Element Abundances at High Redshifts

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Outline

- Motivation
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- Results
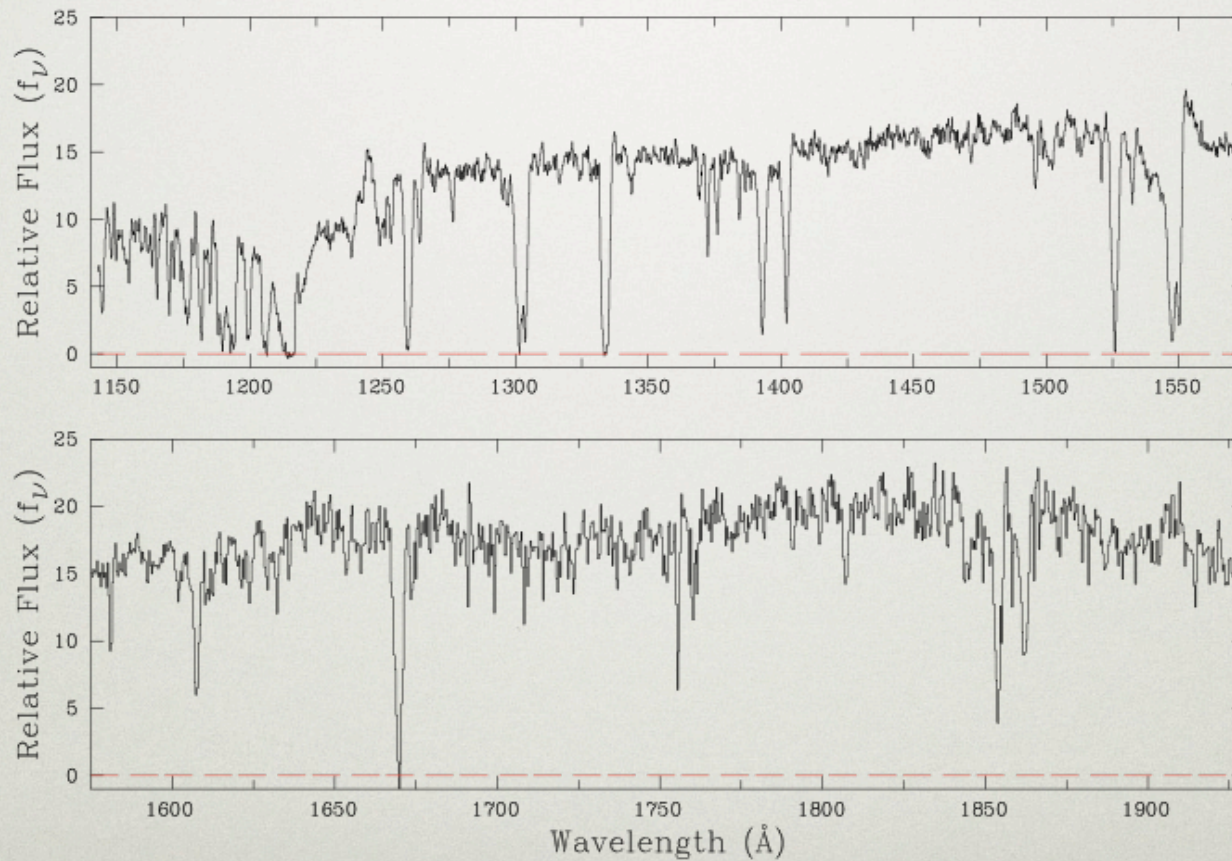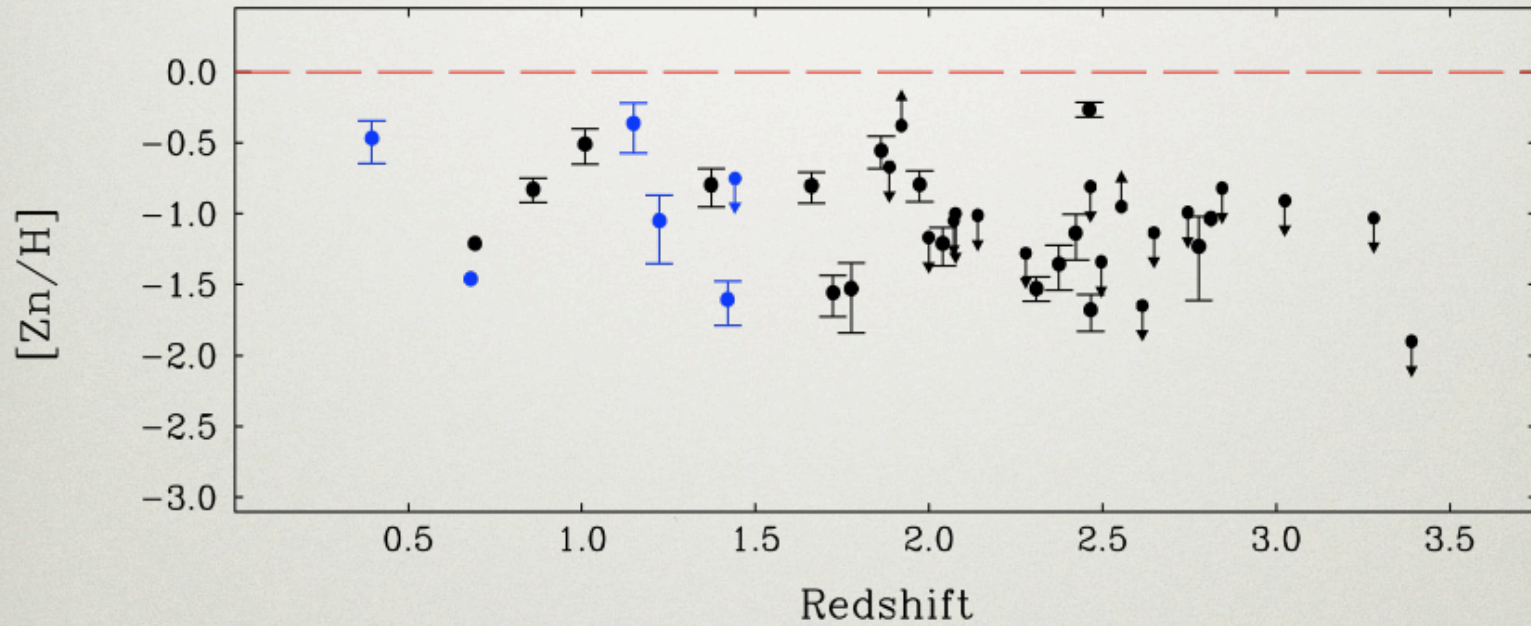
Motivation

