



Characterizing Gas Flow Using Multiply-lensed Quasars

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Gas Flow and Galaxy Evolution

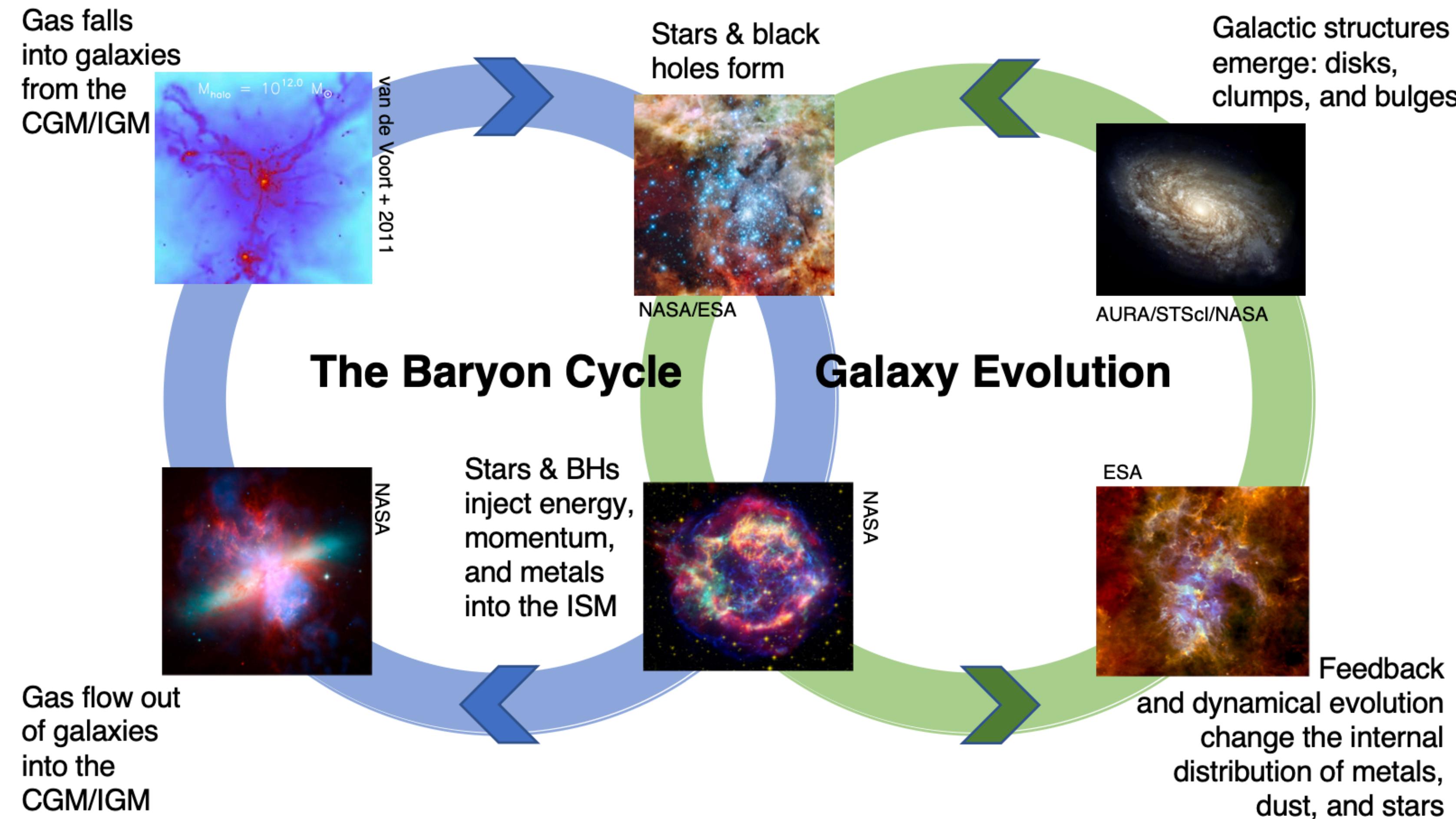
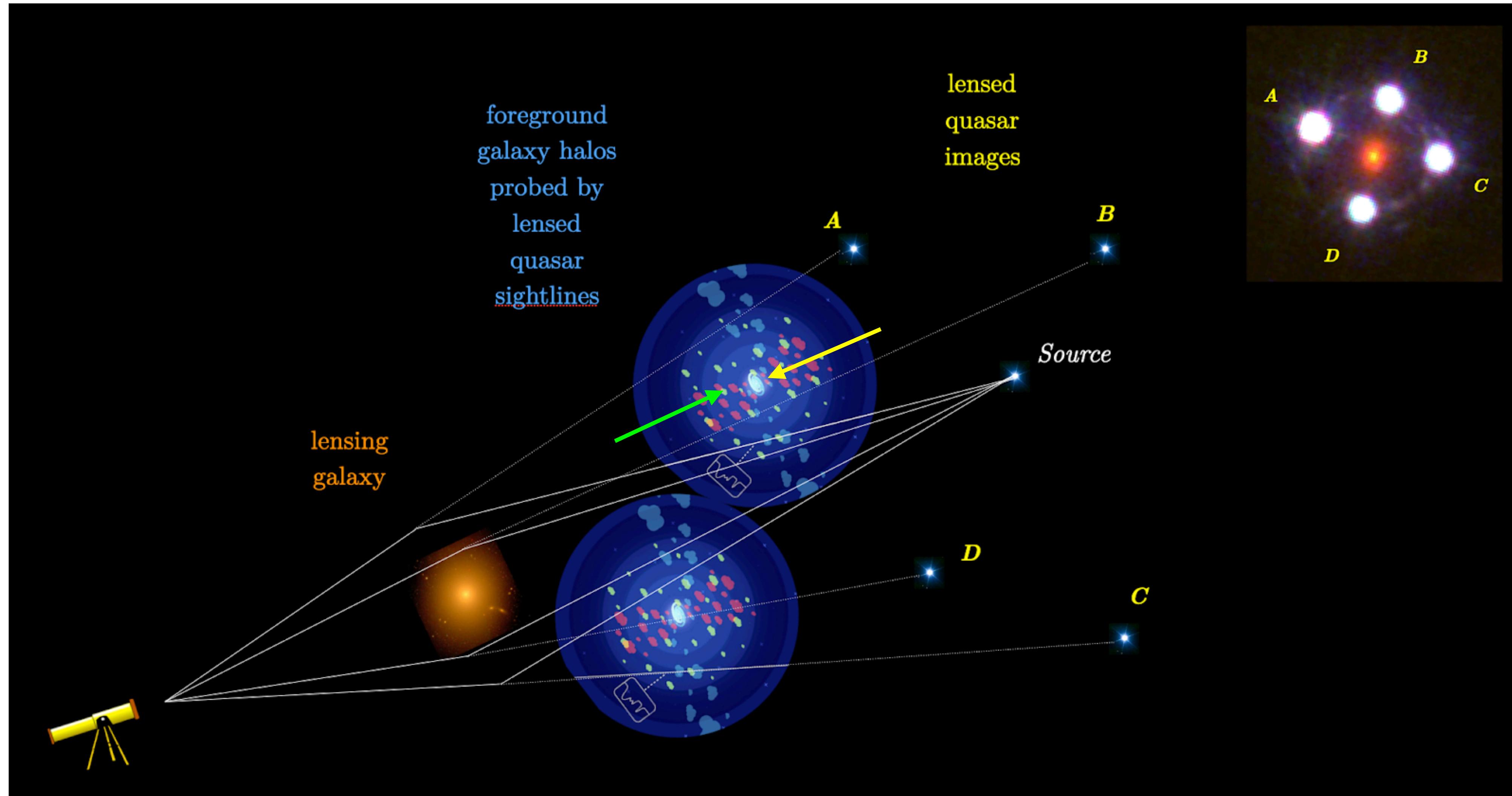
