Metallicity and morphology of the cool circumgalactic medium

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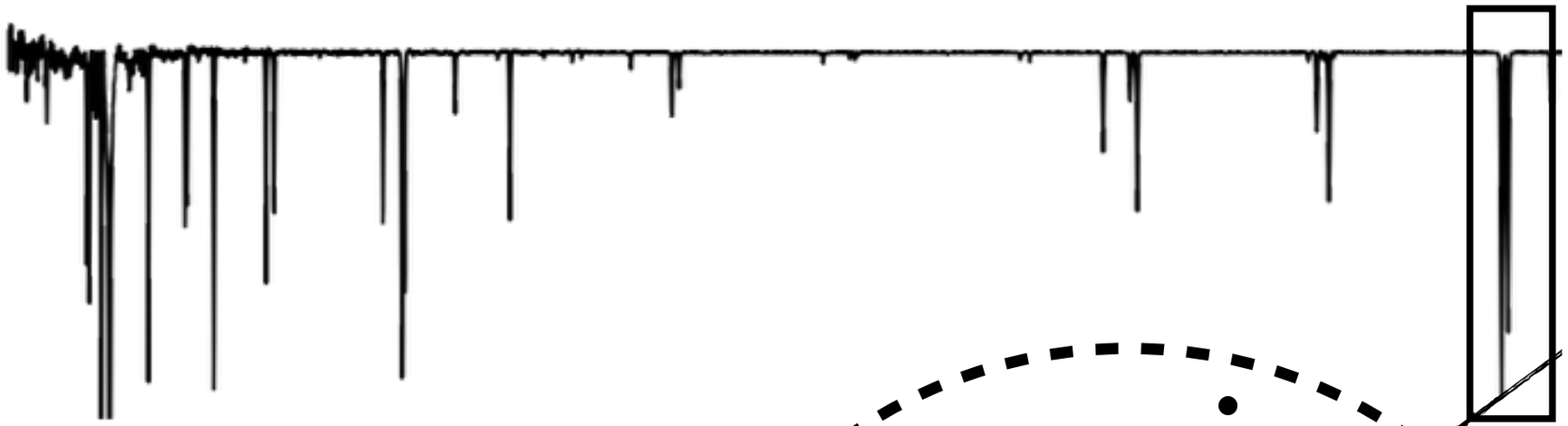
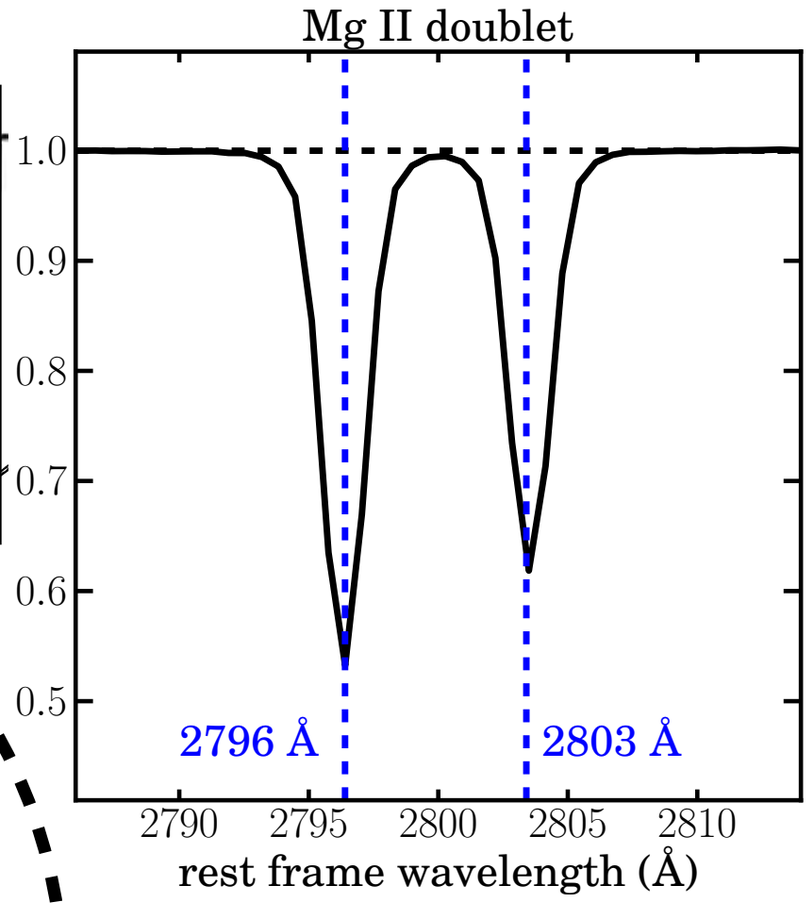
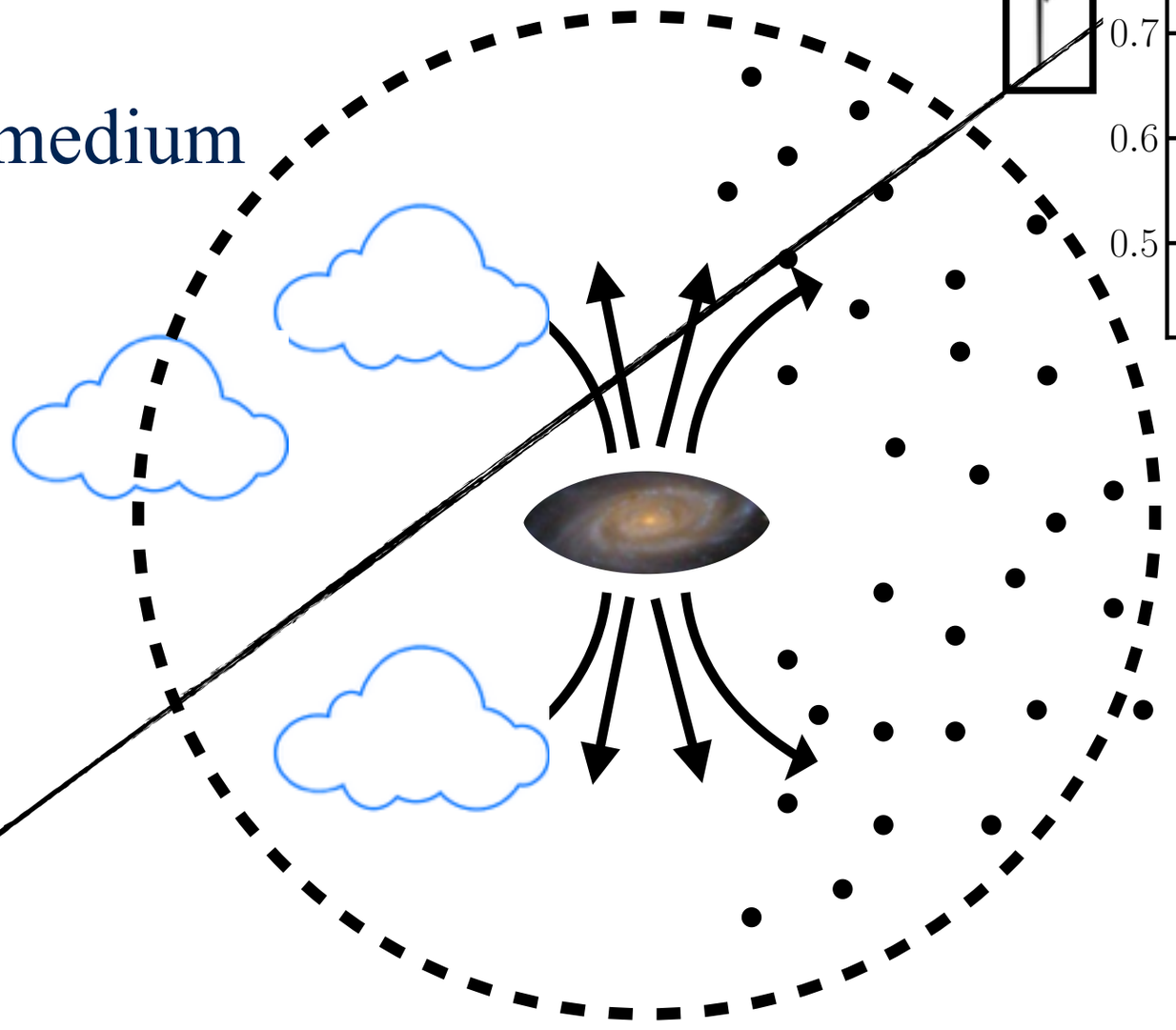
KAVLI IPMU



