MAX PLANCK INSTITUTE FOR EXTRATERRESTRIAL PHYSICS

The Evolution of Resolved Kinematics and Metallicity from z=2.7 to 0.7 with LUCI, SINS and KMOS^{3D}

Eva Wuyts

N.M. Förster Schreiber, R. Genzel, L.J. Tacconi, S. Wuyts, D. Wilman,

K. Bandara, A. Beifiori, R. Bender, G. Brammer, J. Chan, R. Davies, M. Fabricius, M. Fossati, S. Kulkarni, J. Kurk, P. Lang, D. Lutz, J.T. Mendel, I. Momcheva, E. Nelson, D. Rosario, R. Saglia, S. Seitz, R. Sharples, P. van Dokkum, E. Wisnioski, et al.

SUMMARY

Redshift Evolution of Velocity Dispersion

- overall decrease from z~4 to the present day
- driven by the evolution of gas fractions in near-critical disks

Wisnioski et al. 2014, to be submitted soon

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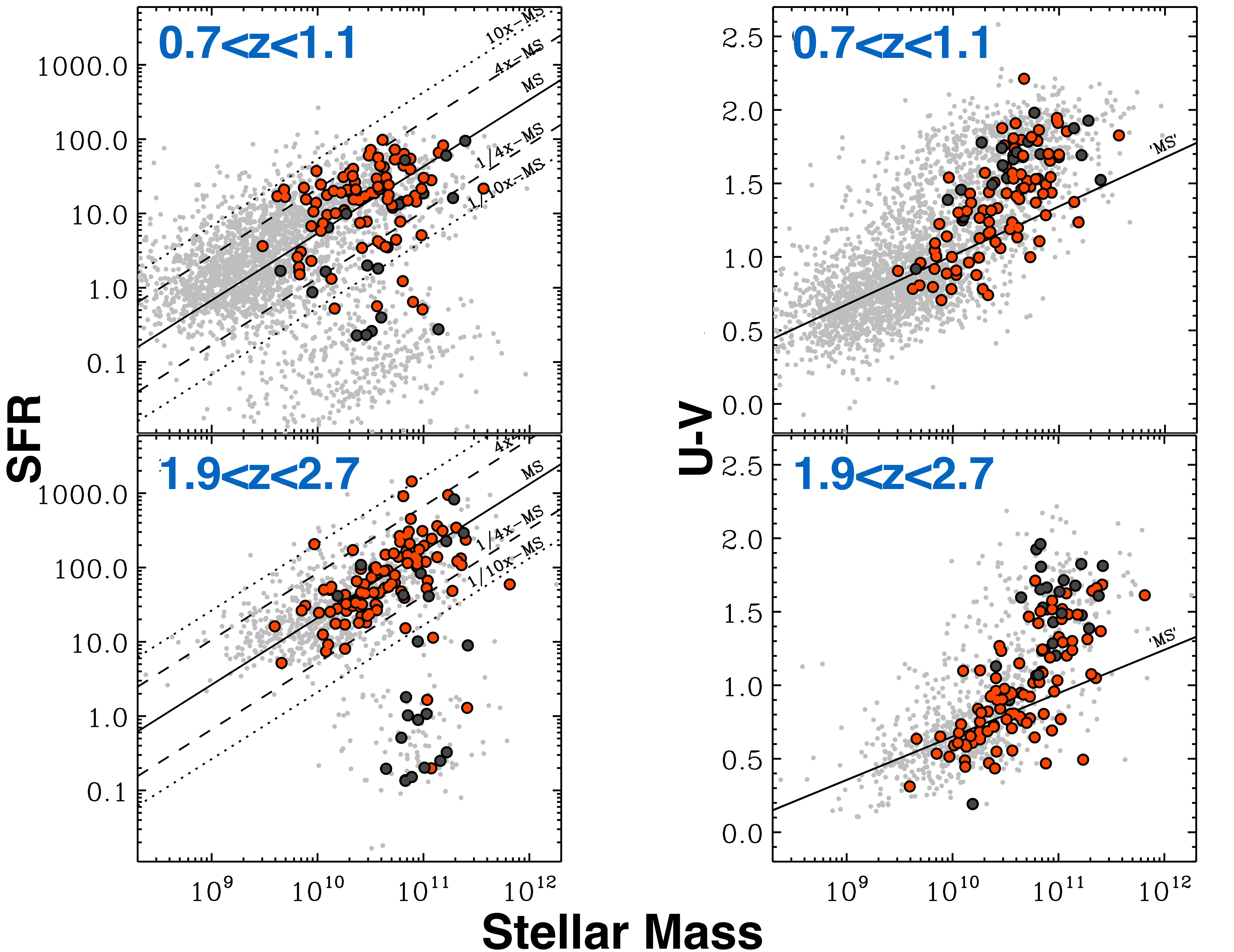
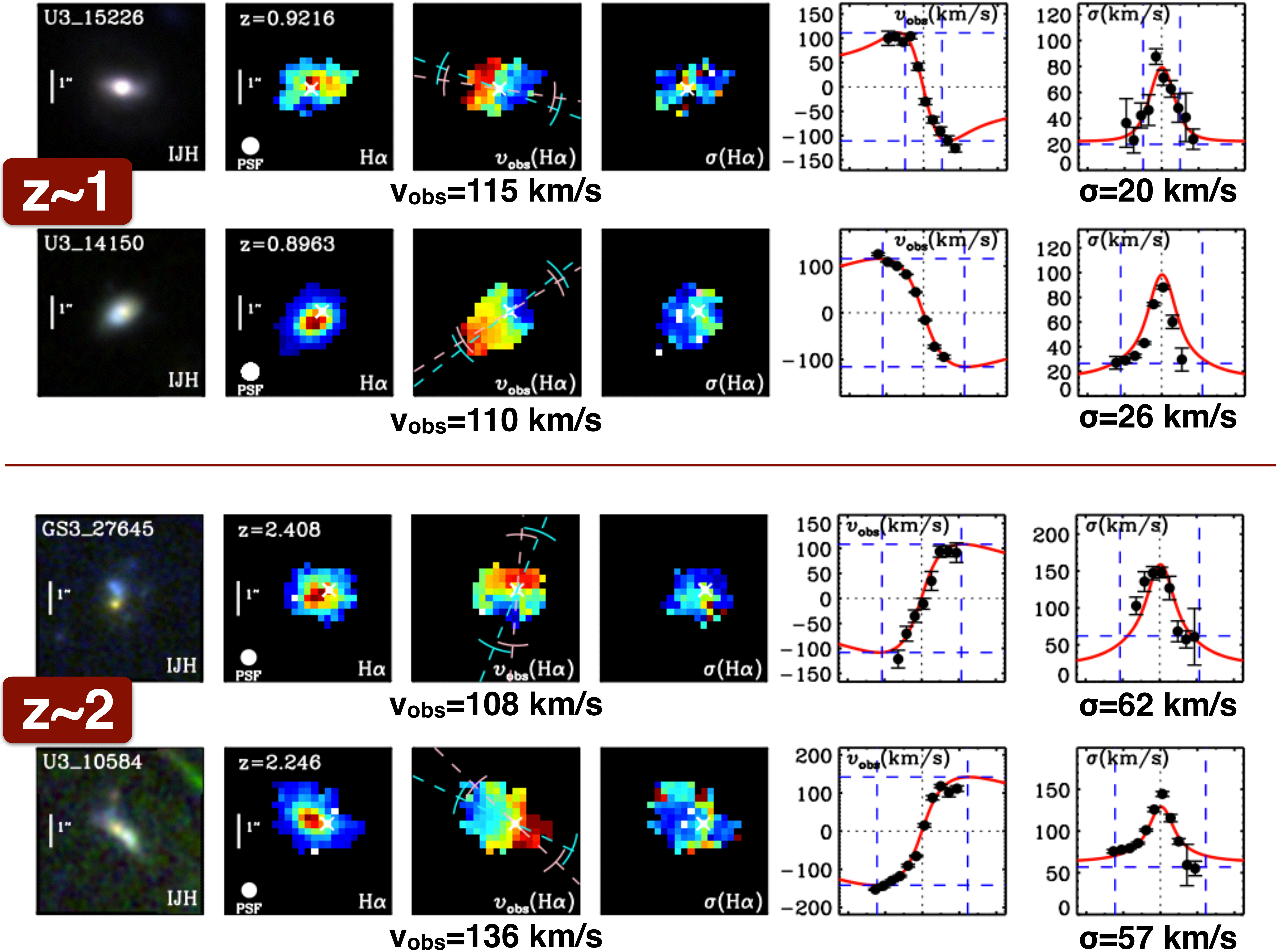
- no correlation between [NII]/Ha and SFR at fixed mass and redshift