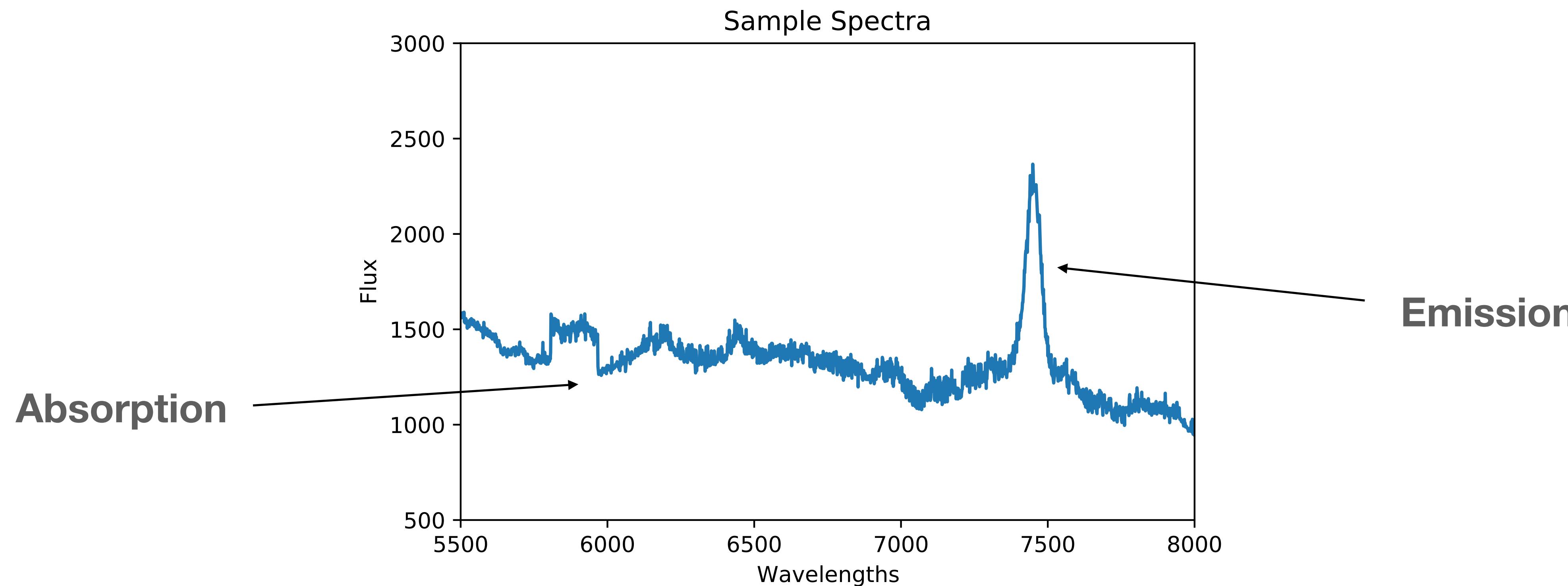
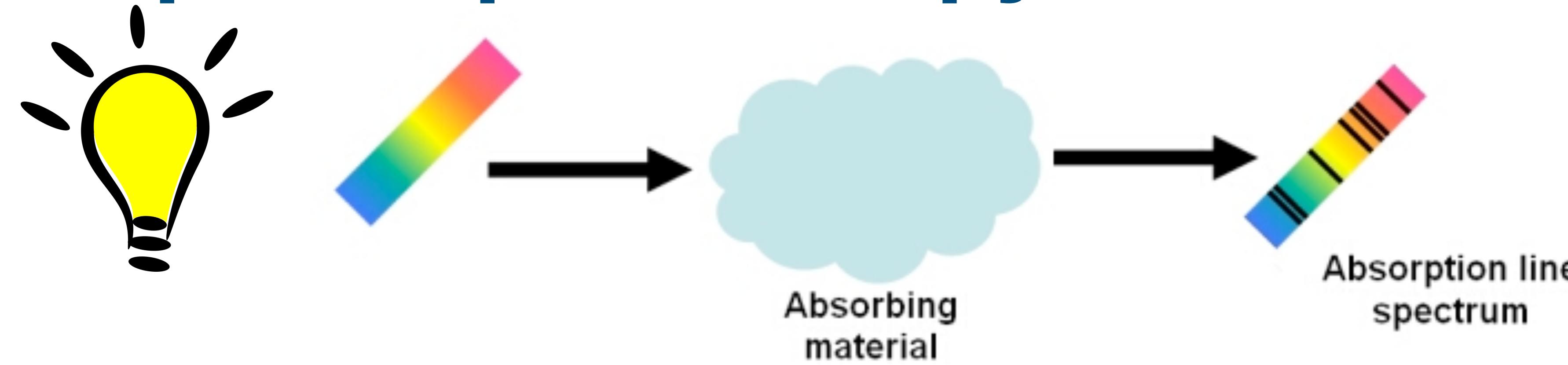