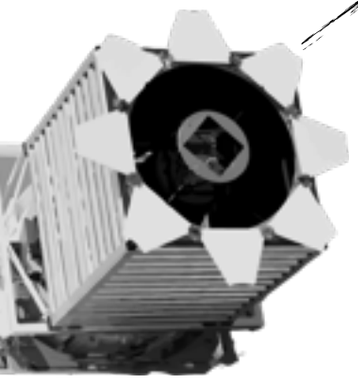


Circumgalactic medium (CGM)



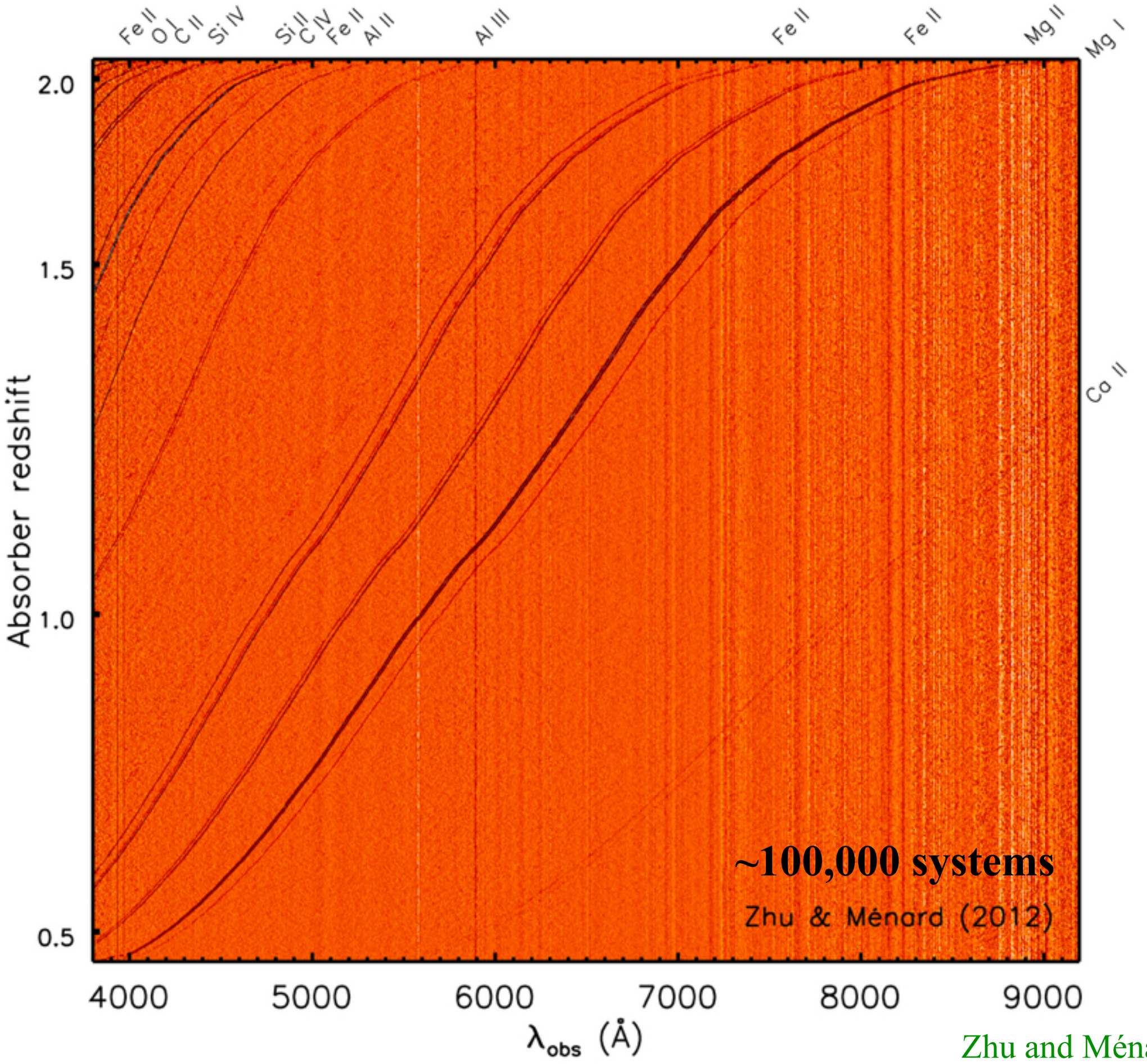
Accessible from z~0.4 to 2.5 in optical regions

