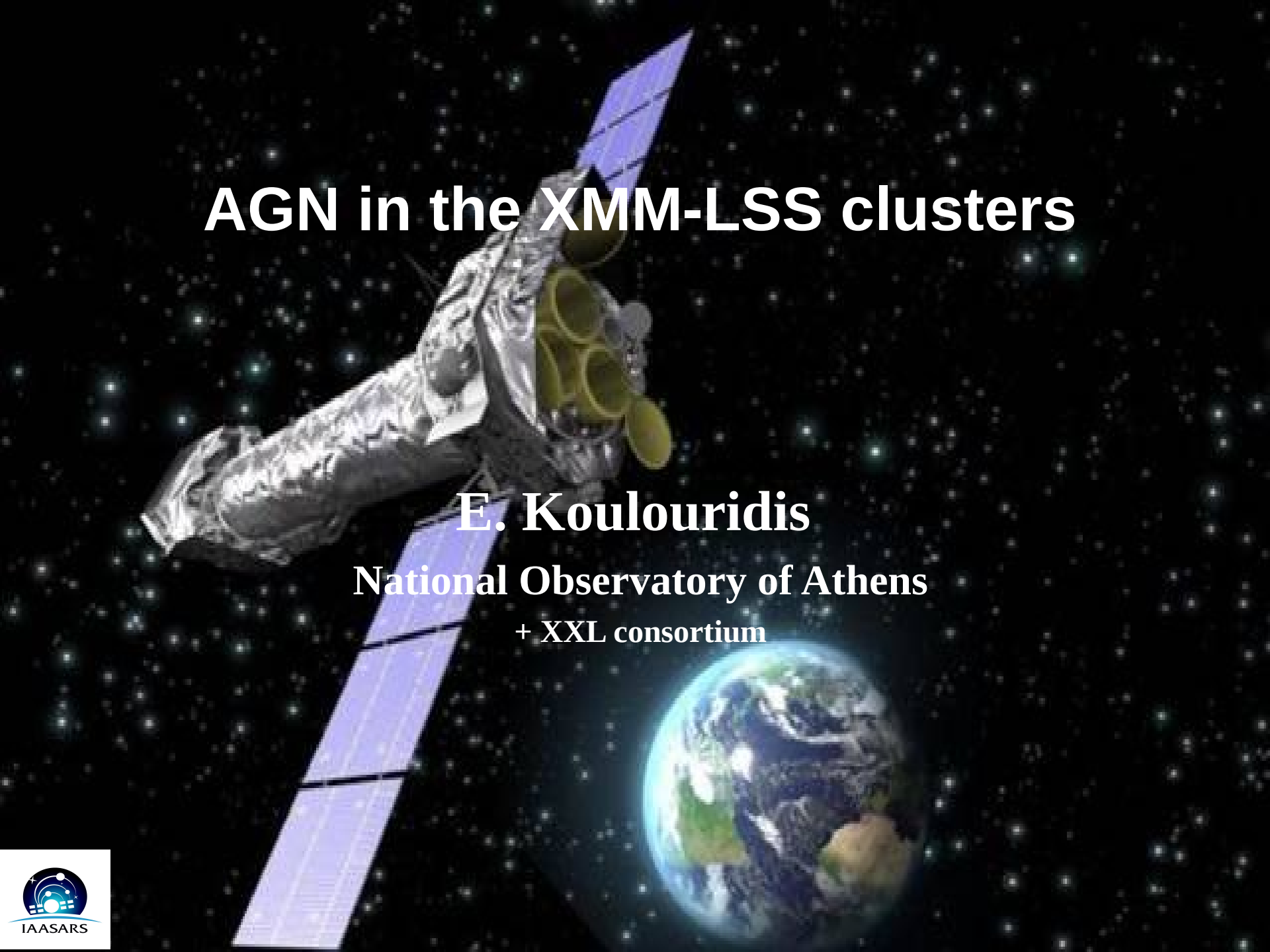
AGN in the XMM-LSS clusters



E. Koulouridis

National Observatory of Athens

+ XXL consortium

Background

- AGN phenomenon requires the gas “feeding” of the central SMBH. Triggering is still a matter of debate.
- Secular evolution, merging and galaxy interactions may play the role of AGN’s “triggering” mechanism.
- Dense environment in the clusters may have an enhancive effect on the triggering but…
- High velocities and dense ICM may also play a role.

