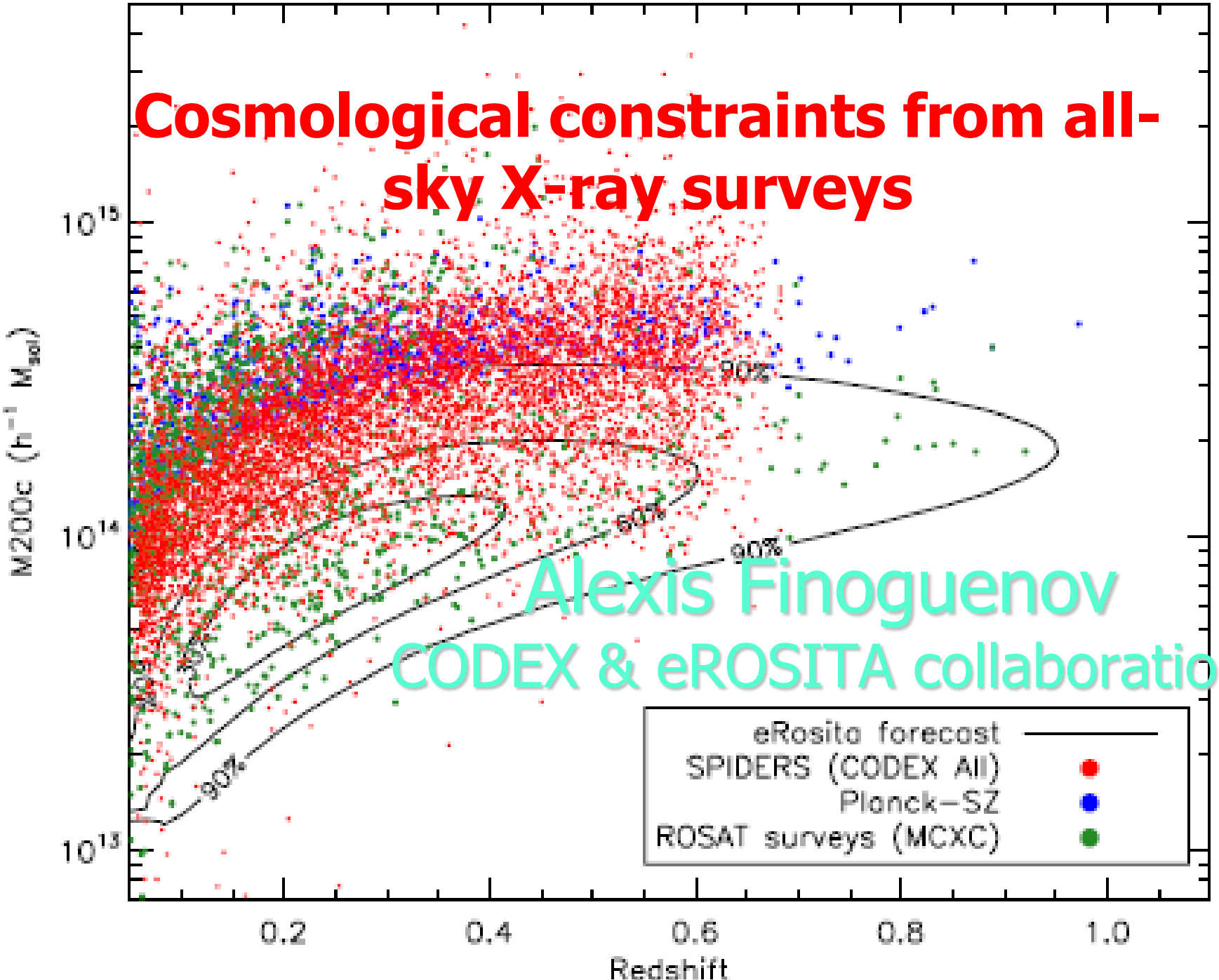
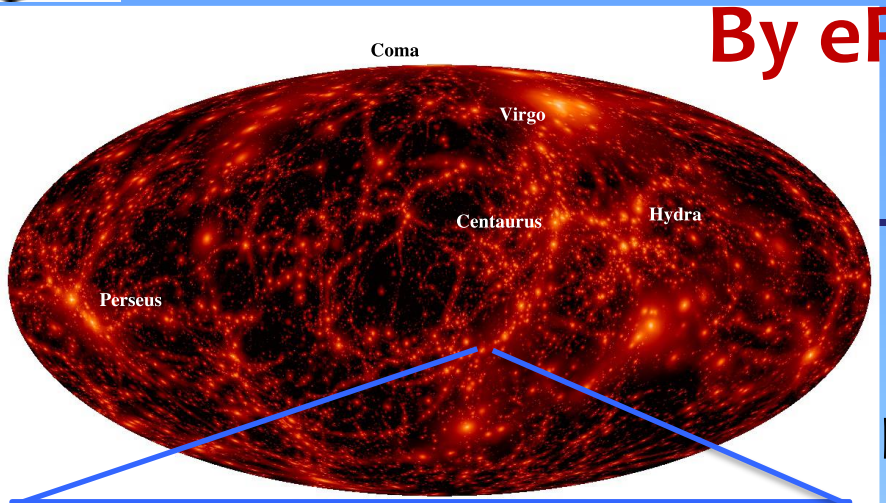
Cosmological constraints from all-sky X-ray surveys