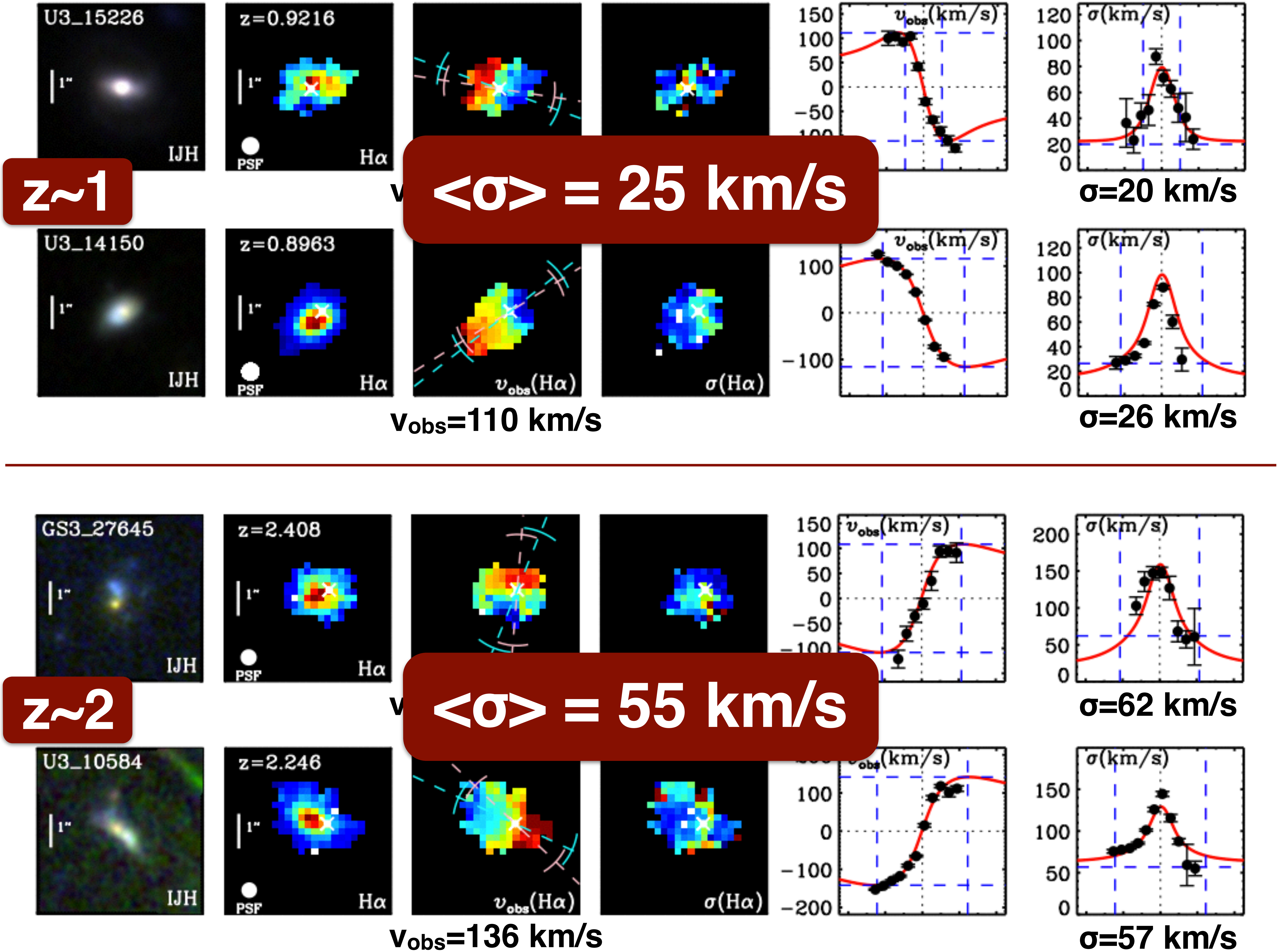
Wuyts et al. 2014, ApJ, 789L, 40

THE KMOS^{3D} SAMPLE



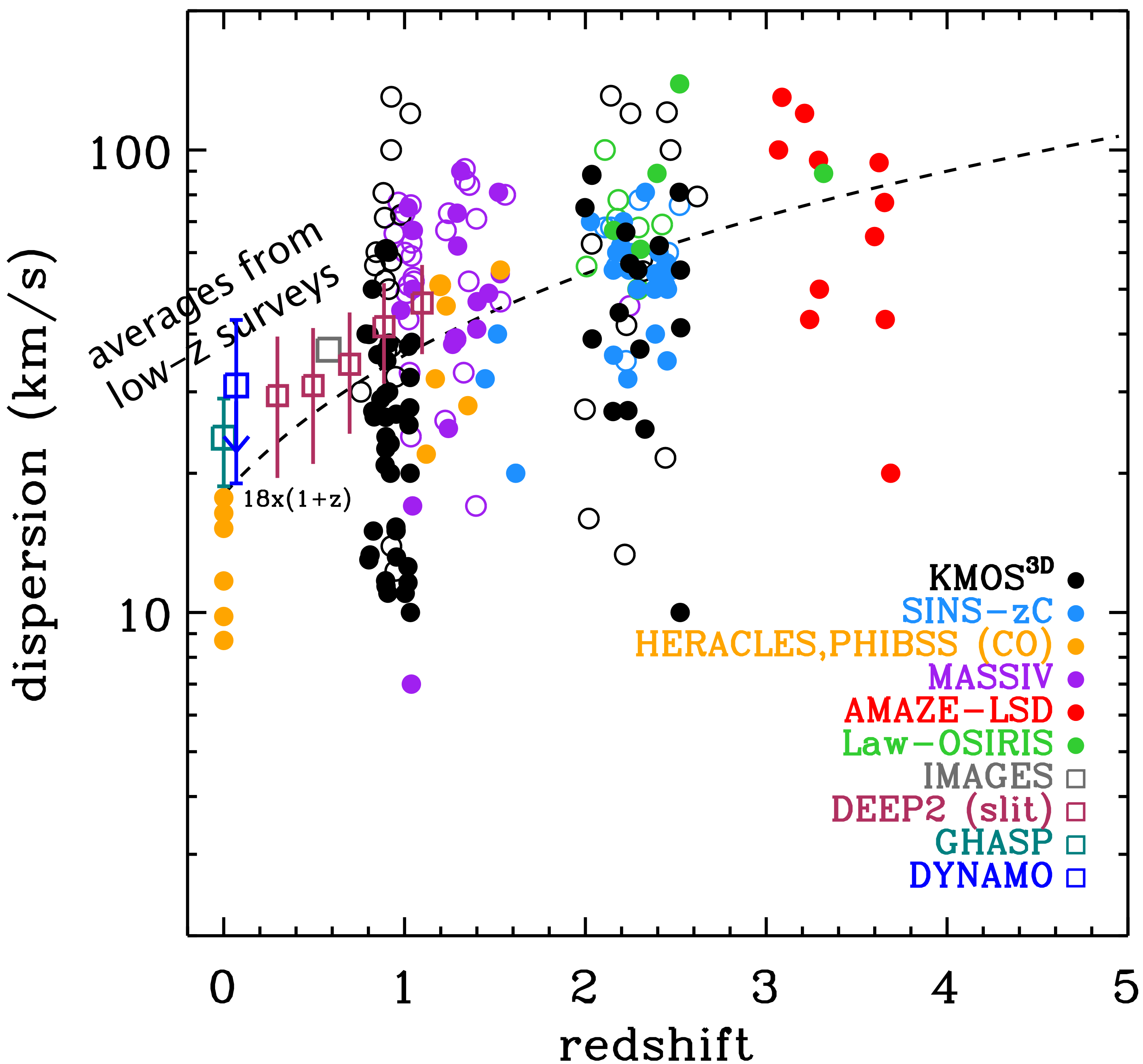


z~1
U3_15226
z=0.9216
IJH
PSF
Hα
v_{obs}(Hα)
σ(Hα)
v_{obs}(km/s)
σ(km/s)
v_{obs}=115 km/s
σ=20 km/s
U3_14150
z=0.8963
v_{obs}=110 km/s
σ=26 km/s
z~2
GS3_27645
z=2.408
v_{obs}=108 km/s
σ=62 km/s
U3_10584
z=2.246
v_{obs}=136 km/s
σ=57 km/s



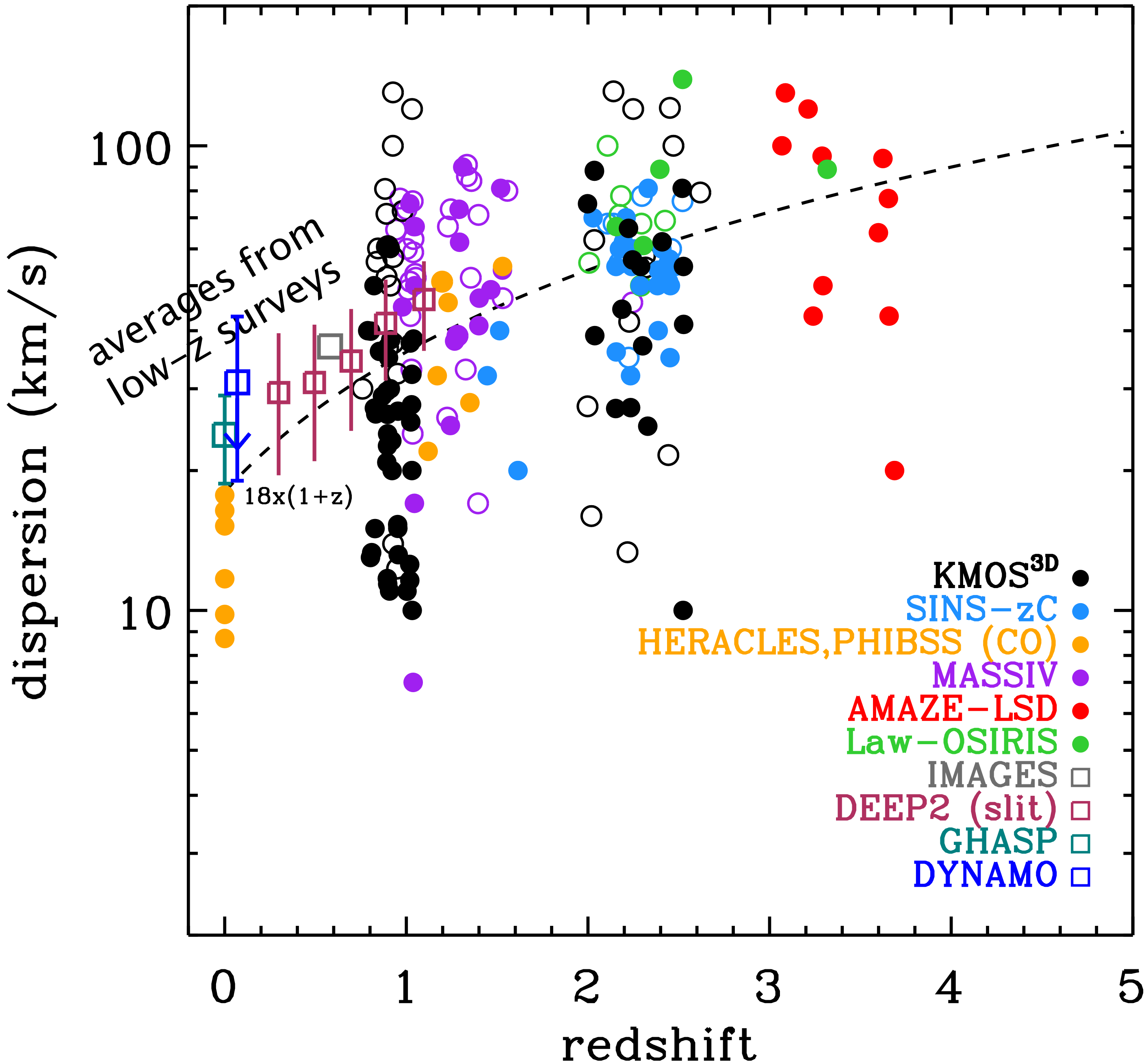
U3_15226
IJH
z=0.9216
PSF
Hα
v_{obs}(km/s)
σ(km/s)
z~1
<σ> = 25 km/s
σ=20 km/s
U3_14150
z=0.8963
v_{obs}(Hα)
σ(Hα)
v_{obs}=110 km/s
σ=26 km/s
GS3_27645
z=2.408
z~2
<σ> = 55 km/s
σ=62 km/s
U3_10584
z=2.246
v_{obs}=136 km/s
σ=57 km/s

DISPERSION EVOLUTION



Wisnioski et al. (in prep), also see Kassin et al. 2012, 2014

DISPERSION EVOLUTION



Toomre stability criterium

$$\frac{v_{\mathrm{rot}}}{\sigma_0} = \frac{a}{f_{\mathrm{gas}}(z)Q_{\mathrm{crit}}}$$

Genzel et al. 2008

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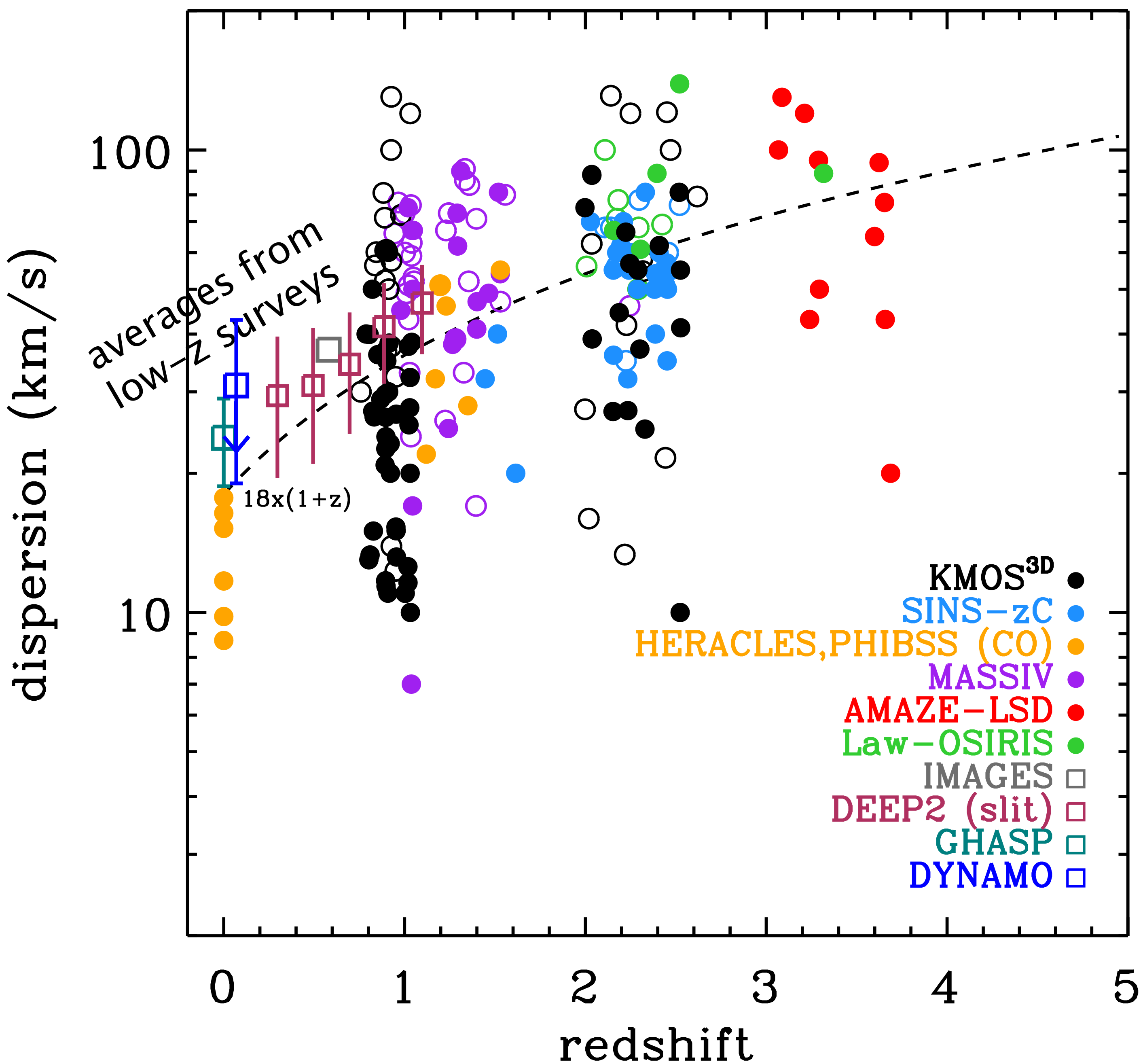
DISPERSION EVOLUTION