Previous Results

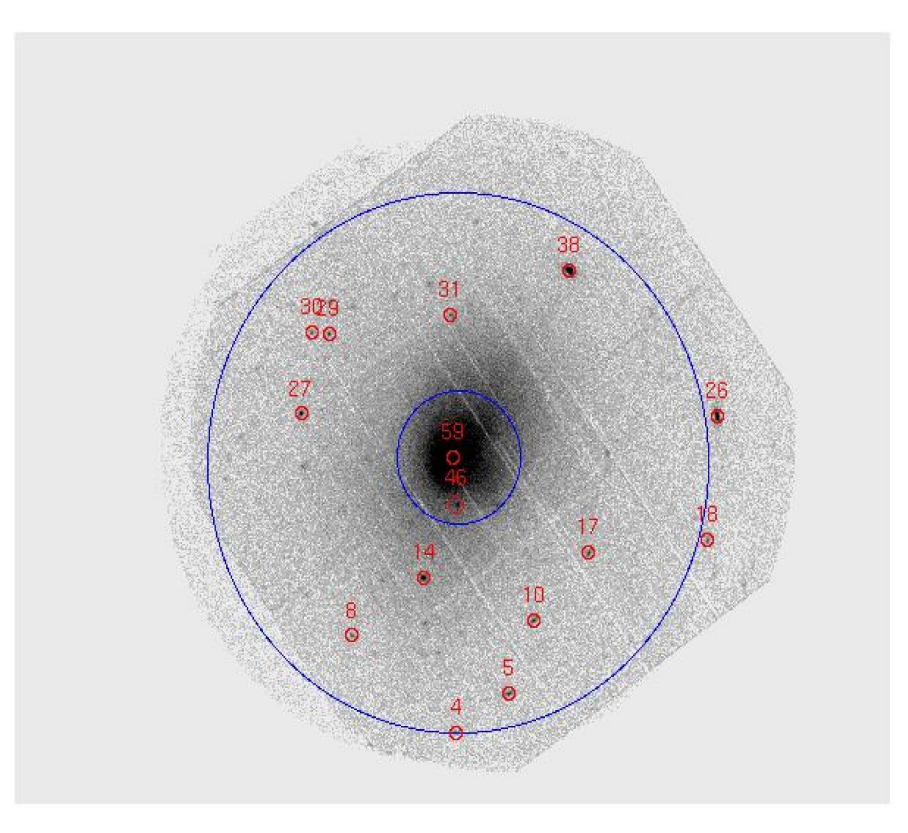
- X-ray point source overdensities reported in the area of clusters (e.g. Cappi et al. 2001; Molnar et al. 2002; D'Elia et al. 2004; Cappelluti et al. 2005; Branchesi et al. 2007; Galametz et al. 2009; Gilmour et al. 2009)
- Spectroscopic confirmation of X-ray sources in some clusters (Martini et al. 2002, 2007, 2009; Johnson et al. 2003; van Breukelen et al. 2009)
- Disconnection of X-ray and optically selected AGN (e.g. Davis et al. 2003; Finoguenov et al. 2004; Arnold et al. 2009)

BUT

Is there an enhancment of AGN activity in clusters with respect to what is expected from the obvious optical galaxy overdensity?

X-ray analysis
(Koulouridis & Plionis 2010)

- Sample of 16 Abell clusters in the SDSS area (>10Ksec).
- Search for X-ray point sources within $3r_c < r < 1$ Mpc and $L_X > 10^{42}$ erg/s at the redshift of the cluster.
- r_c was calculated by adjusting a king's profile to the diffuse emission of each cluster.
- Expected number of sources was estimated by using the logN-logS of Kim et al. 2007.