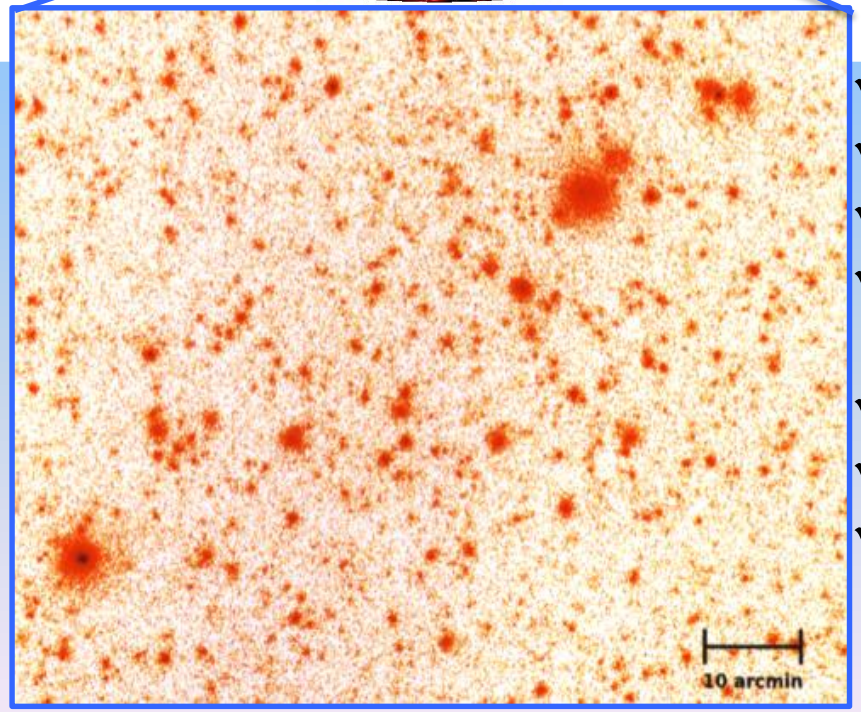


Alexis Finoguenov

CODEX & eROSITA collaboration

Mapping the structure of the hot Universe By eROSITA



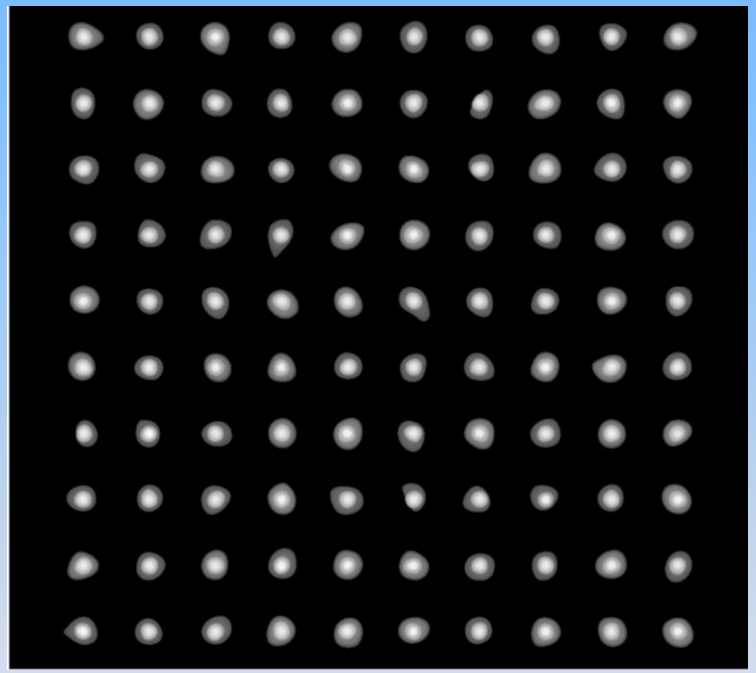


Detect 100.000 Clusters of Galaxies

- ✓ All-sky survey sensitivity 6×10^{-14} erg/cm²/s
- ✓ Deep survey field(s) (~100 deg²) to 1×10^{-14}
- ✓ Individual pointed observations
- ✓ Moderate angular resolution (<30“ aver. over FoV)
- ✓ Large collecting area (> 2000 cm² @1keV)
- ✓ Large FoV (1° Ø)
- ✓ Long duration survey: 4 years ← → 1/2 year (ROSAT)

Images coutesy of K. Dolag (LMU), M. Mühlegger (MPE), O. Hahn (ETH)

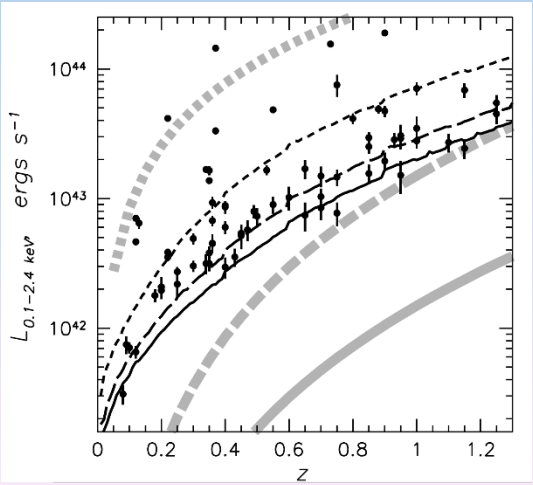
eROSITA: cosmology-driven cluster detection



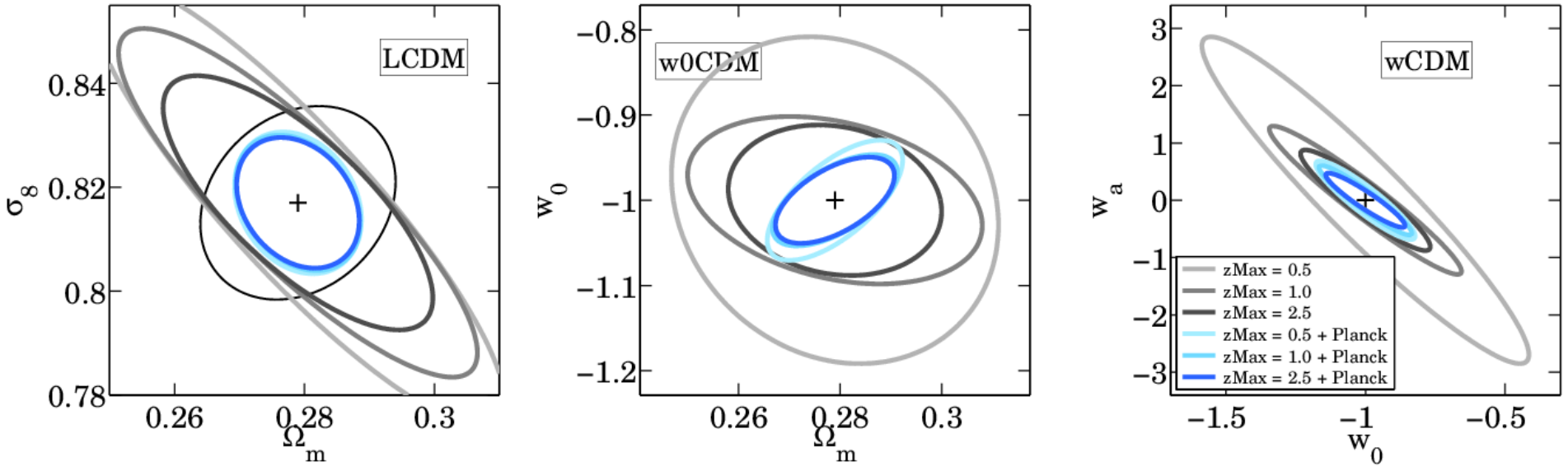
with Florian Kaefer

1. Based on experience with XMM surveys
2. Tuned for eROSITA using SIXTE simulations of AGNs+clusters
3. Goals: provide a physically motivated cluster detection,
to ensure best cosmological performance
4. Improve the success of the cluster follow-up and calibration

