



Multi-wavelength observations of X-ray selected AGN: what we need and why

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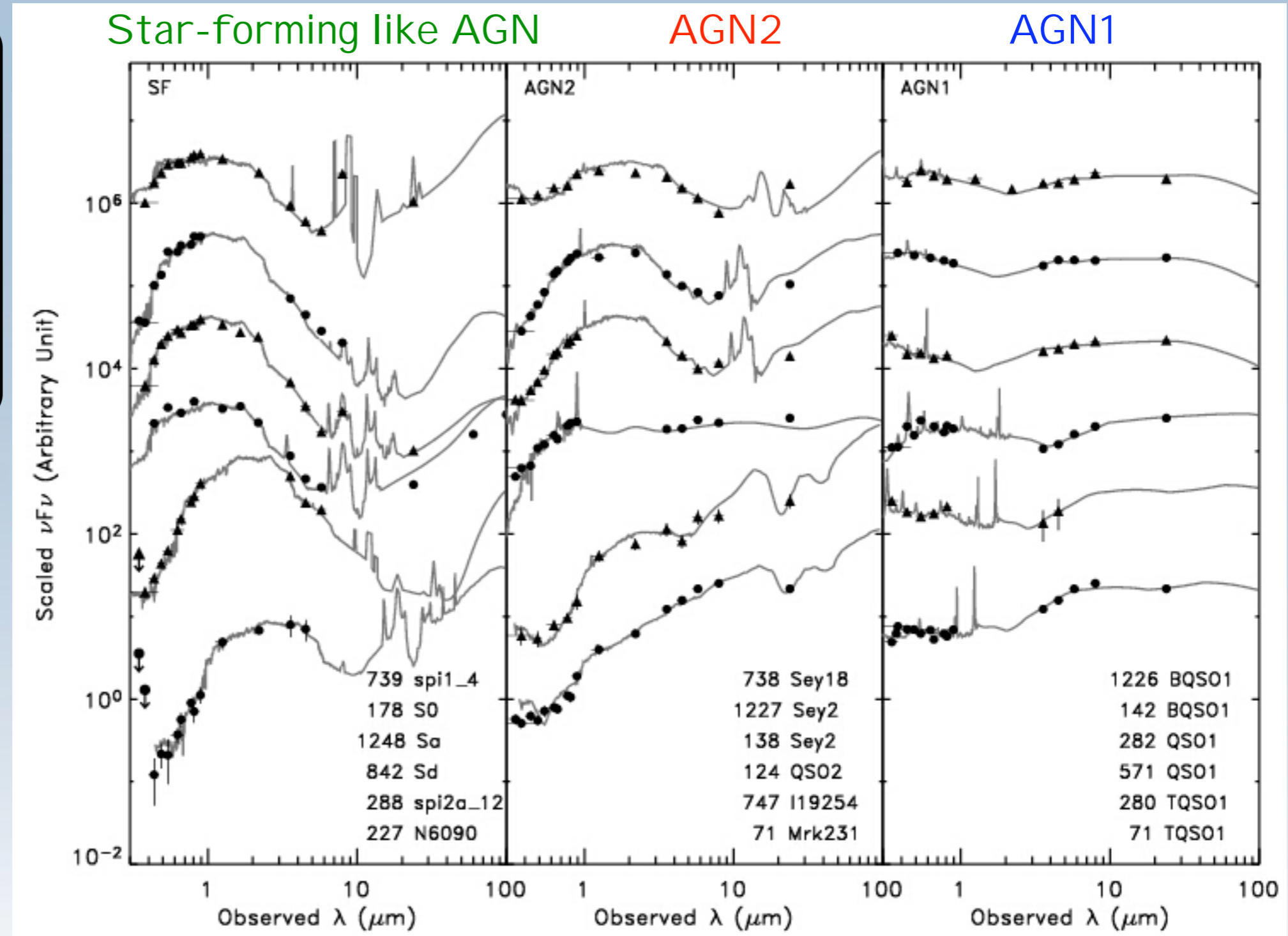
X-ray selected AGN spectral energy distributions

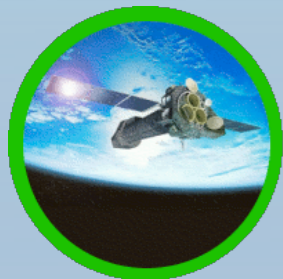
- X-ray selected AGNs show a variety of SEDs

- SED type fraction depends on X-ray flux

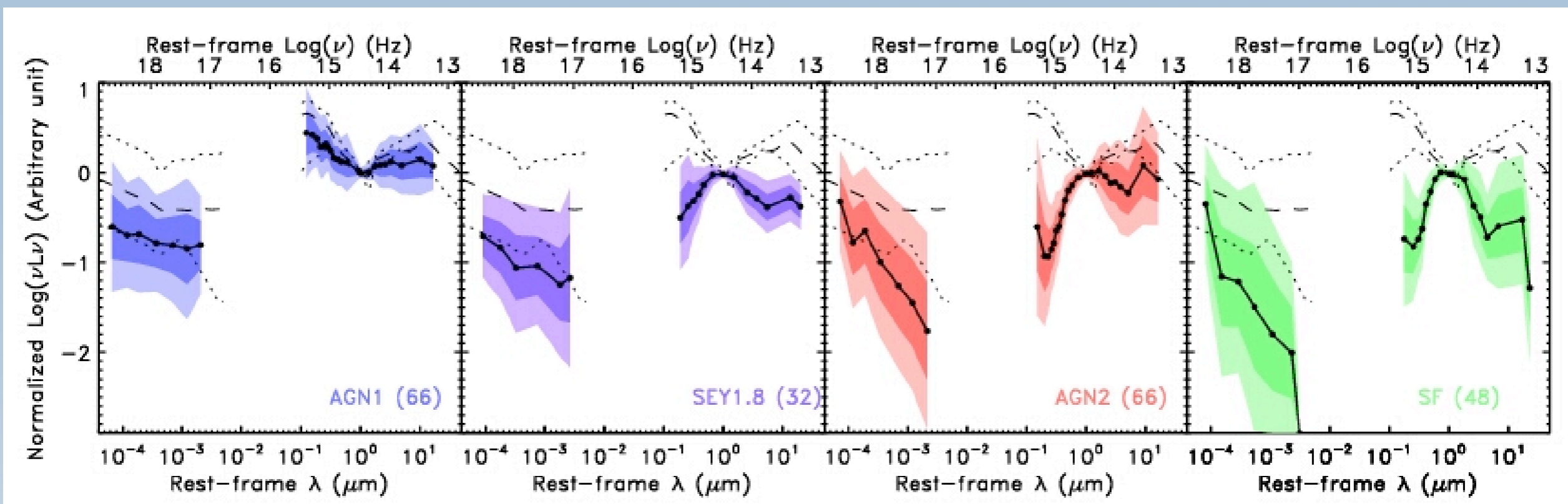
Similar results for spectral type

(e.g. Tozzi et al. 2006; Eckart et al. 2006; Polletta et al. 2007; Franceschini et al. 2005; Fiore et al. 2003)