N_{HI}>=10^{19} cm^{-2}



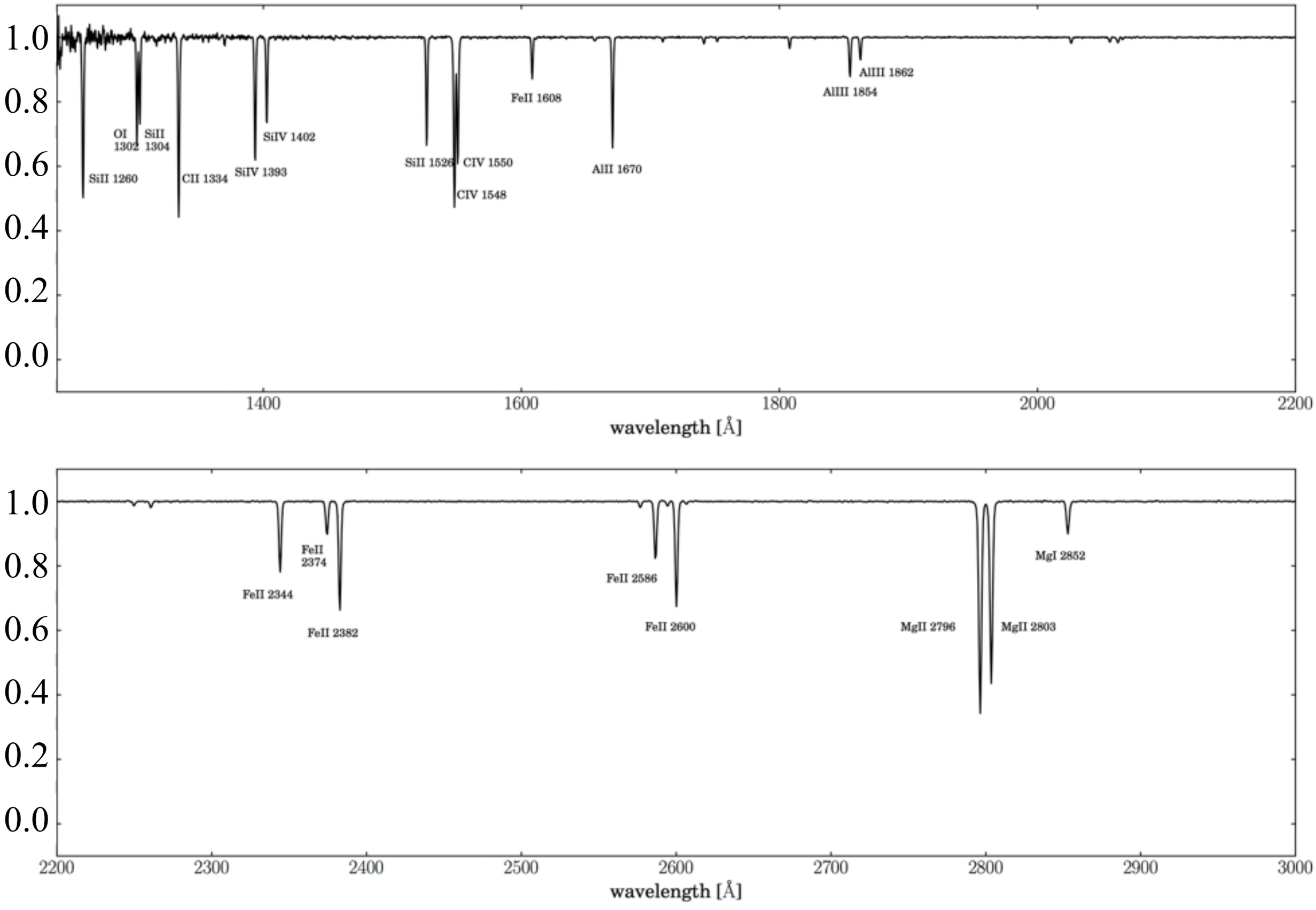
How does the metallicity of the CGM evolve?

What is the morphology of the CGM?

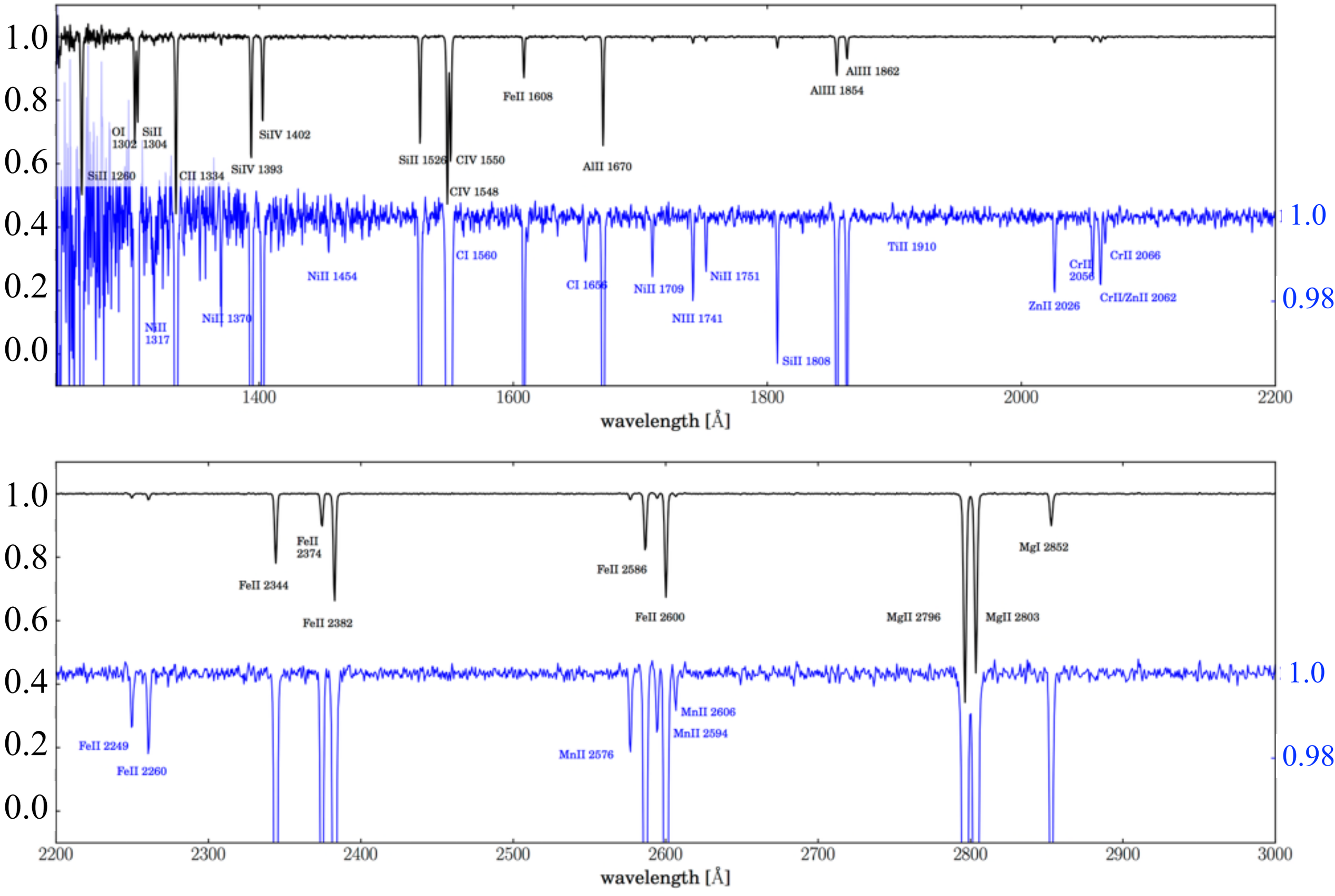


Zhu and Ménard (2013)