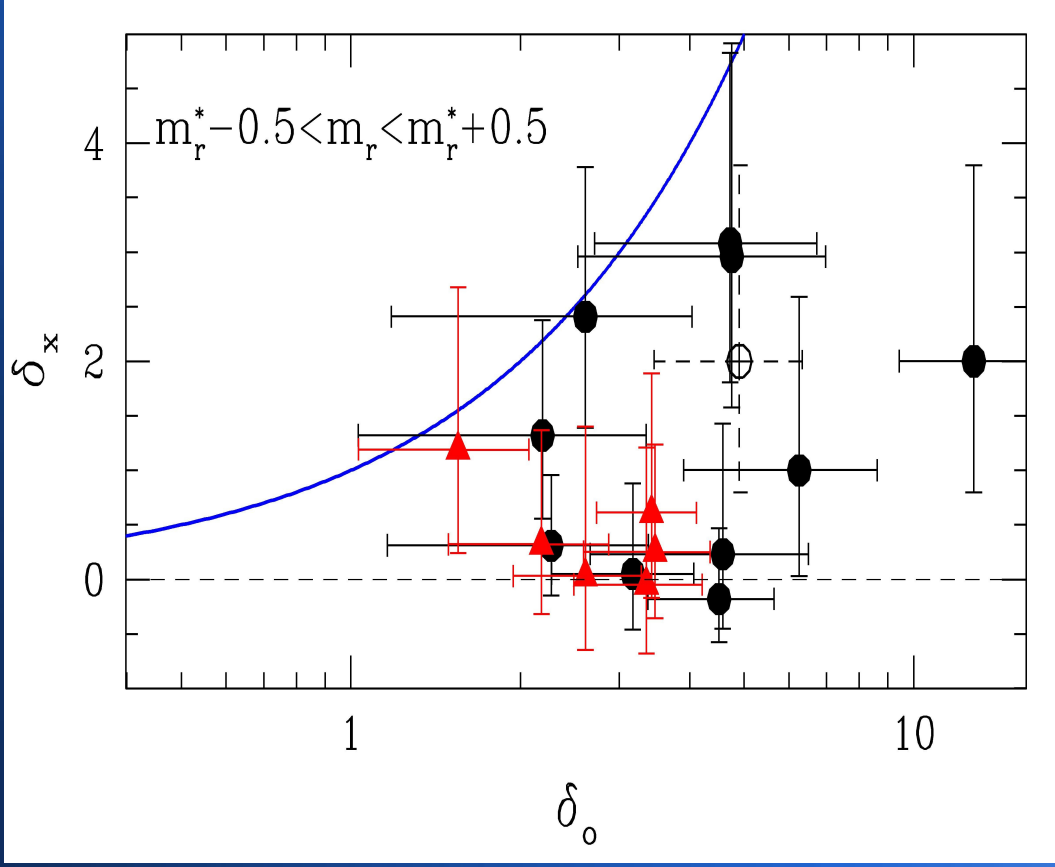


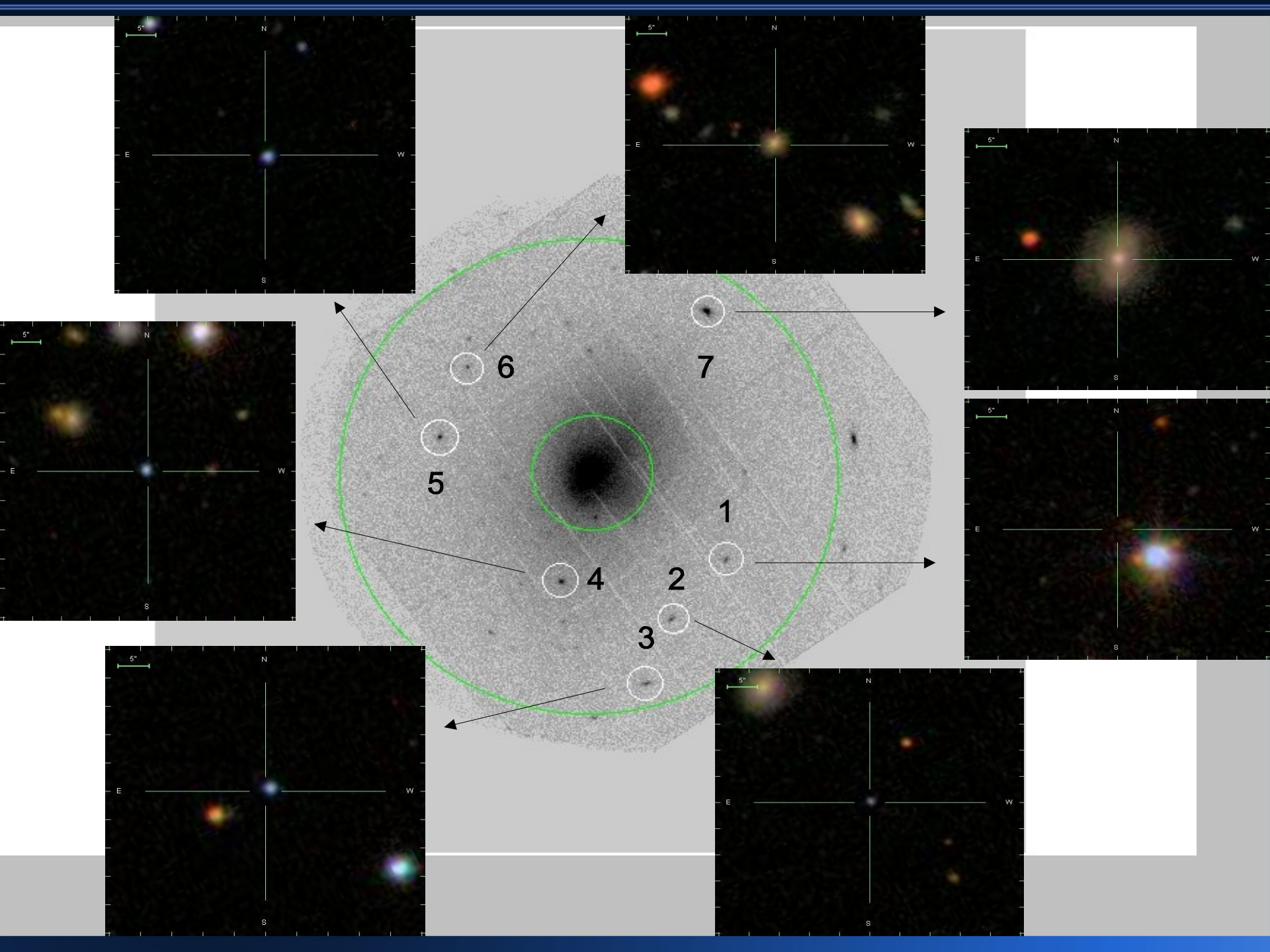
Optical analysis
(Koulouridis & Plionis 2010)

- Search in the SDSS for galaxies with $m_r^*-0.5<m_r<m_r^*+0.5$
- Where m_r^* is the *r*-band magnitude corresponding to M_r^* of the Blanton et al. (2003) luminosity function at the redshift of the cluster.
- Expected number of galaxies was calculated from a 20 deg^2 region near the equatorial coordinate equator.

Optical analysis
(Koulouridis & Plionis 2010)

- Higher optical than X-ray overdensities.
- AGN phenomenon is suppressed in the dense environment of rich clusters.
- Only 6 out of 88 detected X-ray sources are clearly associated with the clusters.




5"
N
E
W
S
1
2
3
4
5
6
7

Possible causes of AGN suppression

Cold gas deficiency because of :

- Ram pressure and/or evaporation caused by the infall through the hot ICM.
- Gas stripping by grazing encounters.

Lack of merging because of

High velocity dispersions

Recent Results

- Hwang et al. 2012 (Abell clusters, SDSS spectroscopy): Investigating morphologies they found that AGN activity is triggered by interactions and merging when the gas supply is available.
- Haines et al. 2012 (26 massive clusters) : AGN are entirely drawn from an in-falling population. No virialized AGN galaxies within the cluster halo.
- Taylor et al. : No X-ray point source has verified redshift within the merging cluster DLSCL J0522.2-4820.

