A catalogue of simulated X-ray AGN from z=0 to 3

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+The XXL collaboration

COSMO-OWLS simulations

- SPH - Gadget-3
- Cosmologies: WMAP7, Planck.
- Number of particles: 2×1024^3

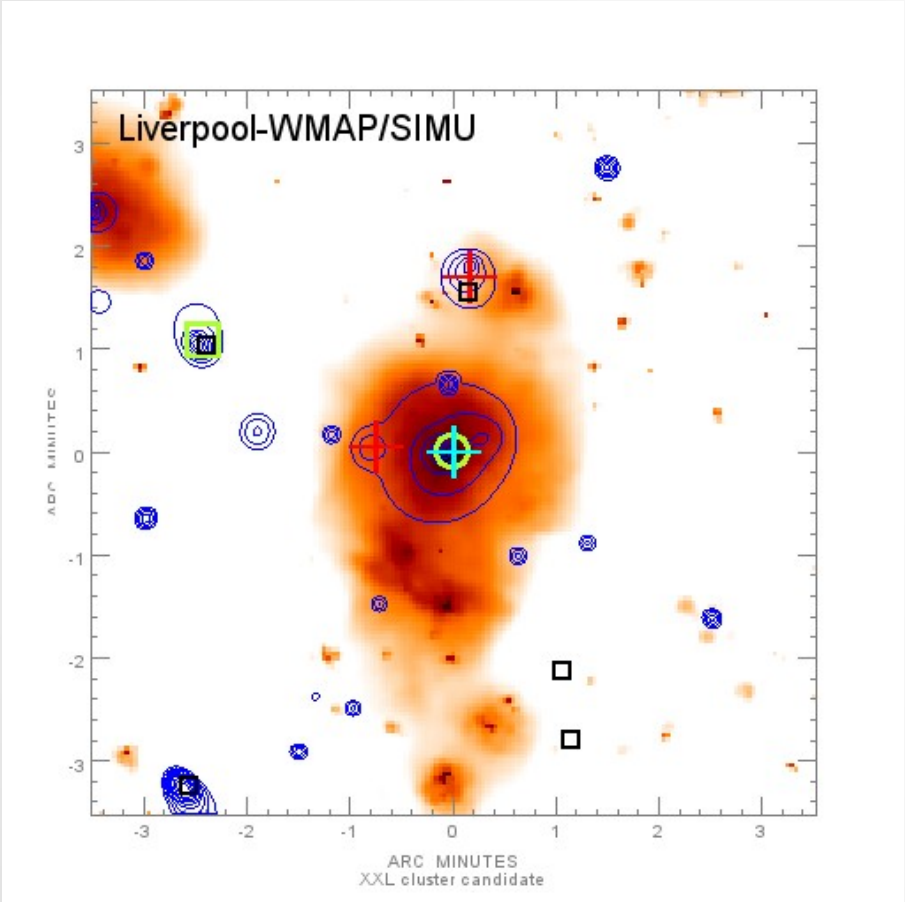
- 3 AGN models: 8.0 – 8.5 – 8.7
- Current results using model 8.0

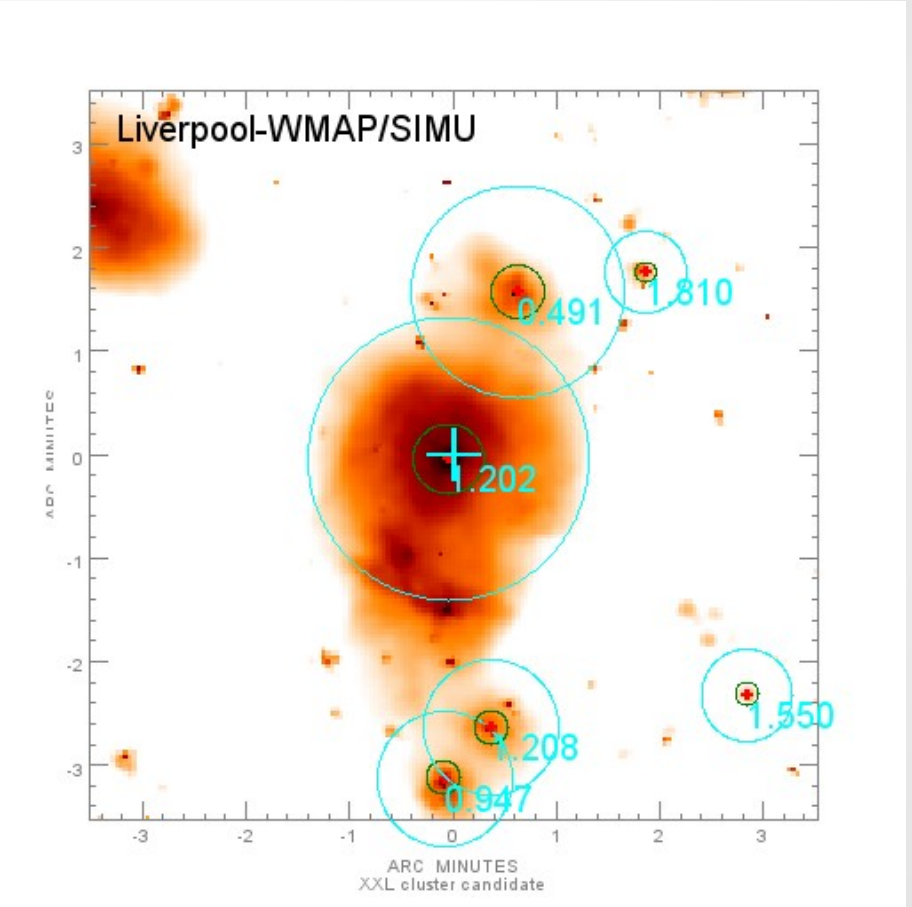
Le Brun, McCarthy+2014

- Black hole (BH) seeds placed at the centre of haloes that exceed some threshold mass, i.e., 100 particles ~ logM(FoF)=11.6 (on the fly).
- Given some seed mass: mseed<<mg (subgrid BH – 0.001 x the gas particle mass)
- BHs grow by mergers with other BHs and by accretion of neighbouring gas (no disruption and capture of stars).
- A certain fraction of rest mass energy of accreted gas is assumed to heat local gas thermally

