L = A \cdot T^{B} \cdot E(z)^{\gamma}$

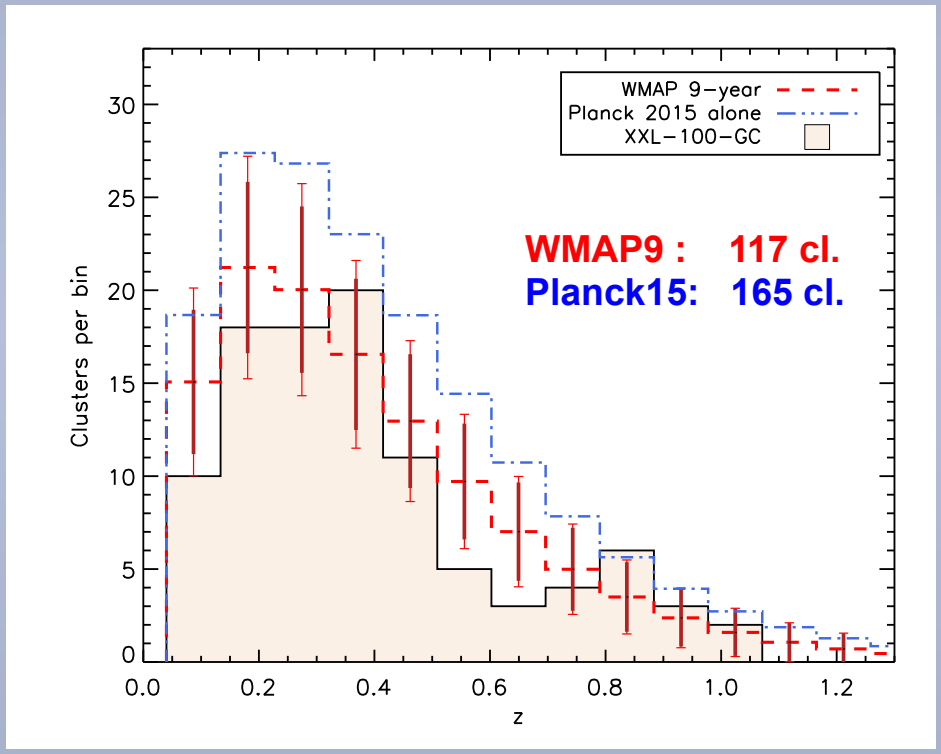
$\Rightarrow$ B=2.65 +/-0.15

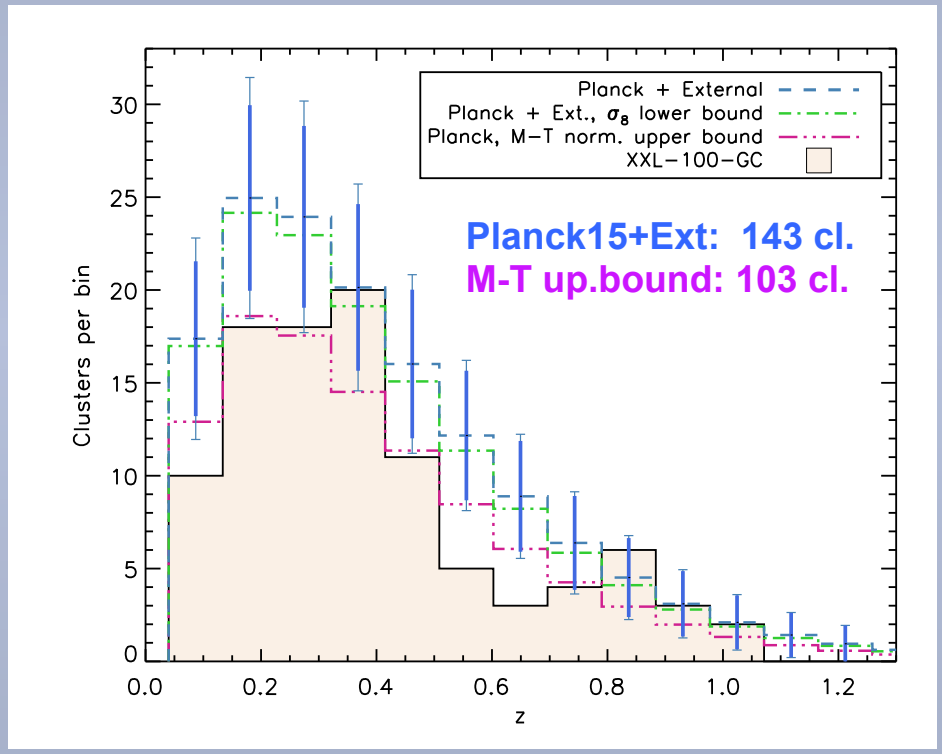
$\Rightarrow$ γ=1.46 +/- 0.8

Paper III: Giles, Maughan, et al. (A&A in press)