AF et al. 2017



Cosmological forecasts

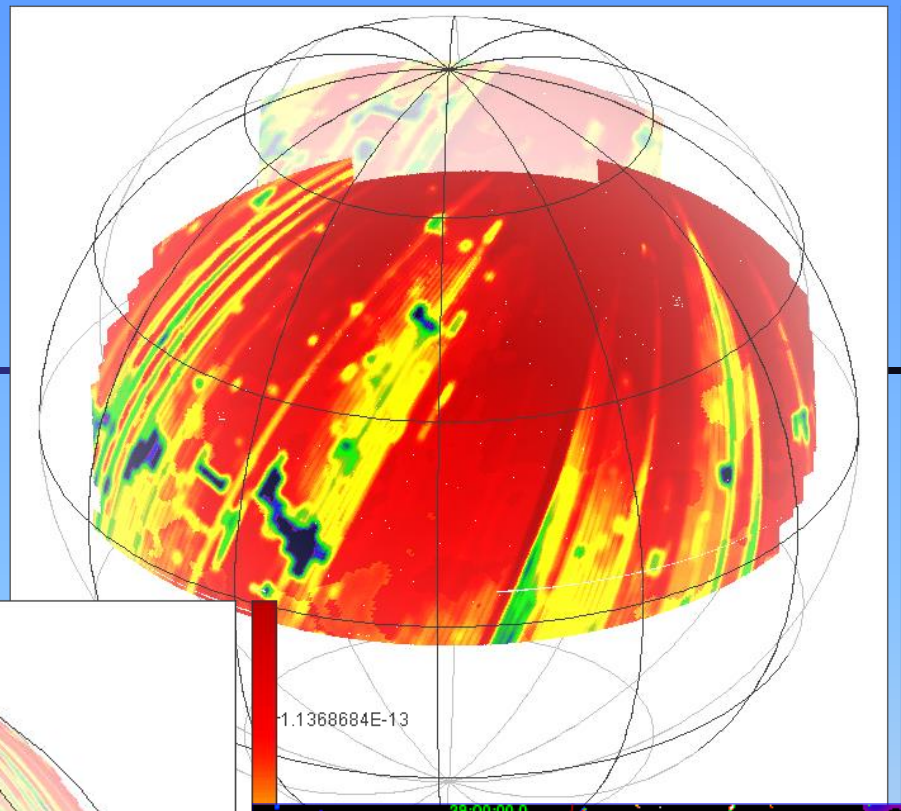


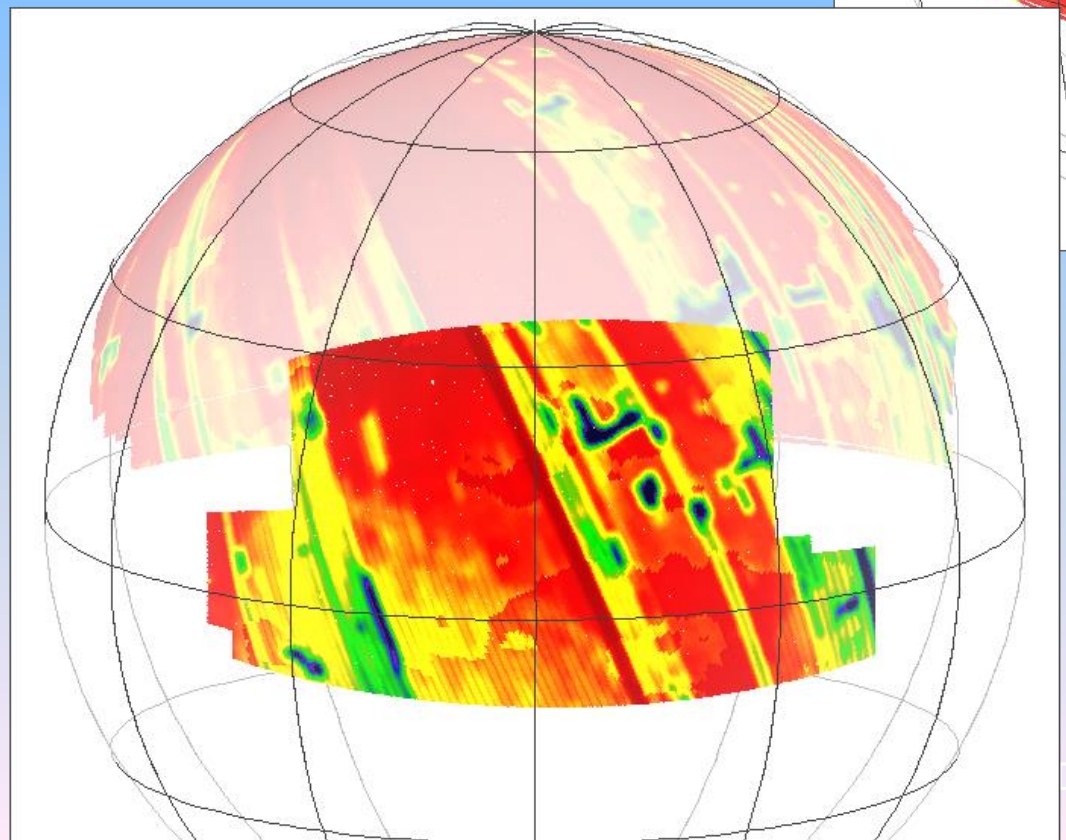
Annalisa Pillepich

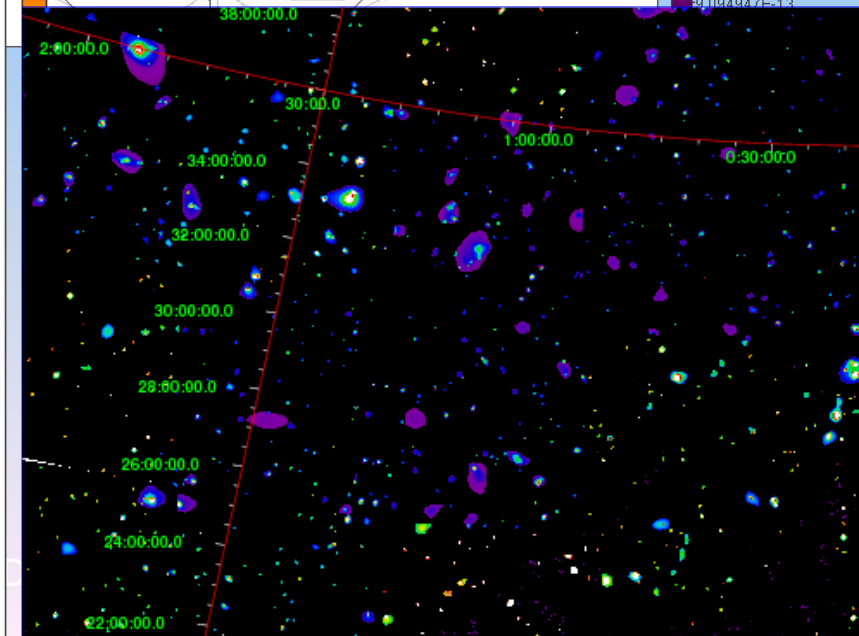
X-ray cluster identification

Point source+by eye **BCS, REFLEX, NORAS, MACS**	**Point source+optical survey** **CODEX, RASSinDES**
Extended source+by eye RDCS, 400 sq.deg., SPT	Extended source+optical survey COSMOS, CDFS, AEGIS, SXDF, XMM-XXL

