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

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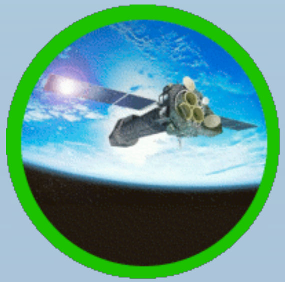
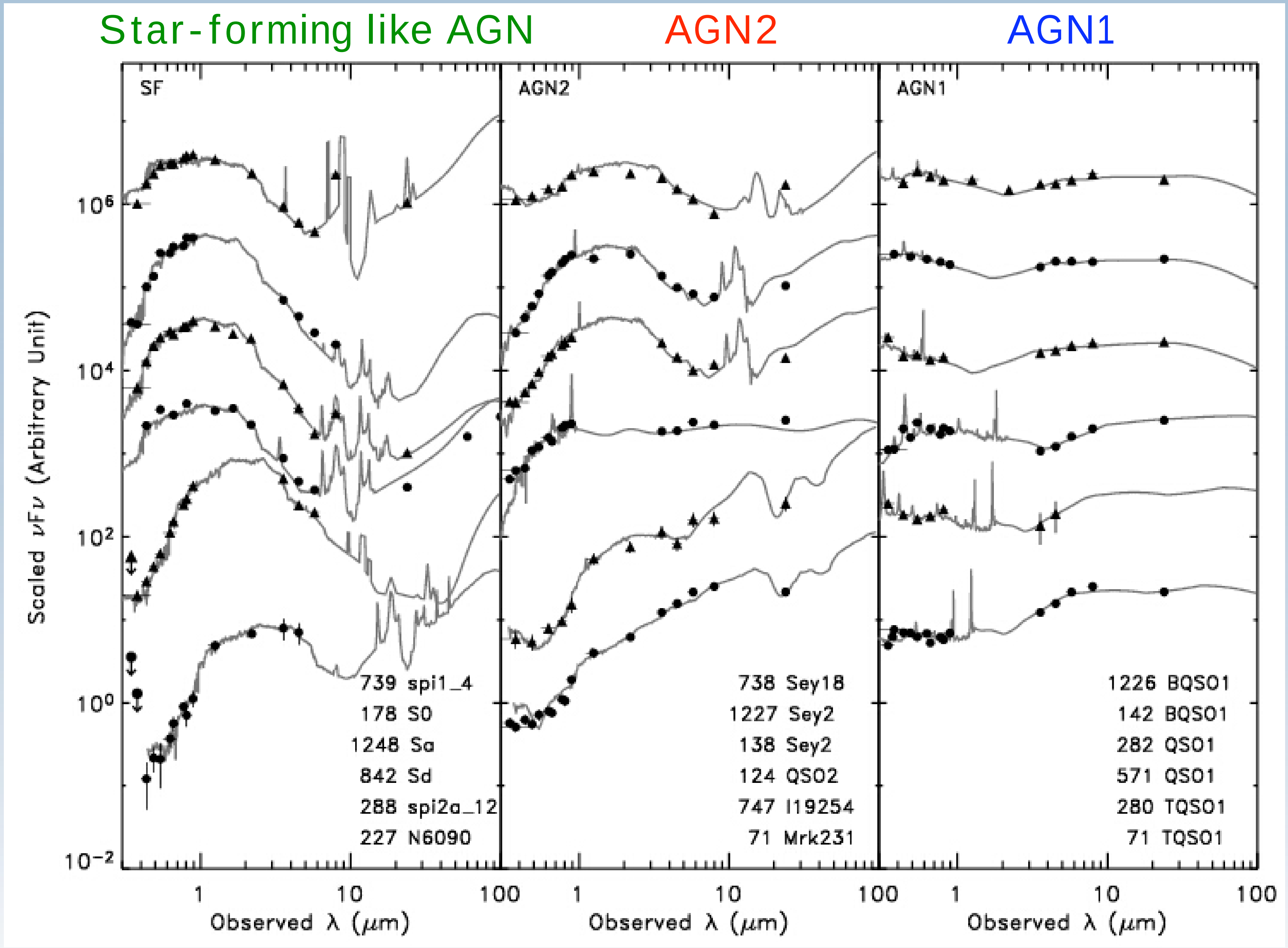


X-ray selected AGN spectral energy distributions

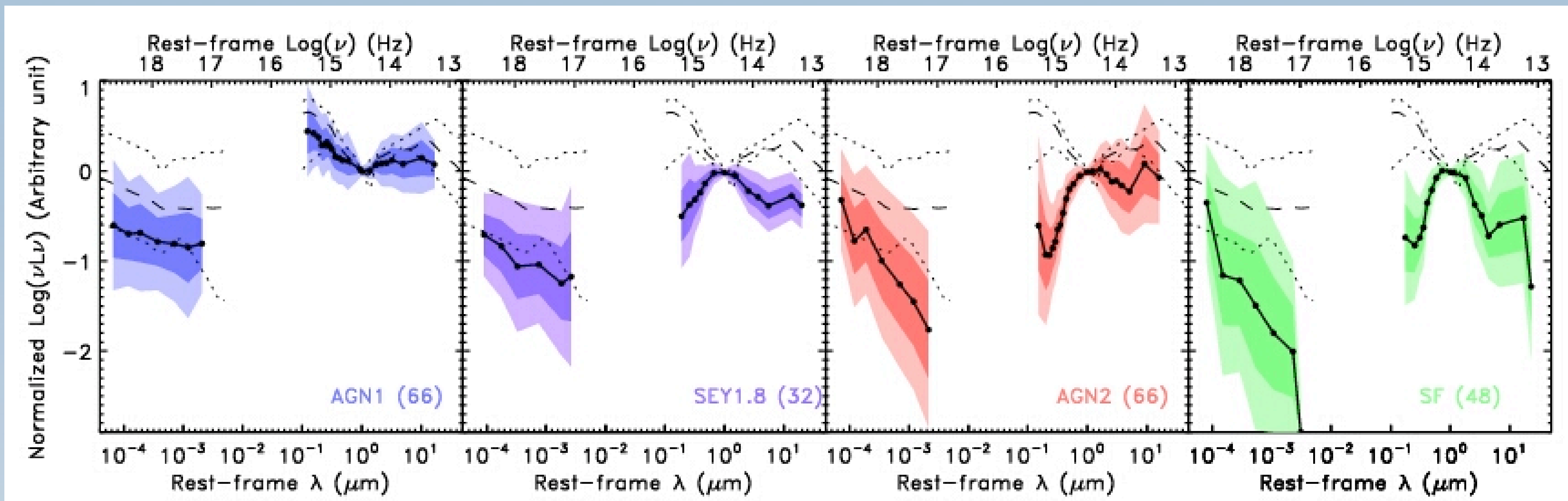
- X-ray selected AGNs show a variety of SEDs
- SED type fraction depends on X-ray flux