Cosmological modelling

Assumption: Tinker+08 mass function, XXL scaling laws, r_c=0.15 r_{500}



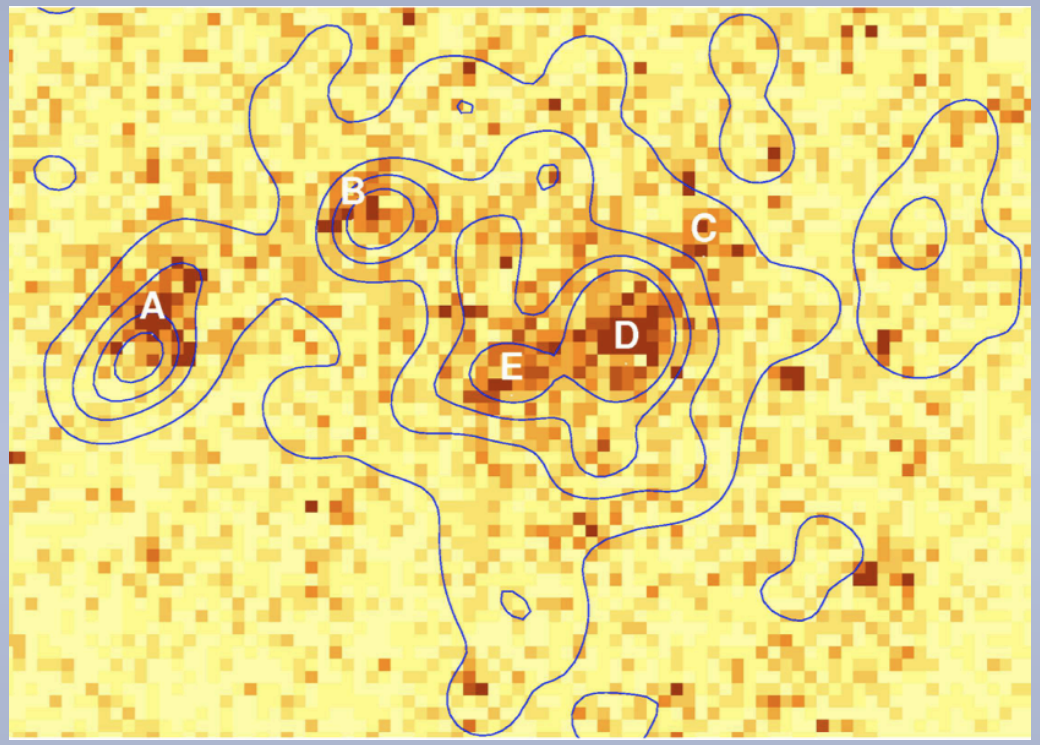


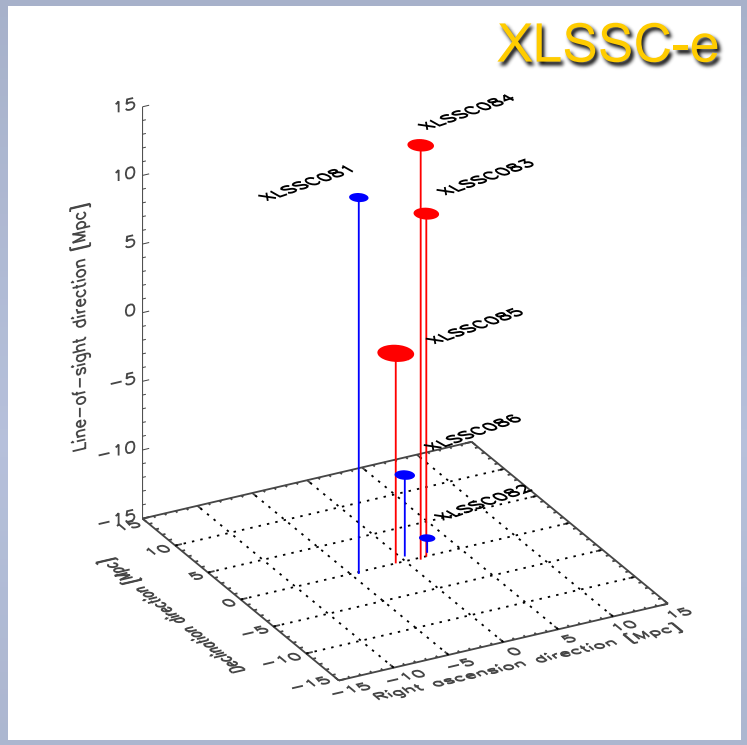
In addition, ~10% fluctuations from error on r_c/r_{500}

Paper II: Pacaud, Clerc, et al. (A&A, in press)

Large Scale Structures

A prominent cluster of 6 groups at z=0.43 (3 in XXL-100-GC)





