Spectral Energy Distribution of highly-obscured AGN beyond the local Universe

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in collaboration with:
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Cosmic X-ray Background and obscured AGN

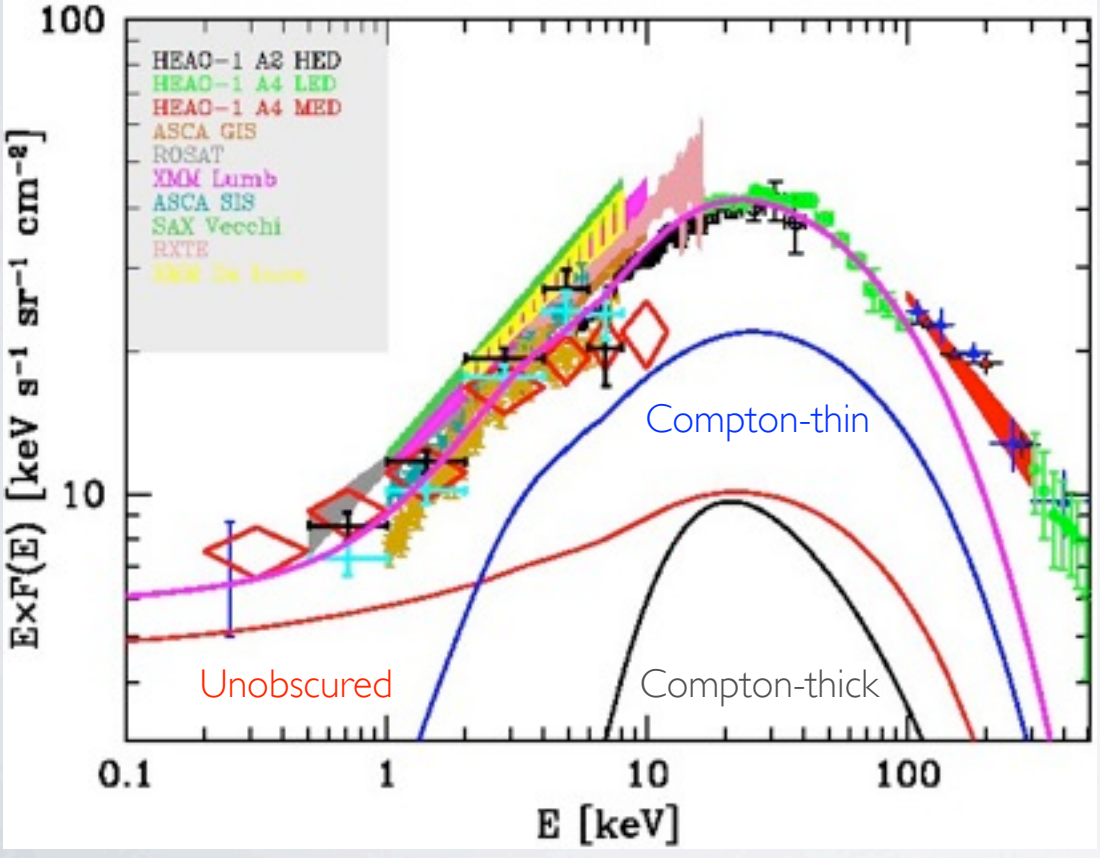
Deep X-ray surveys with Chandra and XMM resolved the XRB up to ~5 keV

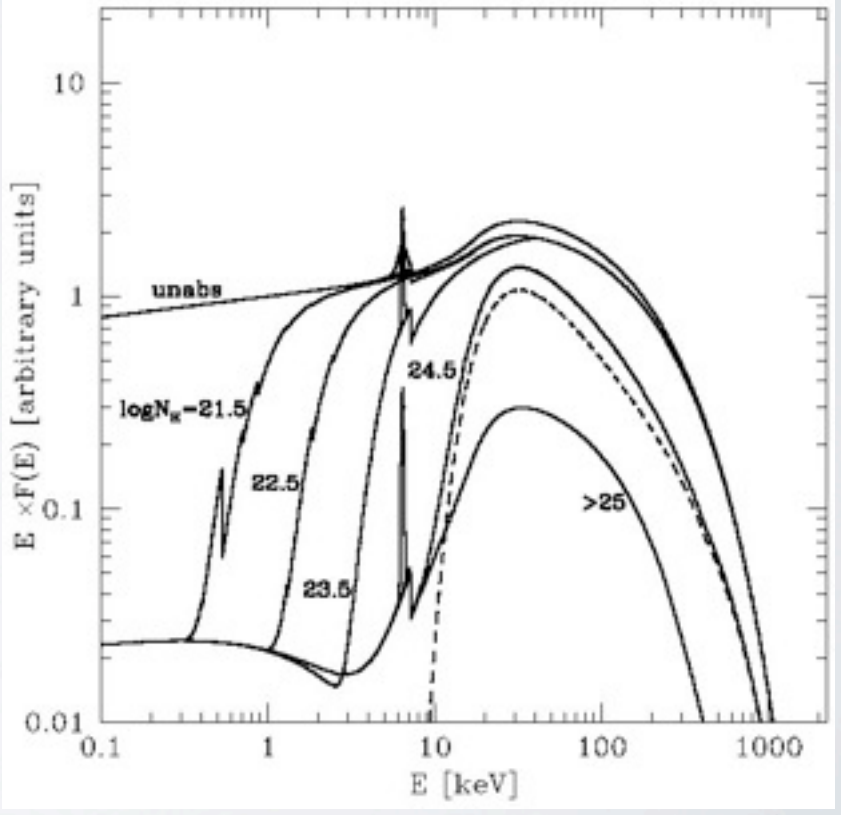
At ~7 keV only 50% is resolved

"Hidden" population of highly obscured AGN may explain the unresolved XRB

The XRB is the product of accretion onto SMBH integrated over cosmic history

A complete census of AGN is complicated by obscuration



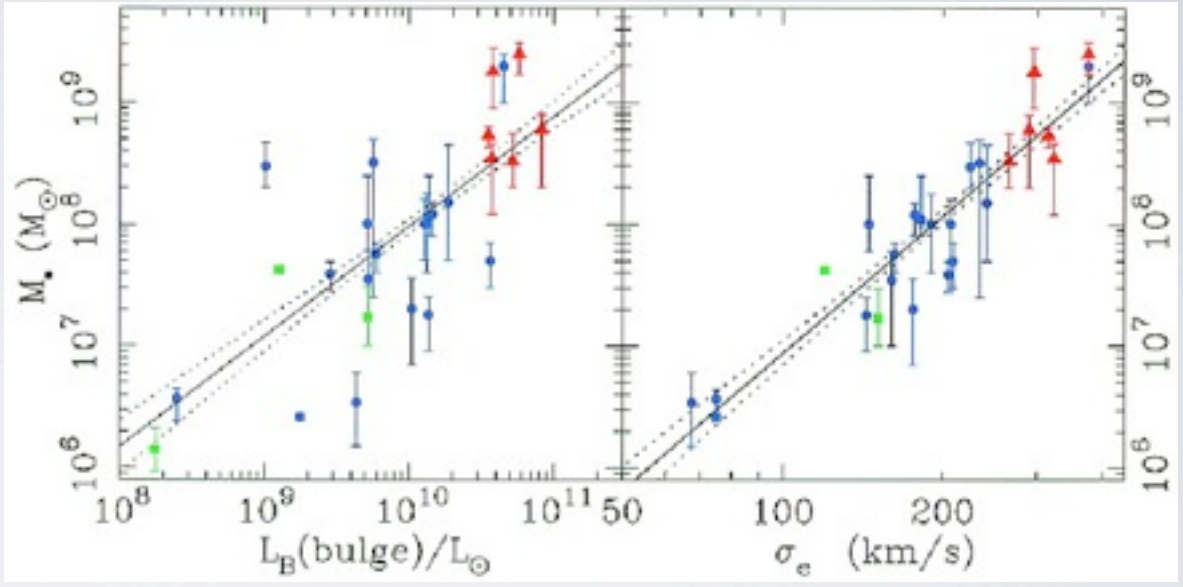


Gilli et al. (2007)

The link between AGN and galaxy properties

Galaxies and AGN are intimately connected

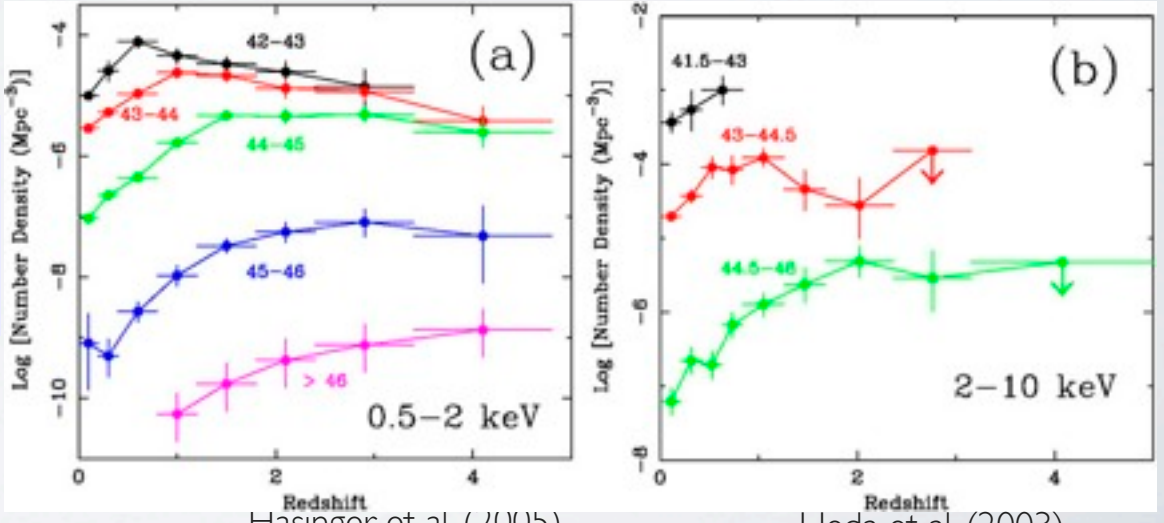
1. M_{BH} scales with properties (L_B, σ) of the host galaxy