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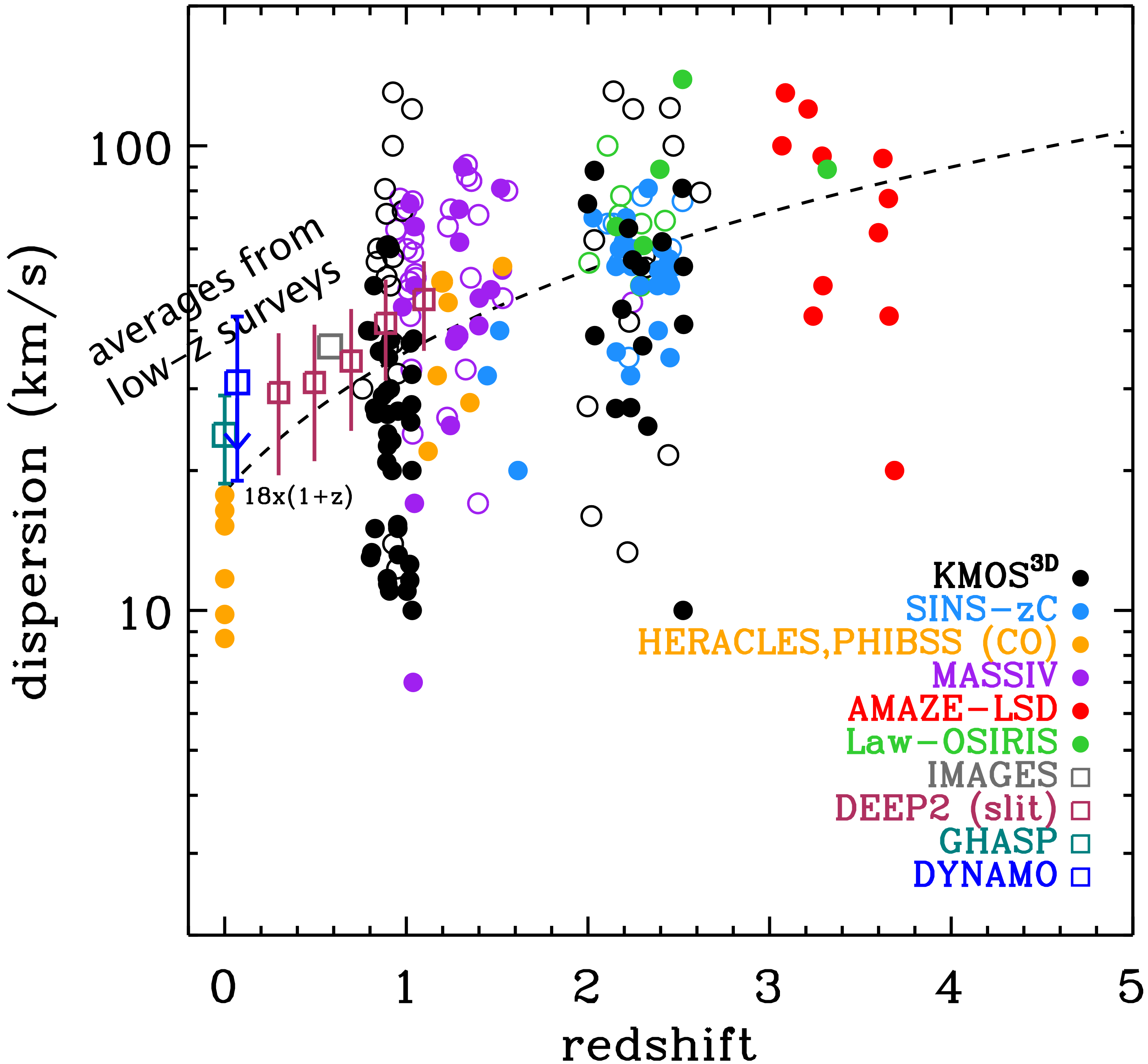

$$f_{\text{gas}} = \frac{1}{1 + (t_{\text{dep}}\text{sSFR})^{-1}},$$

Tacconi et al. 2013

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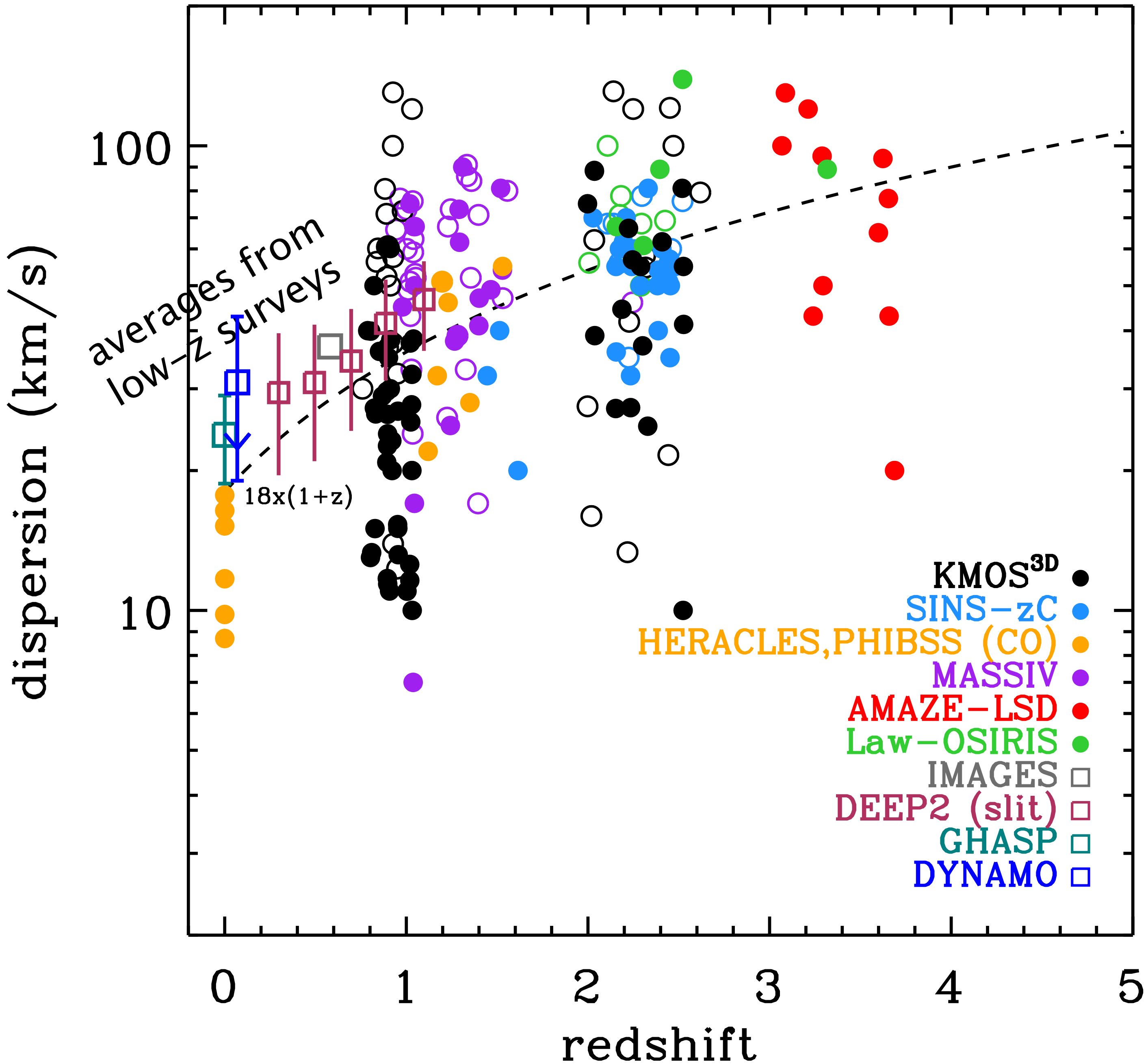


$$f_{\rm gas} = \frac{1}{1 + (t_{\rm dep}{\rm sSFR})^{-1}},$$

$$t_{\rm dep}(z) = 1.5(1+z)^{\alpha}[{\rm Gyr}],$$

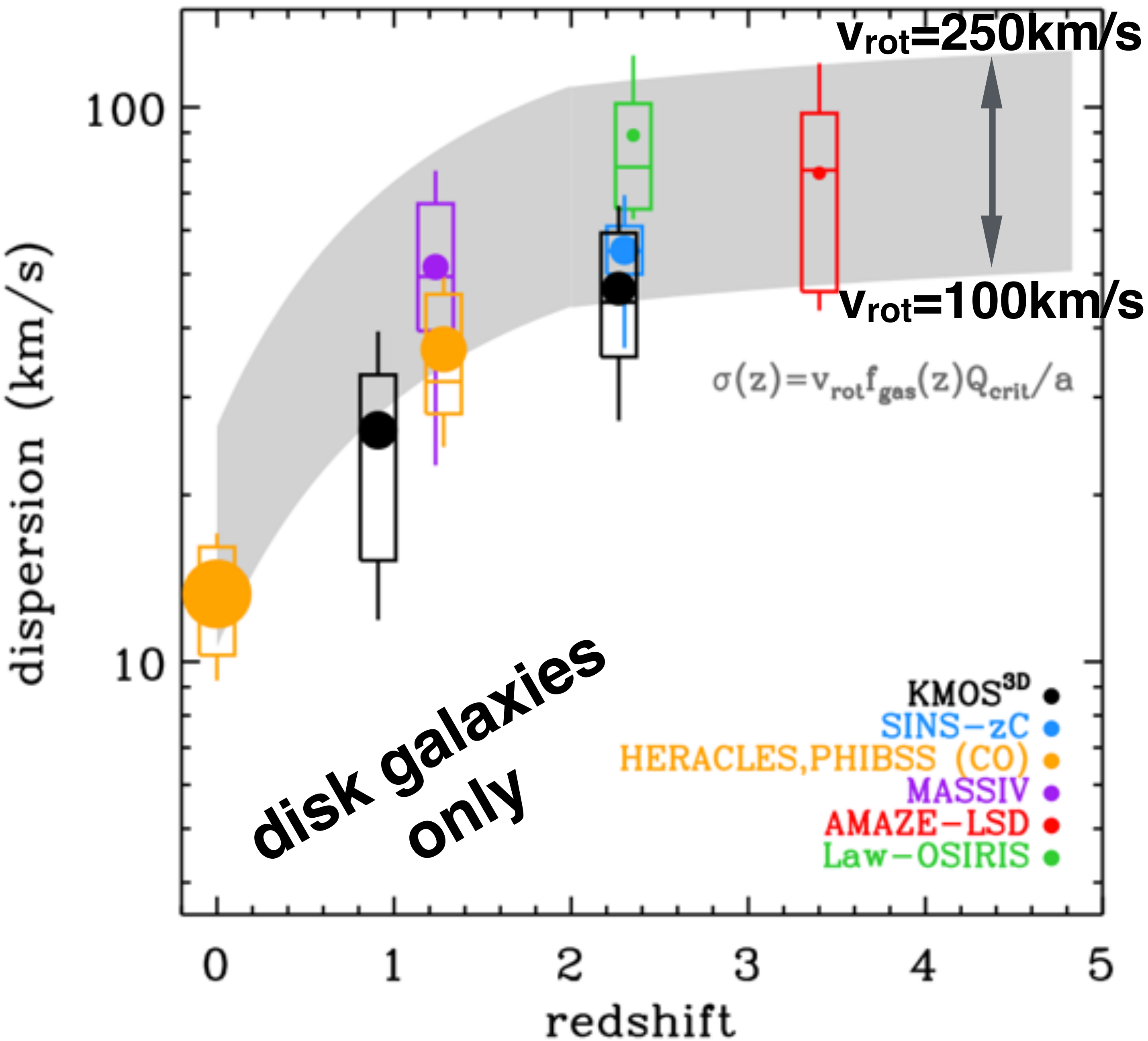
Tacconi et al. 2013

$$\text{sSFR}(M_*, z) = \begin{cases} 0.07 \left(\frac{M_*}{10^{10.5}\,M_\odot}\right)^{-0.1} (1+z)^3 & \text{if } z < 2 \\ 0.30 \left(\frac{M_*}{10^{10.5}\,M_\odot}\right)^{-0.1} (1+z)^{5/3} & \text{if } z > 2. \end{cases}$$

Lilly et al. 2013

Wisnioski et al. (in prep)