Similar results for spectral type

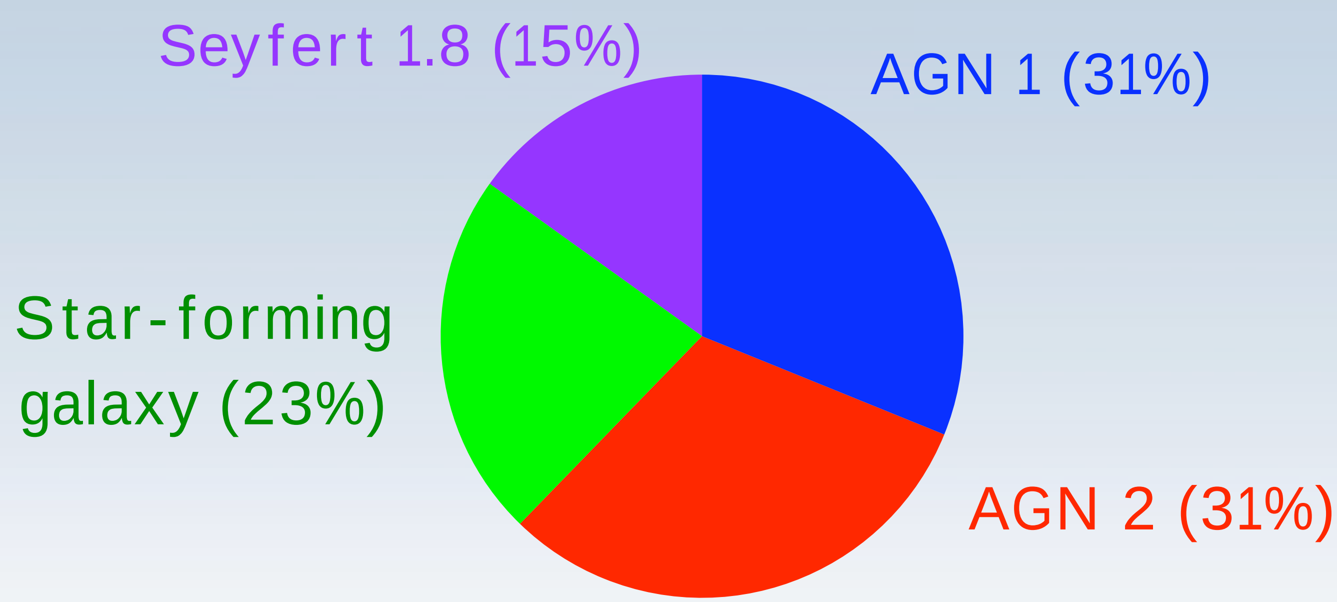
(e.g. Tozzi et al. 2006; Eckart et al. 2006; Polletta et al. 2007; Franceschini et al. 2005; Fiore et al. 2003)



Average X-ray spectral properties vs SEDs



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



AGN SED evolution

SED evolution with L or selection effect ?

Median QSO template
(Elvis et al. 1994)

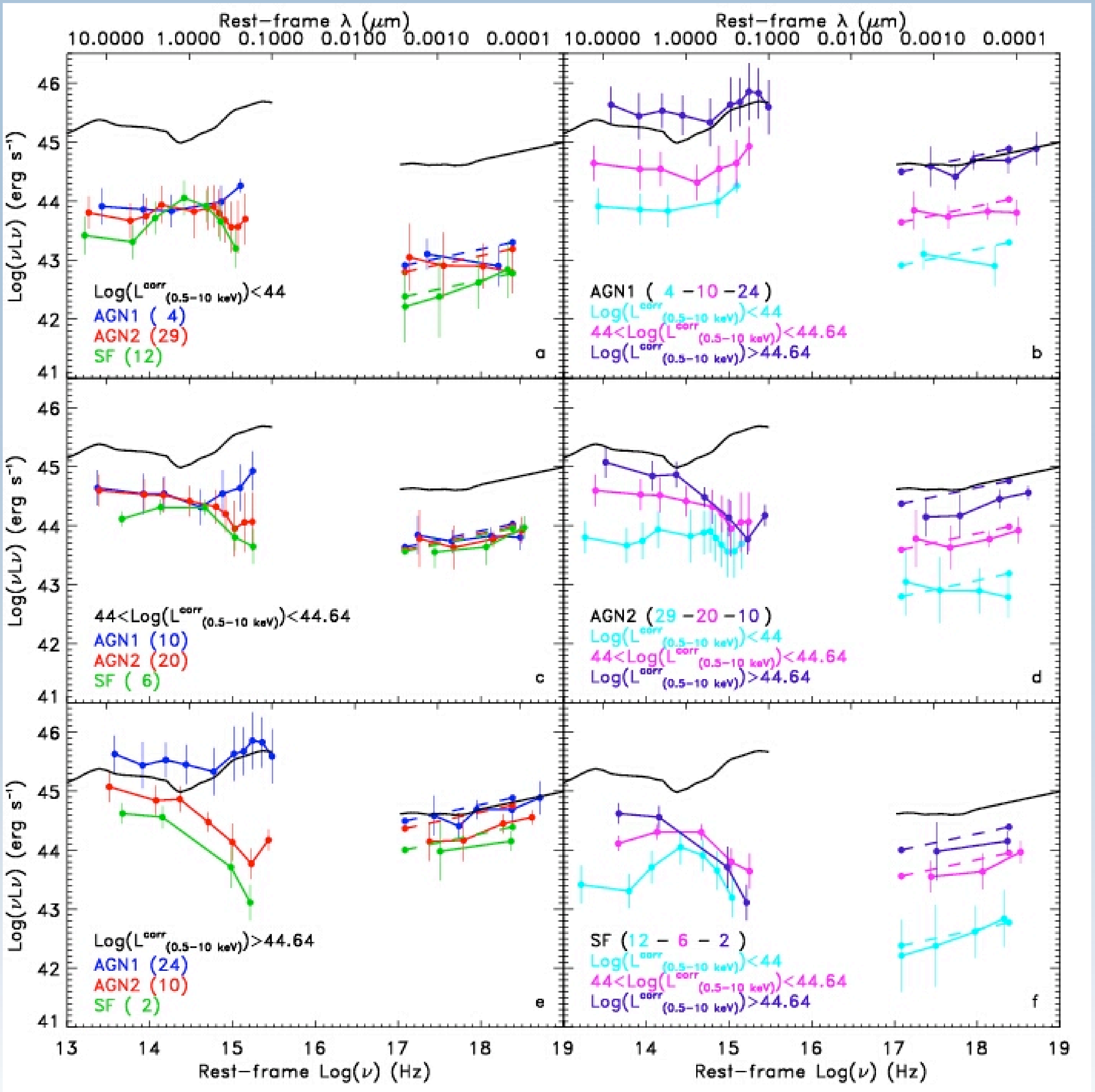
AGN SED types

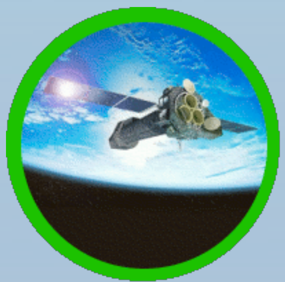
- AGN 1
- AGN 2
- Star-forming galaxy like AGN

