Stellar metallicity in high redshift galaxies

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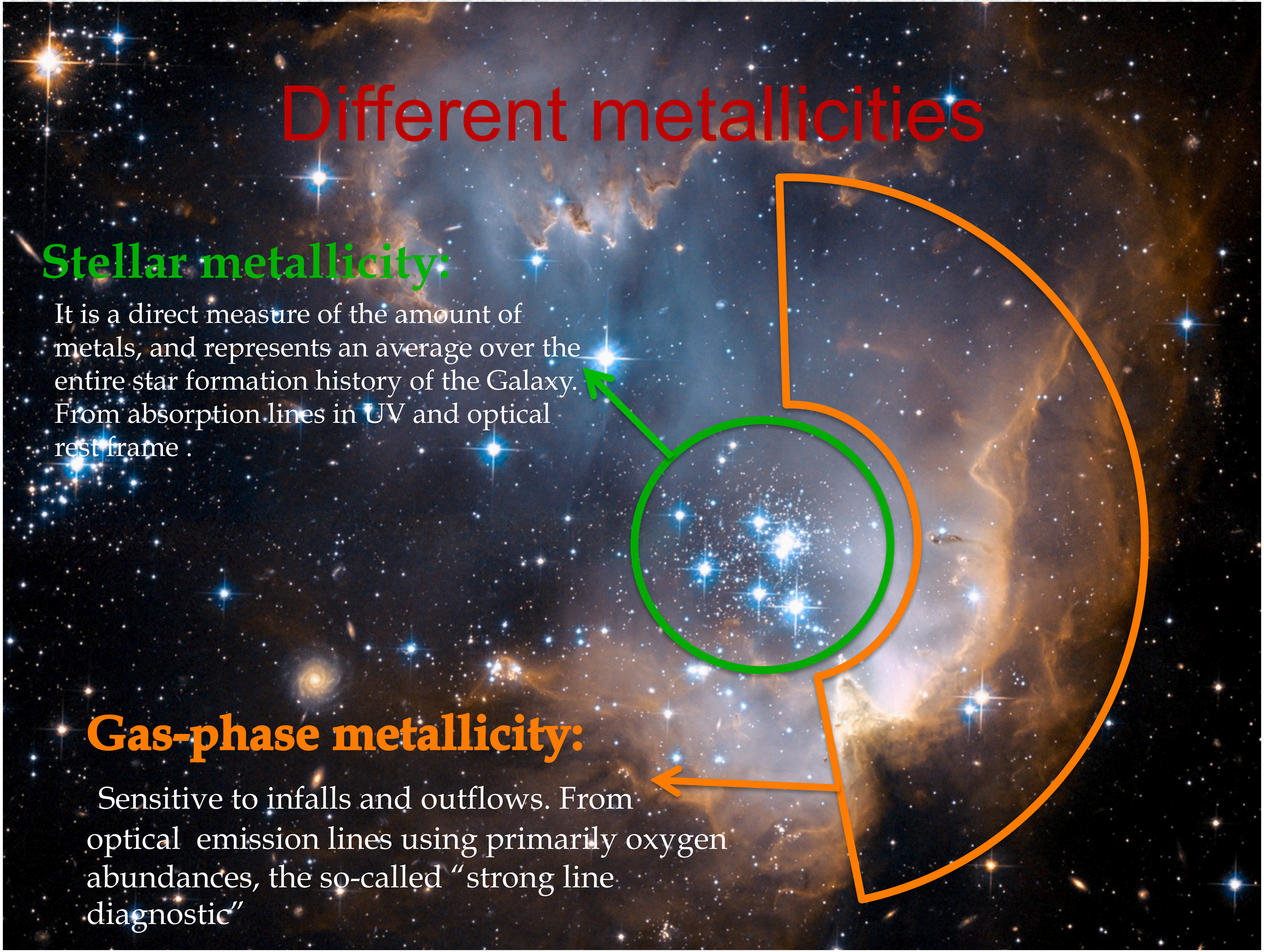


Different metallicities

Stellar metallicity:

It is a direct measure of the amount of metals, and represents an average over the entire star formation history of the Galaxy. From absorption lines in UV and optical rest frame .

Gas-phase metallicity:

Sensitive to infalls and outflows. From optical emission lines using primarily oxygen abundances, the so-called "strong line diagnostic"

Stellar metallicity, why bother....?