DISPERSION EVOLUTION



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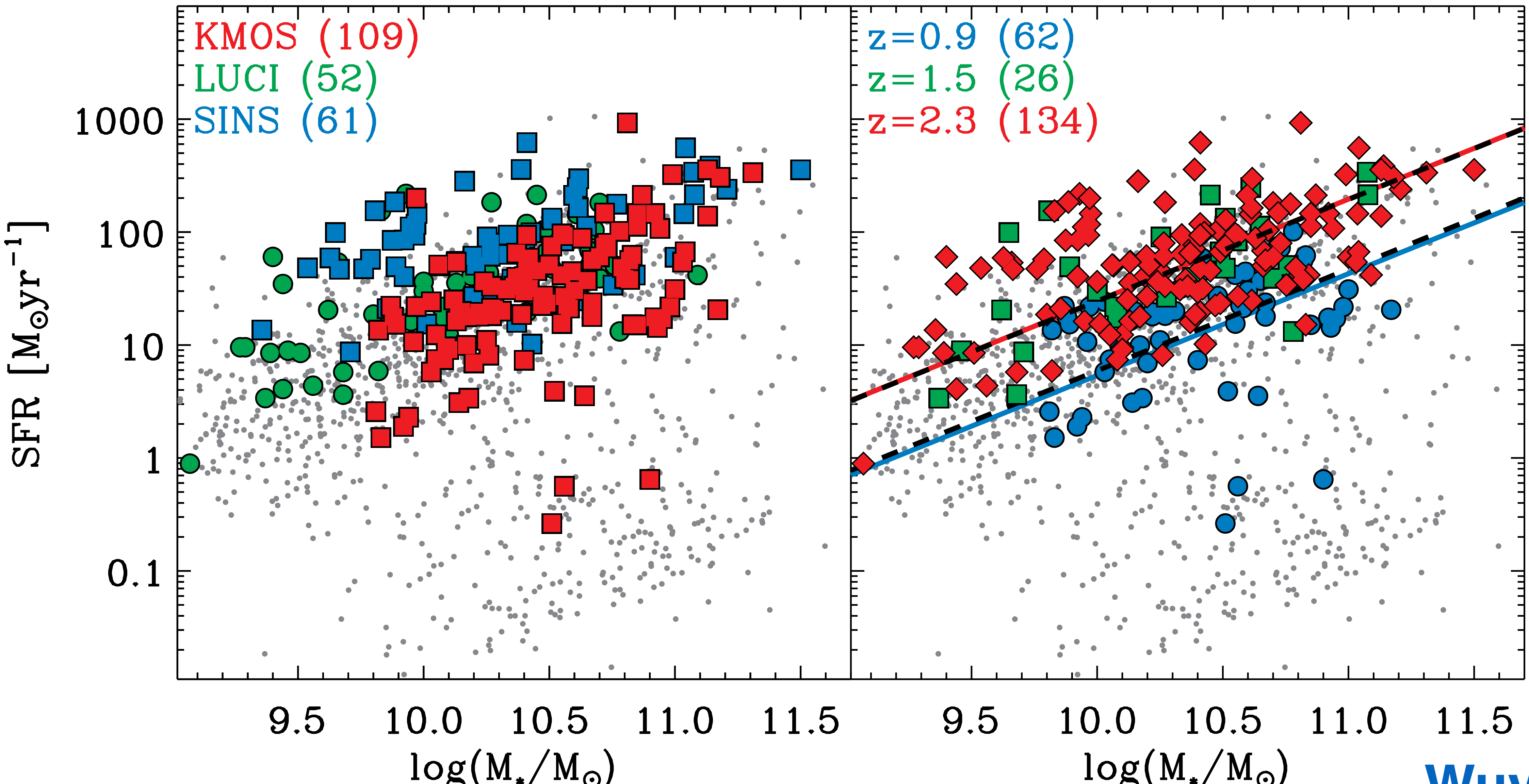
THE COMBINED SINS + LUCI + KMOS^{3D} SAMPLE

222 SFGs @ z=0.9-2.3

SINS/zC-SINF
12 SFGs @ z=1.5
49 SFGs @ z=2.3

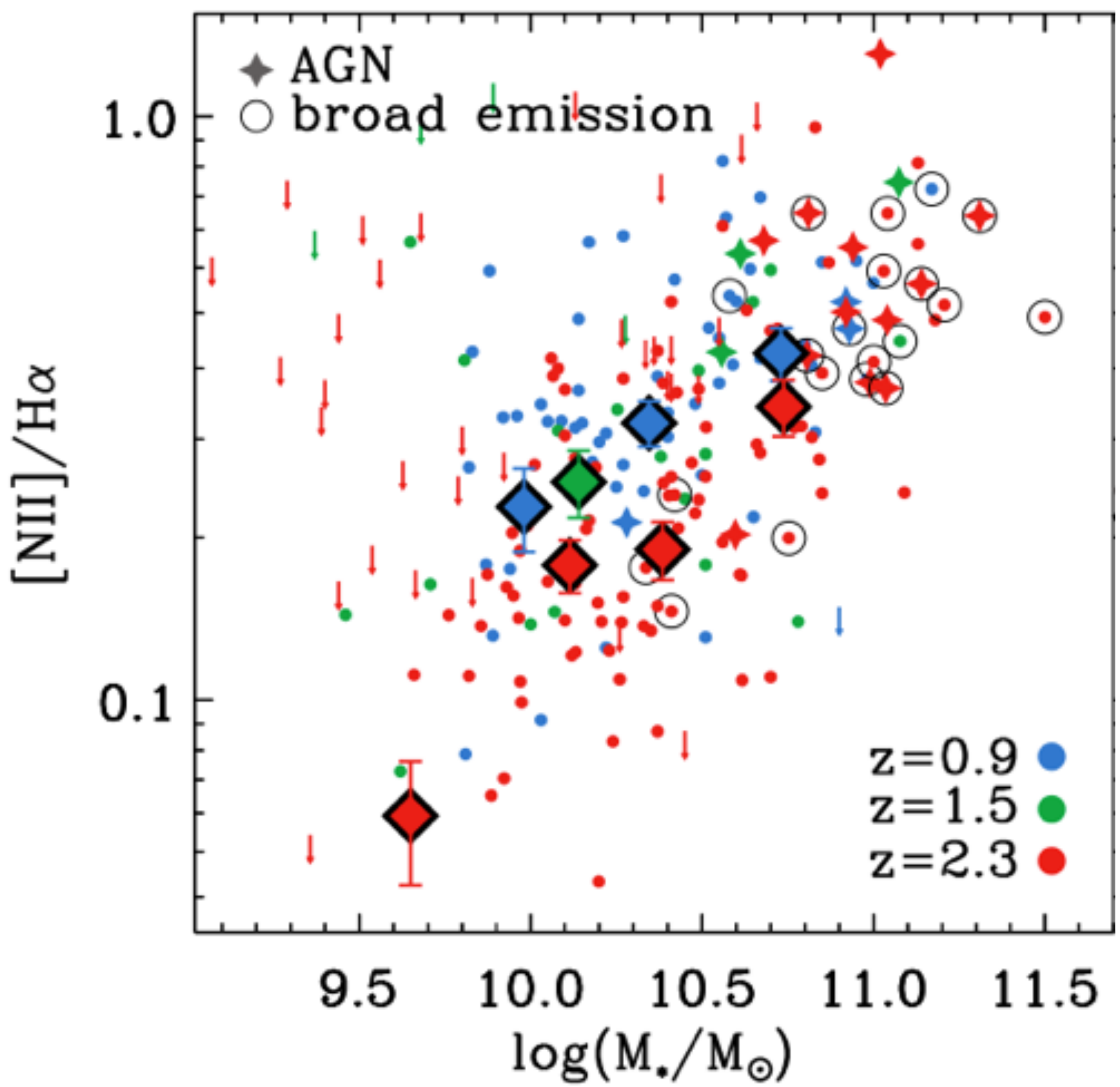
LUCI
14 SFGs @ z=1.5
38 SFGs @ z=2.3

KMOS^{3D}
62 SFGs @ z=0.9
47 SFGs @ z=2.3



Wuyts+2014

THE MASS-METALLICITY RELATION



AGN = classic indicators
X-ray, radio, IRAC colours,
rest-frame UV spectra **(18)**

broad AGN-driven outflows
Genzel+2014 **(20)**

-> 17% contamination

83% detection rate of [NII]

Wuyts+2014

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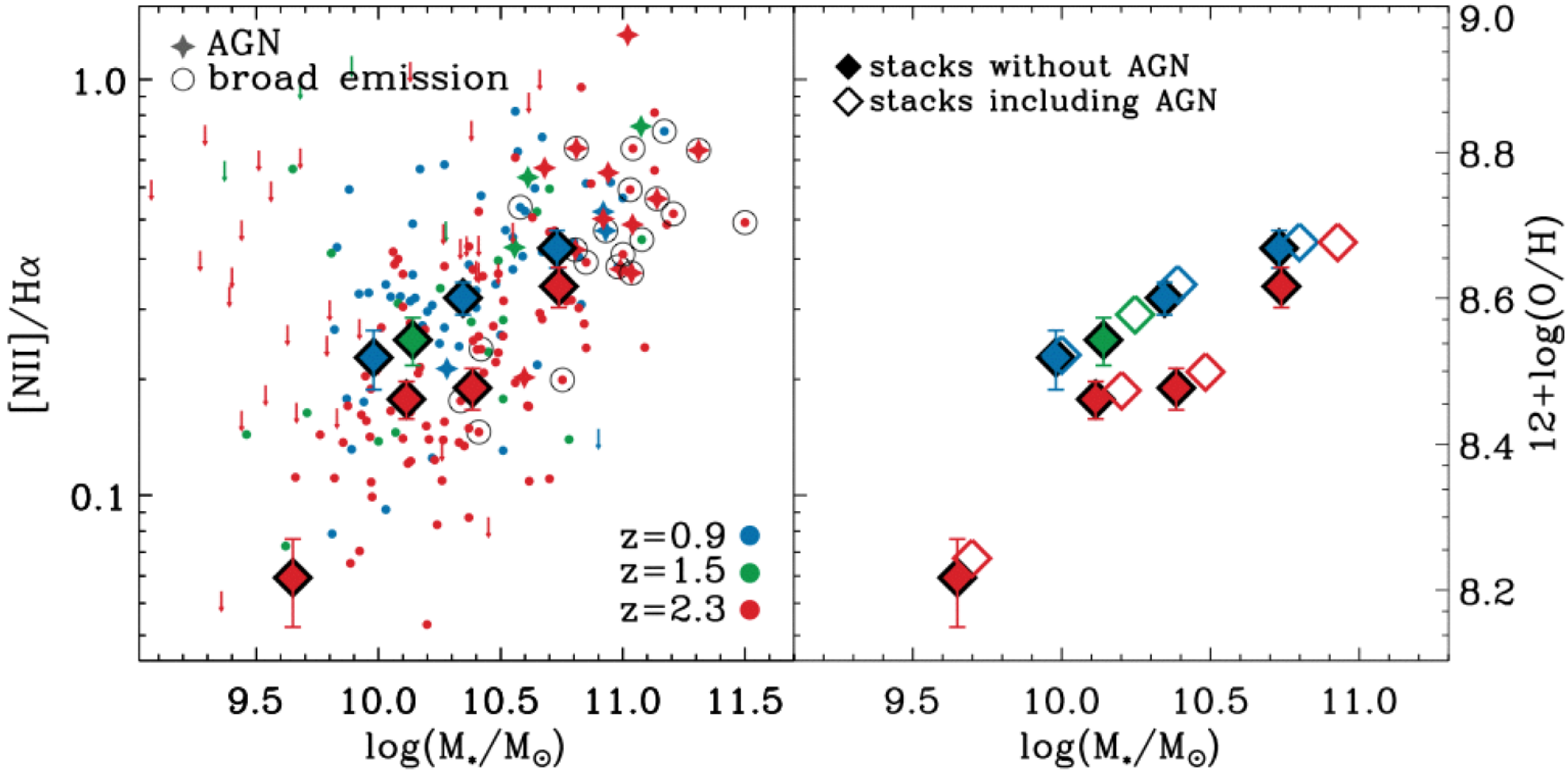

