Mapping the AGN accretion in the SFR–M* plane

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On behalf of:
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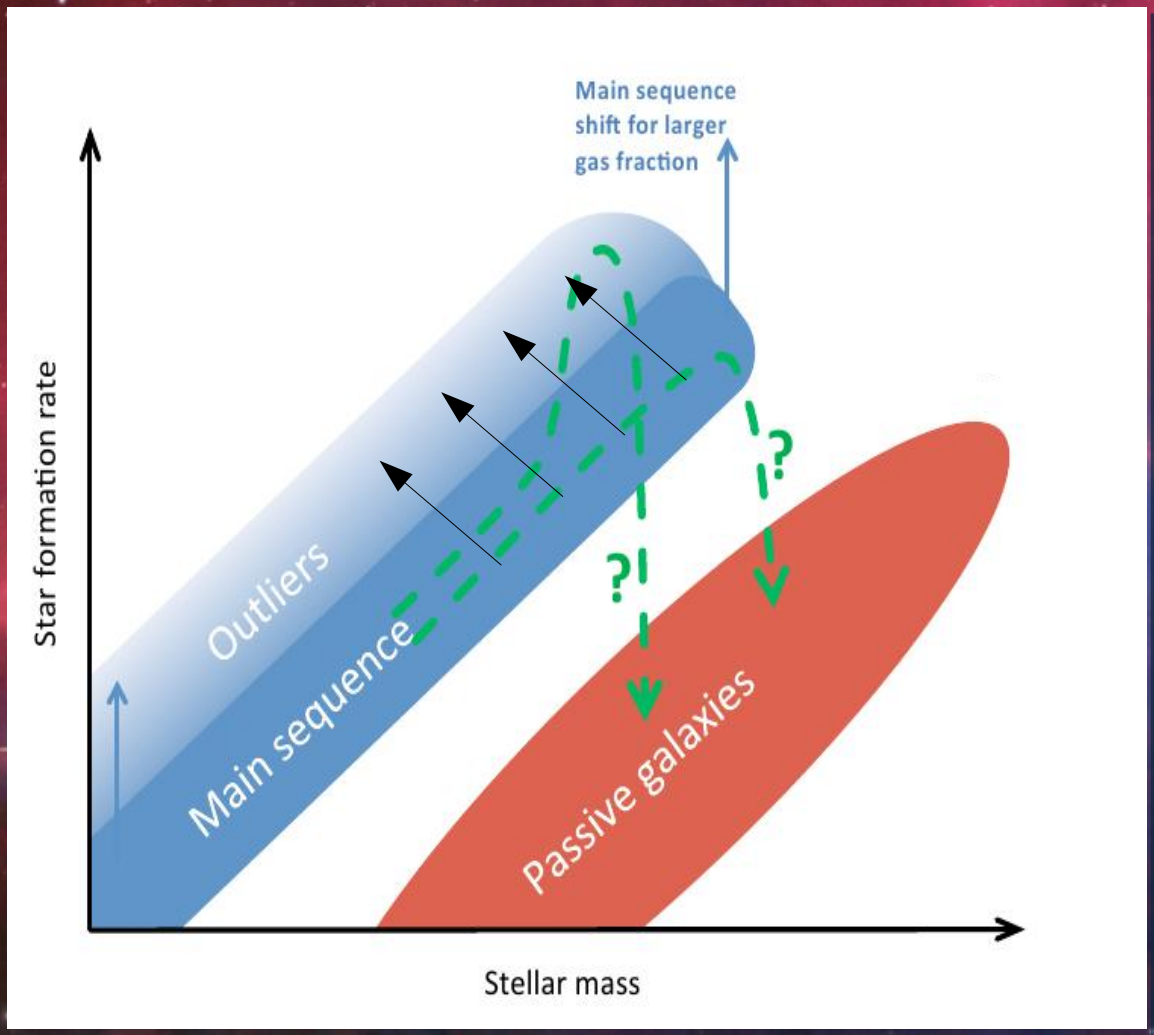
What can we learn from the SFR–M* plane?