- Stellar metallicity is a direct measure of the amount of metals in a galaxy, since large part of heavy elements lies in its stars

- Can be used as an independent measure

- Can put additional constraints on theoretical models

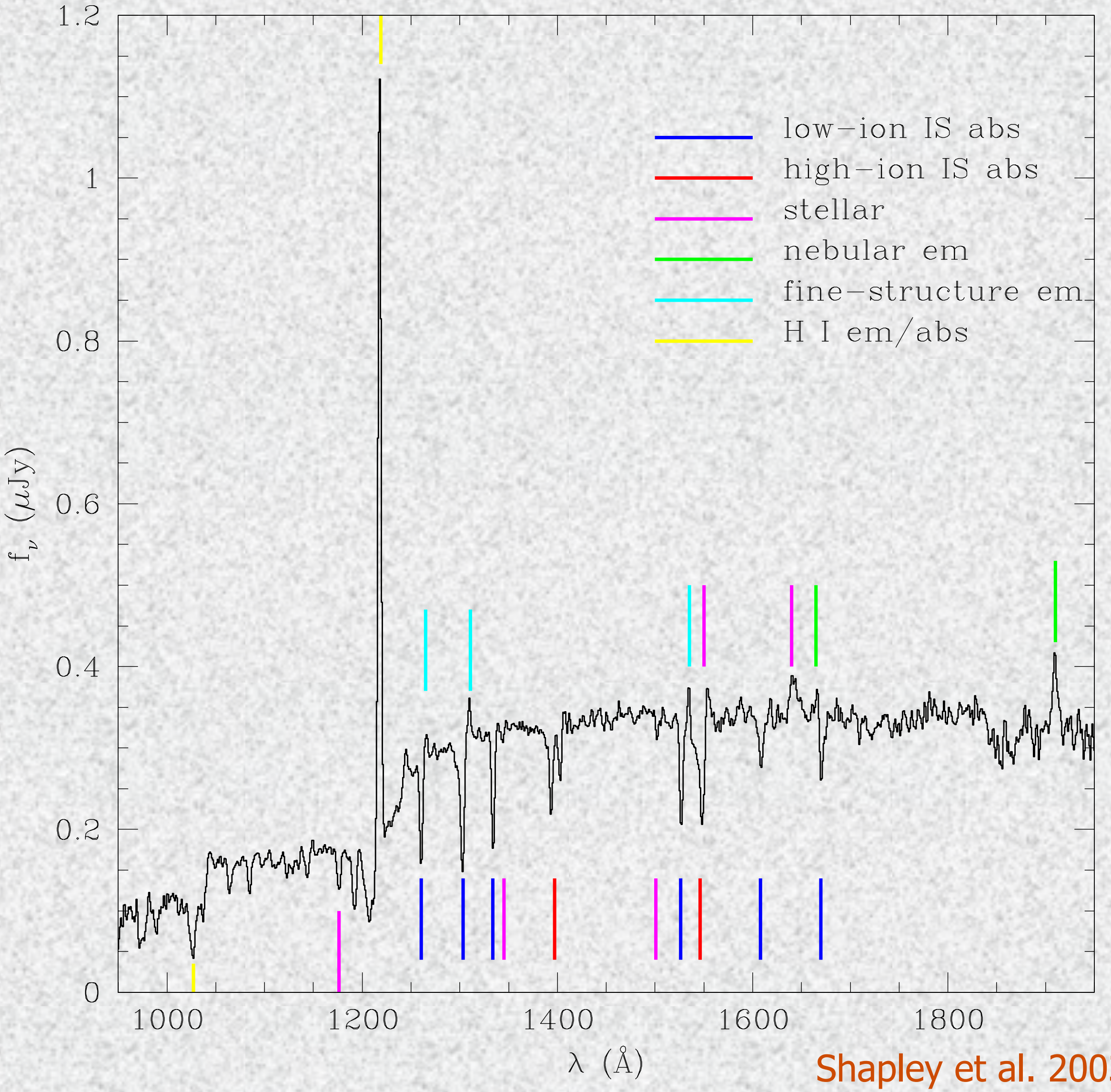
- In spite of its importance, only in a handful of high-z galaxies were computed stellar metallicity

The stellar metallicity at high redshift

Strong features in the rest frame UV due to photospheric absorption lines of C, N , O , Si, and Fe are produced by hot, young O-B stars.

Rest frame UV stellar absorption features of the young stars can be used to derive stellar metallicities at high redshift.