Booth & Schaye 2009

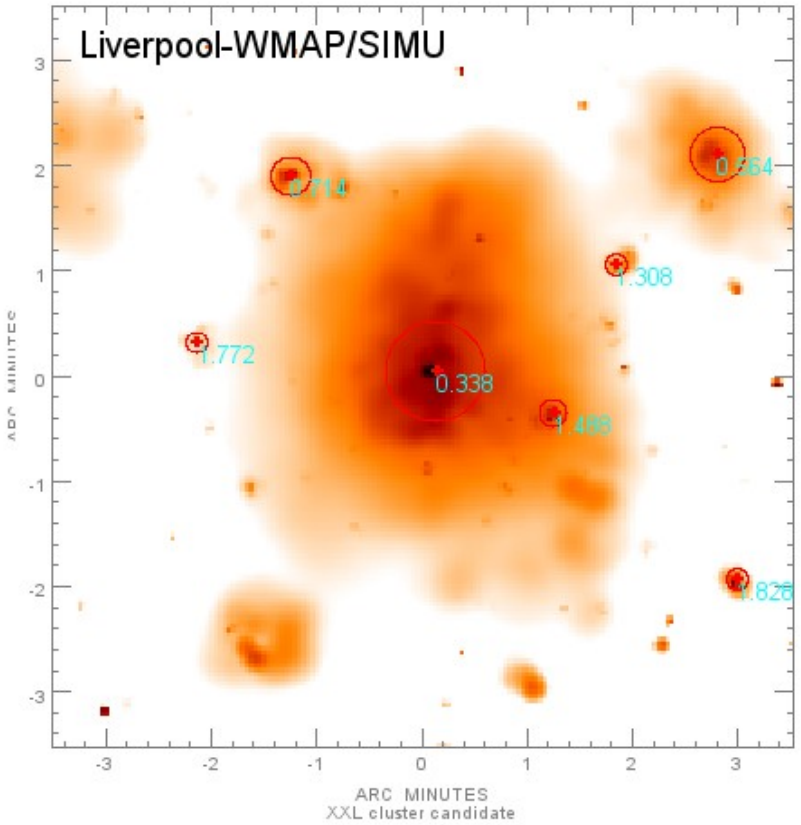
COSMO-OWLS simulations

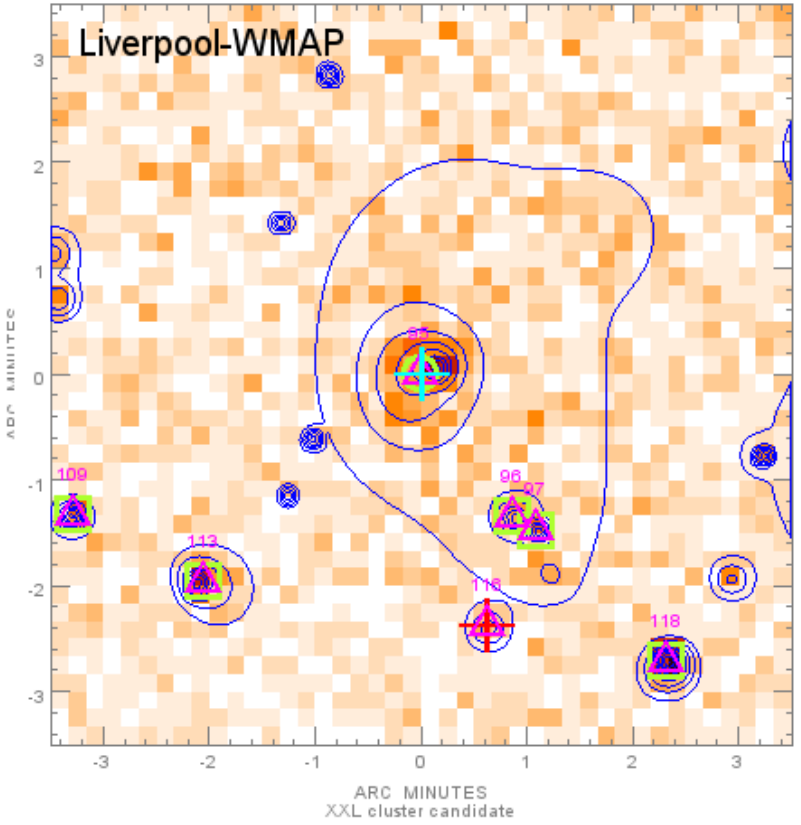




COSMO-OWLS – Producing the dirty maps

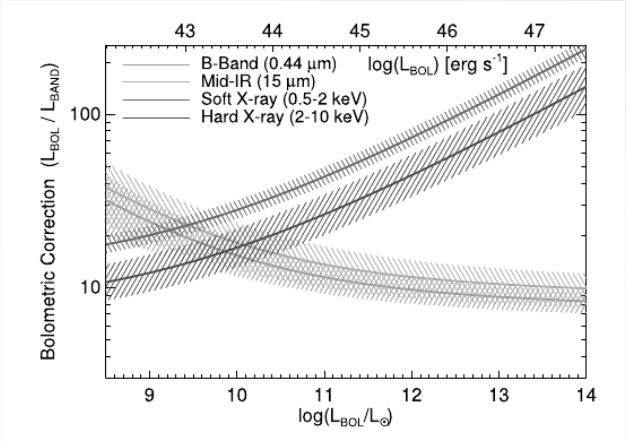
Adding background, XMM observational effects and running the detection algorithms

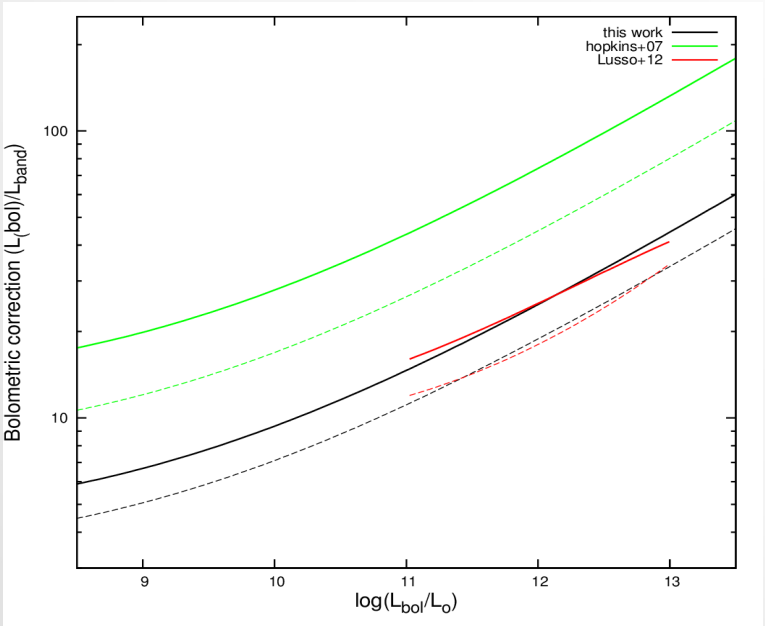


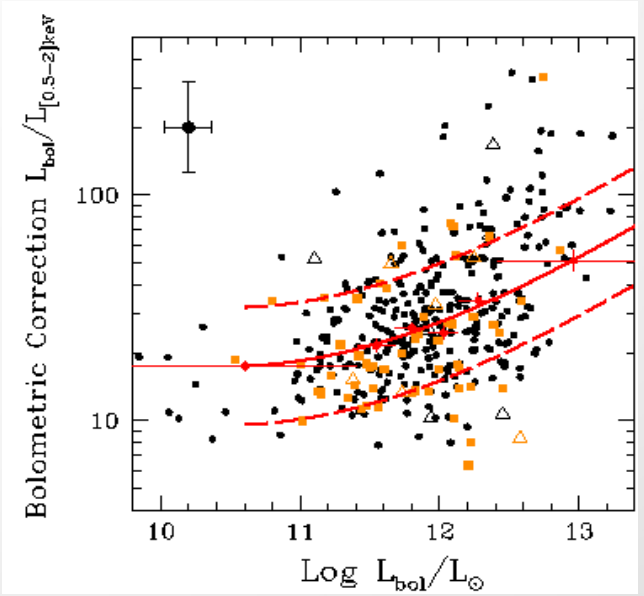


Turning black holes to X-ray AGN

- ~1600000 black holes in 25 sq. deg.
- Known: position, acc. rate, Eddington ratio, bolometric luminosity.
- Only those with acc. rate >10^{-6} Mo/y are considered (Ho 2008)
- Bolometric corrections applied by Hopkins et al. (2007) normalized to Lusso et al. (2012, XMM-COSMOS)