Gebhardt et al. (2000)

2. AGN Luminosity dependent density evolution (LDDE)

Anti-hierarchical behavior of AGN or **'cosmic downsizing'** analogous to star-forming galaxies and massive spheroids

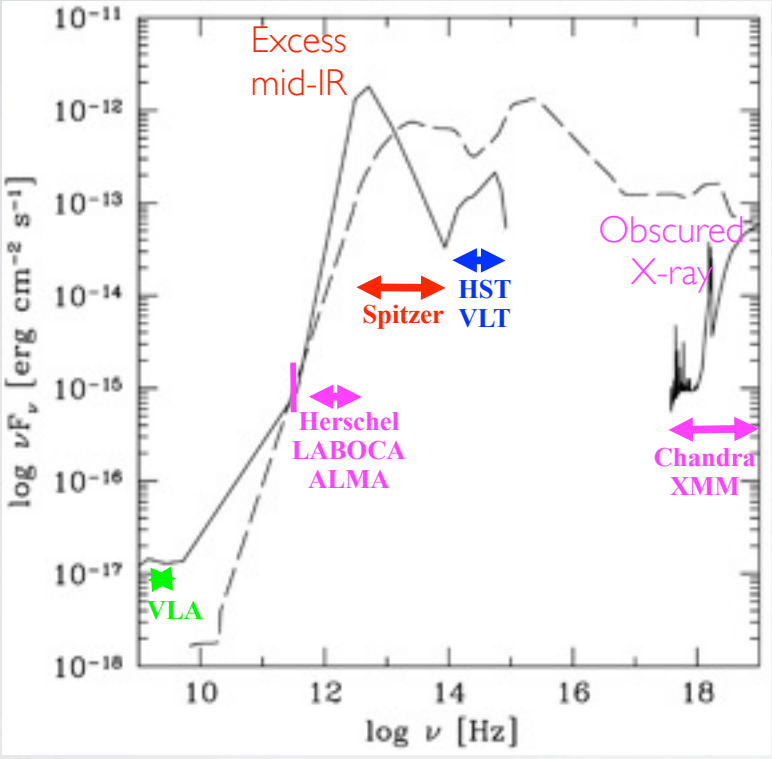


Hasinger et al. (2005)

Ueda et al. (2003)

SED of highly-obscured AGN

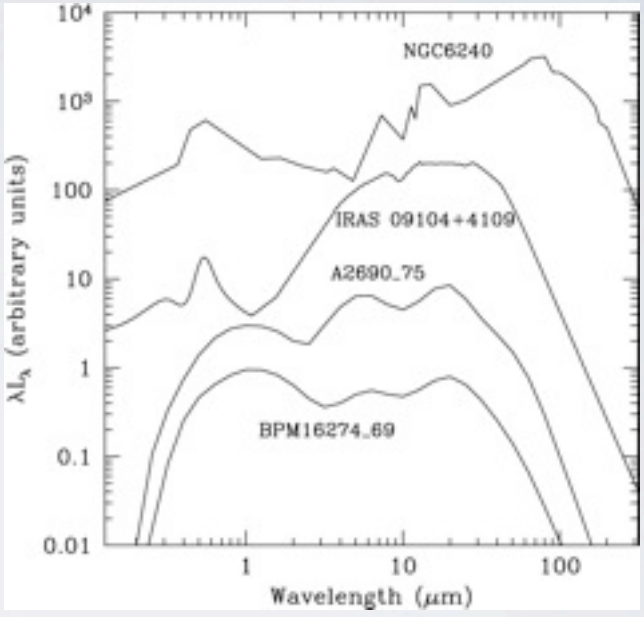
SED of NGC 6240 compared to average radio-quiet quasar



Comastri (2004)

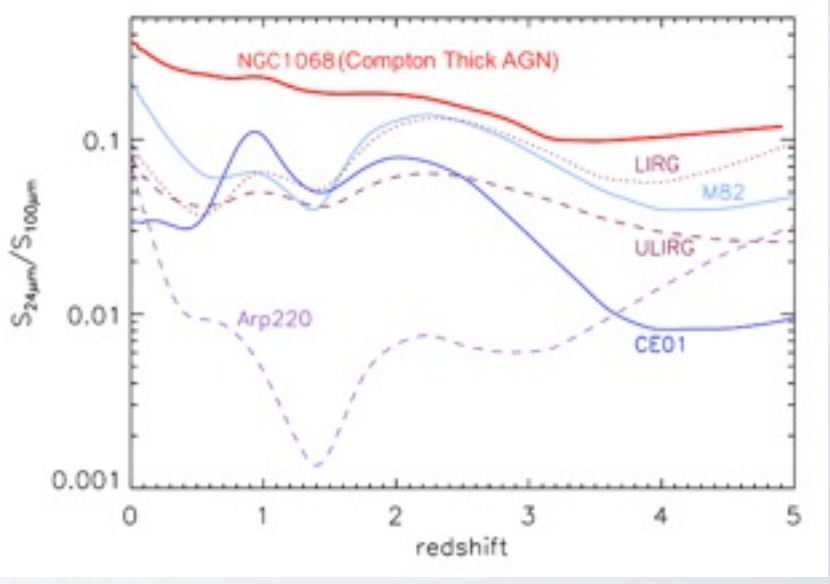
Use the deep **multi-wavelength** coverage of GOODS/CDFS to **characterize typical SEDs**

Template SED of highly-obscured AGN



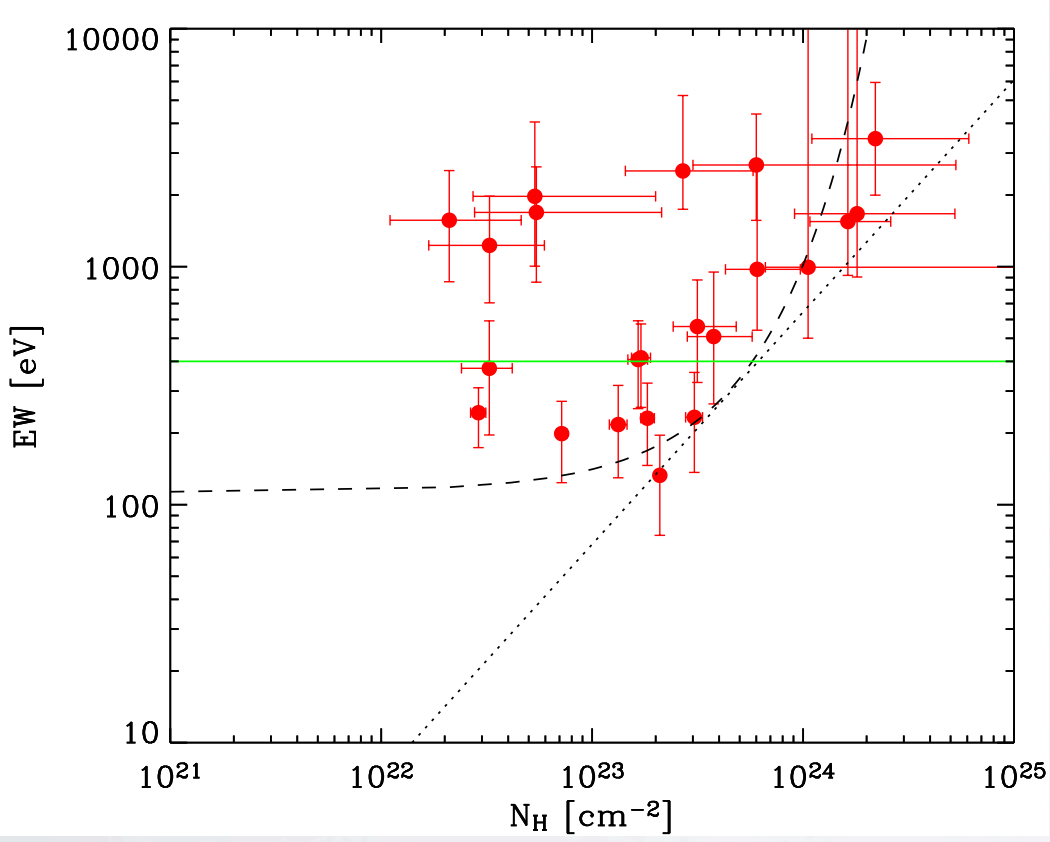
Fiore et al. (2008)

