The Host Galaxies of AGN at 0.2 < z < 1.0

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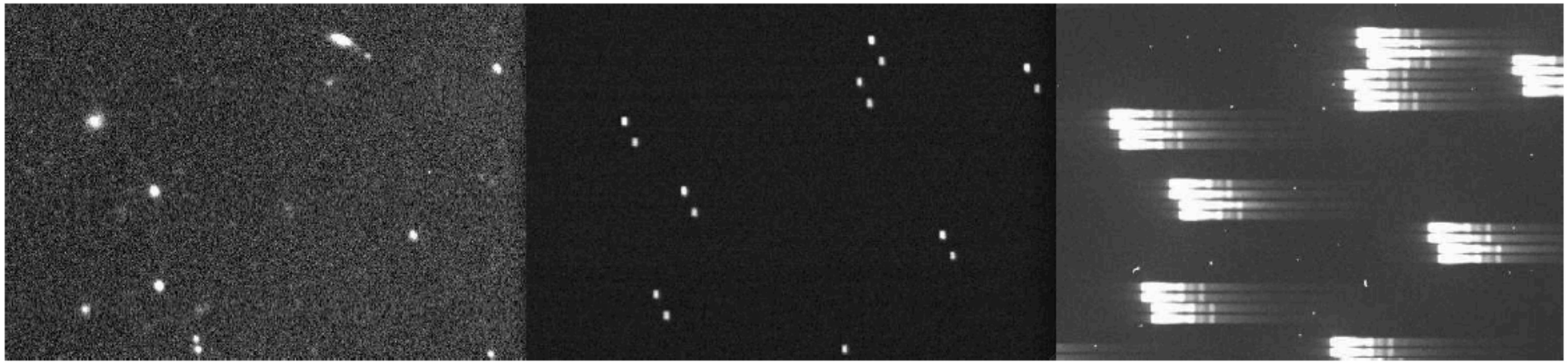
Main Results

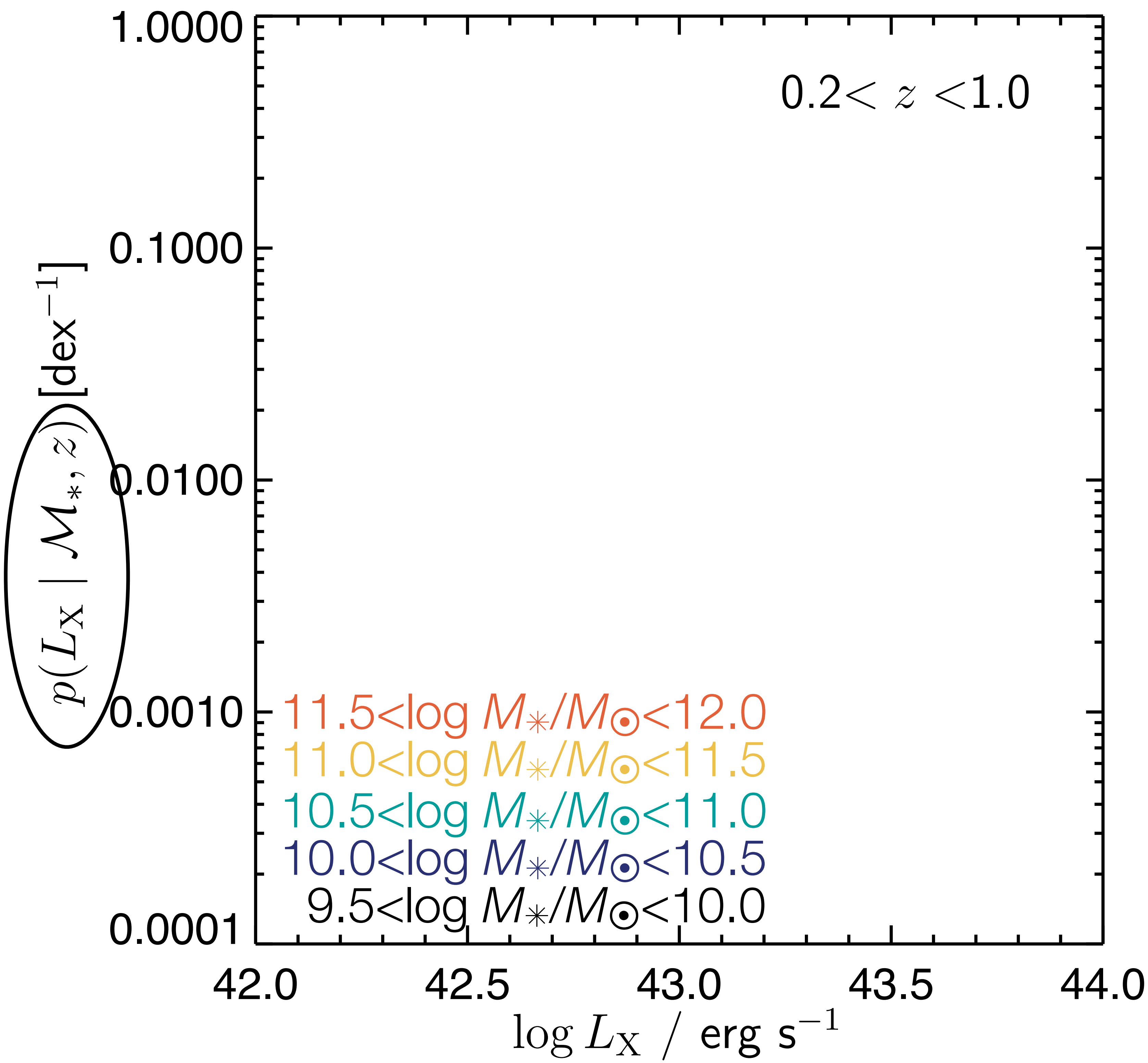
- AGN reside in galaxies of all types: no dependence on stellar mass, very little dependence on star formation rate.
- Strong selection effects in observed AGN populations.
- Lack of stellar mass dependence is consistent with the observed X-ray luminosity function to z=1.
- Very little difference between galaxies that host AGN identified by X-ray emission vs IR emission.

PRIMUS Survey

- 9 sq. deg. over 7 fields with X-ray, UV, optical, MIR
- ~120,000 spectroscopic redshifts to z=1.2
- depth of i~23
- low-dispersion prism, observe ~1000 galaxies at once
- fields incl. CDFS, COSMOS, ES1, XMM-LSS



Which Galaxies Host AGN?



