Clustering properties of AGNs in the XMM-LSS field

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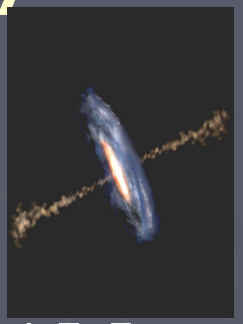
Importance of the deep surveys

- The description of the objects along the wide range of
  - redshifts "time machines"
  - luminosities
- Rich statistics of the different types of objects

- Large Scale Structure studying
- Cosmological parameters
- Measurements of AGN evolution
- Environment of different types of AGN
- Relation between AGN activity and dark matter halo hosts

Types of objects in X-ray surveys

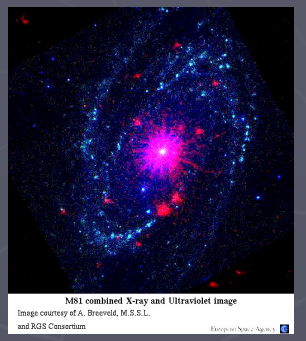
- Obscured and Unobscured AGN



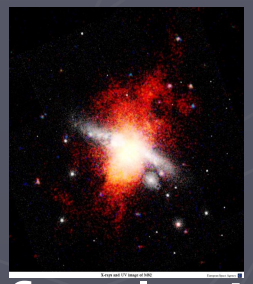
- Optically faint X-ray sources

z ≈ 1.5–5

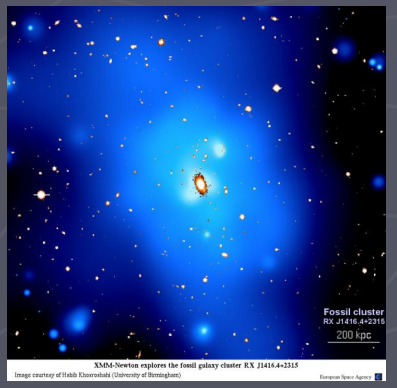
- X-ray bright, optically normal galaxies