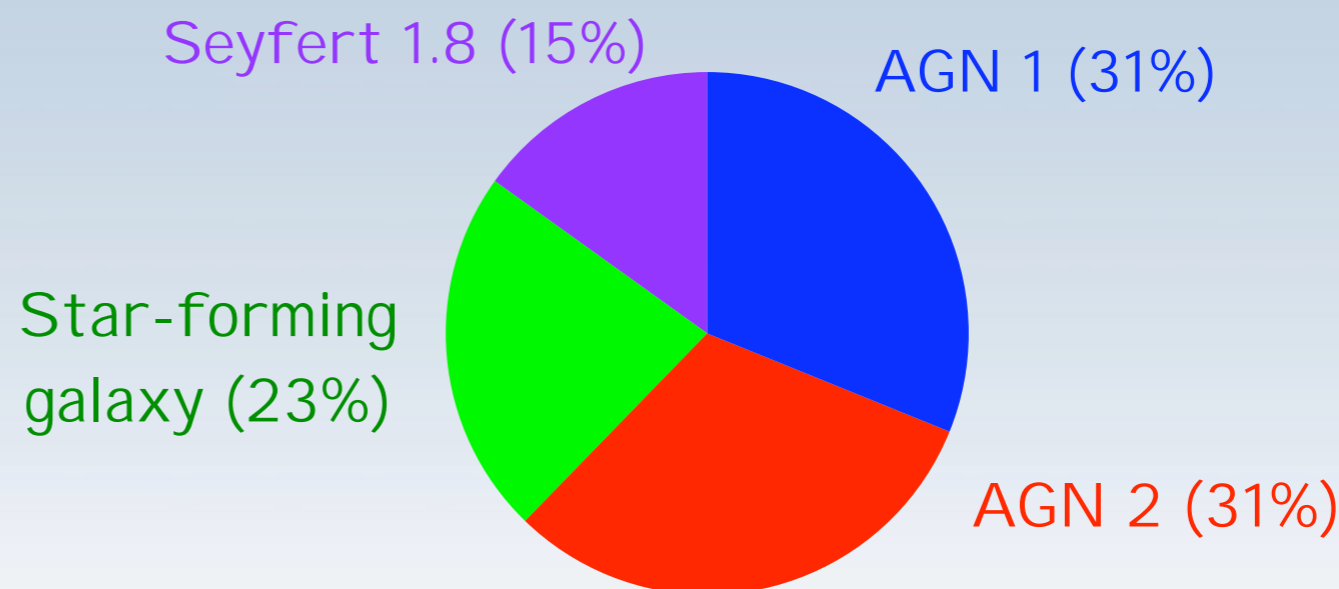




Average X-ray spectral properties vs SEDs



Different SED types correspond to various degrees of absorption in the X-rays





SED evolution with L or selection effect ?

Median QSO template
(Elvis et al. 1994)

AGN SED types

AGN 1

AGN 2

Star-forming galaxy like AGN

AGN X-ray Luminosity

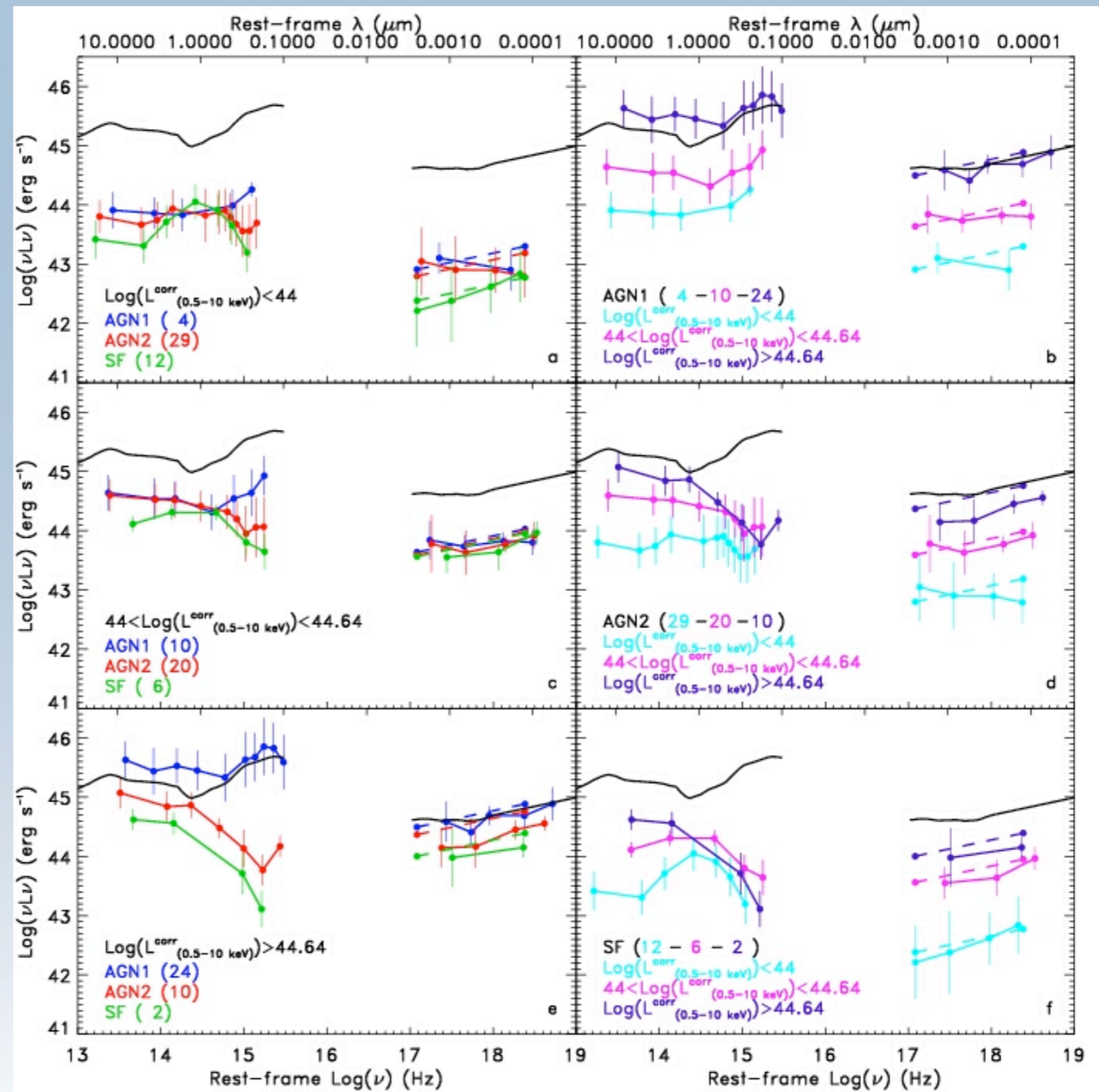
$\text{Log}(L_x) < 44$

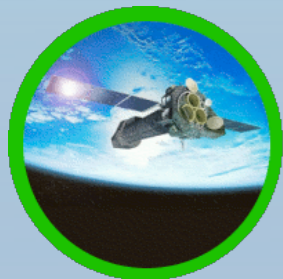
$44 < \text{Log}(L_x) < 44.64$

$\text{Log}(L_x) > 44.64$

(e.g. Polletta et al. 2007;
Shemmer et al. 2006; 2008)