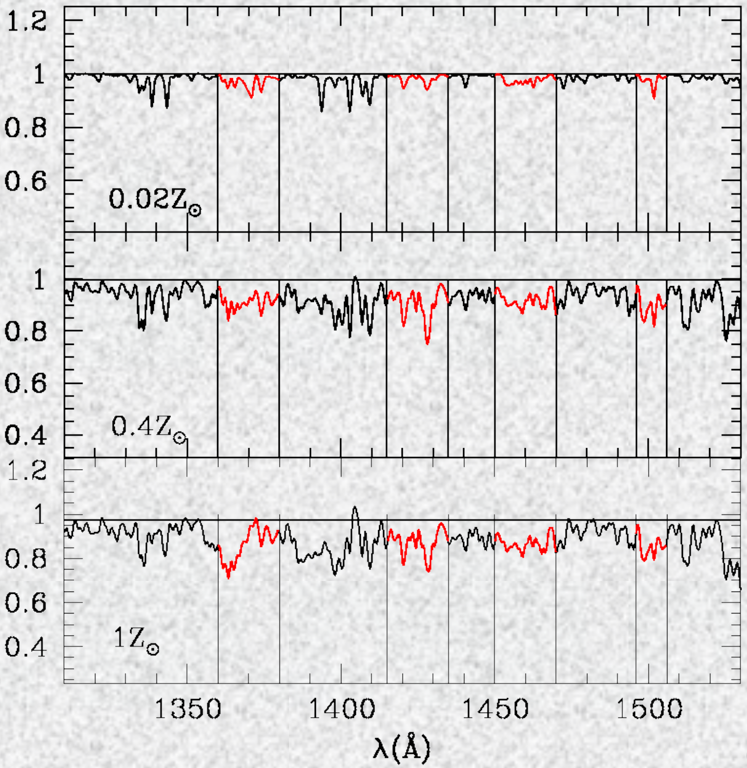
But high S/N on the continuum is required.
There are only few studies up to now, mainly on lensed or co-added spectra



Shapley et al. 2003

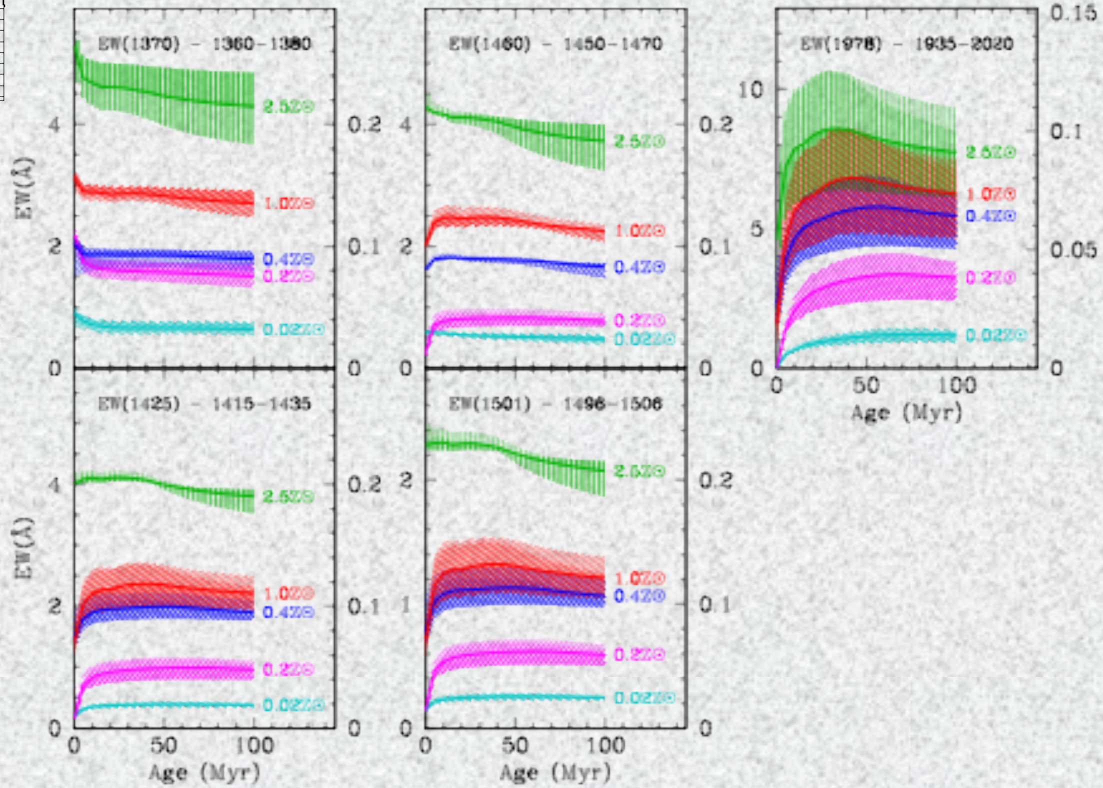
The method

Sommariva et al. 2012



We searched for photospheric absorption lines using theoretical spectra created with Starburst99

We defined two new metallicity indicators, and update the old ones with new stellar libraries