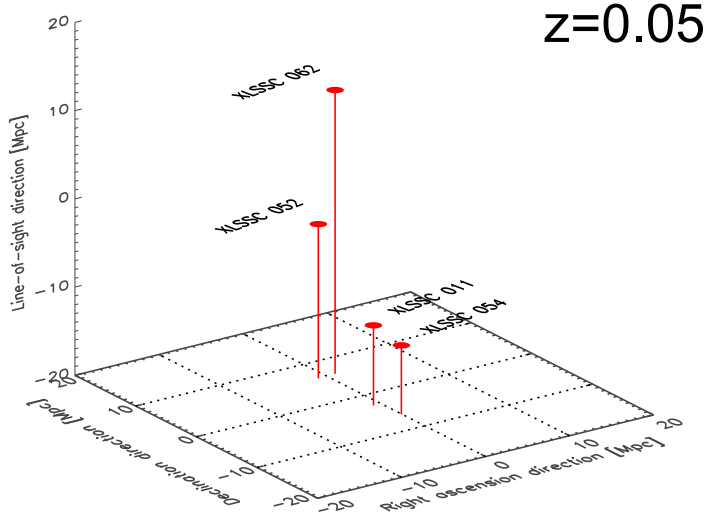
Paper VII: Pompei, Adami, Eckert, et al. (A&A in press)
+ Paper IX: Baran, Smolcic Milakovic et al. (submitted)

Recipe to identify other similar structures (FoF like):

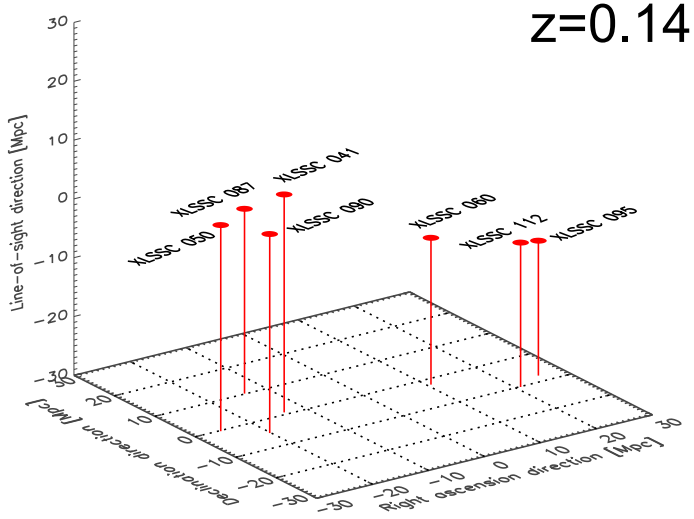
- Find pairs of clusters separated by less than 7 Mpc
- Add other clusters within 20 Mpc to any member