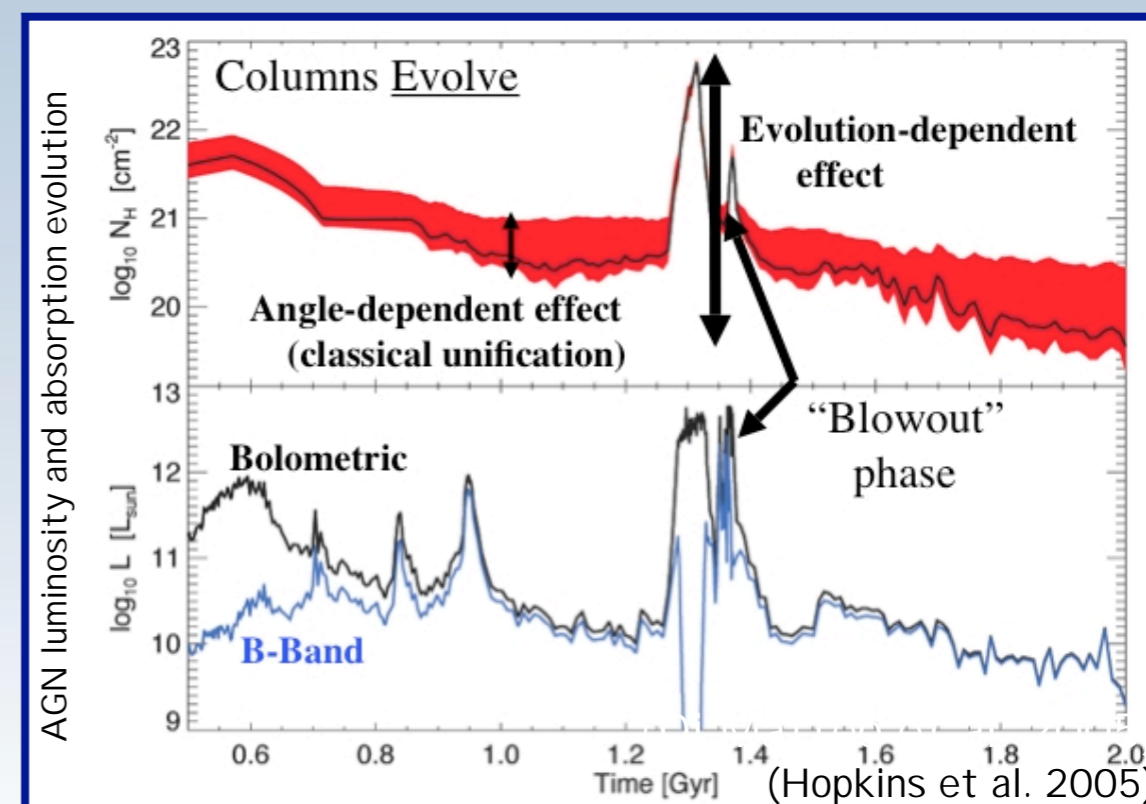
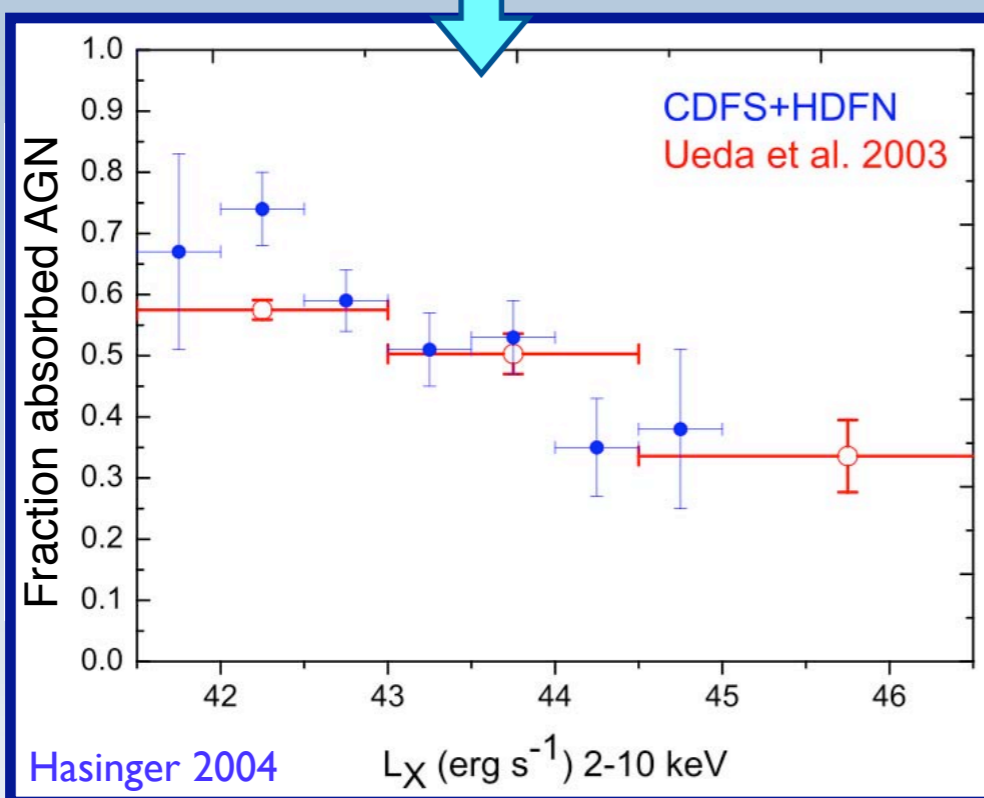
AGN SED evolution



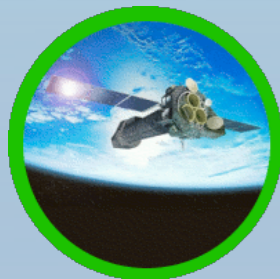


The nature of obscuration in AGNs

Obscuration
vs
environment
host galaxy properties
evolutionary phase
luminosity



(Keel 1980; Lawrence et al. 1982; Hasinger 2004; Simpson 2005; La Franca et al. 2005; Maiolino et al. 2007; Treister & Urry 2006; Akylas et al. 2006)



AGN vs Environment

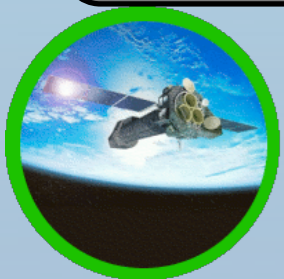
Where do AGNs (type, L, z) reside ? Clusters core, outskirts, infalling regions, field.

