Accreting SMBHs in the COSMOS field and the connection to their host galaxies

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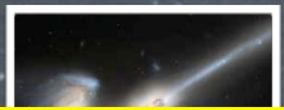
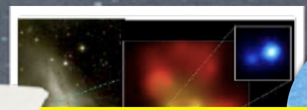
AGN/galaxy co-evolution





- Is the AGN feedback responsible for determining the properties of the host galaxy?

or

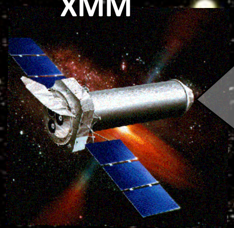
- Are AGN a by-product of star-formation activity and morphological evolution of their hosts?

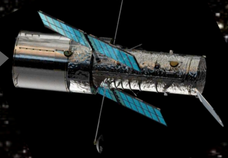
Cosmic Evolution Survey

COSMOS

Multi-wavelength Data

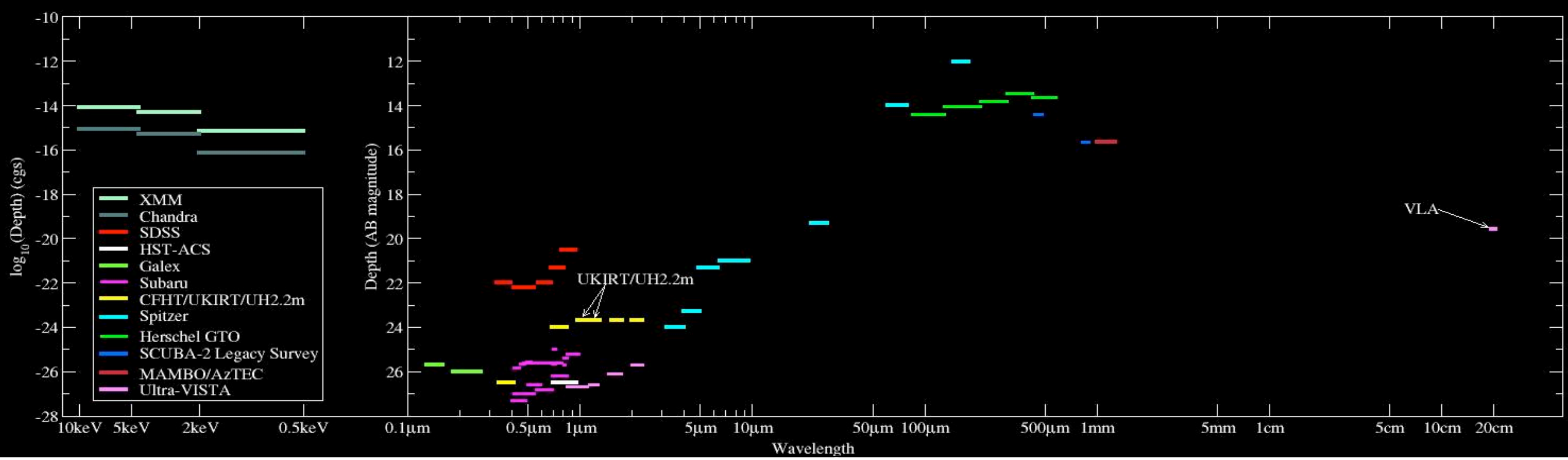
- VLA 1.4 GHz – 7 μJy
- Spitzer-IRAC 3-8 μm – 10 μJy
- Spitzer-MIPS 24 μm – 15 mJy
- HST-ACS – i_{AB}~27
- Subaru Bvriz – m_{AB}~27
- GALEX N/F UV – m_{AB}~26
- FIR PEP-Herschel
- XMM 0.5-10 keV – 10^{-15} cgs
- Chandra 0.5-2 keV - $2x10^{-16}$cgs (1 deg^2)