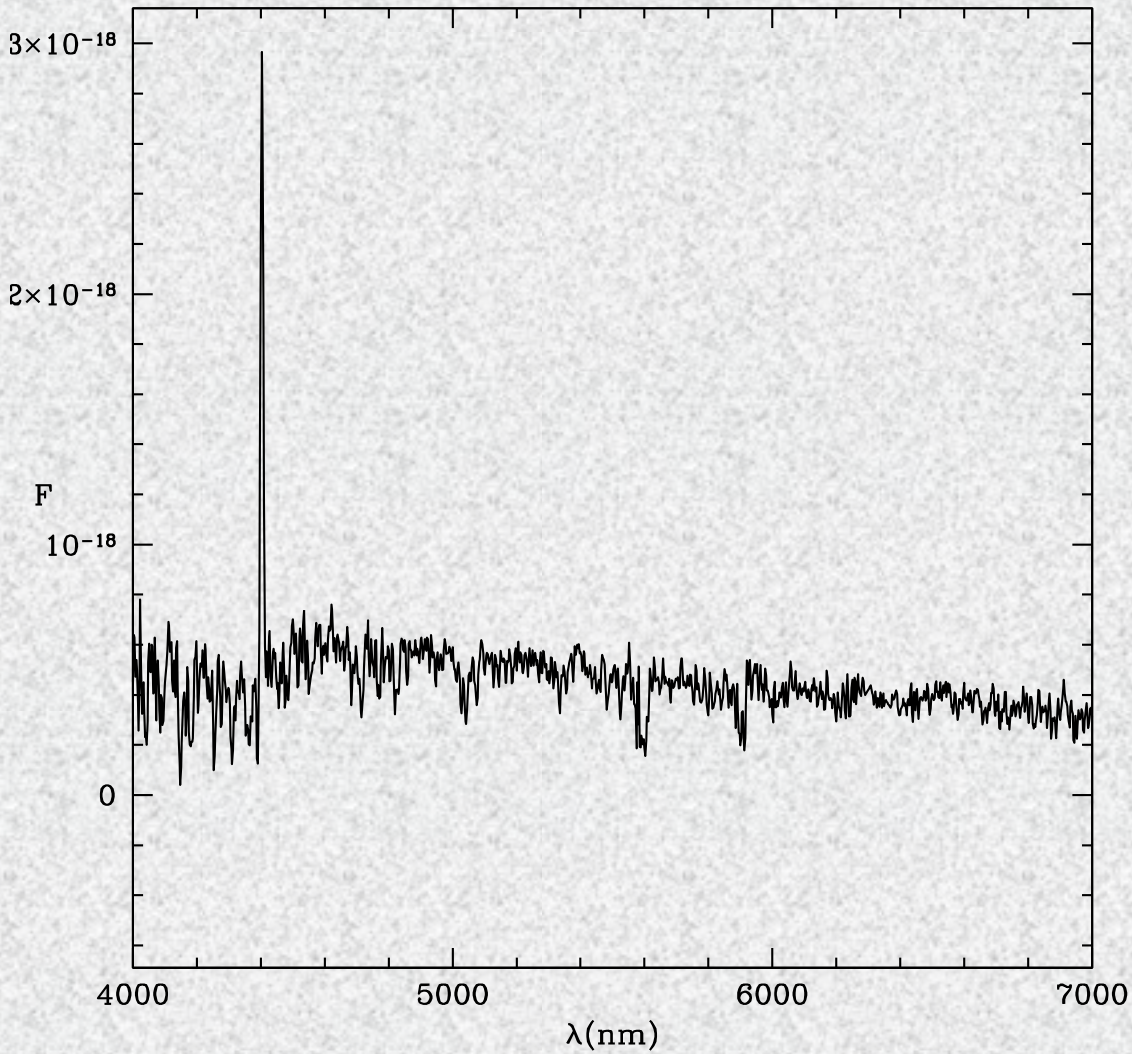
Dependence on the metallicity, and stability with the age are both mandatory

