THE RELATIONSHIP BETWEEN STAR FORMATION AND AGN ACCRETION

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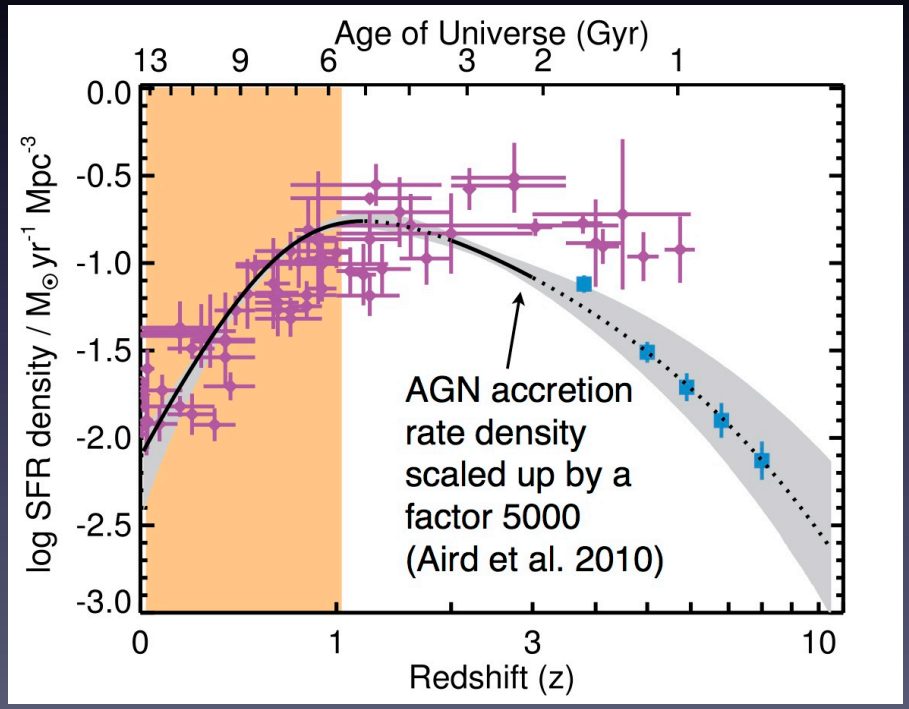
Hints of BH-Galaxy relation

- BH mass-velocity dispersion relation
- BH mass – bulge stellar mass relation
- Evolution of SFR density and BH accretion density with redshifts
  - Hopkins (2004)
  - Bouwens et al. (2012)



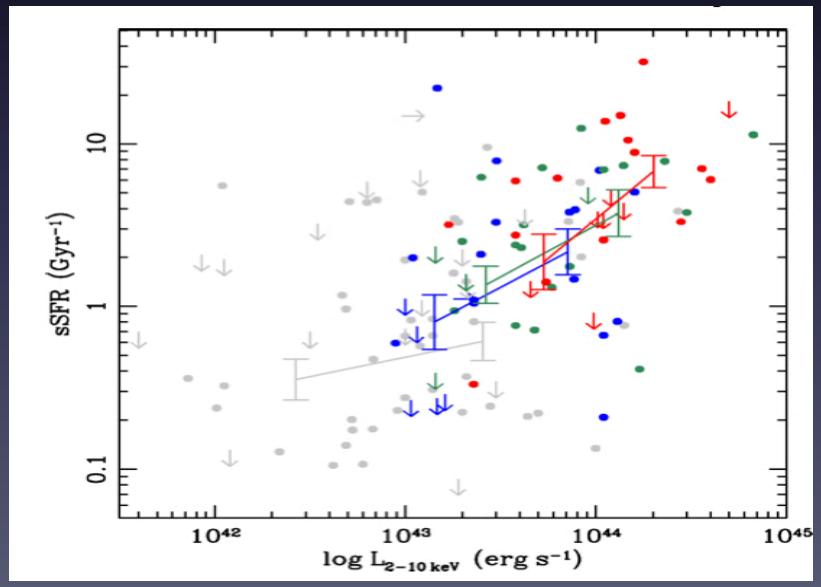
SFR density vs. redshift

Is there an overall correlation between levels of SF and levels of AGN activity?