Superclusters

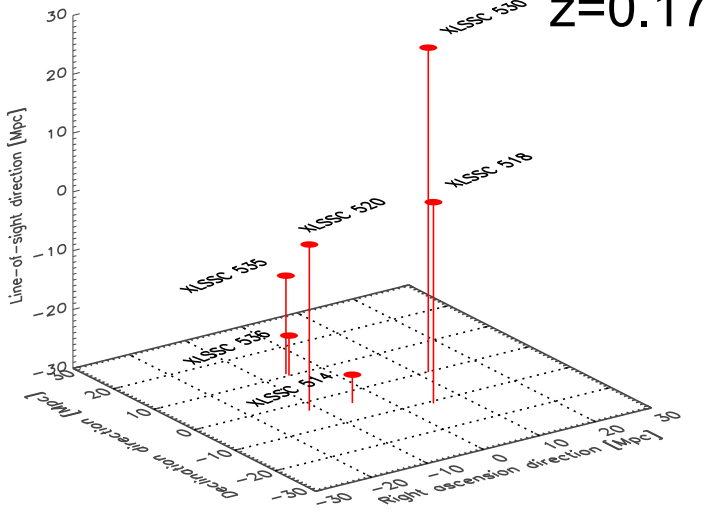
XLSSC-a
z=0.05



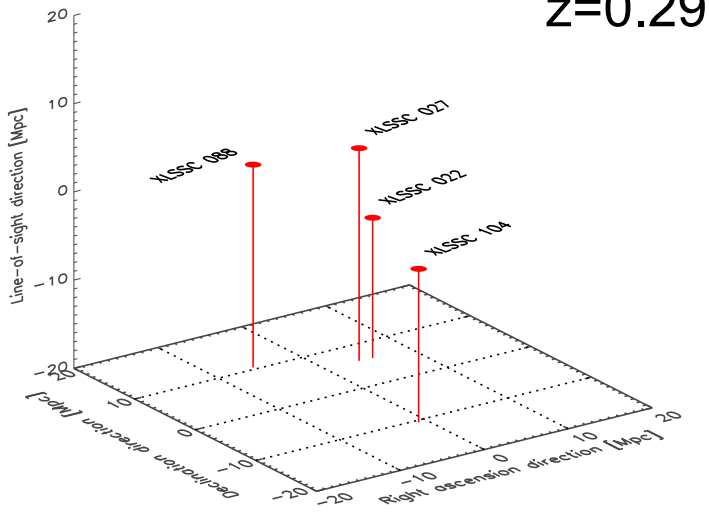
XLSSC-b
z=0.14



XLSSC-c
z=0.17



XLSSC-d
z=0.29



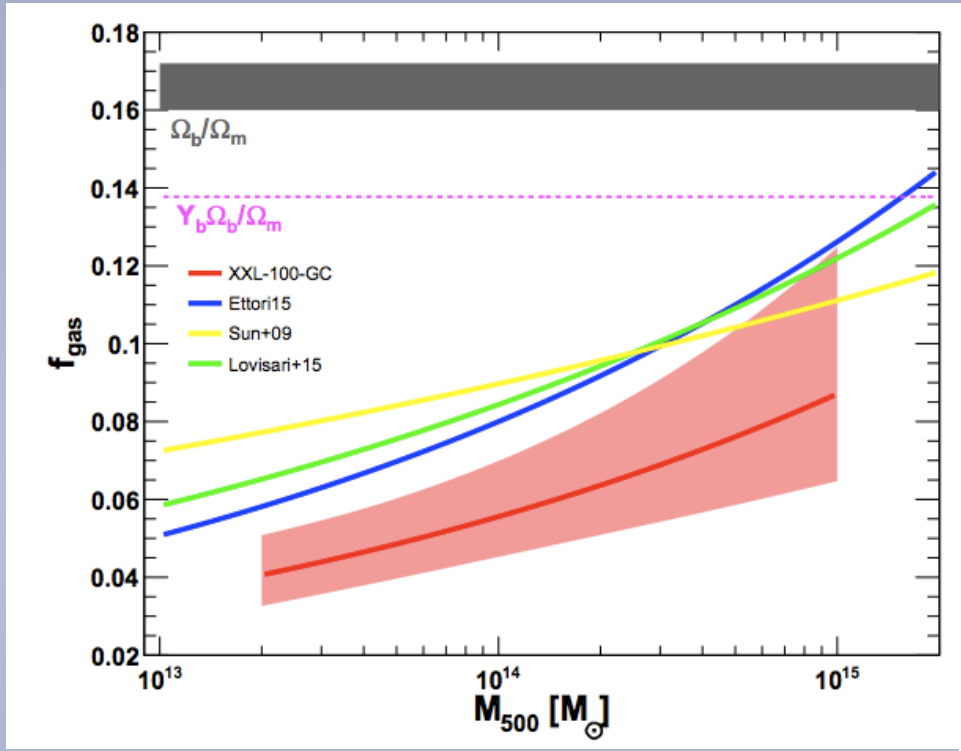
Paper II: Pacaud, Clerc, et al. (A&A in press)