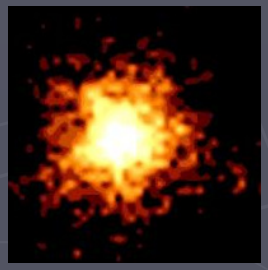
- Starburst galaxies



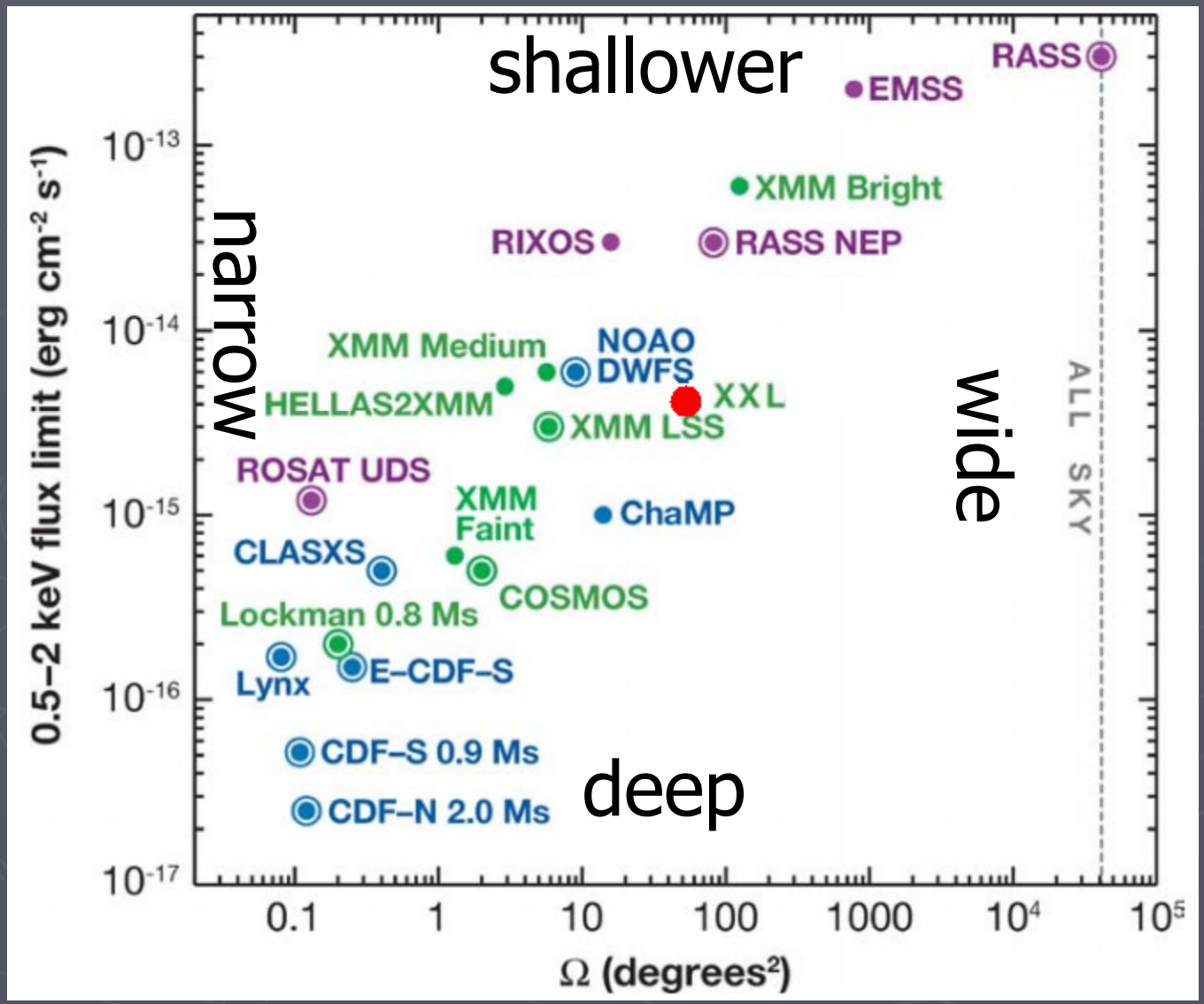
- Groups and clusters of galaxies



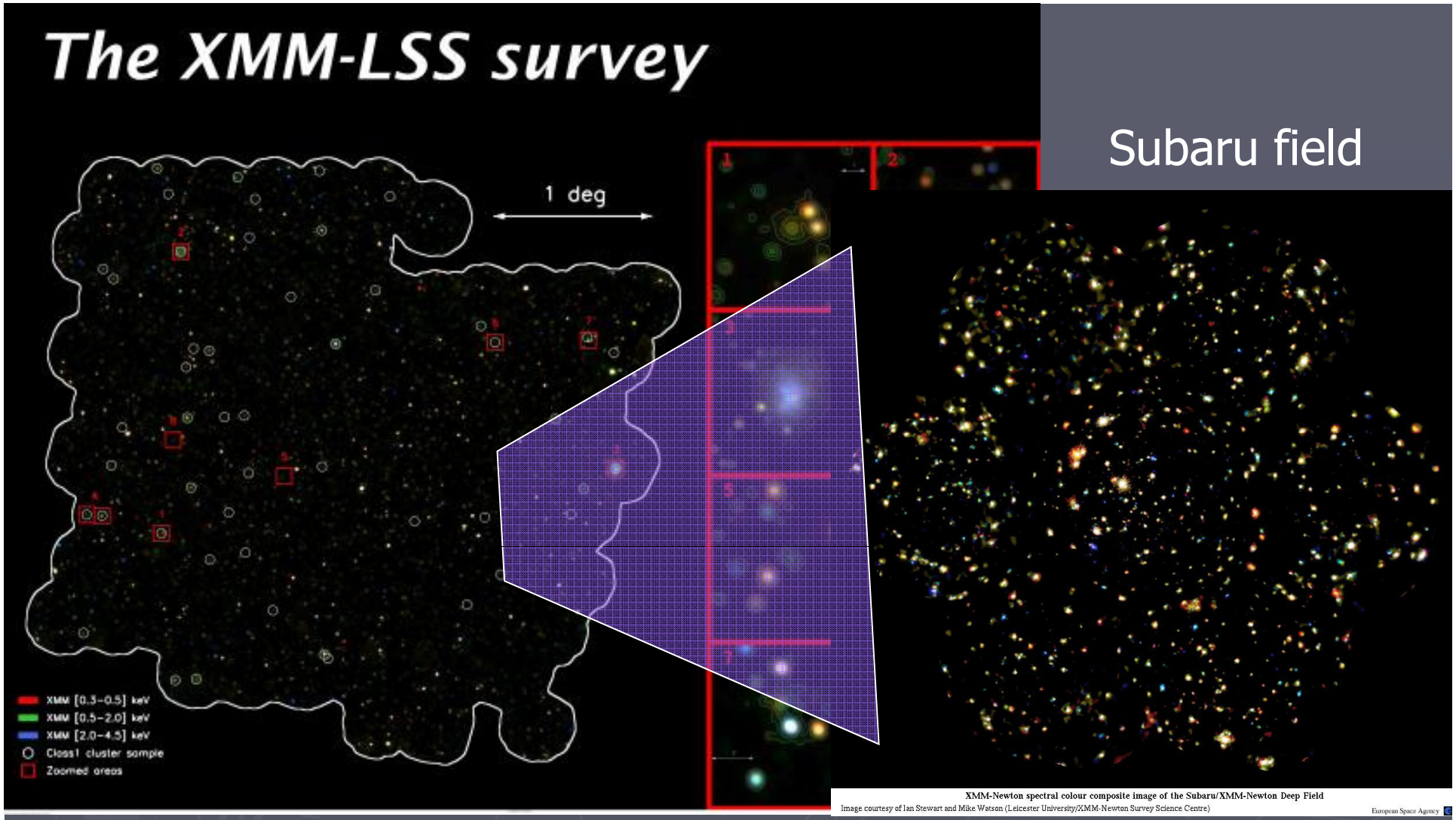
- Galactic stars



XMM and Chandra surveys



The XMM-LSS survey



Subaru field

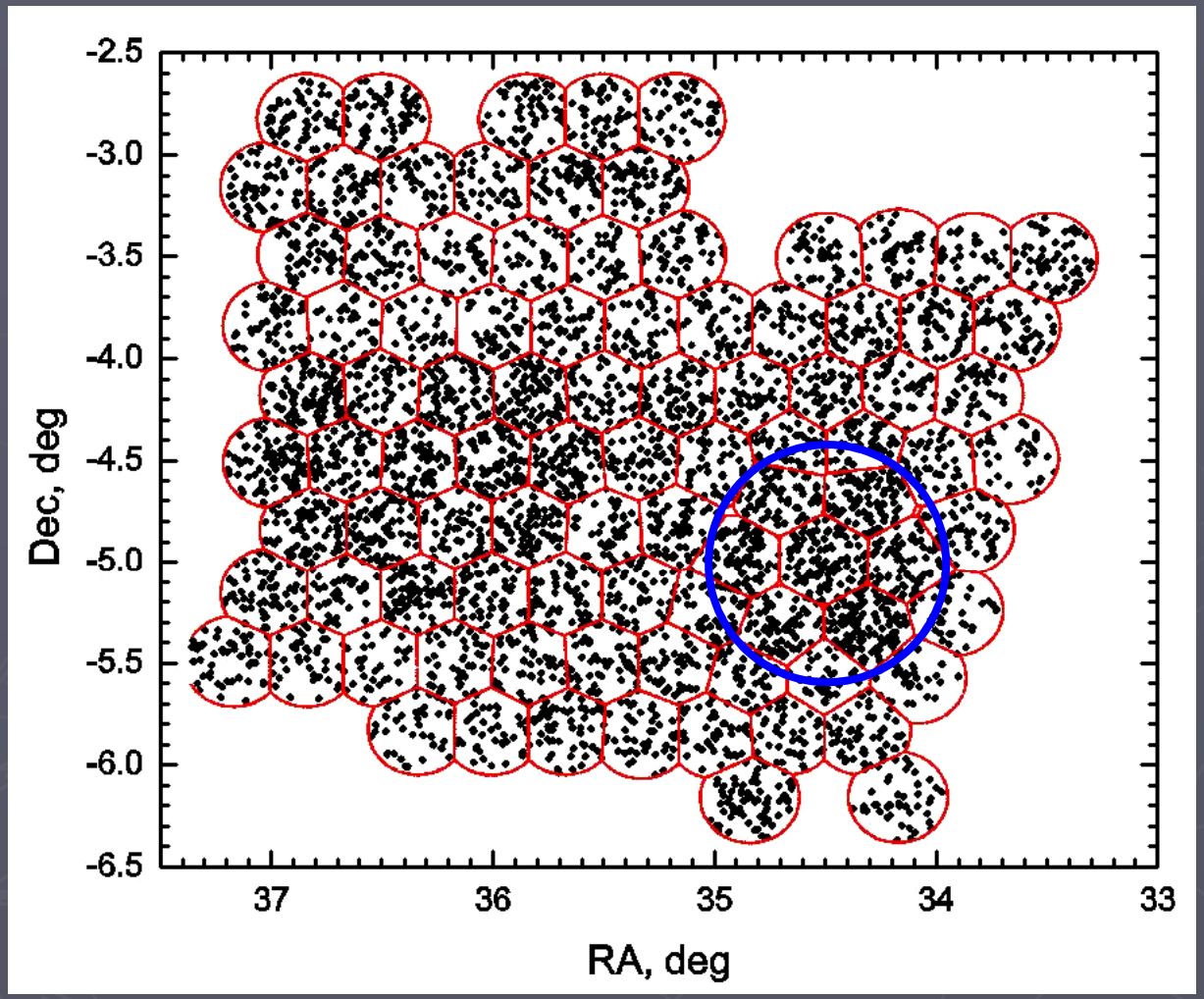
XMM-Newton spectral colour composite image of the Subaru/XMM-Newton Deep Field
Image courtesy of Ian Stewart and Mike Watson (Leicester University/XMM-Newton Survey Science Centre)
European Space Agency