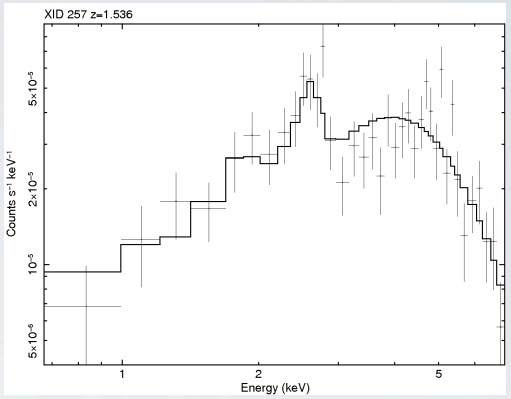
SED dependence on redshift and luminosity

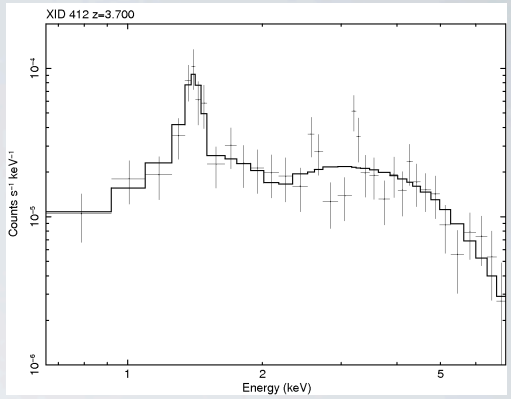


Sample selection

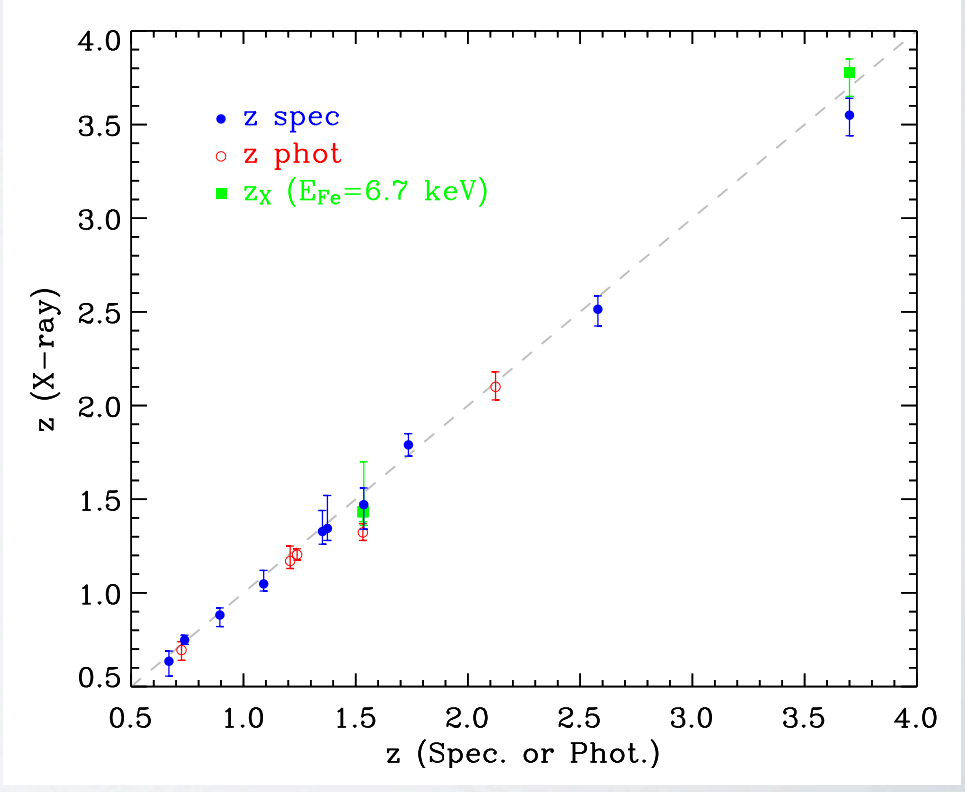
X-ray selected highly-obscured AGN
Strong Fe K line (EW>400 eV)



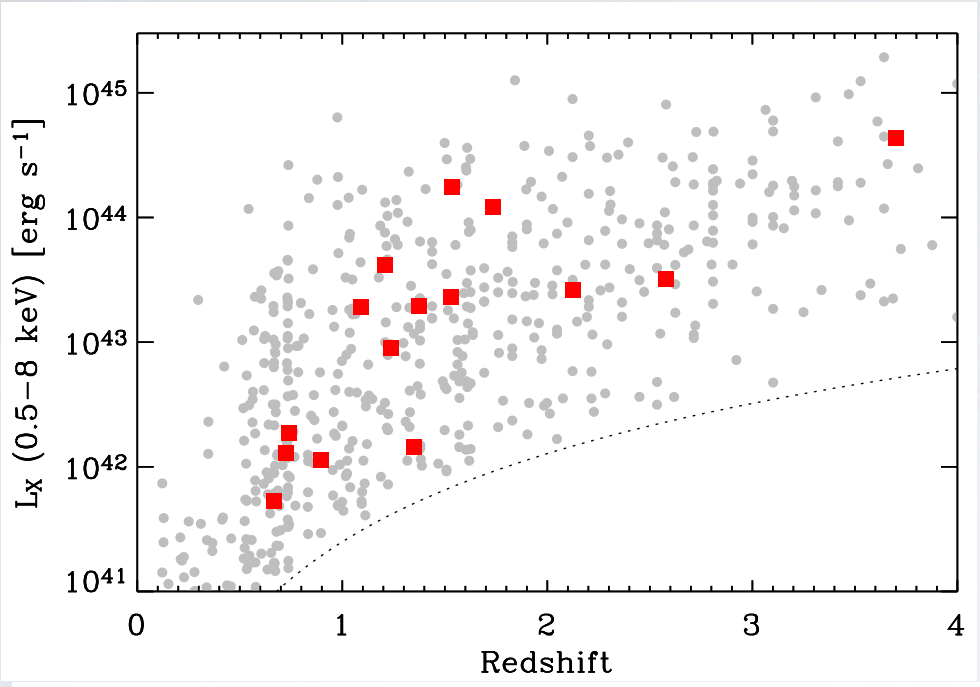


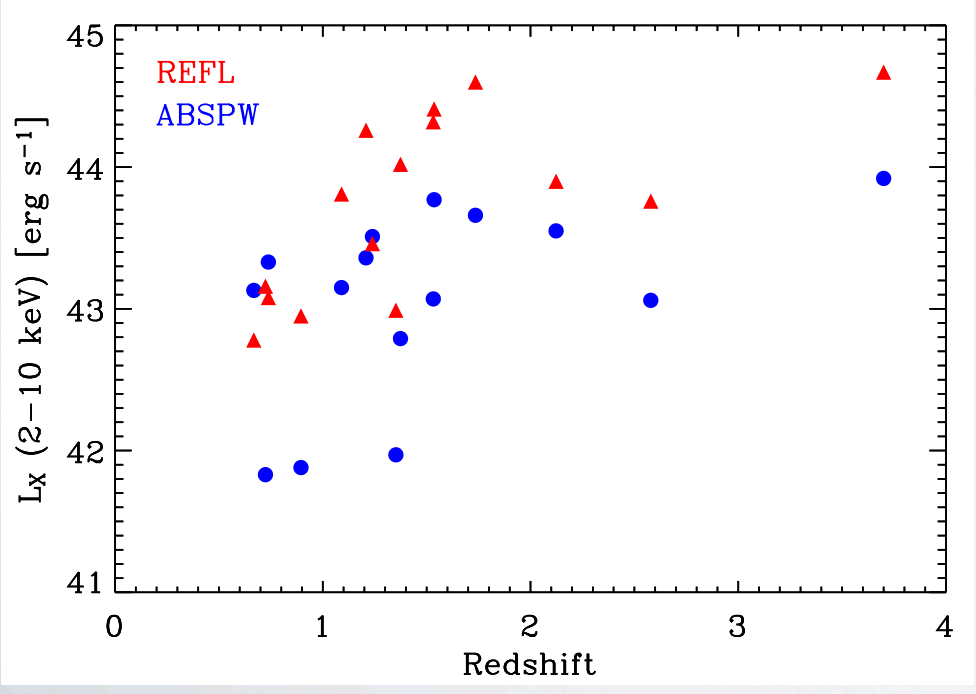


Chandra 4 Ms spectra fitted with an absorbed power law model



X-ray vs mid-IR properties

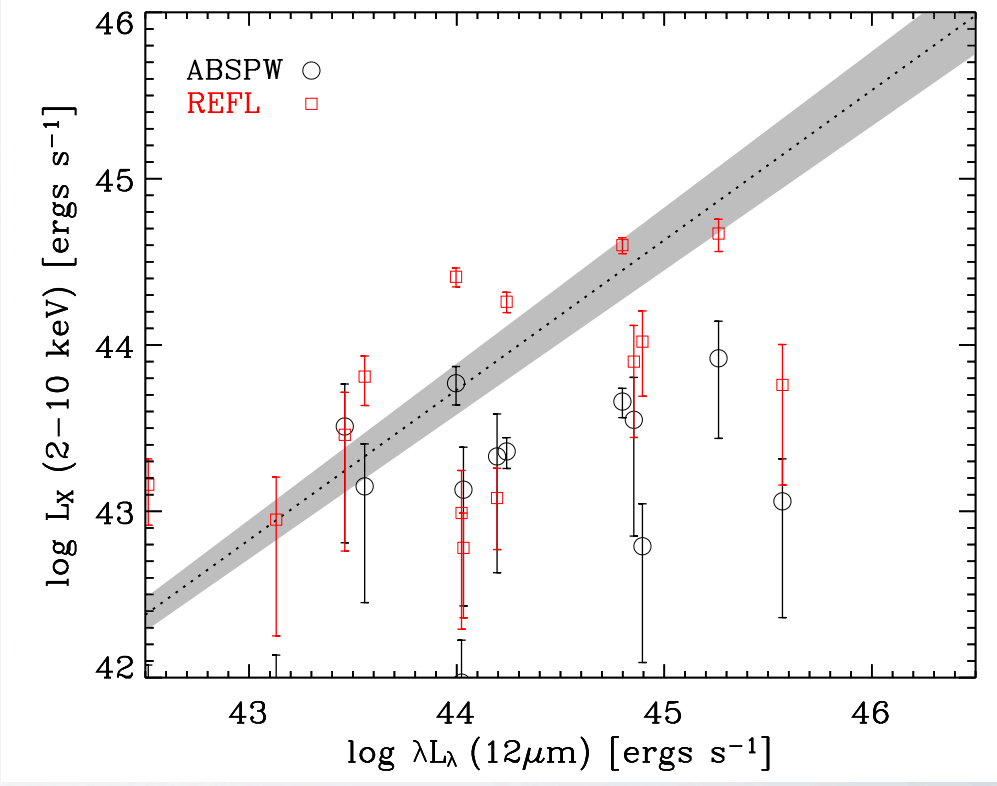




We select different AGN populations at different redshifts

How many are Compton-thick?