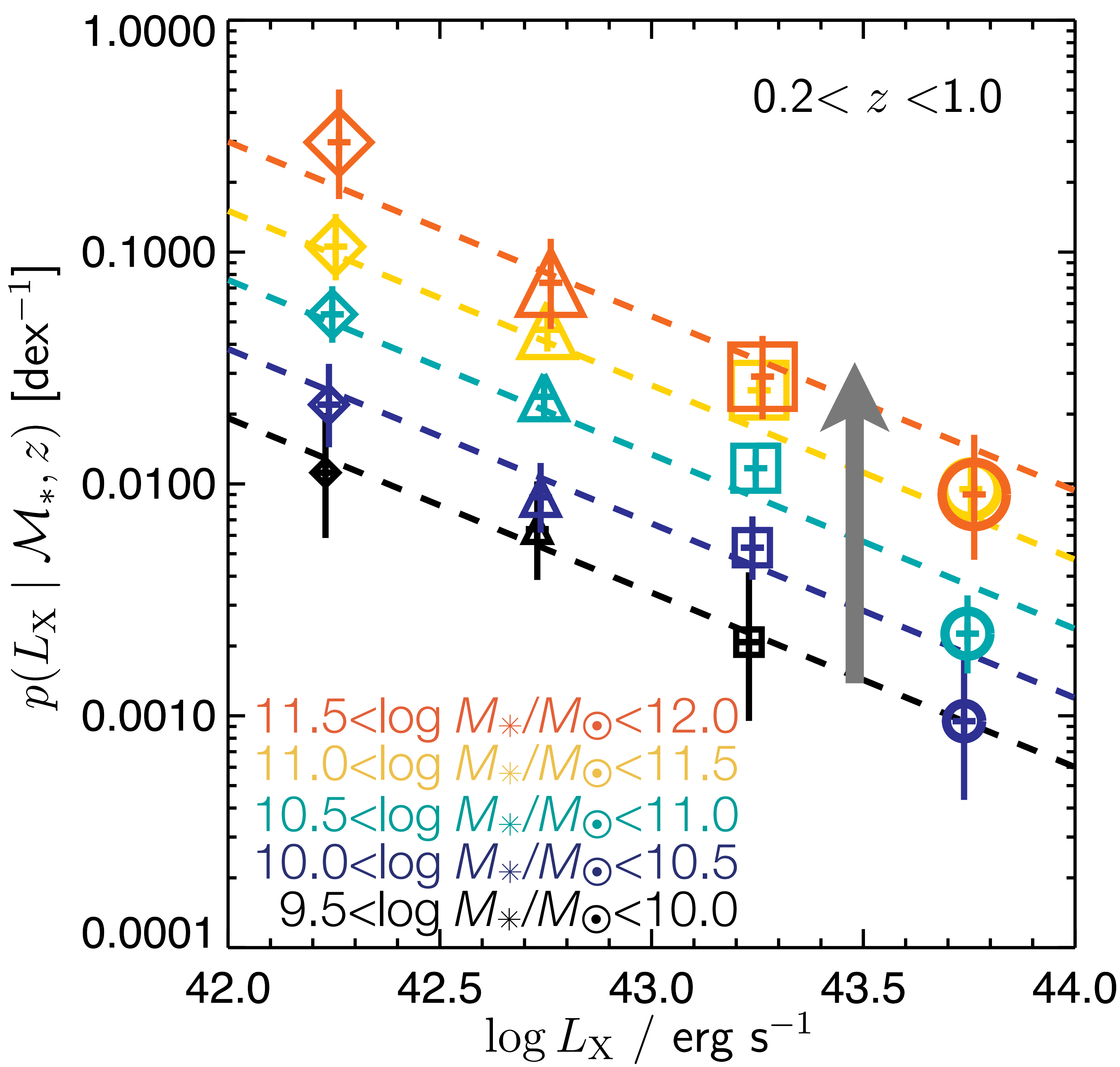
Probability that a galaxy of a given stellar mass, M_*, and redshift, z, hosts an AGN of luminosity, L_X

X-ray AGN in PRIMUS

Exclude QSOs (unable to probe host galaxy)

Aird, Coil, et al. 2012, ApJ

Which Galaxies Host AGN?



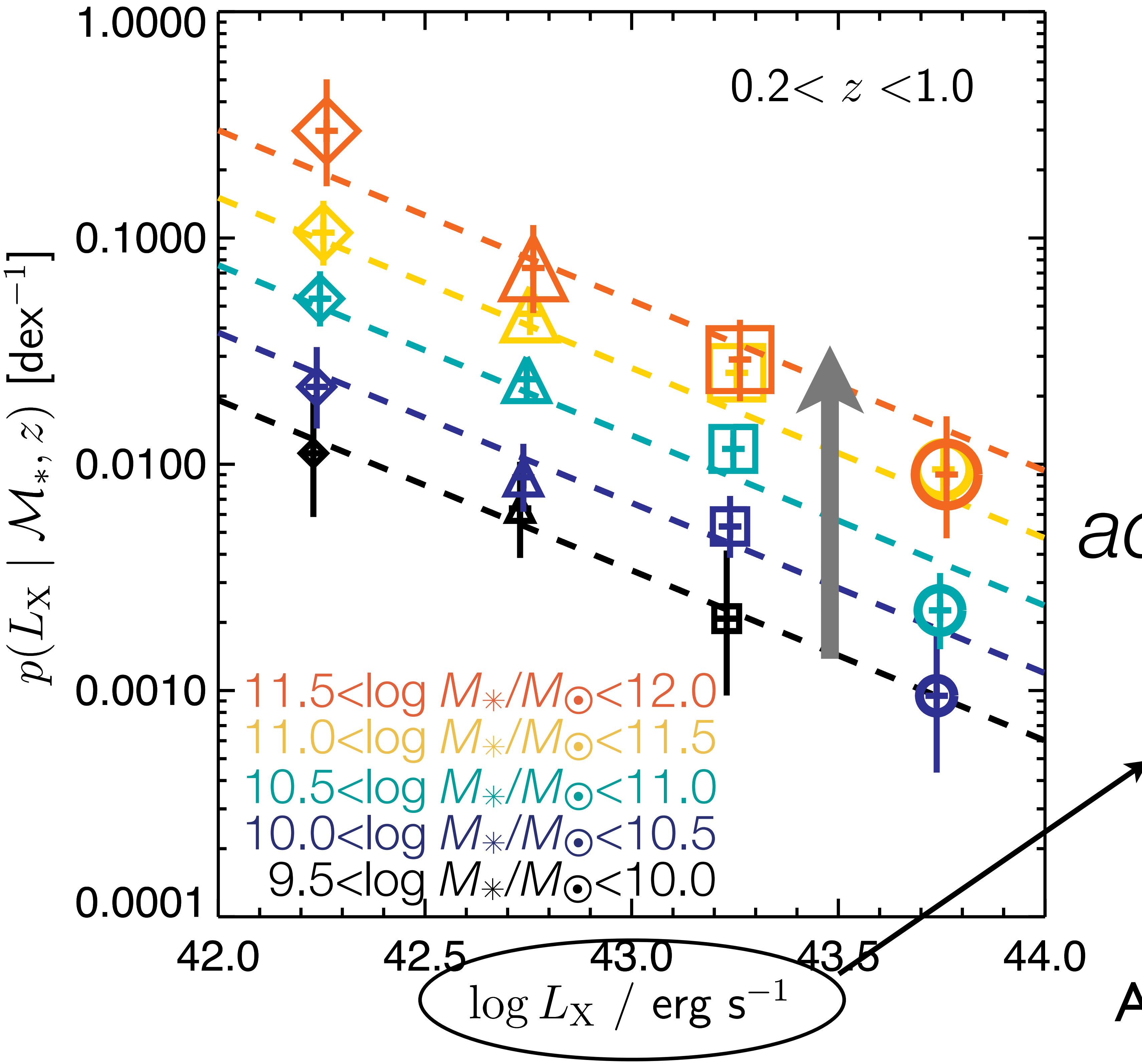
Massive galaxies are more likely to host an AGN of a given L_X.