Is AGN activity triggered by mergers and interactions ?

Is AGN feedback important and how does it work ?

(Previous studies: e.g. Kauffmann et al. 2004; Monaco et al. 2005; Cappelluti et al. 2005; Martini et al. 2006, Georgakakis et al. 2007; Eastman et al. 2007)

See also workshop talks by Yang, Plionis, Garcet, Georgakakis.

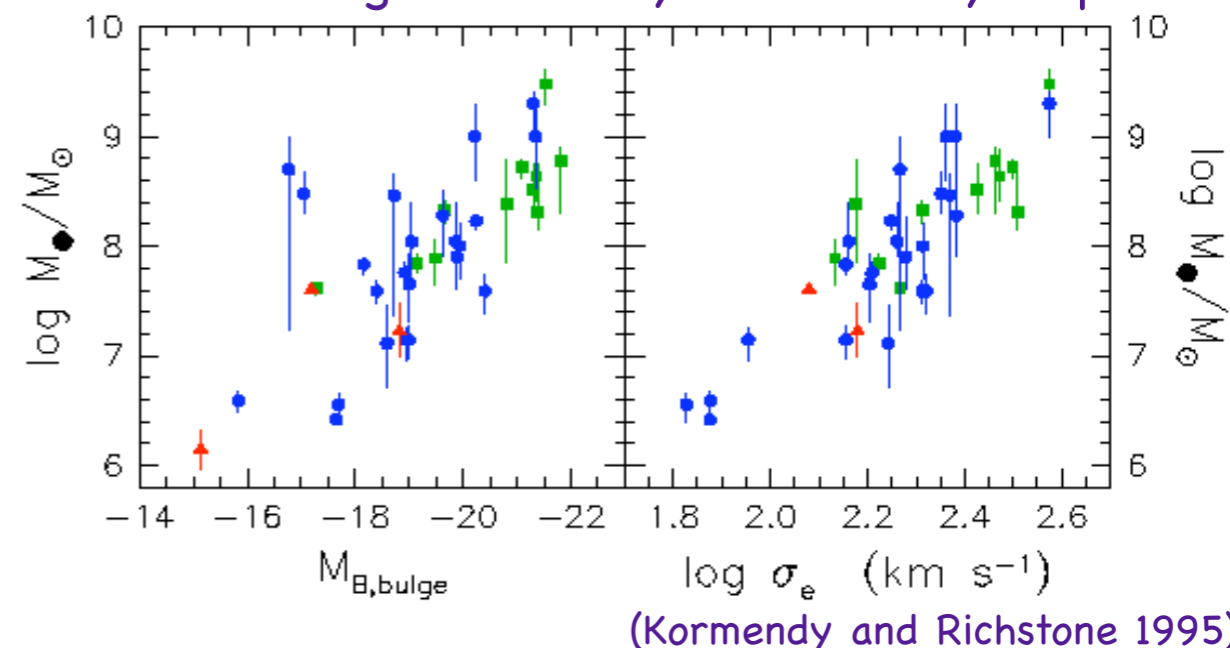


The link between AGN and star-formation

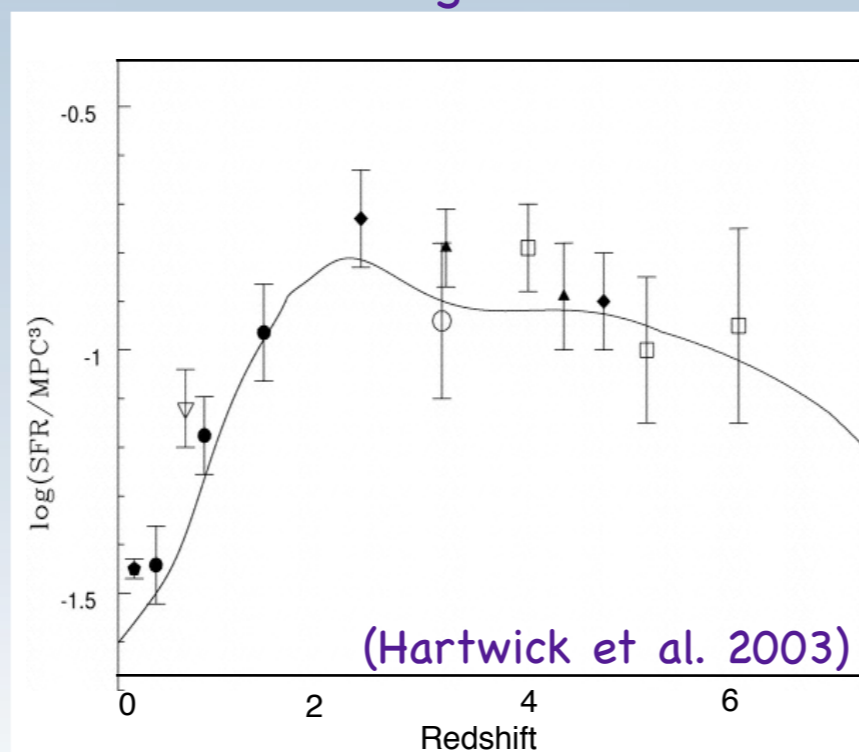
- Are star-formation and black hole growth triggered by the same mechanism ?
- Are star-formation and AGN activities associated ?
- What are their relative timescales ?
- Does the star-formation rate depend on AGN type, luminosity, and redshift ?