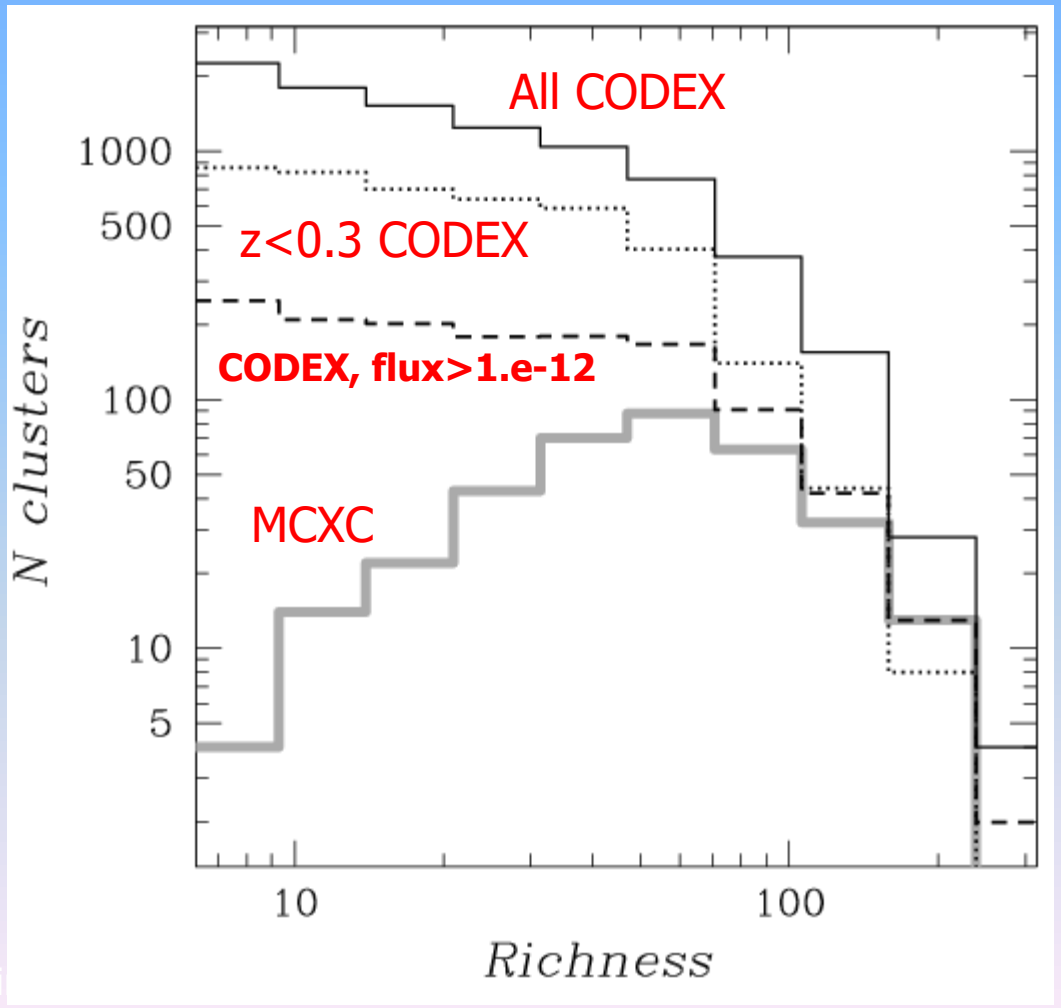
Sensitivity of RASS on BOSS footprint



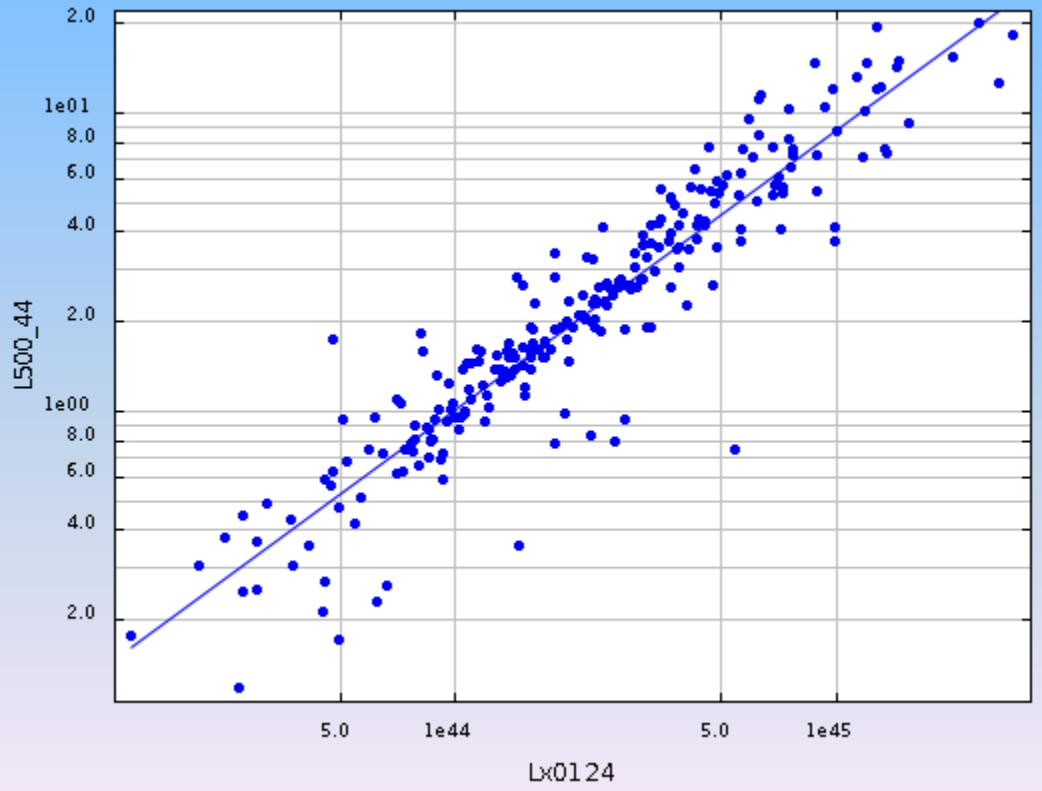




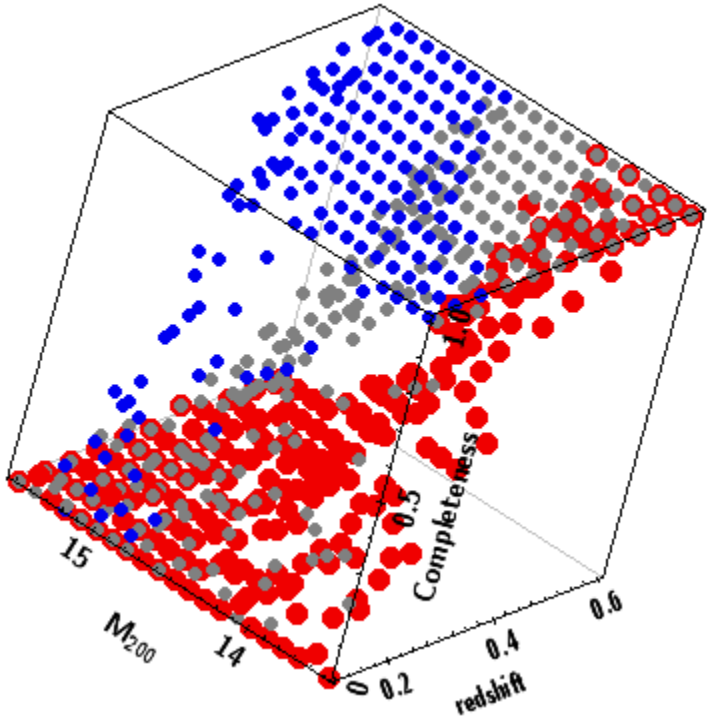
CODEX and MCXC

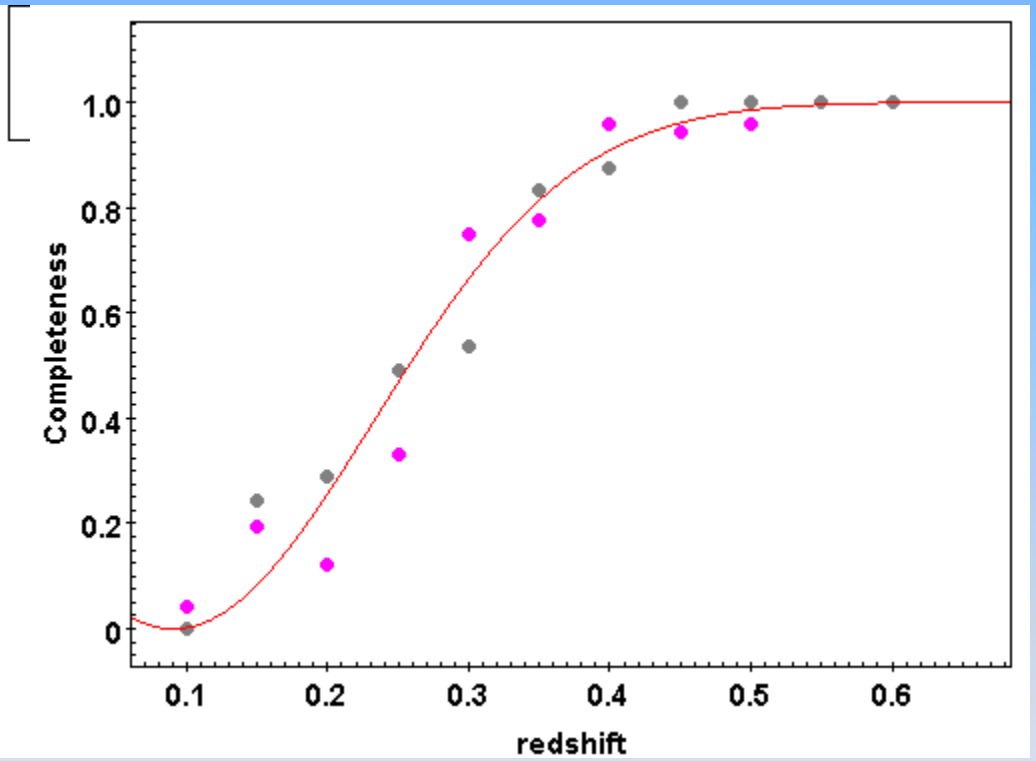


Lx comparison: CODEX vs MCXC

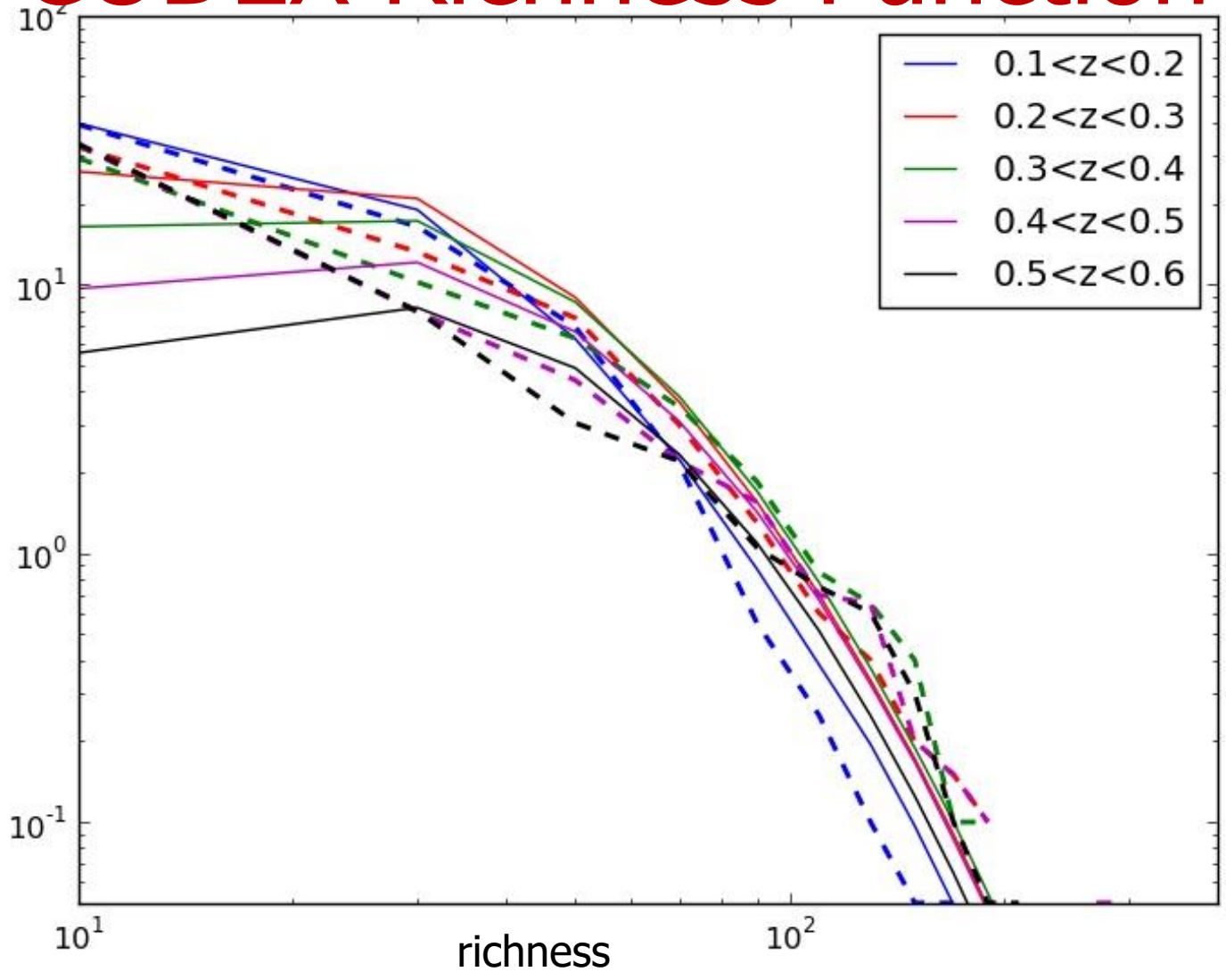


Detection efficiency