Recent results

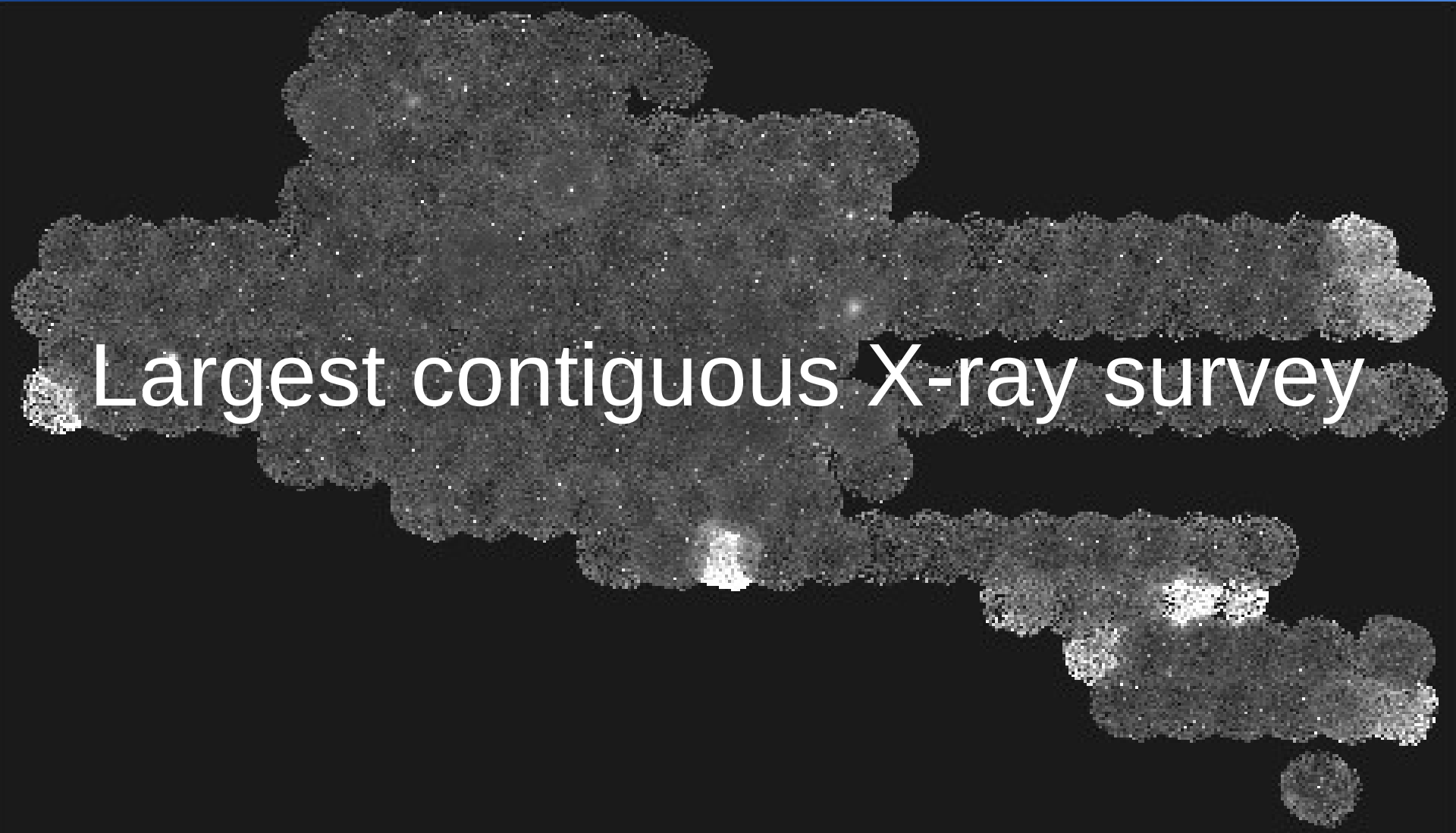
Fassbender, Suhada & Nastasi (2012)

- (22 high-z clusters, 0.9<z<1.6) : 3(soft-band) and 3.5 (hard-band) excess point sources per cluster up to 4Mpc radius (cumulative radial X-ray source counts).
- reported excess <1Mpc and between 2-3Mpc.
- spectroscopic confirmation for some sources in the 2nd hump.
- AGN activity is mostly occurring along the matter in-fall directions (If the elongation of the cluster points to that directions)
- Conclusion : low luminosity AGN within 1Mpc triggered by interactions while the excess in the outer regions is triggered by mergers.

Recent Results

- Martini et al. 2013
- 13 clusters $1.0<z<1.5$
- Sources $L_X>10^{44}$ and 10^{43}
- Above $z>1$ field and cluster AGN are consistent and expected by optical data.
- Redshift evolution.