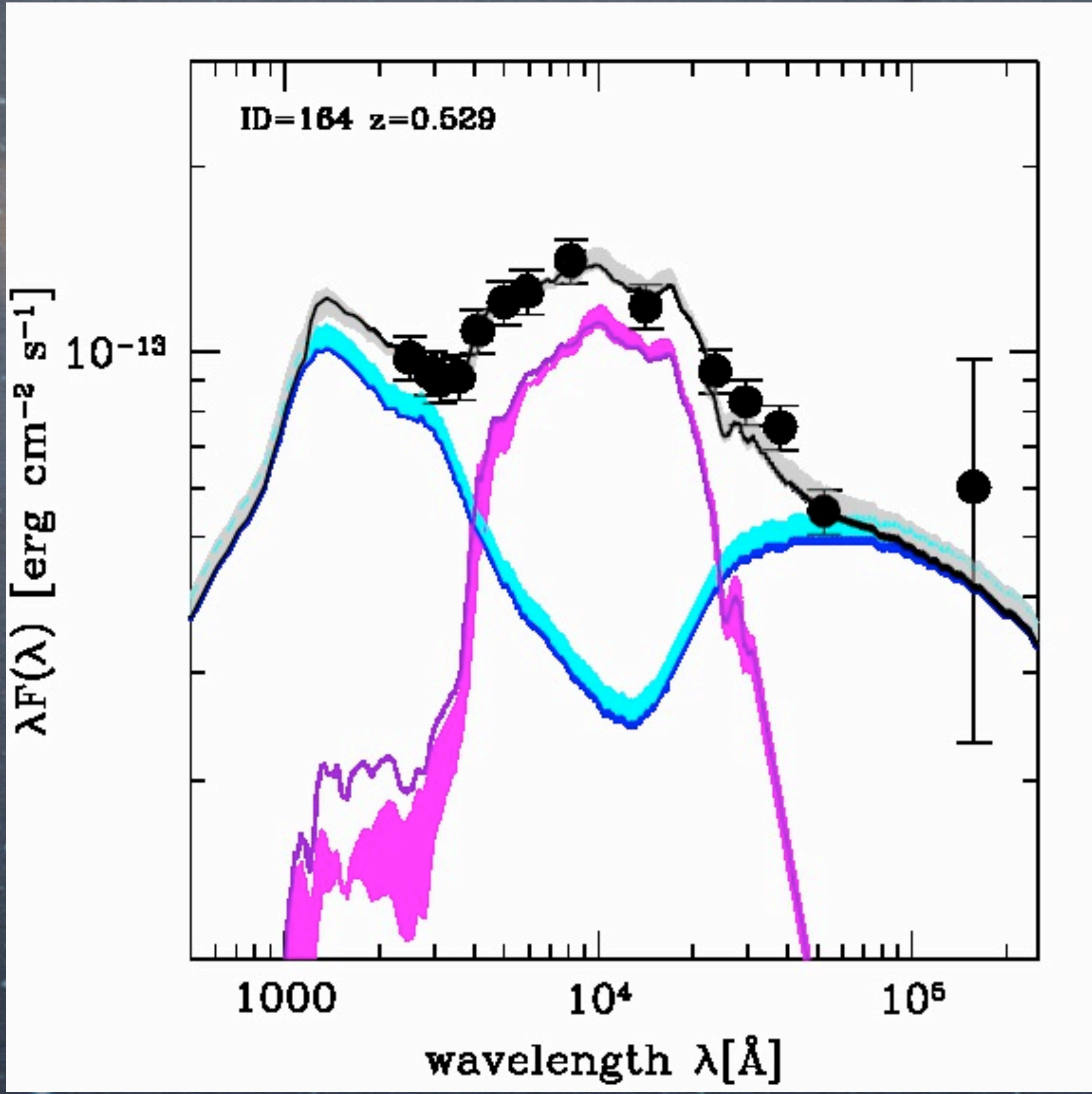
Spitzer

Chandra



Optical-NIR 2-component SED fitting

Used Bands
6 SUBARU bands
K band (CFHT)
4 Spitzer/IRAC
24m Spitzer/MIPS



- AGN templates:
  - Richards et al. (2006)
  - E(b-v)=0-3 in 0.01 steps
- Galaxy templates:
  - Libr. of synthetic sp. (Bruzual & Charlot)
    - a) 10 declining SFH
    - b) 1 constant SF

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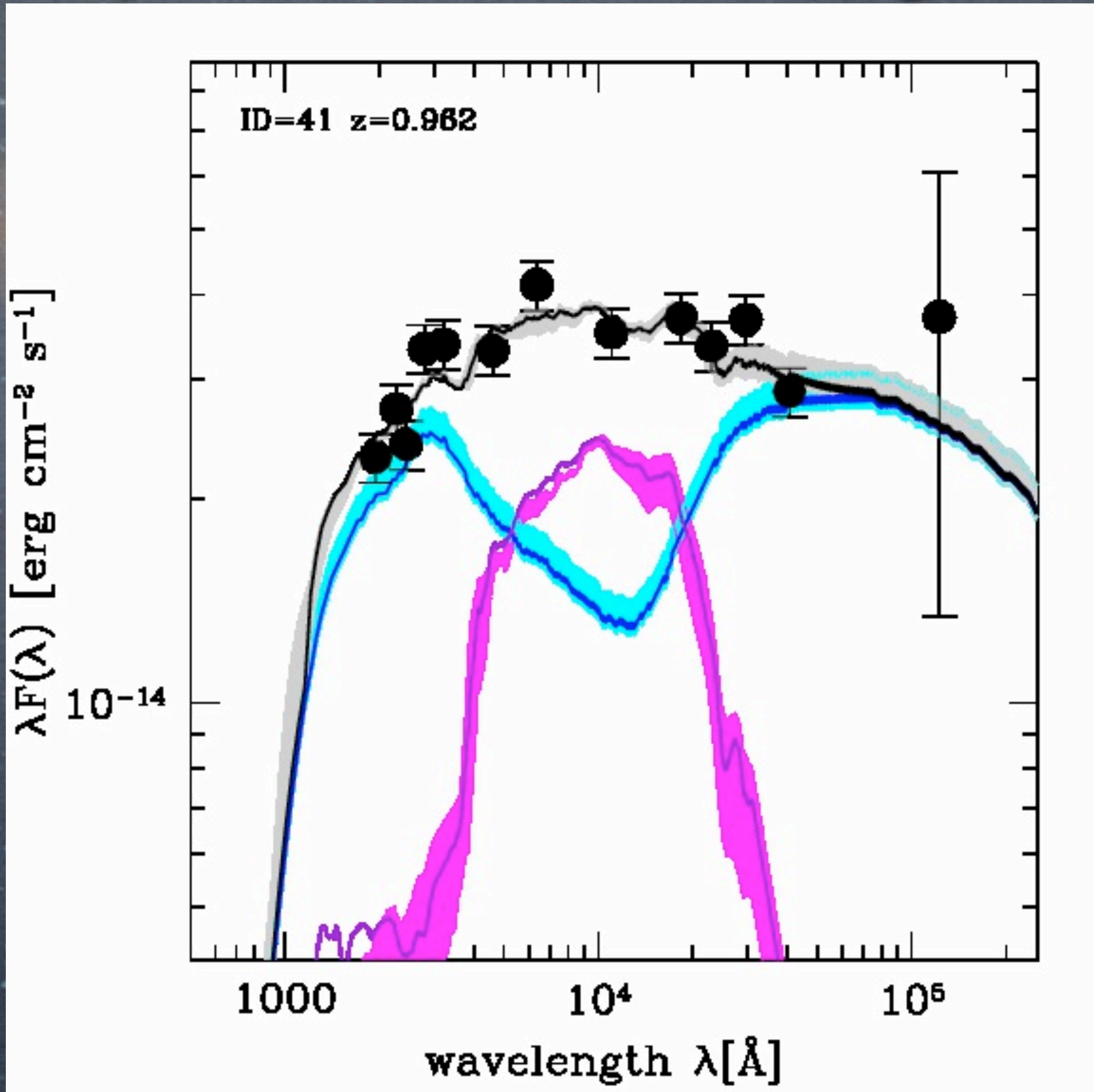