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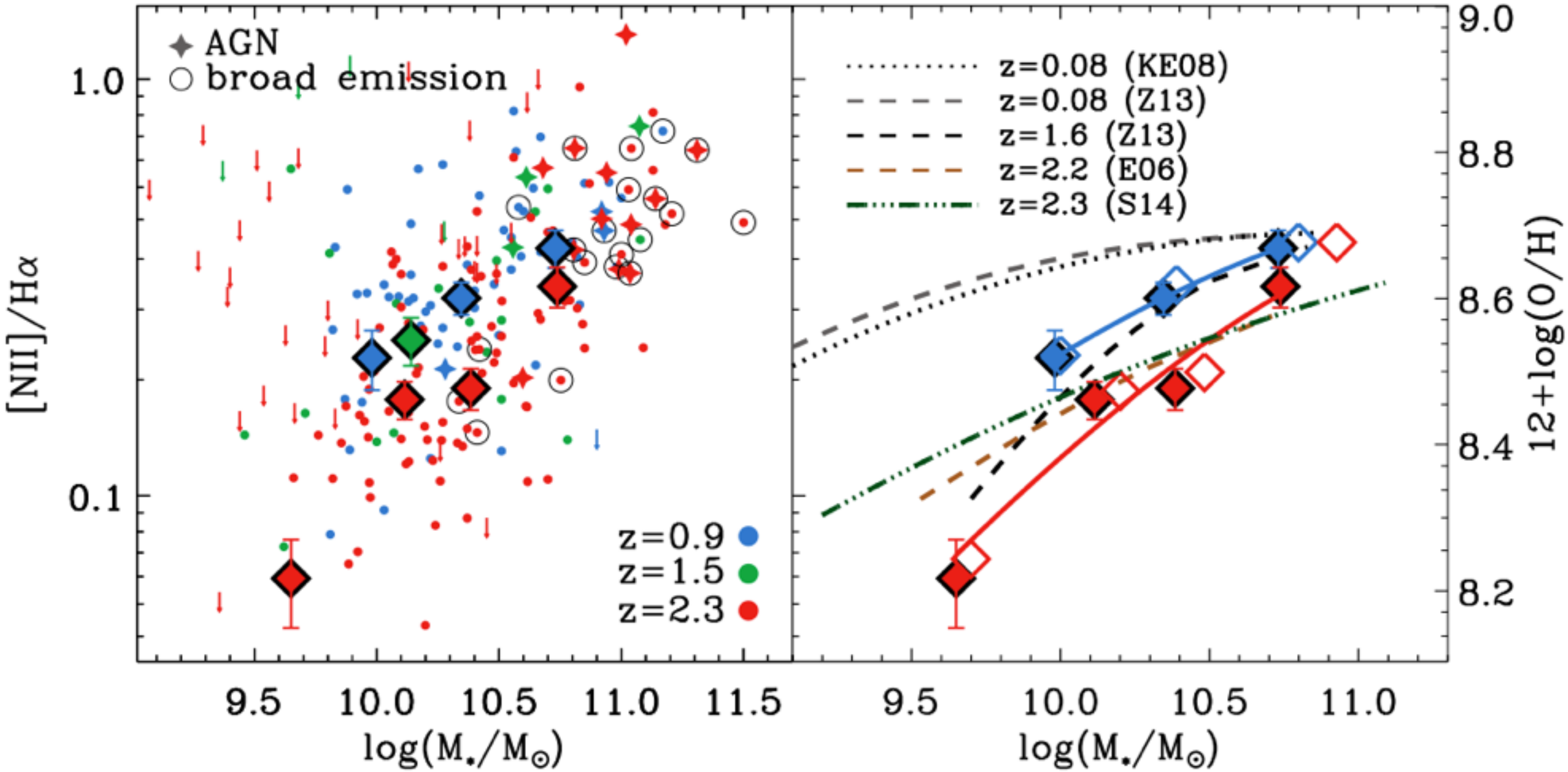
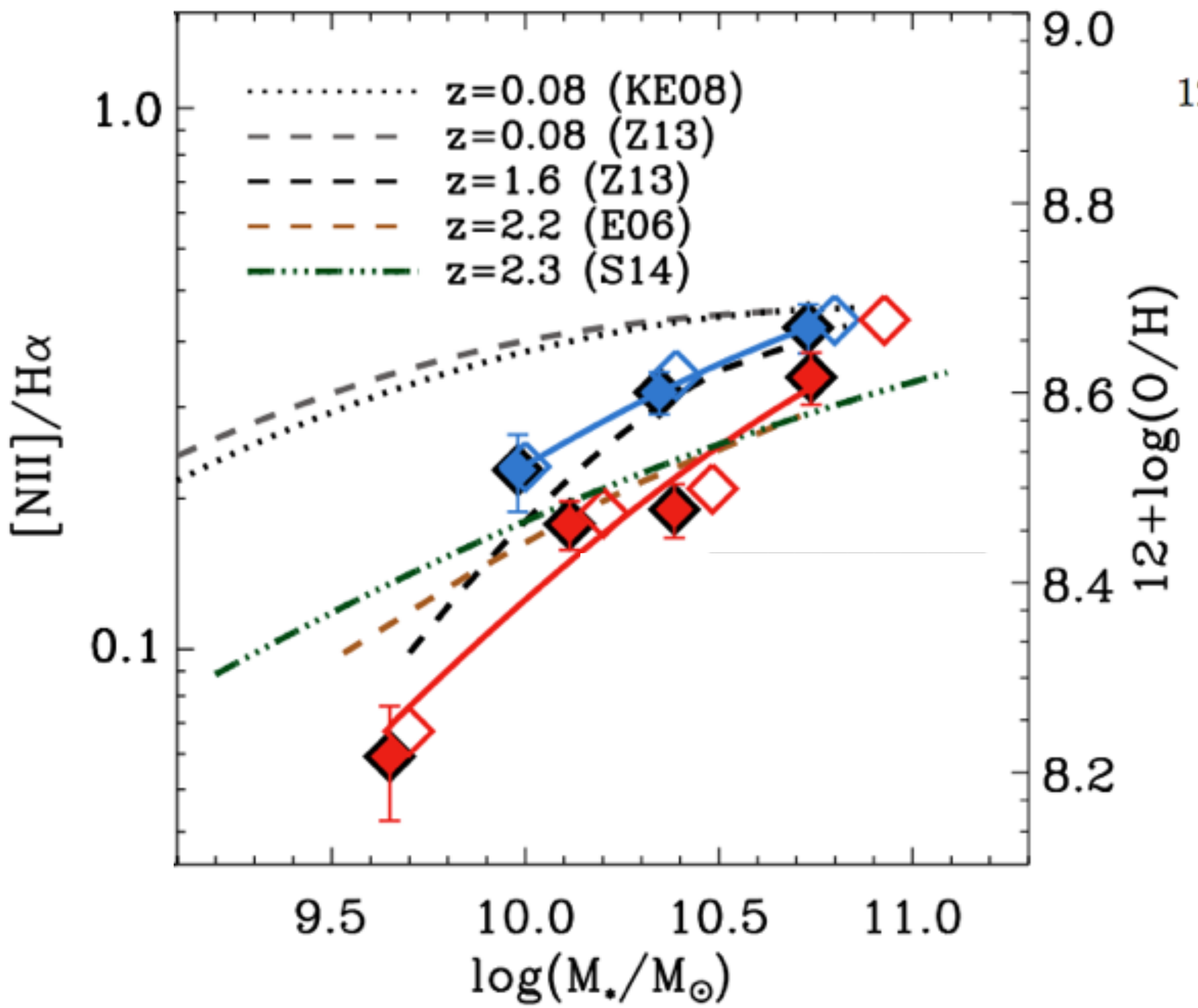


Wuyts+2014

FITTING THE MASS-METALLICITY RELATION



$$12 + \log(\mathrm{O/H}) = Z_0 + \log\left[1 - \exp\left(-\left[\frac{M_*}{M_0}\right]^{\gamma}\right)\right]$$

Zahid+2014

Best-fit Parameters					
Reference	Redshift	Z_0	$\log(M_0/M_\odot)$	γ	$\log(M_0^{\mathrm{fixed}}/M_\odot)$
Z13	0.08	8.69 ± 0.01	9.02 ± 0.02	0.40 ± 0.01	8.95 ± 0.05
This work	0.9	8.8 ± 0.4	10.2 ± 0.9	0.4 ± 0.6	9.78 ± 0.11
This work	2.3	8.7 ± 0.3	10.5 ± 0.5	0.5 ± 0.2	10.36 ± 0.06

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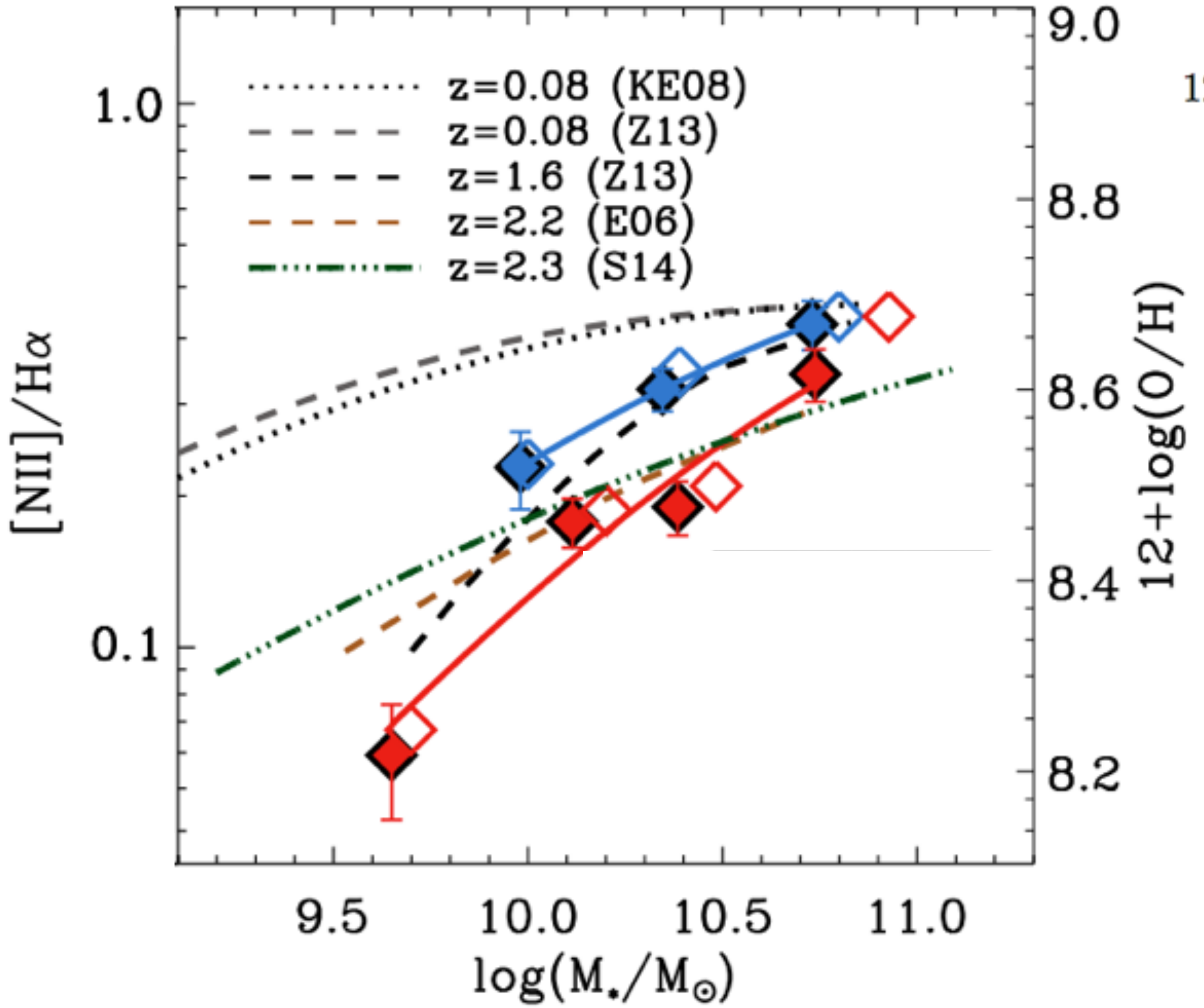

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Constant asymptotic metallicity Z0 = 8.7

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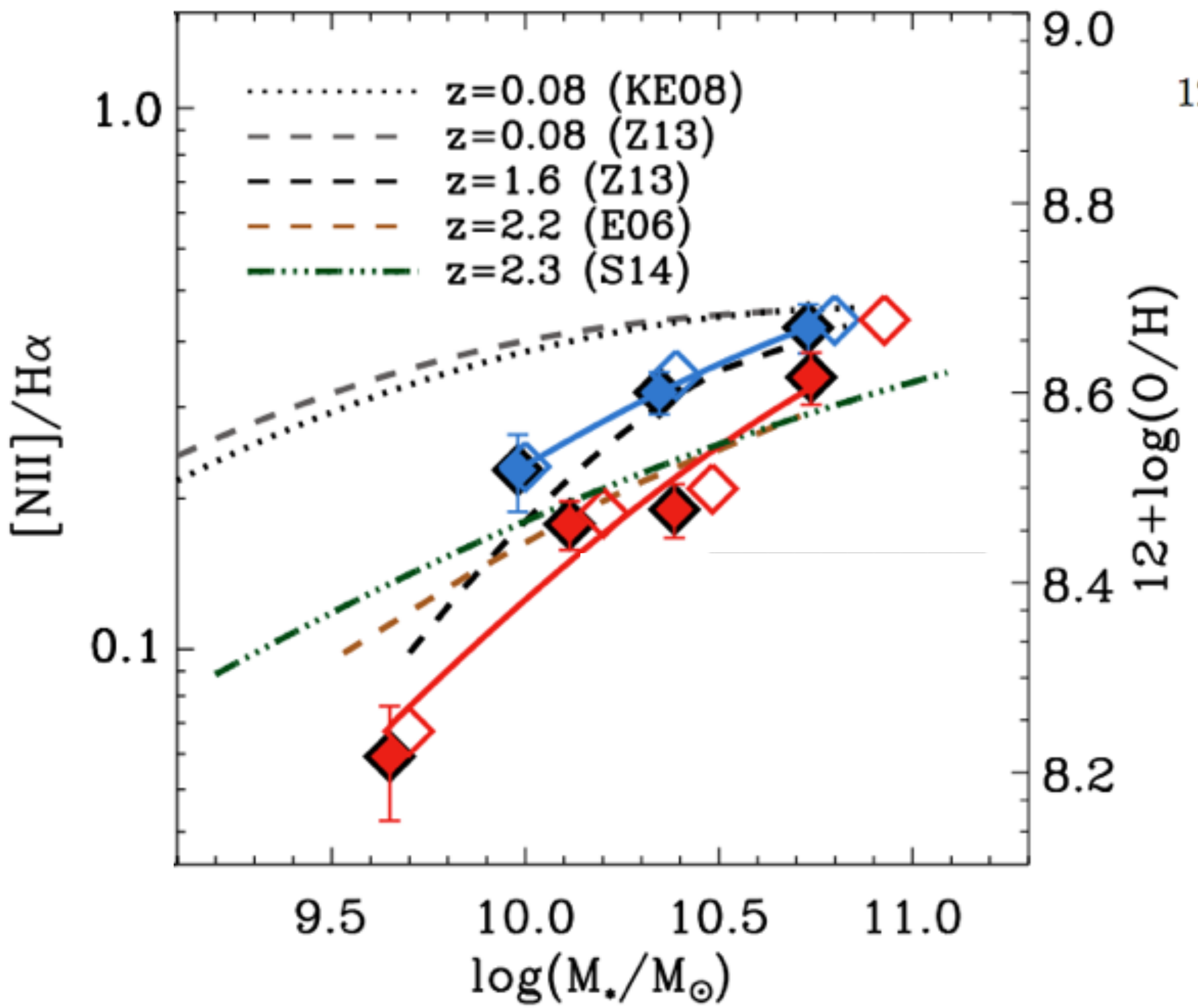

$$12 + \log(\mathrm{O/H}) = Z_0 + \log\left[1 - \exp\left(-\left[\frac{M_*}{M_0}\right]^{\gamma}\right)\right]$$