- BH growing process
- Origin of the $M_{\text{BH}}-\sigma$ relationship

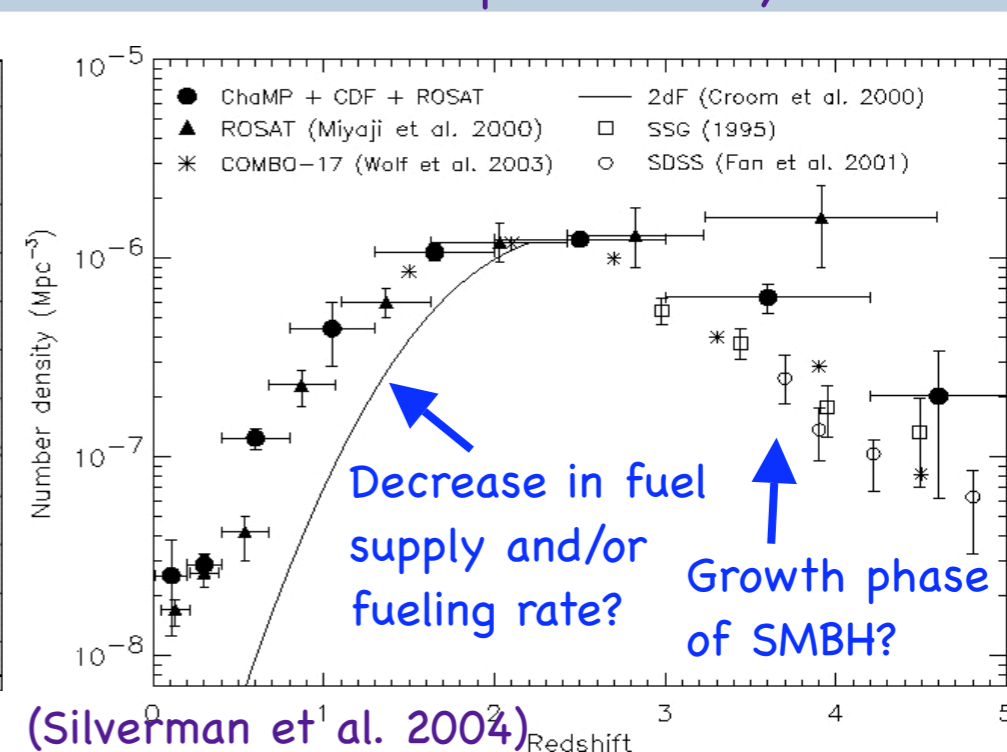
BH Mass vs bulge luminosity and velocity dispersion



SFR/co-moving volume vs z



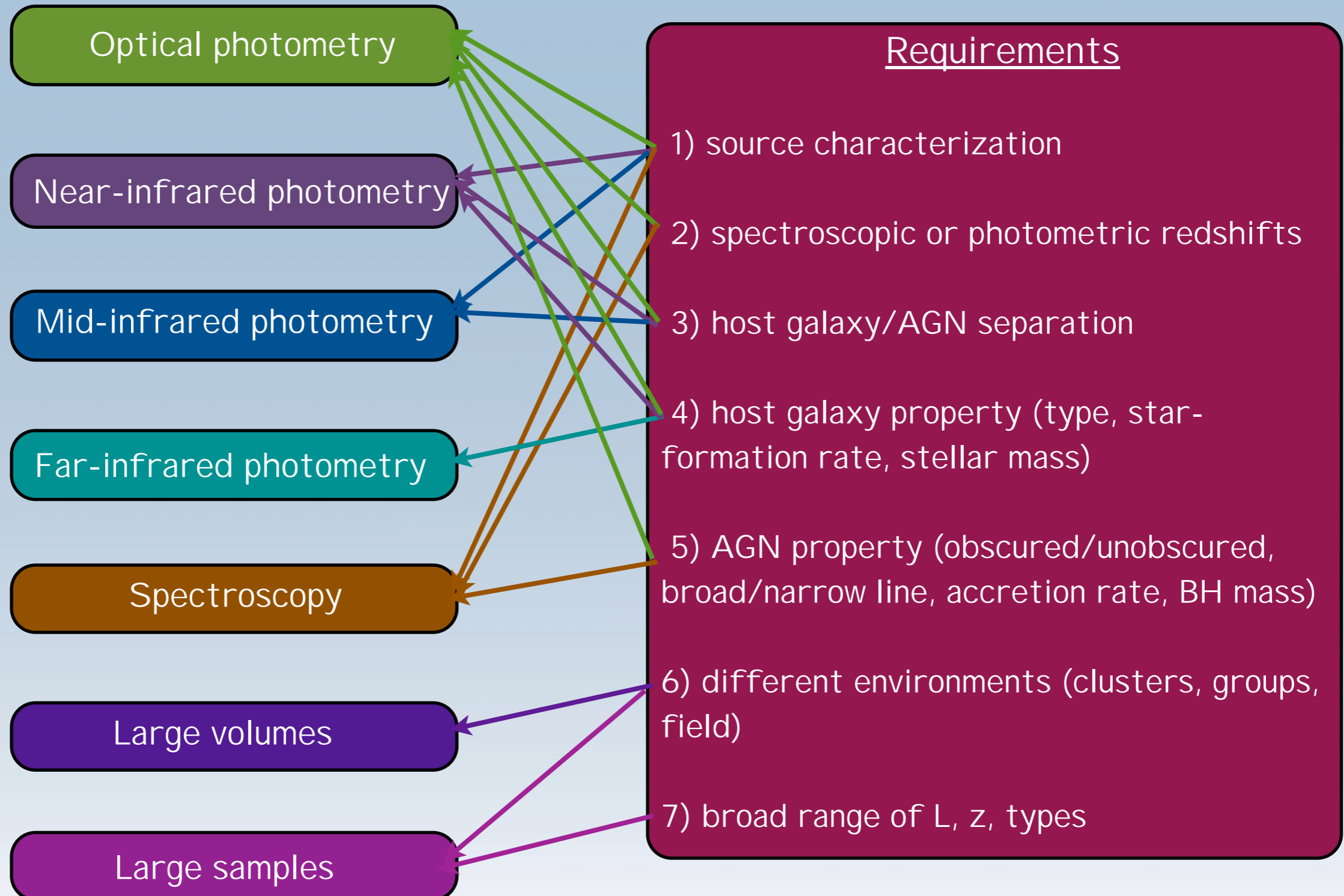
AGN Space Density

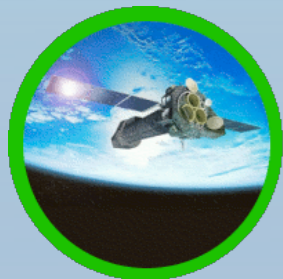


See Alexander's talk.