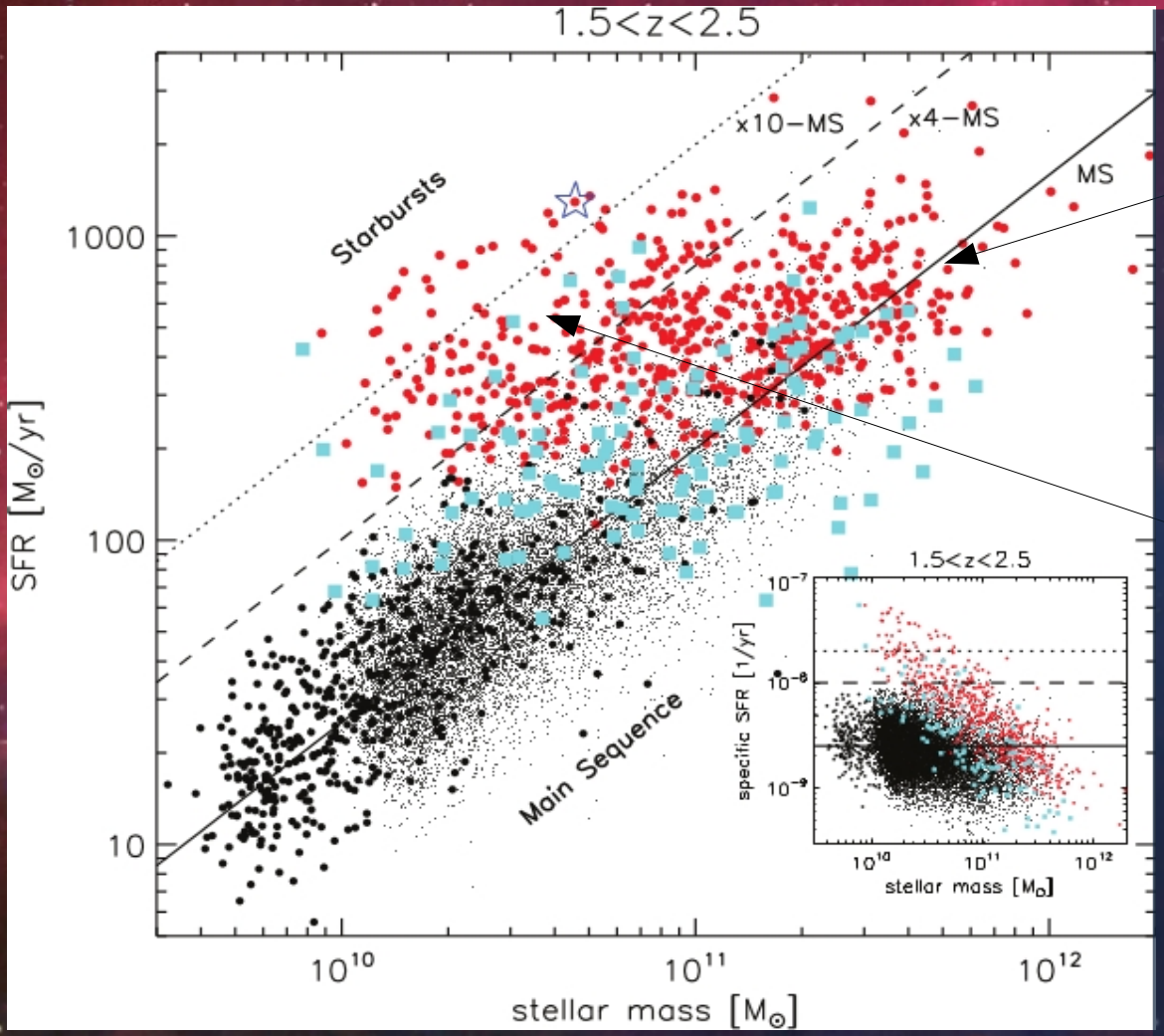
Star formation "main-sequence" (MS):

Duty cycle of steadily star-forming galaxies, fueled by continuous gas inflow (Dekel et al. 2009; Ciotti et al. 2010).

Off-sequence (= starburst) galaxies:

disturbed morphologies (Wuyts et al. 2011), more compact star-formation (Elbaz et al. 2011), higher gas fractions (Gao & Solomon 2004), more efficient in forming stars (Daddi et al. 2010; Genzel et al. 2010).

What can we learn from the SFR–M* plane?



Rodighiero et al. (2011)

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AGN–Galaxy connection...
...from X-ray selected samples

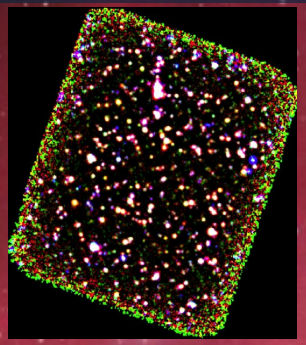
Mullaney et al. (2011): *"Most (80%) of X-ray selected AGN hosts are main-sequence galaxies"*

Santini et al. (2012): *"Higher SFR in X-ray AGN hosts compared to mass-matched sample of inactive galaxies"*

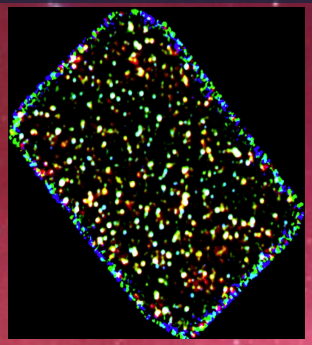
Rosario et al. (2012): *"X-ray AGN hosts are more star-forming (=less likely to be quenched) than inactive galaxies"*

All these studies independently suggest that most of the SMBH accretion takes place in STAR FORMING systems

AGN–Galaxy connection...
..from SFR selected samples (Herschel PEP/HerMES)

