Evolution of the interstellar medium in star-forming galaxies

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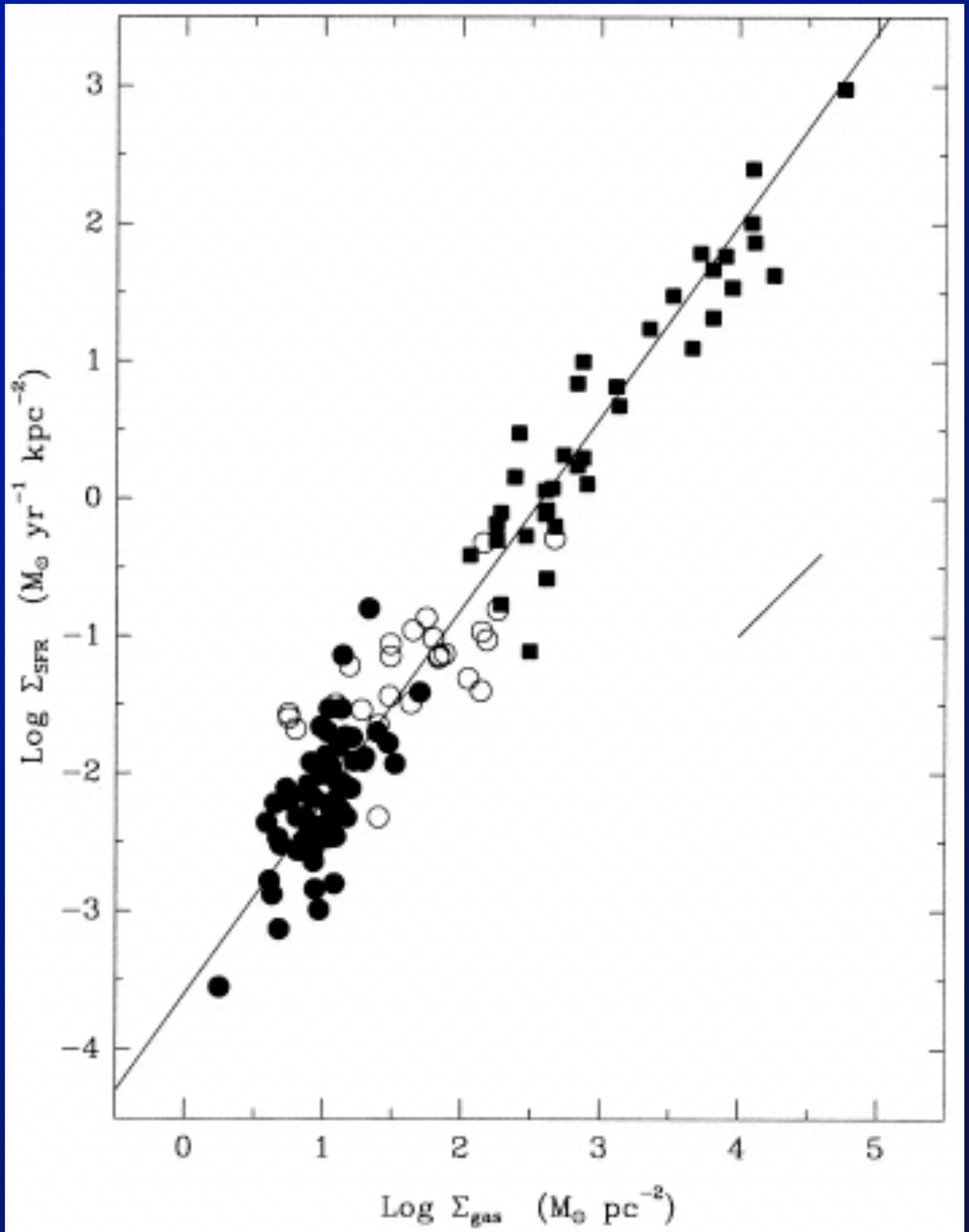
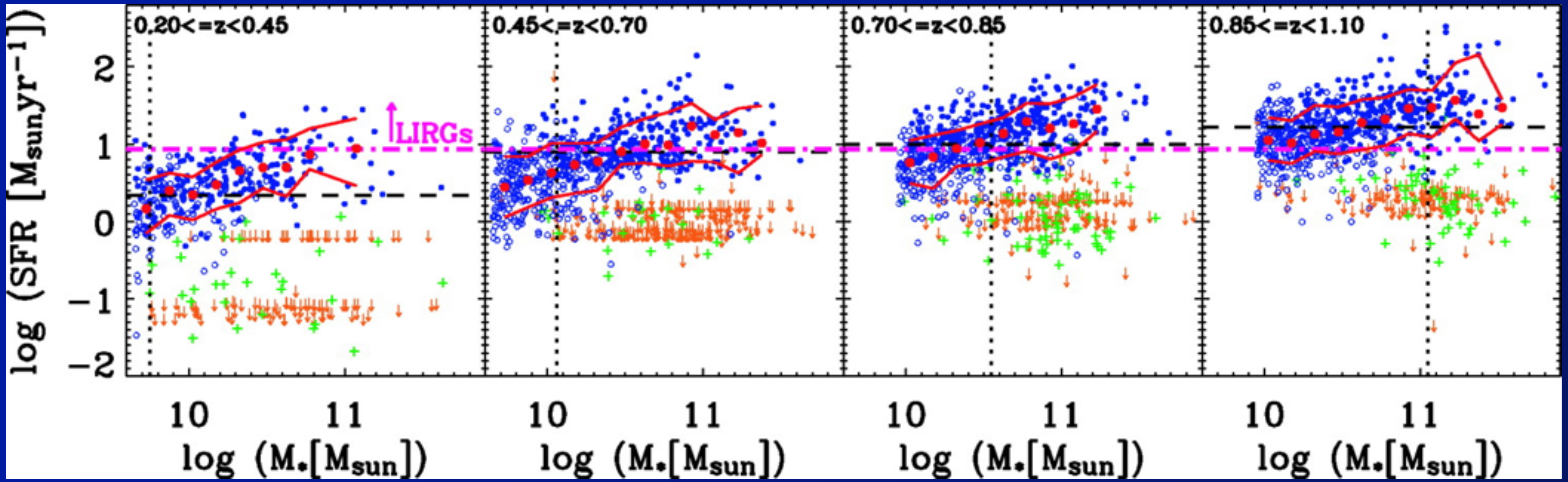
The Schmidt-Kennicutt relation