AGN in the XXL clusters



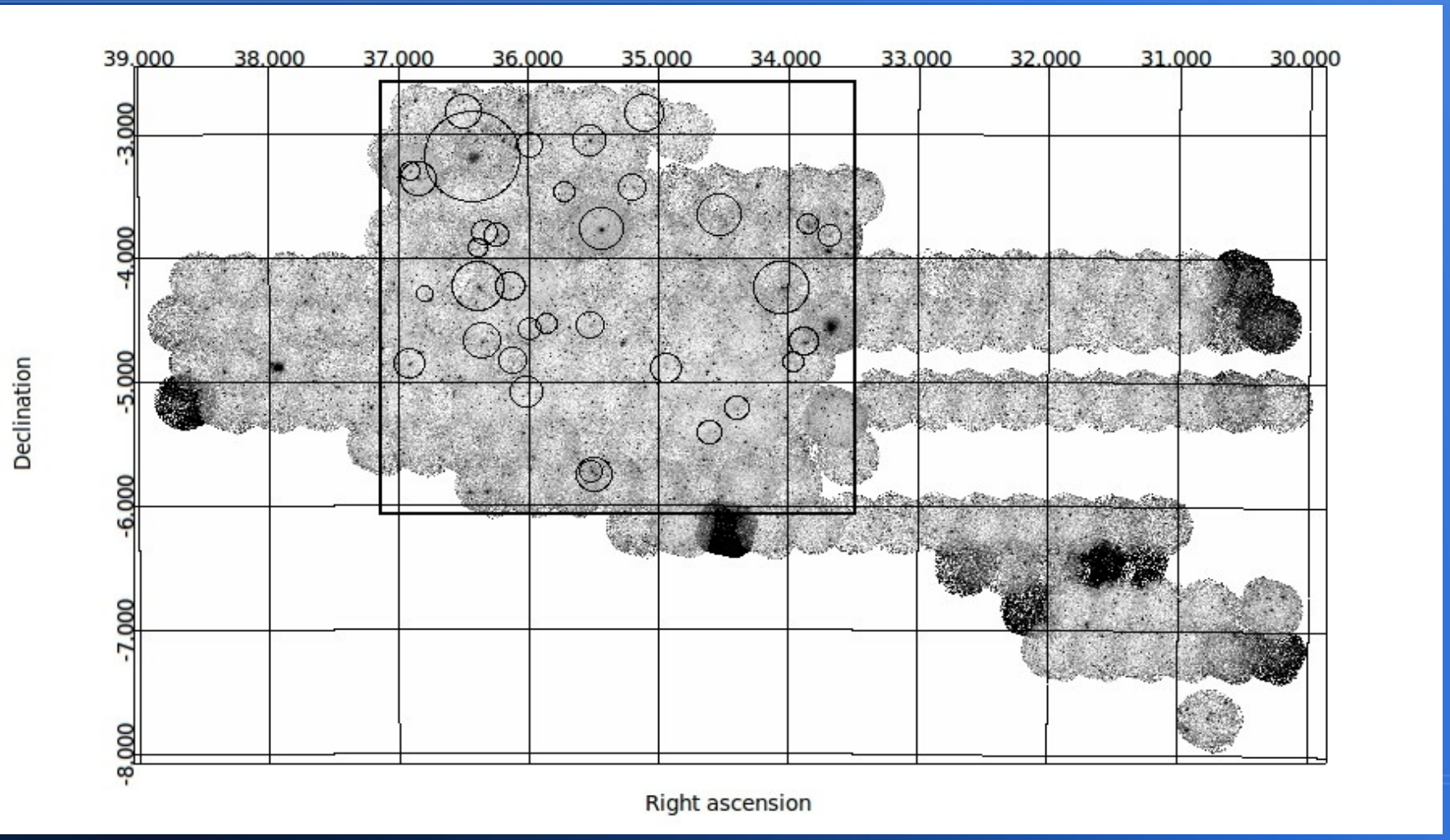
Why the XMM-XXL survey.

- Larger contiguous X-ray survey.
- Complete catalogue of X-ray point sources up to a large distance from the cluster centres.
- Well defined properties of a large fraction of the clusters (e.g. Alshino et al.2010; Adami et al 2010).