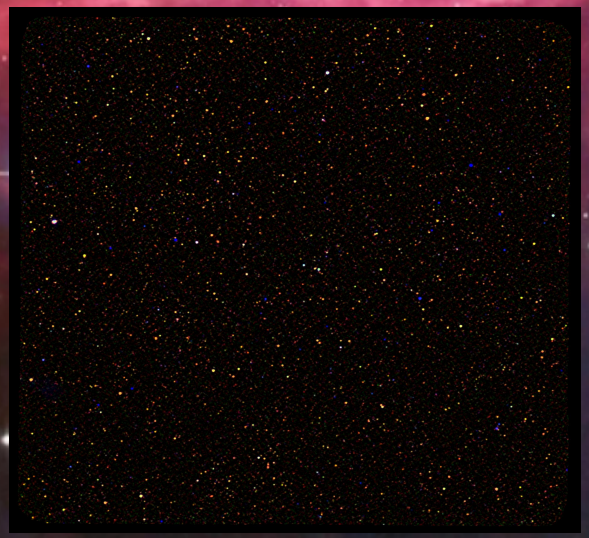


GOODS-S



GOODS-N

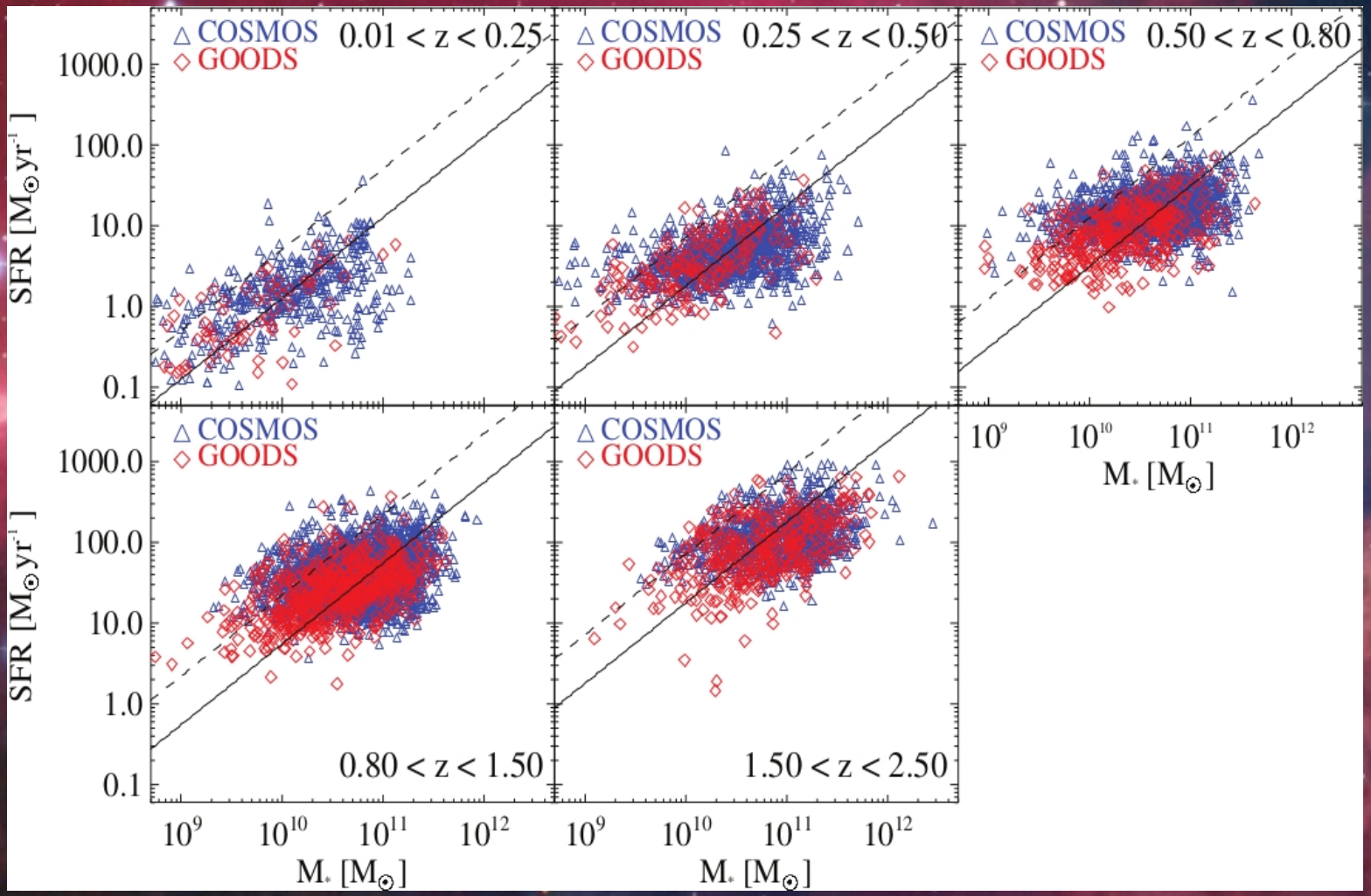
COSMOS



About 8600 Herschel-selected galaxies
at $0 < z < 2.5$
Far-IR/sub-mm data cross-matched with
optical/UV/near-IR/mid-IR photometry

SED-fitting decomposition: robust estimates of SFR and M*, both corrected for a possible AGN contribution

AGN–Galaxy connection...
...from SFR selected samples (Herschel PEP/HerMES)



AGN–Galaxy connection...
...from SFR selected samples
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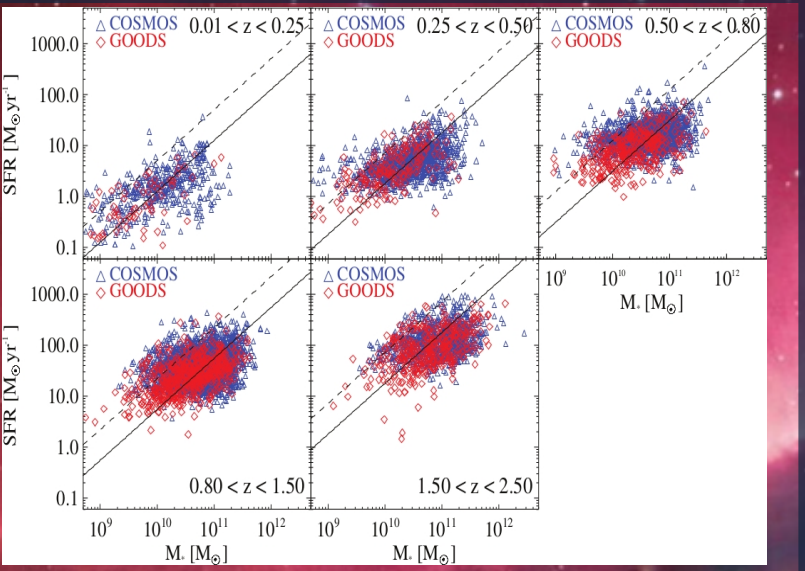


Analysis:

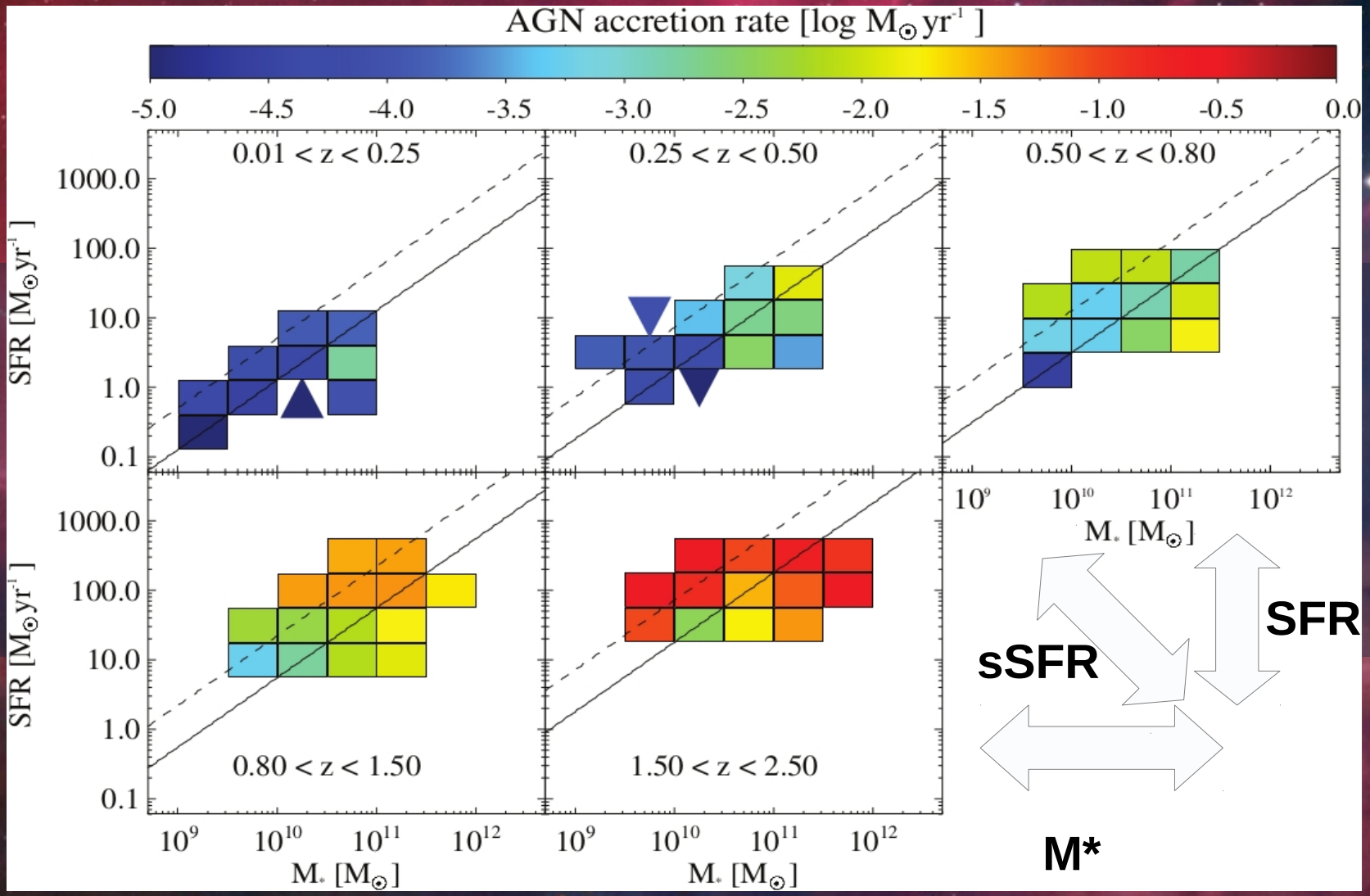
1) Splitting the sample in bins of SFR, M*, z
2) Cross-match with public X-ray data from Chandra observations
3) Stacking on X-ray maps
4) Weighted average signal:

$$S = \frac{S_{stack} \times N_{stack} + \sum_{i=1}^{N_{det}} S_i}{N_{stack} + N_{det}}$$

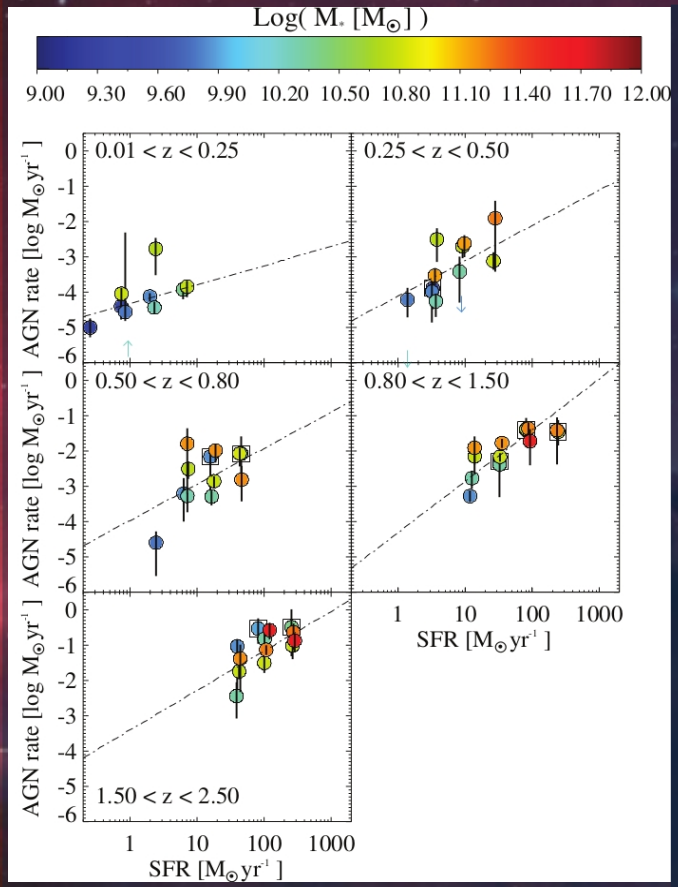
5) From the average signal S – to – < BHAR > through widely adopted conversion factors

< BHAR > = f(SFR, M*, z)

Mapping AGN accretion (BHAR)



