Element Abundances at High Redshifts

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Outline

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• Lyman Break Galaxies
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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 $z=2.7252$

[Graph showing wavelength vs. relative flux for MS 1512-cB58 Rest Frame at $z=2.7252$.]
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. Metalliccity

Abundances at High Redshift ($z = 3$)
**Results Epilogue**

![Graph showing the relationship between log(\(\rho_*\)) and Lookback Time (Gyr) with Redshift on the x-axis. The graph includes data points with error bars and a trend line.](image)
Results\Epilogue

\[ \int_0^{13 \text{ Gyr}} \dot{\rho}_* \, dt \approx 3.3 \times 10^8 \, M_\odot \, \text{Mpc}^{-3} = 0.0043 \, \rho_{\text{crit}} \approx \Omega_{\text{stars}} \rho_{\text{crit}} \quad (2) \]

- Sufficient to explain all present-day stars

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

- “Missing Metals” problem
Conclusions

• Gas Transportation to IGM
• DLA’s Rapid Star Formation, but not major contributor
• LBG Calibration
• Missing Metals Problem