But more massive galaxies host more massive AGN!

The rise with stellar mass may simply reflect that more massive AGN *are easier to detect.*

Aird, Coil, et al. 2012, ApJ

Which Galaxies Host AGN?

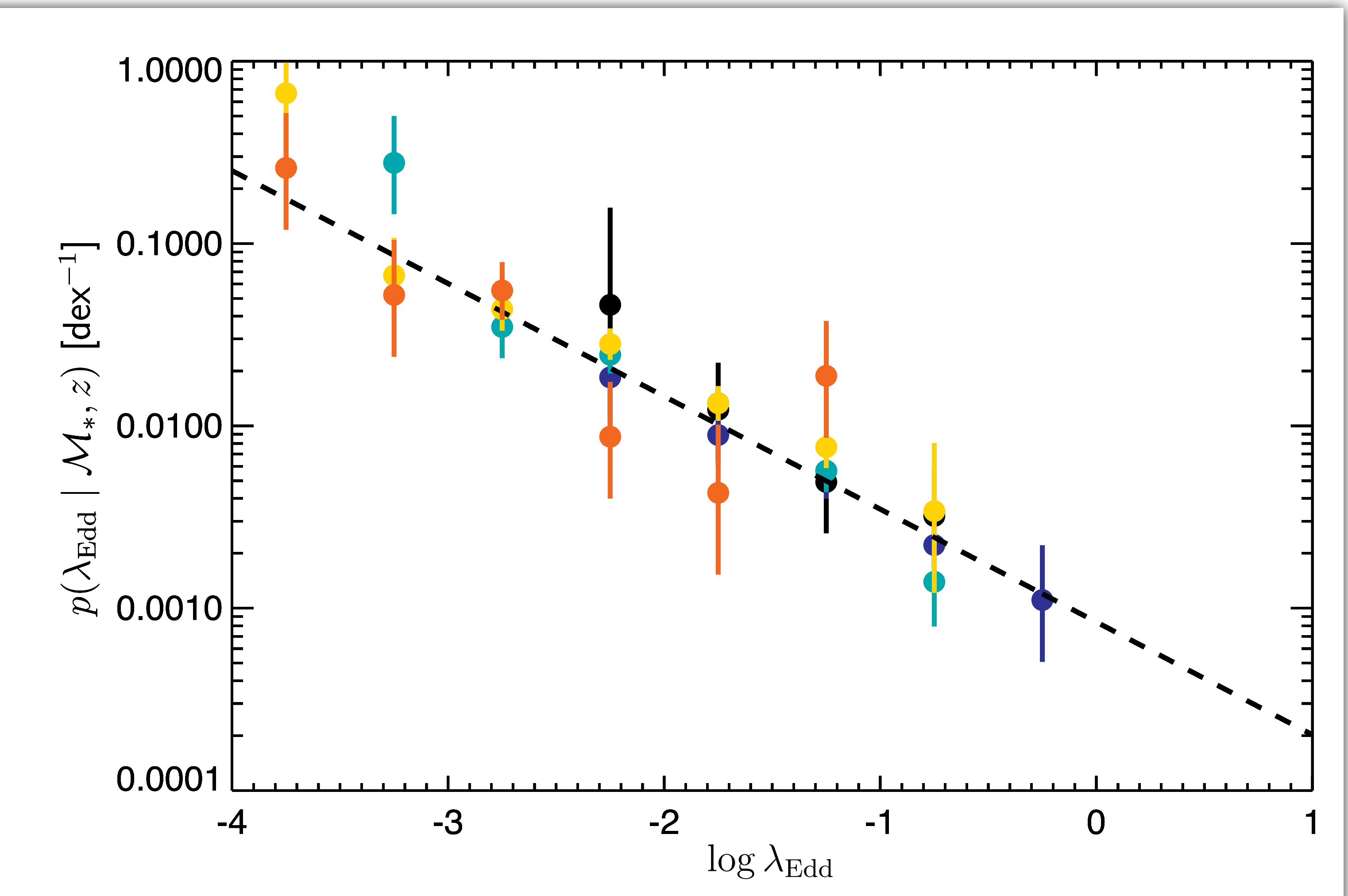


Specific accretion rate

$$\lambda \propto \frac{L_{bol}}{M_*}$$

Aird, Coil, et al. 2012, ApJ

No Stellar Mass Dependence



Specific accretion rate

$$\lambda \propto \frac{L_{bol}}{M_*}$$

When plot probability of galaxy hosting an AGN as a function of specific accretion rate, the stellar mass dependence disappears!

The probability of a galaxy hosting an AGN of a given specific accretion rate is independent of stellar mass.