Relationships BHAR VS SFR and BHAR VS M*



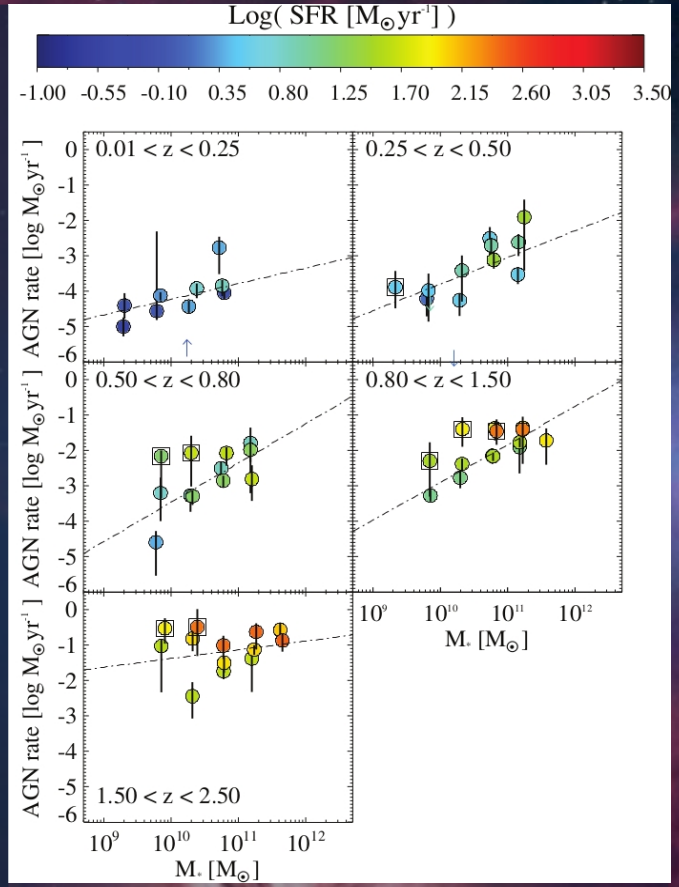
(z<1)

BHAR depends on both SFR and M* with similar significance levels

(z>1)

SFR best predictor of AGN accretion:

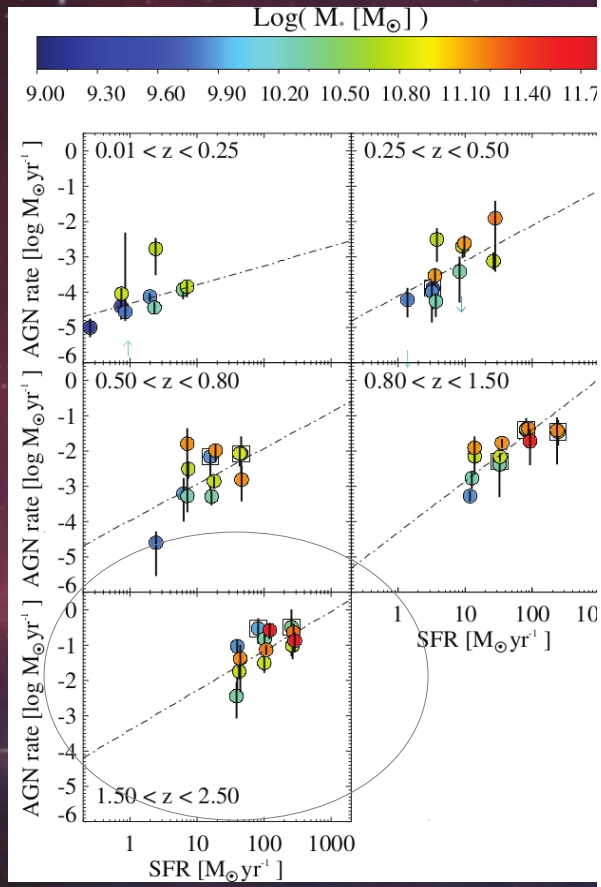
connection with total amount of gas? (see Vito's poster!)