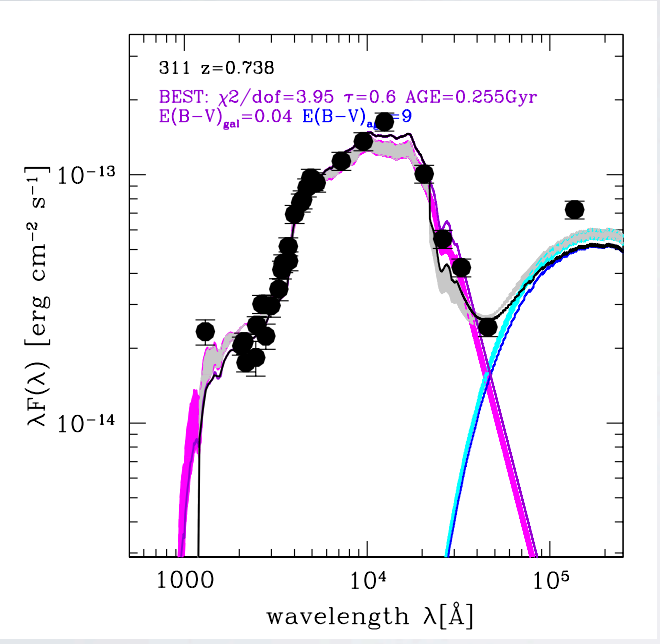
Diagnostic based on local L_X-L_{IR} cannot be used at high-z due to contamination of SF of host

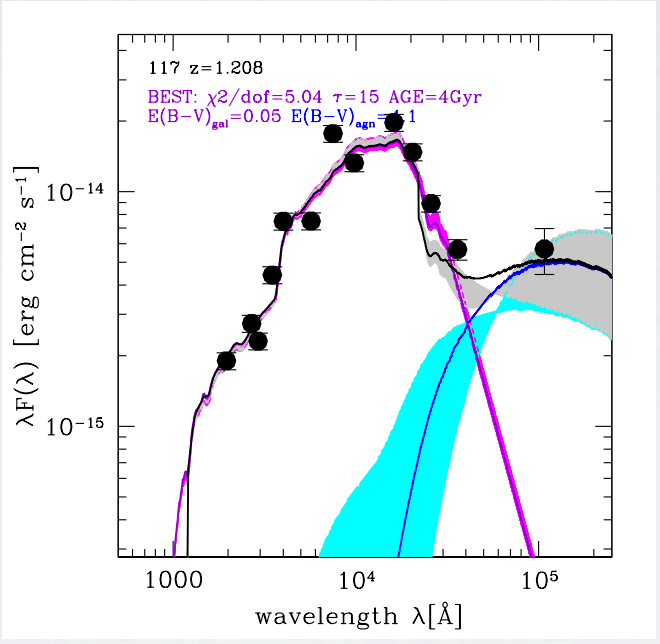


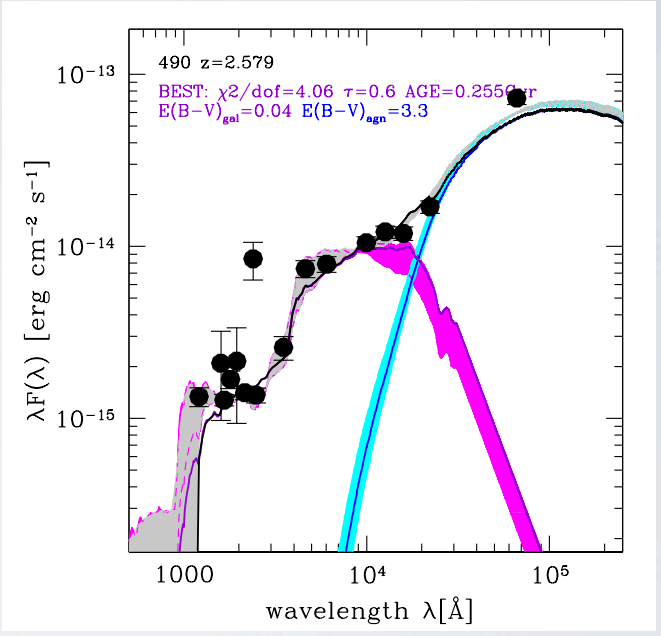
SED fits

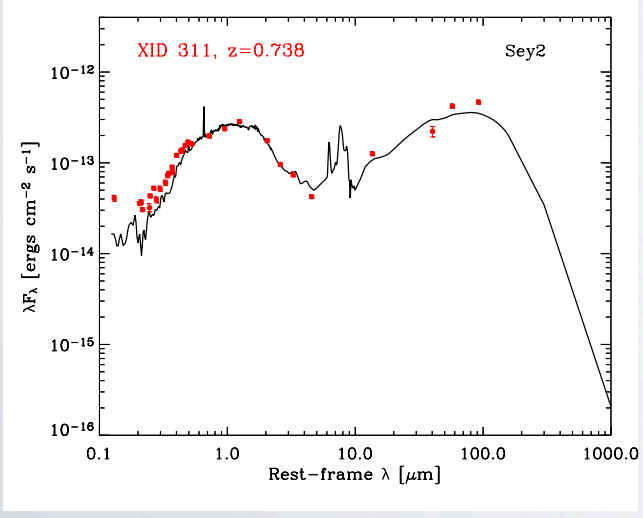
SED fit decomposition
to separate AGN from the host galaxy