AGN X-ray Luminosity

- $Log(L_X)<44$
- $44<Log(L_X)<44.64$
- $Log(L_X)>44.64$

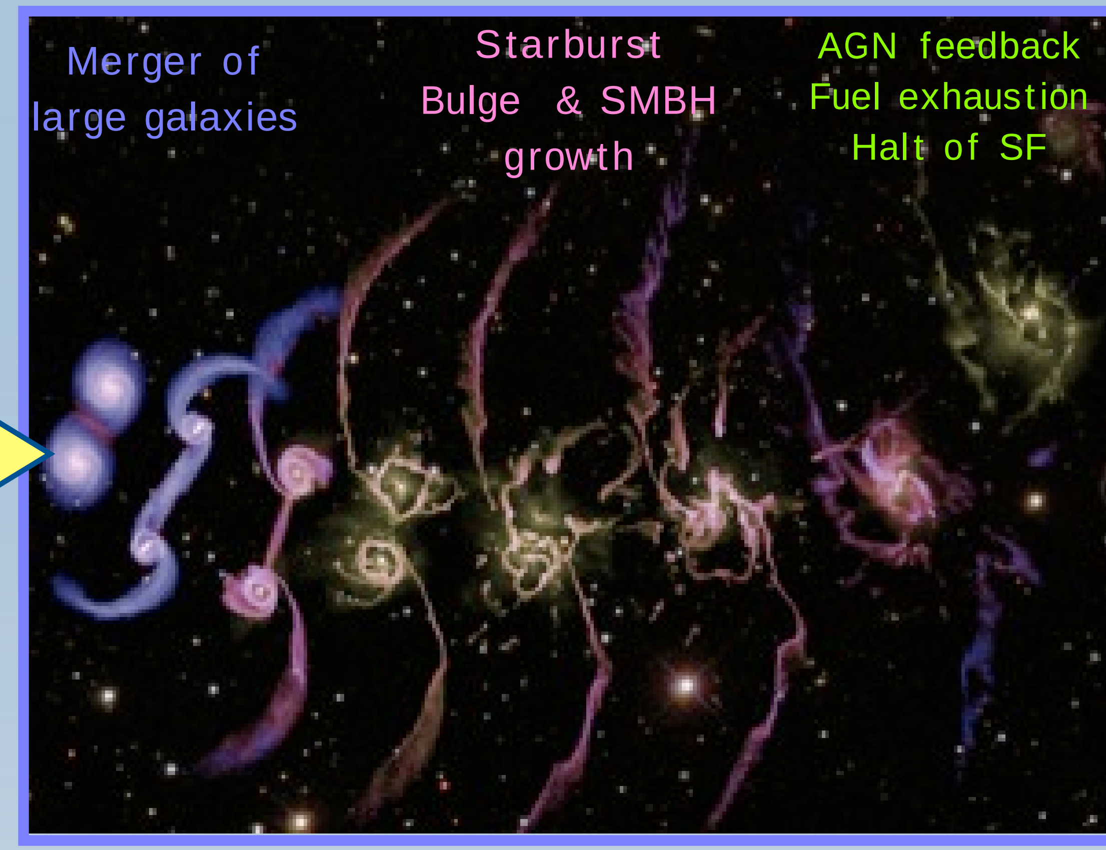
(e.g. Polletta et al. 2007;
Shemmer et al. 2006; 2008)