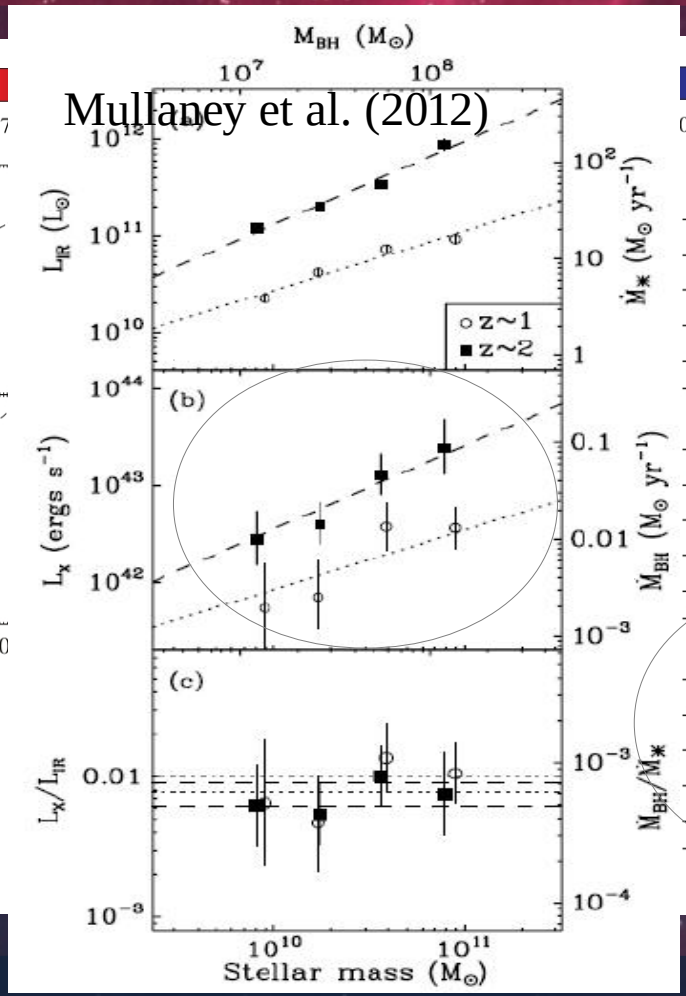


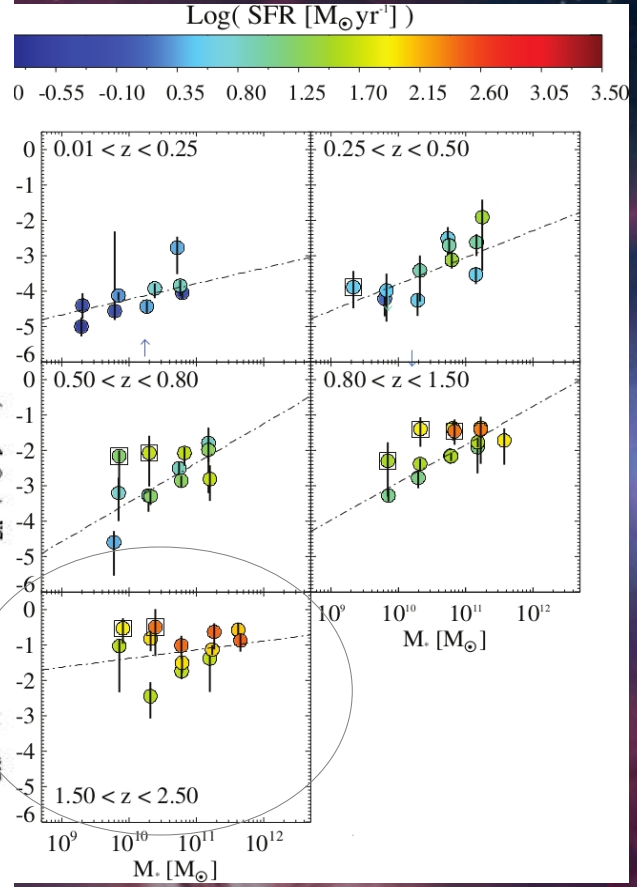
Statistical analysis: Spearman's rank + Monte Carlo bootstrapping

Relationships

BHAR VS SFR and BHAR VS M*





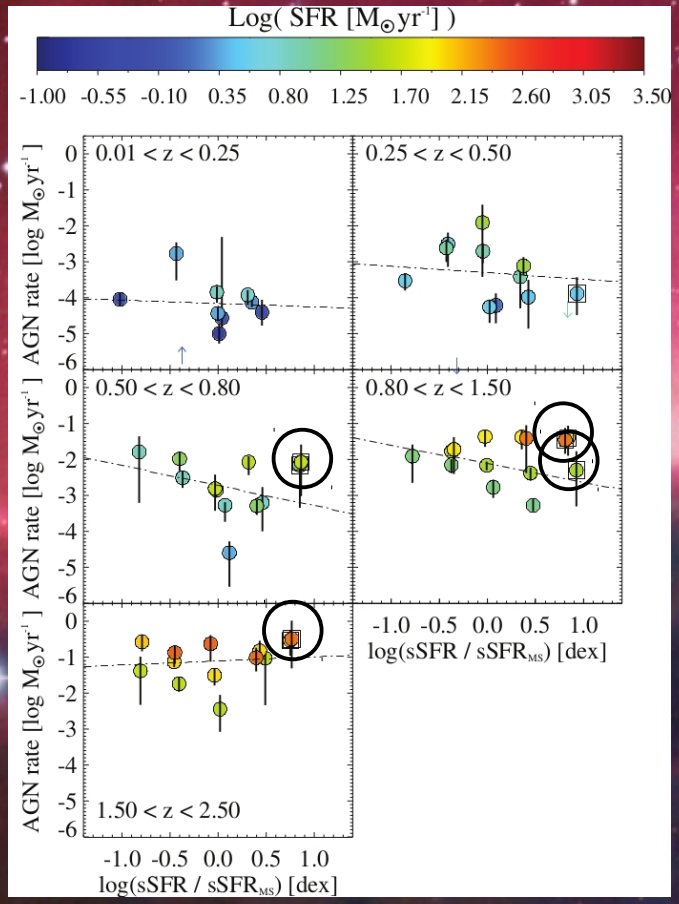


Splitting in bins of M* and SFR

Splitting in bins of M* only

Splitting in bins of M* and SFR

Relationships
BHAR VS specific-SFR (=SFR/M*)



1) sSFR (= MS offset) not a good predictor of AGN accretion.

2) Average BHAR(starburst) stand out of those on the main-sequence

3) BHAR/SFR evolve in a similar fashion with MS offset (fed by the "same gas"?)

Summary

1) < BHAR > shows a positive evolution as a function of both SFR and M* at z<1.

2) At higher redshift, our data establish the SFR as the best predictor of AGN accretion.

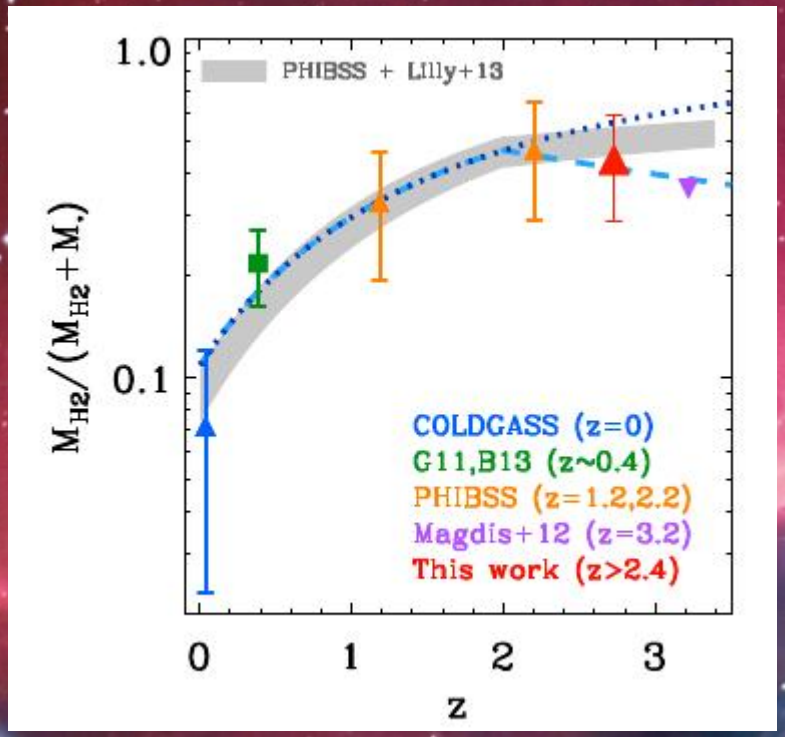
3) The BHAR-M* relation found at z~2 by Mullaney et al. (2012) is likely a consequence of the trend with SFR and of the MS relation that holds between SFR and M*.