Zahid+2014

Constant slope
γ = 0.4

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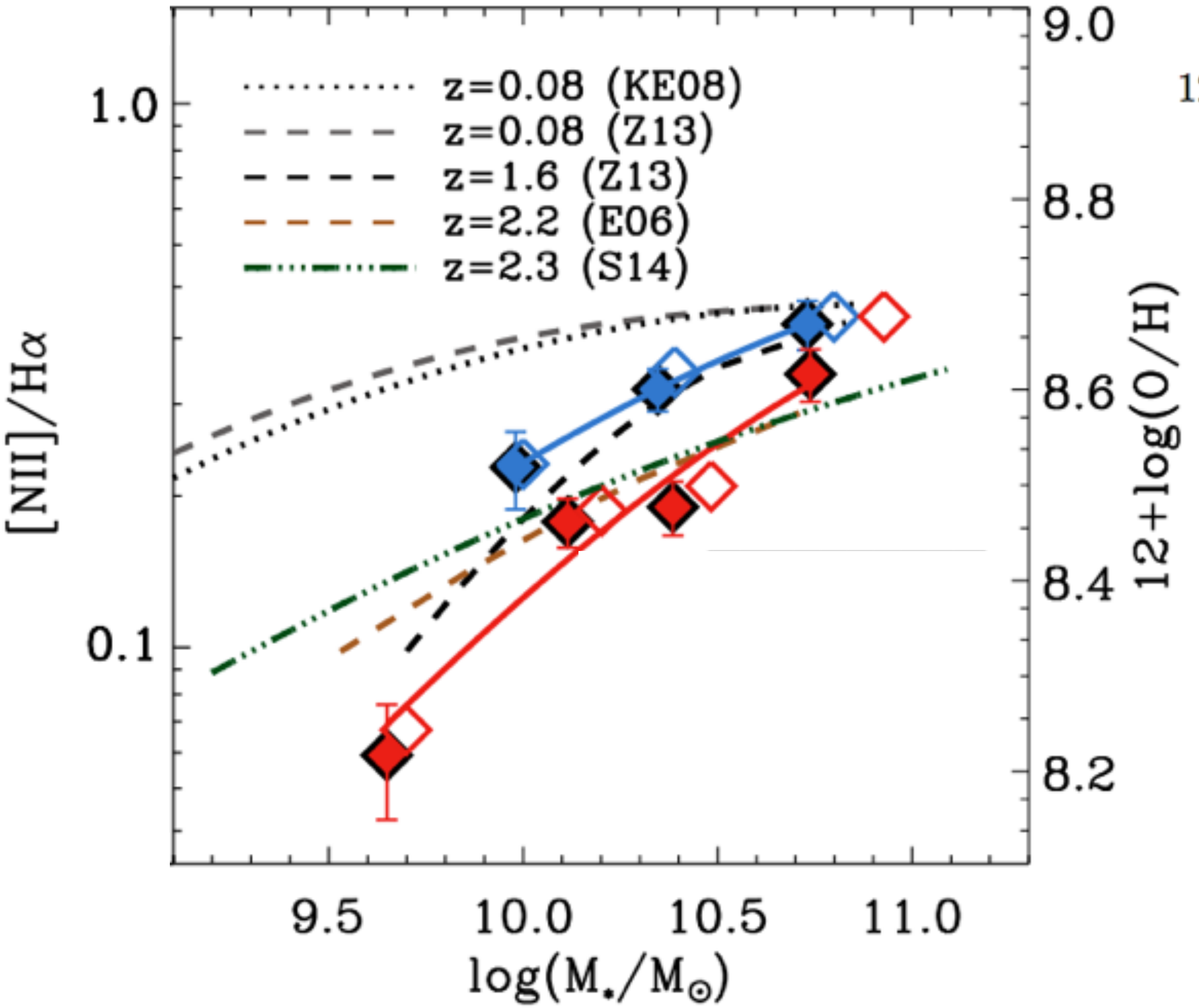

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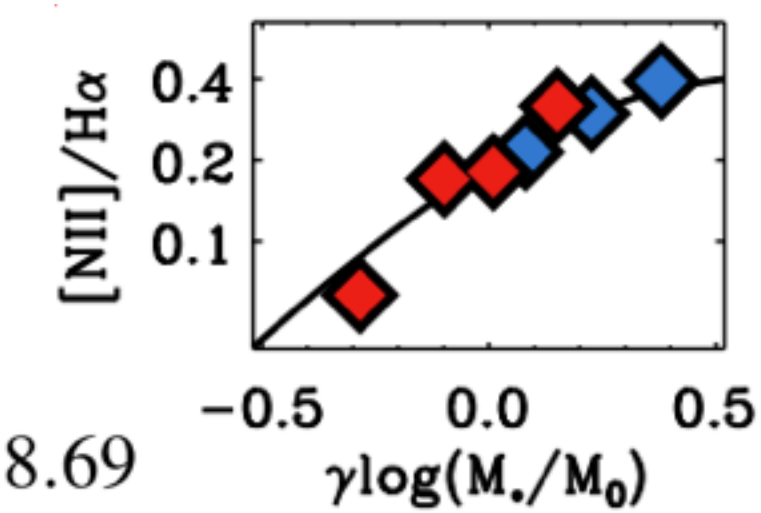
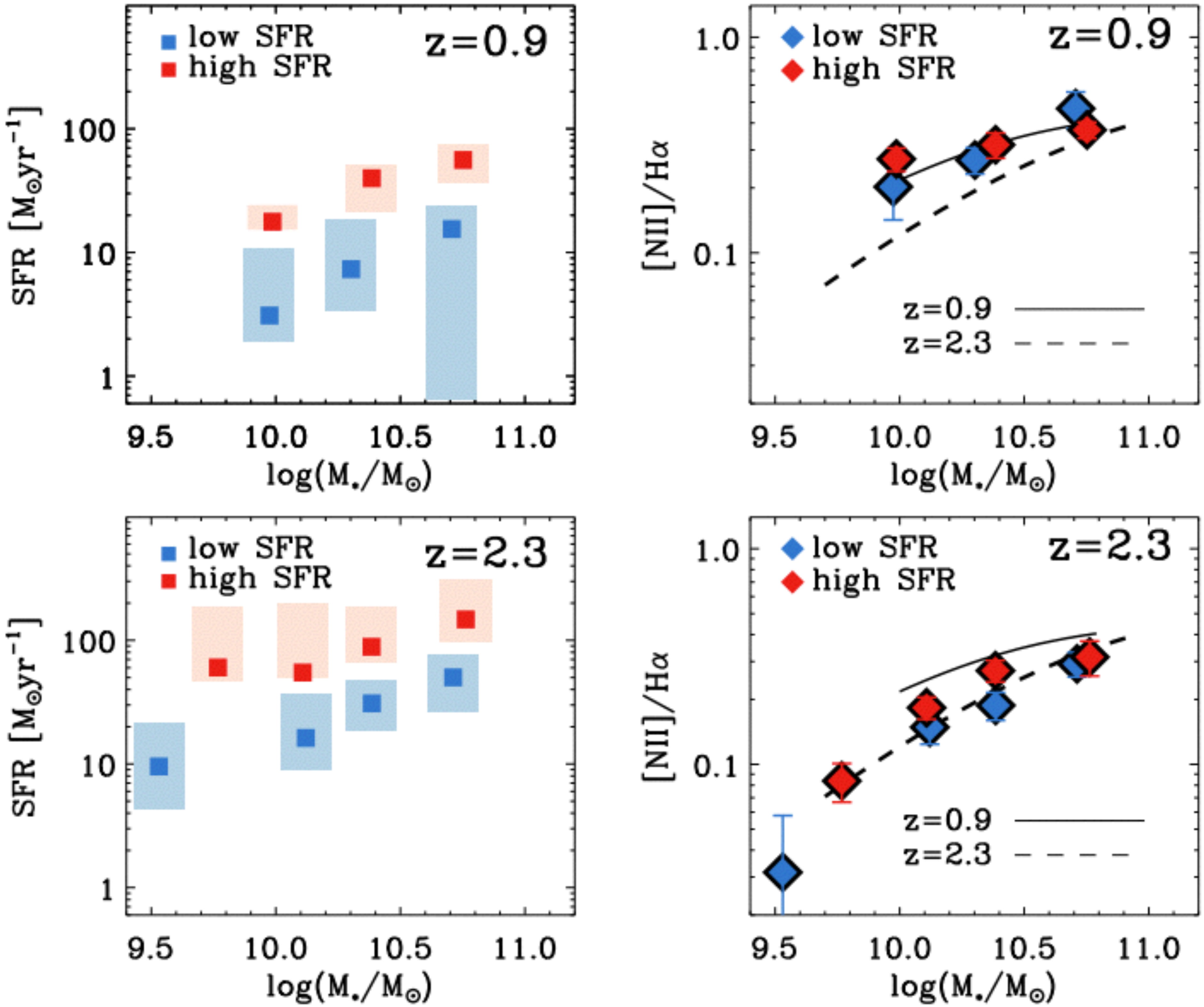


$$Z_0 = 8.69$$
$$\gamma = 0.40$$

The redshift evolution of the MZR can be described fully in terms of the evolution of the characteristic turnover mass