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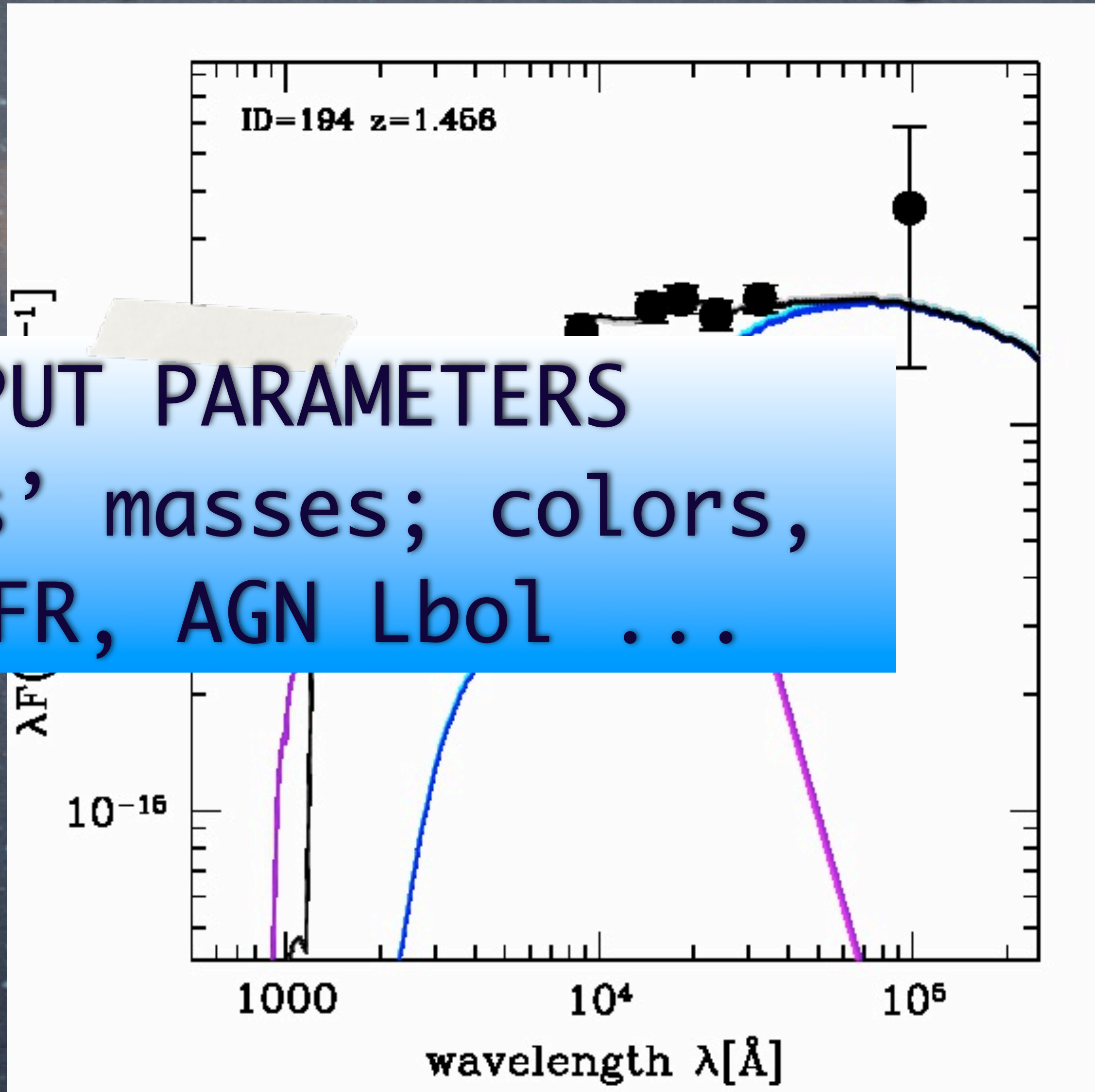
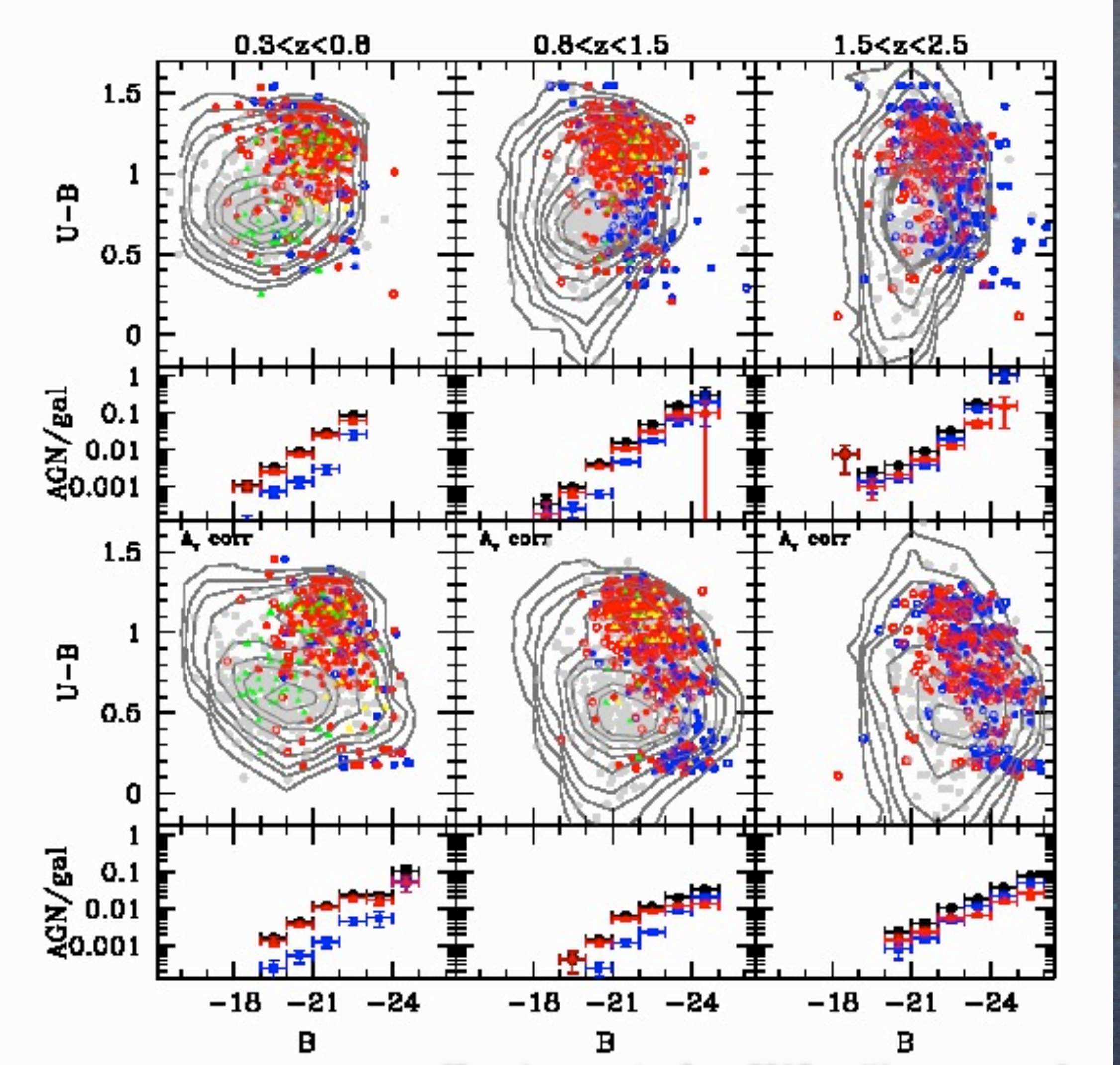


OUTPUT PARAMETERS
Galaxies' masses; colors, Gal. SFR, AGN Lbol ...