high galactic latitude, near celestial equator

11 deg^2 field; 87 observations from the XMM-LSS program, ranging from 8 to 23 ks,
7 from the Subaru Deep Survey, ranging from 16 to 47 ks.

Near 7.000 sources, most of them are AGNs or stars (point-like sources),
the others are mainly clusters of galaxies (extended sources).

Point-like sources in soft band

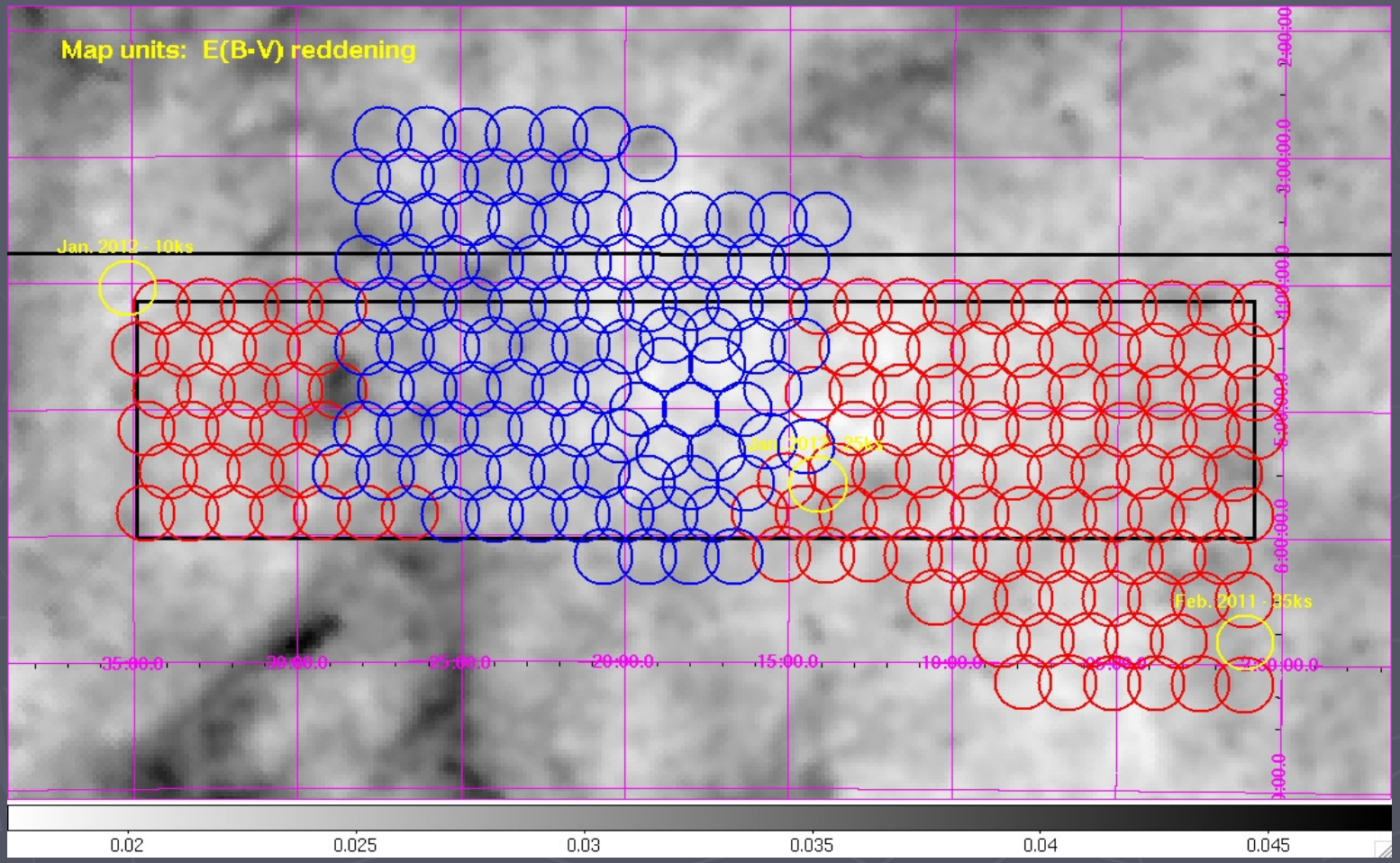


5094 AGN in the soft band (0.5 -2 keV) $S>10^{-15}$ erg s^{-1} cm^{-2}
2370 AGN in the hard band (2 – 10 keV) $S>3\cdot10^{-15}$ erg s^{-1} cm^{-2}

XXL: Overview

- In December 2010, the XXL survey, an XMM-Newton Very Large Programme, has been granted time to map two extragalactic regions of 25 deg^2, (using 10 ks observations).
- Main science goal: the equation of state of the dark energy from clusters of galaxies
- Large Scale Structure studying using AGNs population