4) Evolutionary trends of < BHAR > with SFR, M* and s-SFR are plausible in the context of the evolution of the molecular gas content, if BHAR is linked to the content of dense star forming gas.

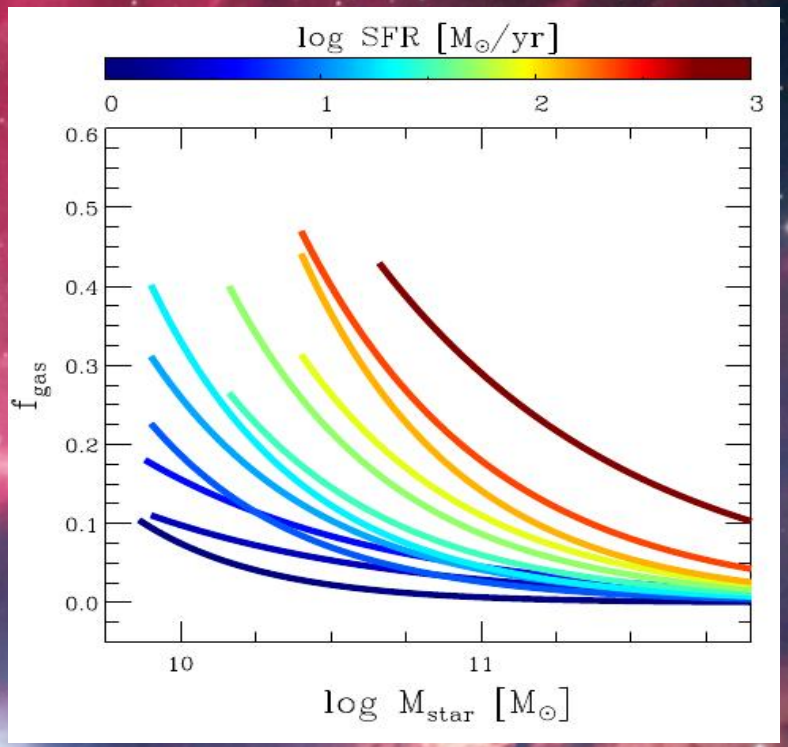

Thank you!

Supplementary slides

Evolution of the gas fraction f_{gas}

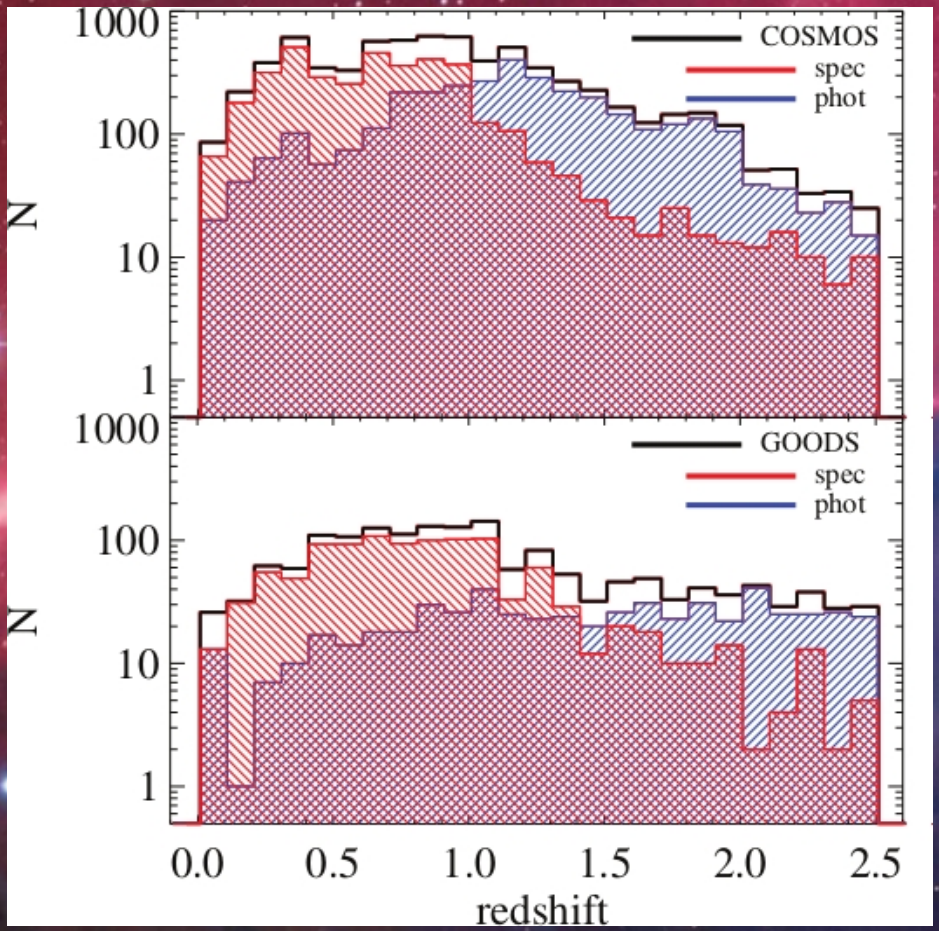


Saintonge et al. (2013)