Figure: Newman/Carnegie Institute of Science, 2020

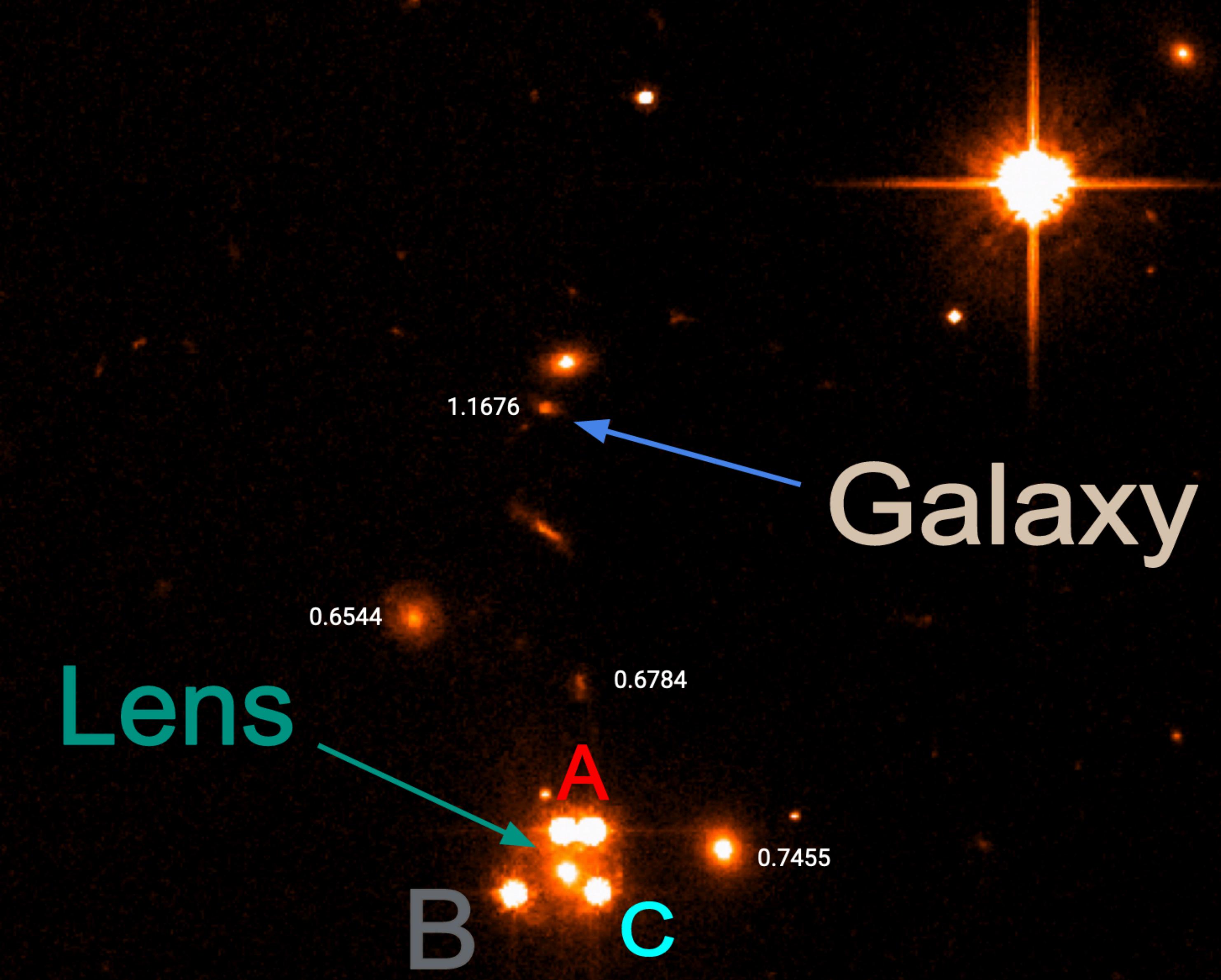
Gravitational Lensing Illuminates Otherwise Undetectable Gas