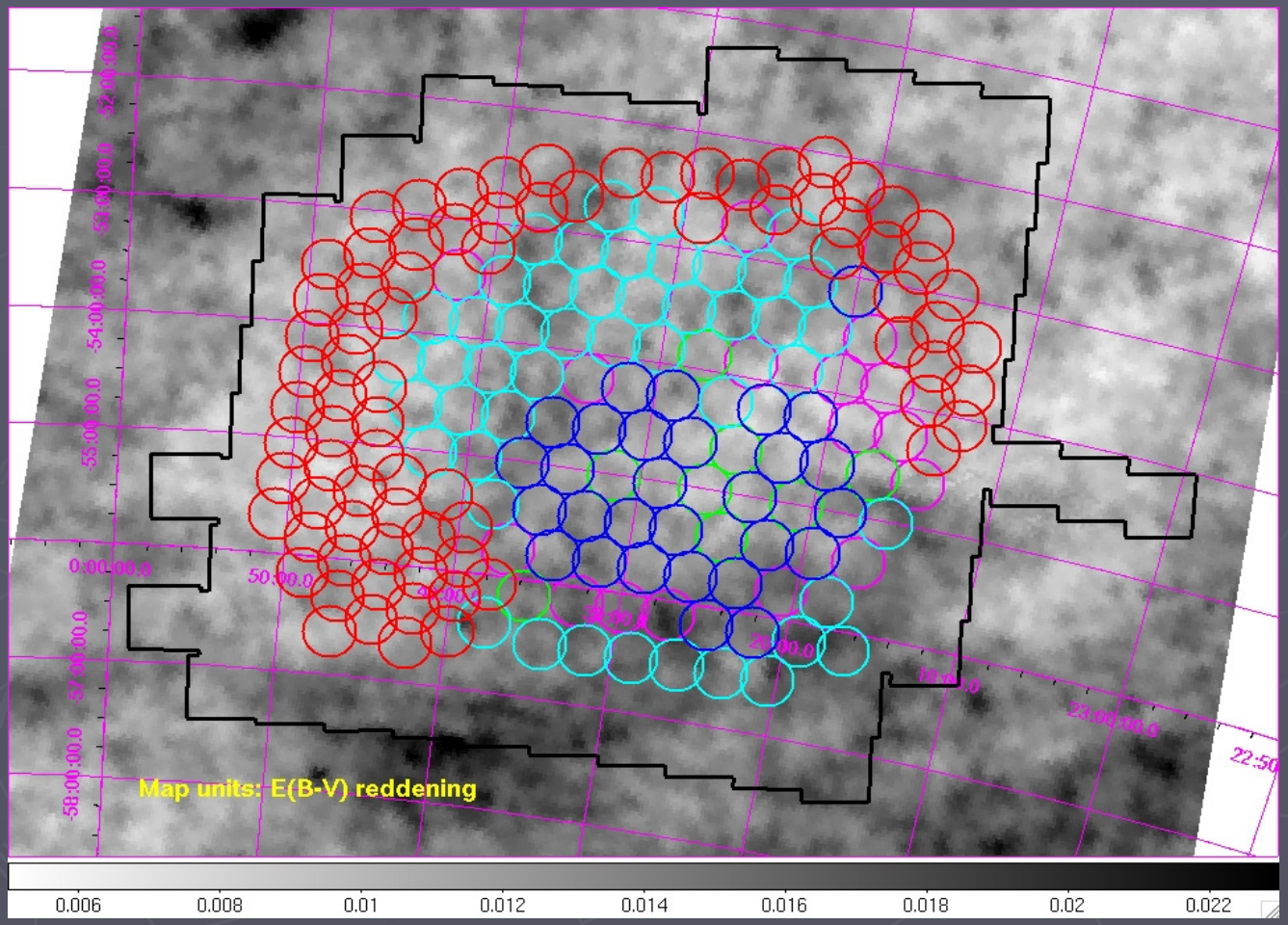
First field 25 deg^2 2h23 -5d00
(extension of the XMM-LSS field)



In red: the new observations (126)

$\Delta\alpha = \Delta\delta = 20'$ everywhere

Second 25 deg^2 field 23h30 -55d00
(extension of the XMM-BCS field)



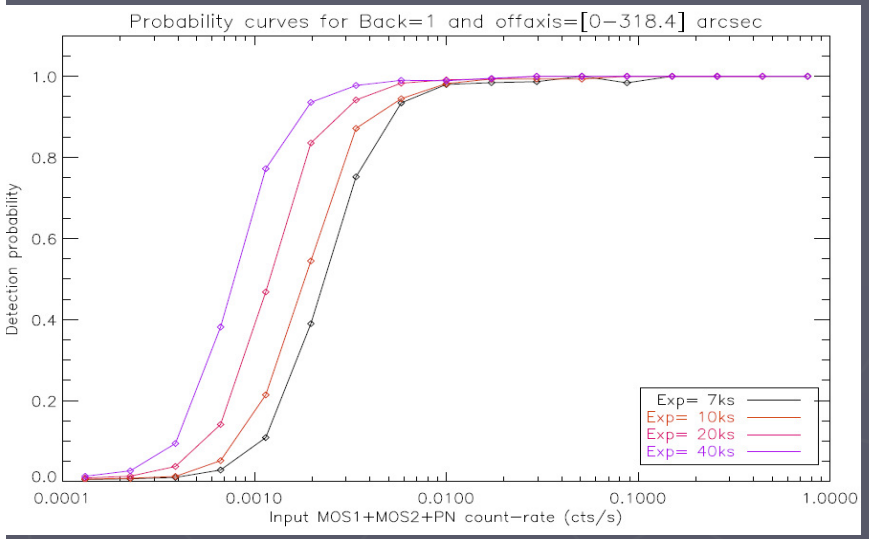
In red: the new observations (80)

$\Delta\alpha = \Delta\delta = 20'$ ($\Delta\alpha = \Delta\delta = 23'$ in the initial central survey)

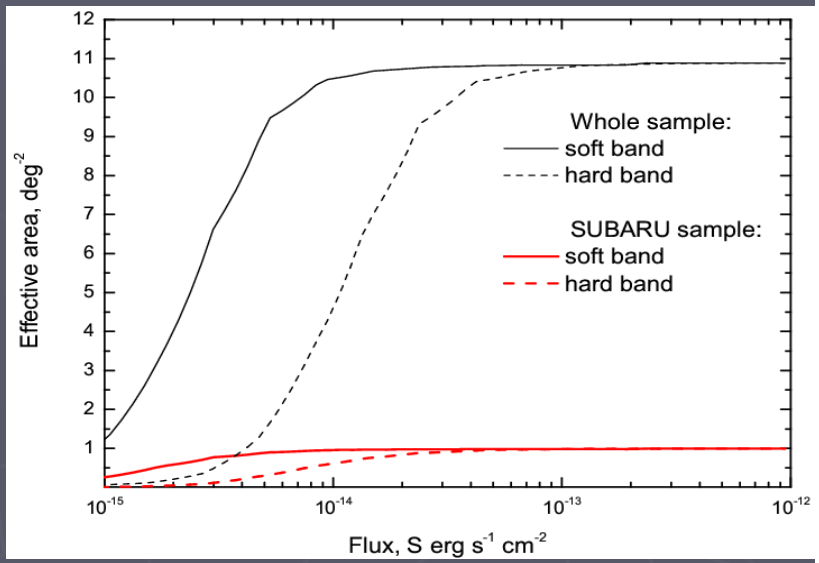
AGN 'hot topics'