$$\Sigma_{SFR} = A\Sigma^{n}_{gas}$$

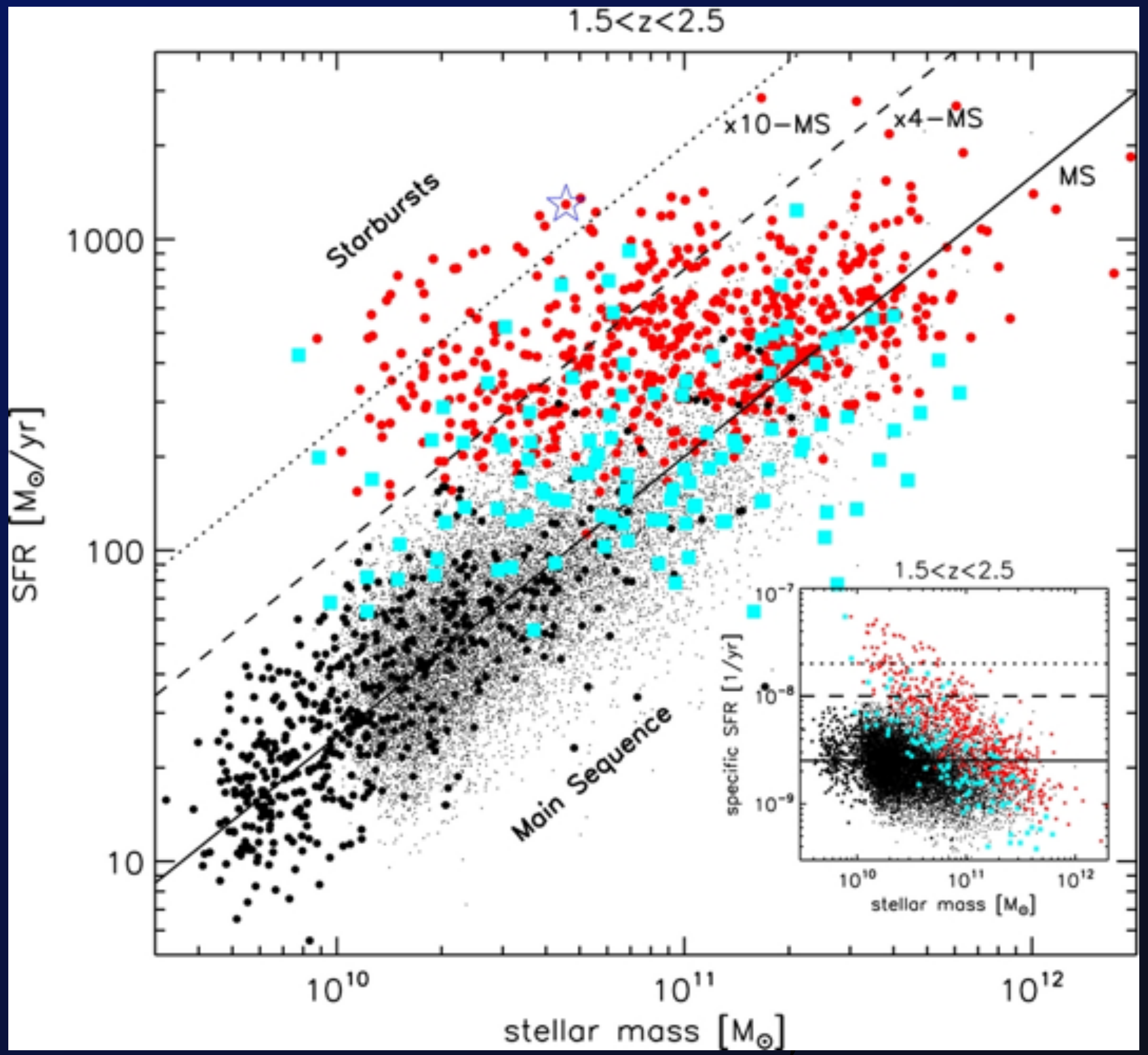
Schmidt 59, Kennicutt 98

The “Main Sequence” of galaxies

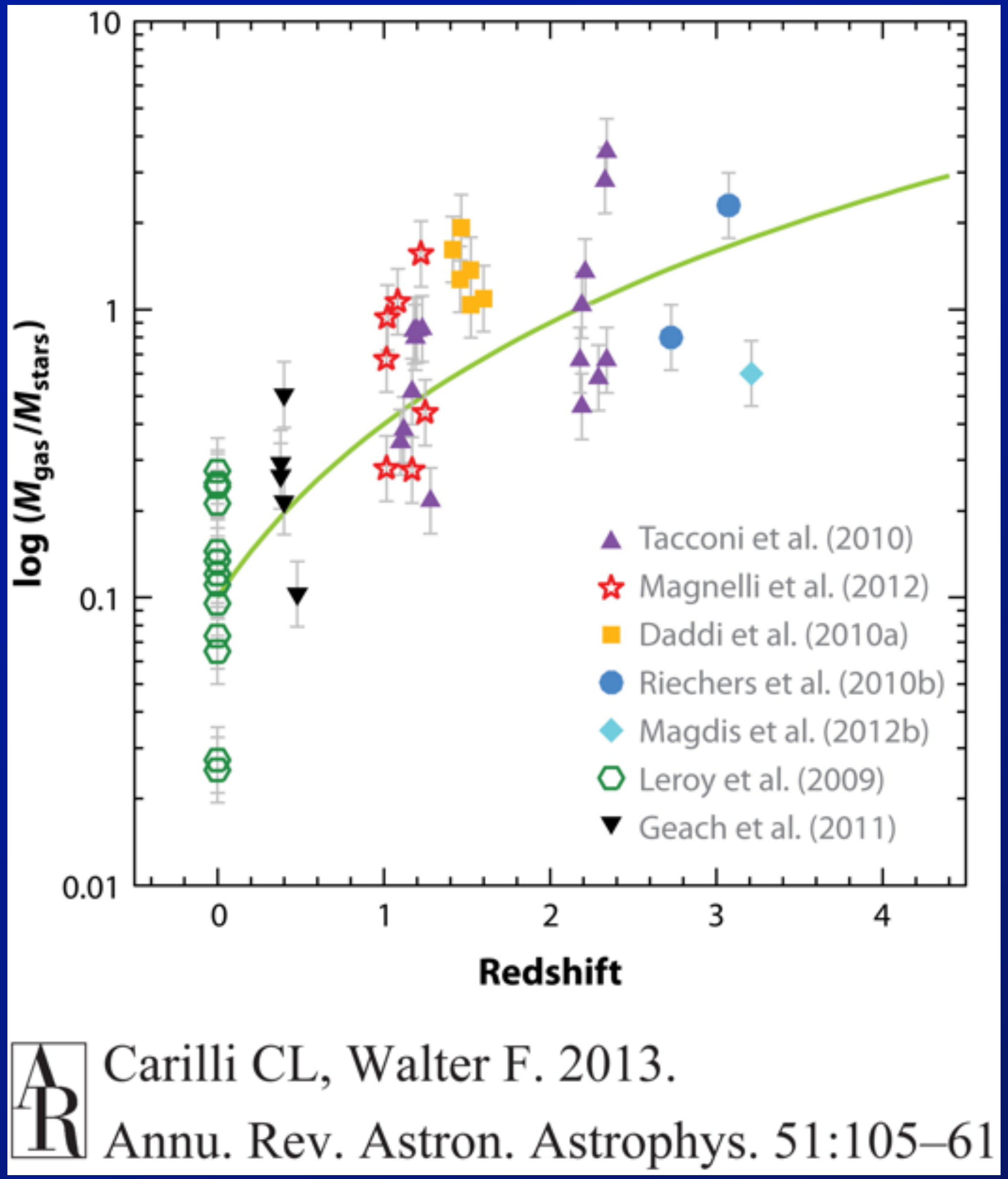


Noeske+07

The main sequence evolves!!