$$\log(M_0/M_\odot) = (8.86 \pm 0.05) + (2.92 \pm 0.16)\log(1+z).$$

CORRELATION WITH STAR FORMATION RATE



Wuyts+2014

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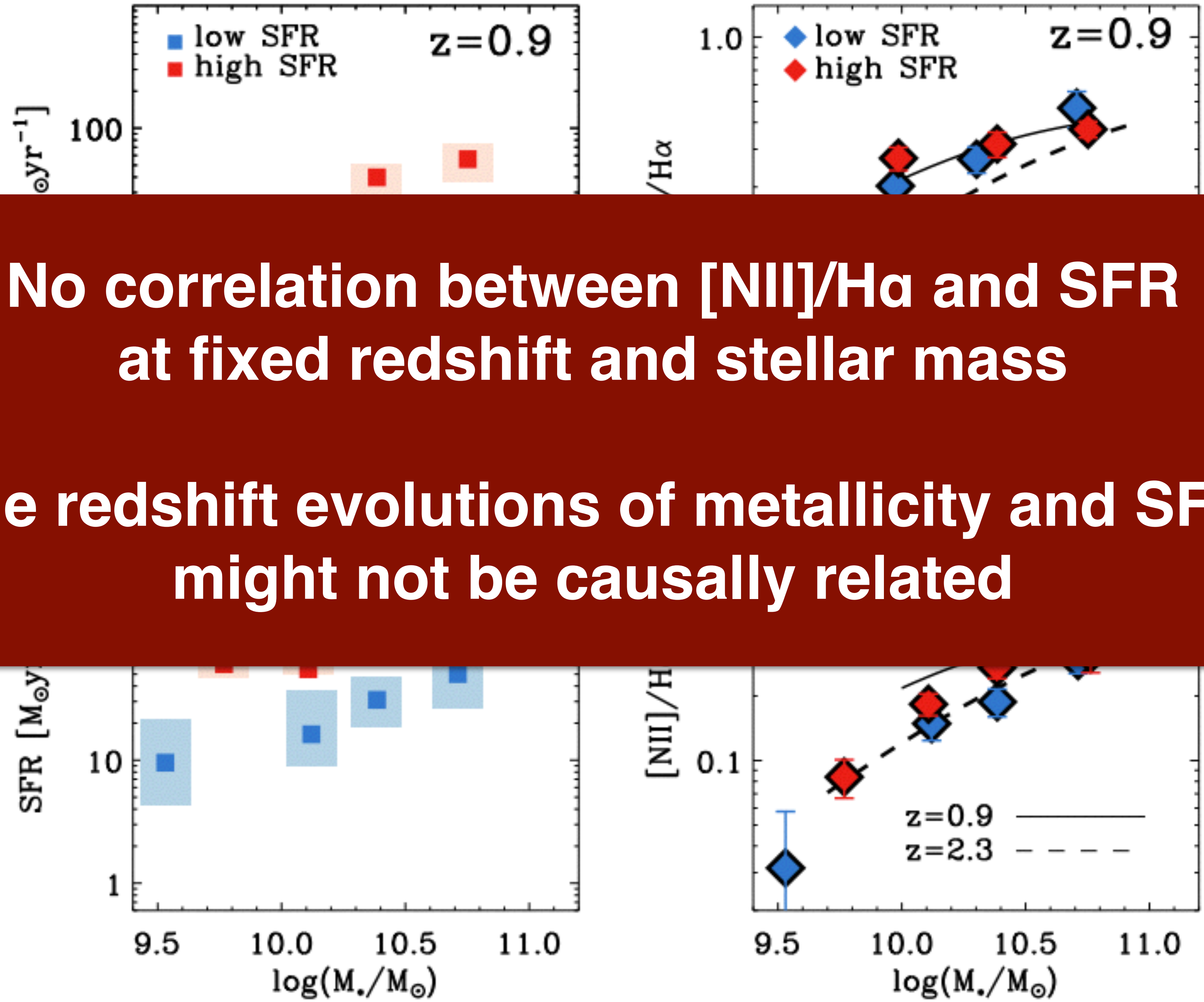
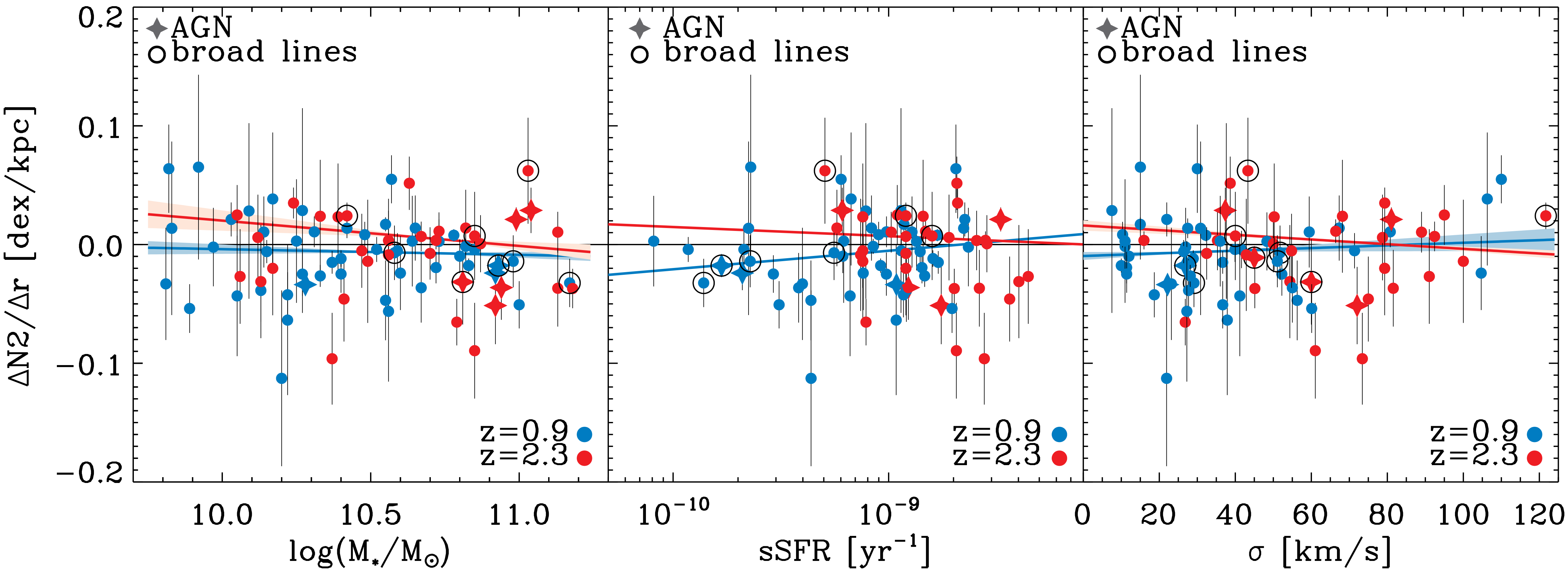


No correlation between [NII]/Hα and SFR at fixed redshift and stellar mass

The redshift evolutions of metallicity and SFR might not be causally related

Wuyts+2014

METALLICITY GRADIENTS



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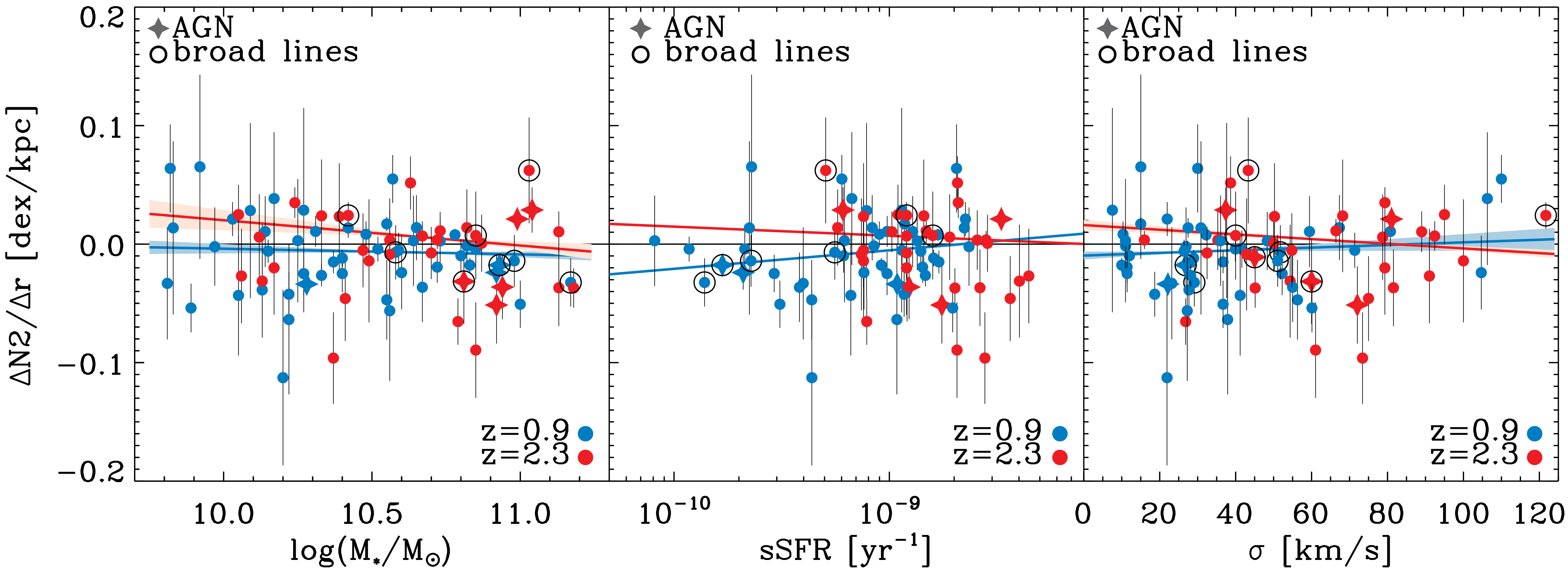
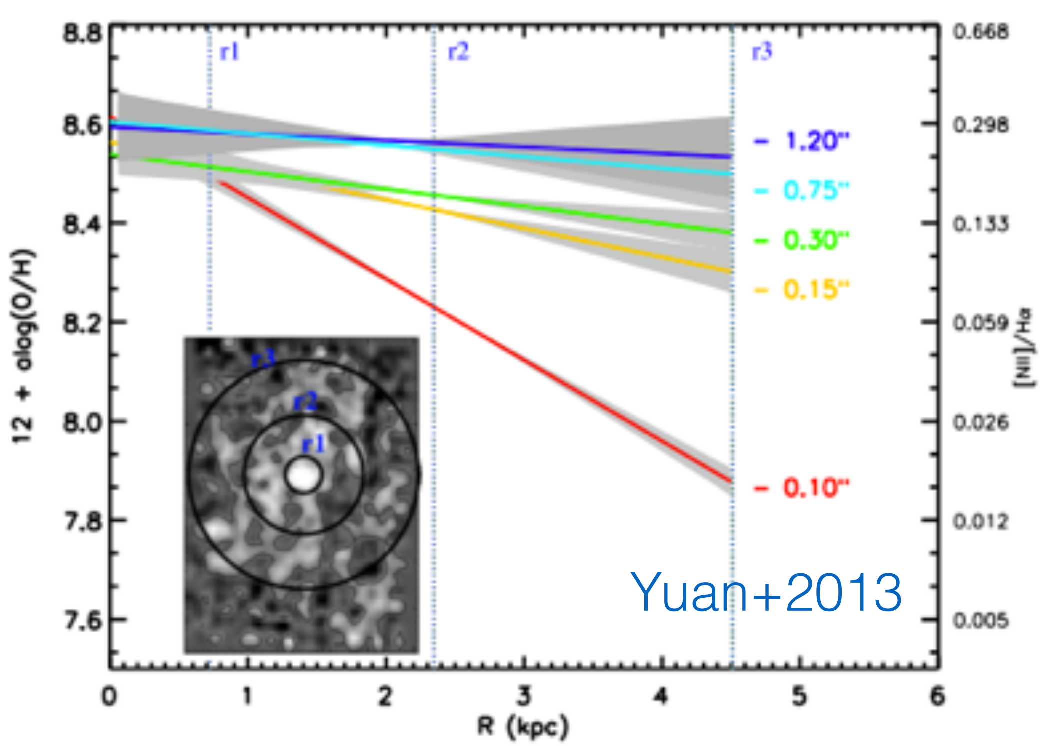
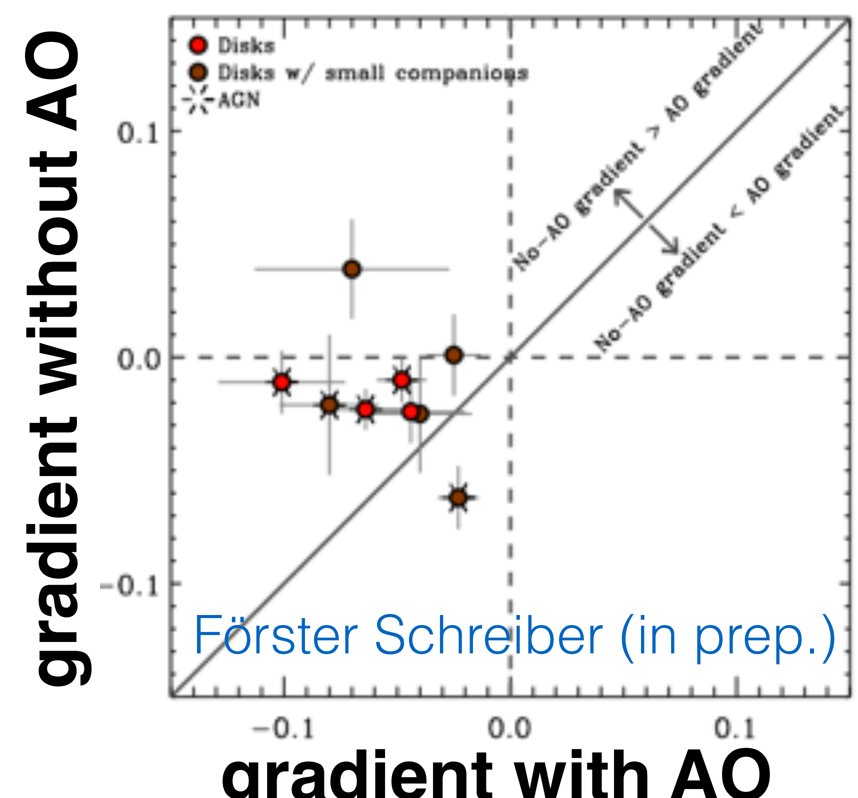