Rovilos et al. 2012

Field: CDFS

Correlation between **sSFR and L_X** at
log L_X>43.5 at z>1

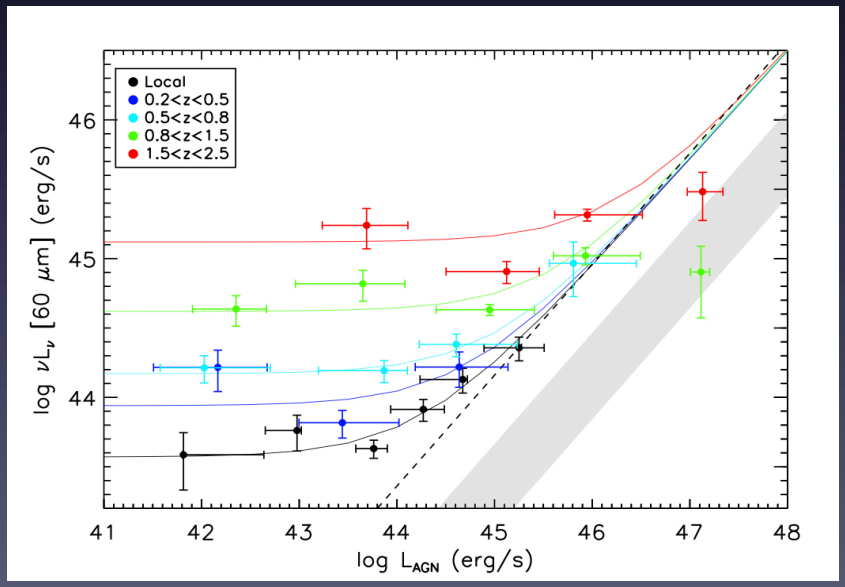


Rosario et al. 2012

Field: CDFS,CDFN &COSMOS

$L_{60\mu m}$ ∝ SFR

Correlation between **$L_{60\mu m}$ and L_{AGN}** at
log L_{AGN} > 44.5 at z<1



e.g. Mullaney et al. 2012, Harrison et al. 2012, Page et al. 2012

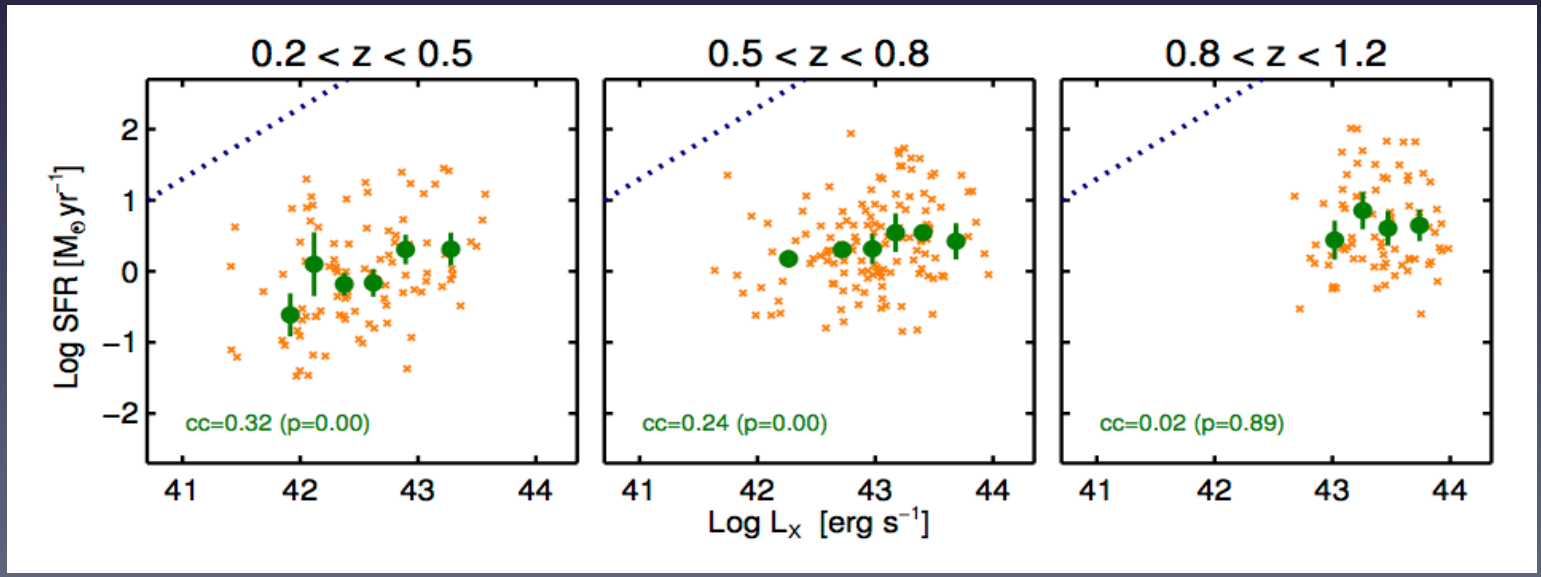
DATA

- **PRIMUS: Prism Multi-object Survey** (used IMACS on Magellan with a low-dispersion prism R~40)
- Redshift: 0.2< z <1.2 with precision 0.5%
- Fields: COSMOS, ELAIS S1, XMM-LSS, CDFS
- Stellar mass and SFR estimation: SED fitting, UV and optical photometry
- AGN:
  - X-ray luminosity tracer of AGN activity, Chandra& XMM-Newton
  - Exclude BLAGN
  - Hard-band X-ray detections, $L_{X(2\text{-}10\ keV)}$
  - X-ray luminosity 41 <Log L_X < 44 erg/s

309 AGN

The relation between SFR and instantaneous L_X

- **Instantaneous Lx: observed X-ray luminosity of individual sources**
- Weak but significant correlation between SFR an Lx
  at 0.2< z <0.5 and at 0.5< z <0.8
- No correlation between stellar mass and L_X