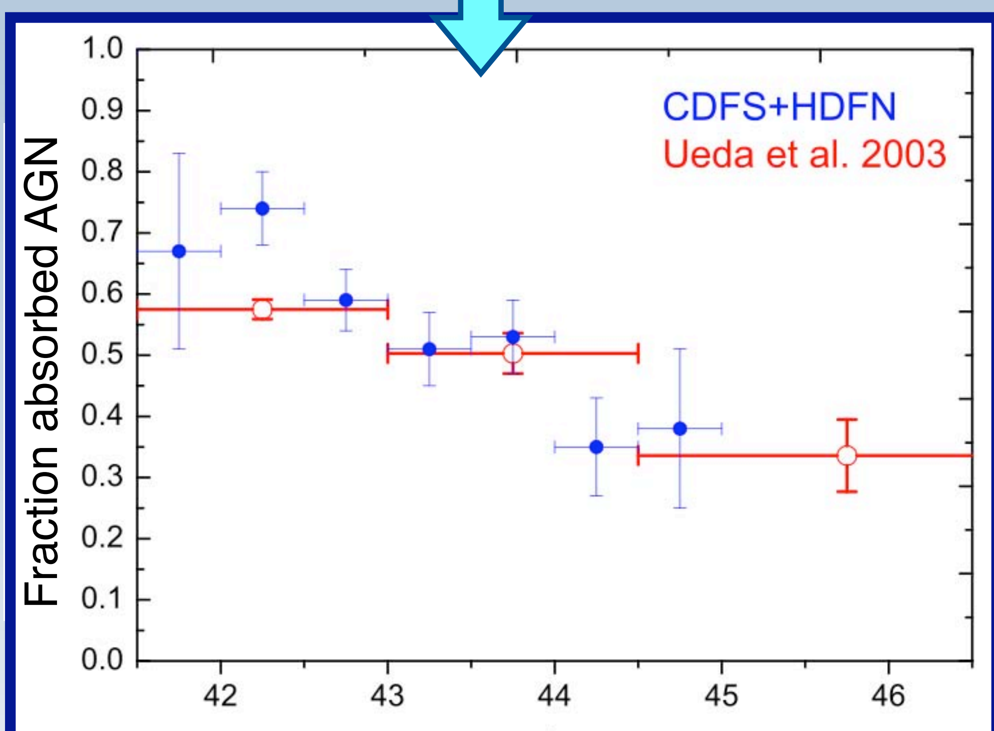




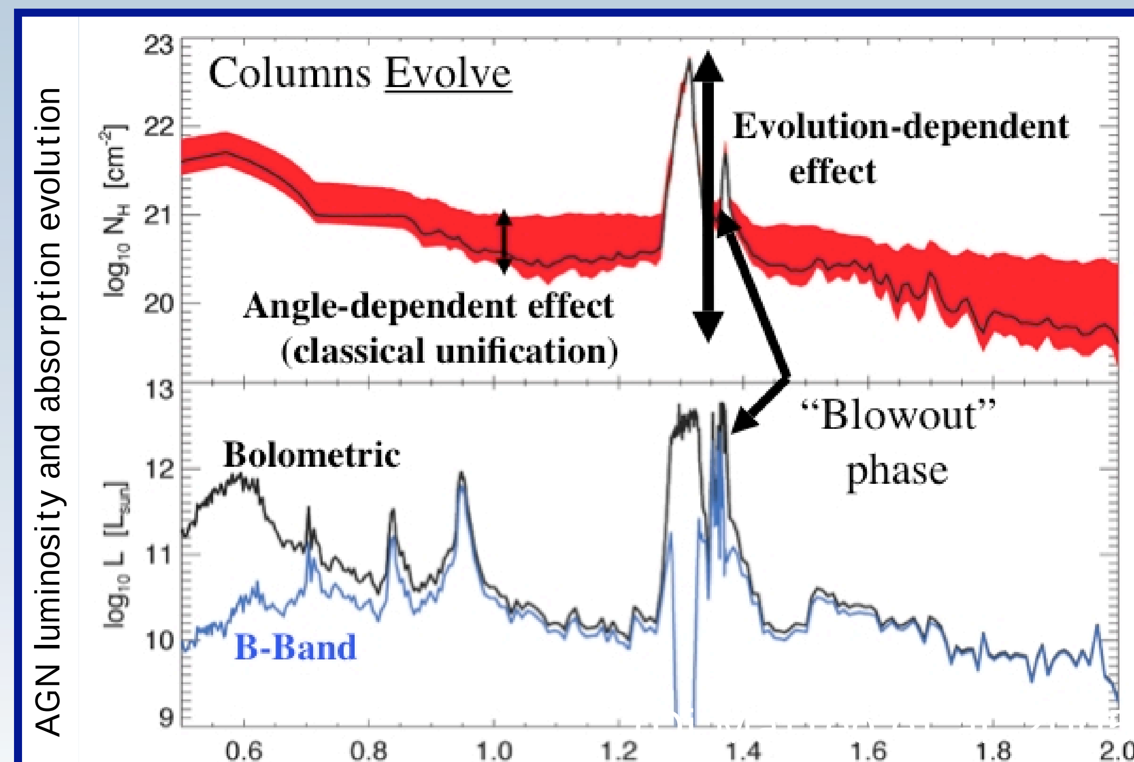
The nature of obscuration in AGNs

Obscuration
vs
environment
host galaxy properties
evolutionary phase
luminosity





Hasinger 2004



(Hopkins et al. 2005)

(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, outskirt, 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)

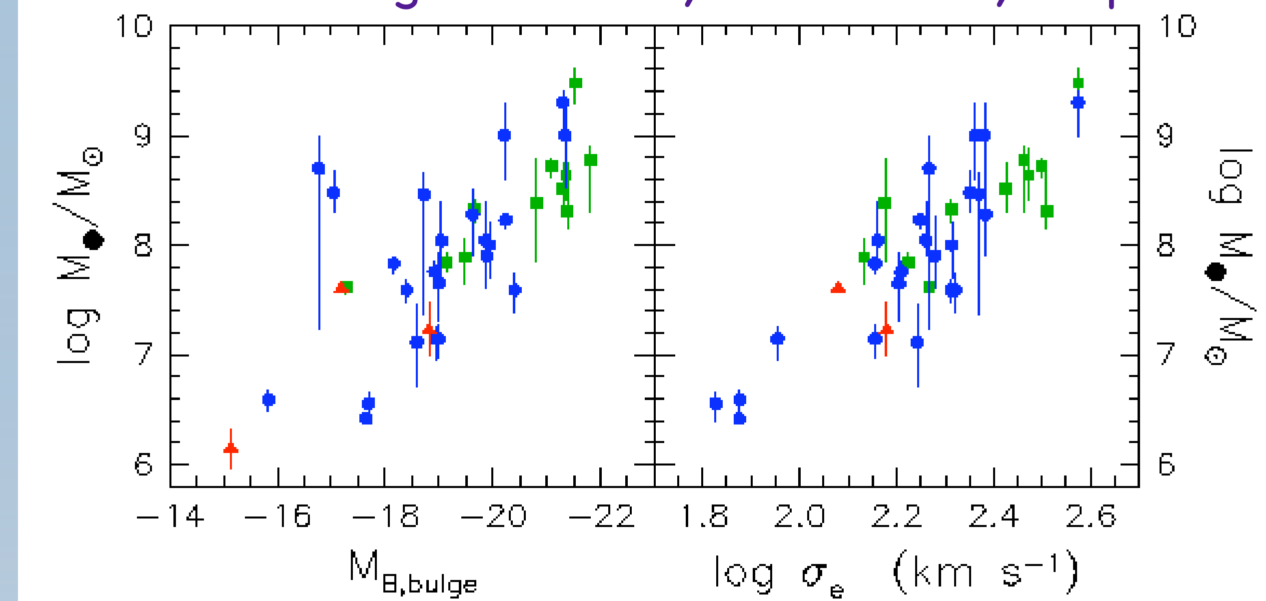
See also workshop talks by Yang, Plionis, Garcet, Georgakakis.

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 ?

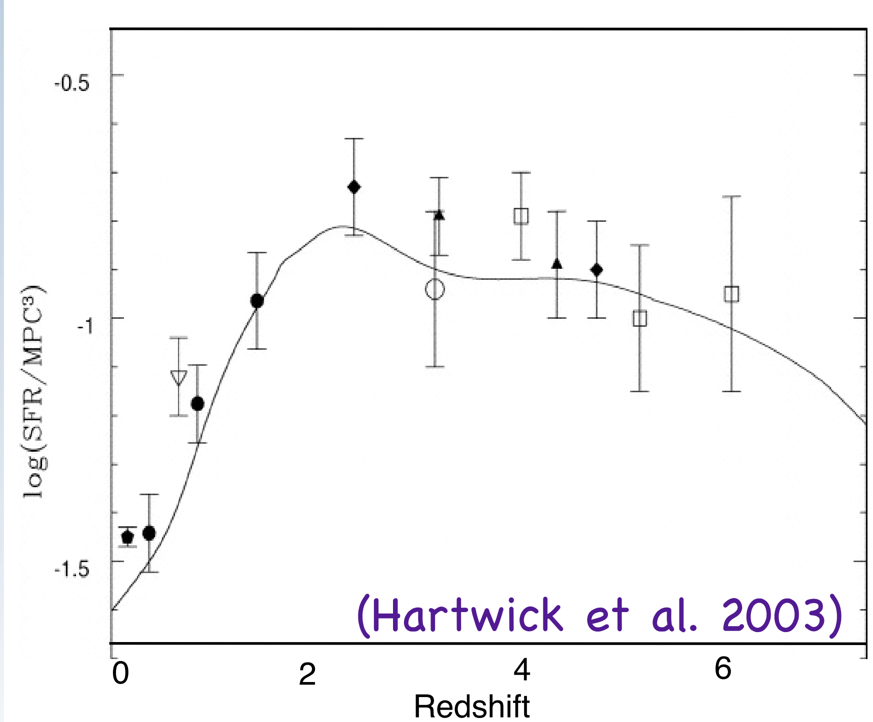
- BH growing process
- Origin of the M_{BH}-σ relationship