Stellar metallicity z › 2 Sommariva et al. 2015

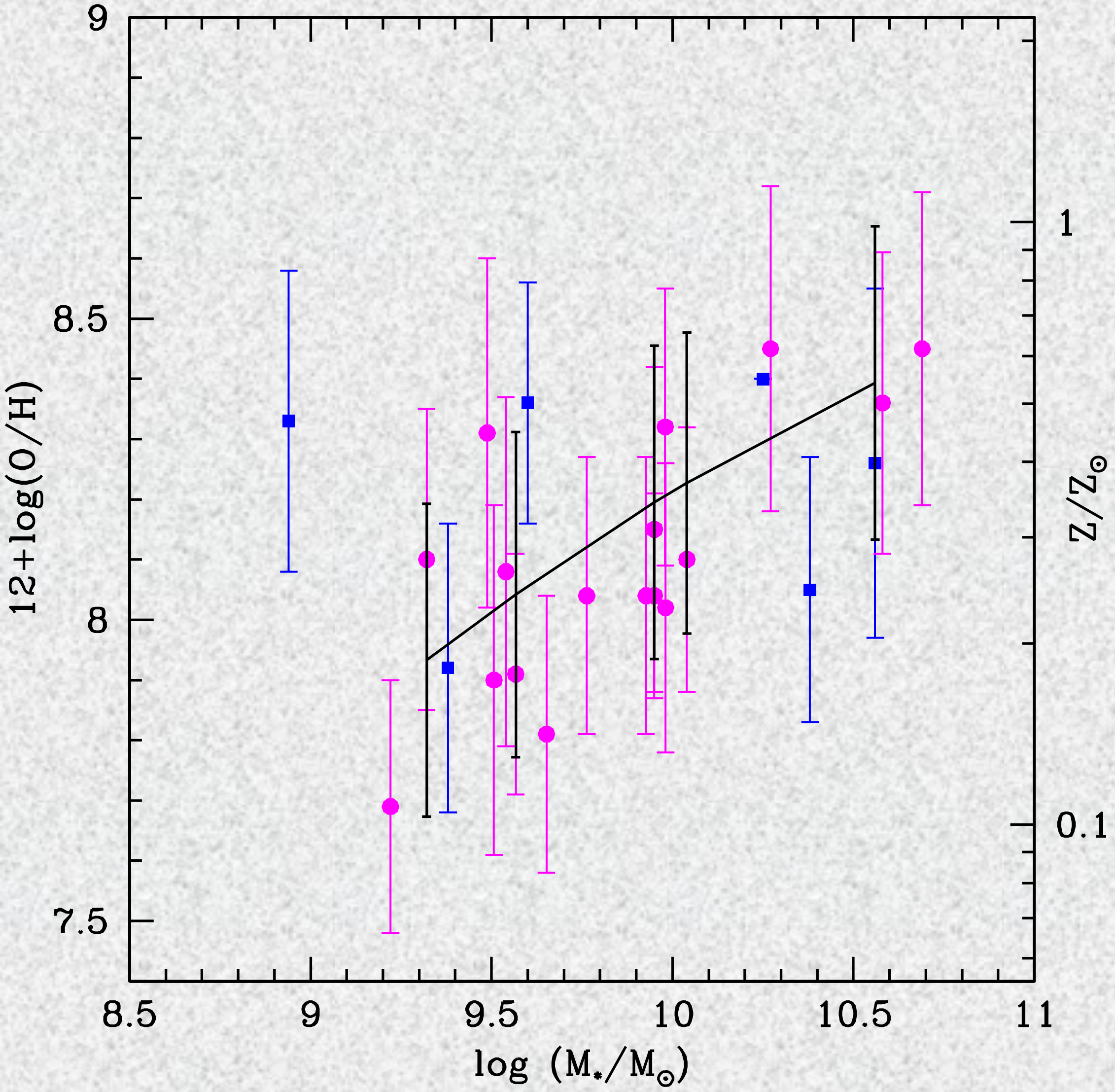
AMAZE SAMPLE
FORS2@VLT R =600
37h hours
5 galaxies z>3