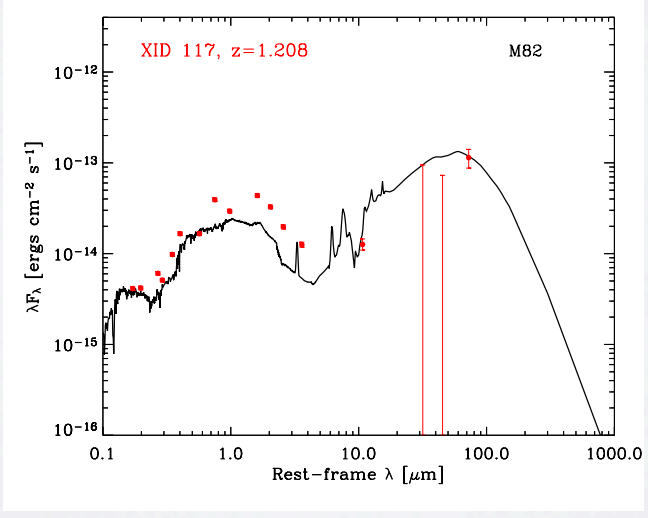
- M*
- SFR

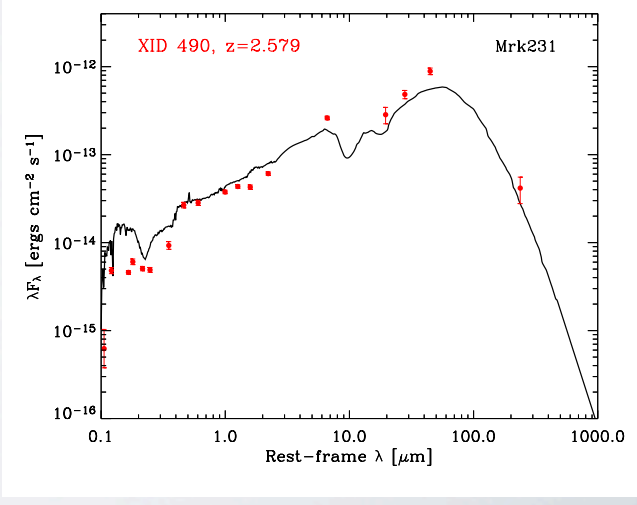




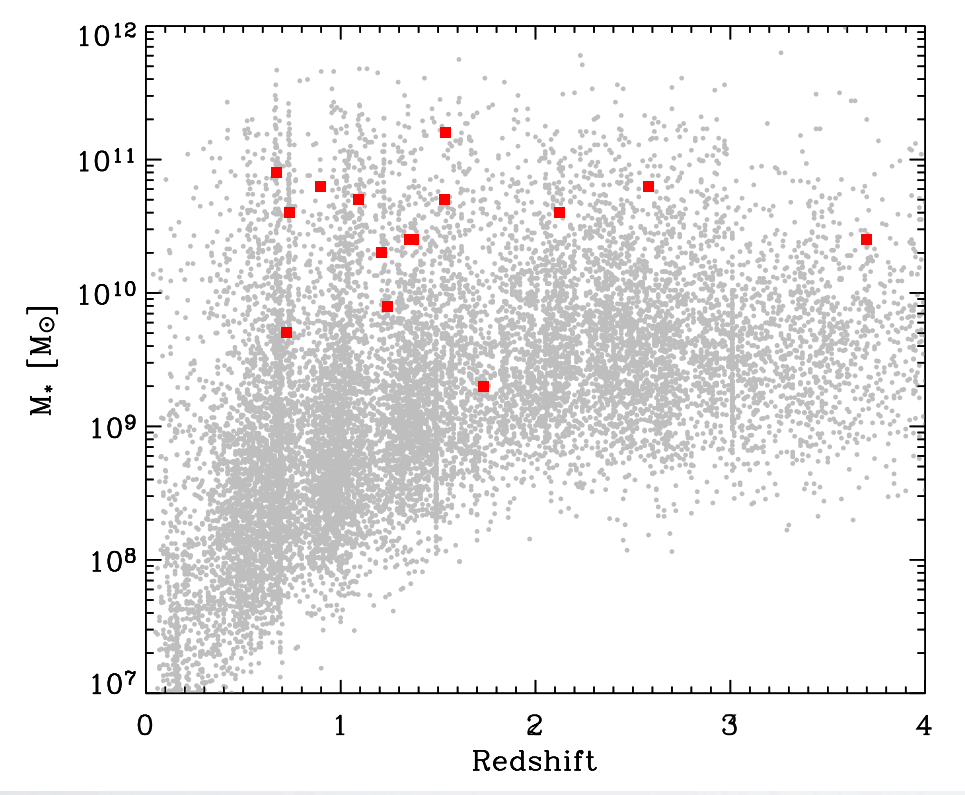


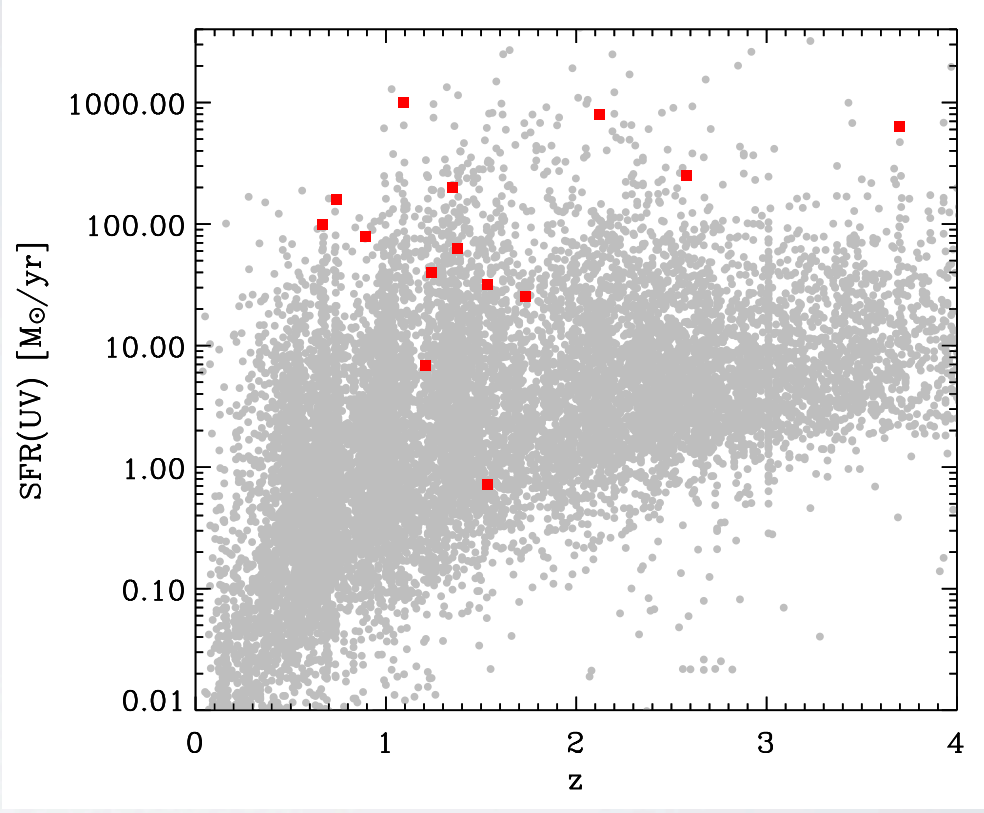






SED fit results: M* and SFR





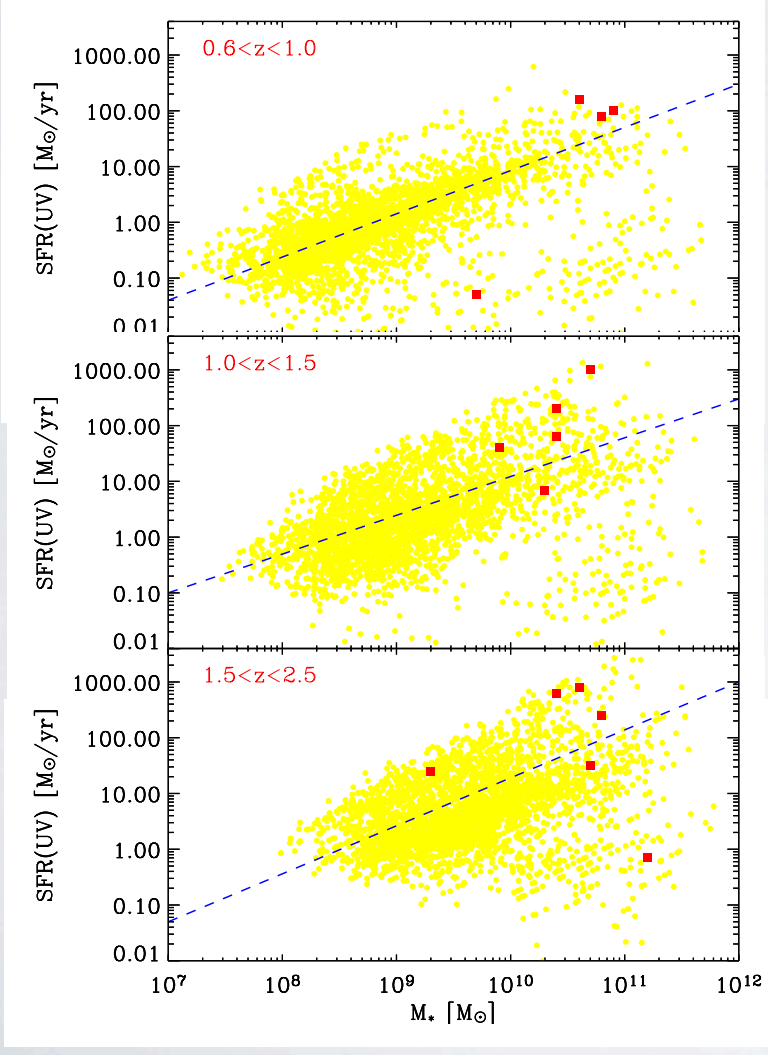
Highly-obscured AGN are hosted by

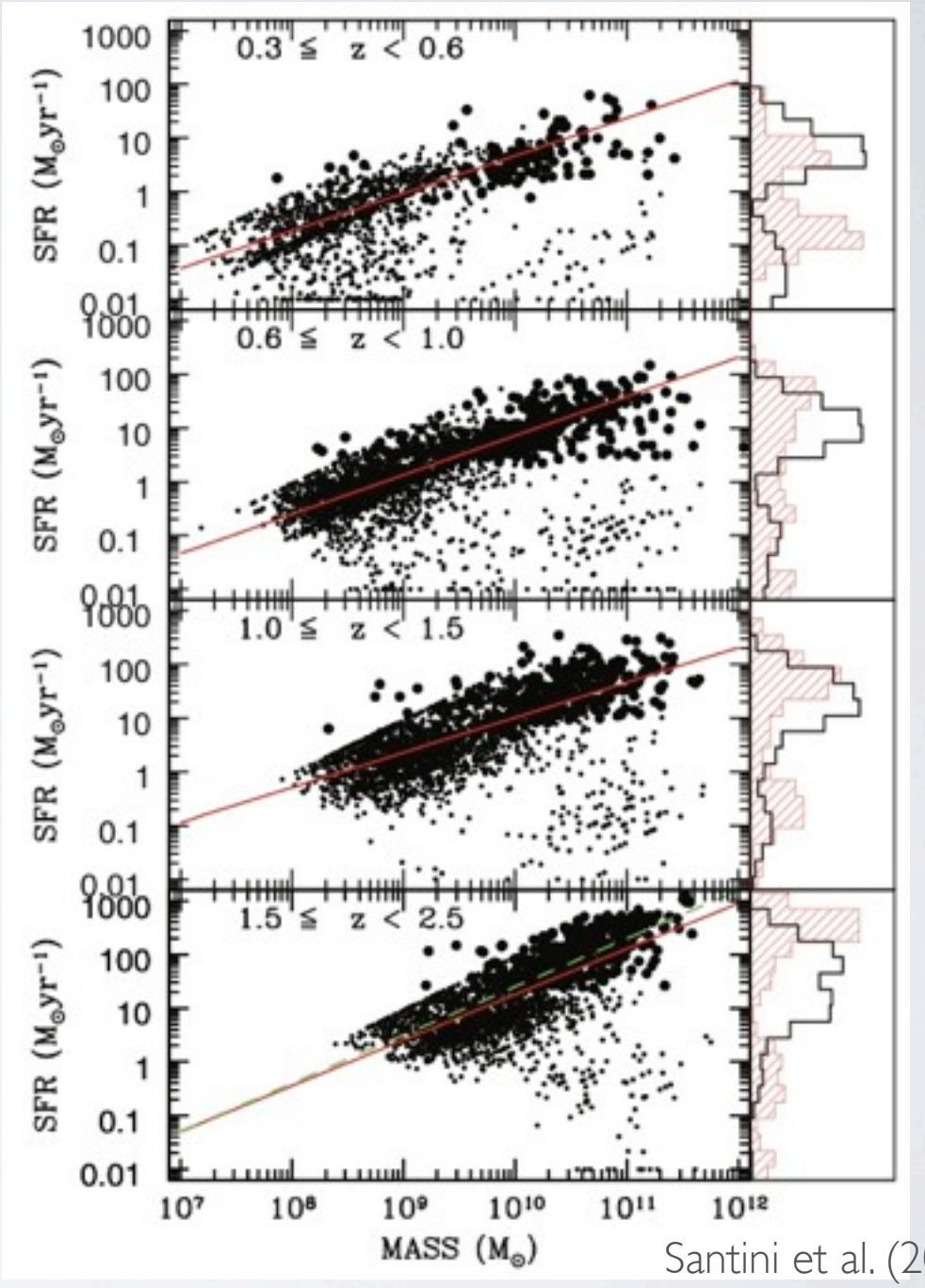
- **massive galaxies**
(e.g. Brusa et al. 2009, Silverman et al. 2009, etc.)

- **with relatively high SFR**
(e.g. Santini et al. 2012)

SFR - Comparison with "main sequence" galaxies

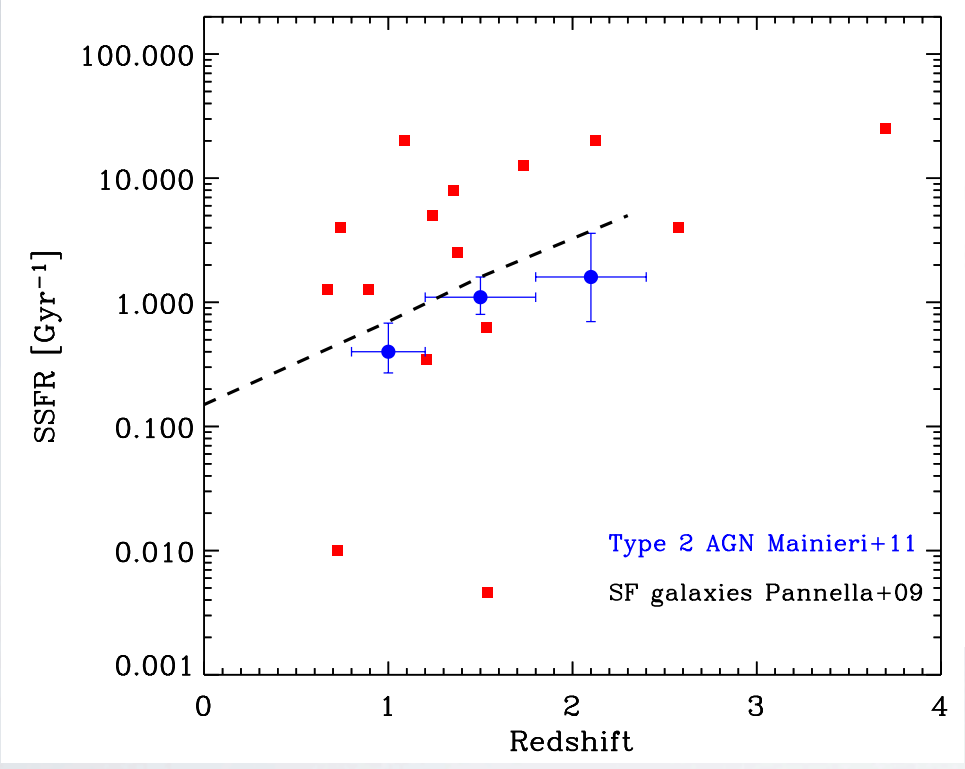
Broadly consistent with main sequence galaxies

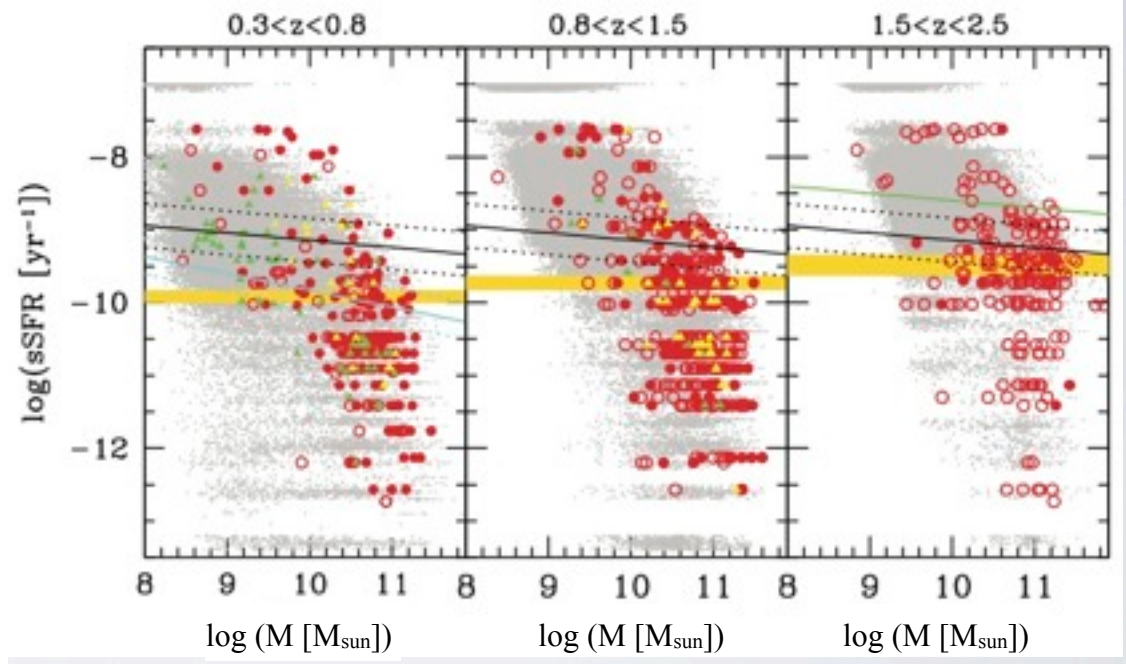