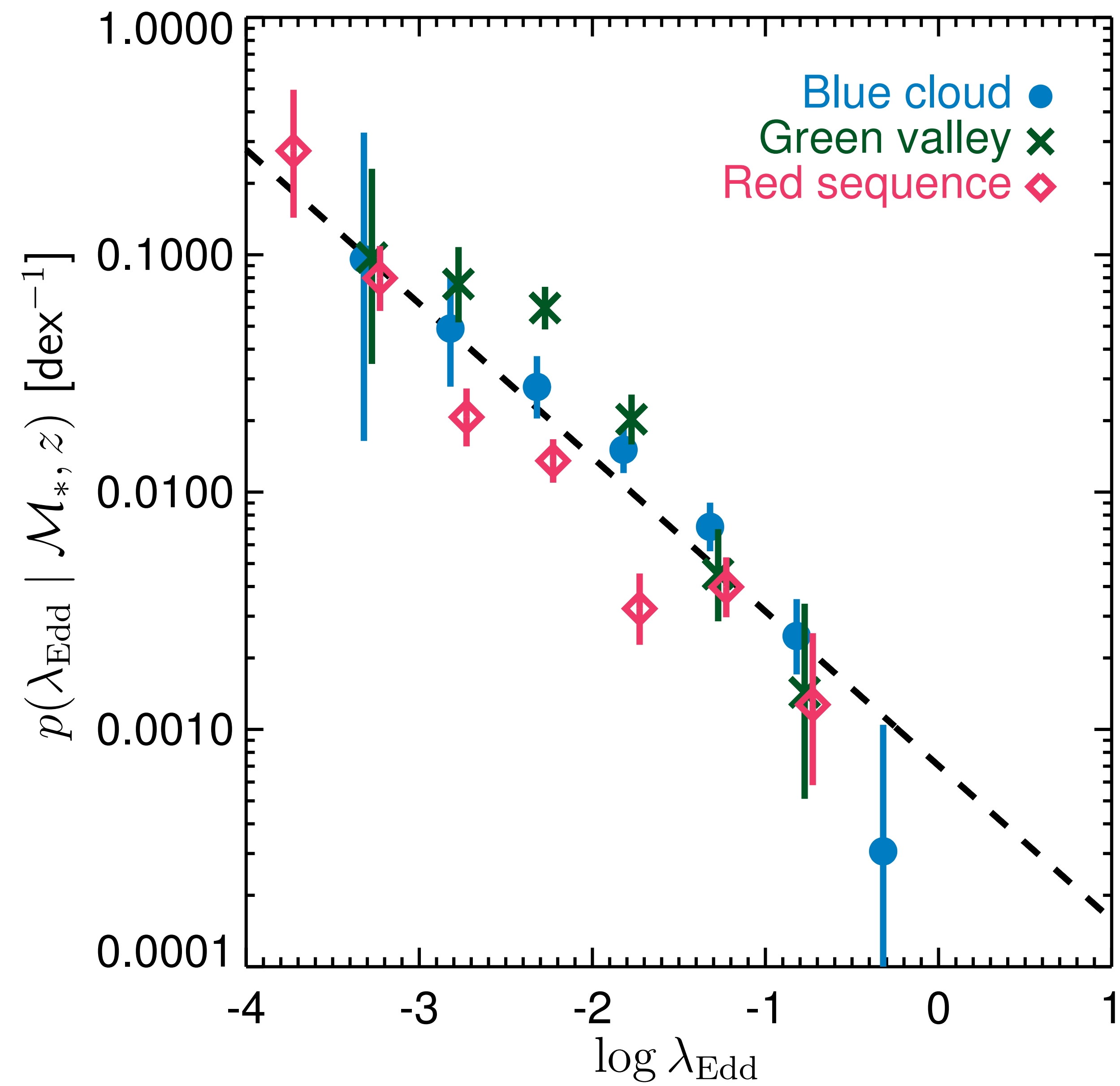
Aird, Coil, et al. 2012, ApJ

Dependence on Star Formation?

Galaxies with on-going star formation are somewhat more likely to host an AGN.

Mild enhancement (factor 2-3) in prevalence of AGN in blue cloud and green valley relative to red sequence galaxies.

AGN are found in galaxies of *all* colors (ie, SFRs) and *all* stellar masses (log M~9.5-12).



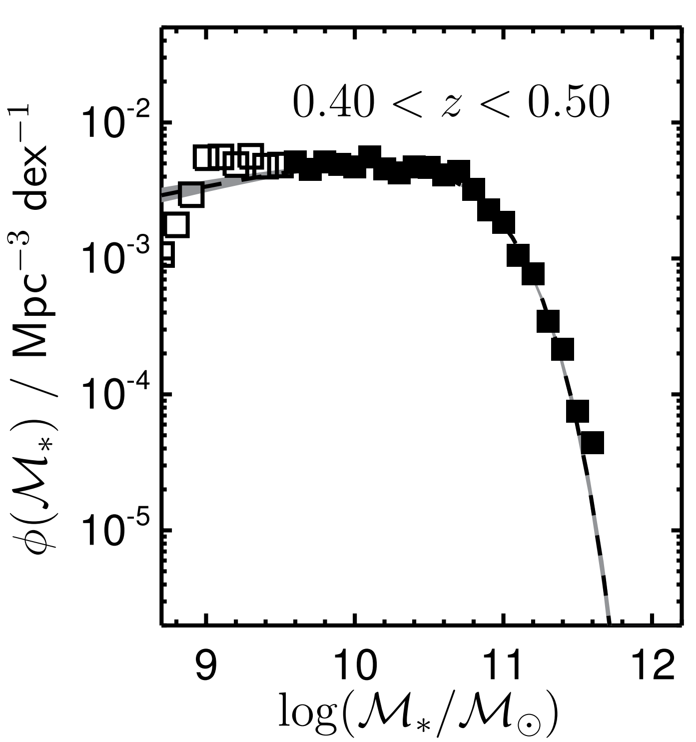
Specific accretion rate

Aird, Coil, et al. 2012, ApJ

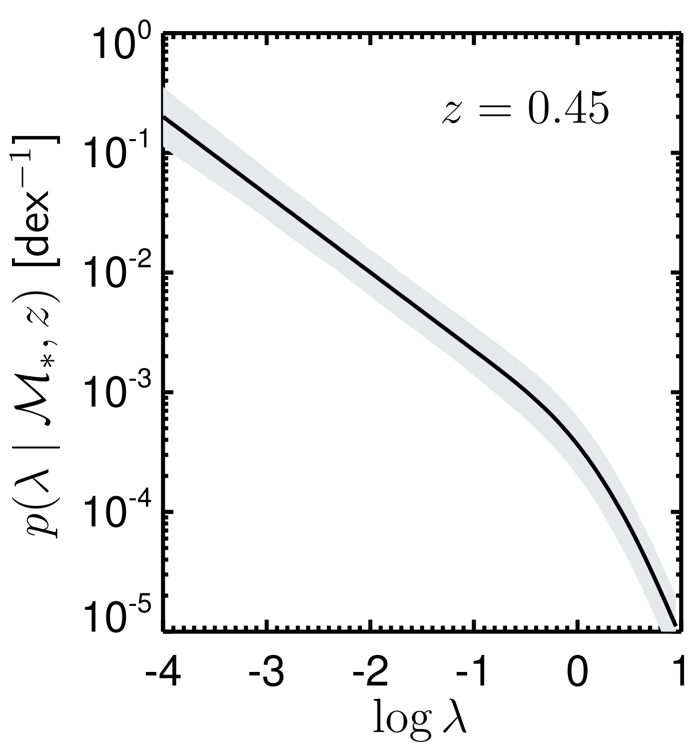
Are these results consistent with the observed X-ray luminosity function?

Modeling the XLF:

PRIMUS galaxy stellar mass function * AGN specific accretion rate distribution → X-ray luminosity function