MODS@LBT (PI V. Sommariva)
16hs R= 600
10 galaxies 2<z<2.5

GMASS (ESO archive)
FORS2@VLT spectra R=600
10 spectra 1.9<z<2.7

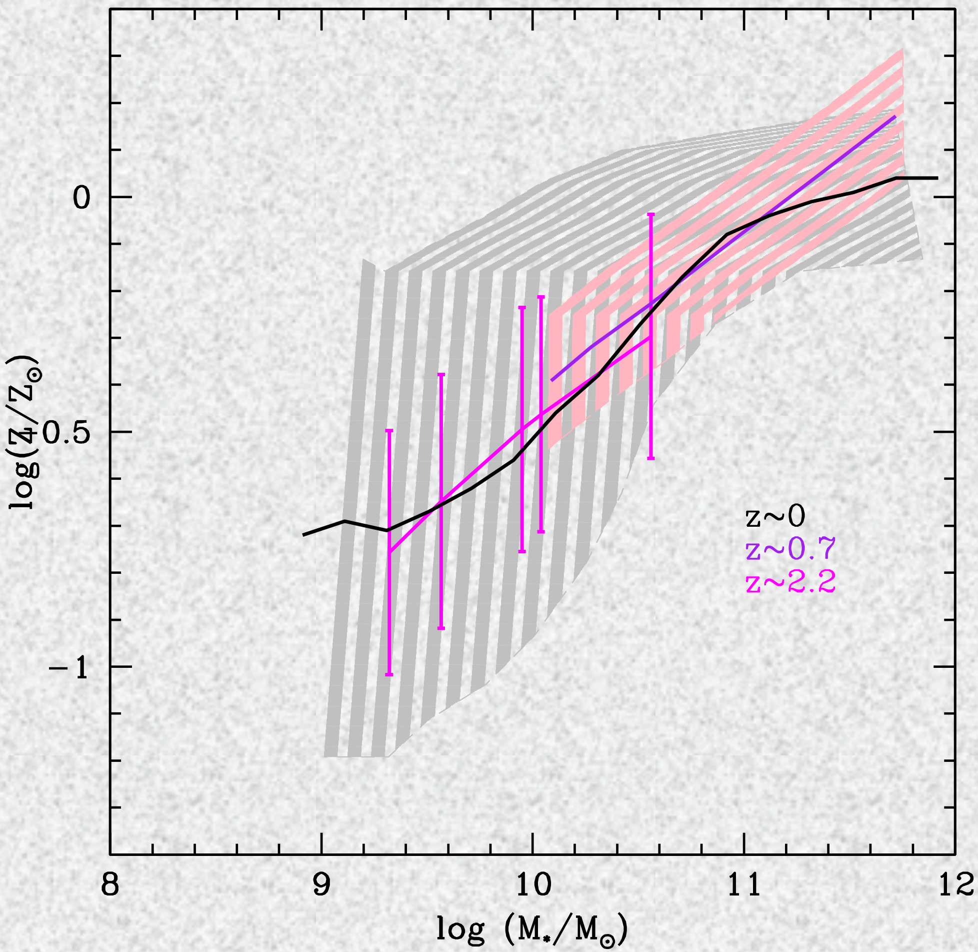


The first mass stellar metallicity relation at z≈2.2



- low chemical abundances
- confirm the general shape
- No different trends between z~2 and z~3

Evolution of stellar metallicity

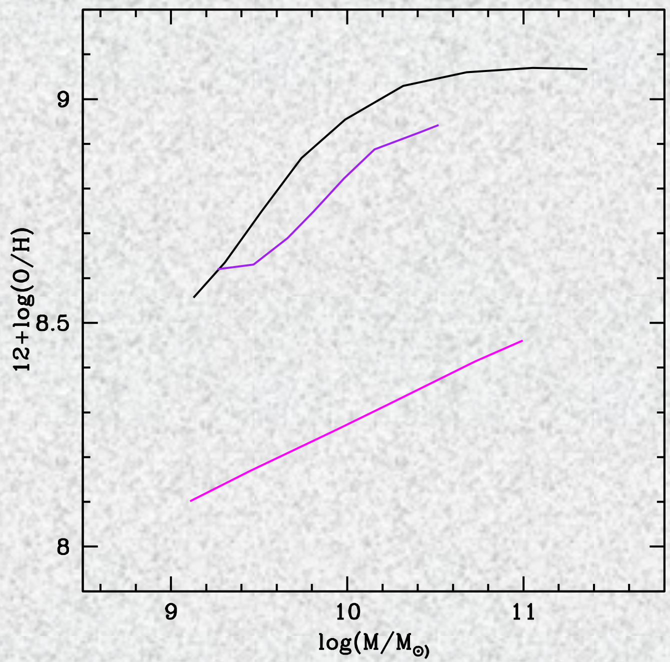


Galazzi et al. (2005) SDSS galaxies

Gallazzi et al. (2014) ECDF

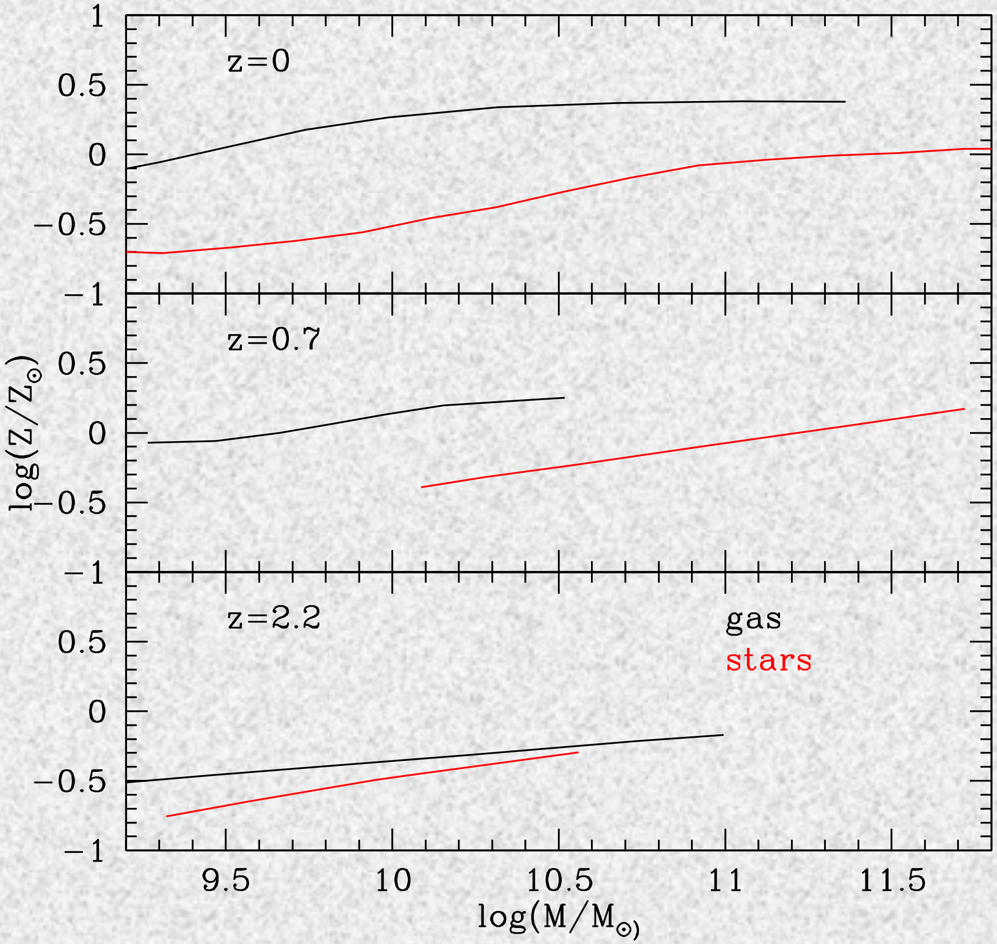
Sommariva et al. (2015)