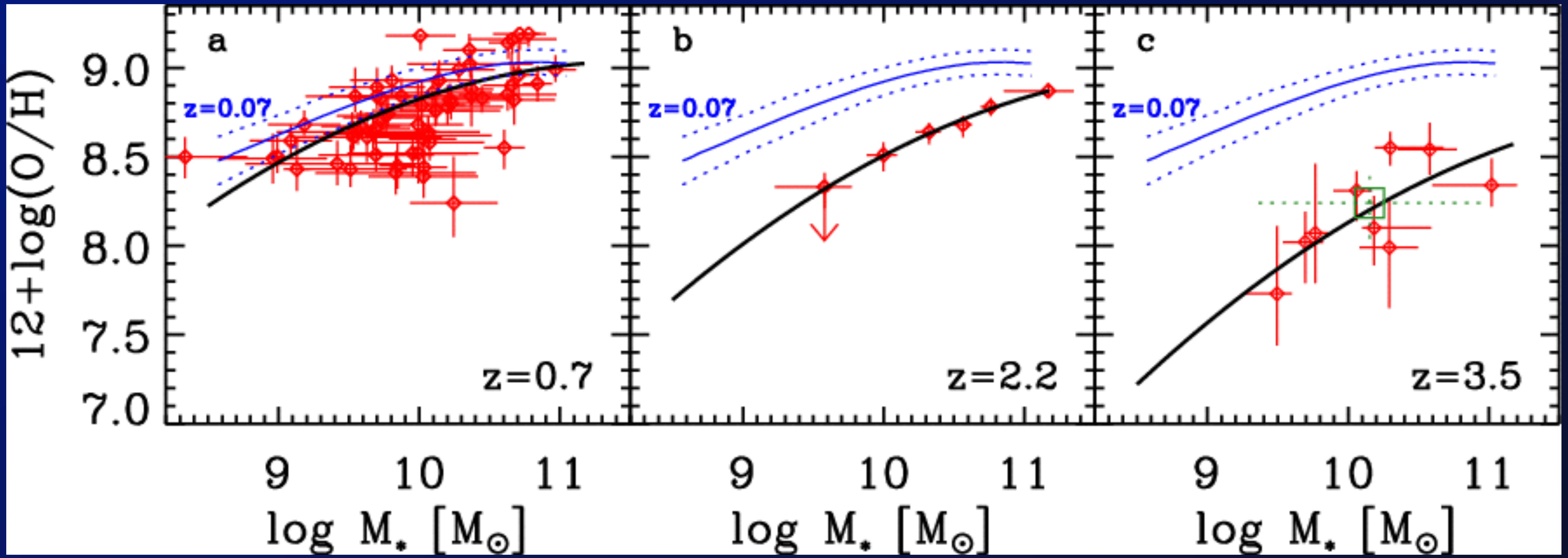


Rodighiero+11



Galaxies had more gas and less metals in the past

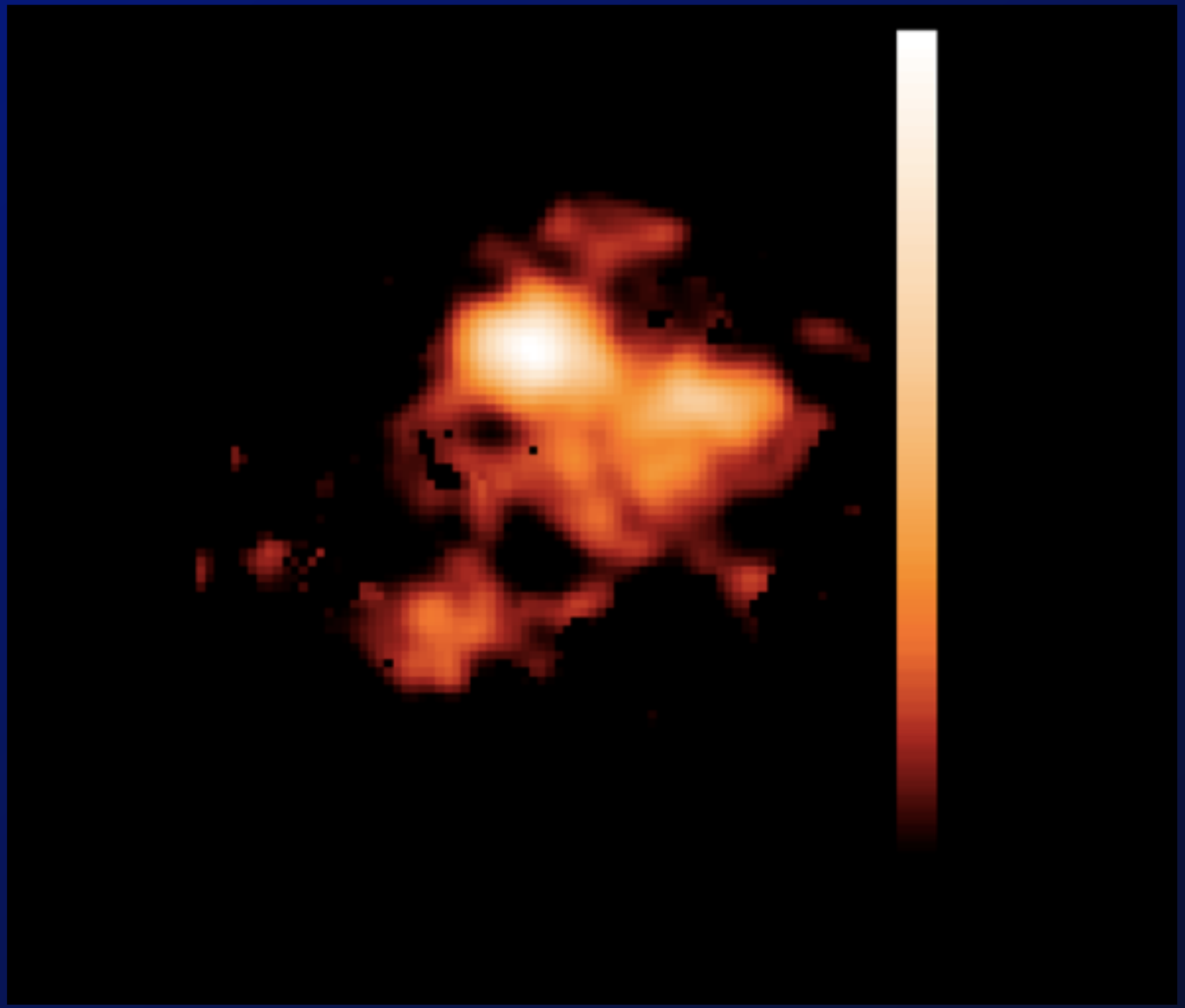
Maiolino+08



Galaxies are different at different epochs…

Local universe

High redshift

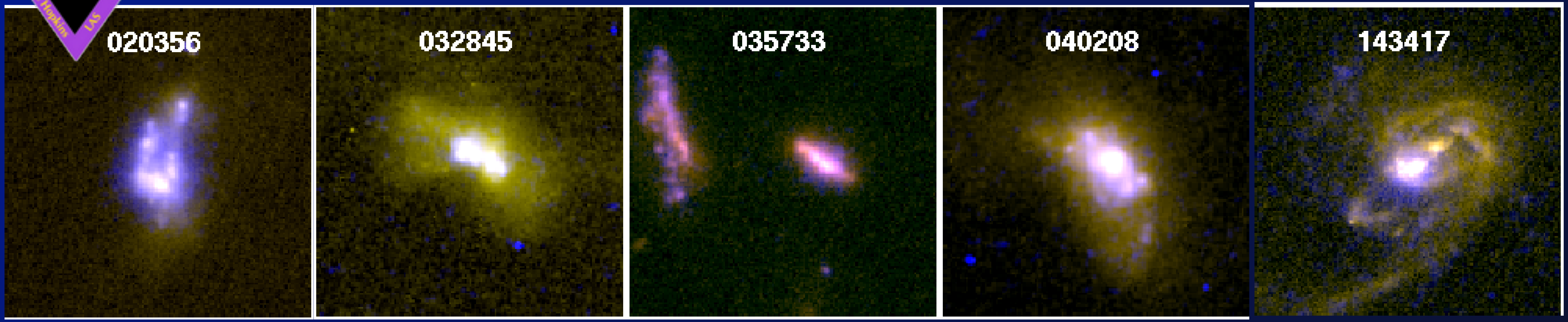


BUT: studies at high-z are hard!!

- Luminosity distances are large!
- Cosmic surface brightness dimming

The sample of Lyman break analogs

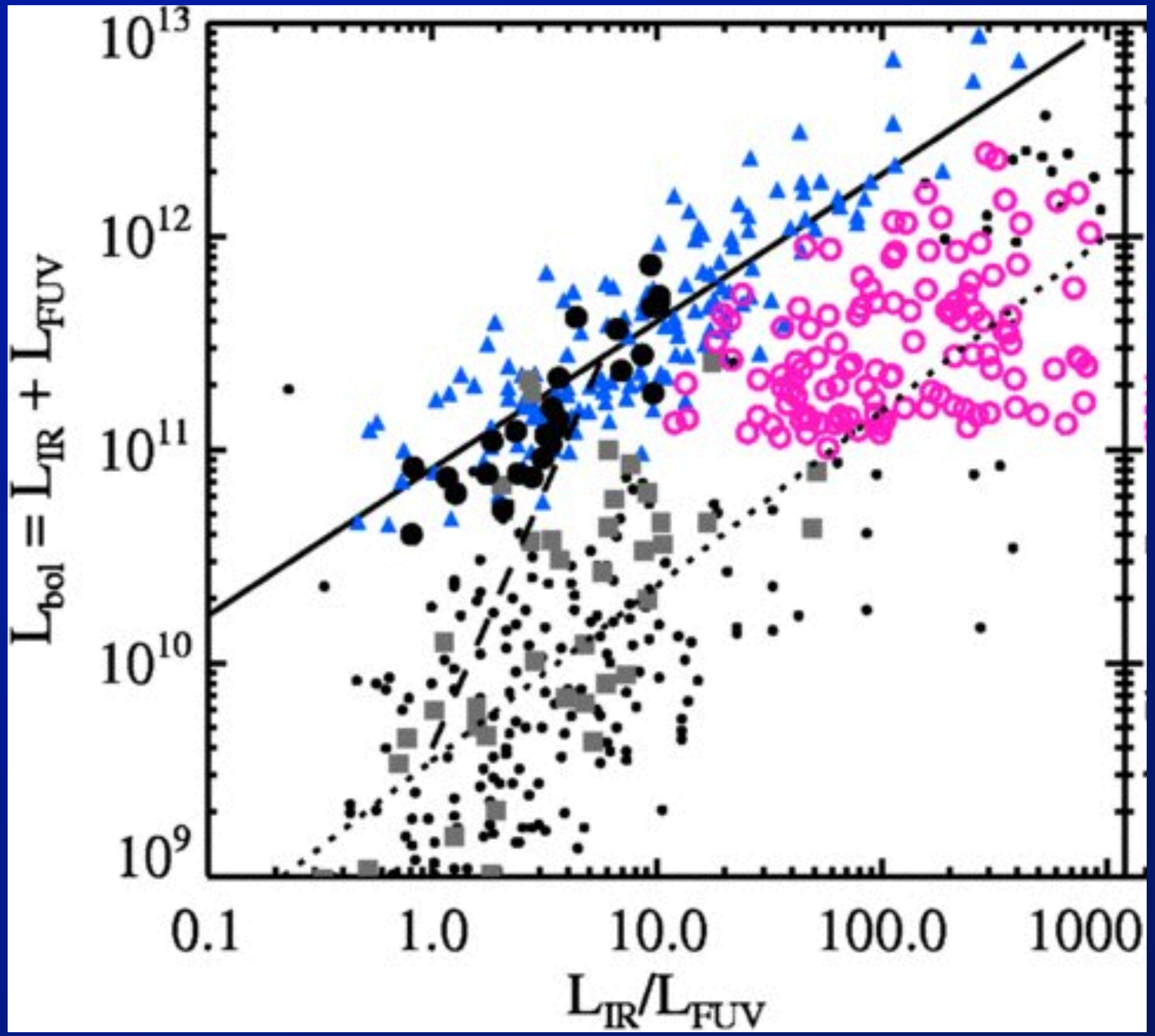
$z \sim 0.2$



$L_{FUV} \geq 2\times10^{10}\ L_{\odot}$
$I_{1530} \geq 10^{9}\ L_{\odot}\ \mathrm{kpc}^{-2}$