Absorption Spectroscopy

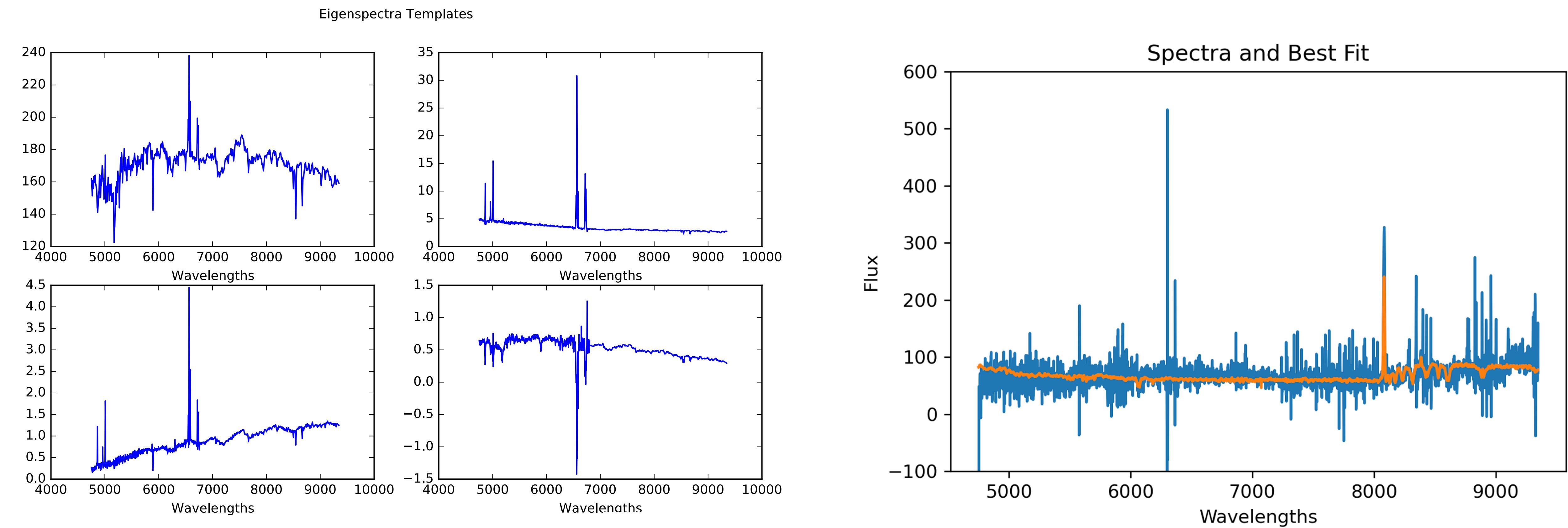


WFI-2033 and Galaxy of Interest



Chi-Squared Minimized Model

Systemic Redshift, $z = 1.1676$