- Large Scale Structure
- The studying of the cosmic network underlined by clusters of galaxies and AGN distribution
- Angular and space clustering of the different types of the AGNs
- Relation between AGN activity and dark matter halo hosts
- Distant / Exotic AGNs
- The statistic of lensed QSOs

Properties of the XMM-LSS field

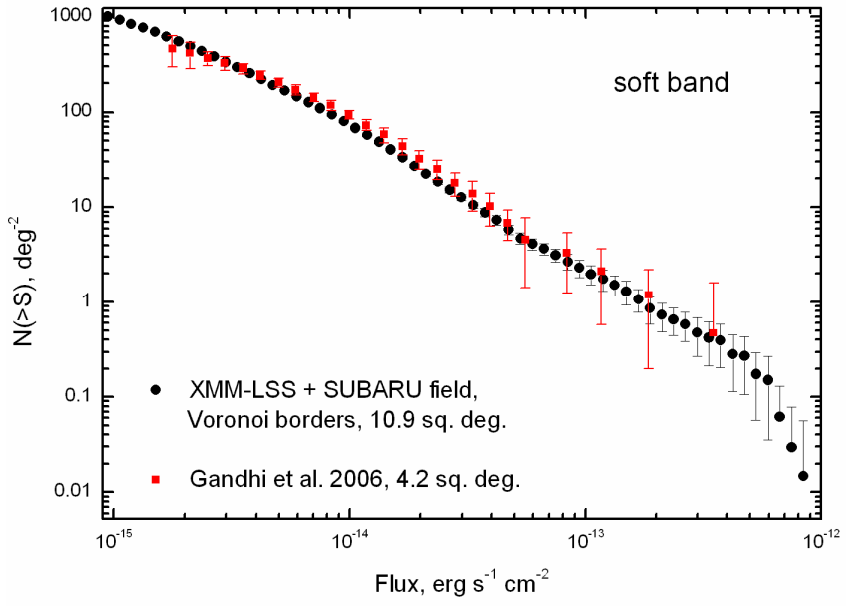


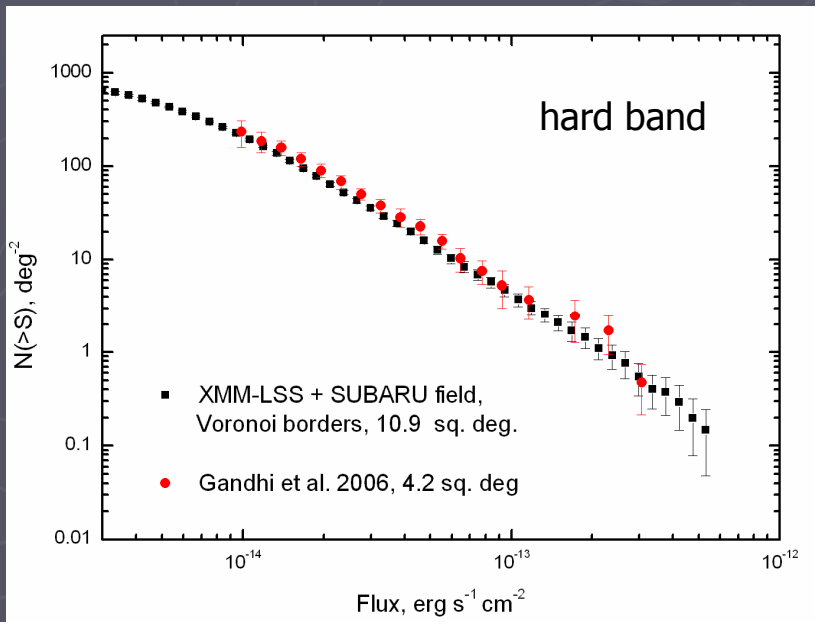
detection probability



area curves

Log(N)
-Log(S)





Procedure of CF determination

Main steps:

- to reconstruct the true Log(N)-Log(S) distribution
-to generate the random catalogs according to flux distribution taking into account the detection probability and flux redistribution

$$\omega(\theta) = f\frac{DD(\theta)RR(\theta)}{DR(\theta)DR(\theta)} - 1$$

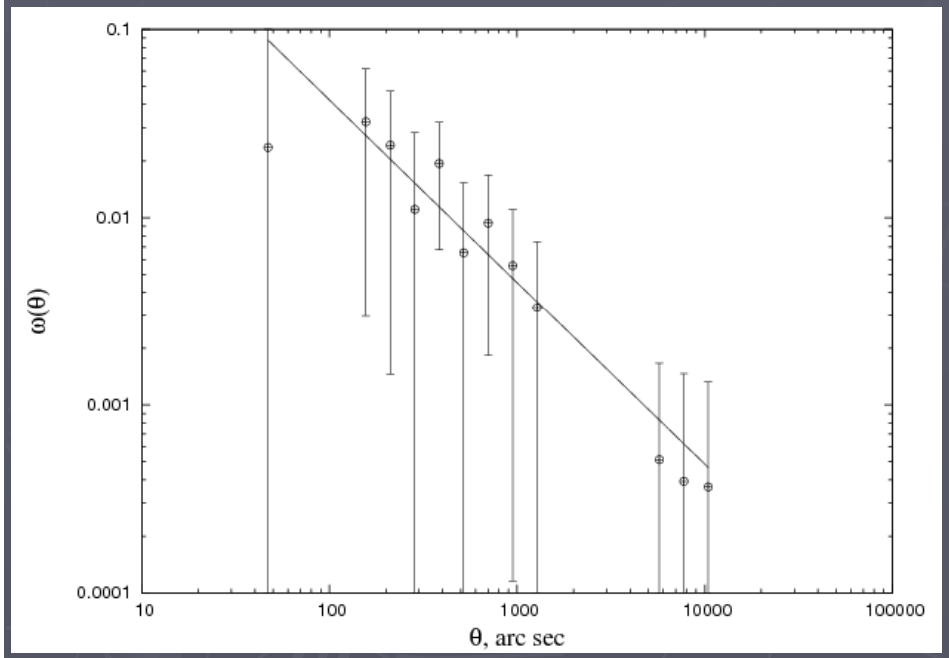
Two-point correlation function (Hamilton 1993)
DD(θ) – number of pair from real catalog with size in the range [**θ**, **θ**+d **θ**]
RR(θ) – average number of pair in random catalogs
DR(θ) – average number of data-random pairs