Hoopes et al. (2007)
Overzier et al. (2009)

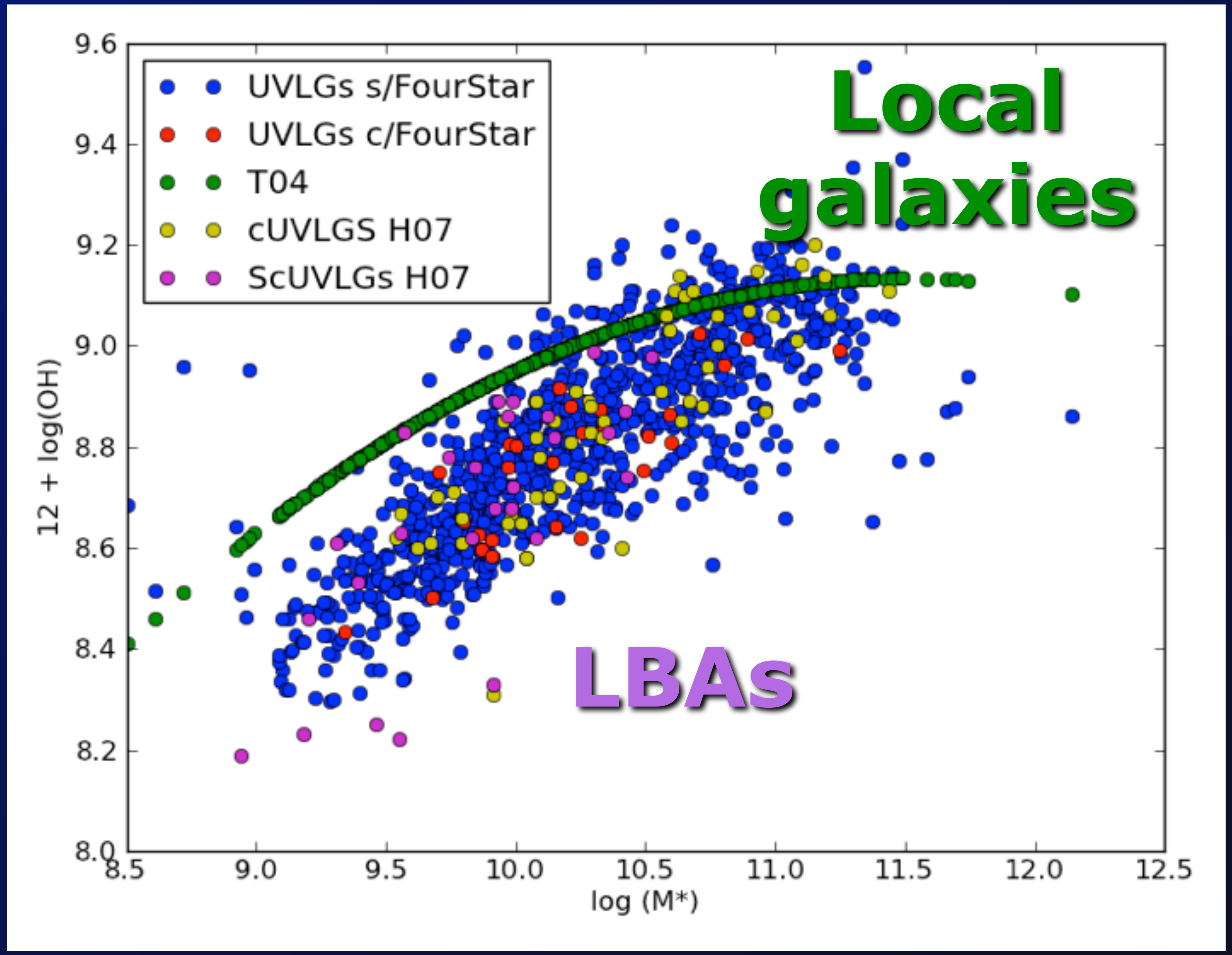
LBAs are similar to high-z starbursts!