Host galaxies rest-frame color



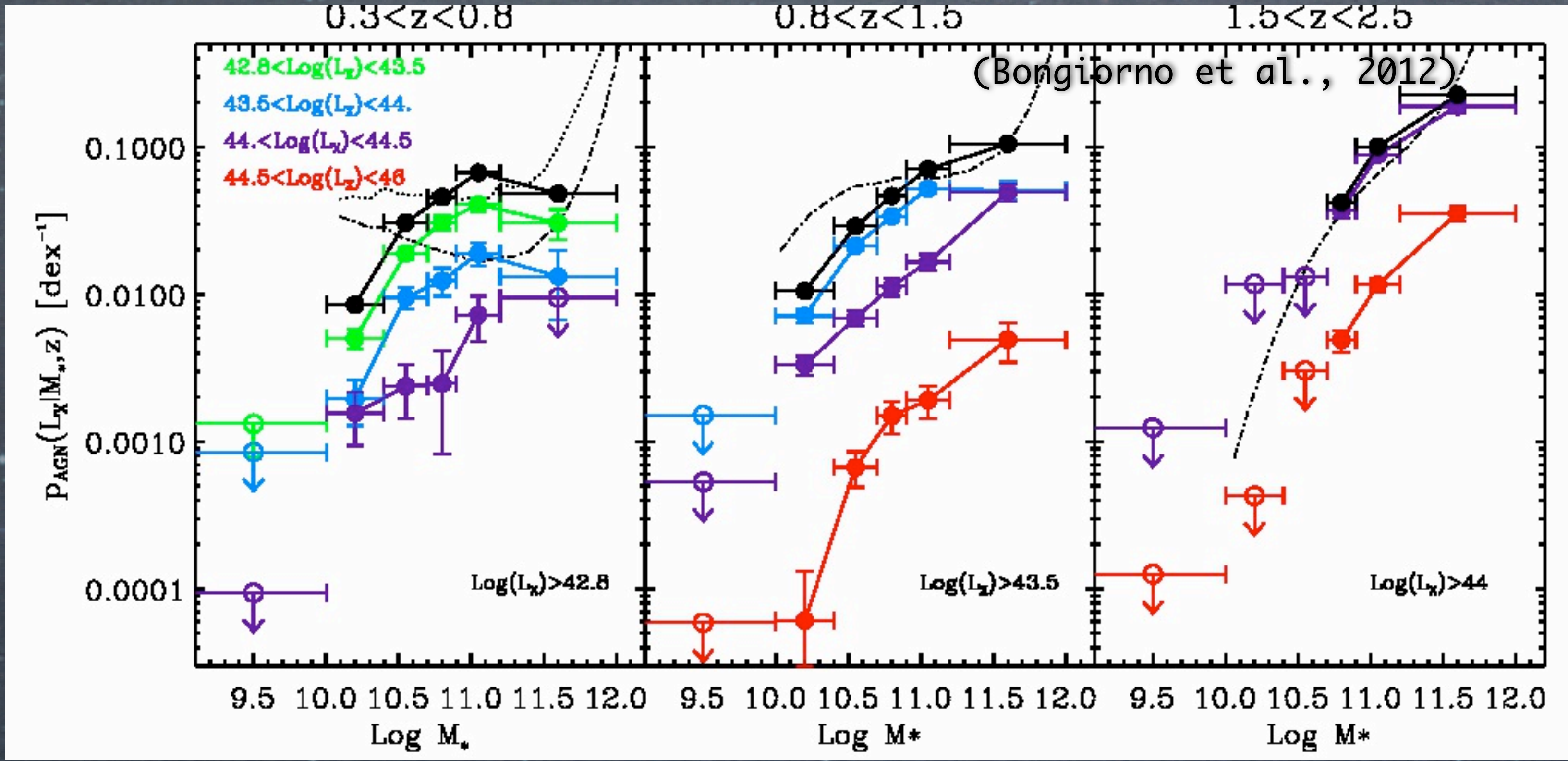
(Bongiorno et al., 2012 arXiv1209.1640)

- AGN are almost exclusively hosted in bright galaxies and the fraction of galaxies hosting AGN increases going to higher luminosities.

- No color bi-modality

- AGN mainly in red galaxies
- No green valley as previously thought (no proper subtraction of the host ?)

AGN Duty cycle vs stellar Mass (Lx bins)