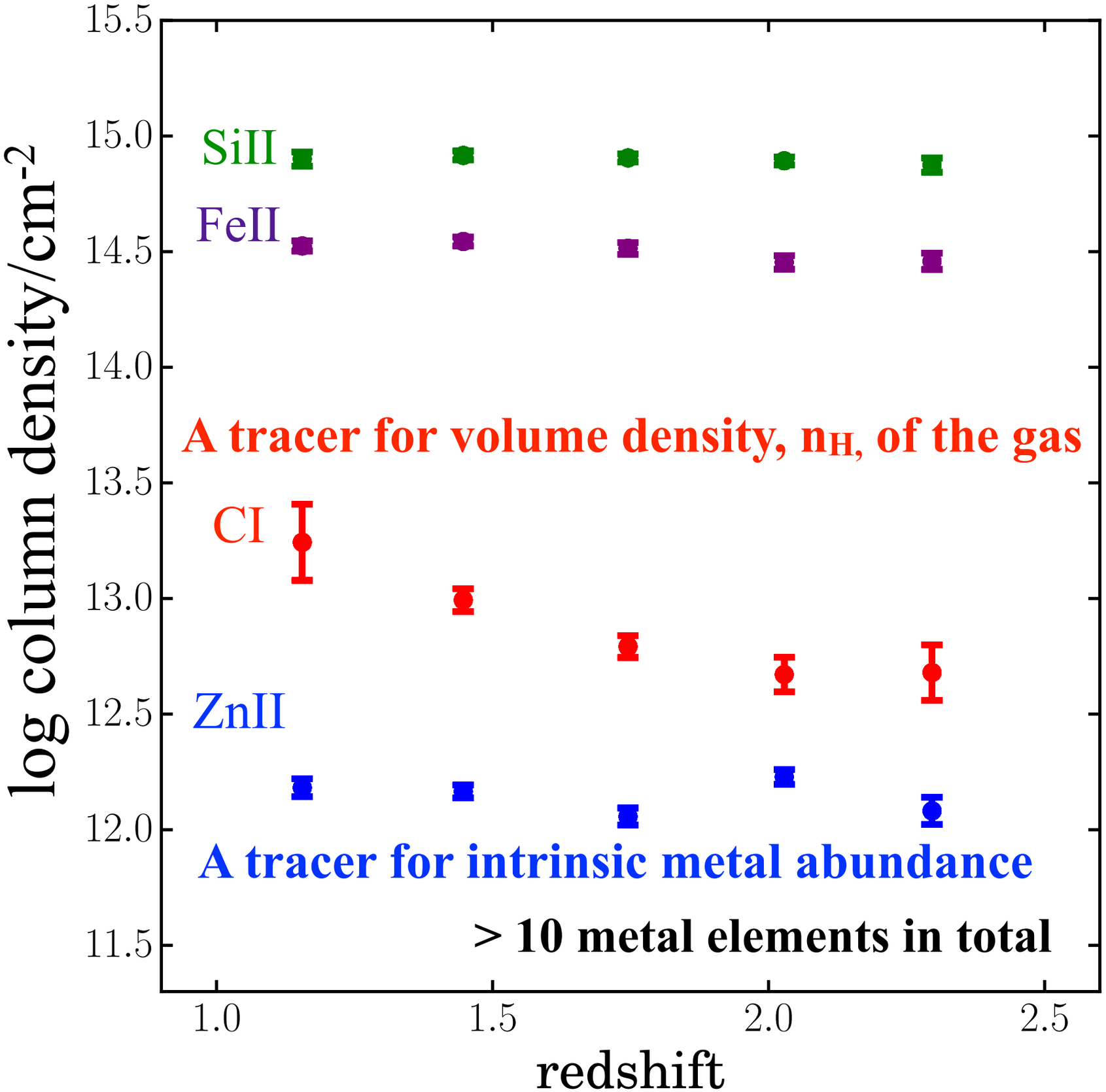
Metal composite spectrum



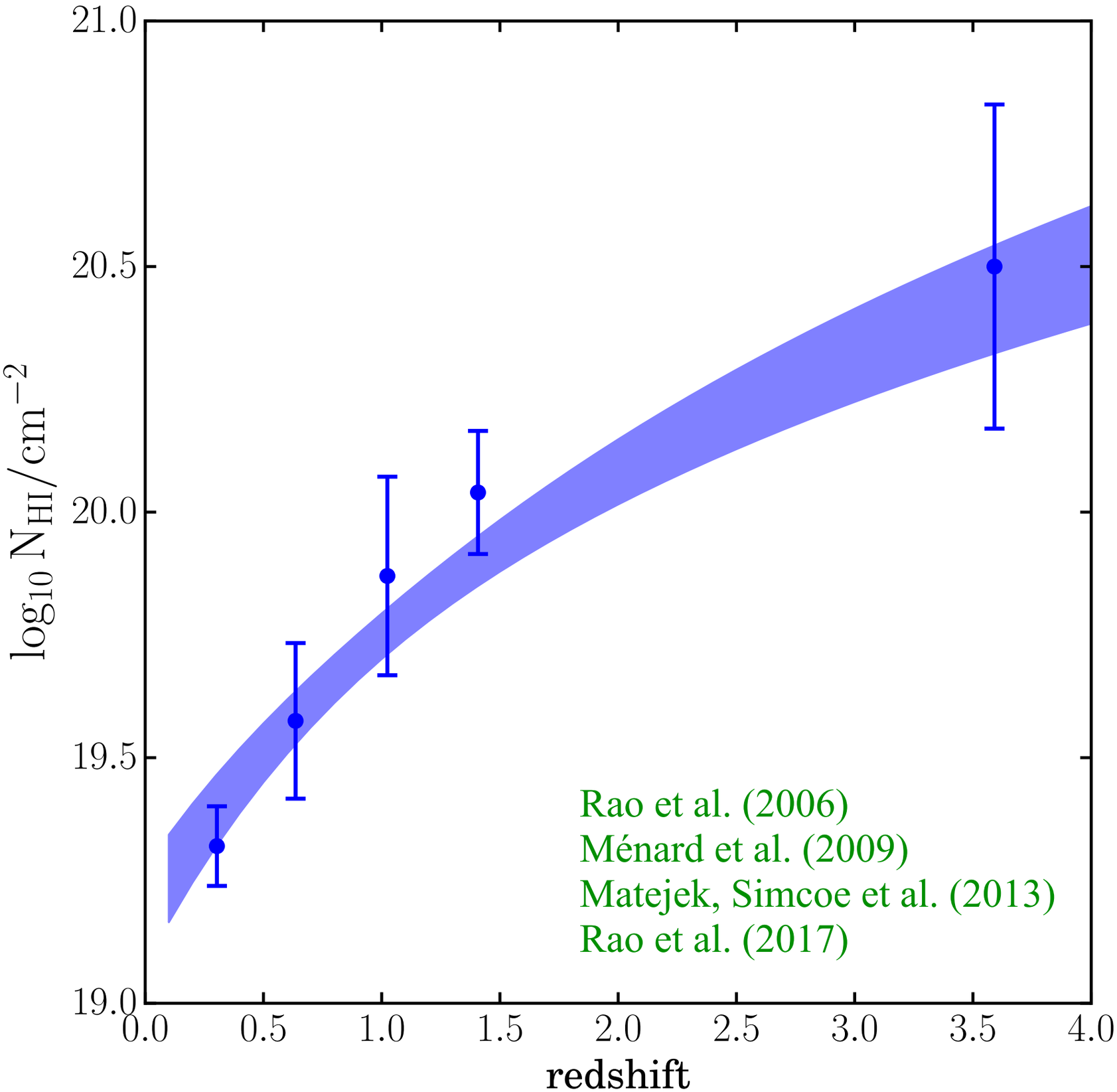
Metal composite spectrum