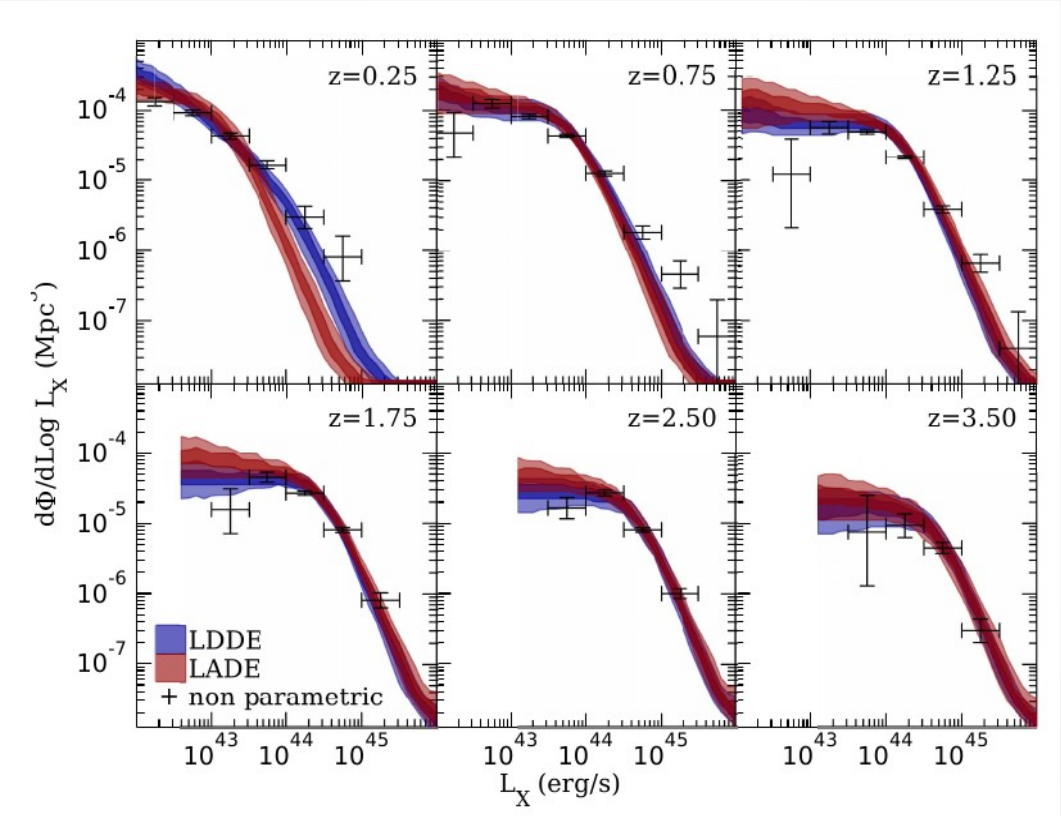


Unobscured hard X-ray LF

Ranalli, Koulouridis + the XXL consortium 2016

First test: LF comparison

XMM-LSS, CDFS, COSMOS



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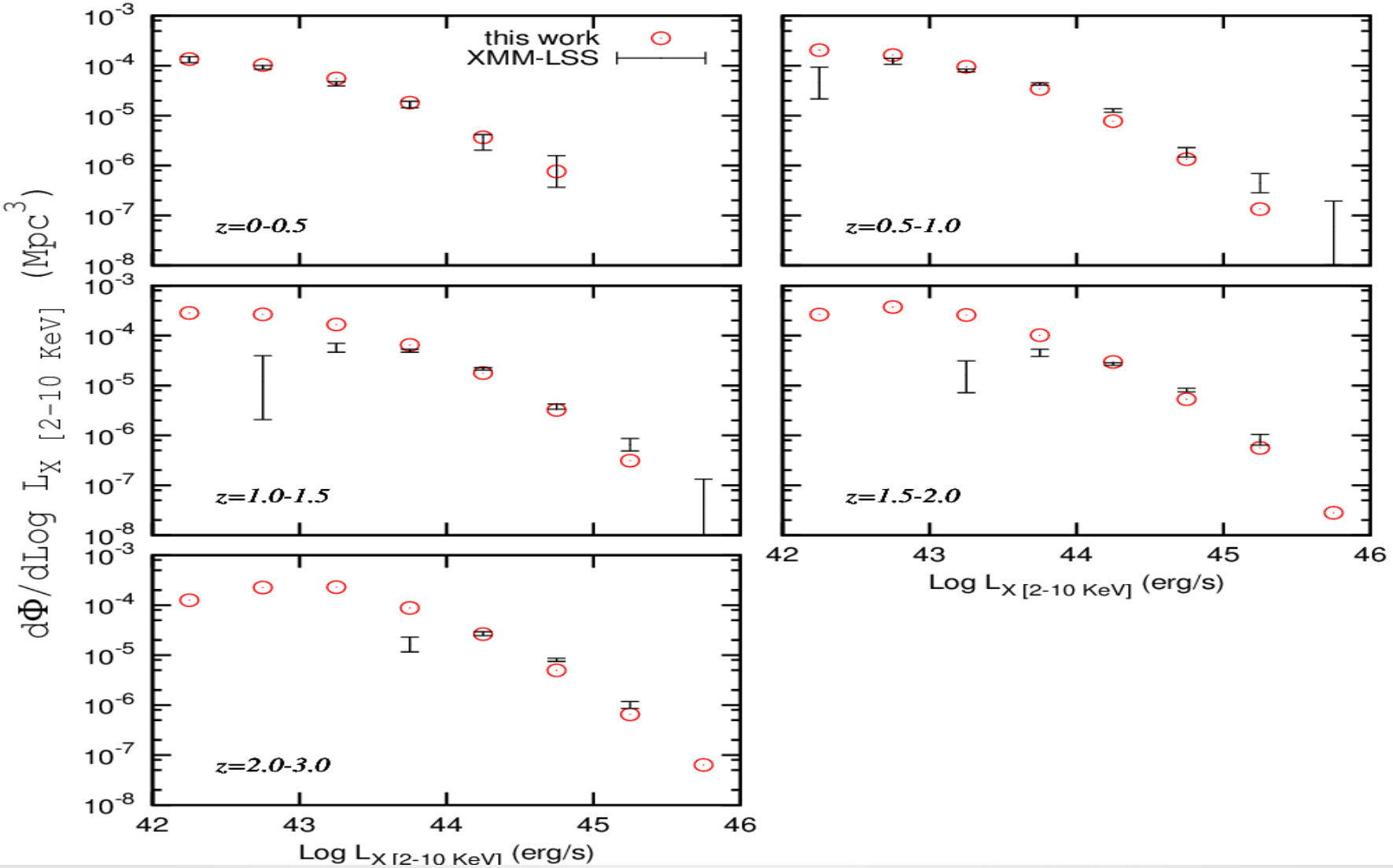


Adding obscuration

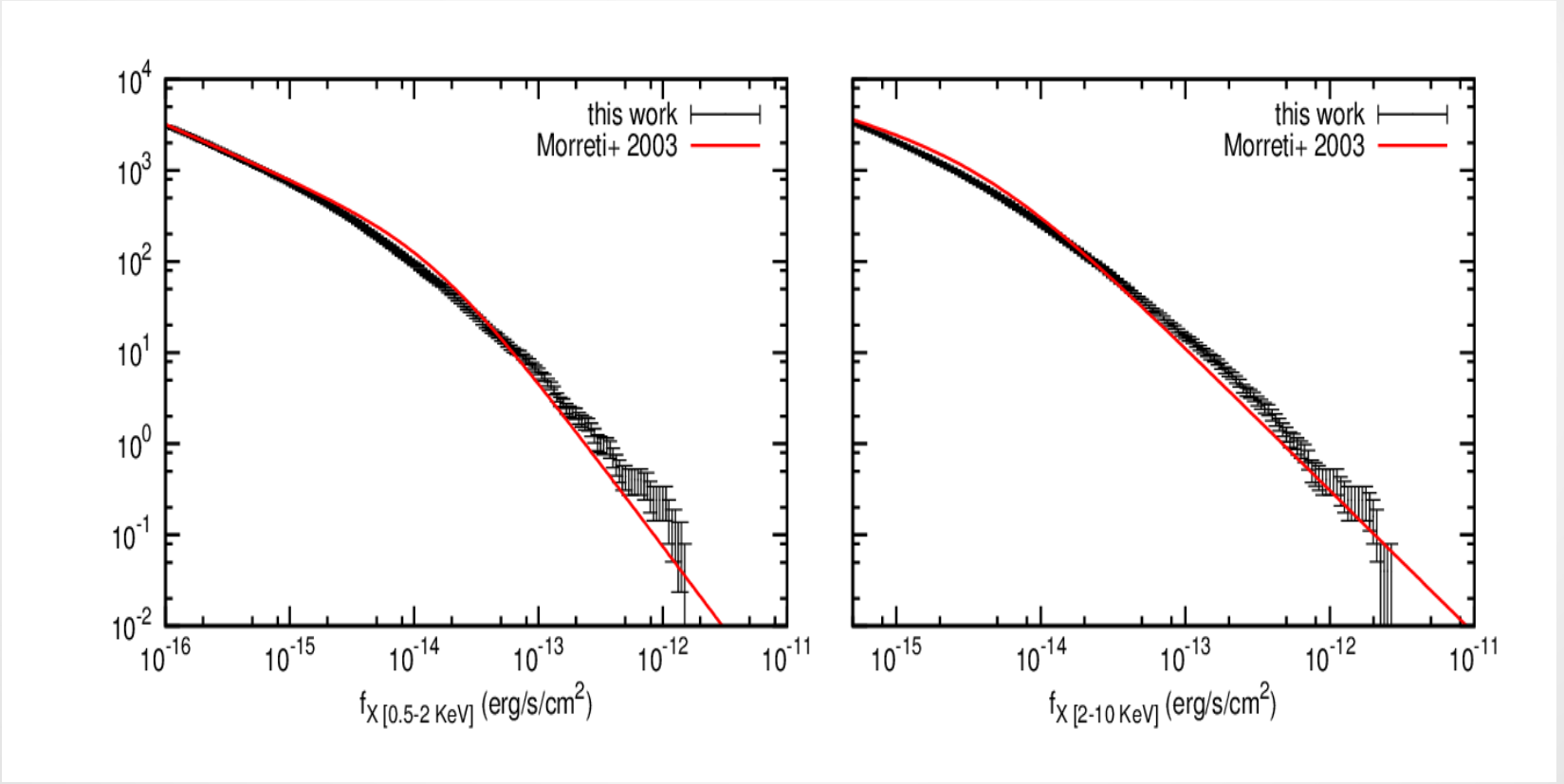
- Obscuration is luminosity (strong) and redshift (weak) dependent.
- Compton-thick AGN are also included.