Santini et al. (2009)

SSFR - Comparison with other samples





Bongiorno et al. submitted

SSFR (SFR per unit Mass) on average in agreement with that of SF galaxies and other samples of Type2 AGN

Larger samples from COSMOS show the same trend of increasing SSFR with redshift

Conclusions

We selected a sample of **15 highly-obscured AGN (N_H>10^{43} cm^{-2})** via X-ray spectral analysis of the 4Ms Chandra data

- **Detection of relatively strong Fe line (EW>400 eV)**

We analyzed their SED via fit decomposition to separate AGN from host galaxy

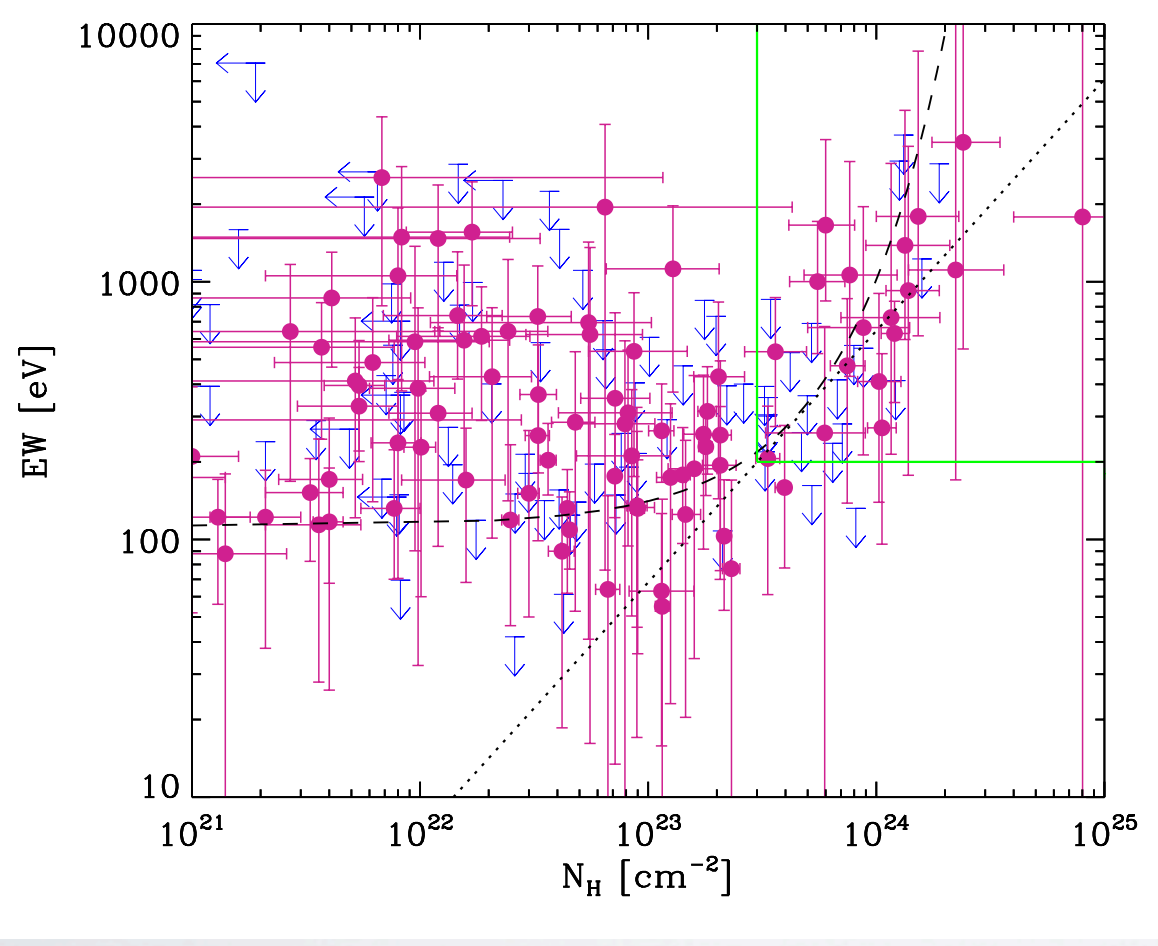
- **M_* and SFR are broadly consistent with "main sequence" galaxies**