Low extinction

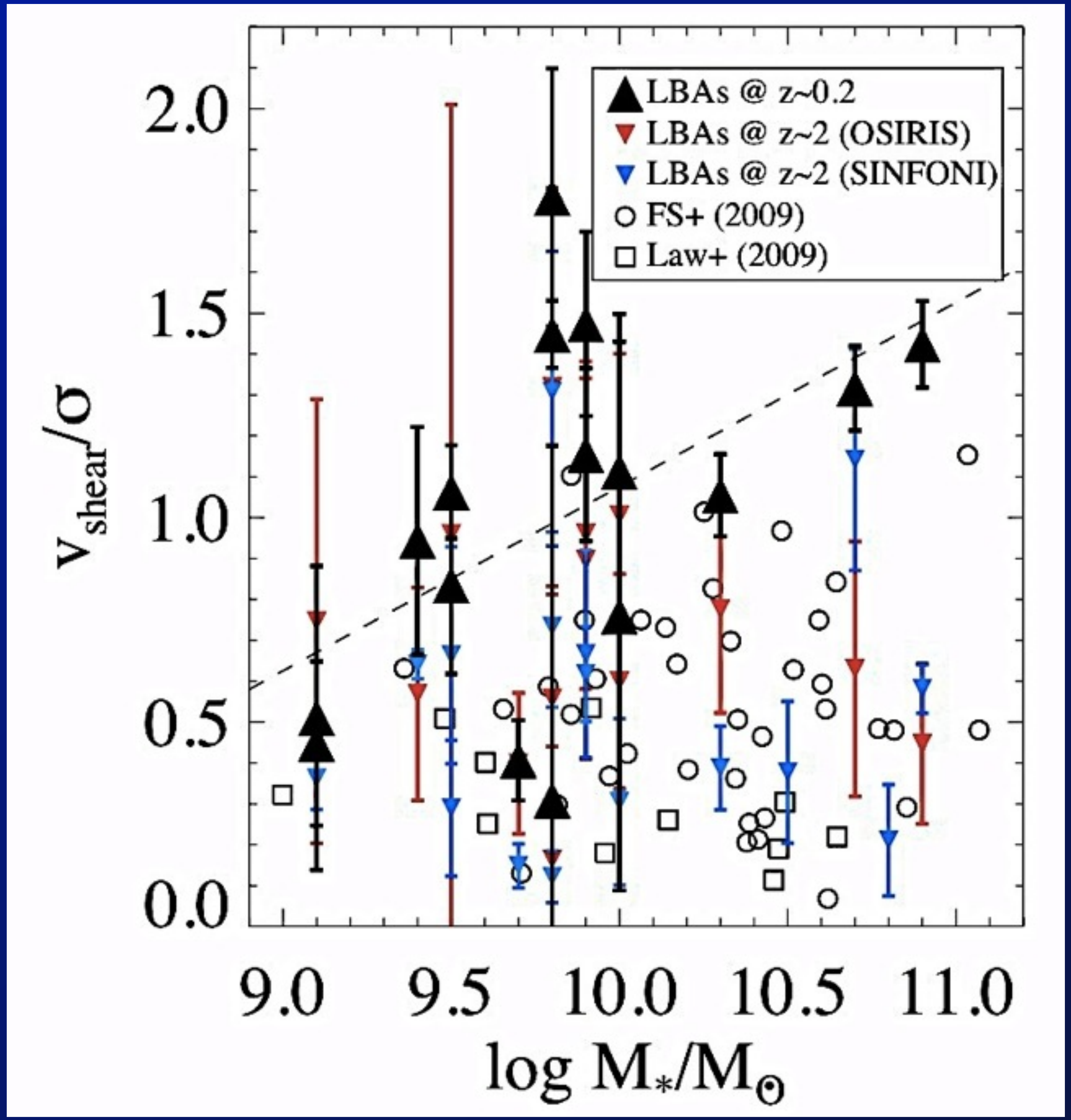
Overzier+11

Mass-metallicity relation



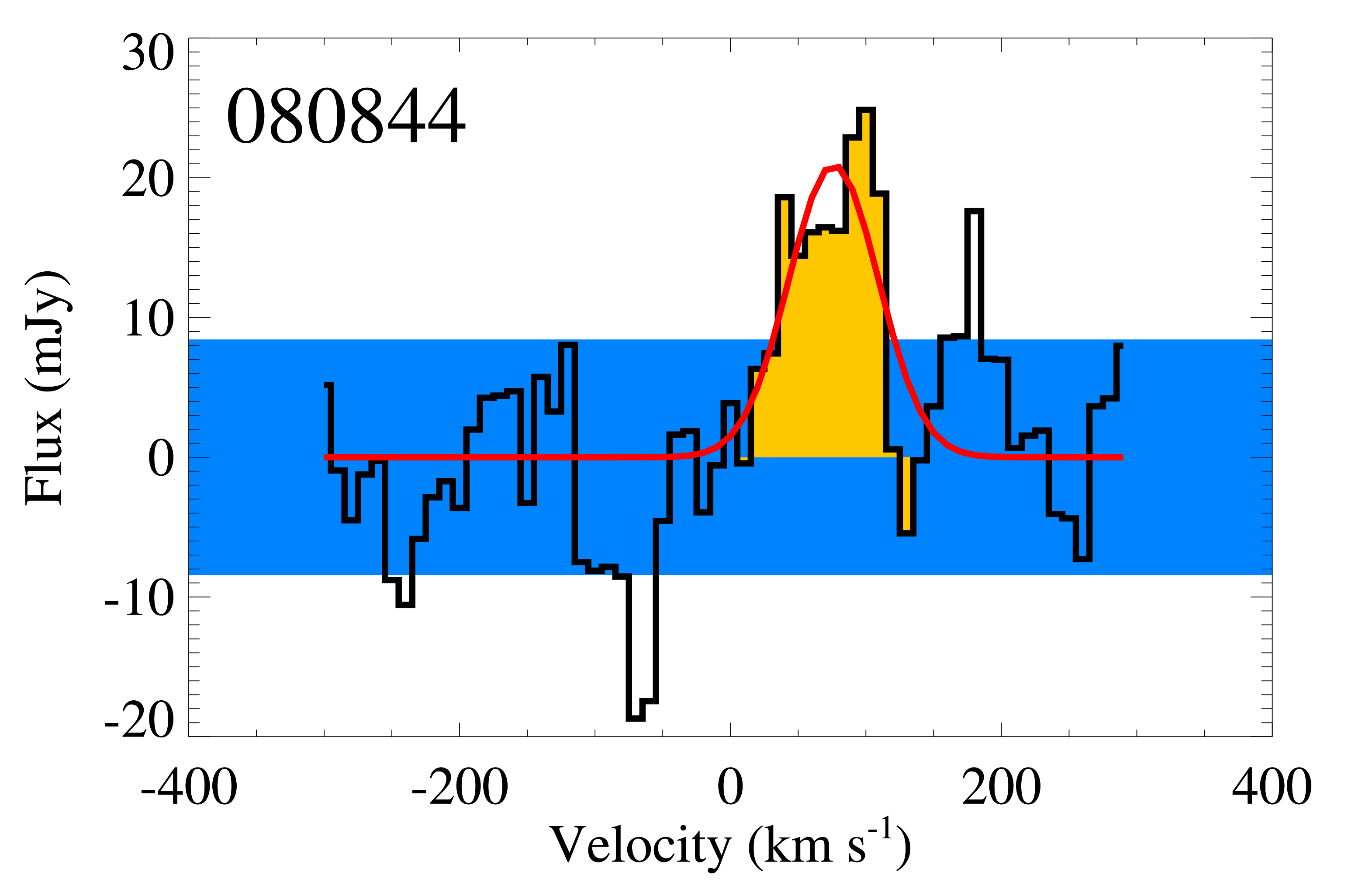
Santos-de-Oliveira et al., in prep

IFU: LBAs are turbulent



Gonçalves+10

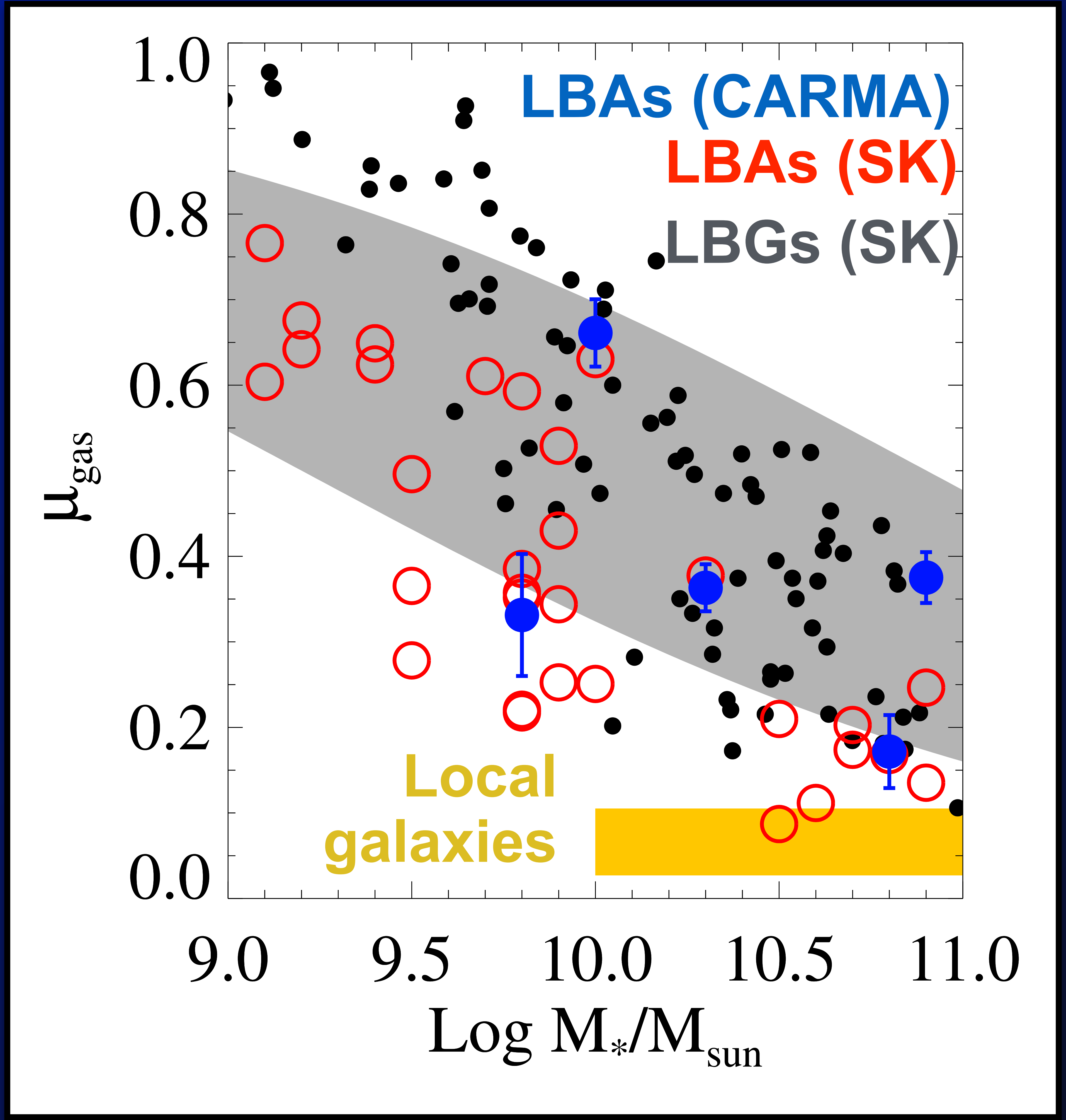
The molecular gas in LBAs



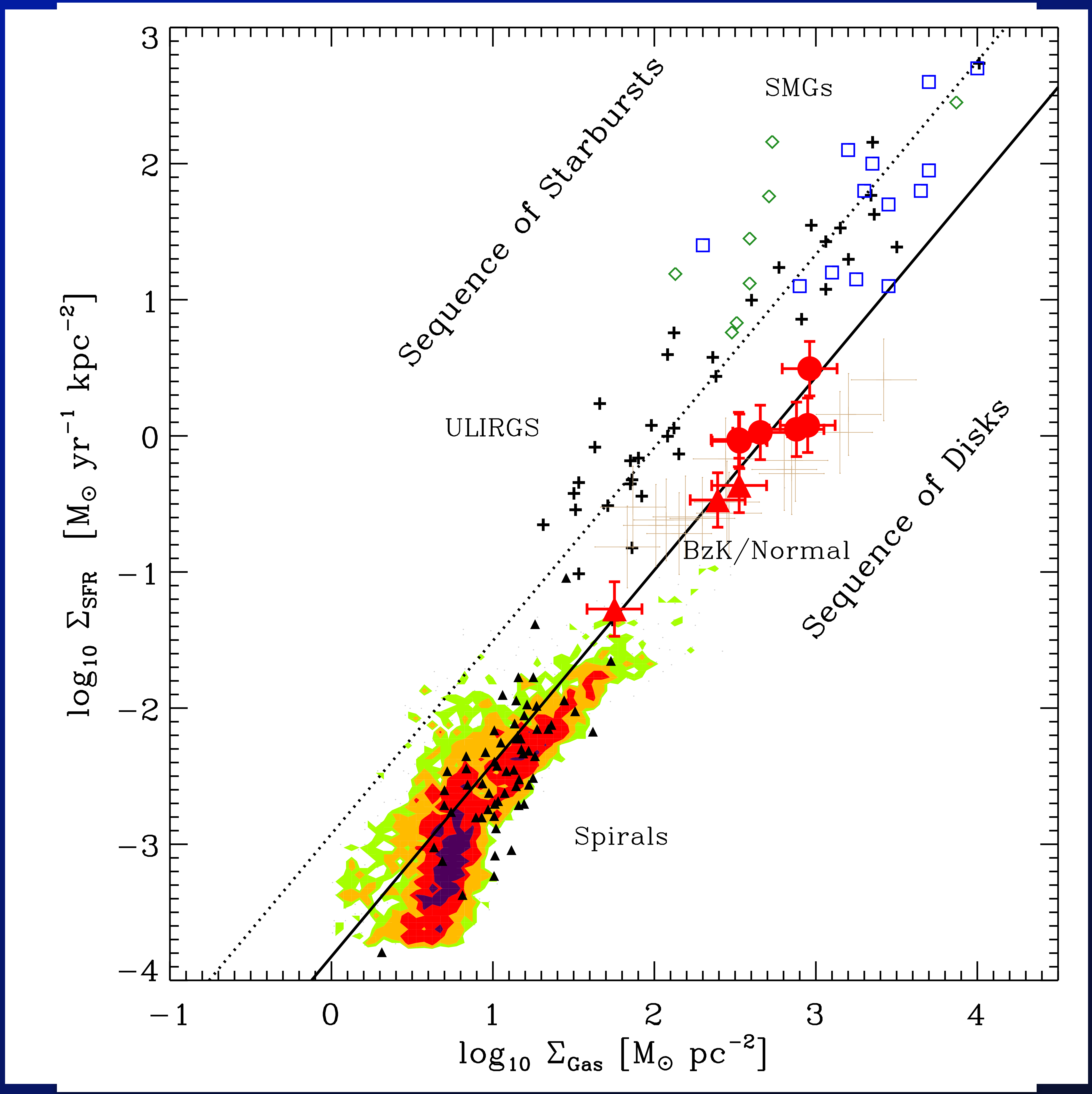
- 15 antennas in Cedar Flat, California
- CO(1-0) survey of Lyman break analogs with CARMA (~100h)