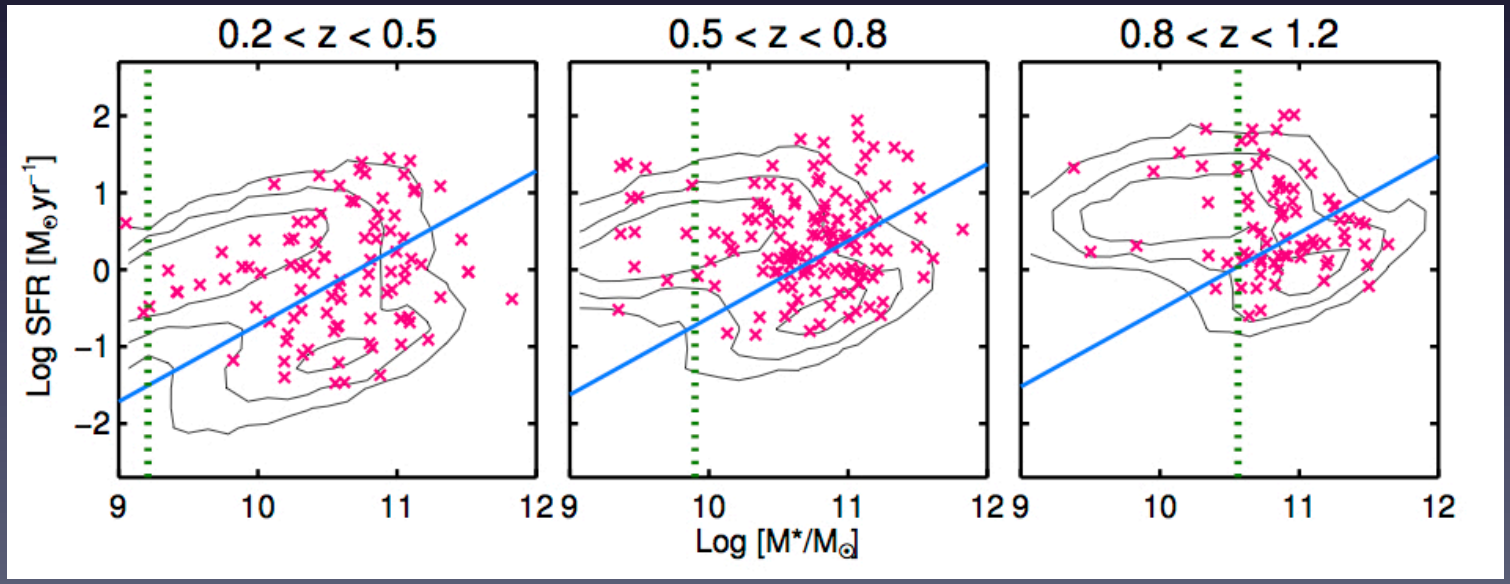


Star forming and Quiescent host galaxies

- AGN reside in both SF and Q galaxy populations

Contours: PRIMUS Galaxies

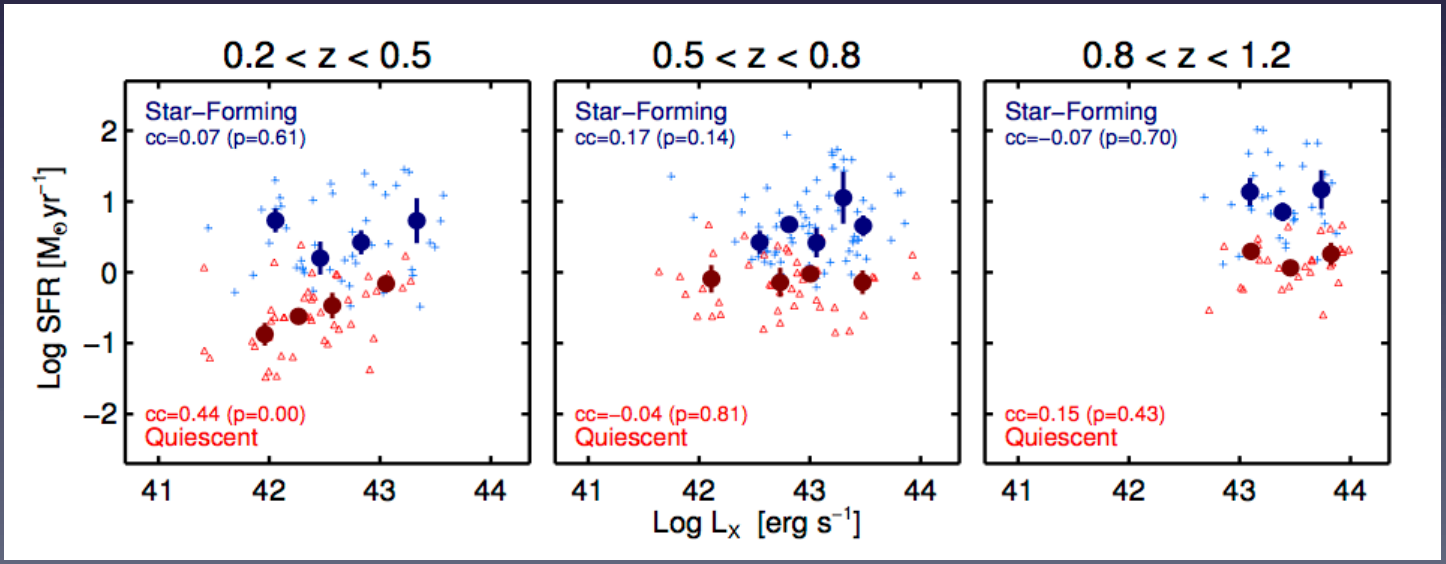
× AGN



The relation between SFR and instantaneous L_X in SF & Q host galaxies

- No correlation between SFR and L_X in SF hosts at any redshift bins
- A weak but significant correlation in quiescent galaxies at $0.2<z<0.5$
  - No correlation between stellar mass and L_X
  - No correlation between SFR and specific accretion rate in quiescent galaxies