Metal column densities as a function of redshift

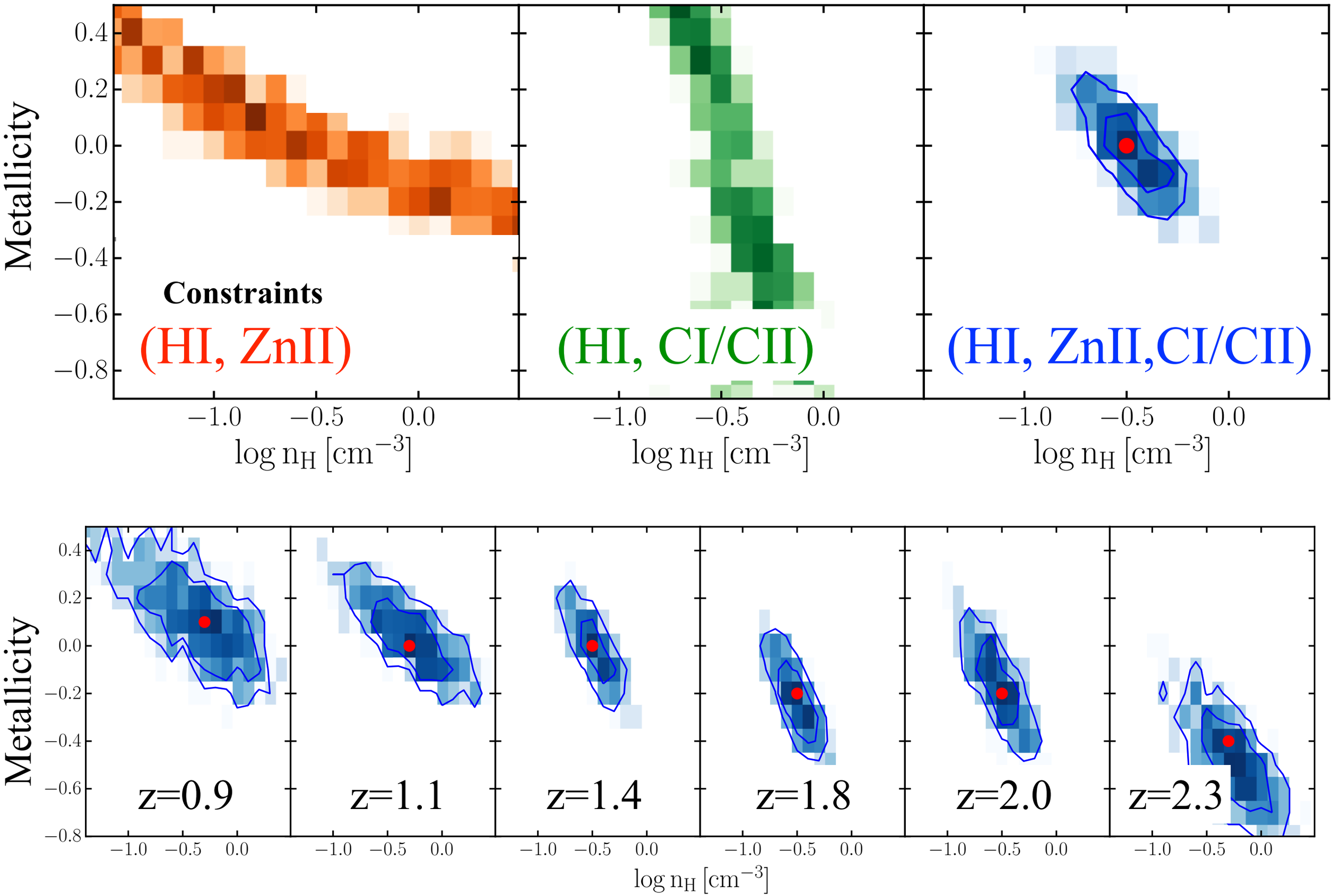


Neutral hydrogen column densities as a function of redshift

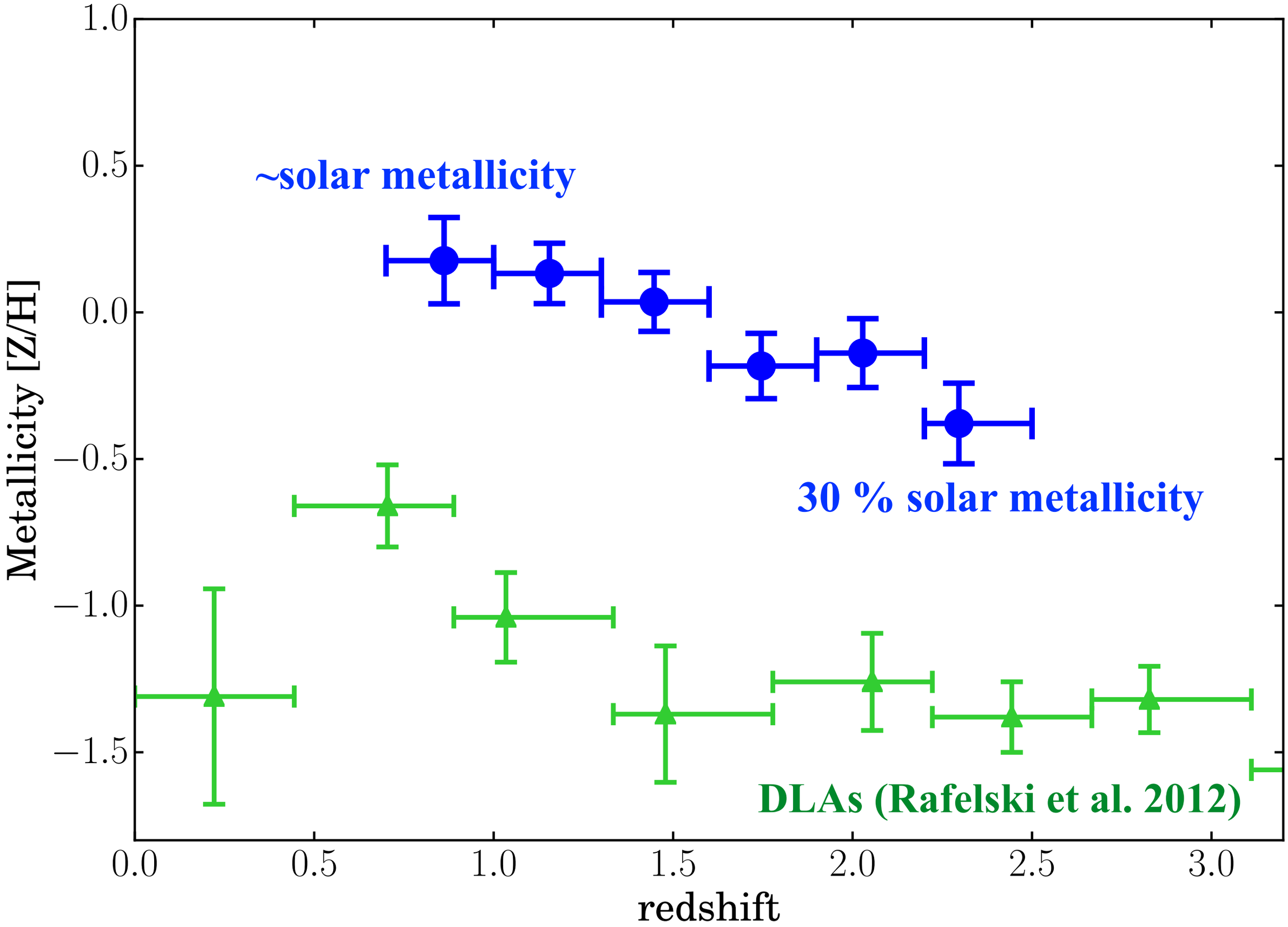