We don’t observe evolution with redshift

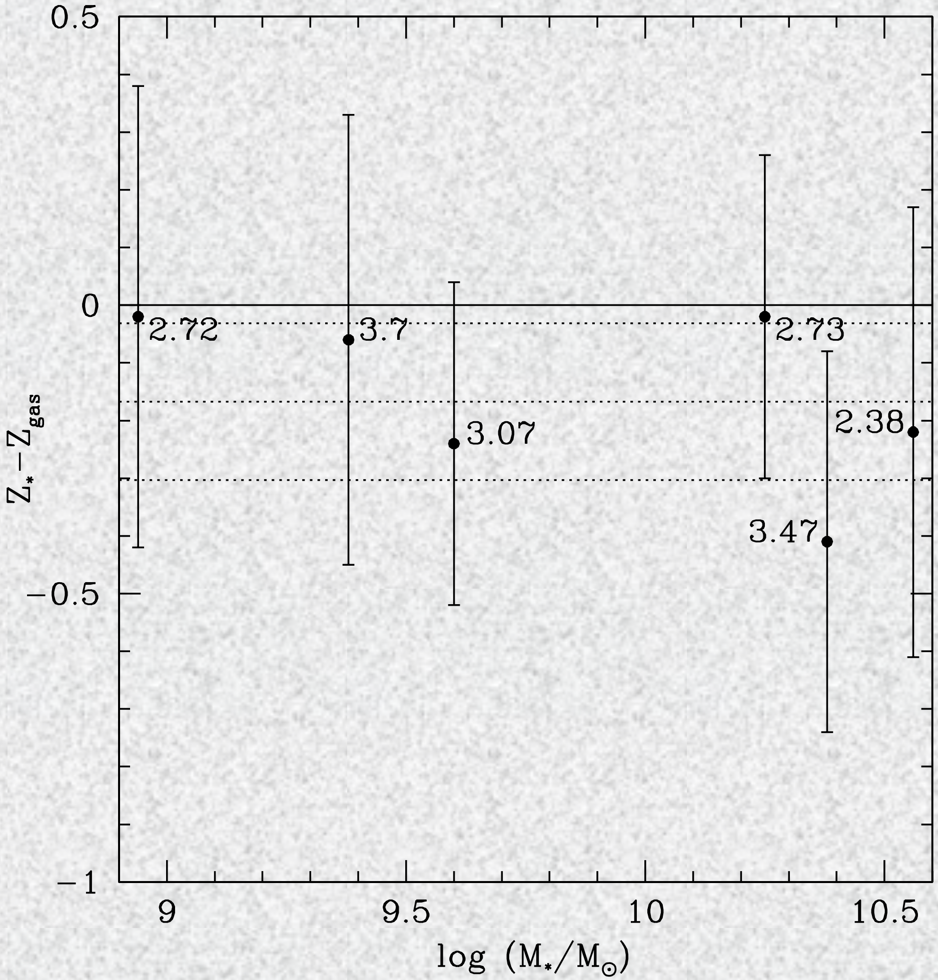


Note that the metallicity indicators are different

Comparison with gas phase

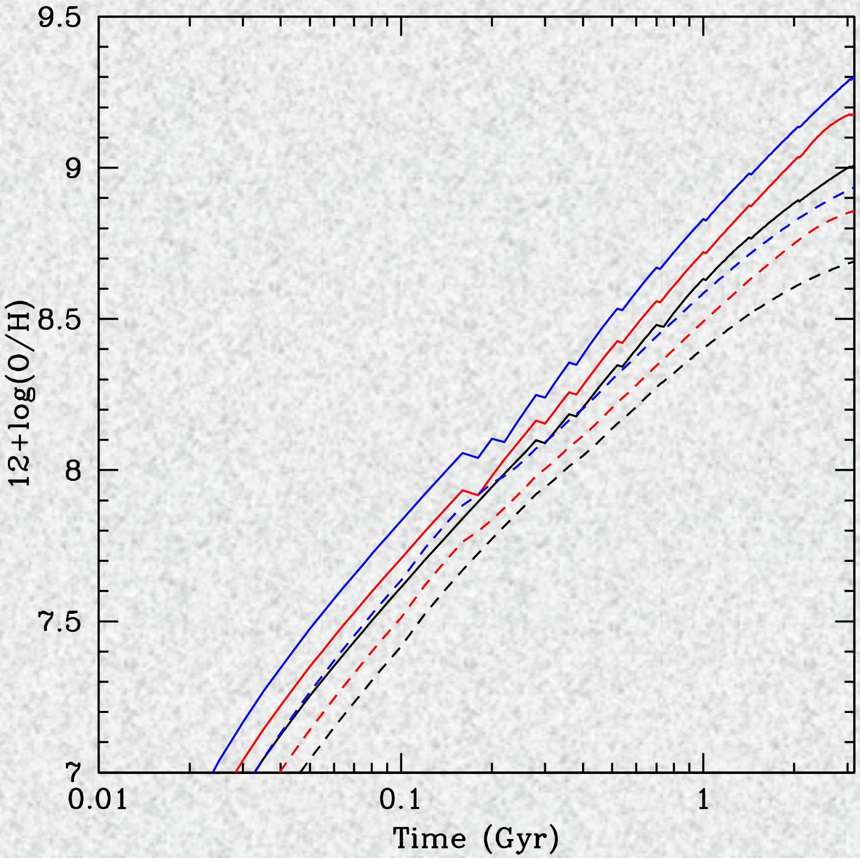


Stellar metallicity < gas phase one



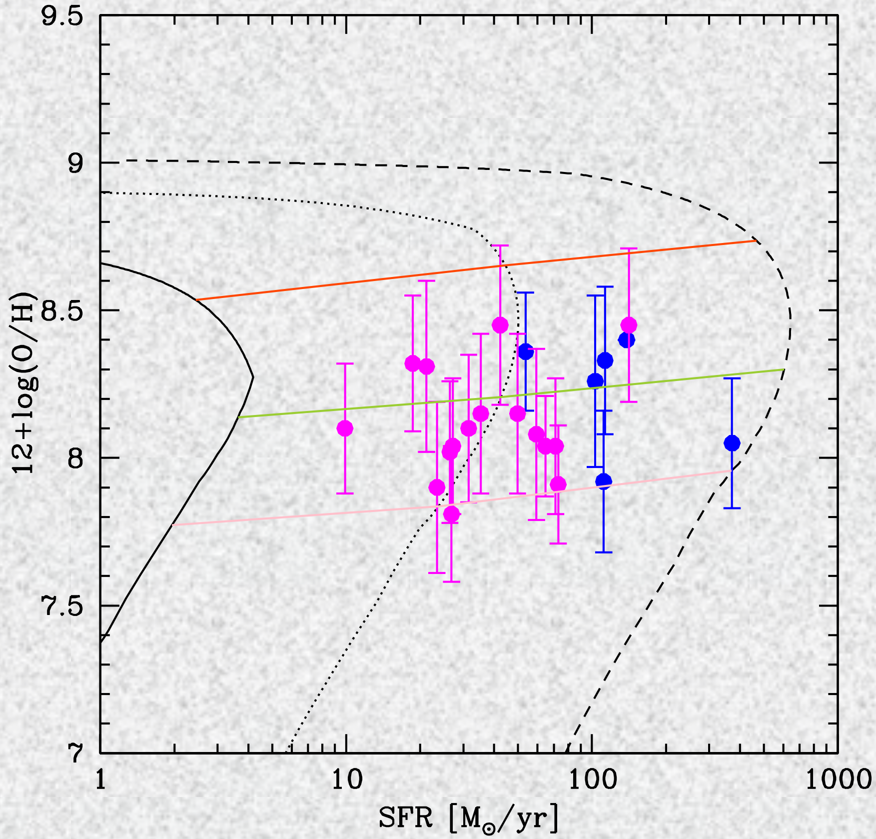
Going to lower redshift the difference increases, as expected

Comparison with model



Calura et al. 2009 Numerical model of chemical evolution as a function of time.

At evolutionary times greater than ~3 Gyr the gas phase increases faster than the stellar metallicity



Summary

- we define two new stellar metallicity indicators for high-z SF galaxies
- For the first time we derive the mass stellar metallicity relation at z~2.2
- We find lower stellar metallicity compared to gas-phase one
- There is no apparent evolution of stellar metallicity with redshift
- The sample size will increase in the next years thanks to VANDELS (Laura’s talk)