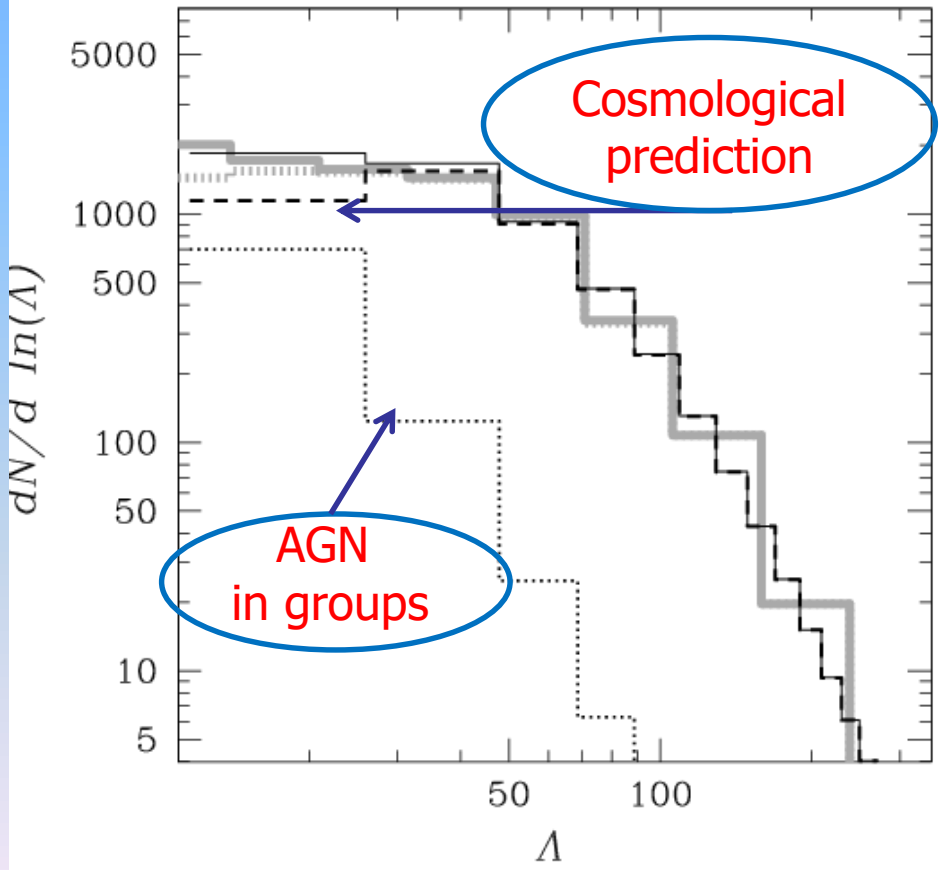


CODEX Richness Function

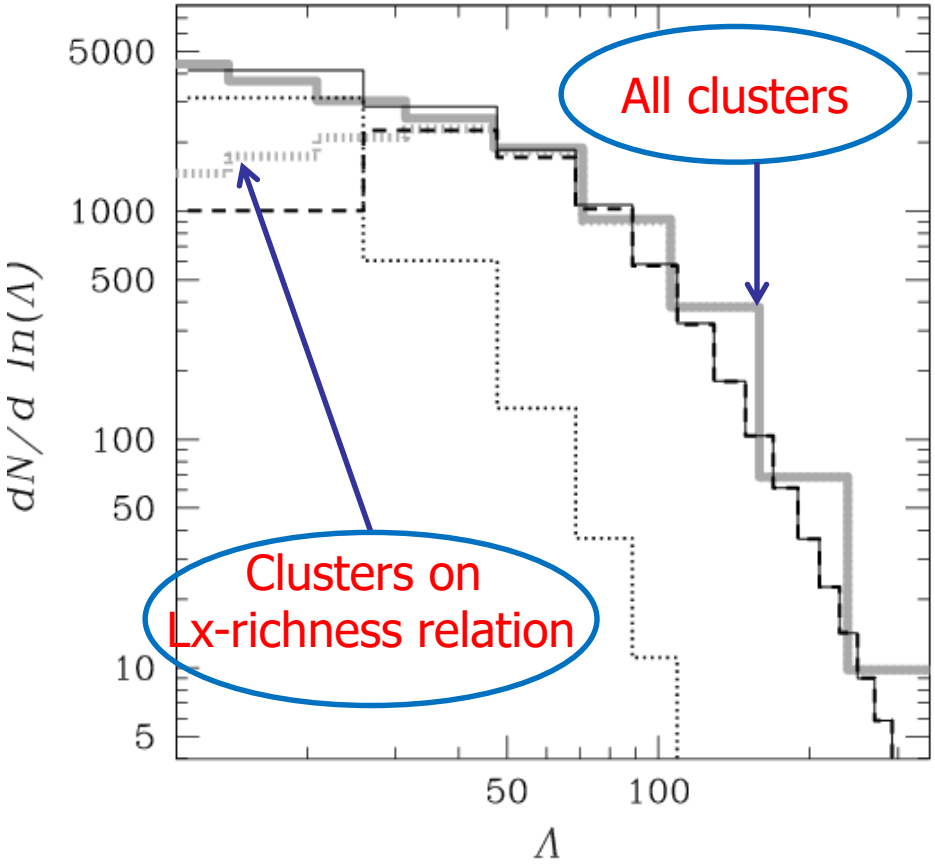


CODEX richness function

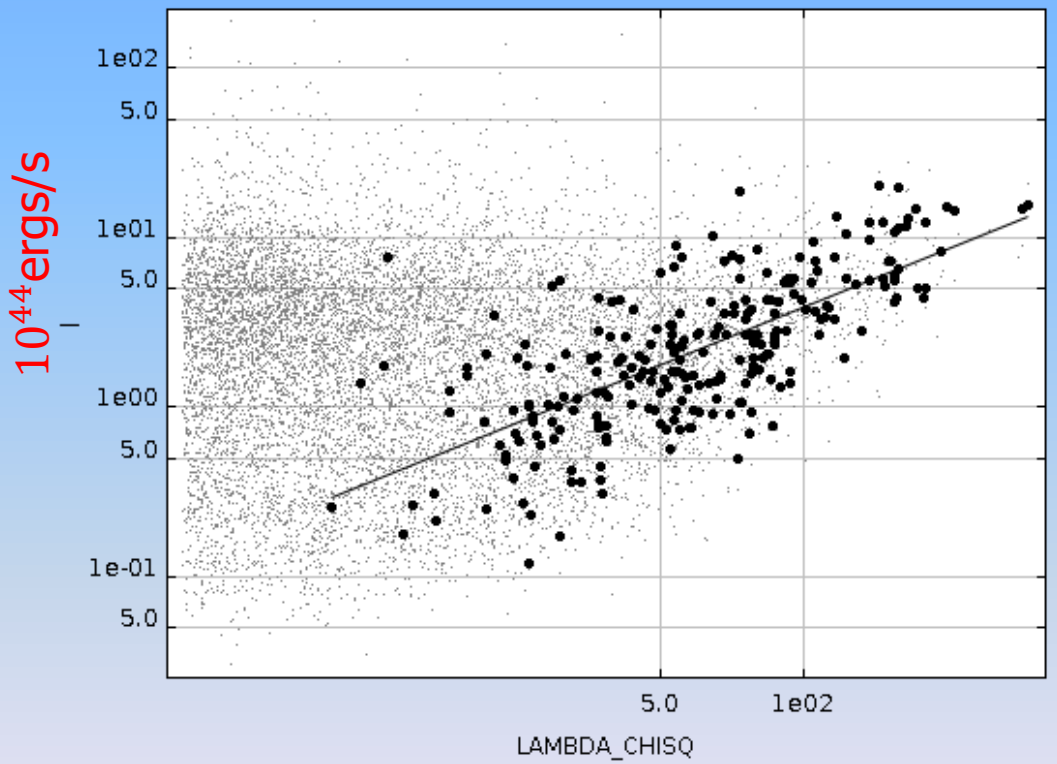
0.1<z<0.3

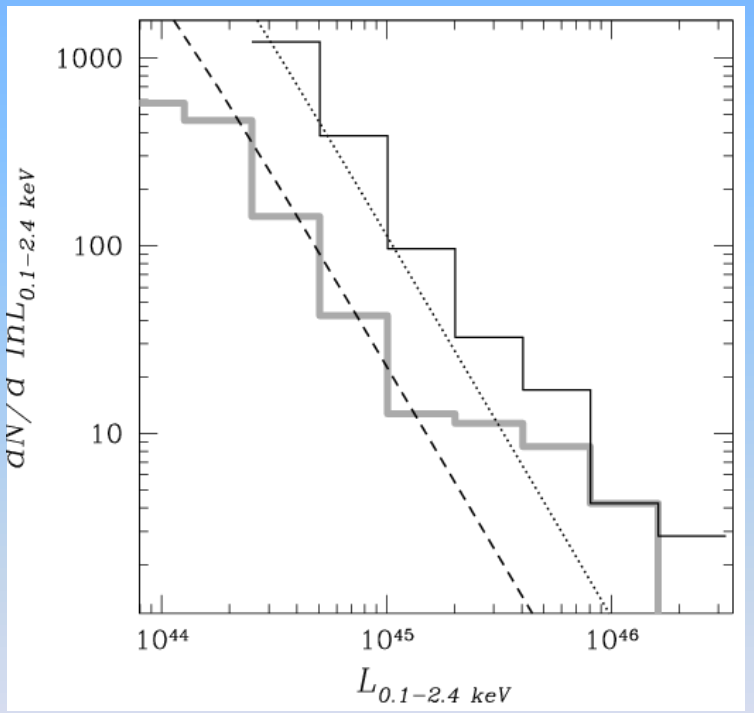


0.1<z<0.6

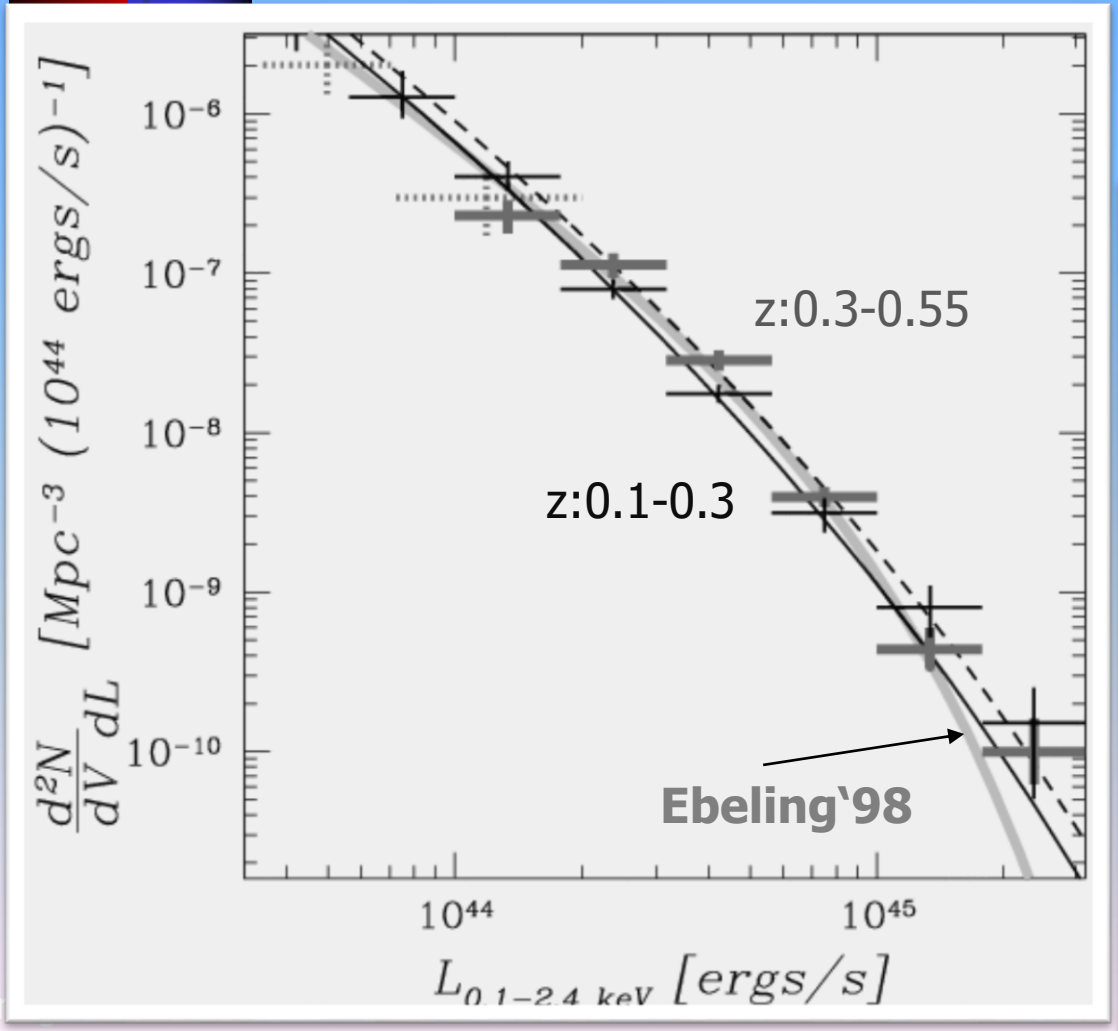


Lx-richness relation

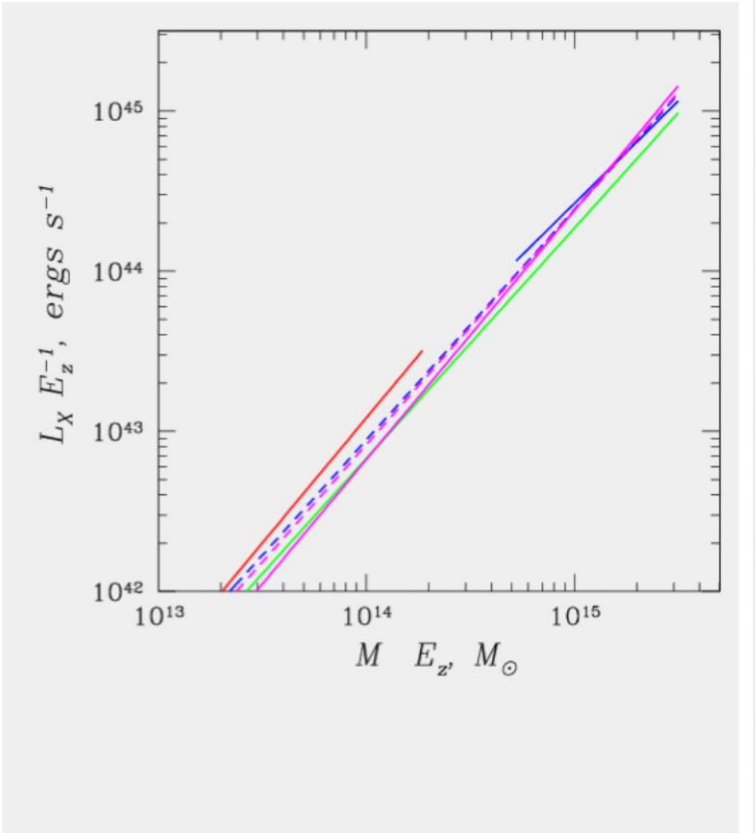