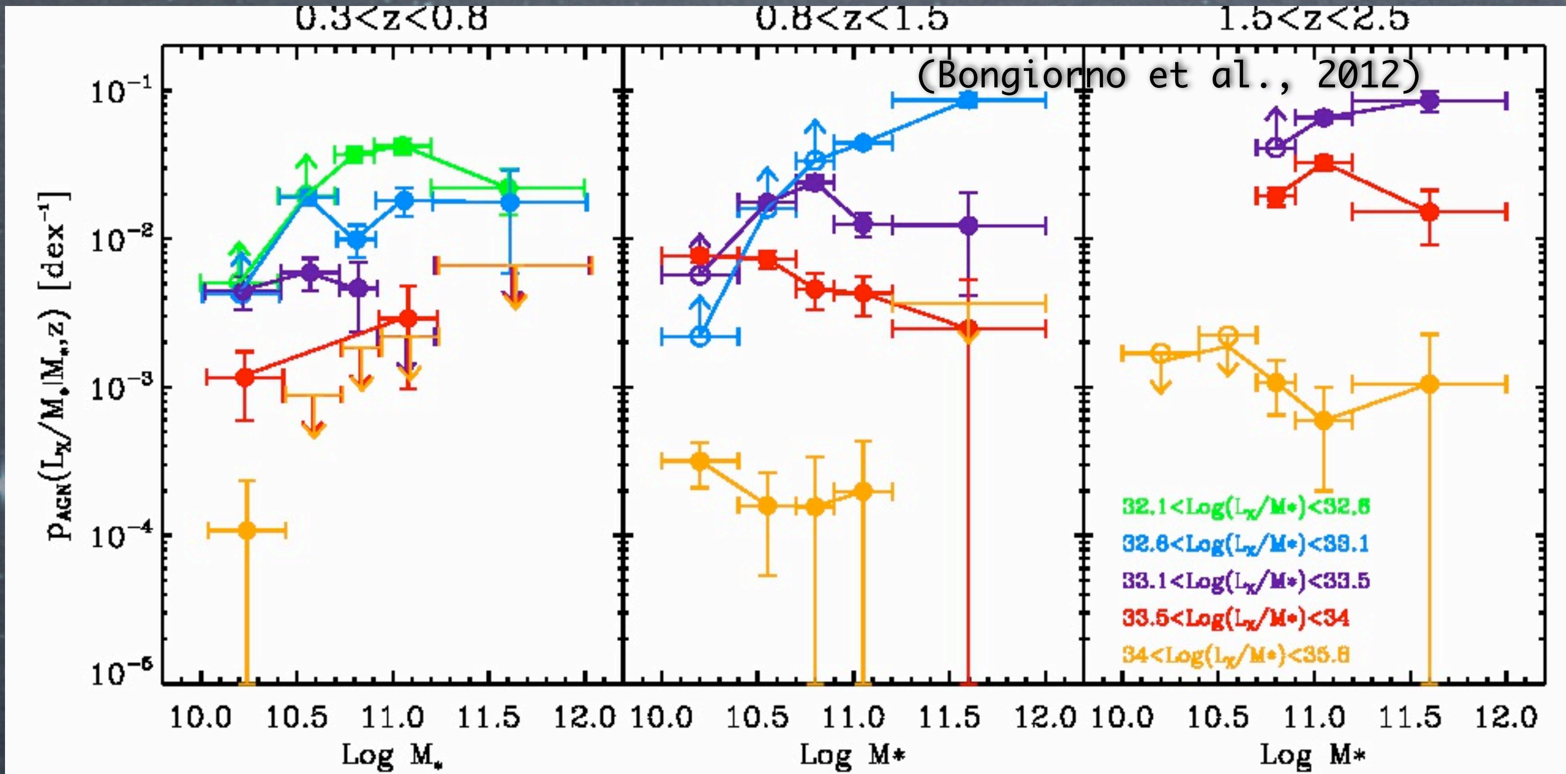


- The fraction of AGN increases going to higher mass galaxies
- This trend is true for any Lx!! it is not true that high Lx AGN in high M galaxies implying a broad Eddington ratio distribution)

AGN Duty cycle vs stellar Mass (Lx/M bins)

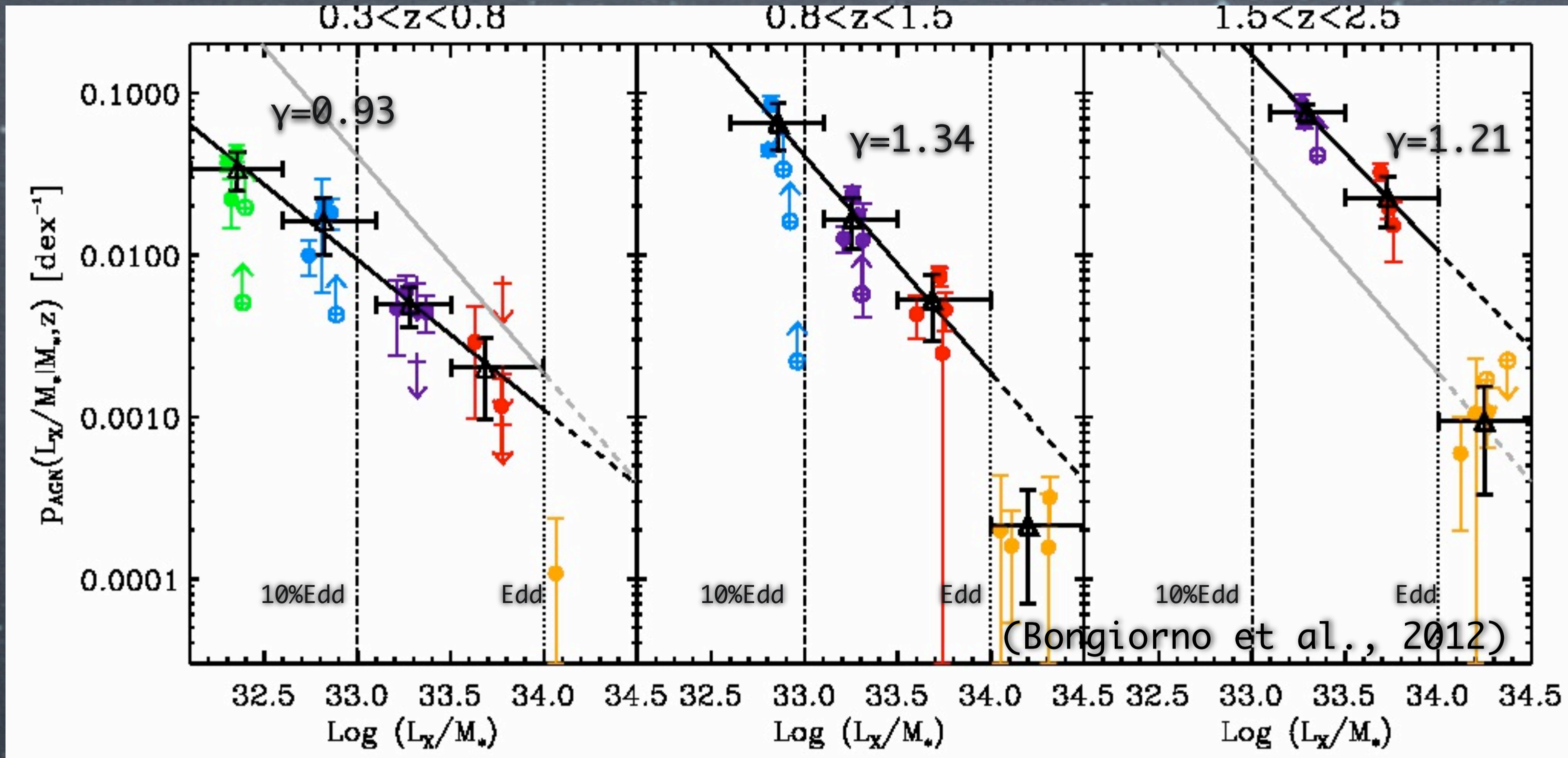
Lx/M=specific accretion rate

$$\lambda_{edd} = \frac{A \cdot k_{bol}}{1.3\times10^{38}} \times \frac{L_X}{M_*}$$



- The probability for a galaxy to host an AGN of a given Lx/M is the same at any Mass!
- In agreement with Aird et al 2012 (PRIMUS 0.3<z<1)