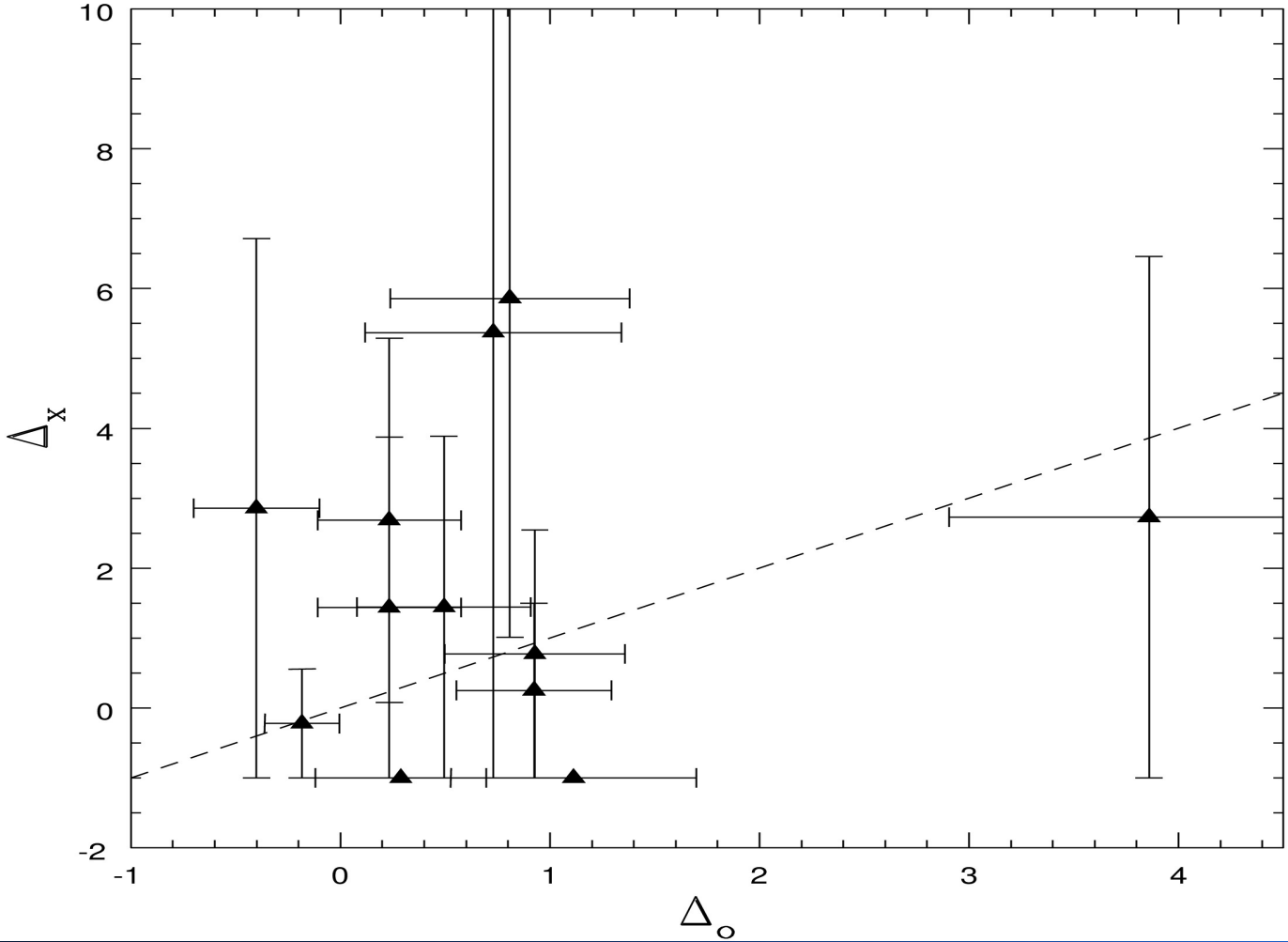
Sample in the XMM-LSS

- 19 clusters below z = 0.33 → AGNs with $L_X > 10^{42}$ detectable everywhere.
- 15 high-z (0.43<z<1.05) clusters.

