

Star Formation in AGN hosts in GOODS-N

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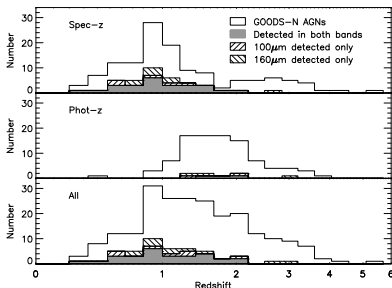


Motivation

Measuring star formation in AGN hosts is one of the keys to study AGN evolution. At $z \sim 1$, *Herschel*/PACS provides direct measurement to the far-infrared SED peak, which is a good proxy of star formation rate. *Herschel* also has high sensitivity to detect much lower star formation rates than previous FIR/submm telescopes.

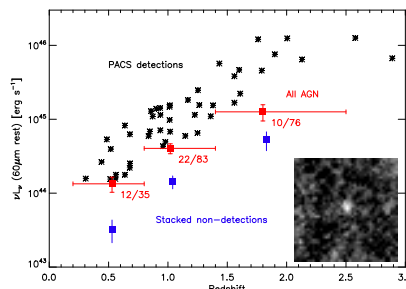
Data

We select 224 AGN from 2Ms Chandra X-ray catalog, with a combination of criteria to distinguish X-ray AGN from star formation dominated objects (Bauer et al. 2004). We use both spectroscopic (Barger et al. 2008) and photometric redshifts.



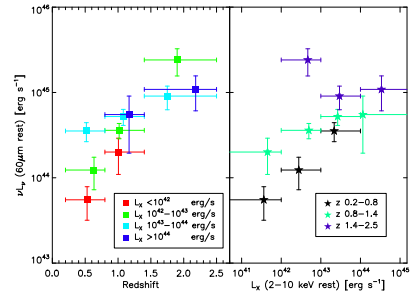
Results

The rest frame 60µm luminosity is calculated from the detection wavelength closer to rest 60µm or logarithmically interpolating from both bands at $0.67 < z < 1.67$. For undetected sources, we use stacked 100µm and 160µm fluxes to derive the mean rest $\nu L_{\nu}(60\mu\text{m})$, adopting median z of the particular sample in small redshift bins.

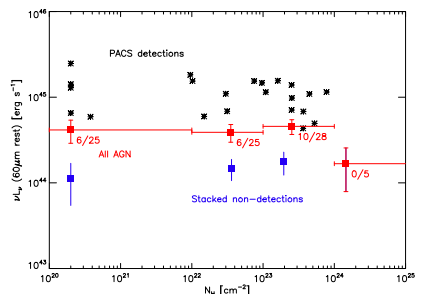


FIR luminosity as a function of redshift. The red symbols are the average of the detections and nondetections. The errors are from bootstrap. Bottom-right is an example of stacked image.

The detection number is large enough to allow us to split the sample into smaller bins, both in z and L_X .

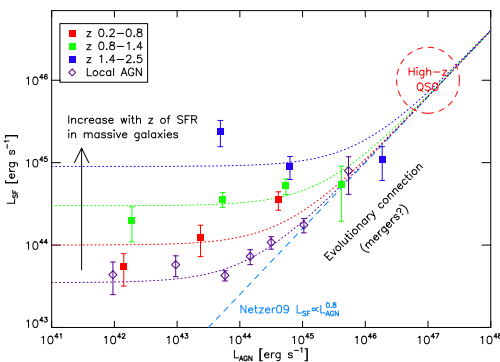


This figure shows our effort to break the redshift/luminosity degeneracy. Left: FIR luminosity as a function of redshift, for different bins in intrinsic rest frame 2-10keV luminosity. Right: FIR luminosity as a function of intrinsic X-ray luminosity, for different redshift bins.



Far-infrared luminosity as a function of X-ray obscuring column. Sample for redshifts $0.8 < z < 1.4$. Low obscuring column objects have been placed at $2 \times 10^{20} \text{cm}^{-2}$. There is no significant trend of L_{IR} with column density.

AGN/host relation: two modes of co-evolution



Left figure shows star forming (=far-infrared) luminosity as a function of AGN bolometric luminosity (converted from L_X , see eq. 5 of Maiolino et al. 2007) for GOODS-N AGN and a local ($z < 0.3$) reference sample of extremely hard X-ray selected *Swift*/BAT AGN.

The dotted lines indicate schematically how the observations are explained by **two modes of AGN/host co-evolution**.

The dashed line in the left figure is the relation implied by Netzer et al. (2009) with their local bright Seyferts sample. It extends to higher luminosities where the high redshift QSOs reside. There seems to be **an evolutionary mechanism, likely merging, to make host star formation tightly coupled with AGN activity**, i.e. this diagonal trend 'evolutionary connection'.

However, at lower AGN luminosities, the data points deviate from the log-linear correlation. We propose the 'flatten' part reflects a **secular evolution without close coupling of AGN luminosity and galaxy-integrated host star formation**. The hosts star formation of moderate luminous AGN are similar to that for the general galaxy population at the same redshift, which corresponds to the increase of secular star formation rate from local Universe to $z \sim 2$.