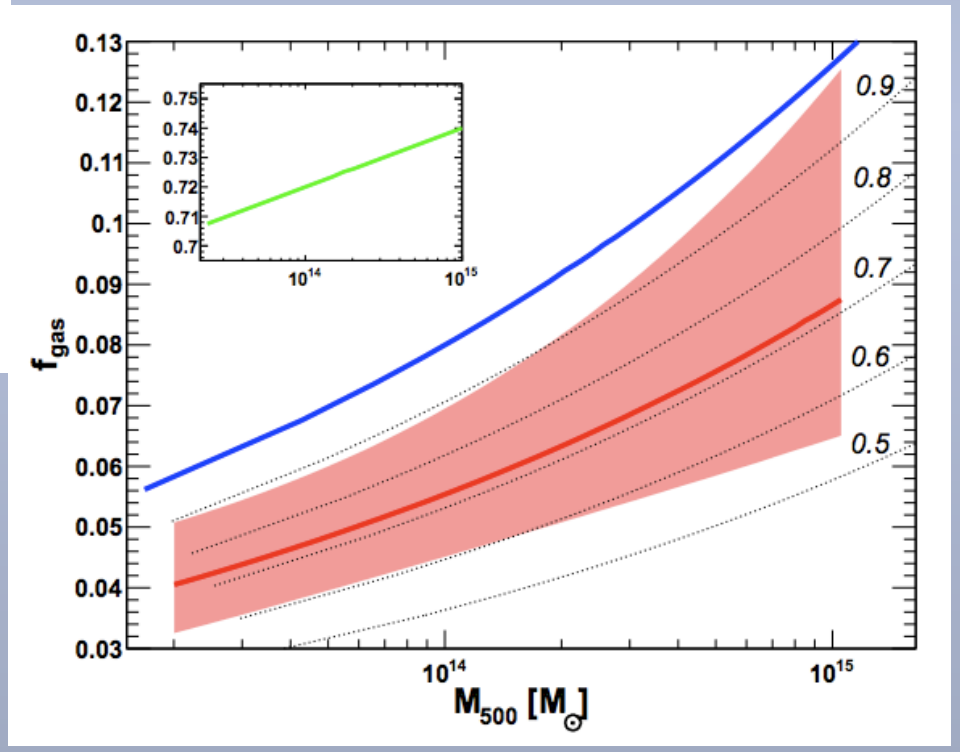
LSS: 3d visualization

https://vimeo.com/148201638

Credit: D. Pomarède

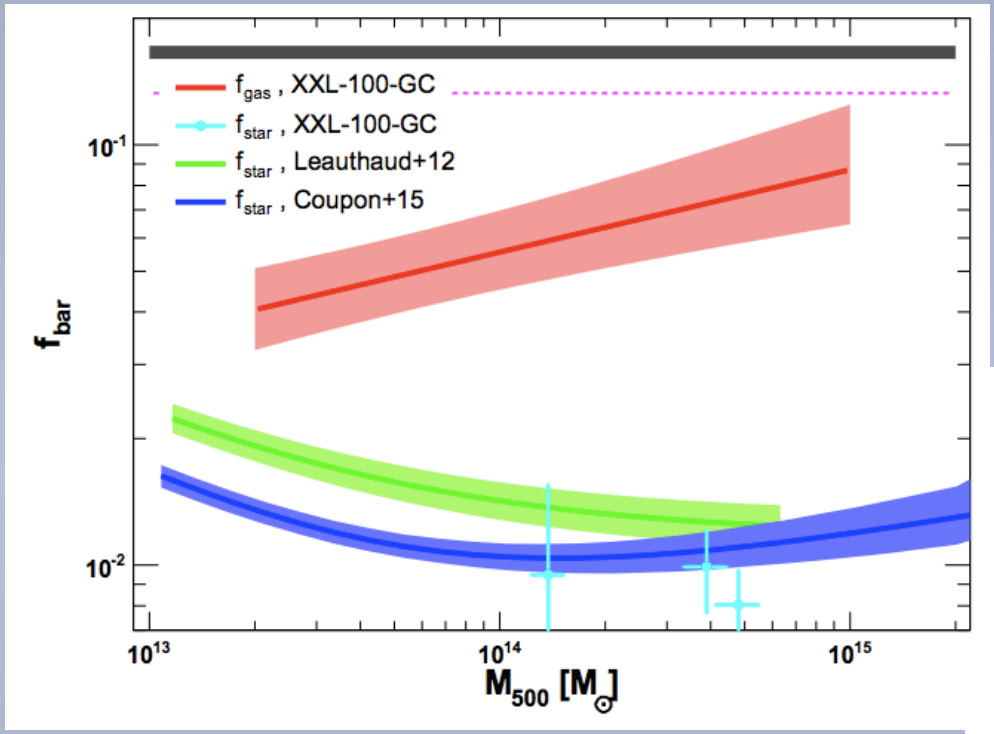
Gas mass content of XXL-100-GC

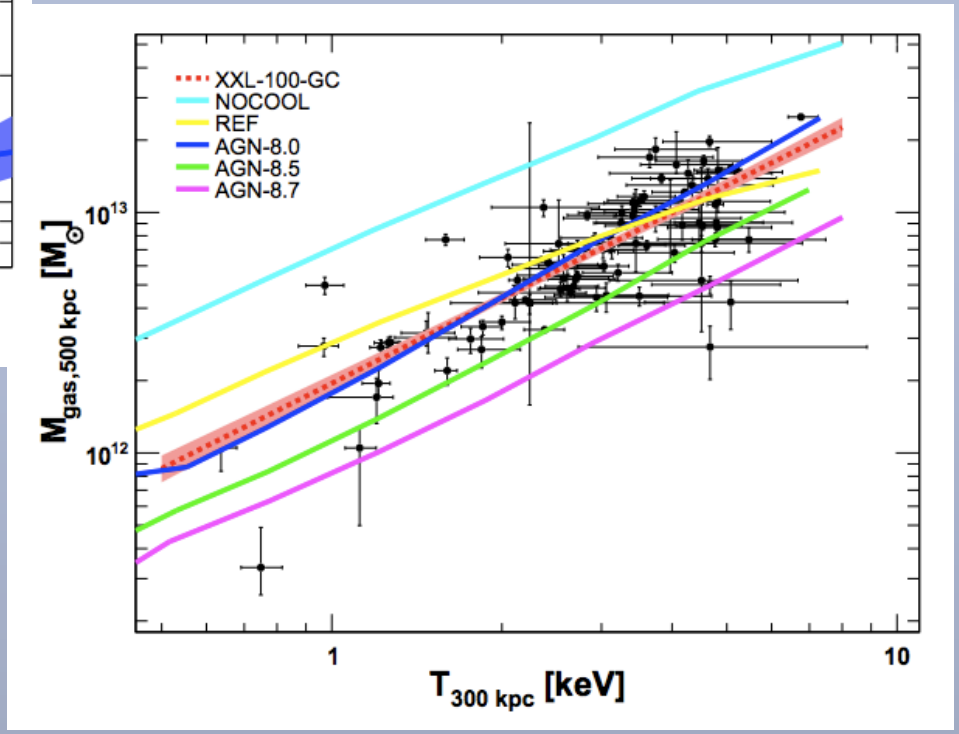




Paper XIII: Eckert, Ettori, et al. (A&A in press)

Gas mass content of XXL-100-GC





Paper XIII: Eckert, Ettori, et al. (A&A in press)

Conclusions

- XXL team assembling a unique multi-λ legacy data set
- First results of XXL (and X-ray maps) just issued:
  - ~ self-similar evolution of L500-T300kpc
  - Lower number density than predicted by Planck-CMB
  - Unveiling the 3d structures in the field
- Too many interesting details to describe here:

  Have a look at the papers on A&A arXiv !

- Next steps:
  - full sample (release planned in 2017)
  - two-point correlation function analysis
  - better mass-observables and selection modeling
  - more data (AO13 re-obs. + AO15 program)