- D configuration, spatial resolution ~5"

High gas fractions in starbursts

Very similar to other high-z samples



Erb+06, Gonçalves+14



Gonçalves+10

Daddi+10

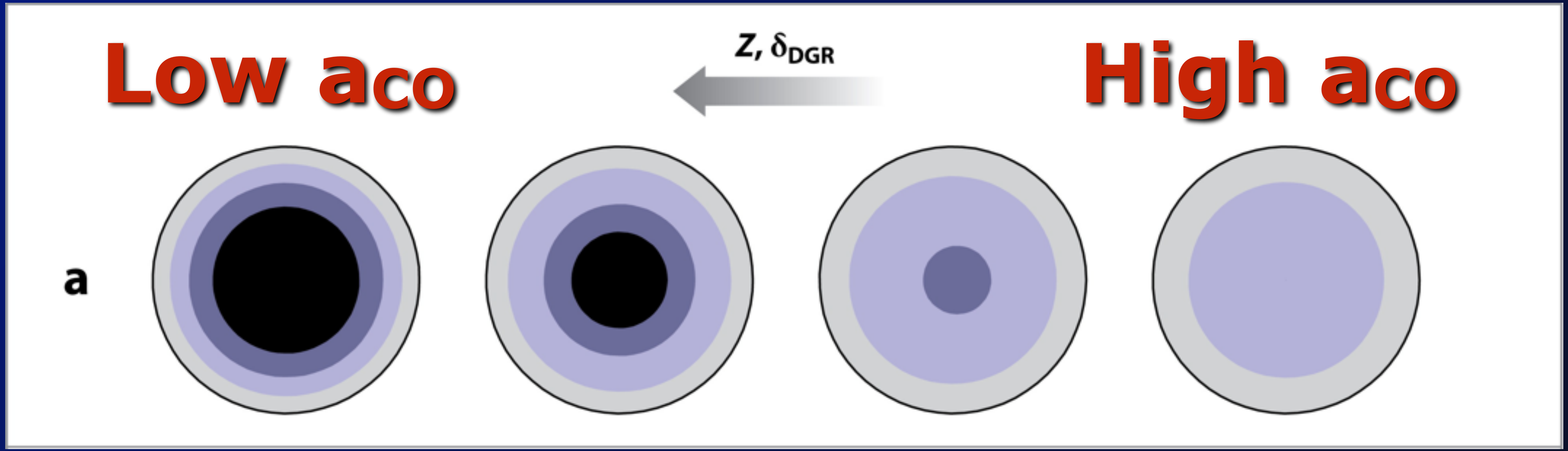
The conversion factor for starburst galaxies

IR-bright galaxies: hot AND turbulent! =>
High CO luminosities

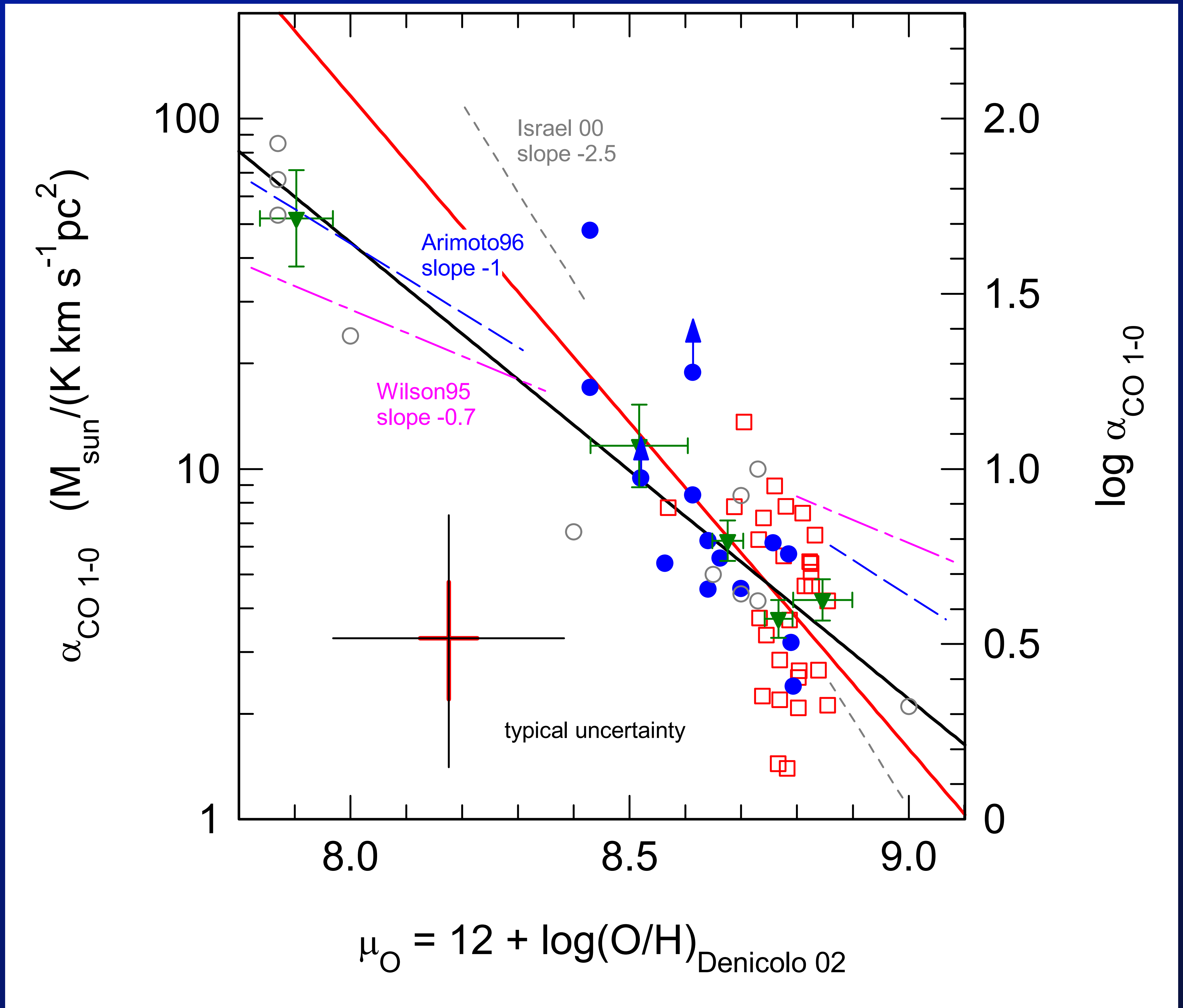
Narayanan+11, Papadopoulos+12

$a_{CO} \sim 4$ (MW), $a_{CO} \sim 0.9$ (ULIRGs)