Moustakas, Coil, et al. 2013, ApJ



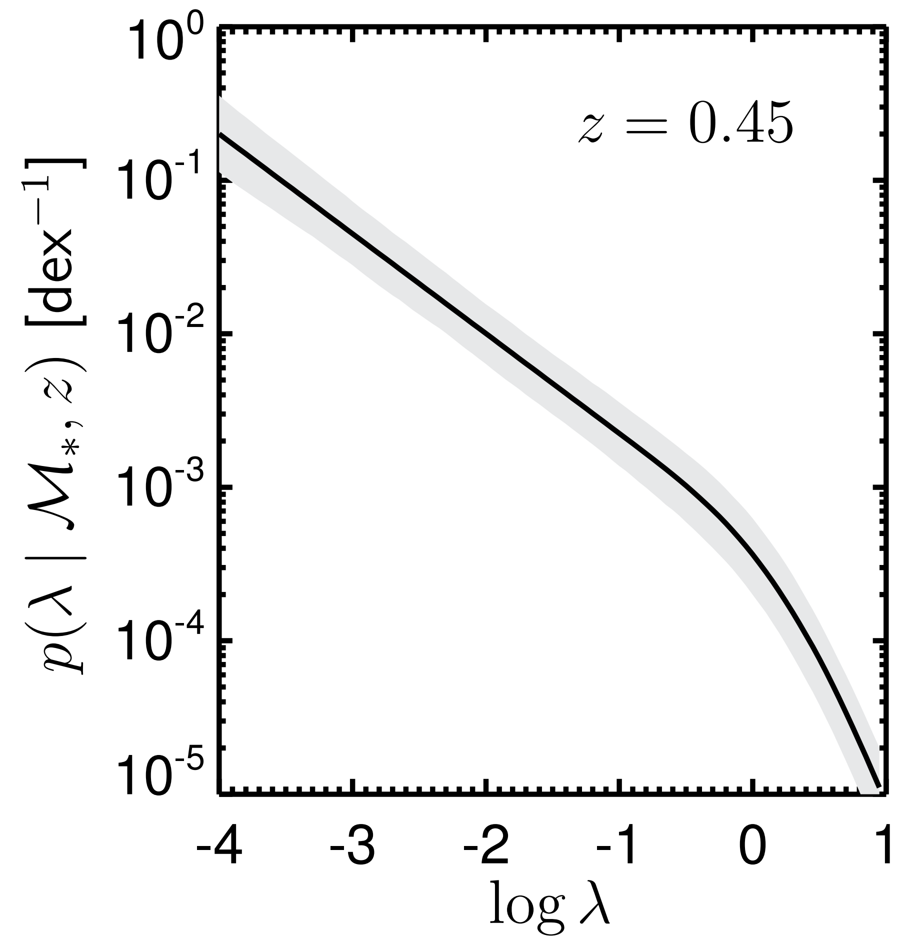
Aird, Coil, et al. 2012, ApJ

- incl. evolution to z=1

Modeling the X-ray LF

Model:

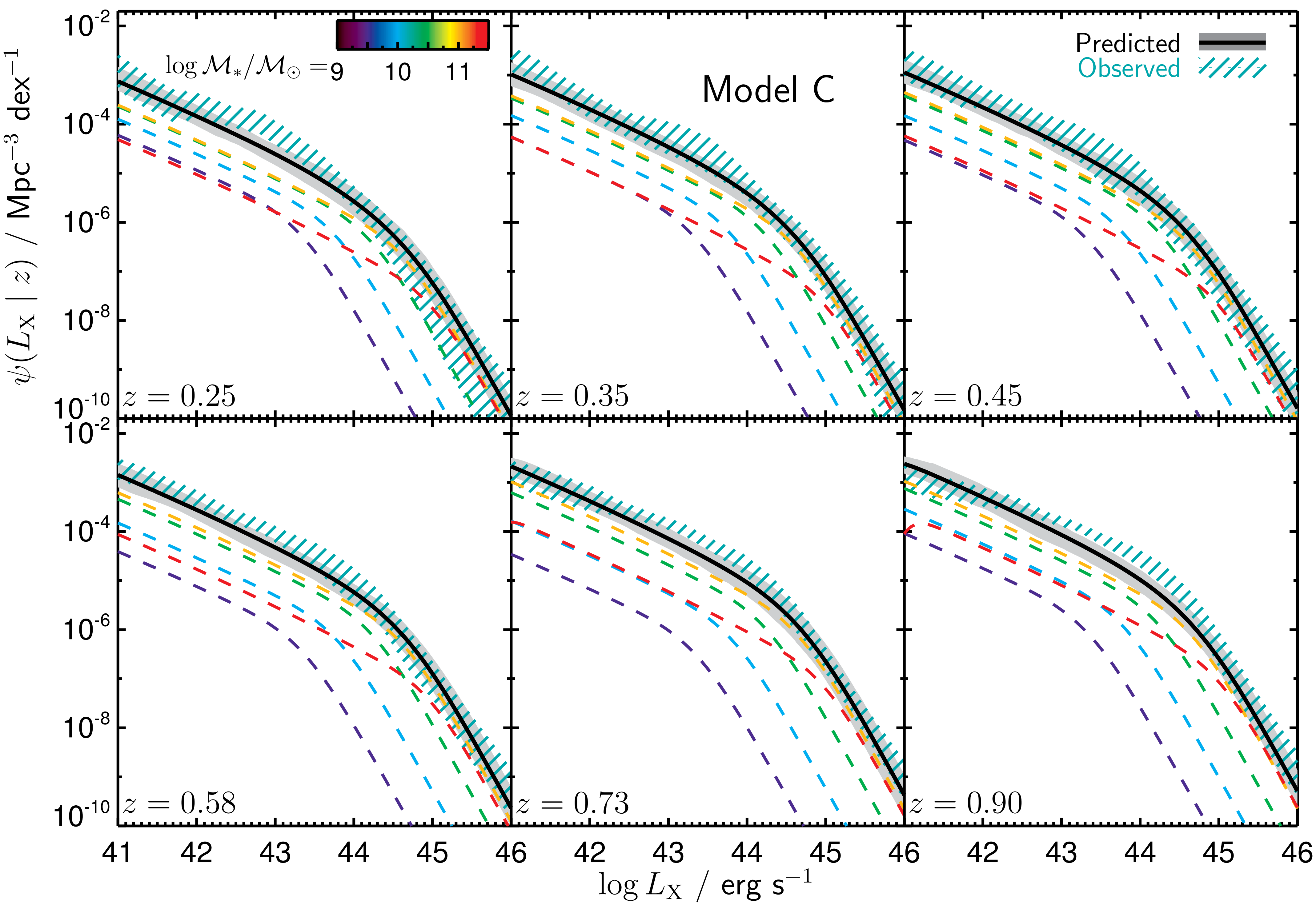
- Assume probability of hosting an AGN is determined only by specific accretion rate and z.
- Assume single scaling b/w black hole mass and host stellar mass. Include observed 0.38 dex scatter (Bennert et al. 2011).
- Power-law specific accretion rate distribution with tail to super-Eddington rates (slope of tail is the *only* free parameter).