See also Matejek, Simcoe et al. (2013)

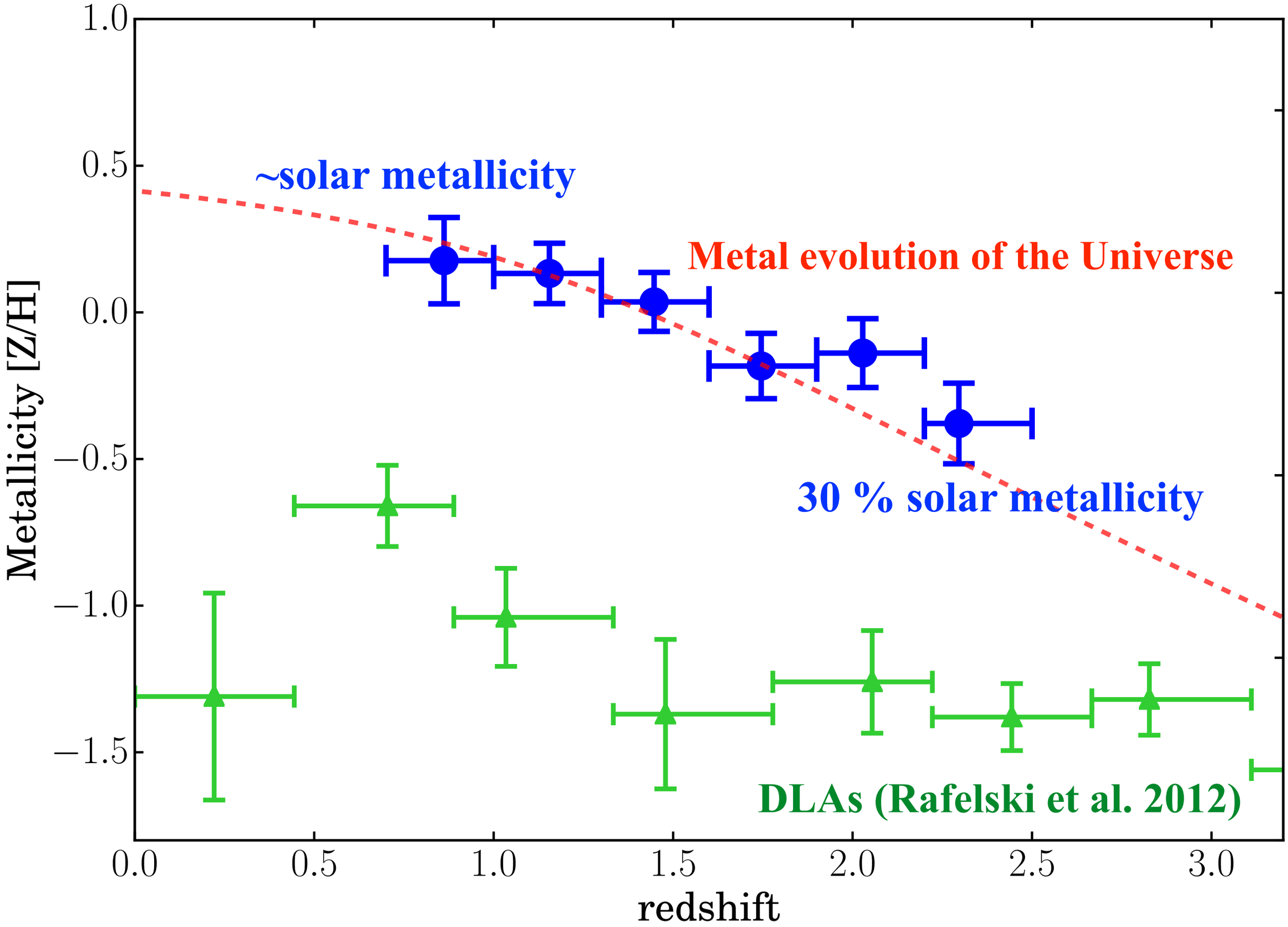
Constraining the physical properties of gas with CLOUDY