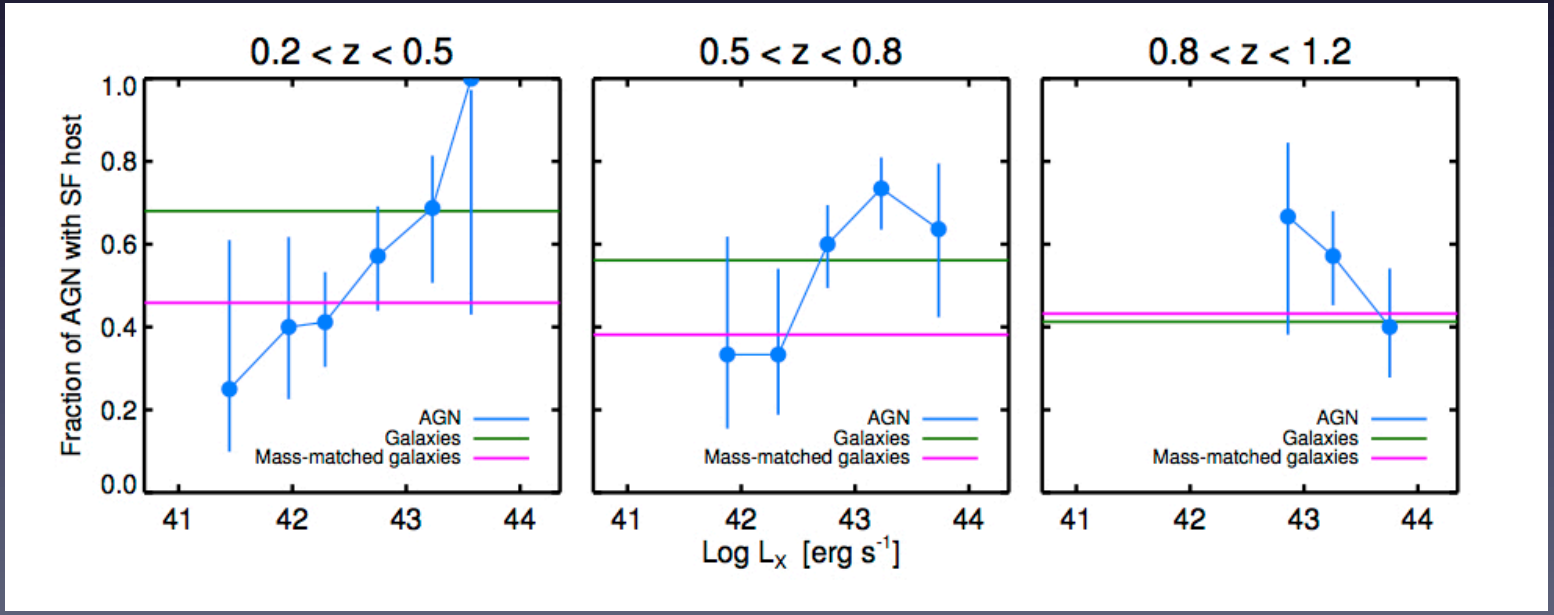
Specific accretion rate ∝ L_{bol} /M*



The fraction of star forming host galaxies

- Fraction of AGN in SF galaxies increases with L_X at $z < 0.8$

- The correlation between SFR and L_X in the entire sample at $z < 0.8$ could be due to the presence of more powerful AGN in SF galaxies