Ueda+2014

- *Count: ~78000 soft point-like sources per 25 sq. deg. (~80000 Moretti+2003)*

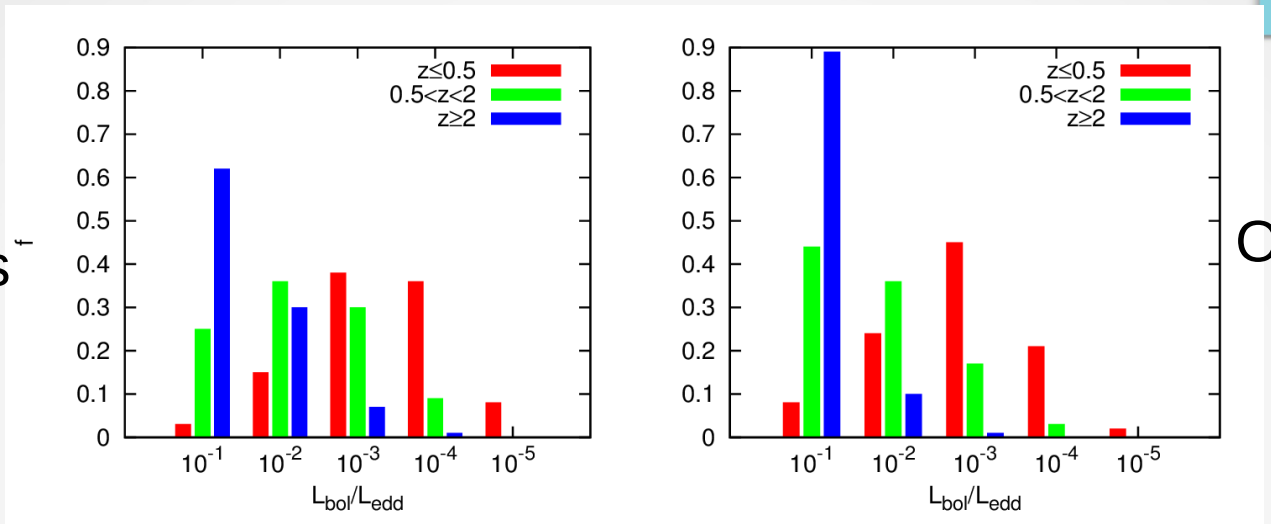
Second test: comparing the logN-logS

LogN-logS by Moretti+2003



Eddington ratio distribution

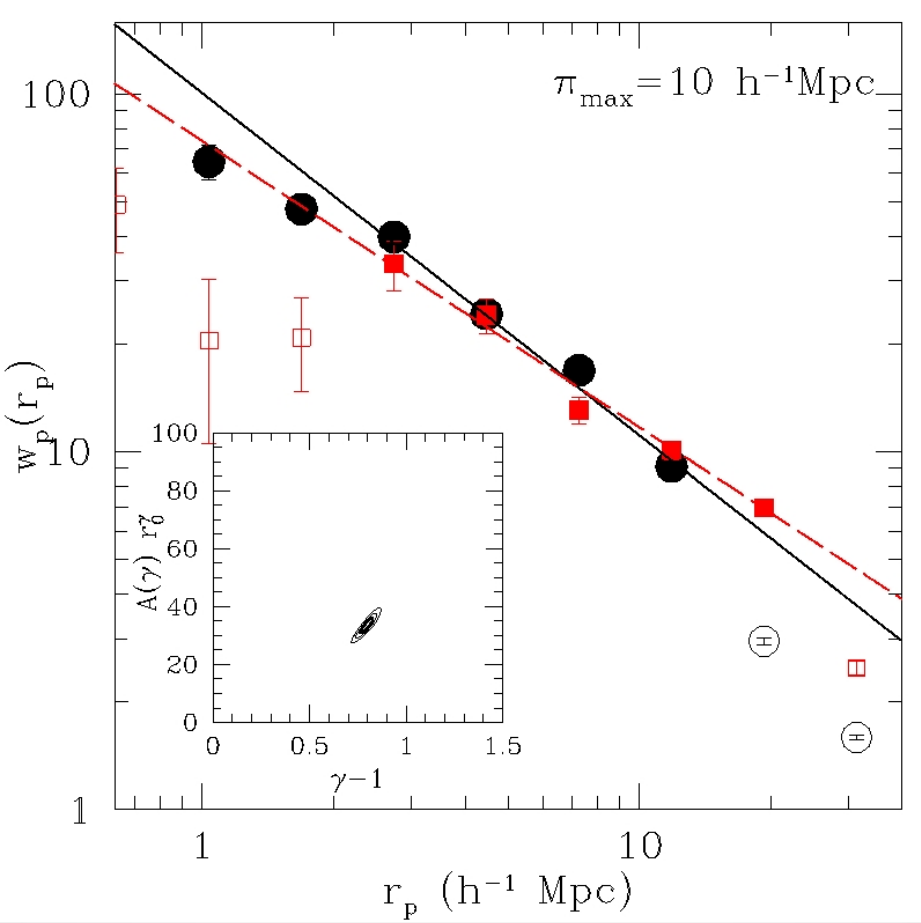
Before the observations



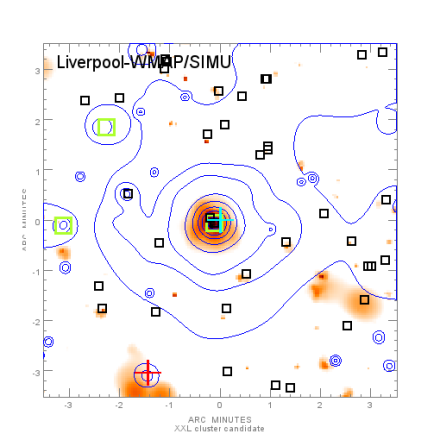
Observed

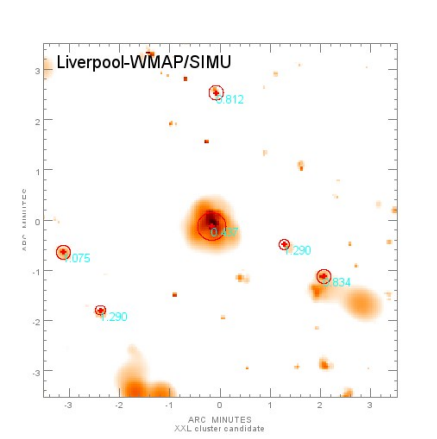
- The majority of AGNs in the local Universe have Eddington ratios of 10^{-6} – 10^{-3} (Ho 2008; Goulding et al. 2010).
- At z=0.3 -1.5 X-ray AGNs appear to be massive and are growing more rapidly than similarly massive BH in the local Universe (10^{-3} – 10^{-1}). (Babic et al.; 2007; Ballo et al. 2007; Rovilos & Georgantopoulos 2007; Alonso-Herrero et al. 2008; Hickox et al. 2009; Raimundo et al. 2010; Simmons et al. 2011).
- At even higher redshift they probably grow faster but the uncertainties are large (Alexander & Hickox 2012)