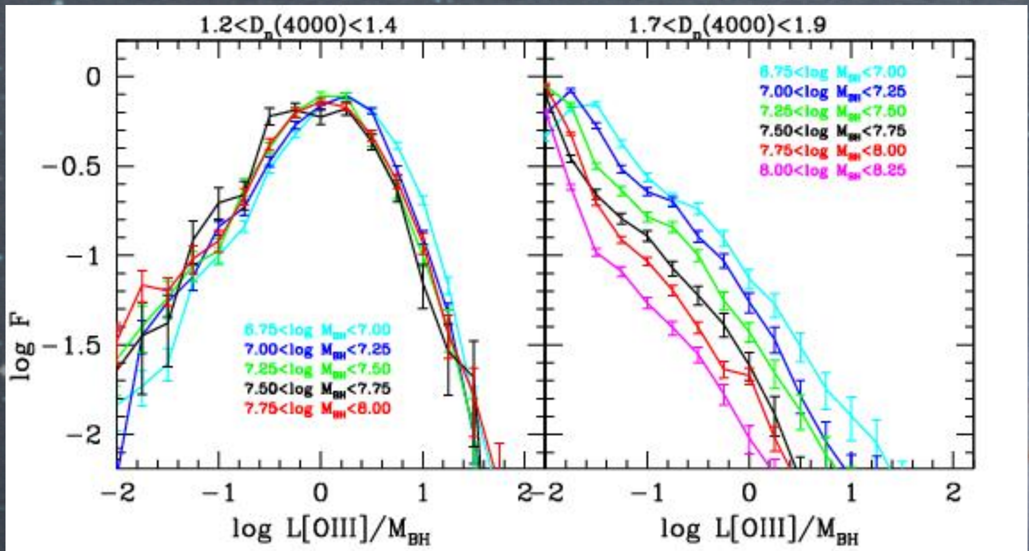
AGN fraction vs Eddington ratio (Lx/M)



$$p_{AGN} = K\left(\frac{L_X}{M_*}\right)^{-\gamma}$$

- The probability for a galaxy to host an AGN is only function of Lx/M
- It is a power law
- The normalization strongly evolves with redshift $\propto(1+z)^{4.2}$ @$L_X/M = 33.2$
- It follows the overall evolution of the sSFR of the galaxy population (Mullaney+12):
- from COSMOS (Karim+11) sSFR$\propto(1+z)^{4.3}$

SDSS type-2 AGN sample @z<0.3 (Kauffmann & Heckman 2008)

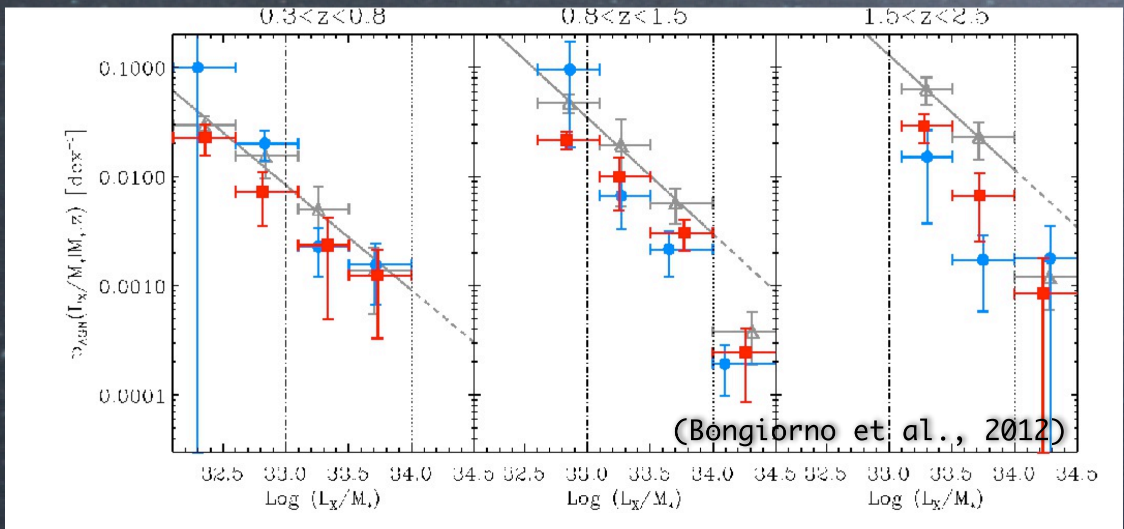


1.2<D(4000)<1.4, gal. with young stellar pop.

Feast: Galaxies rich in cold gas; BH growth is regulated by small scale feedback

1.7<D(4000)<1.9, gal. with old stellar pop.

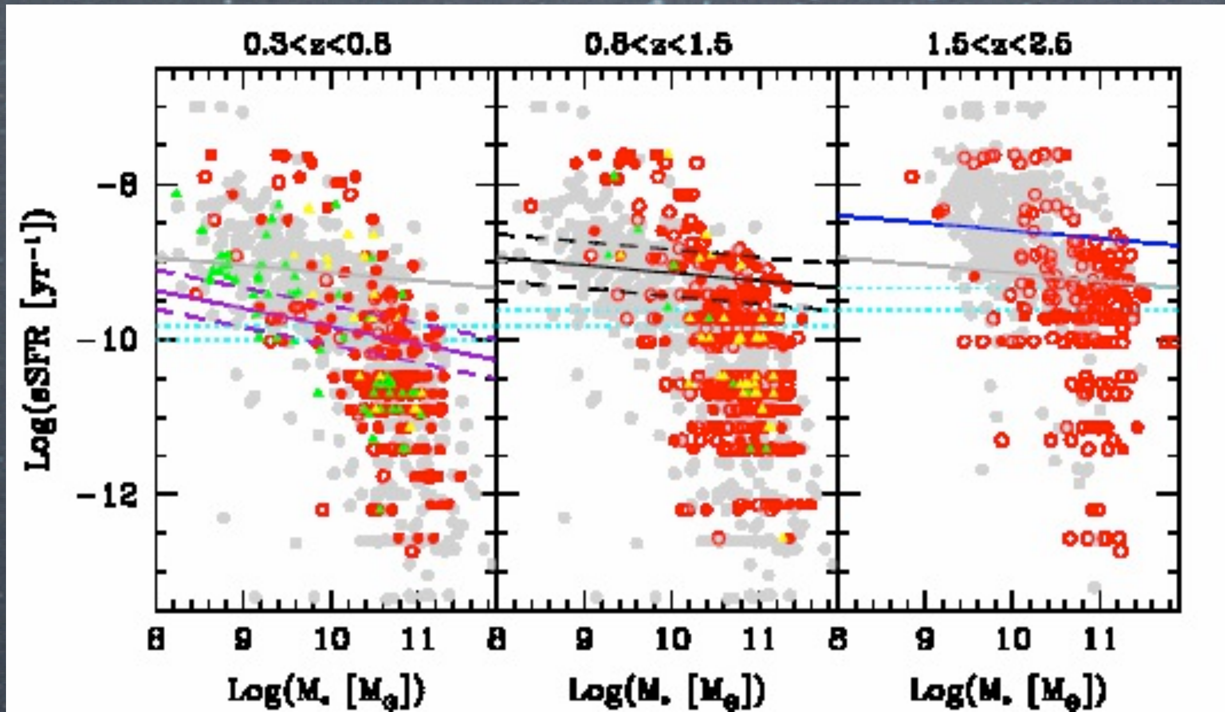
Famine: Galaxies poor in cold gas; BH accretes ~0.3 - 1% of the mass lost by evolved bulge stars