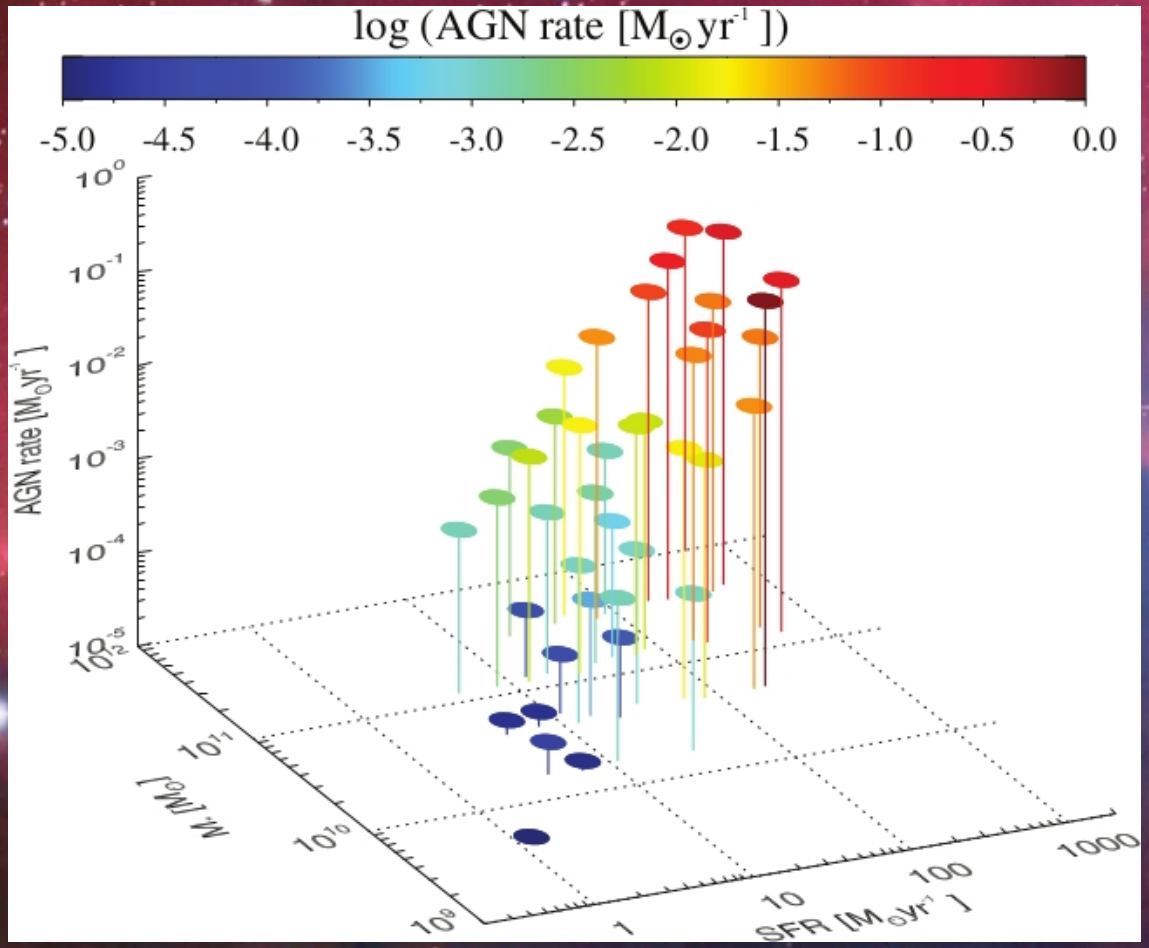


Santini et al. (2014)

z-distribution of Herschel galaxies

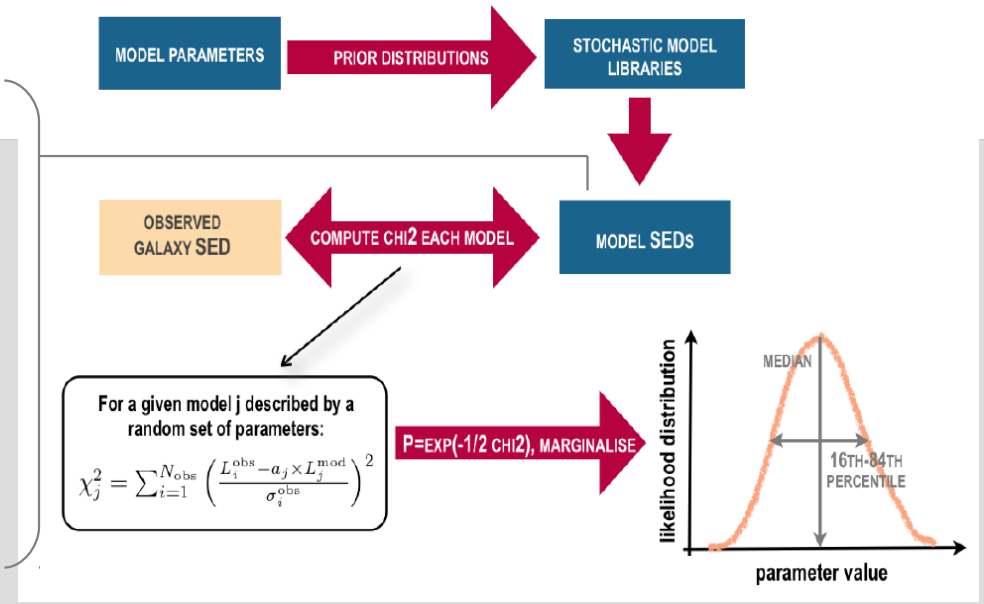


Merging all z-bins together (80% complete sub-sample)



SED-fitting: how does MAGPHYS + AGN work?

- Same approach as MAGPHYS
- Stellar+dust normalization is random
- AGN is added to reproduce what is left out between star formation and the observed SED, seeking for χ^2 minimization



1) We perform the SED-fitting for each observed SED
2) We test the relative incidence of the AGN (Fisher test)
3) We prefer the best-fit with AGN if the X^2 significantly (>99% CL) improves wrt the fit without AGN