BH Mass vs bulge luminosity and velocity dispersion



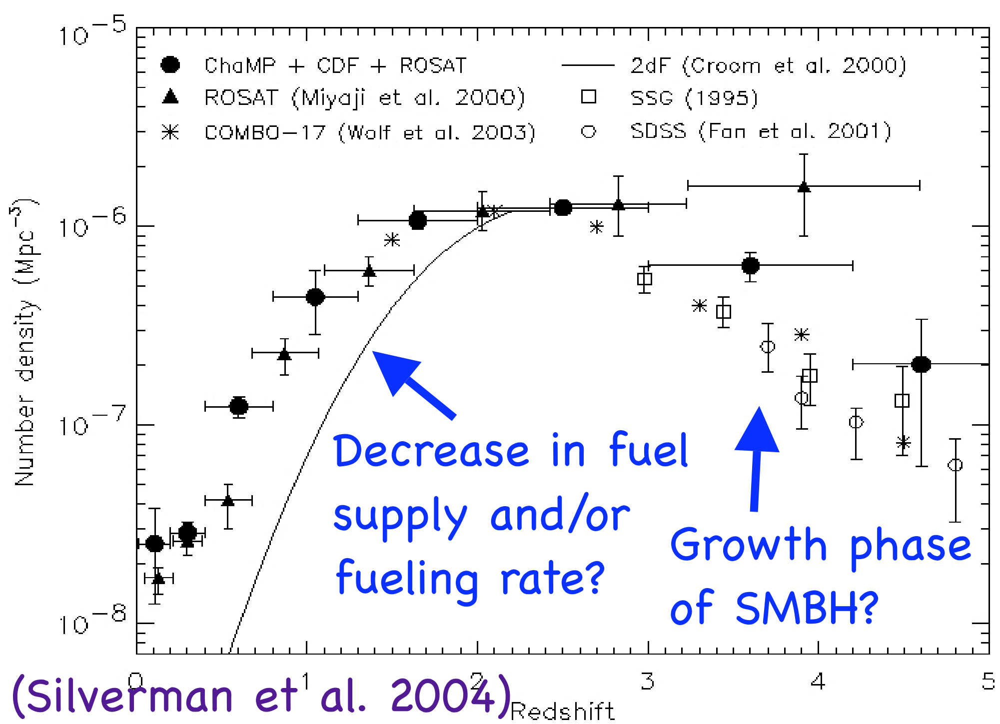
(Kormendy and Richstone 1995)

SFR/co-moving volume vs z



(Hartwick et al. 2003)

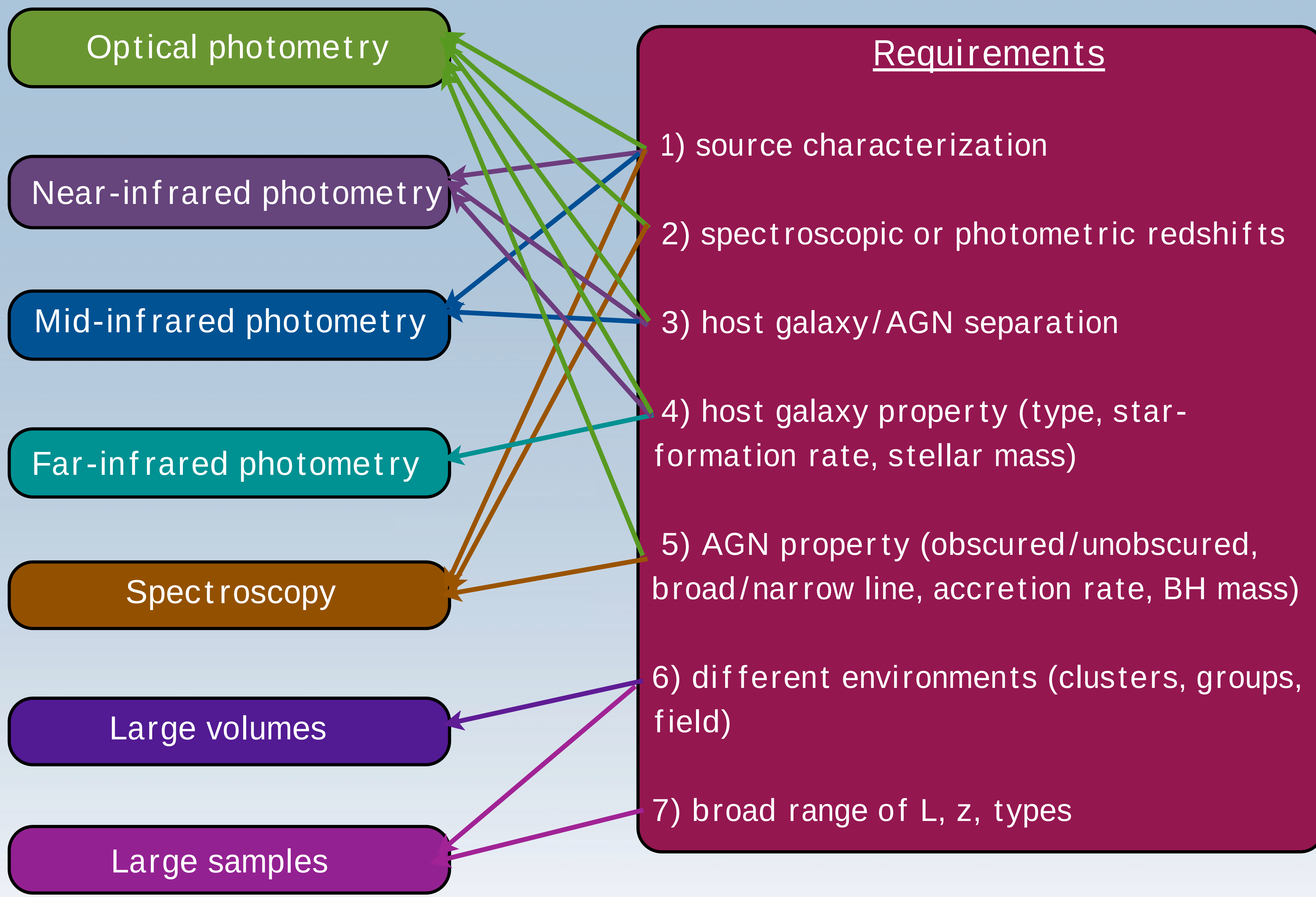
AGN Space Density



(Silverman et al. 2004)