- Primordial Abundances of Light Elements

- Census of Metals at Different Cosmic Epochs (Tracer of Star Formation)

- Element Ratios as a function of Metallicity

- Abundances in Active Galactic Nuclei
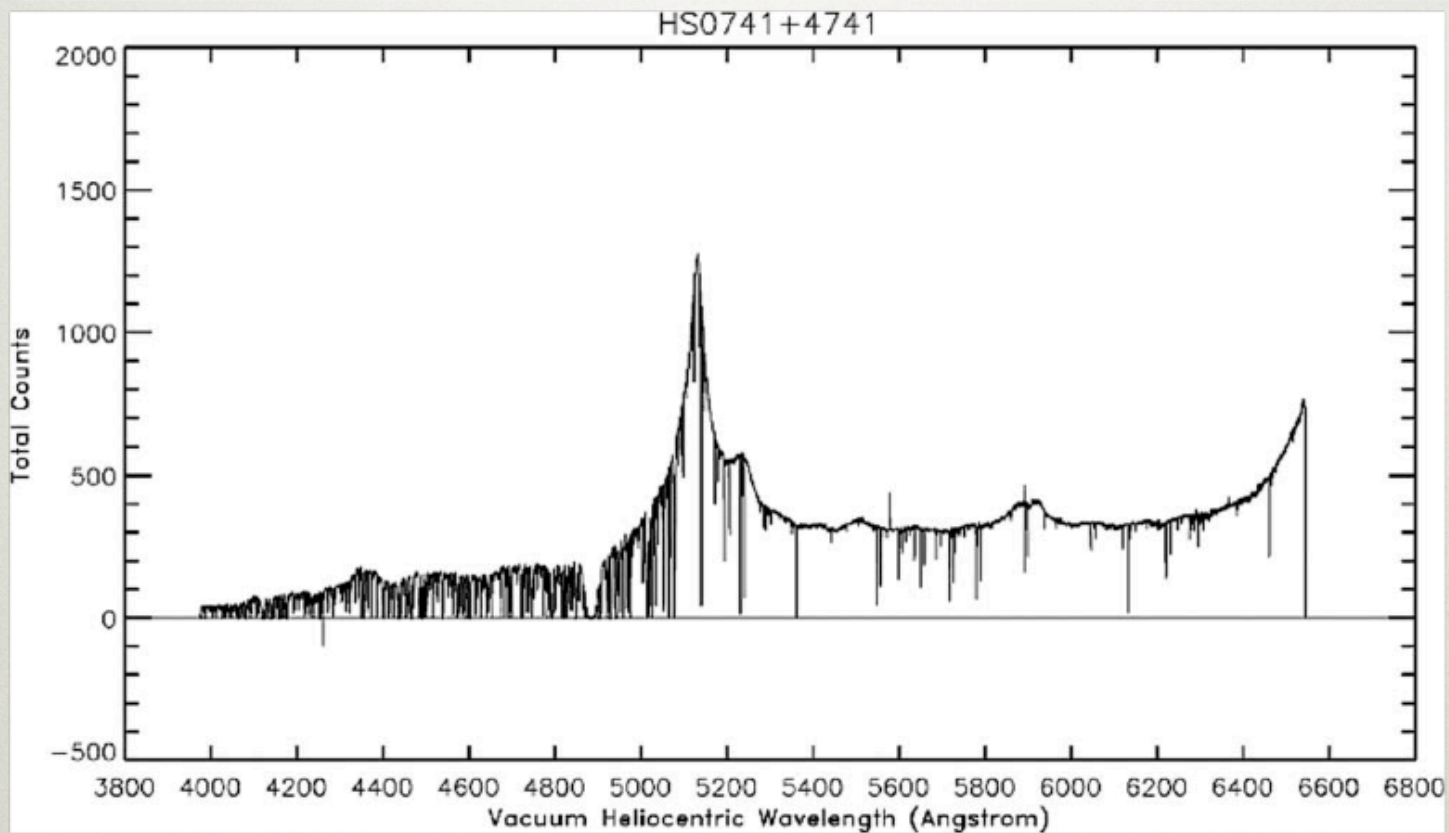
Lyman Break Galaxies