We find a trend of **increasing specific SFR toward high redshifts** consistent with that found for normal star-forming galaxies

This suggests a similar evolutionary path for the host galaxies of highly-obscured AGN and "non-active" galaxies

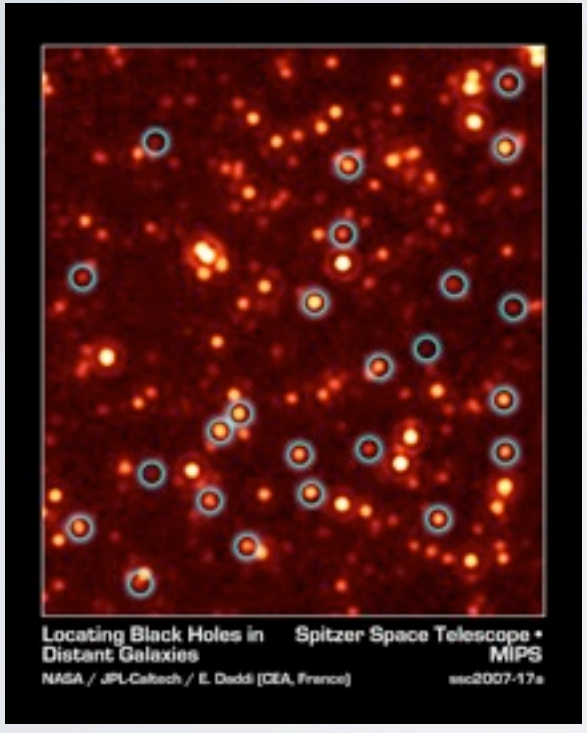
Most galaxies must have built up their mass by secular gas accretion, while mergers only play a role in the formation of the most massive QSO

Extras



Heavily obscured AGN selected by mid-IR excess

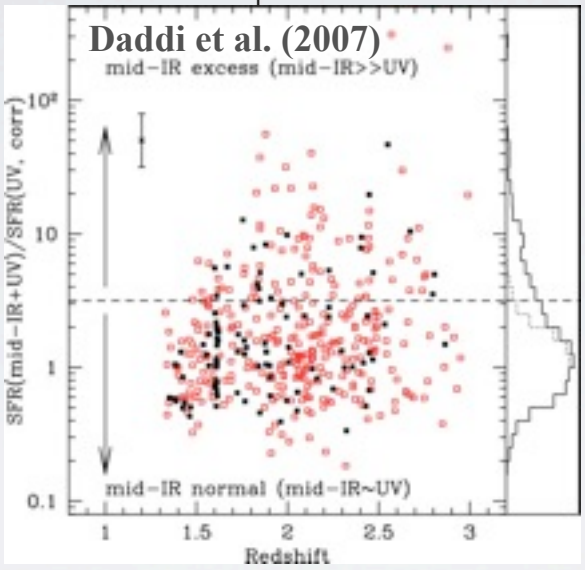
Deep Spitzer MIPS 24 μm image

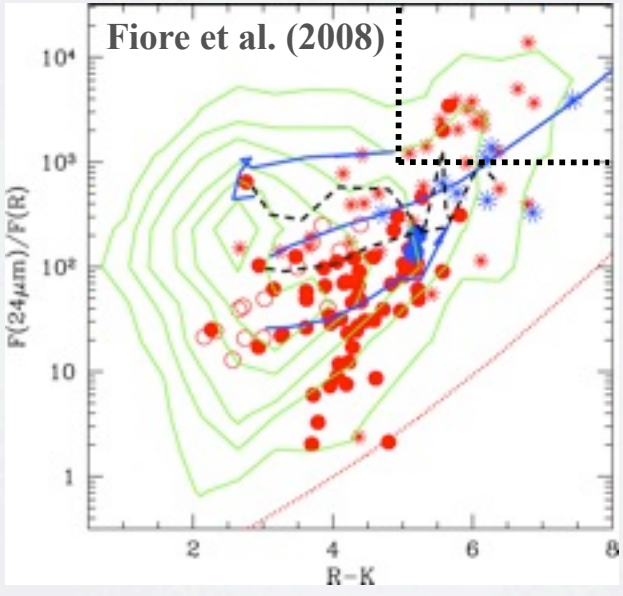


Daddi et al. (2007)