$$\omega(\theta) = (\theta_0/\theta)^{\gamma-1}$$

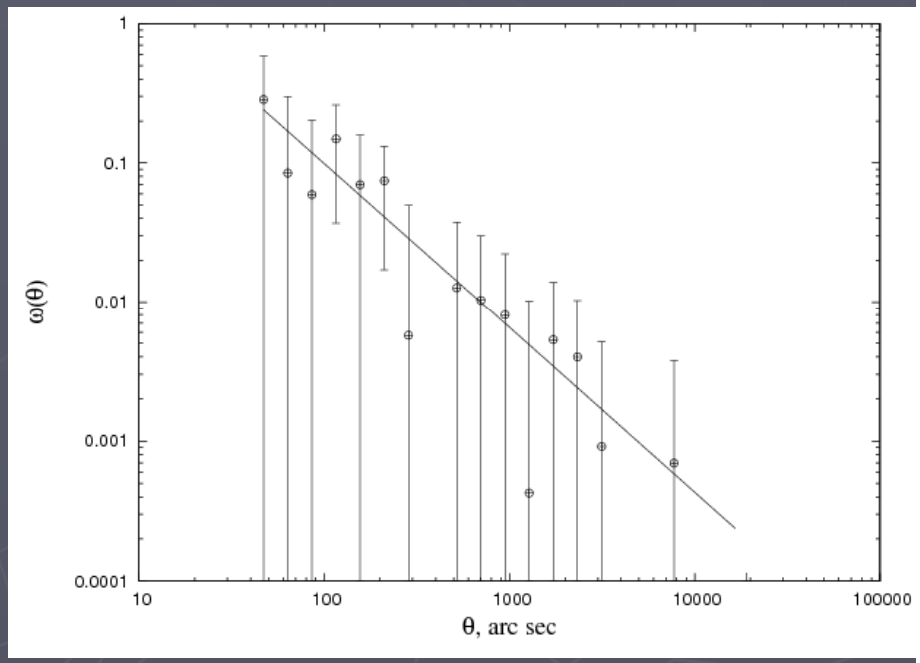
Power-law fitting of the correlation function