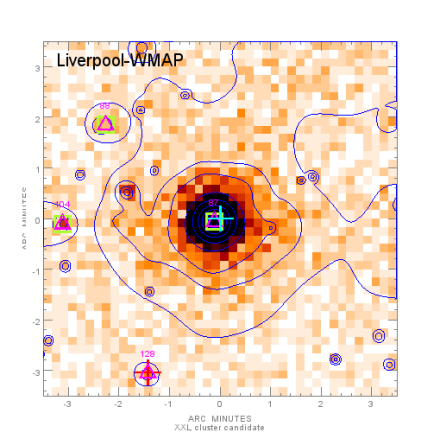
3D Correlation functions

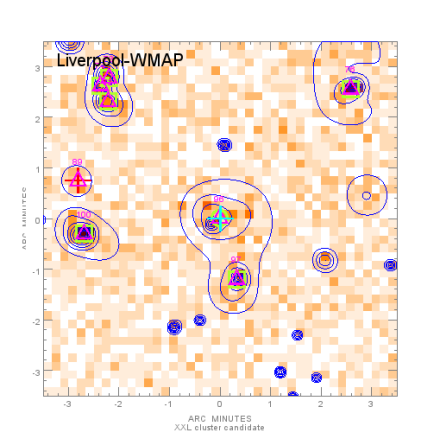


LOST - Very powerful central AGN

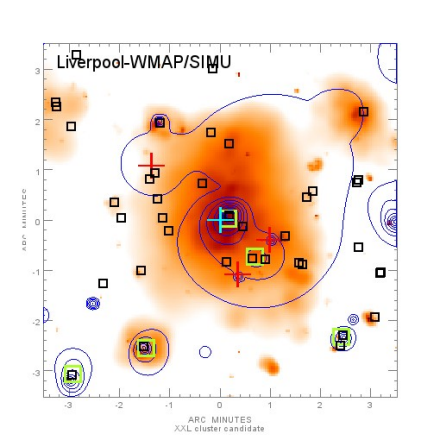


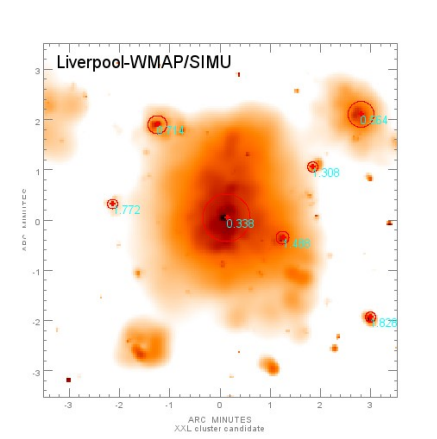


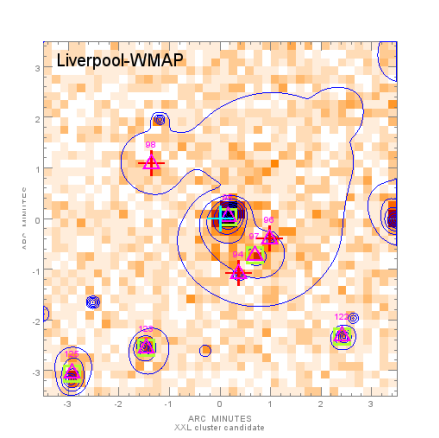


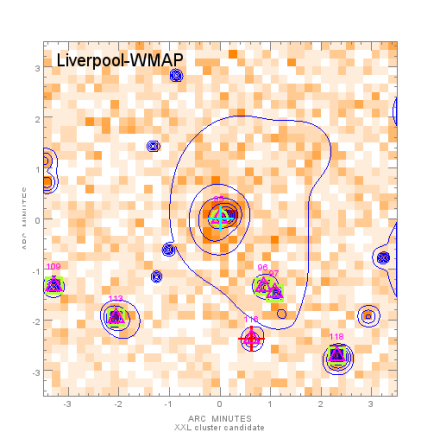


Double source – contamination

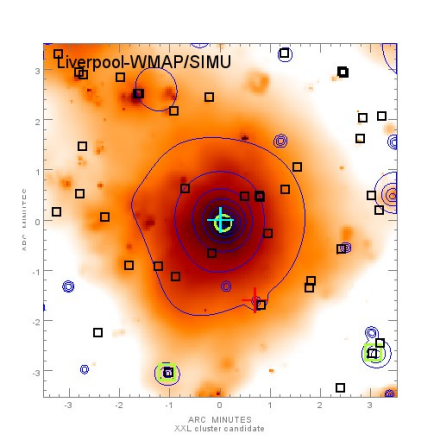