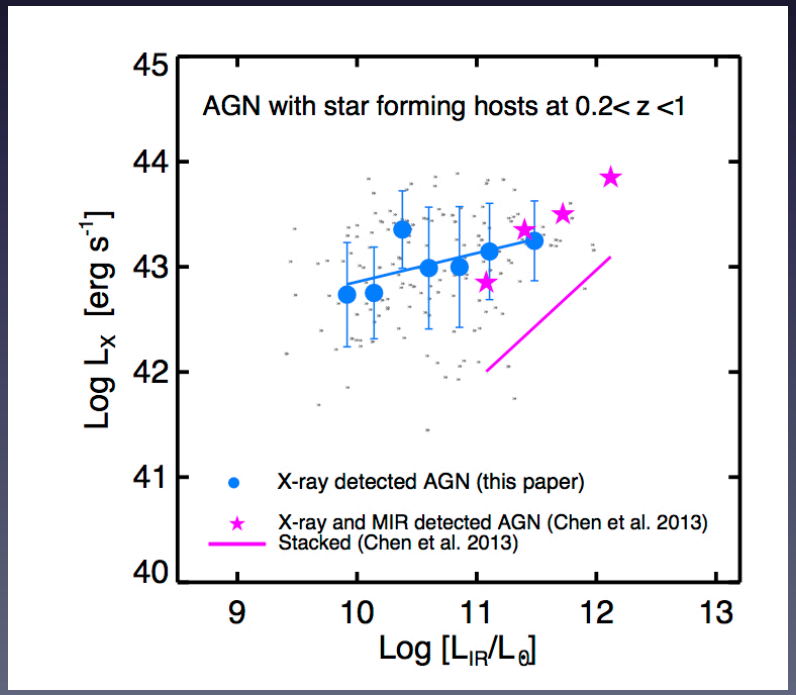


The relation between SFR and average L_X in star forming galaxies

- AGN stochastic fueling
  - AGN variability
  - Average L_X: averaging BH growth over long timescales

- Correlation between average L_X and SFR in SF galaxies at $0.2 < z < 1$

SFR α L_{IR}



The probability of hosting AGN in galaxies

- We use PRIMUS galaxy sample instead of AGN sample
- Divide galaxies to star forming and quiescent
- Probability of hosting an AGN in each population
- Specific accretion rate as the indicator of AGN activity

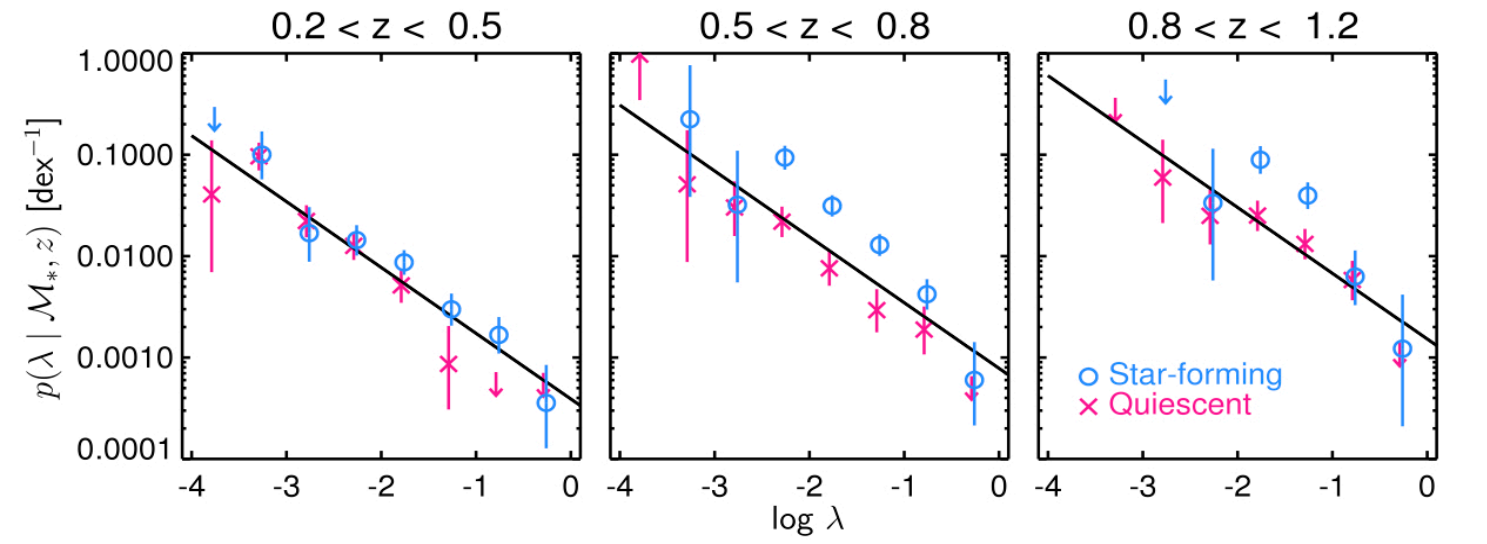
Specific accretion rate $\lambda \propto L_{bol}/M^*$