(Bongiorno et al., 2012)

No evidence of a difference in the shape between SF and quiescient host galaxies!

AGN fraction vs galaxy SFR

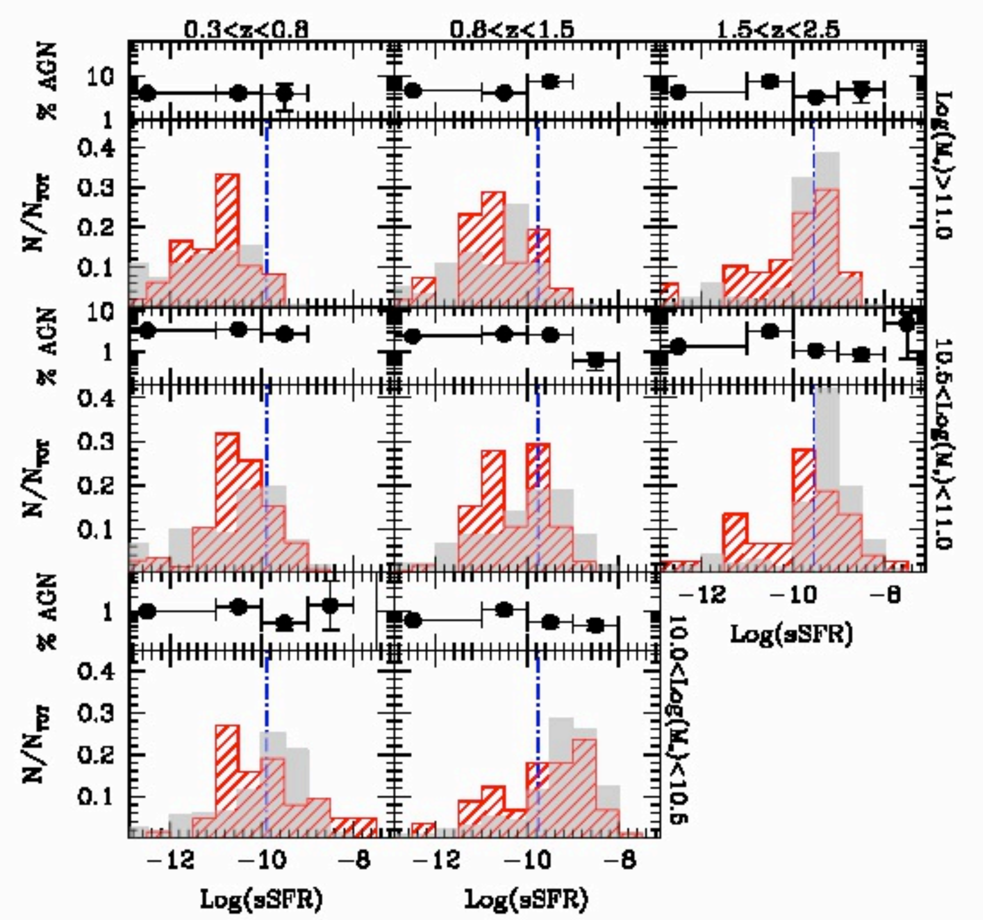


Mullaney+2012 (Herschel GOODS)

<10% SB galaxies	<10% SB galaxies
27% - 37% main sequence galaxies	79% main sequence galaxies
58%, 66% quiescent galaxies	15% quiescent galaxies

Differences explained by the difference in the SFR estimates ... see next slides

AGN fraction vs galaxy SFR



- quiescent fraction:
  > 75%, 65%, 61% for AGN host
  > 51%, 41%, 32% for normal gal

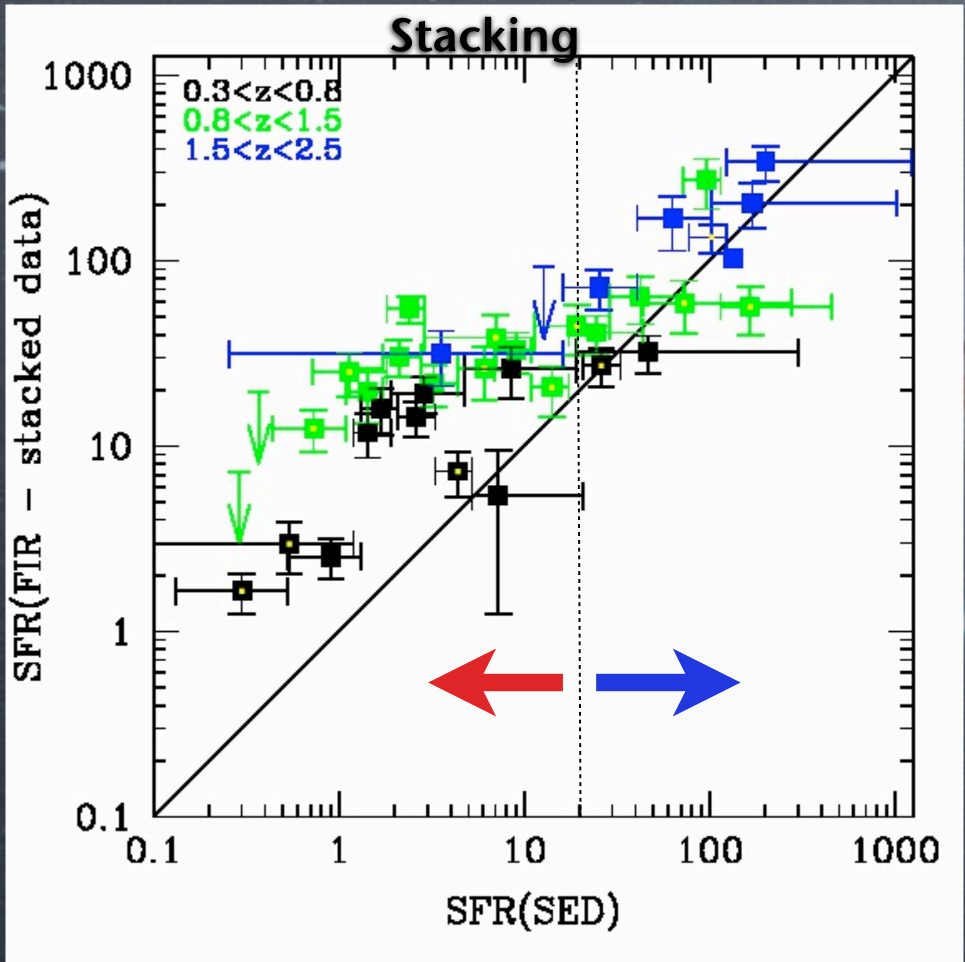
- no strong evidence powerful AGN influence on the star-forming properties of their host galaxies