The conversion factor for metal-poor galaxies

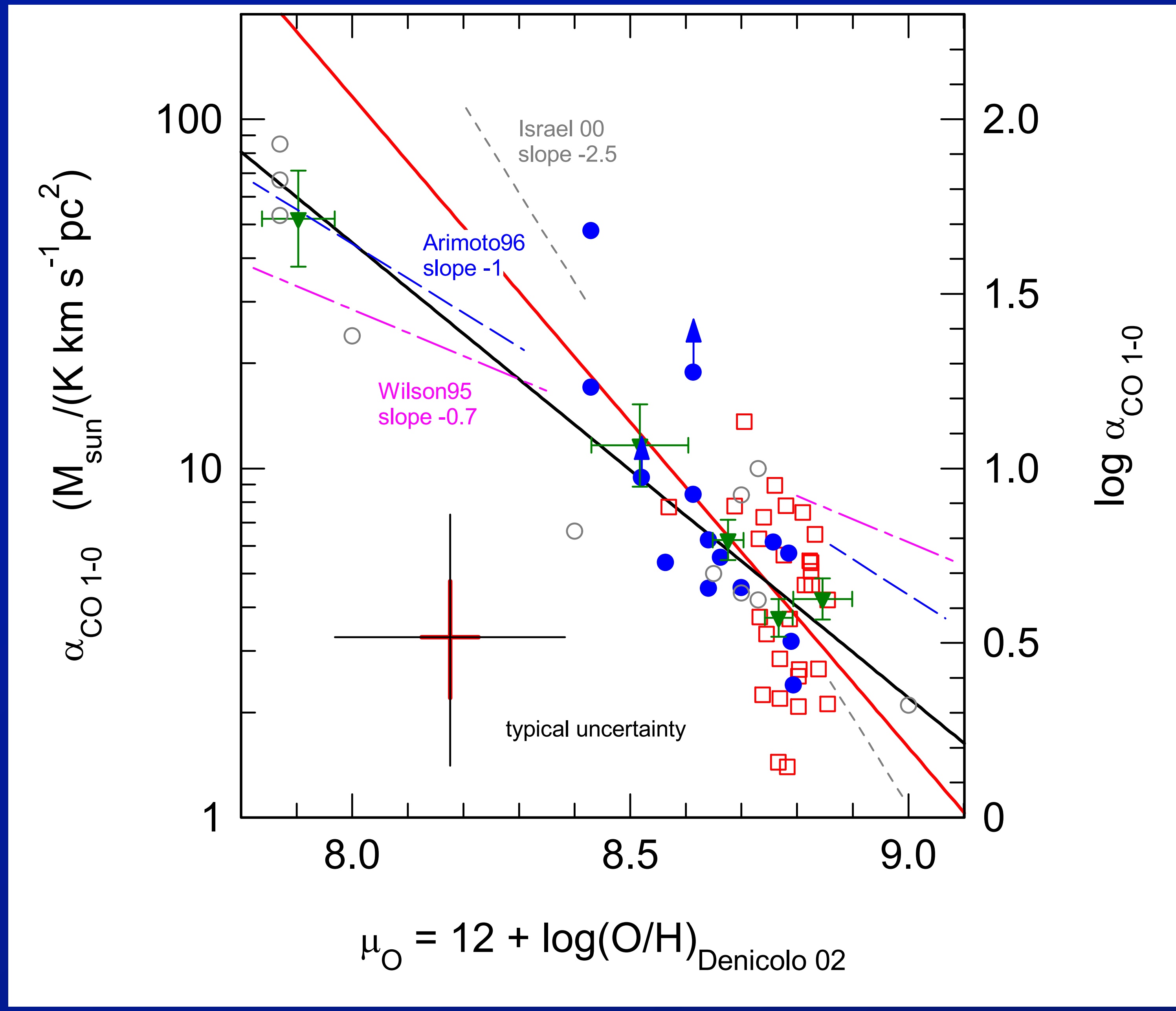


High-z galaxies?

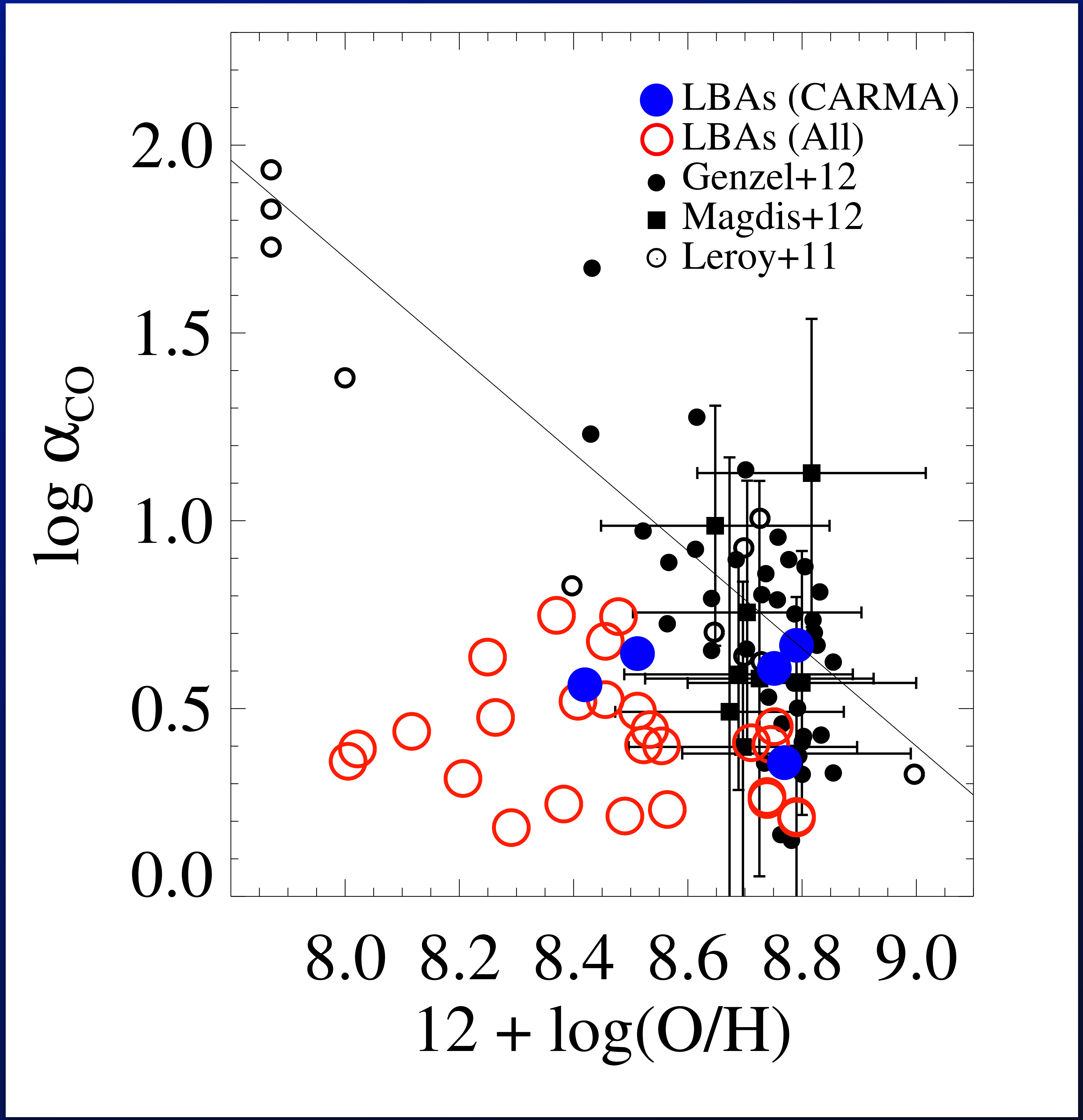


Genzel+ 11

BUT: UV-bright galaxies are
turbulent AND metal-poor!!