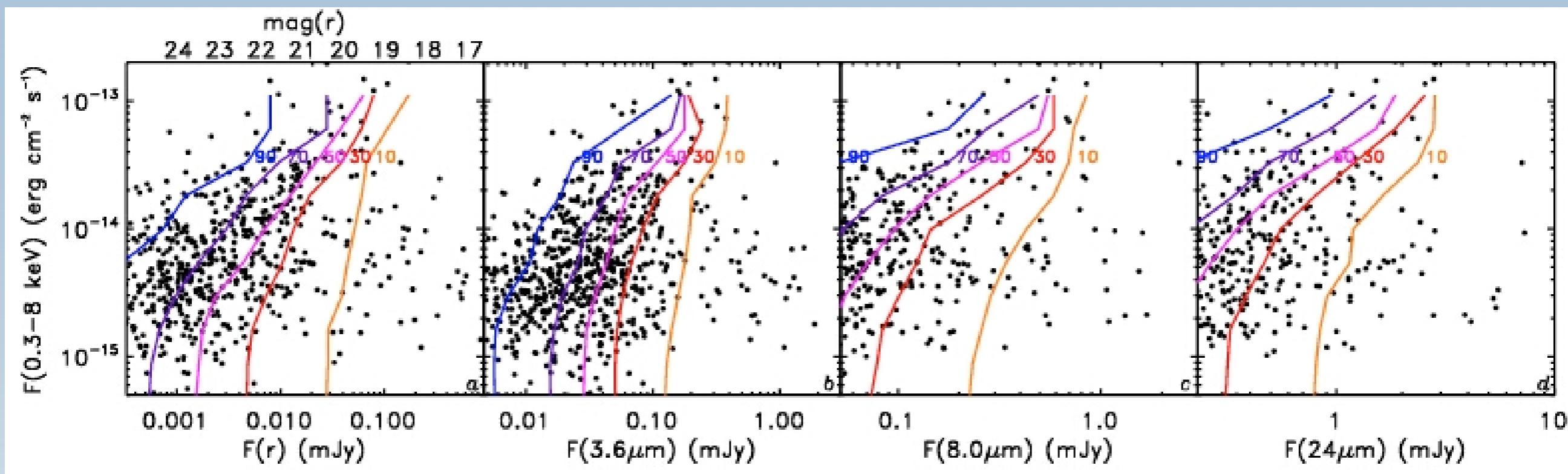
Necessary ancillary data





Matching optical, infrared and X-ray depths

Fraction (10, 30, 50, 70, 90%) of X-ray sources with $F(X) \geq [y\text{-value}]$ detected with $F \geq [x\text{-value}]$
 [x value]: r, 3.6, 8.0, 24 μm

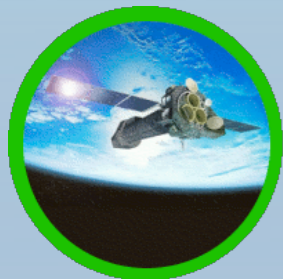


Detection fraction at the SWIRE depth of X-ray sources with $F(X) > 3 \times 10^{-15} \text{ erg cm}^{-2} \text{ s}^{-1}$:

100% detections at 3.6 μm

80% with $\text{mag}(r) < 25$

50% detections at 8 μm and 24 μm



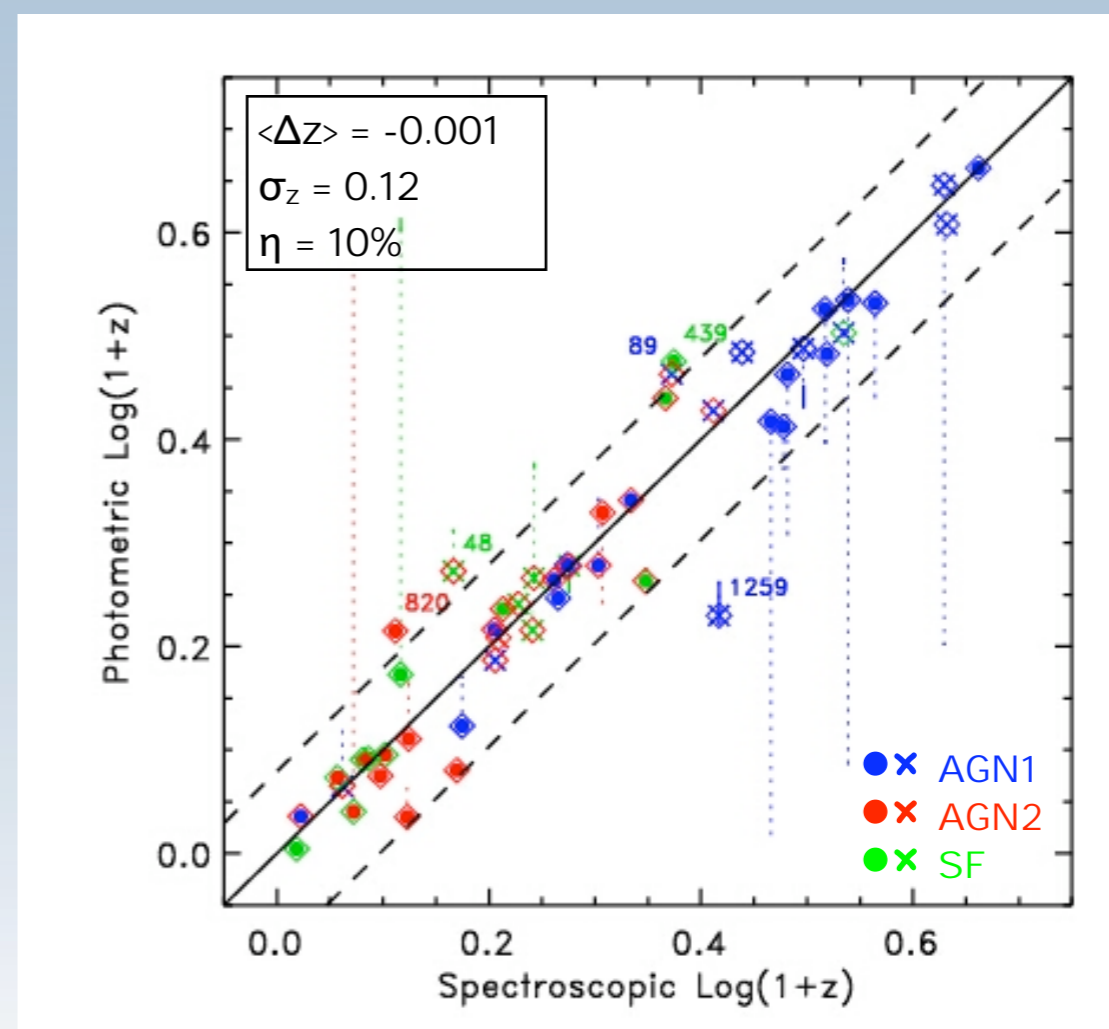
Photometric redshift requirements

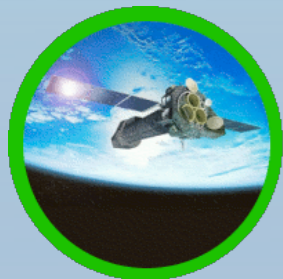
Photometric redshifts of AGN samples:

5 Optical bands (Ugriz) \Rightarrow 25% outlier fraction (Kitsionas et al. 2005)

5 Optical bands (Ugriz) + 5 IR bands (Spitzer) \Rightarrow 10% outlier fraction (Polletta et al. 2007)

14 Optical-IR bands \Rightarrow <4% outlier fraction (Salvato et al., in prep.)





Survey Strategy

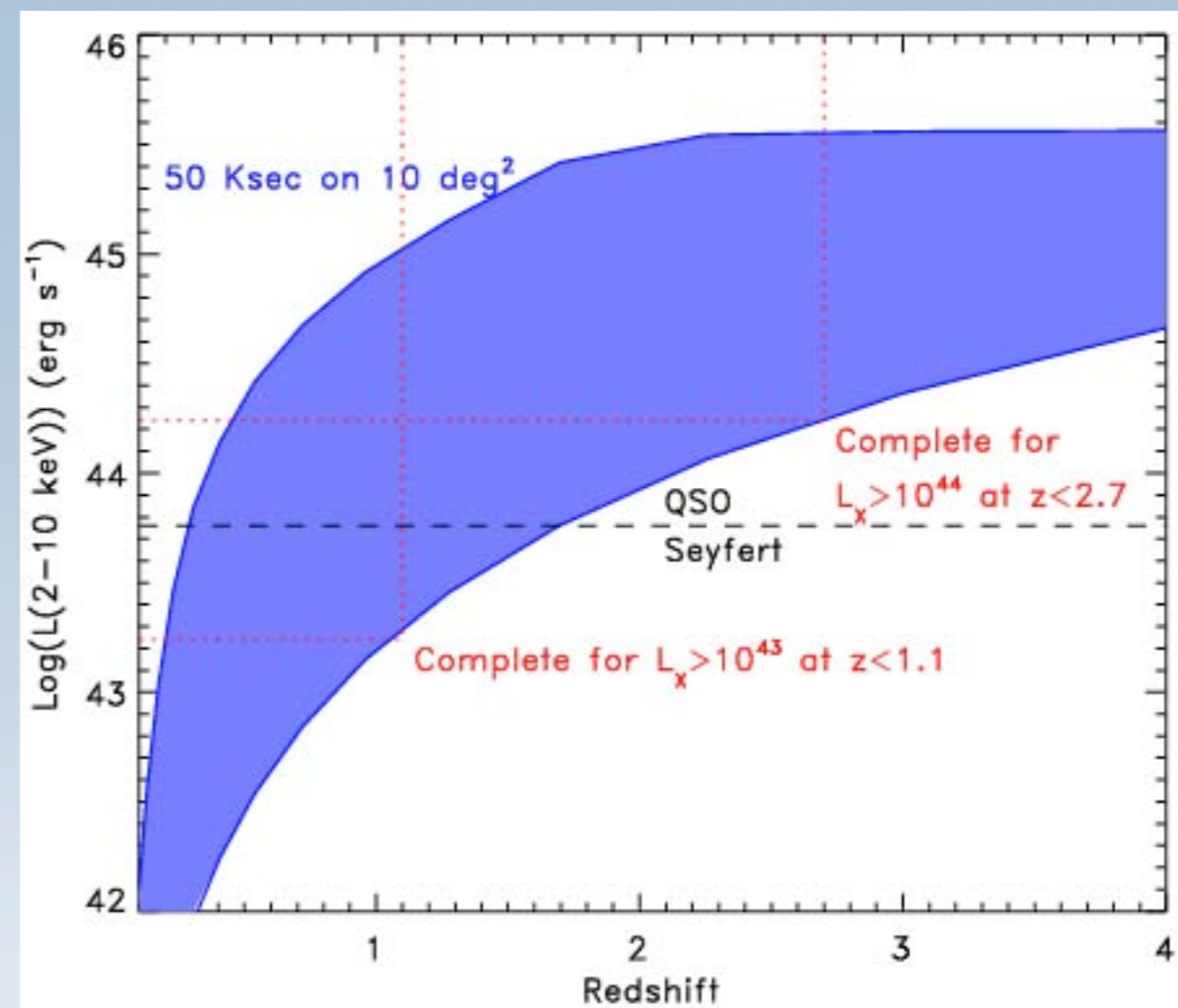
Multiple wide fields
 > 3 fields of surface > 4 deg²

Sample size
 10 density bins x 5 redshift bins x 5 luminosity bins x
 2 environment bins x 4 AGN types x 10-20 AGNs/bin:
 20,000-40,000 AGNs

Good XMM-Newton visibility
 visibility > 50 ksec

Multi-wavelength coverage
 Multi-band optical, near-IR, and Spitzer coverage
 (Far-IR/mm, radio, spectroscopic data)

Hard X-ray luminosity and z space sampled
 by a 10 deg² survey with 50 ksec exposure





Best field candidates

>4 deg² Fields with multi-wavelength coverage:

10-20 ksec visibility: EFLS, NDWFS, ELAIS-N1, ELAIS-N2, EGS/CFHTLS-W3

60 ksec visibility: Lockman Hole

120-130 ksec visibility: XMM-LSS/CFHTLS-W1, ELAIS-S1, CDFS, CFHTLS-W2,
VVDS-D4/UKIDSS-DXS/CFHTLS-W4

With multi-band optical, near-IR and Spitzer coverage

Further available data:

Herschel (far-IR), SCUBA2 or APEX (sub-mm),
UKIDSS or VISTA-VIDEO (near-IR: zYJHK),



Summary

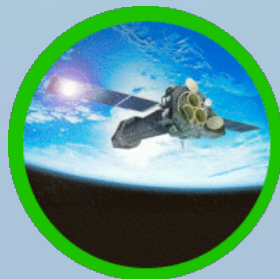
The study of the properties of X-ray AGNs are limited by selection effects, limited statistics, and small volumes

Some open questions regarding the AGN population are the link between AGN and star-formation activity, the AGN dependence on the environment, the AGN SED evolution, and the nature of the obscuring material

To address the above questions we would need X-ray observations on > 3 fields with multi-wavelength coverage

We select 5 best field candidates, mostly from the CFHTLS and SWIRE surveys. Most of the selected fields are or will be under an intense observing schedule.

We propose a 50 ksec XMM-Newton survey over 10 deg^2 divided into 3 fields.



AGN vs Environment

Where do AGNs (type, L, z) reside ? Clusters core, outskirts, infalling regions, field.

Is AGN activity triggered by mergers and interactions ?

AGN activity depends strongly on local density (Kauffmann et al. 2004)

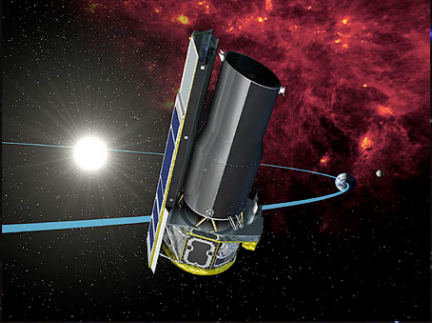
AGNs hosted in early spirals tend to reside in denser environments than non-AGNs

⇒ support for interaction stimulated nuclear activity (Monaco et al. 2005)

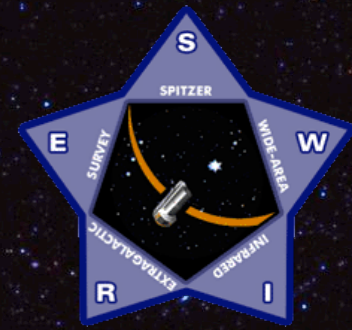
Large (5-10 Mpc) clustering lengths found for X-ray selected AGNs

⇒ AGN reside in richer environments than early-type galaxies (Georgakakis et al. 2007)

See also Cappelluti et al. 2005, Martini et al. 2006, Eastman et al. 2007 and talks by Yang, Plionis, Garcet, Georgakakis.