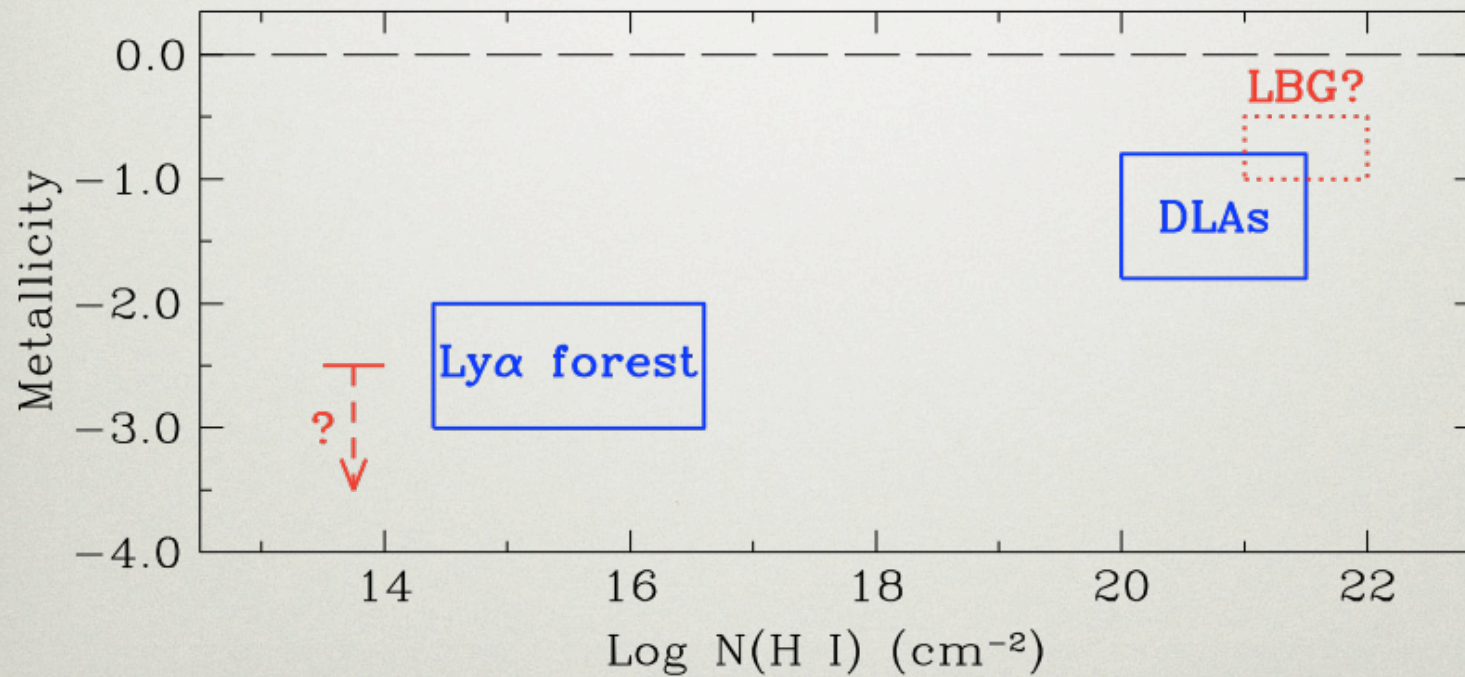MS 1512−cB58 Rest Frame z=2.7252
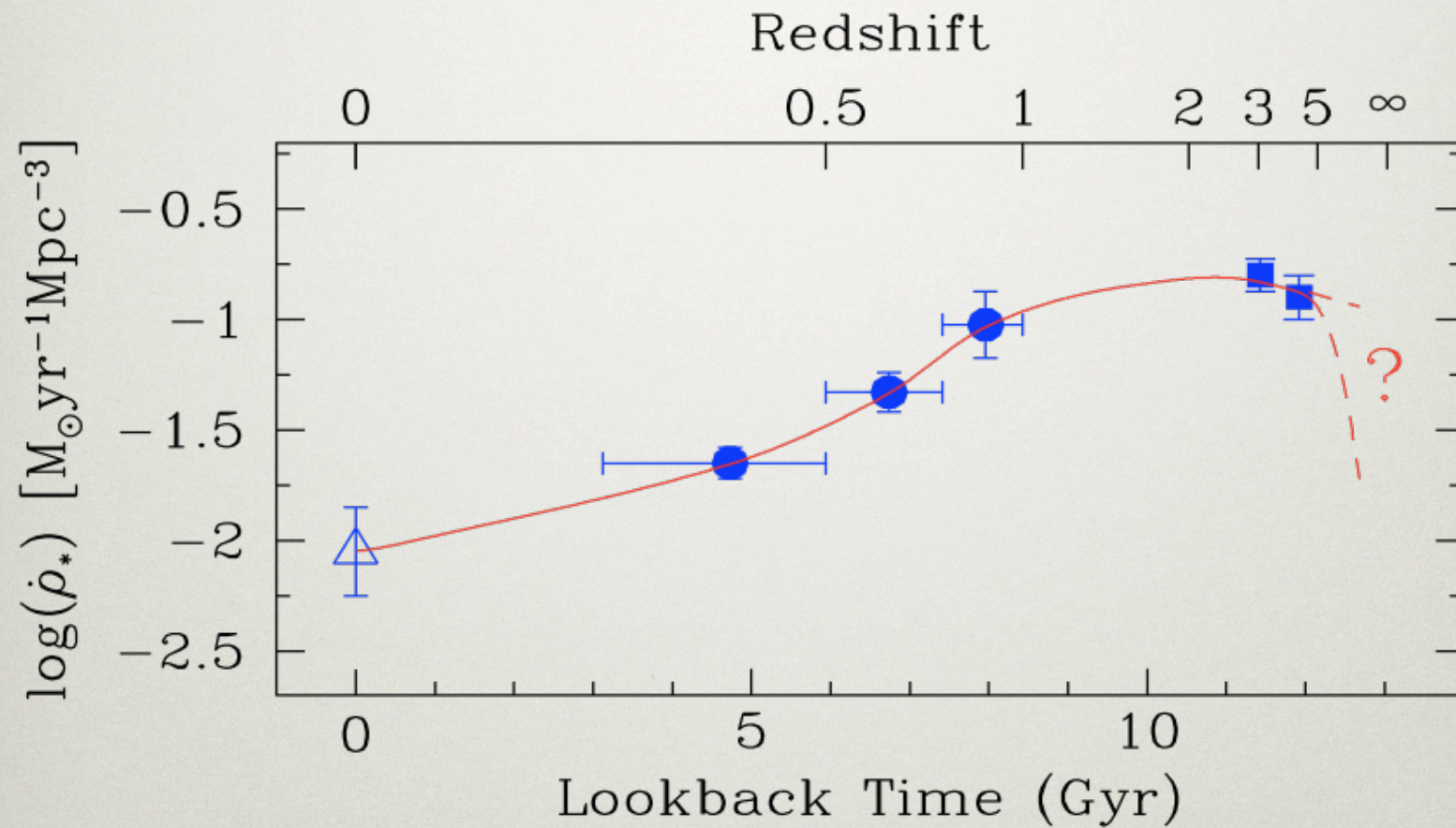
Damped Lyman Alpha Systems

Lyman Alpha Forest

Plot from Meiksin, Avery A., The Physics of the Intergalactic Medium, 2008, Reviews of Modern Physics, vol. 81, Issue 4, pp. 1405-1469

Column Densities Vs. Metaliccity

Abundances at High Redshift (z = 3)

Results\Epilogue

Results\Epilogue

$$\int_0^{13\ Gyr} \dot{\rho}_*' \, dt \simeq 3.3 \times 10^8 \ M_\odot \ \mathrm{Mpc}^{-3} = 0.0043 \ \rho_{\mathrm{crit}} \approx \Omega_{\mathrm{stars}} \ \rho_{\mathrm{crit}} \qquad (2)$$

- Sufficient to explain all present-day stars

$$\int_{11\ Gyr}^{13\ Gyr} \dot{\rho}_{\mathrm{metals}} \, dt \simeq 4.5 \times 10^6 \ M_\odot \ \mathrm{Mpc}^{-3} \simeq 0.04 \times (\Omega_B \times 0.0189)$$

- "Missing Metals" problem

Conclusions

- Gas Transportation to IGM

- DLA's Rapid Star Formation, but not major contributer

- LBG Calibration

- Missing Metals Problem