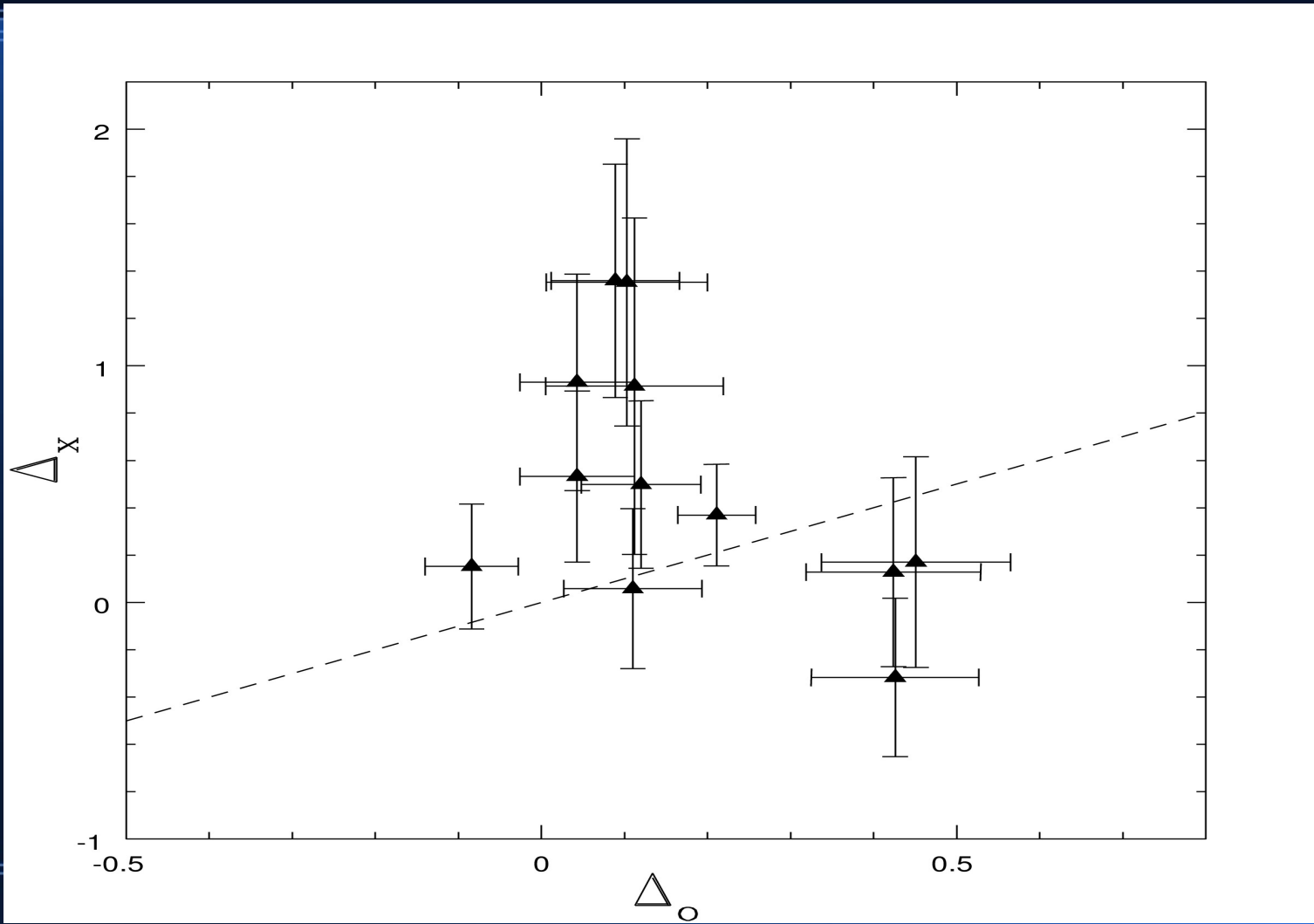
Sample


39.000
38.000
37.000
36.000
35.000
34.000
33.000
32.000
31.000
30.000
-3.000
-4.000
-5.000
-6.000
-7.000
-8.000
Declination
Right ascension

X-ray vs Optical galaxy overdensity up to radius = r500

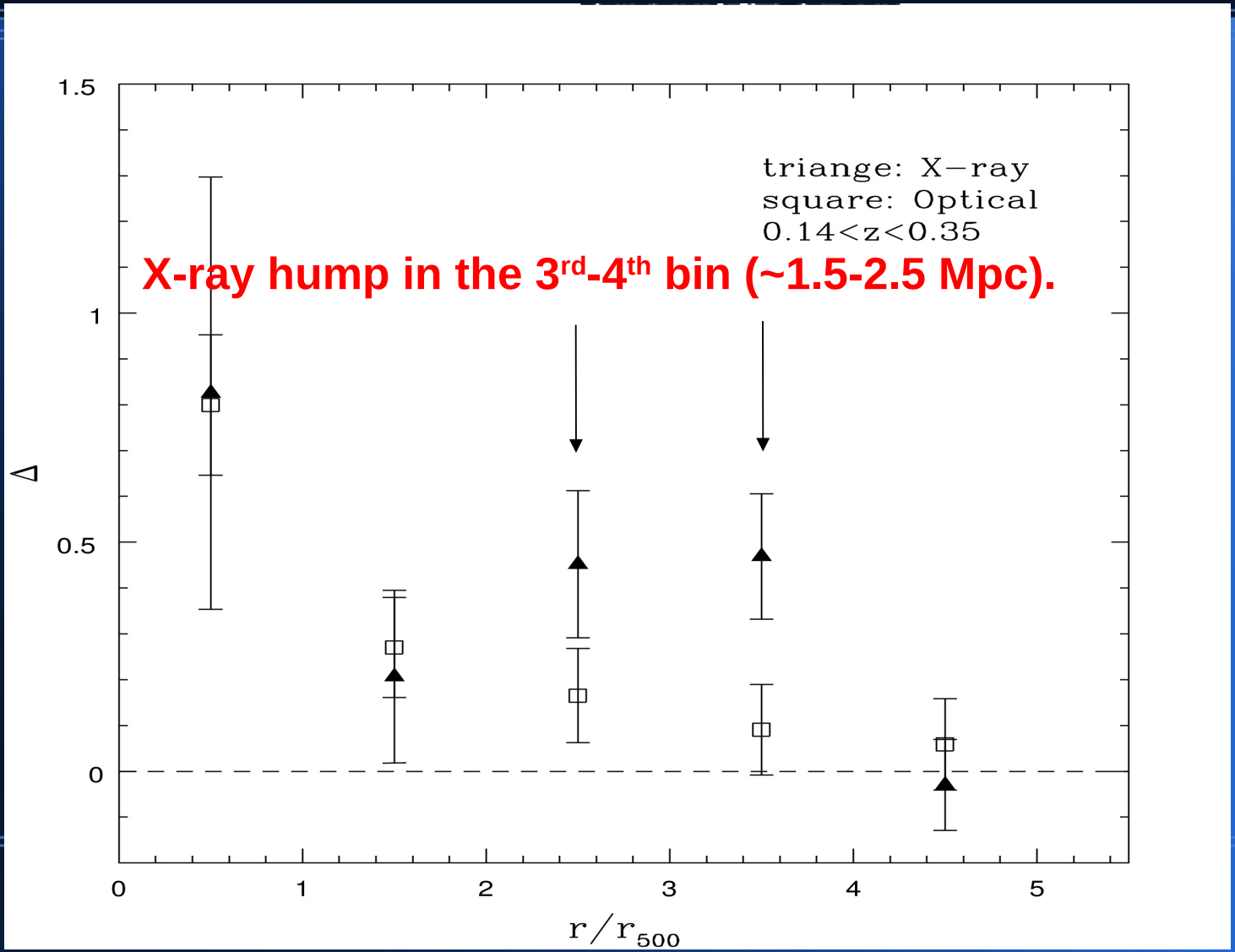


X-ray vs Optical galaxy overdensity up to radius = 4 x r500

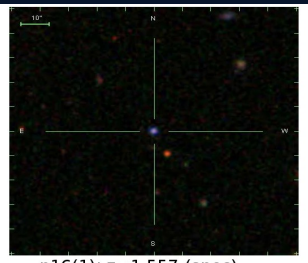


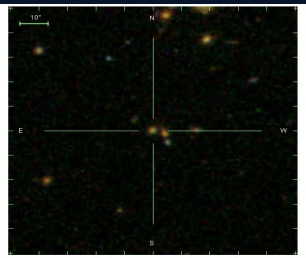
X-ray overdensities within r_{500} annuli using logN-logS by Elyiv et al. (2012). optical overdensities using CFHTLS and SDSS photometric redshifts.