Correlation function

Soft band

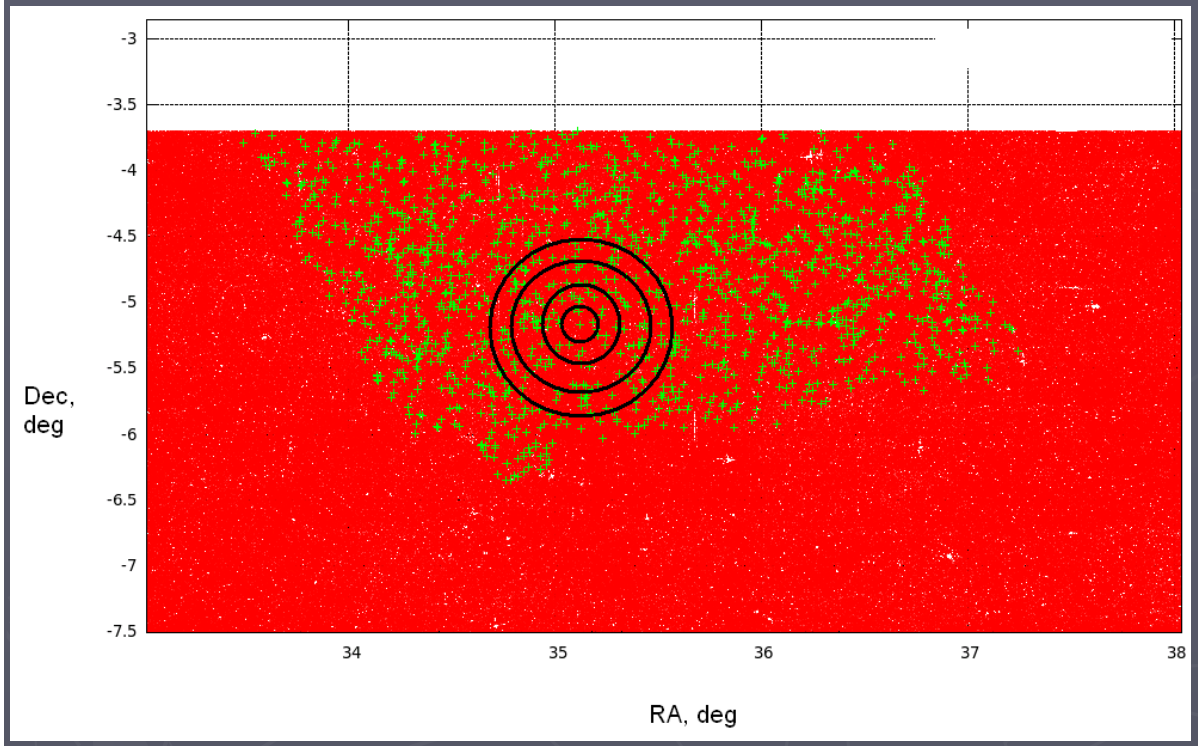


Hard band



Band	θ_0, ”	γ
soft	3.82 ± 0.46	1.97 ± 0.02
hard	14.07 ± 1.91	2.18 ± 0.05

Environment of the AGNs from XMM-LSS



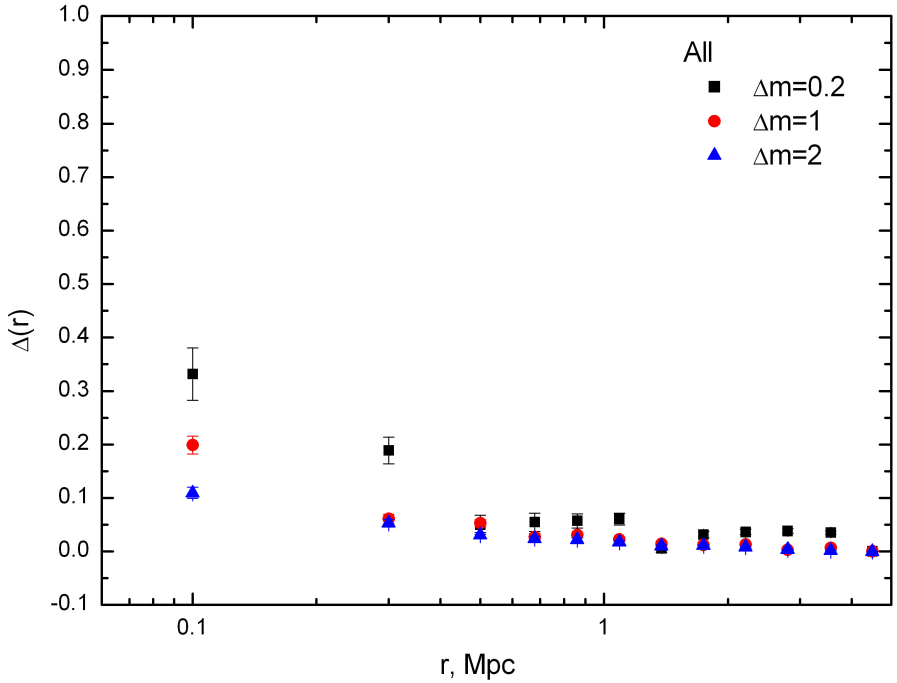
$$\Delta(r) = \frac{\rho(r) - \langle \rho \rangle}{\langle \rho \rangle}$$

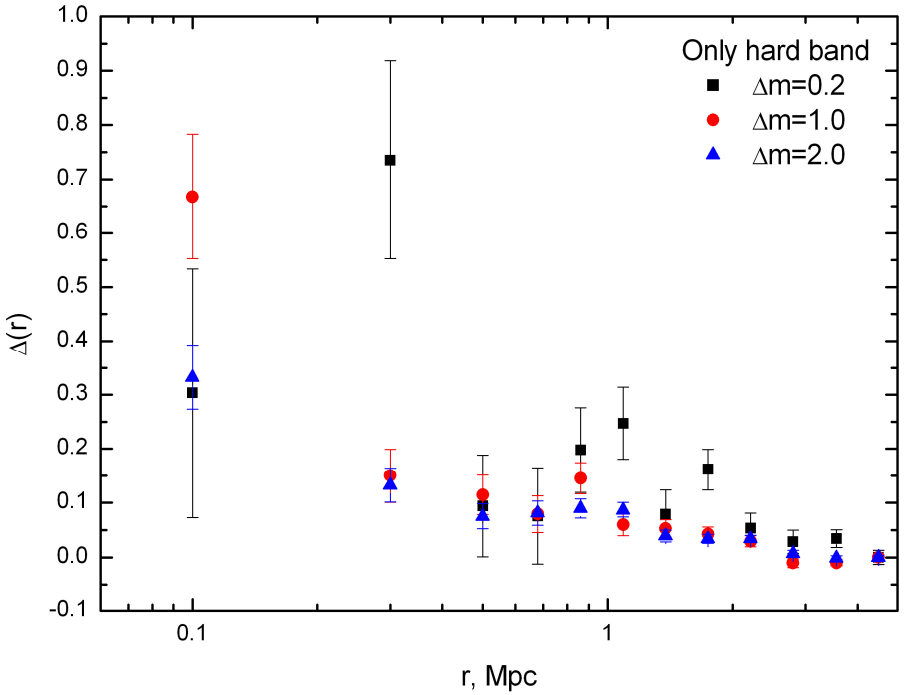
Selection criteria:

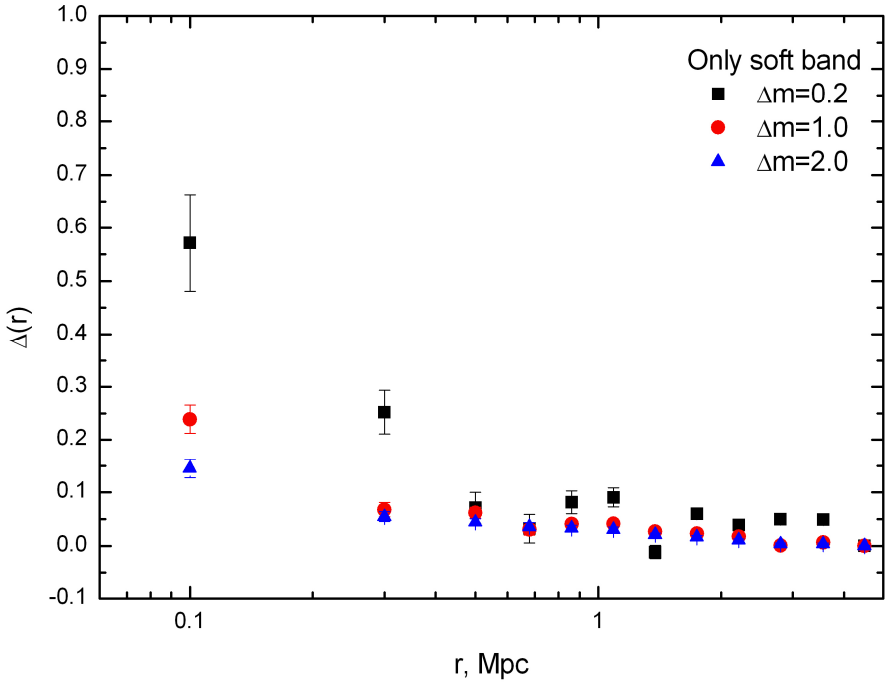
1. magnitude range Δm (0.2, 1, 2)
2. redshift range Δz (2σ, 3σ)

Red dots - CFHTLS i-band field
Green dots - 1534 AGNs with known spectro- or photo-redshifts