we need to understand beam-smearing



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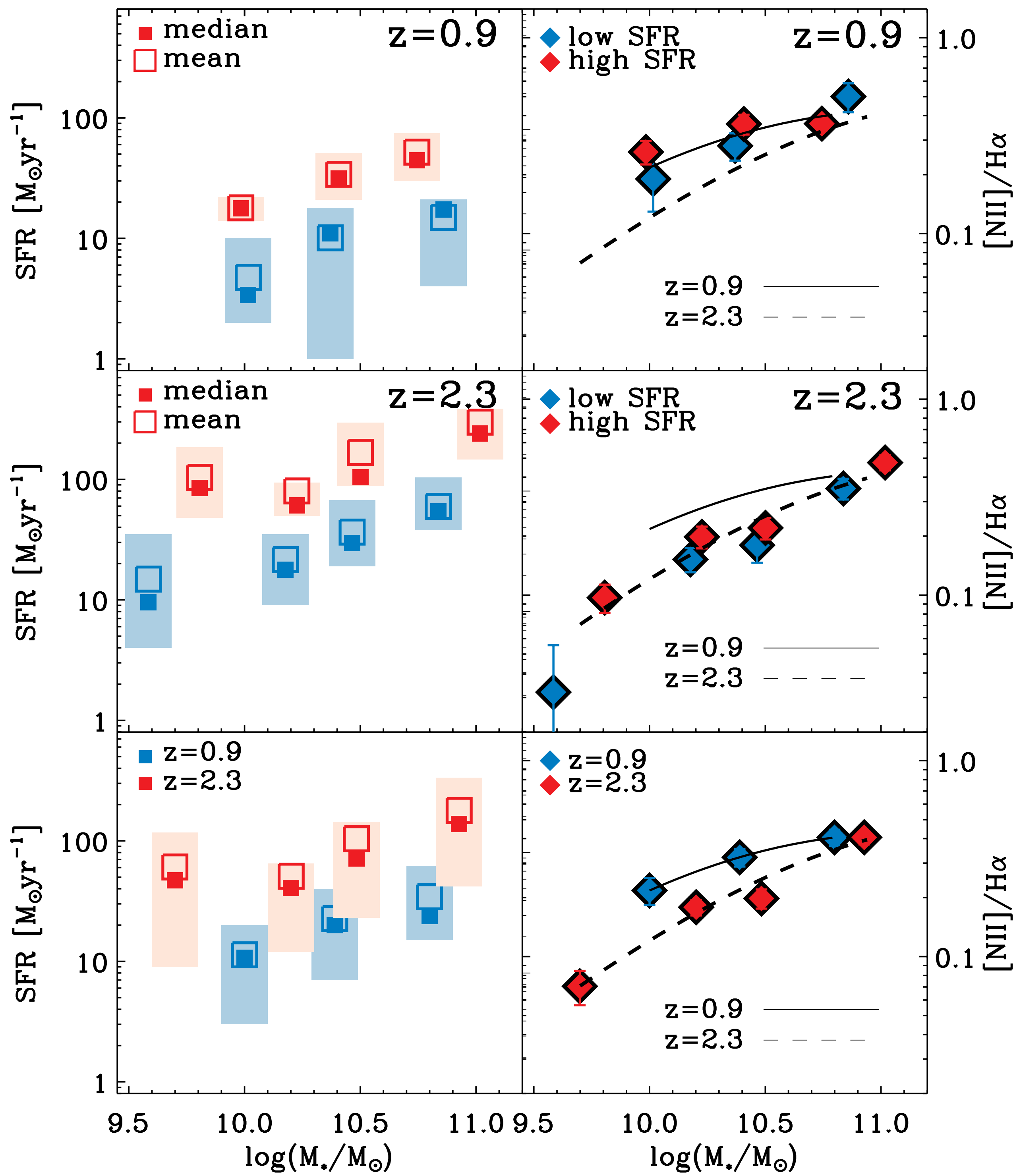
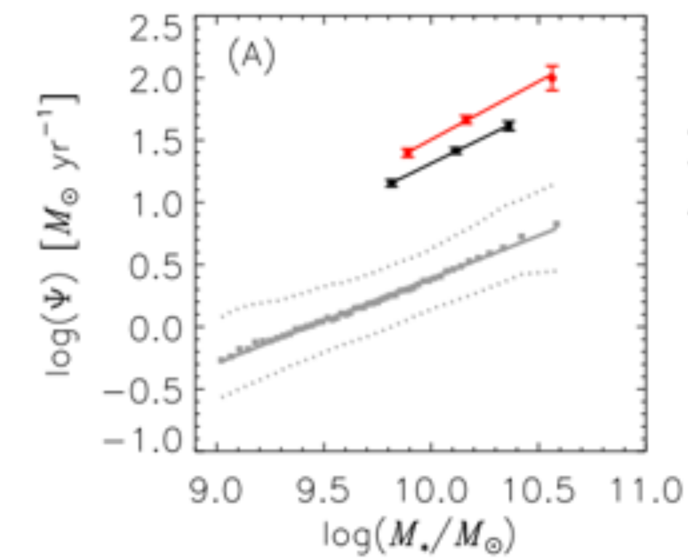
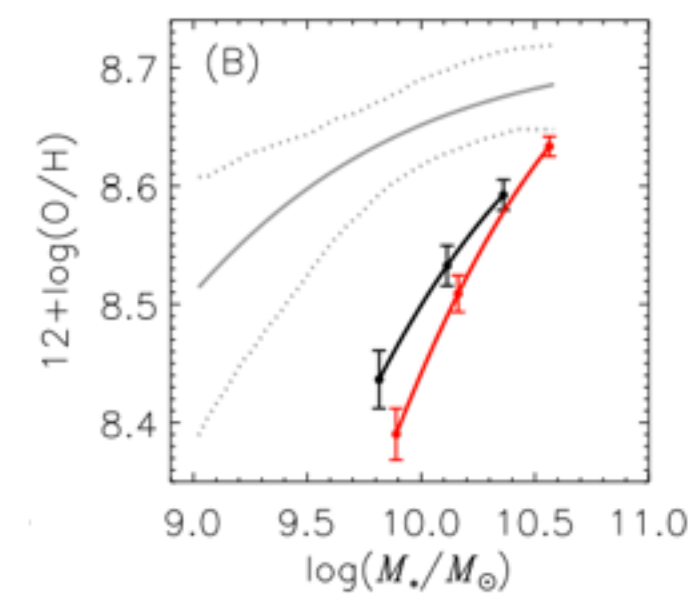
extra

CORRELATION WITH STAR FORMATION RATE



162 galaxies, FMOS, z=1.6

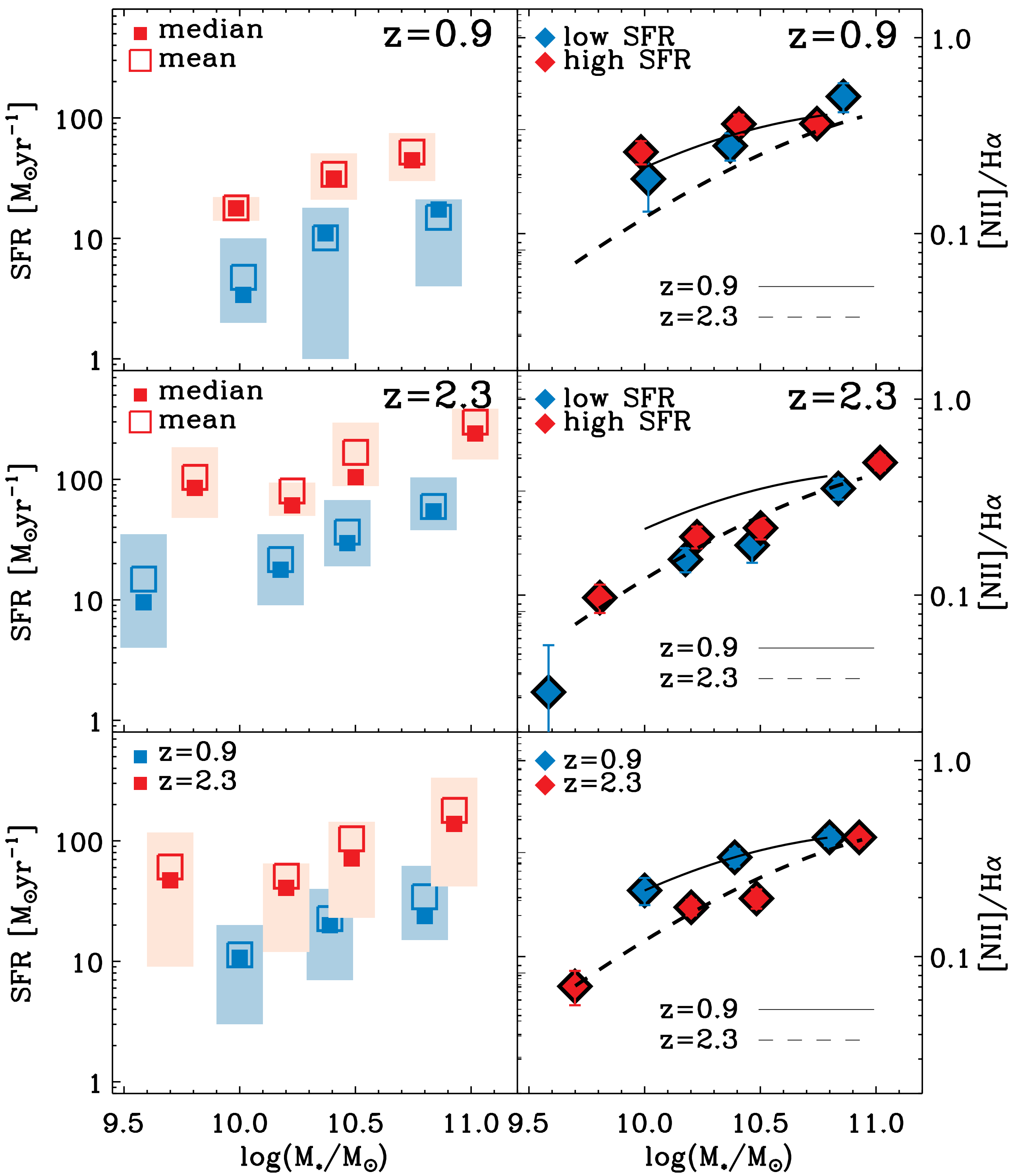




Zahid et al. 2013

CORRELATION WITH STAR FORMATION RATE

SFR_{UV+IR} ⟷ $SFR_{H\alpha}$



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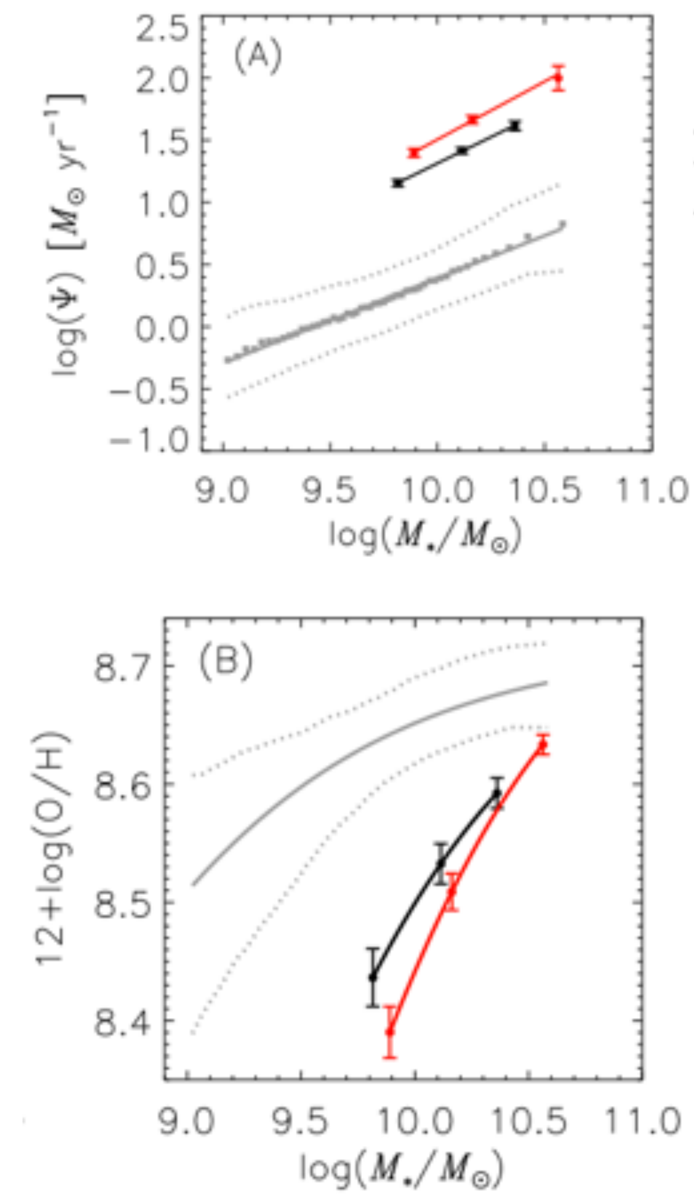

Zahid et al. 2013