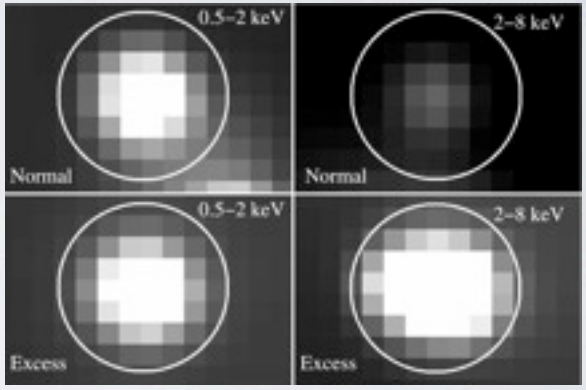
'Mid-IR excess' objects selected by

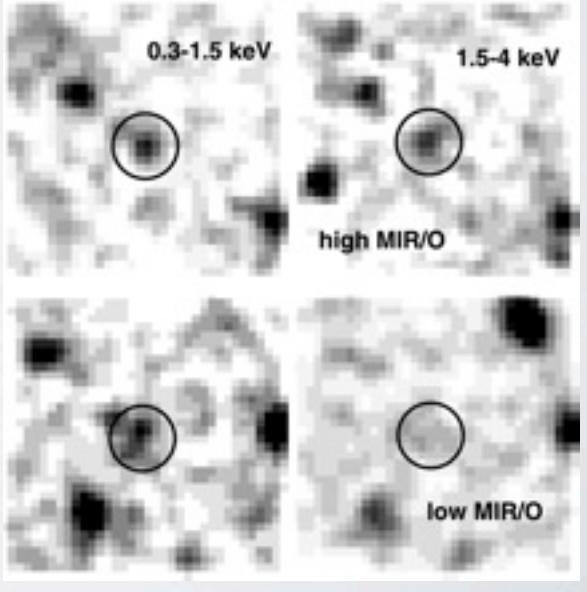
mid-IR/optical colors





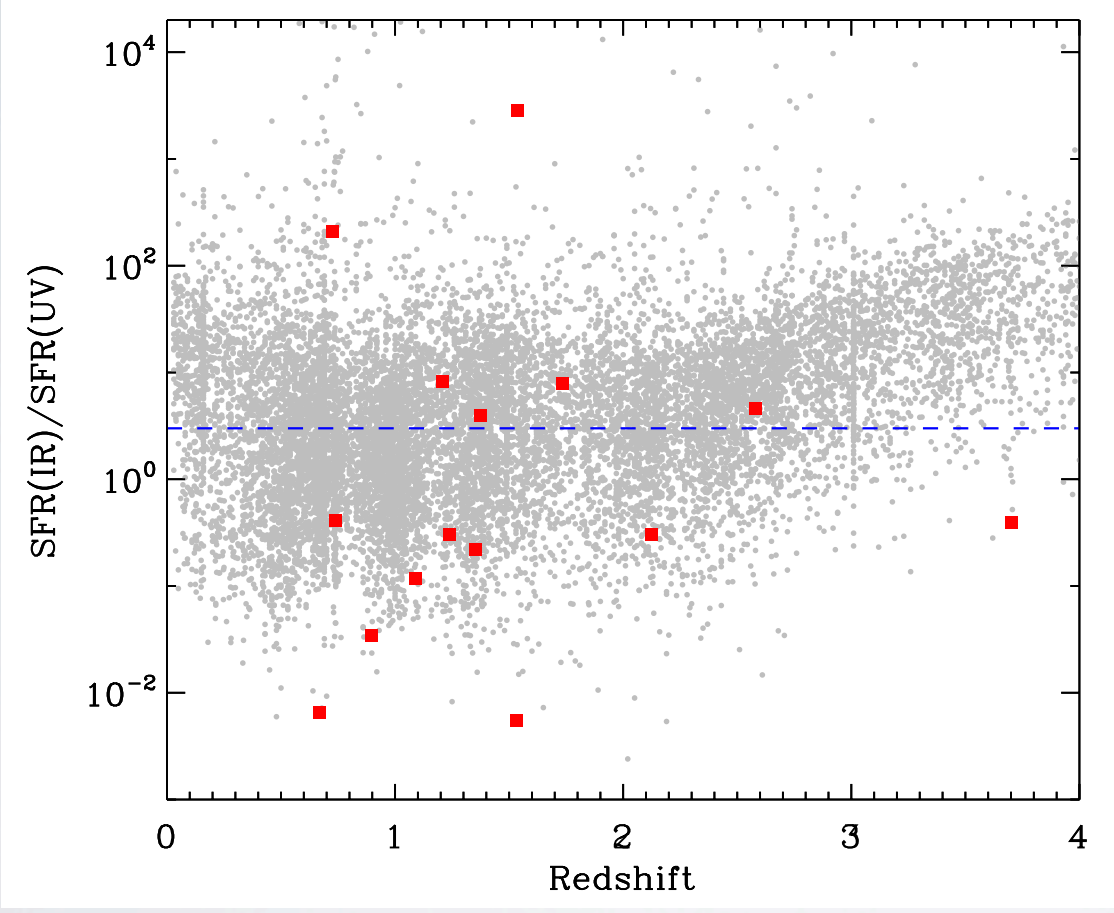
X-ray stacked images in the CDF-N and -S of 'mid-IR excess' sources revealed a population of obscured AGN at z~2





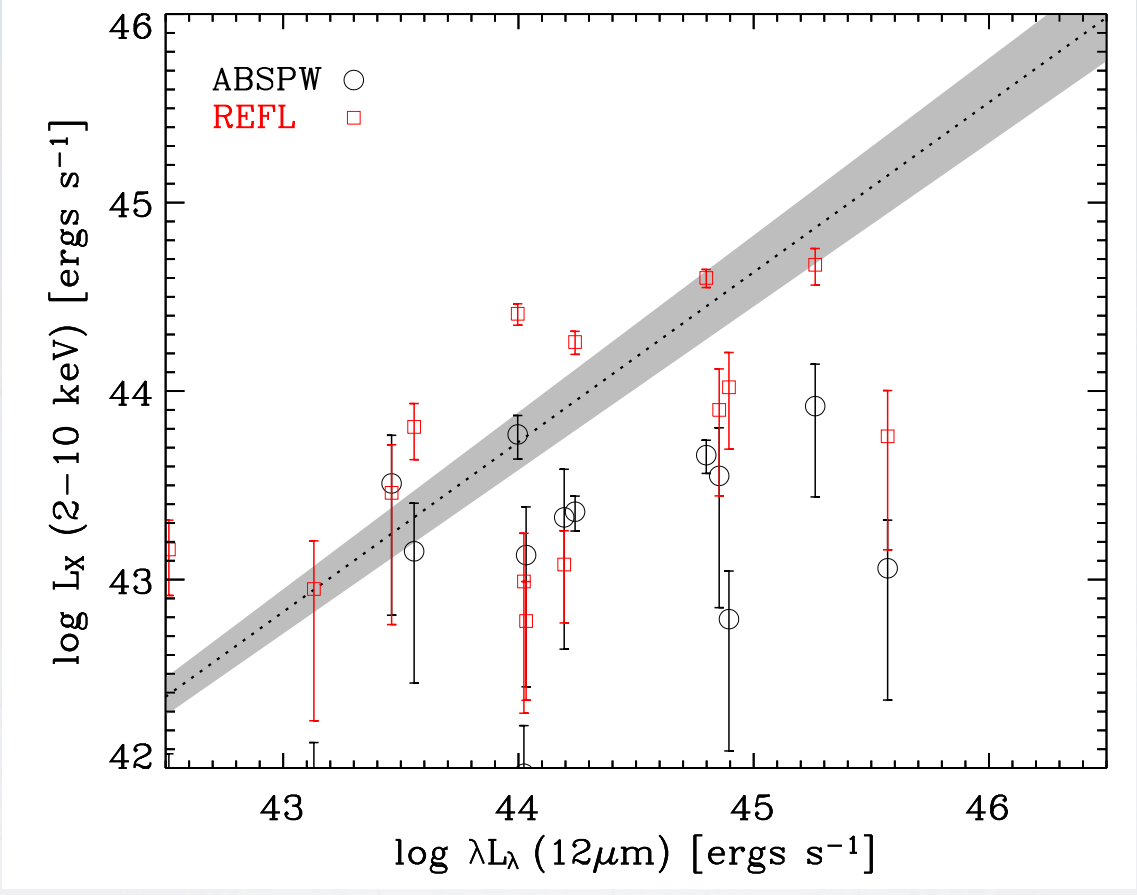
Selection based on "mid-IR excess"

SRF(IR)/SFR(UV)



Only ~40% are mid-IR excess sources

X-ray vs mid-IR luminosities

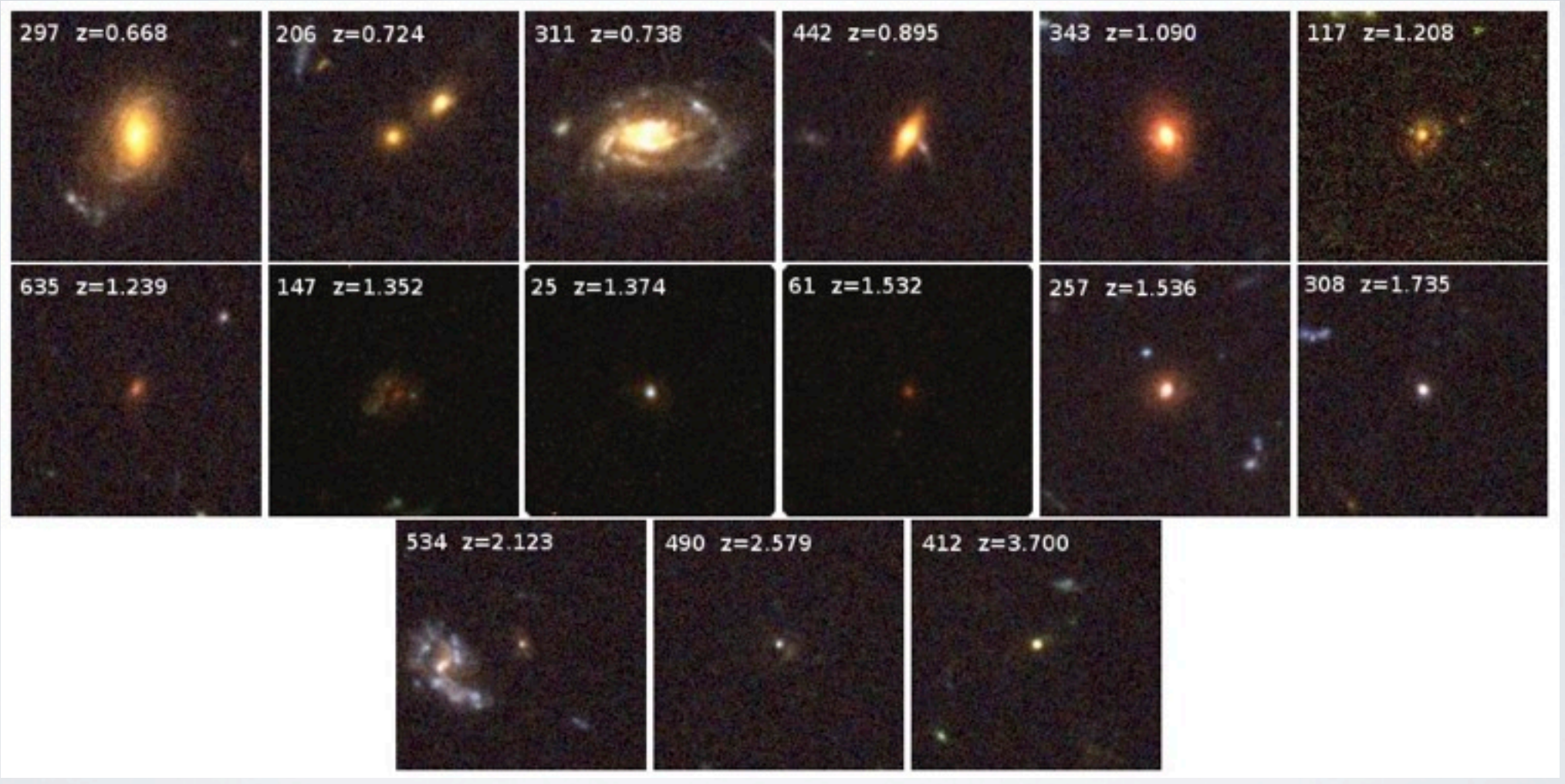


Looking for Compton-Thick AGN

ABSPW = Transmission dominated model

REFL = Reflection dominated model

Morphology of host galaxies



Significance of the Fe K line

Significance of the Fe line tested through simulations

All lines are detected at >96% c.l.