Specific accretion rate

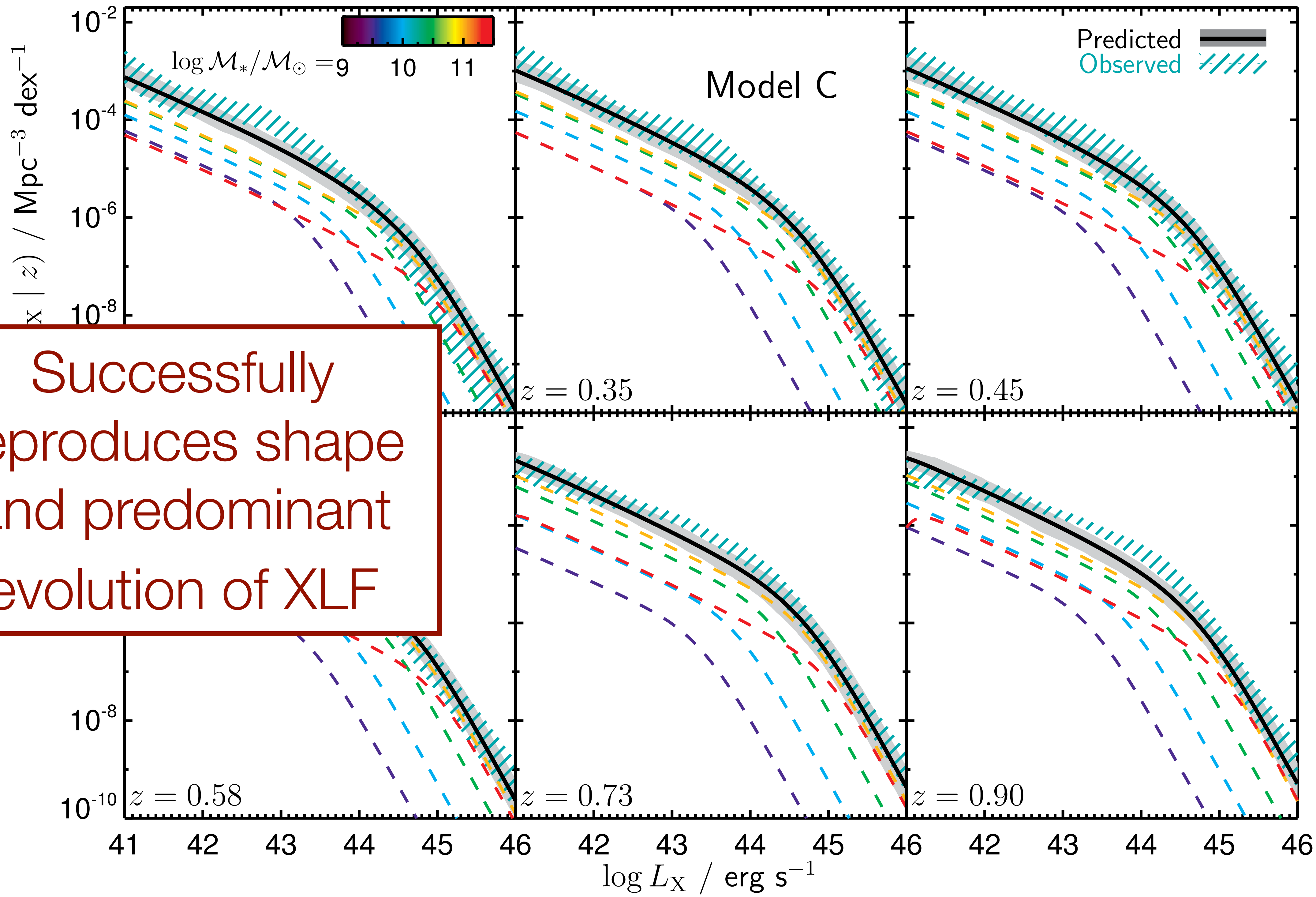
Aird, Coil, et al. 2013, ApJ

Modeling the X-ray LF



Aird, Coil, et al. 2013, ApJ

Modeling the X-ray LF

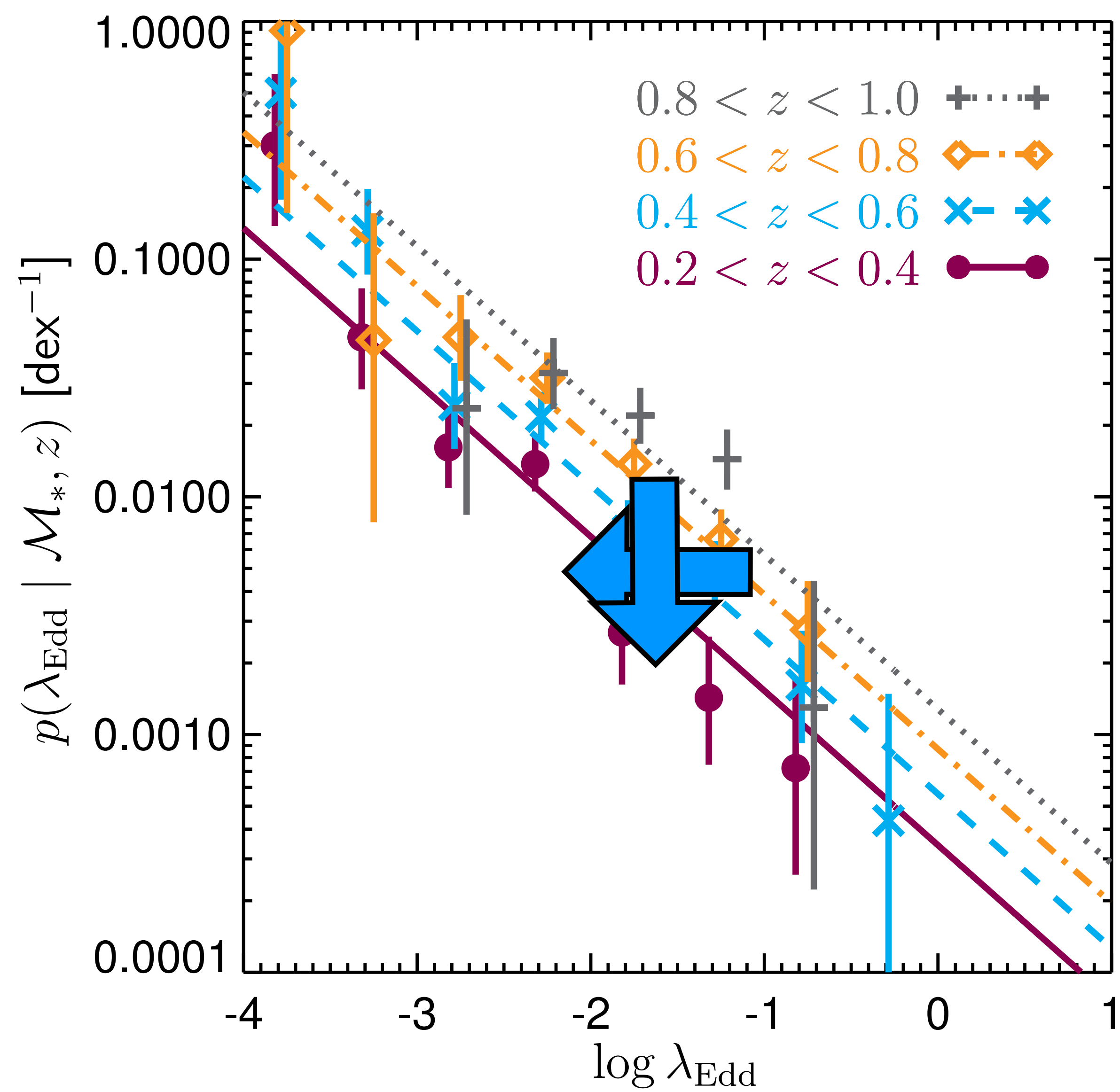


Successfully reproduces shape and predominant evolution of XLF

Aird, Coil, et al. 2013, ApJ

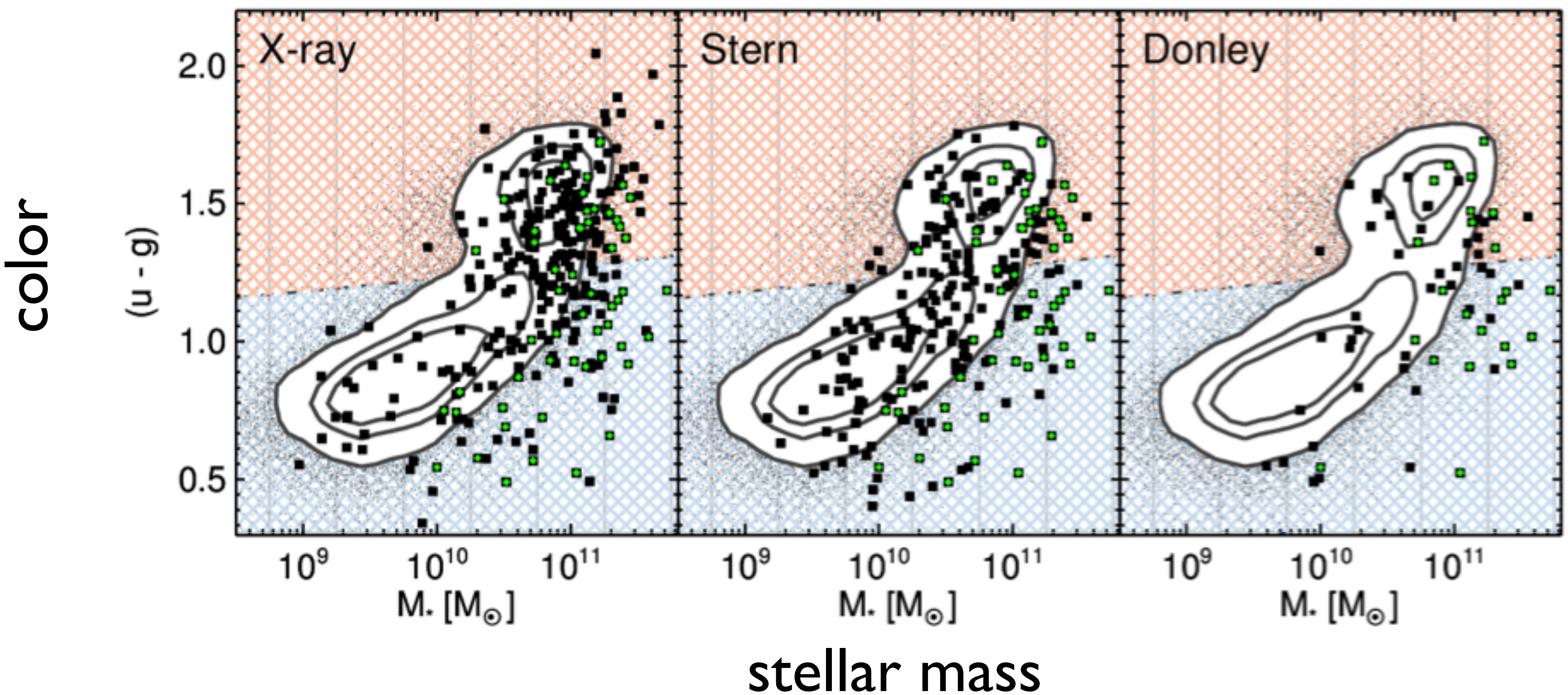
Evolution of AGN Population

- Strong observed evolution of XLF at z<1 is due to a reduction in probability of hosting an AGN for galaxies of **all** stellar masses.
- Driven by drop in duty cycle? Or shift to lower accretion rates?
- Wide distribution of accretion rates for all galaxies and all *z* (with break set by Eddington limit).
- No mass-dependent downsizing