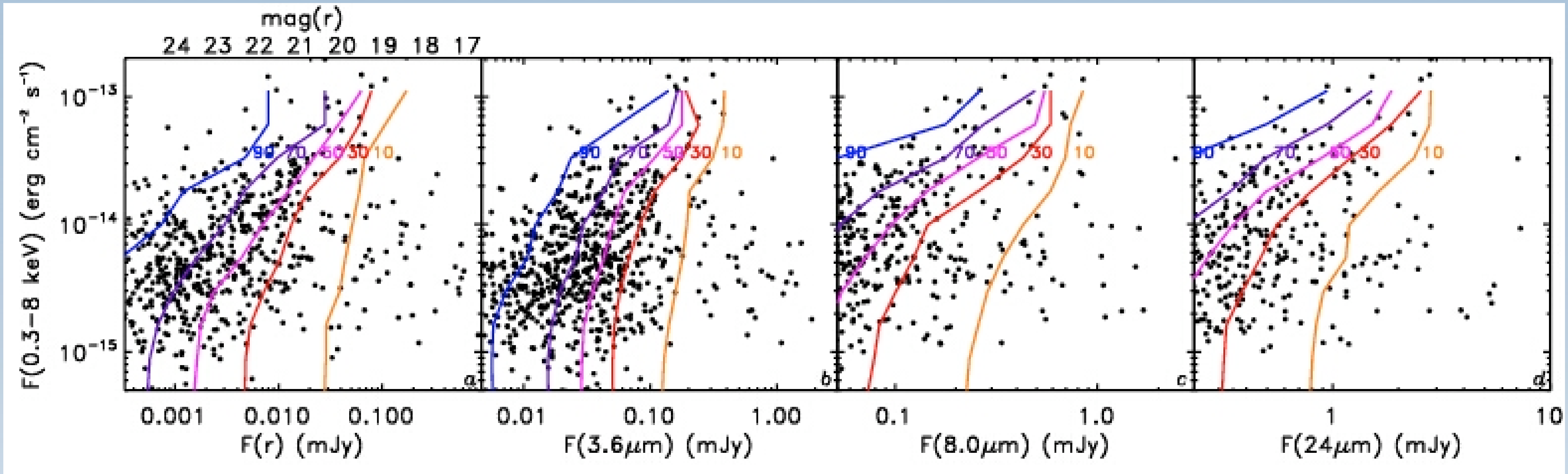
See Alexander's talk.

Necessary ancillary data



Matching optical, infrared and X-ray depths

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



Detection fraction at the SWIRE depth of X-ray sources with F(X)>3x10^{-15} erg cm^{-2} s^{-1}:

100% detections at 3.6 μm

80% with mag(r)<25

50% detections at 8μm and 24μm

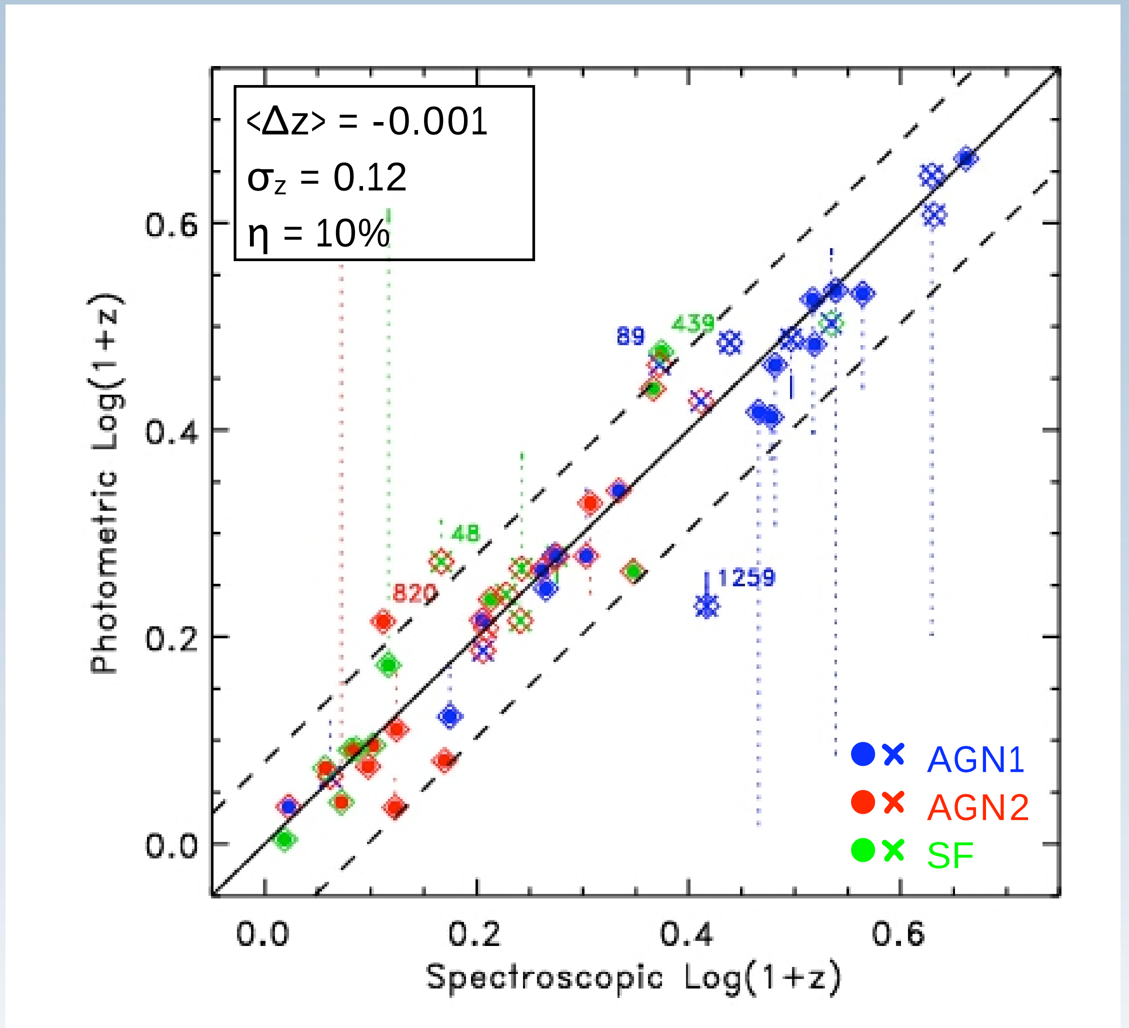
Photometric redshift requirements

<u>Photometric redshifts of AGN samples:</u>

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

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

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



Survey Strategy

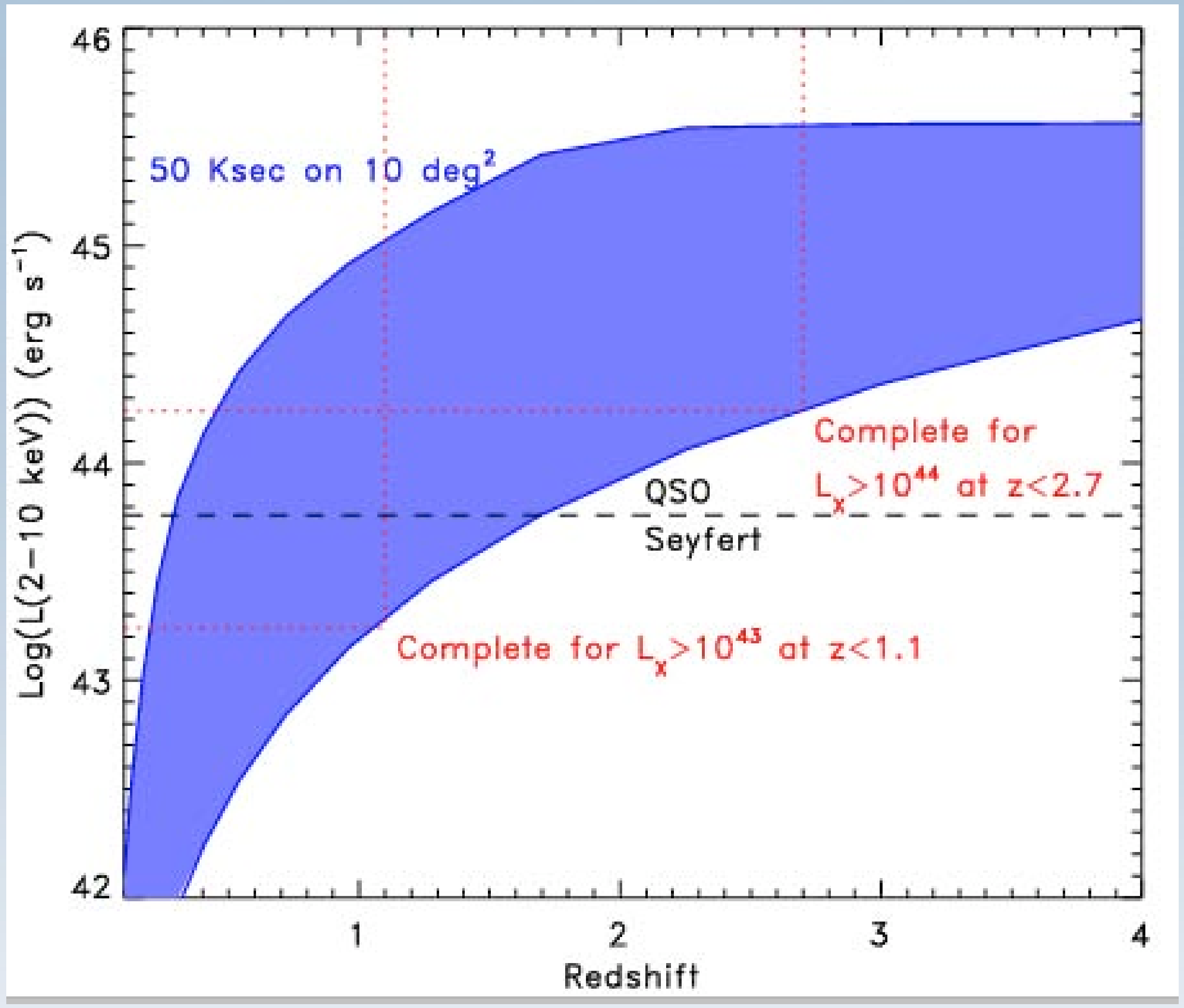
Multiple wide fields
> 3 fields of surface > 4 deg^2

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 deg^2 survey with 50 ksec exposure



Best field candidates

>4 deg^2 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 obscuing 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, outskirt, infalling regions, field.

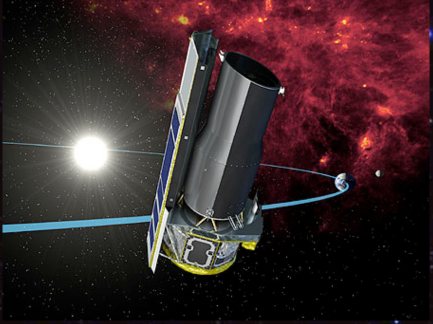
Is AGN activity triggered by mergers and interactions ?

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.