- The probability density for a galaxy of a given stellar mass, redshift and SFR to host an AGN of specific accretion rate of λ:

$$\mathbf{p(\lambda|M^*,z)}$$

The probability of a galaxy hosting an AGN as a function of SFR

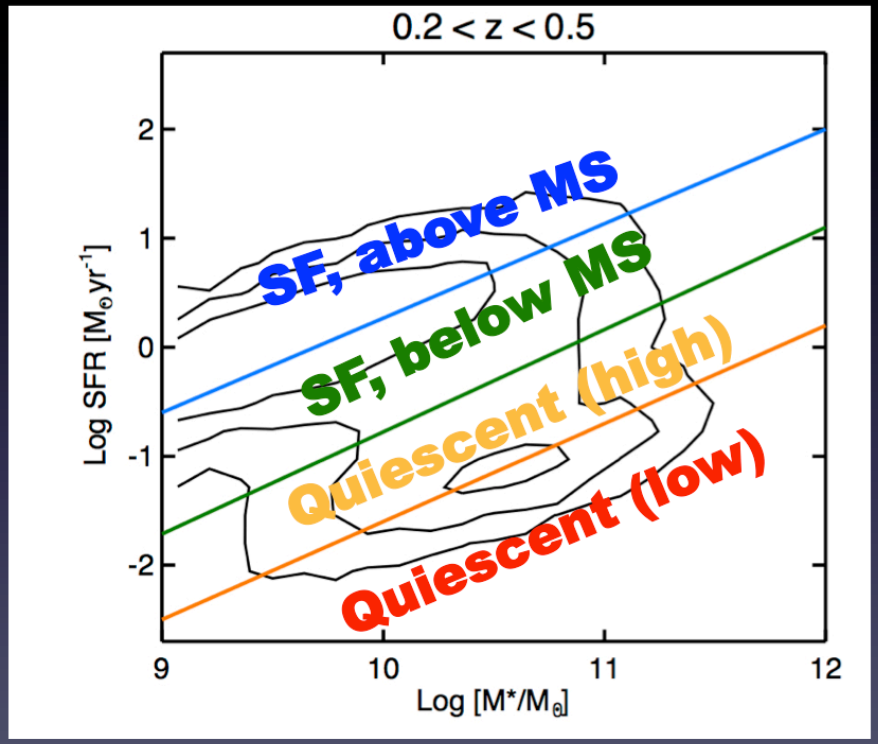
- Similar power law distribution in both populations
- More likely to find AGN with lower specific accretion rate
- More likely to find AGN in SF host galaxies by 2-3 times
- For a given λ the probability of find an AGN increases with redshift in both population