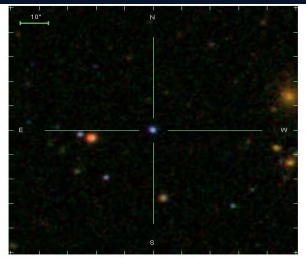
19 low-z (0.14-0.35) clusters.

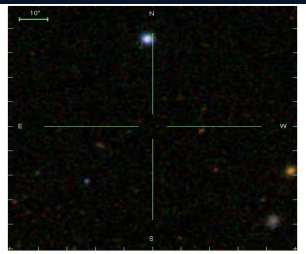


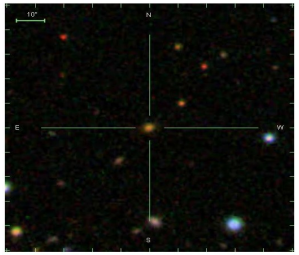
Optical counterparts within r_{500}

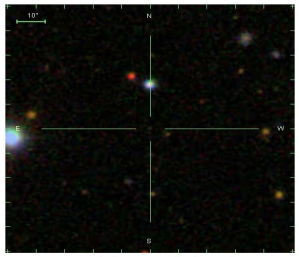

n16(1): z=1.557 (spec)

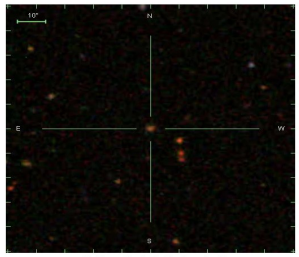

n21(1) : 0.213 (spec)

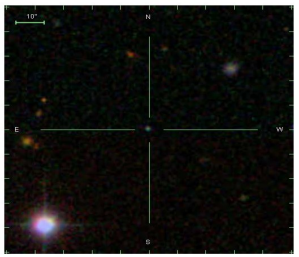

n21(2): 2.310 (spec)

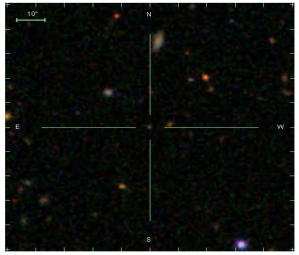

n22(1): 2.46 (photo)

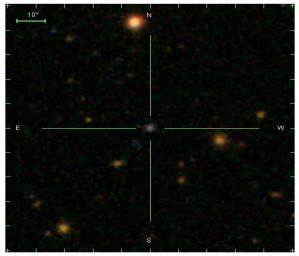

n22(2): 0.265 (spec)

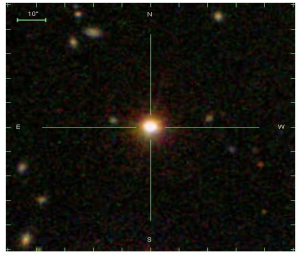

n22(3): 1.98 (photo)

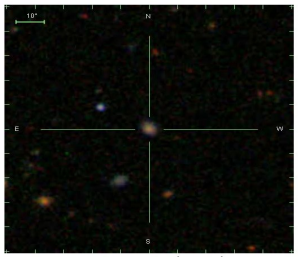

n24 : 0.49 (photo)

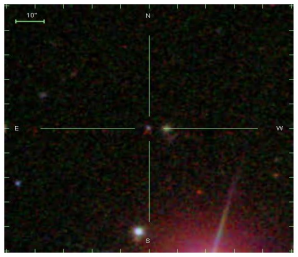

n11(1): 1.05 (photo)

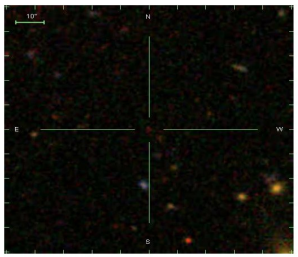

n11(2): 1.17 (photo)

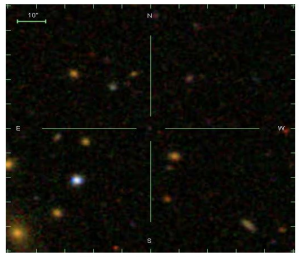

n33: 0.47 (photo*)

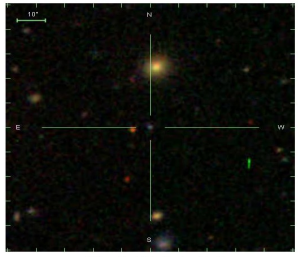

n46 : star


n57: 0.210 (spec)


n53: 1.52 (photo)


n83(1): 1.32 (photo)


n83(2): 1.45 (photo)


n91: 1.11 (photo)