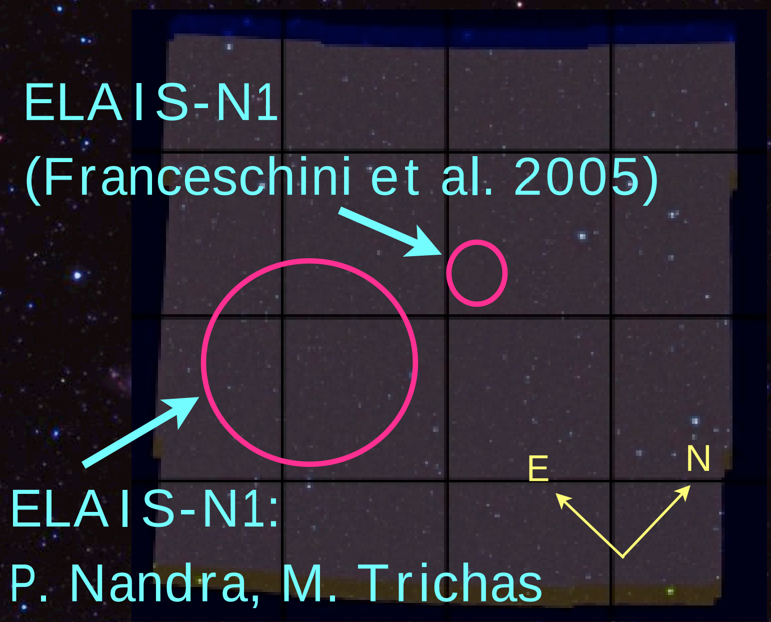


SWIRE Fields and X-ray coverage

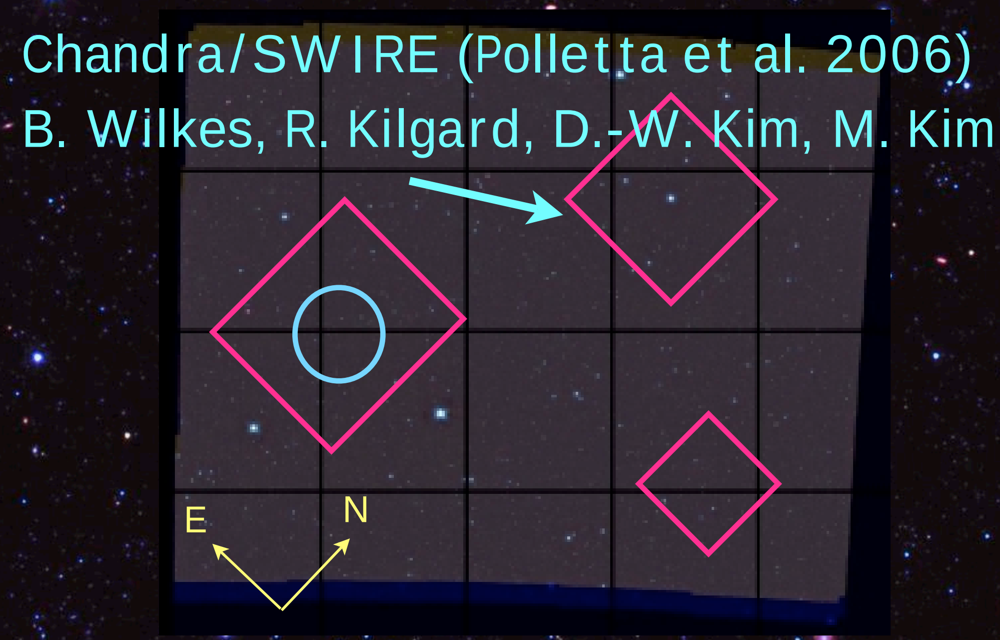
Spitzer: 49 deg^2 & X-ray: 16 deg^2

Chandra: 5 deg^2 & XMM-Newton: 11.5 deg^2

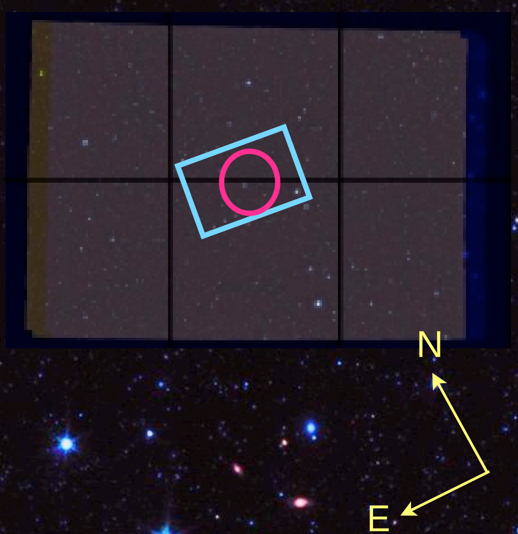
ELAIS-N1 (9 deg^2)



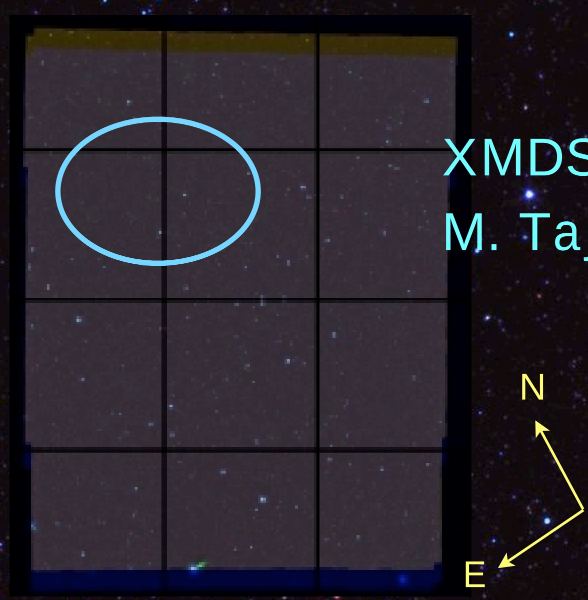
Lockman-Hole (11 deg^2)



ELAIS-N2 (4 deg^2)

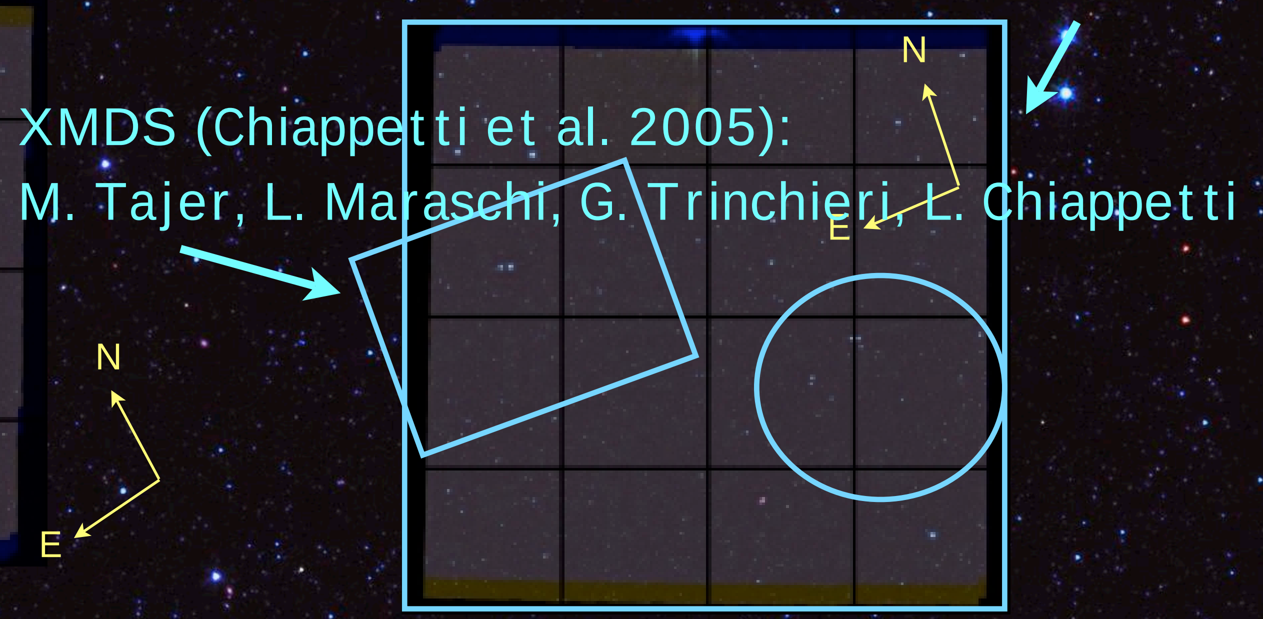


ELAIS-S1 (7 deg^2)

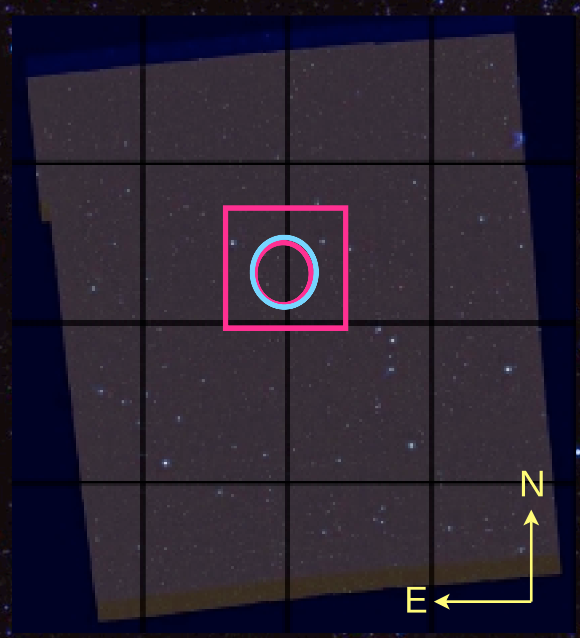


XMM-LSS (9 deg^2)

M. Pierre & the XMM-LSS Team



CDFS (8 deg^2)



SWIRE (PI: C. Lonsdale): (http://swire.ipac.caltech.edu/swire/swire.html)