Aird, Coil, et al. 2013, ApJ

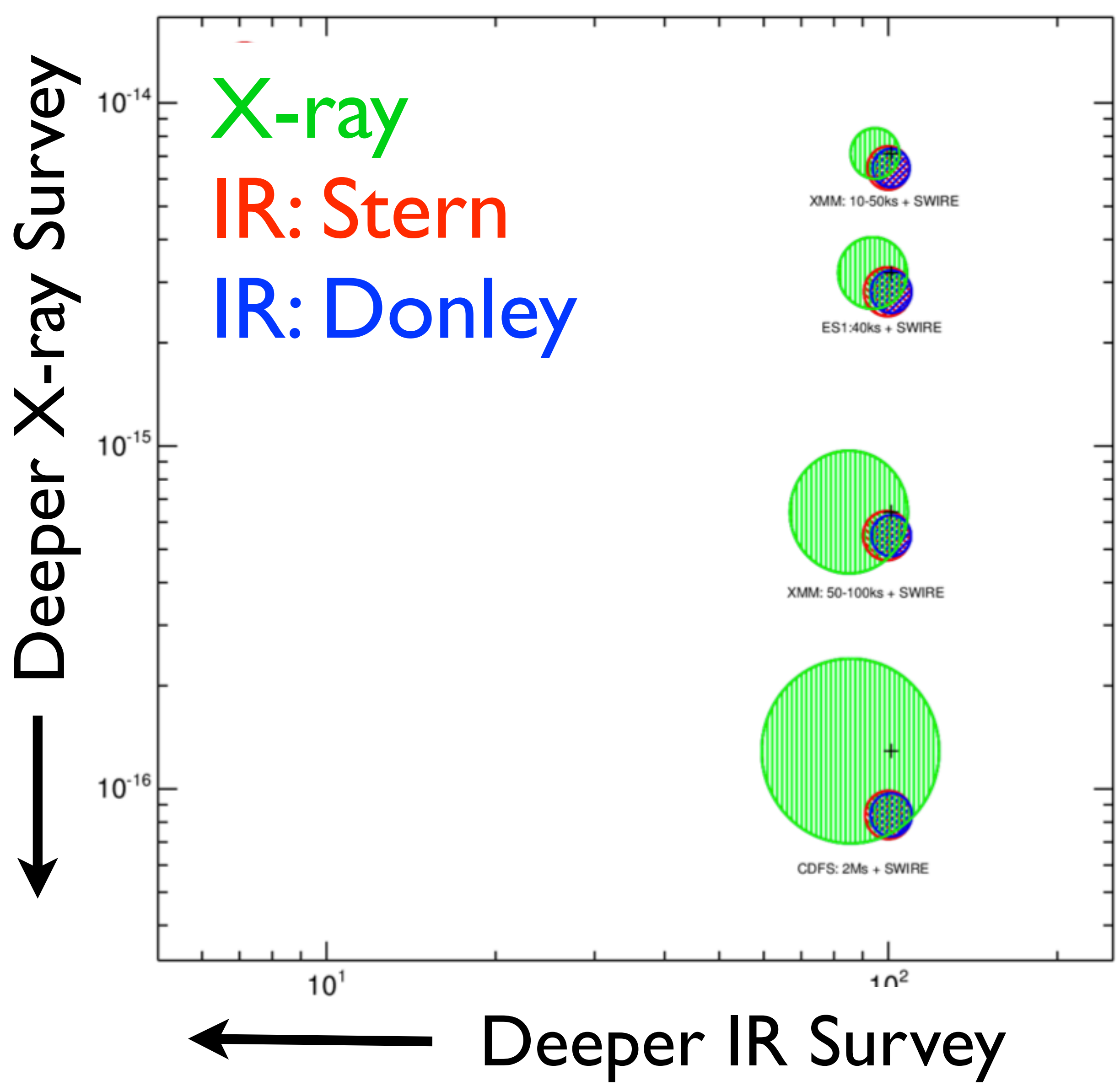
X-ray vs IR AGN Host Galaxies



- X-ray and IR AGN host galaxy populations have similar fractions of red/quiescent and blue/SF galaxies.
- Both are observed in massive galaxies - selection effect!

Mendez, Coil, et al. 2013, ApJ

X-ray vs IR AGN Selection



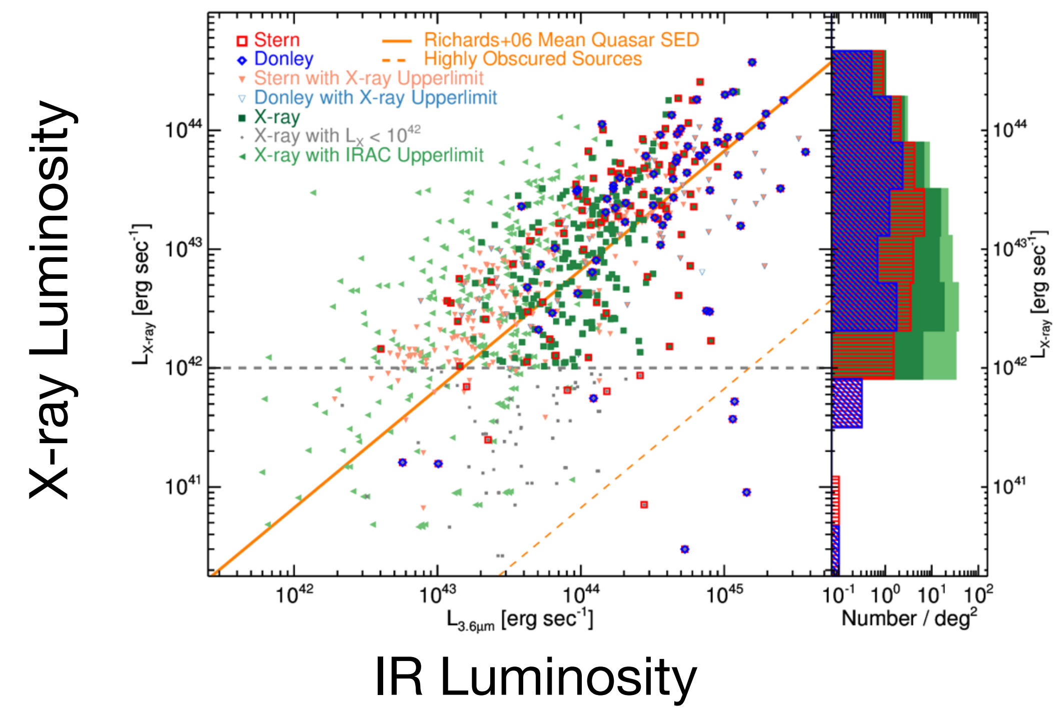
- ~90% of IR-AGN are X-ray detected in deepest X-ray data
- ~10% of IR-AGN are not detected in extremely deep X-ray data -- an upper limit on the fraction that could be very heavily obscured, Compton-thick sources
- IR selection will find some additional AGN not identified in X-rays

- Circle size represents number per deg^2

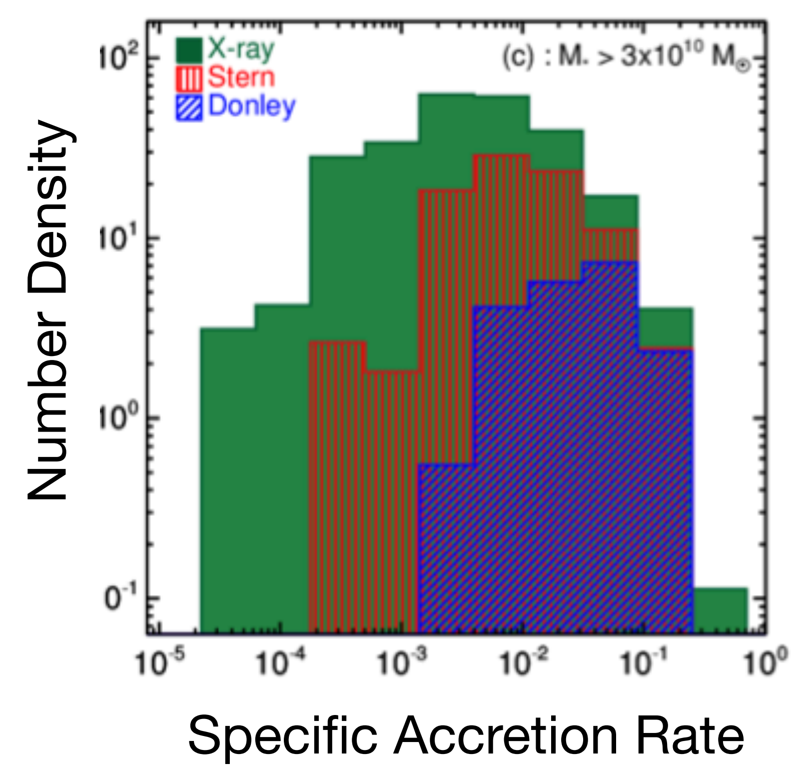
Mendez, Coil, et al. 2013, ApJ

X-ray vs IR AGN Properties

- IR-AGN selection identifies more luminous AGN



- X-ray AGN samples span a wide range of specific accretion rates
- IR-AGN samples incl. higher specific accretion rates only



Mendez, Coil, et al. 2013, ApJ

Conclusions

- Observed AGN samples are strongly biased towards identifying high stellar mass host galaxies.
- All galaxies have roughly equal probabilities of hosting an AGN with a wide range of possible accretion rates.
- The strong evolution of AGNs at $z<1$ is driven by a drop in the probability of hosting an AGN across *all* stellar masses.
- To constrain AGN triggering, don't worry about matching the XLF. Instead match the single accretion rate distribution observed for all stellar masses and all star formation rates.
- IR AGN selection identifies luminous AGN with higher specific accretion rates. Does not identify a large population of highly obscured AGN.