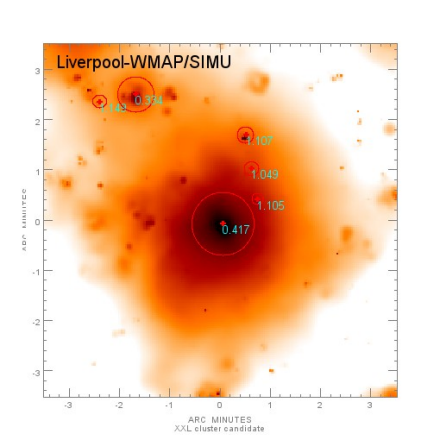


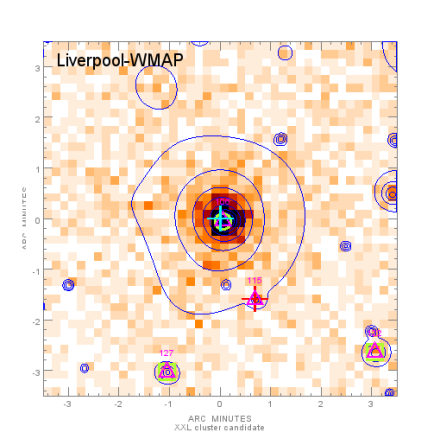


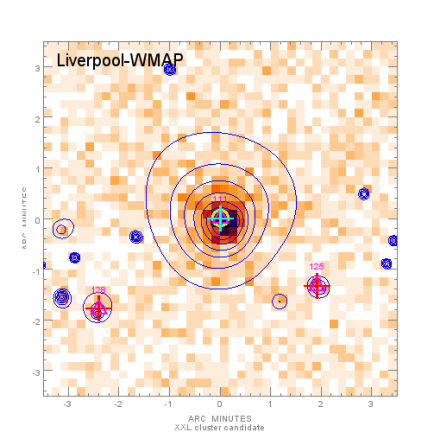


(marginal) C1 to C2

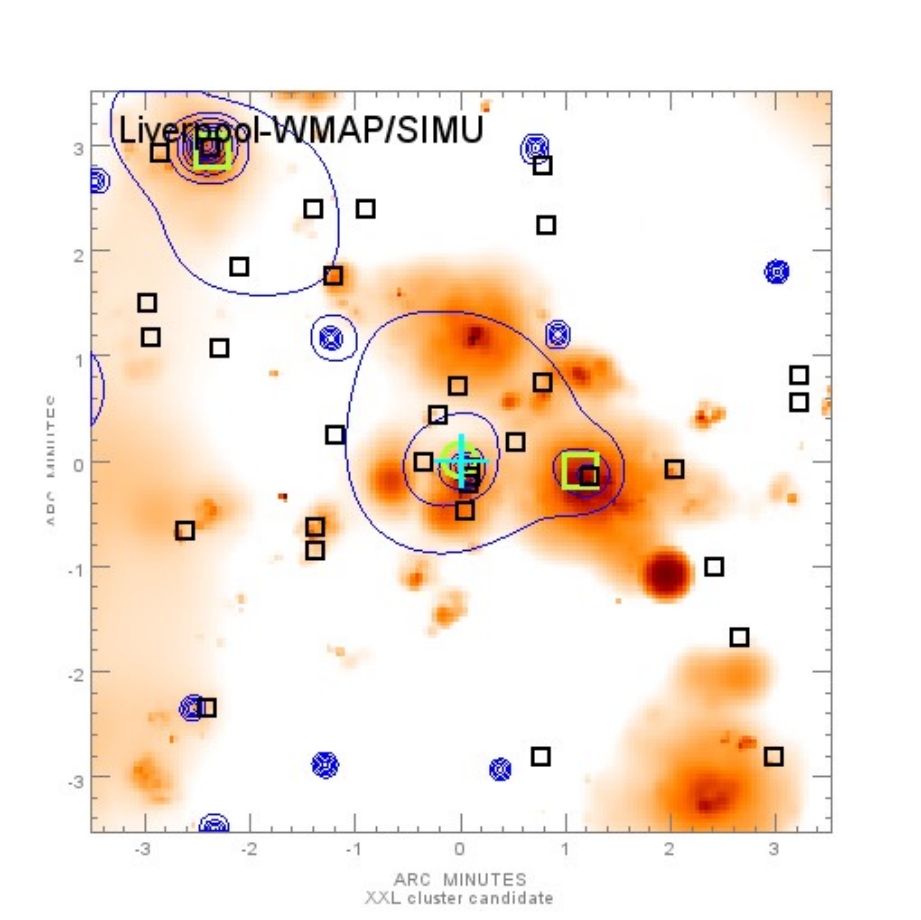


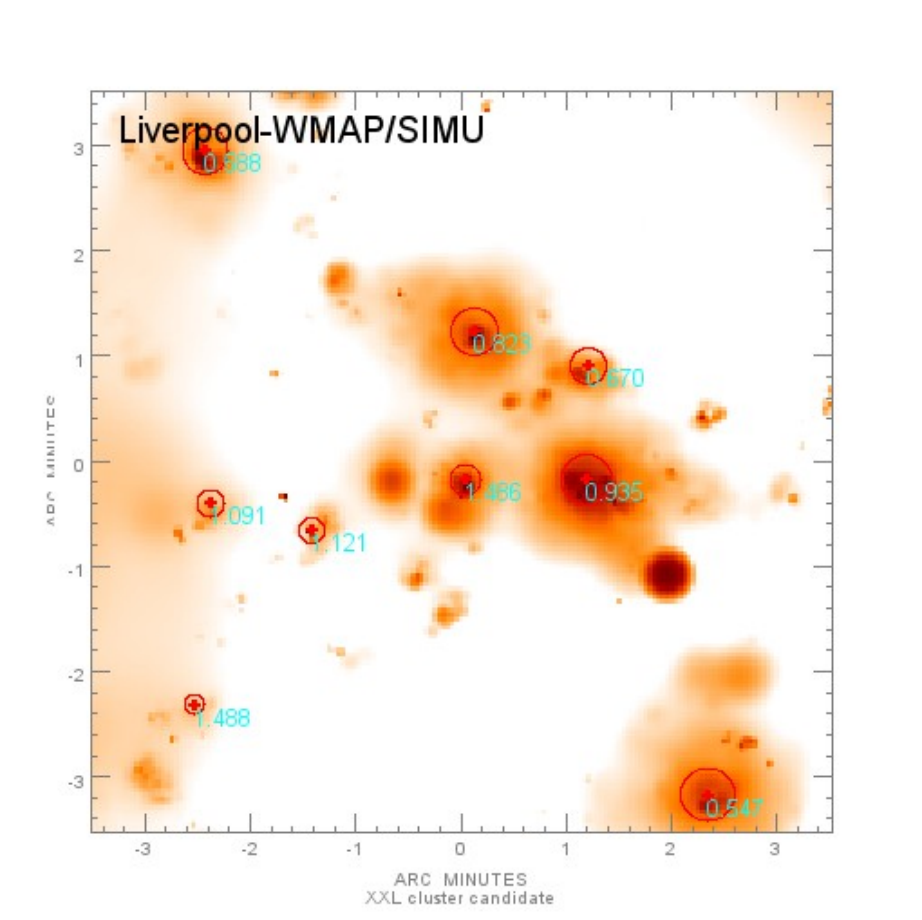






Simulated AGN in the cosmo-OWLS





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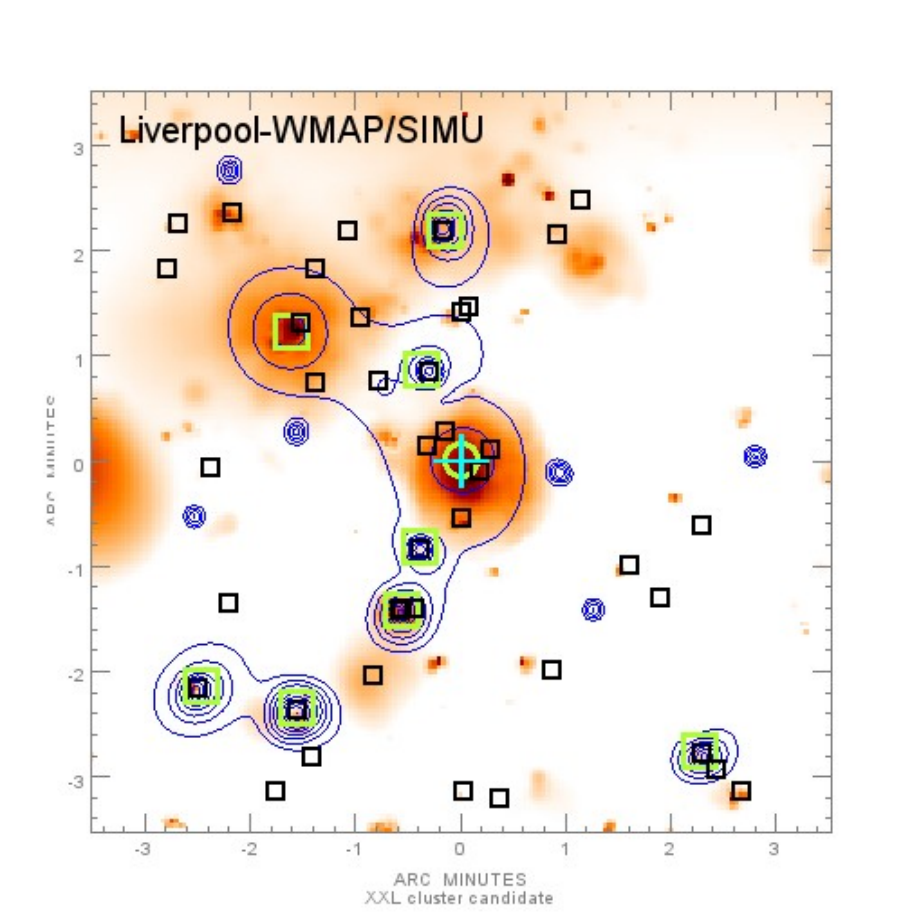