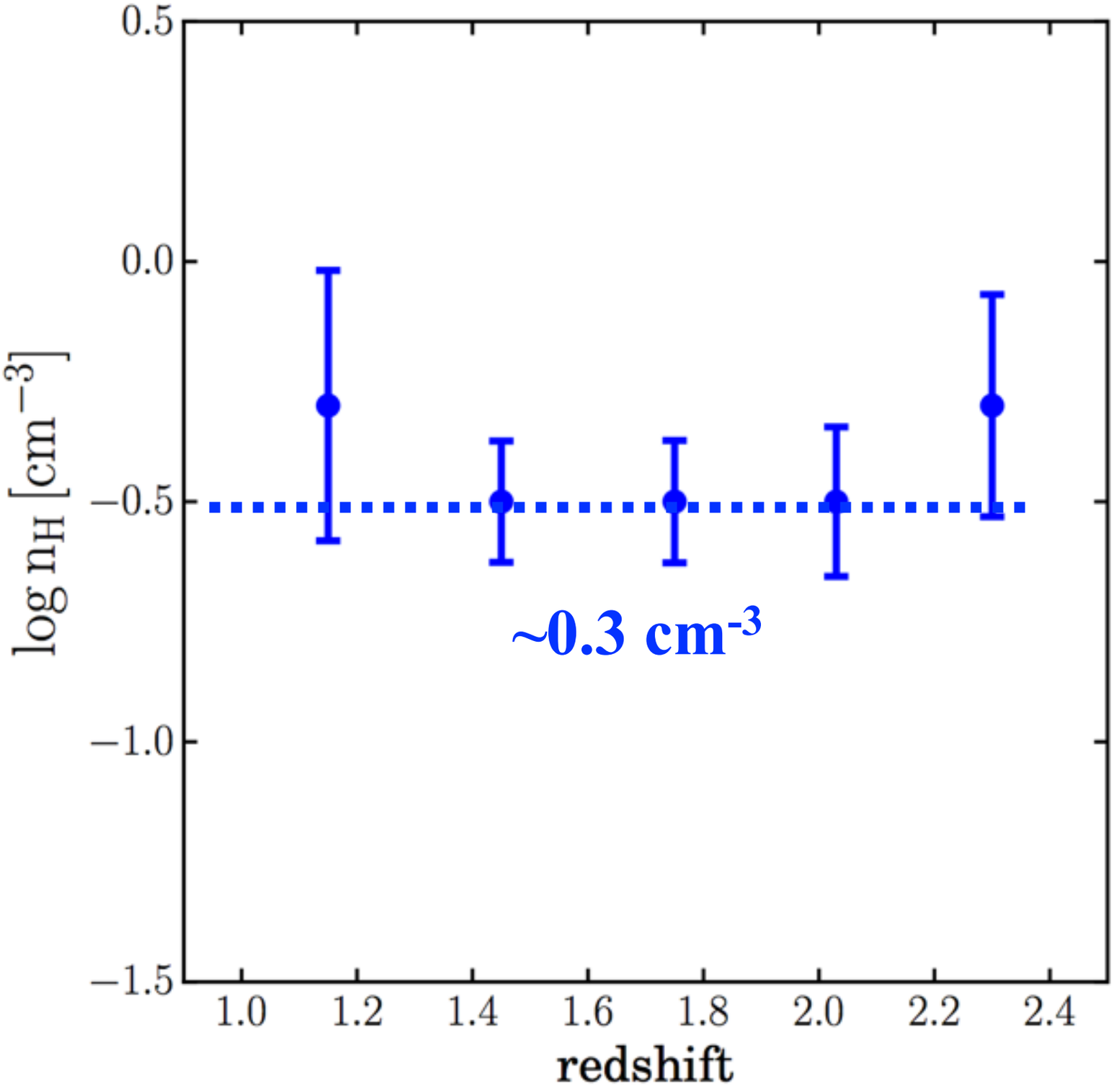
Metallicity evolution



Metallicity evolution



Gas cloud volume density



size of clouds ~ N_H / n_H ~ 30 pc

Covering fraction

1

0.1

0.01

Number of clouds ~

$$\frac{f_c \times \text{area}}{\sigma_{\text{cloud}}} \sim \mathbf{10^6}$$

Lan, Ménard & Zhu (2014)

See also Chen et al (2010), Huang et al. (2015), Nielsen et al. (2013)