SWIRE Fields and X-ray coverage



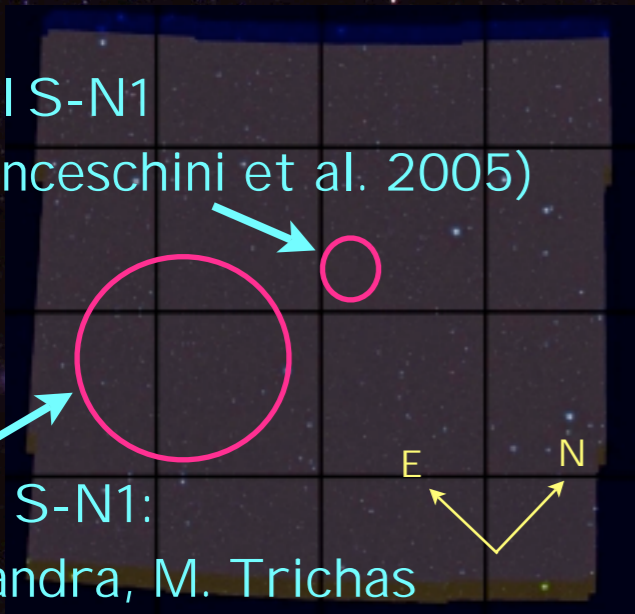
Spitzer: 49 deg² & X-ray: 16 deg²

Chandra: 5 deg² & XMM-Newton: 11.5 deg²

ELAIS-N1 (9 deg²)

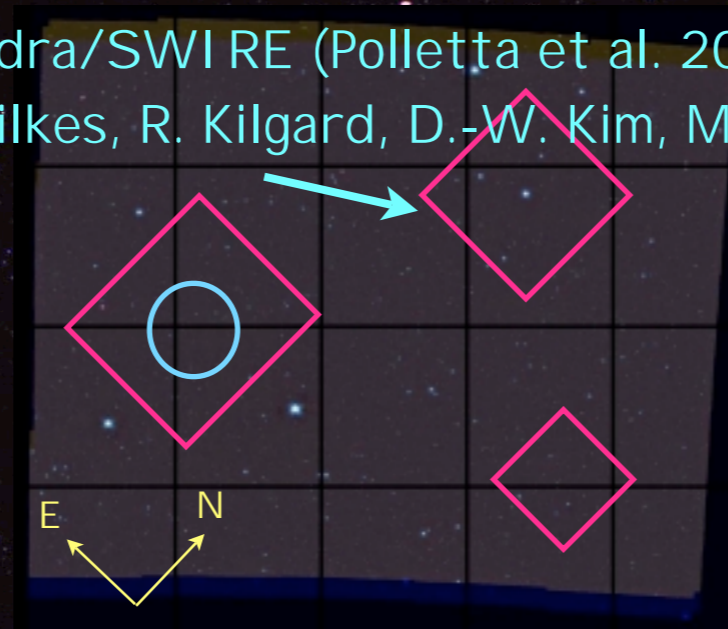
ELAIS-N1
(Franceschini et al. 2005)

ELAIS-N1:
P. Nandra, M. Trichas

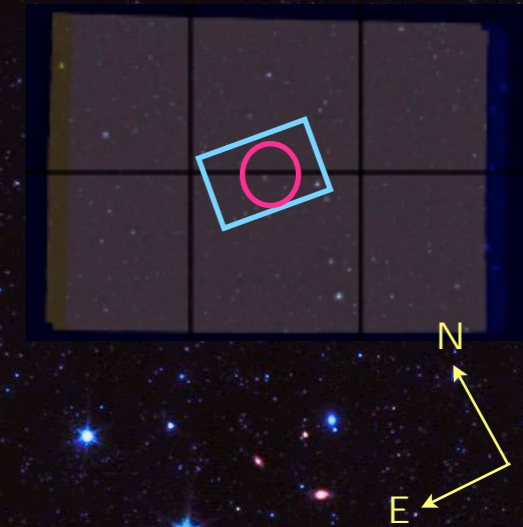


Lockman-Hole (11 deg²)

Chandra/SWIRE (Polletta et al. 2006)
B. Wilkes, R. Kilgard, D.-W. Kim, M. Kim



ELAIS-N2 (4 deg²)

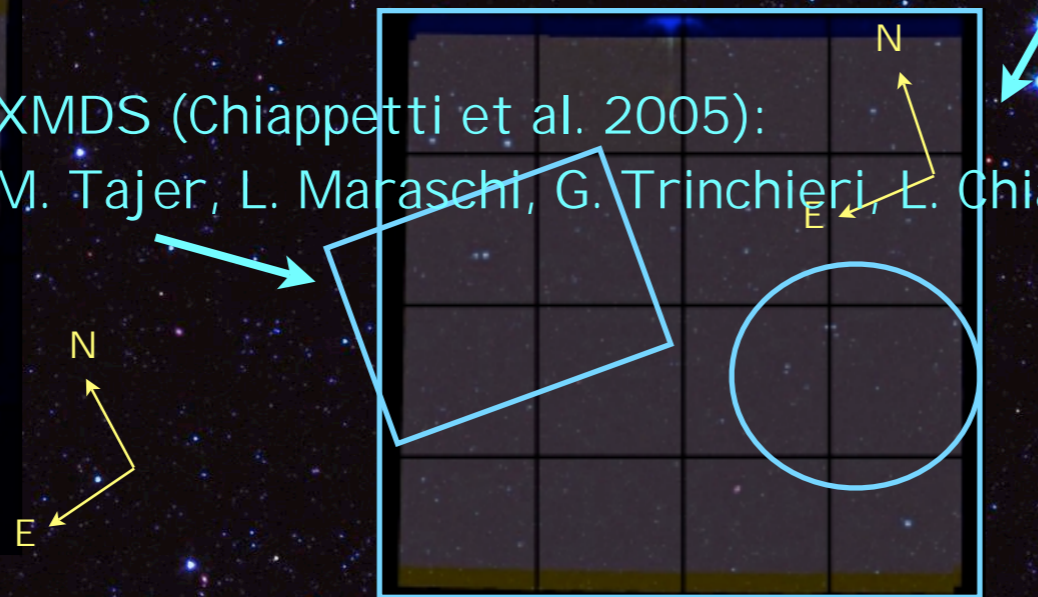


ELAIS-S1 (7 deg²)



XMM-LSS (9 deg²) M. Pierre & the XMM-LSS Team

XMDS (Chiappetti et al. 2005):
M. Tajer, L. Maraschi, G. Trinchieri, L. Chiappetti



CDFS (8 deg²)