SummaryII

- The hosts of AGN are mainly red (no green valley)
- The probability for a galaxy to host an AGN is only function of z and Lx/M (eddington ratio)
- it is a power law decreasing towards higher values of Lx/M
- It strongly increases with z, i.e. as $(1+z)^{4.2}$ at λ_{edd} = 10% Edd which follows the evolution of the sSFR in the galaxy population
- AGN hosts have on average the same or lower SFR than non active galaxies of the same mass and z
  - Whatever physical process is responsible for triggering and fueling AGN activity is the same from z~2.5 to z~0.3 but must decrease in frequency or shift towards lower accretion rates
  - AGN activity and SFR seem to have the same triggering mechanism but there is no evidence that AGN activity can influence SFR

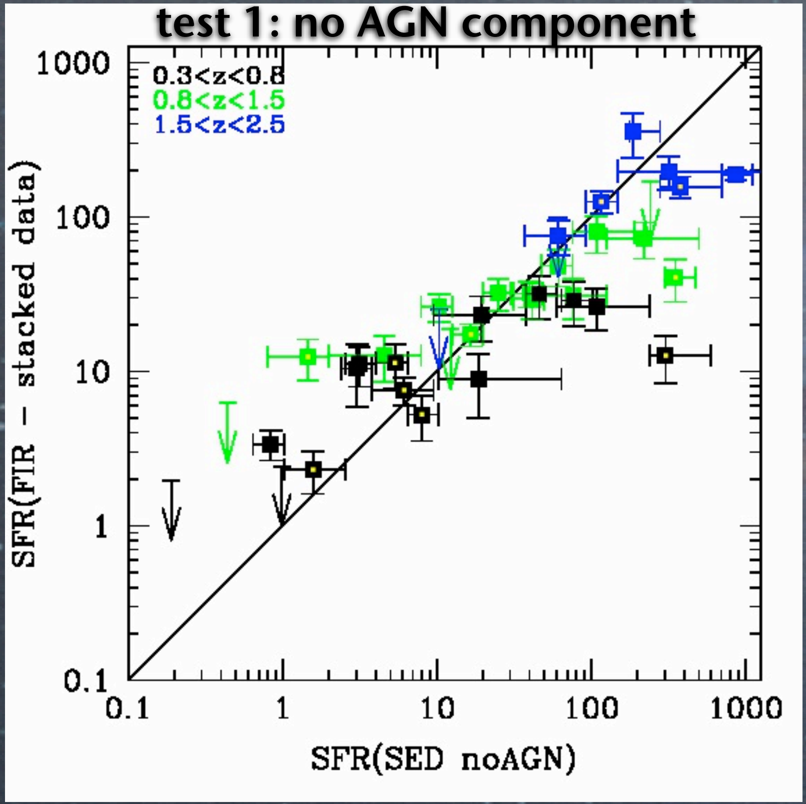
Comparison between SFR(SED) and SFR(FIR)

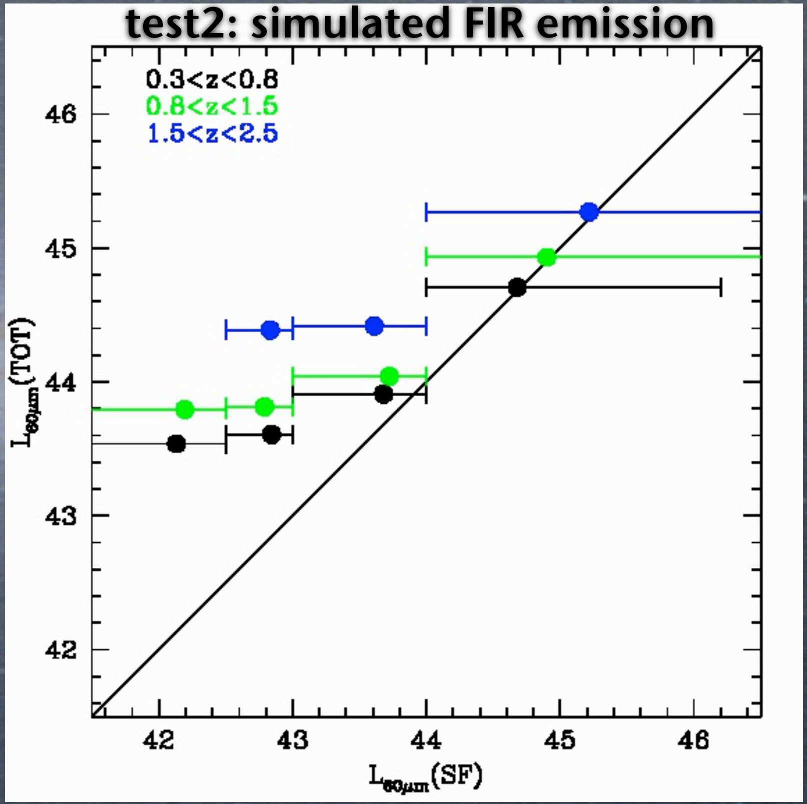
1700 AGN --> only 100 detected by Herschel



- at SFR>20Msun/yr ok
- at SFR<20Msun/yr --> SFR(fir)>SFR(sed)

Understanding the discrepancy between SFR (sed) and SFR(FIR)





opposite trend:

- at SFR<20Msun/yr --> ~ ok
- at SFR>20Msun/yr --> SFR(fir)<SFR(sed)

simulated data L60m(AGN+GAL) vs L60m(GAL)

- at high L60mic (SFR) --> ~ ok
- at low L60mic (SFR) --> AGN contribution!