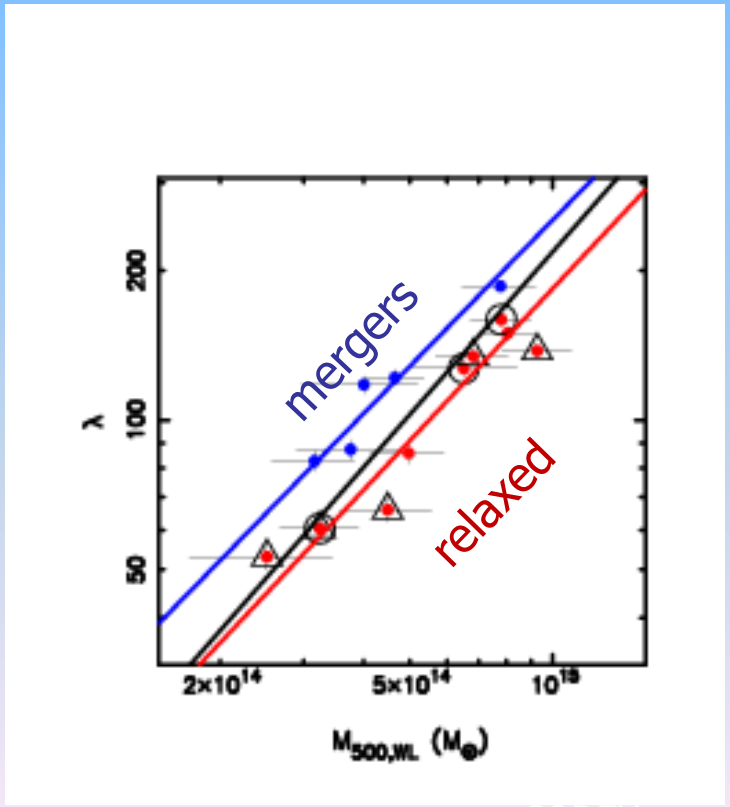
XLF



M-Lx relation

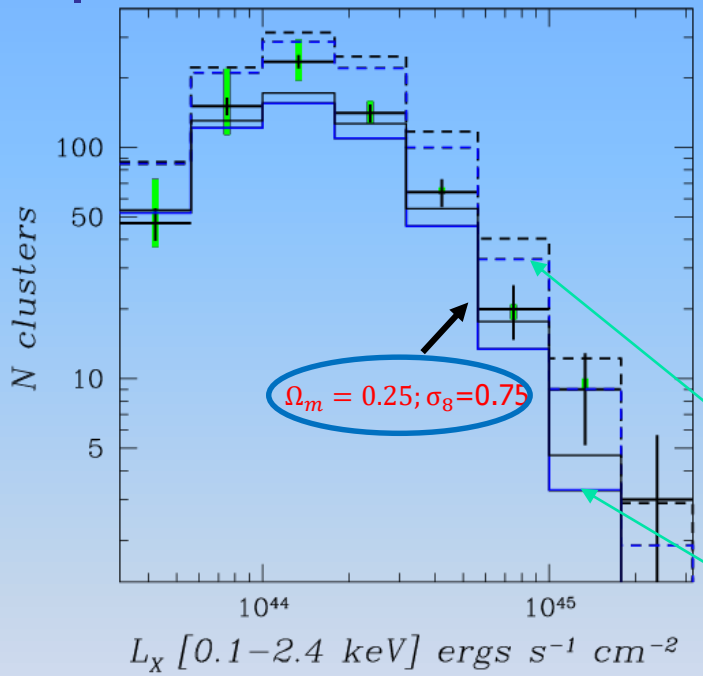


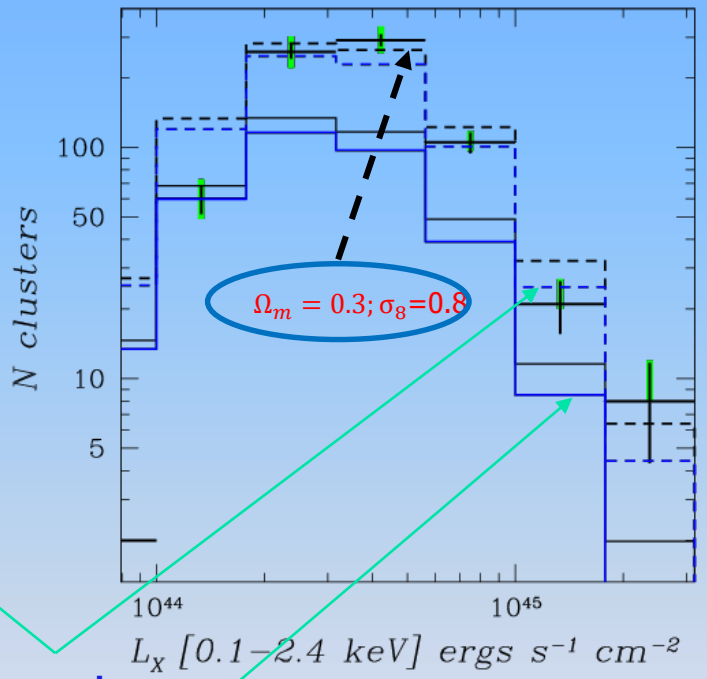
Studying the covariance with richness: LoCuSS



At the same time relaxed clusters have higher Lx for a given mass => negative covariance is expected
Farahi et al. in prep.

Effect of covariance between richness and Lx



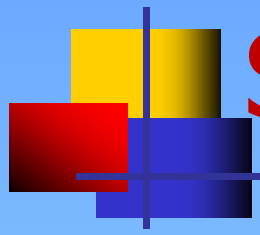


covariance

$$\mathcal{P}(\ell, t \mid \mu, z) = \frac{1}{2\pi R} e^{-\delta^T C^{-1} \delta}$$

With Fabrice Brimioulle, Nathalia Cibirka, Matteo Constanzi, Steffen Hagstotz

Nord et al. 2008



Summary

- eROSITA will provide Stage IV FoM using spatially resolved core-excised cluster detection
- We identify a number of problems associated with RASS cluster catalogs:
  - Richness-dependent incompleteness
  - Richness-dependent AGN contamination
  - Covariance between richness and Lx
  - Remaining inconsistencies in the cluster Lx-M calibration