10

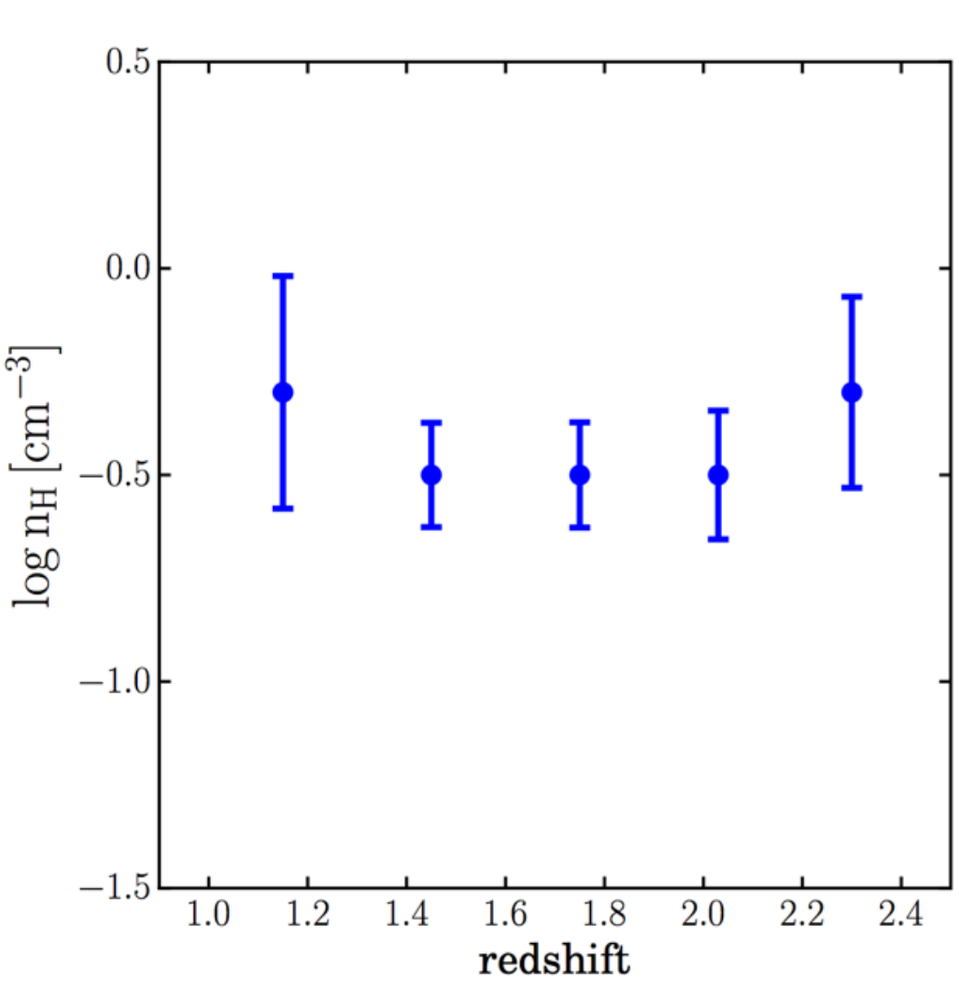
100

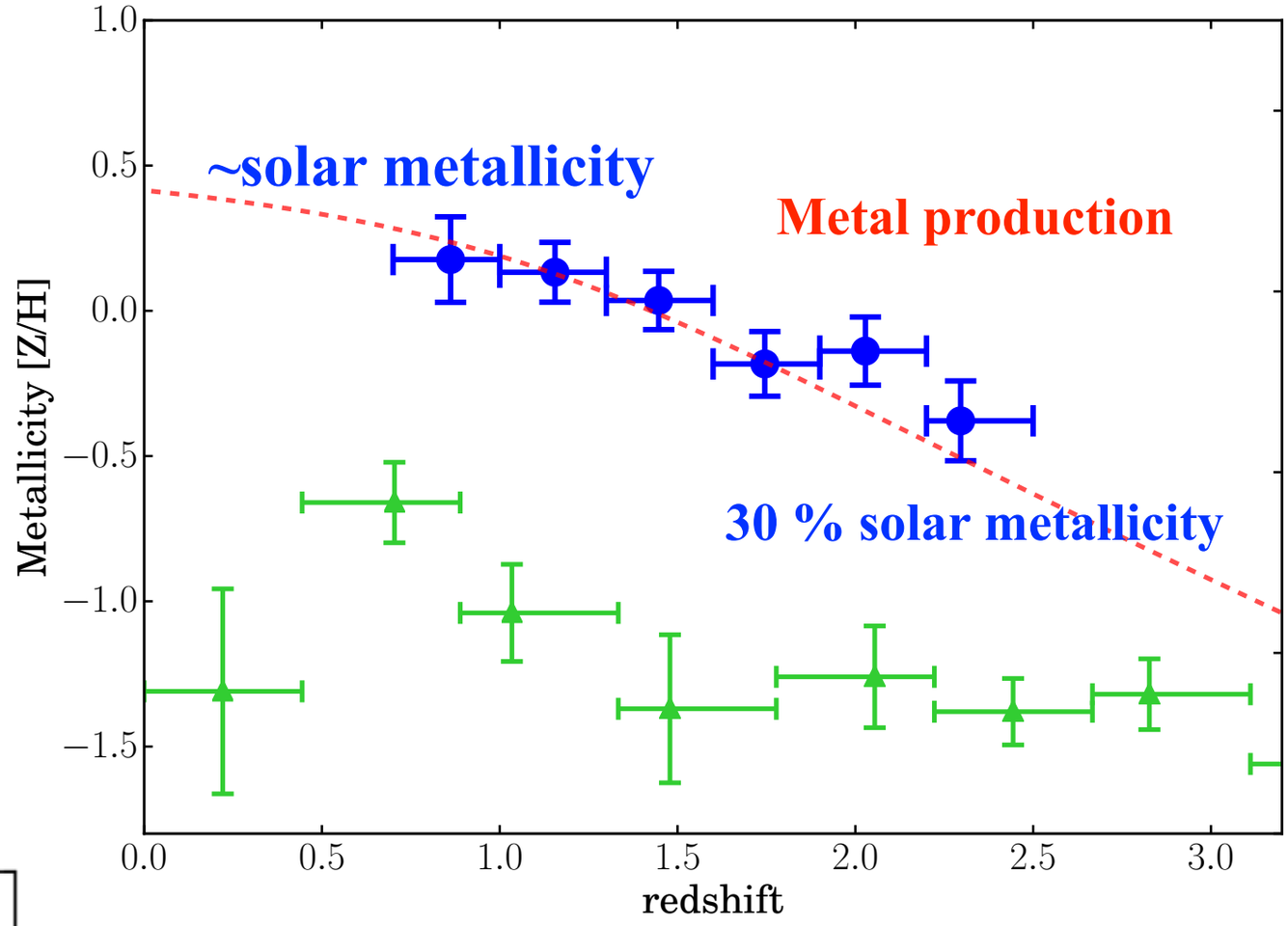
500

r_p [kpc]

Summary

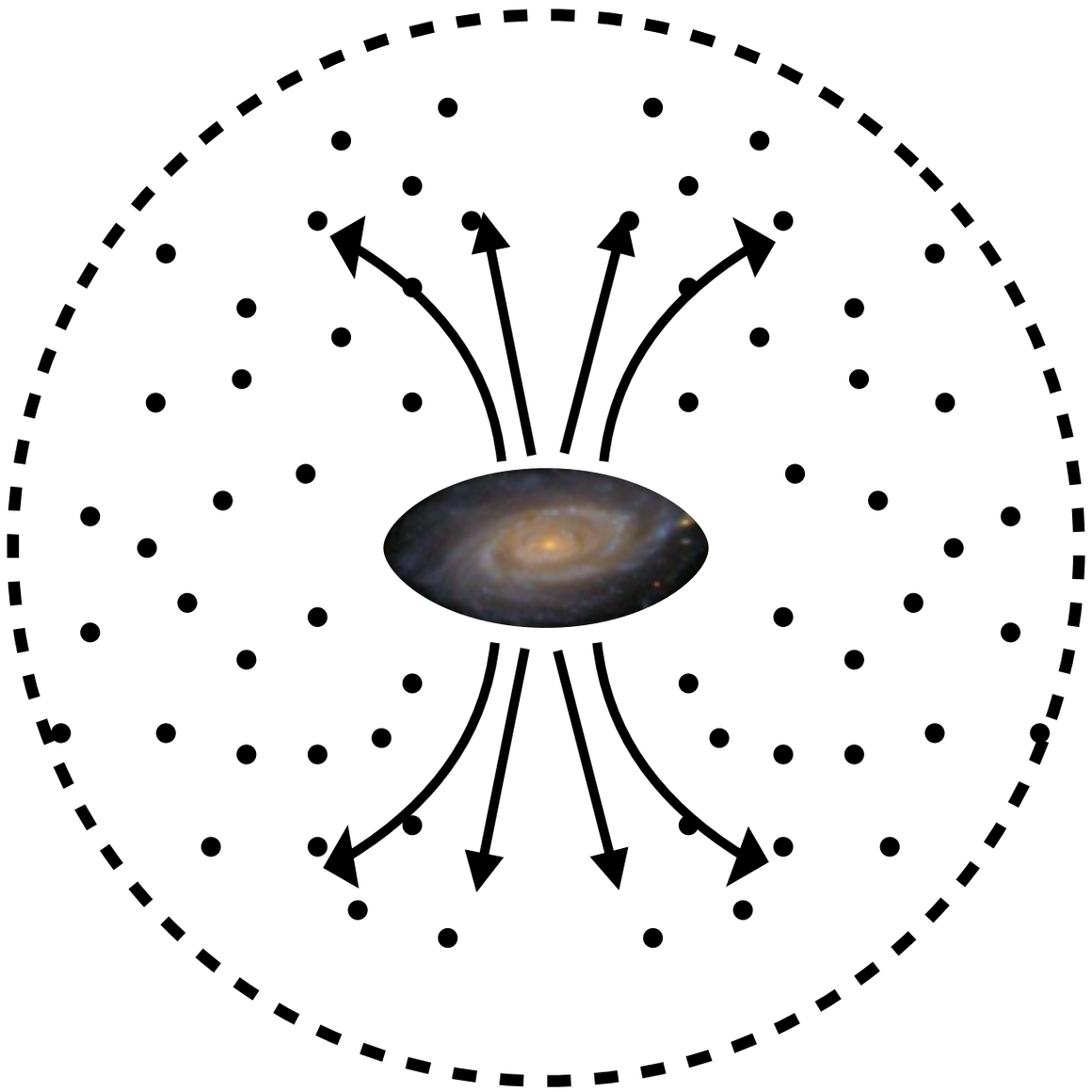
Metallicity evolution





volume density ~ 0.3 cm^{-3}

cloud size ~ 30 pc



The CGM is clumpy,

consisting of ~10^6 metal-rich clouds.