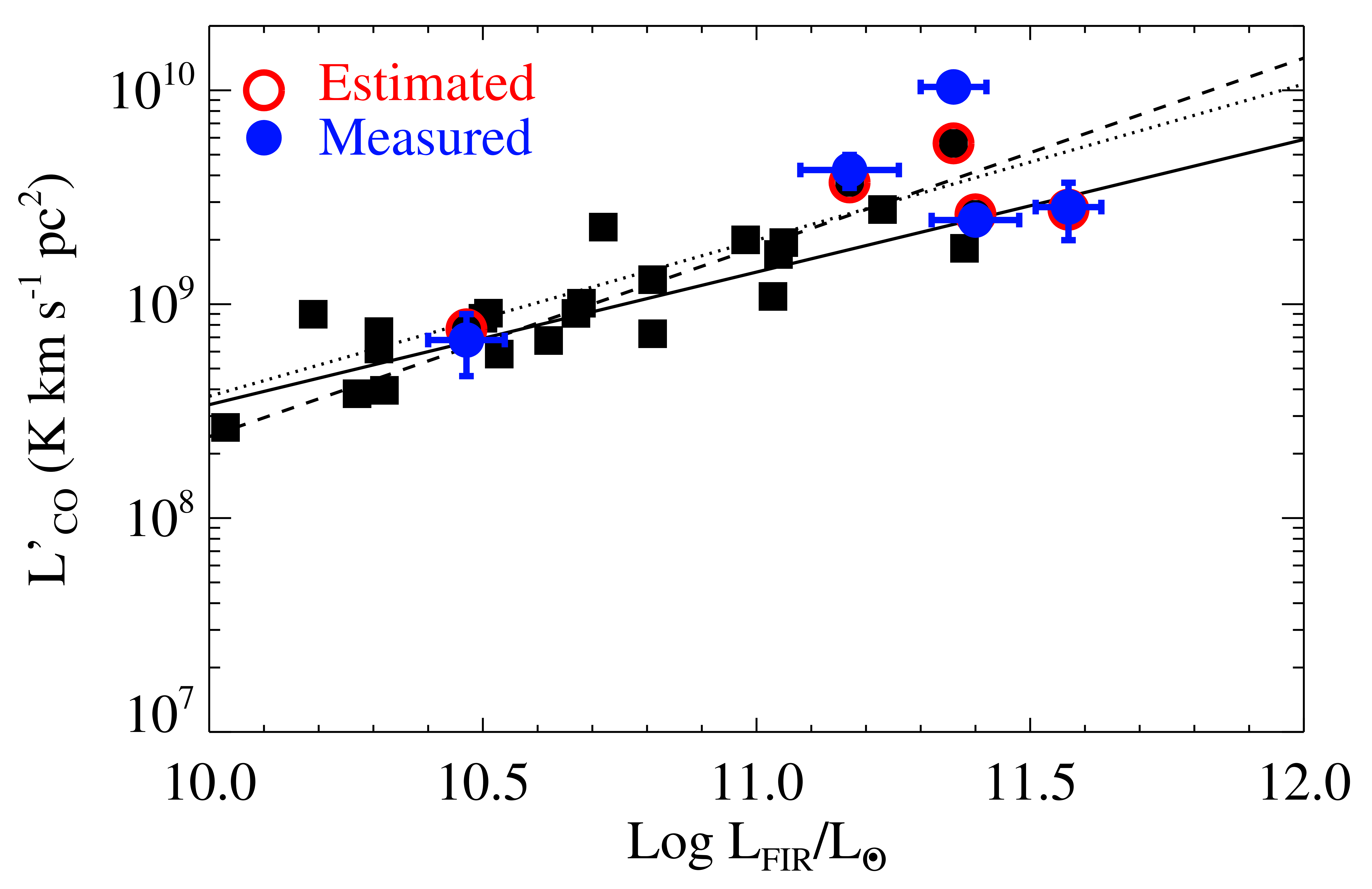


Genzel+ 11



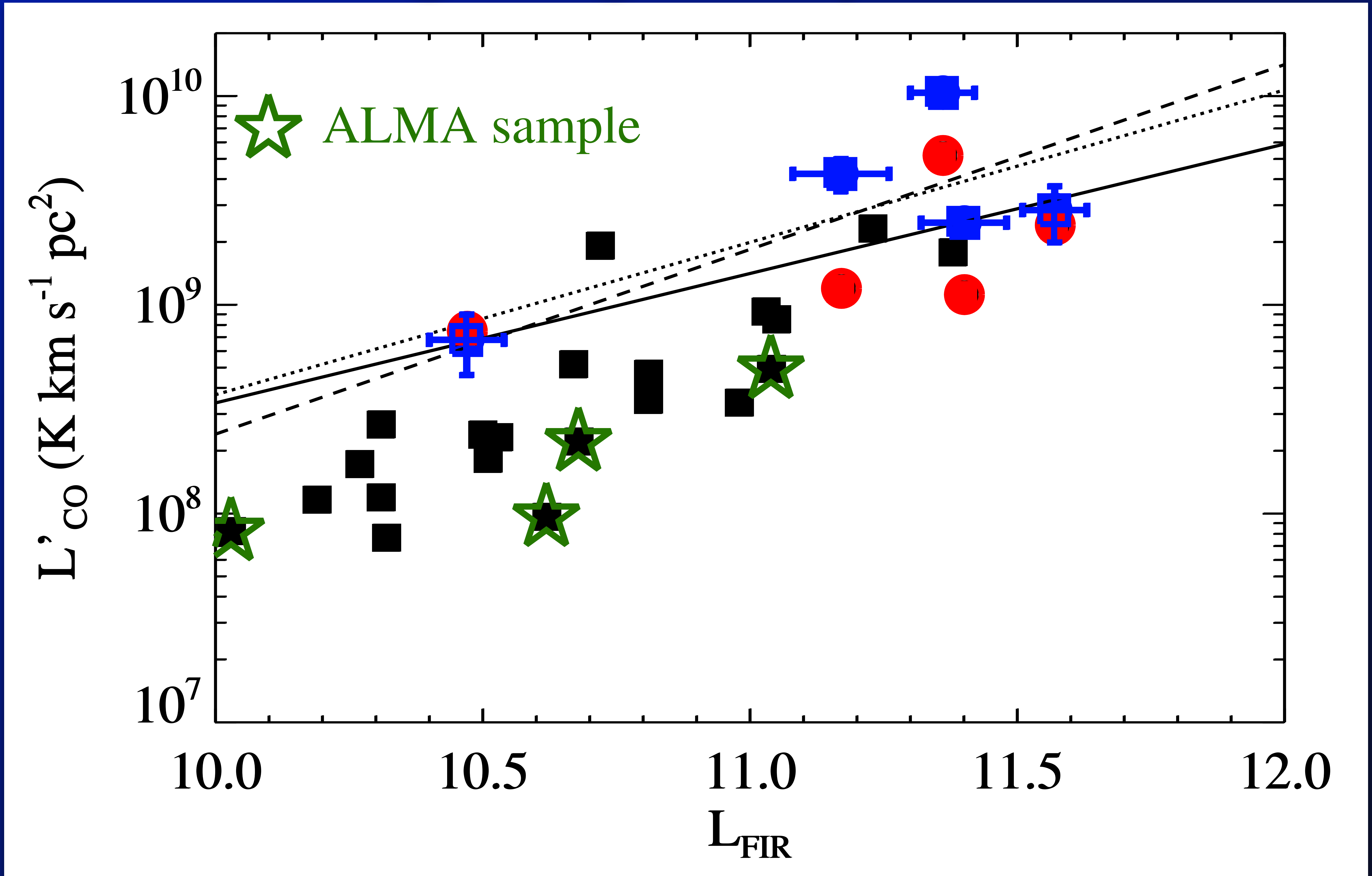
Gonçalves+14

The FIR-CO relation



Gonçalves+14

Assuming high alpha...



S-K Law? α(Z)? L'(CO)-L(FIR)?

Summary

- Galaxies in the past had more gas and less metals; how were they formed? Cold flows, mergers?
- LBAs make an excellent case for local analogs to star forming galaxies at z~2-3, and can be studied in more detail
- LBAs have a lot of very dense, turbulent gas, but still follow S-K relation
- The a_{CO} problem: very unclear for high-z galaxies