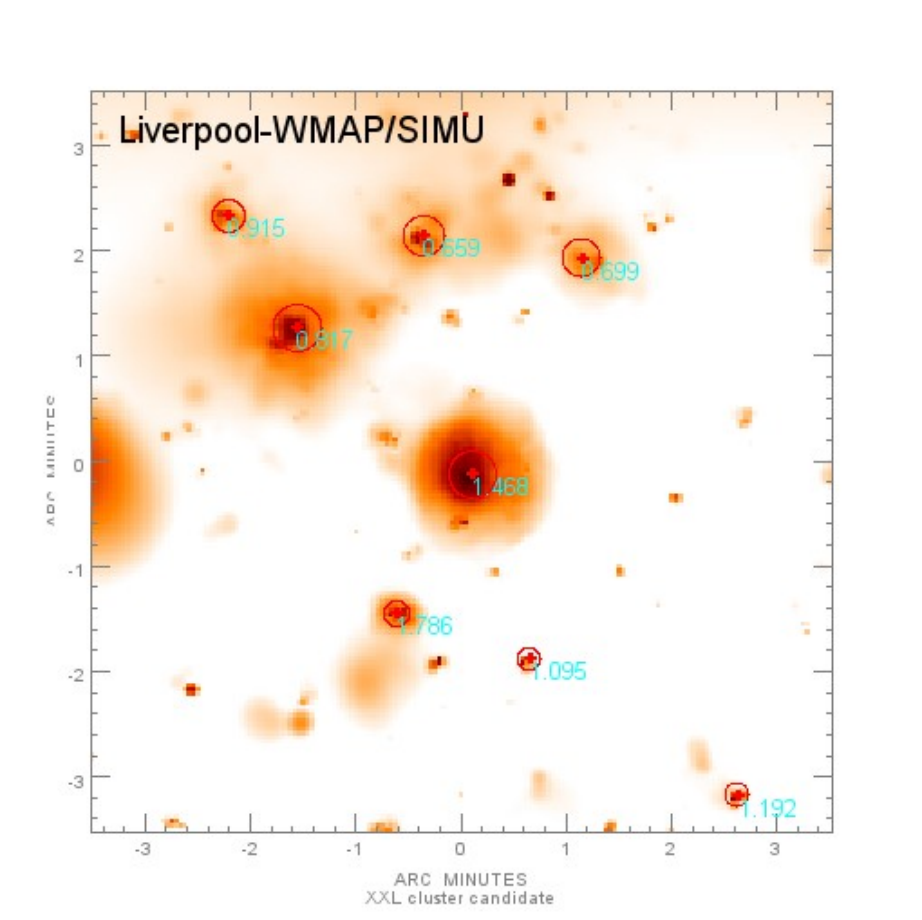

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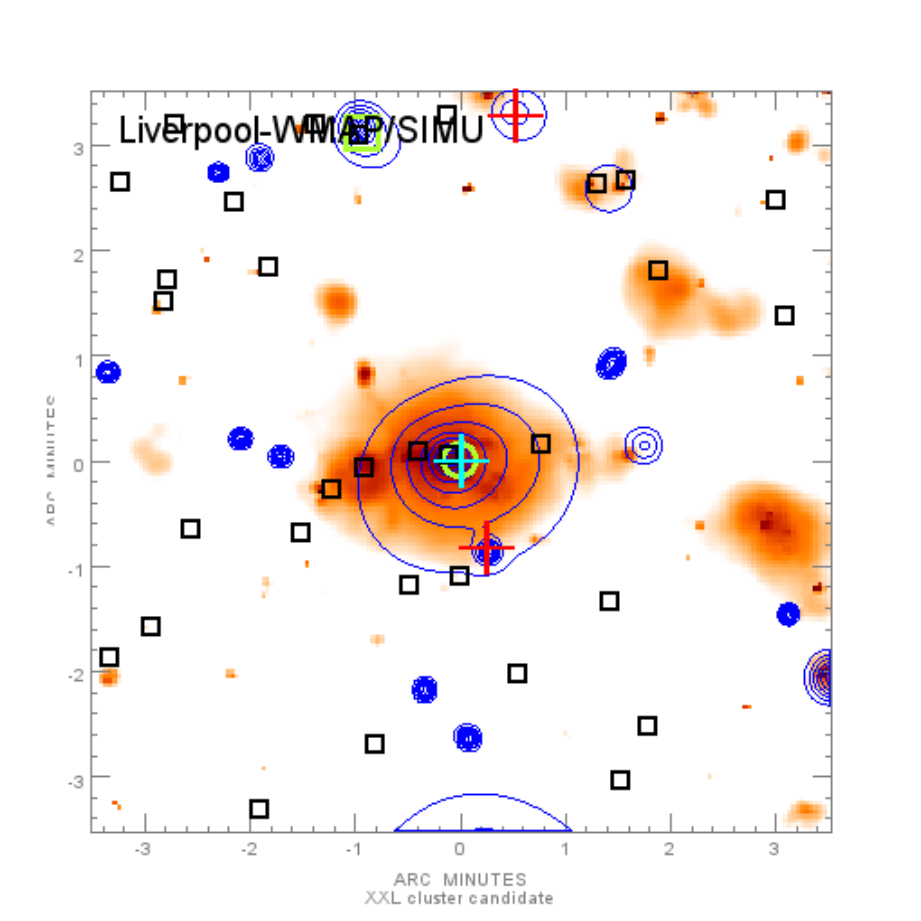

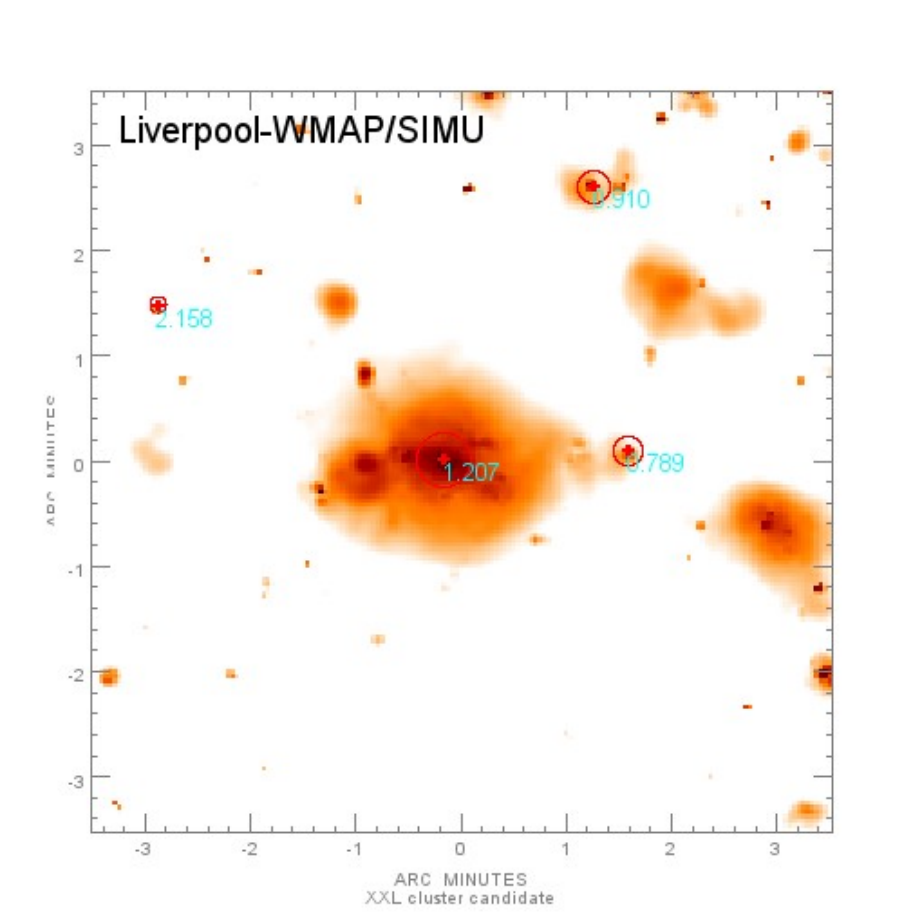

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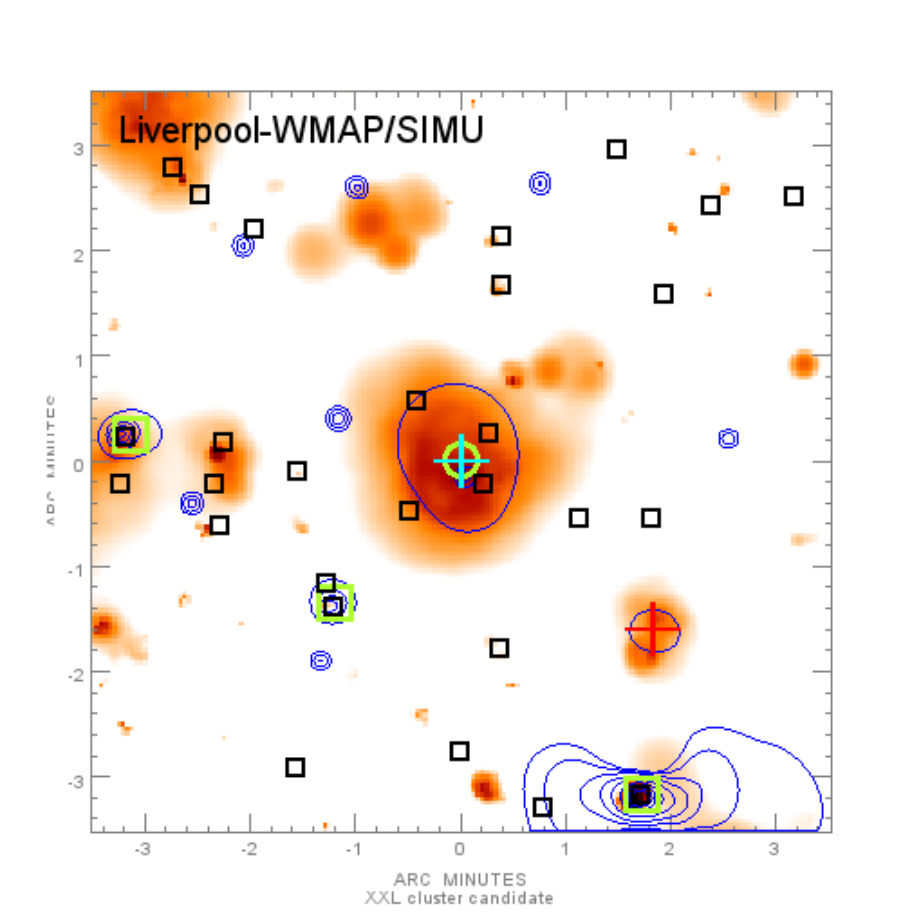