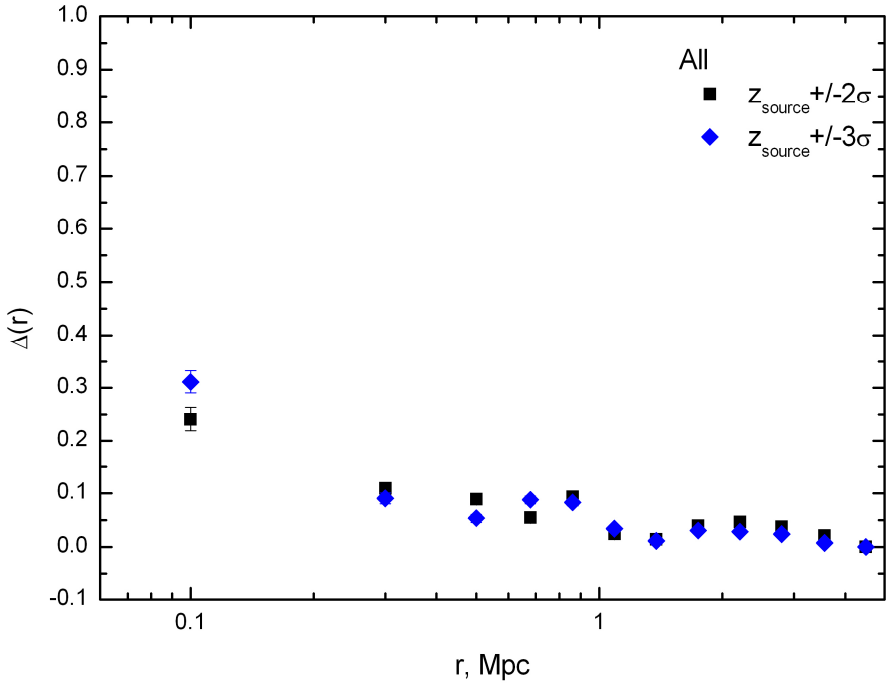
Magnitude range selection

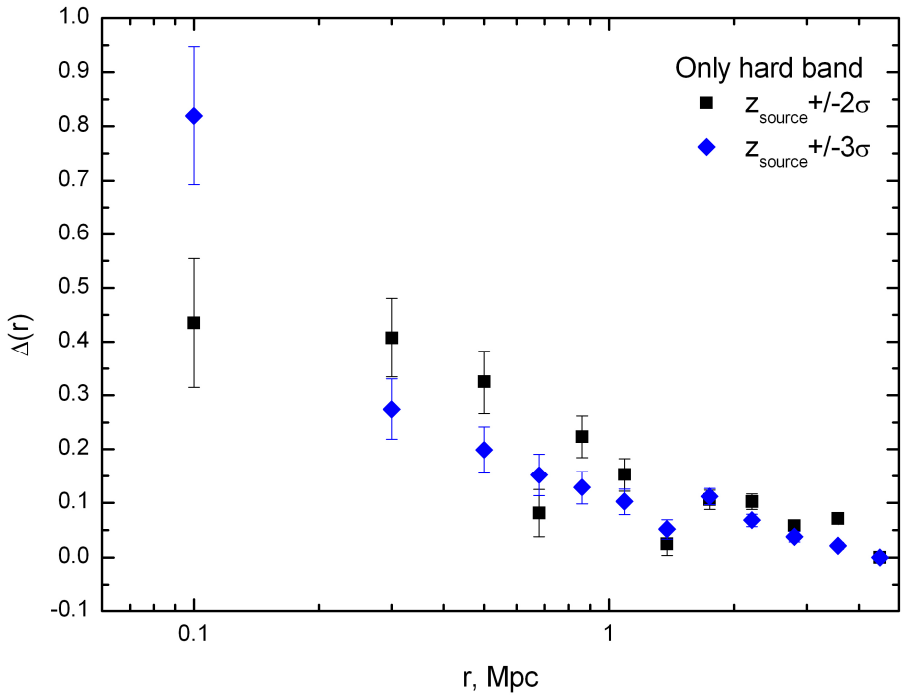


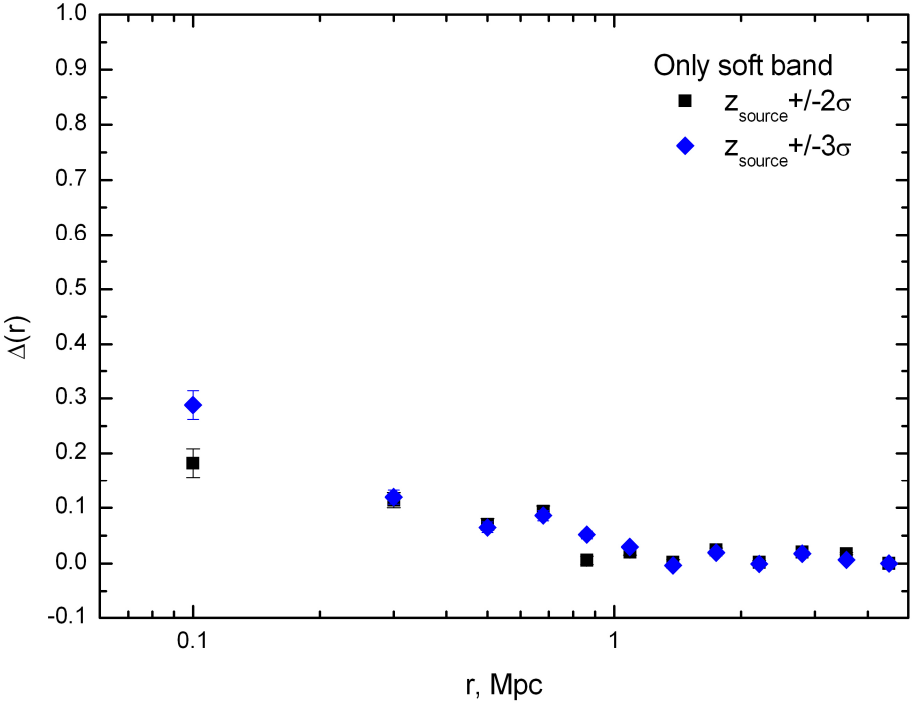




Redshift range selection







Main conclusions

1. The Log(N)-Log(S) distributions for the soft and hard bands are found to be in good agreement with the results from previous works. Using the joined sample of the XMM-LSS and Subaru fields, we have extended the Log(N)-Log(S) to fainter and brighter fluxes.

2. The amplitude of the correlation function $\omega(\theta)$ is substantially higher in the hard than in the soft band.

3. The resulting γ of the power-law slopes for all considered subsamples and both bands are found to be quite similar, between 1.6 and 2.

4. The scale of CF θ_0 is found to be substantially smaller in the soft band (near 3") than in the hard band (above 10").

5. The considered obscured and unobscured subsamples of AGN show some difference. The correlation scale is larger for HR>-0.2 (10") than for HR<-0.2 (below 5").

6. Both hard and soft samples show the significant overdensities what mean that they both are in the high-density environments.