Dividing galaxies based on their sSFR

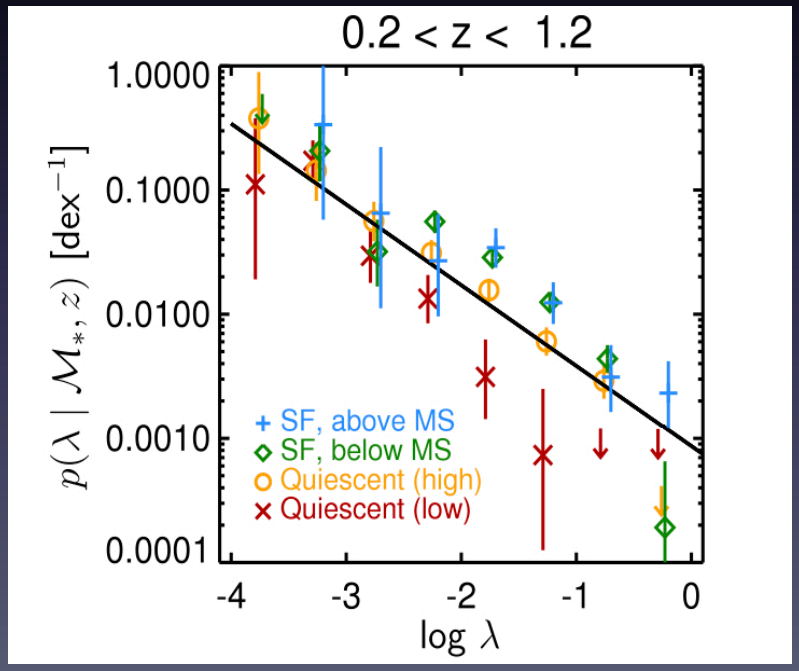
Star Forming galaxies
- Above main sequence
- Below main sequence

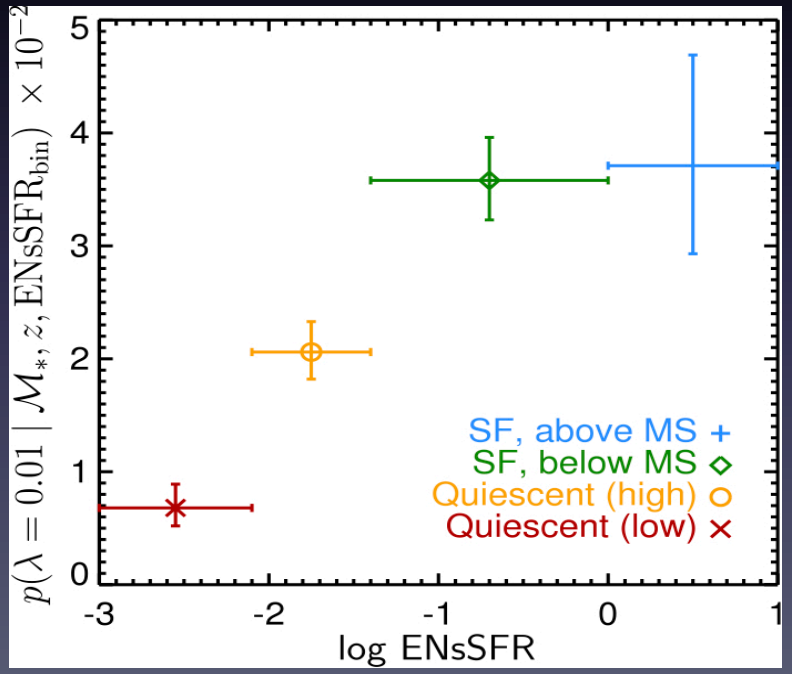
Quiescent galaxies
- Quiescent with high SFR
- Quiescent with low SFR



The probability of hosting AGN as a function of SFR

- P(λ|,M*,z) has similar shape in 4 populations
- Normalization: The probability of hosting AGN increases with sSFR within quiescent galaxies but not in star forming galaxies.





Normalization vs. sSFR

Take home points

- We find AGN in both SF and Q host galaxies with wide range of SFR at a given L_X. There is **no correlation** between SFR and instantaneous L_X in SF galaxies.

- However, We do find a **weak but significant correlation** between the mean L_X and SFR in SF galaxies that could be due to a common cold gas supply.

- The probability that a galaxy at a given stellar mass and redshift hosts an AGN is factor of 2-3 higher in SF galaxies. This probability increases with SFR in quiescent galaxy population, but doesn't change across the main sequence of star formation.