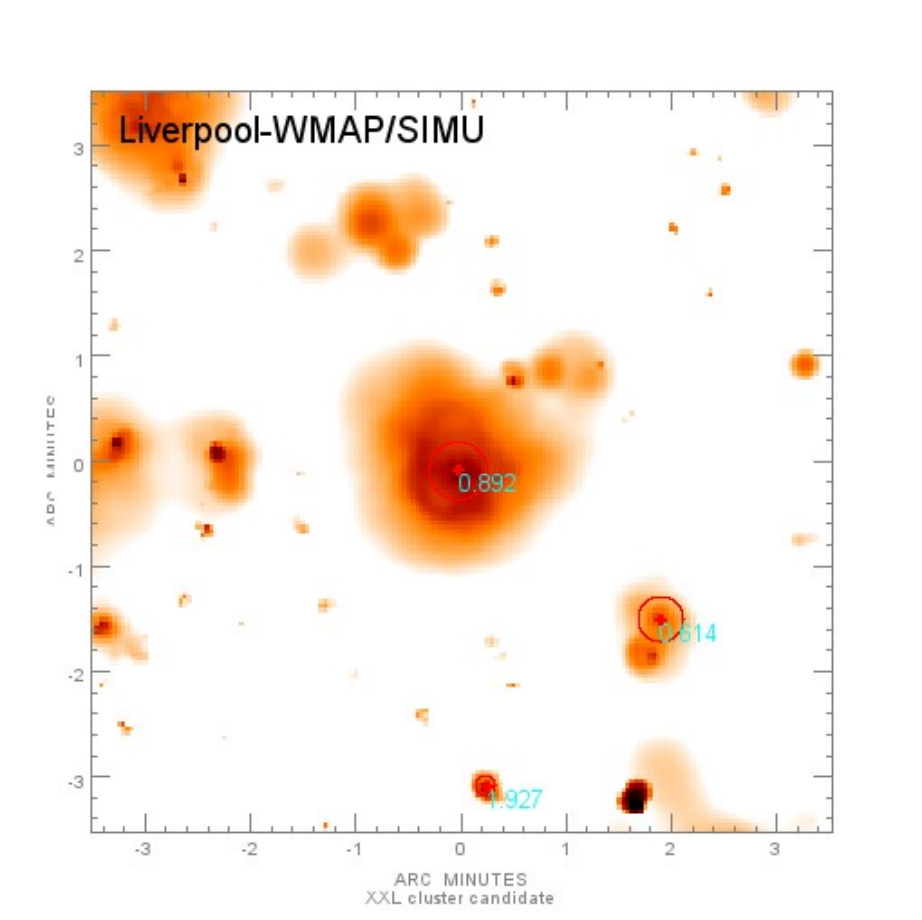

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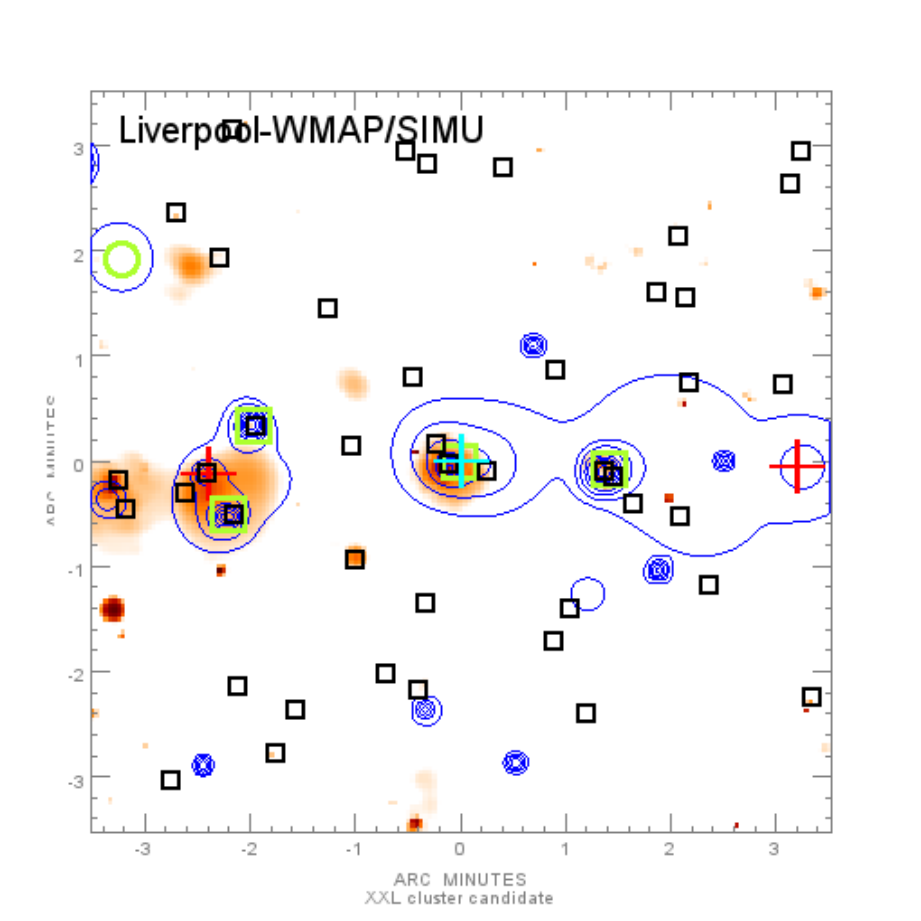

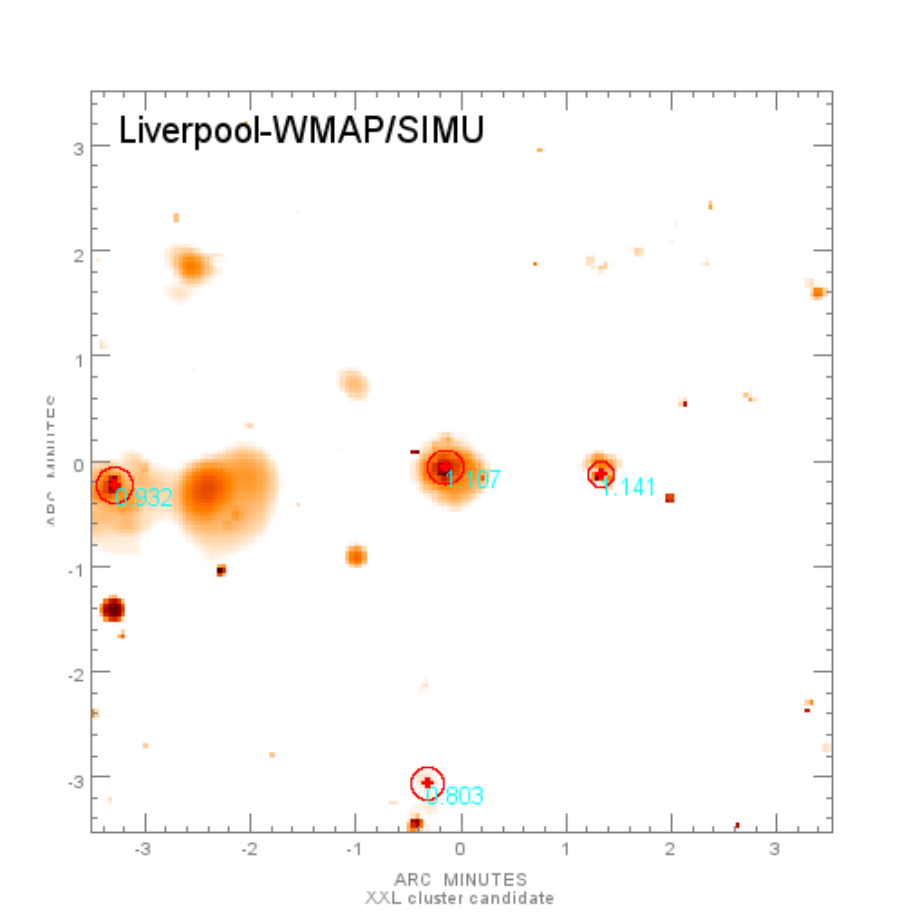

Screening results & PCA analysis

- 167 C1 detections

  9% false.
- 202 C2 detections

  ~50% false

  NOTE: False detections are purely double AGN detections (or single in the random AGN model). Boosted clusters are considered as true detections.

- Using parameters of the single and the double fit (e.g. extension & separation) we run the PCA analysis.
- Separate successfully most of the false detection. False detections are 4%. in the C1 sample.
- Separate successfully many AGN boosted clusters (not detectable otherwise)

Near-future plans

PRODUCTS & TESTS

- To test AGN catalogues using more powerful-AGN models (AGN 8.5 , AGN 8.7?) **DONE**
- To produce AGN catalogues for the available 250 sq. deg. **and screen them. DONE**
- Some more testing:

  Edd. Ratio distr. (Bongiorno+2016)

  HOD, BHMF

SCIENCE

- To calculate the selection function of galaxy clusters and high redshift clusters (z>1).
- To compare the **simulated/real** AGN in the **100 simulated/real** brightest clusters
- AGN science