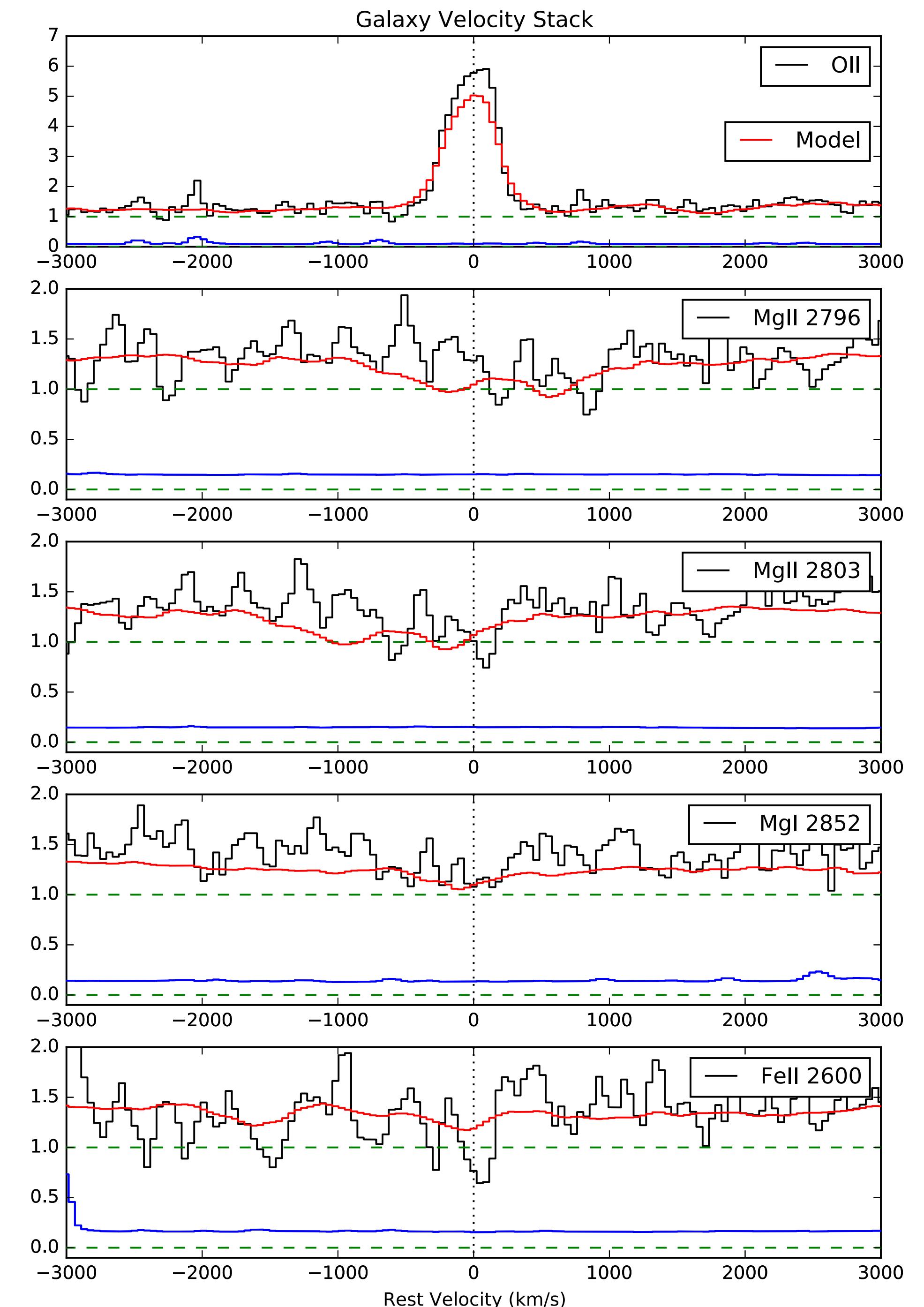
$$Model(\lambda) = \sum_0^i A_i E_i (\lambda)$$

Local Redshift of Key Gases in the Galaxy

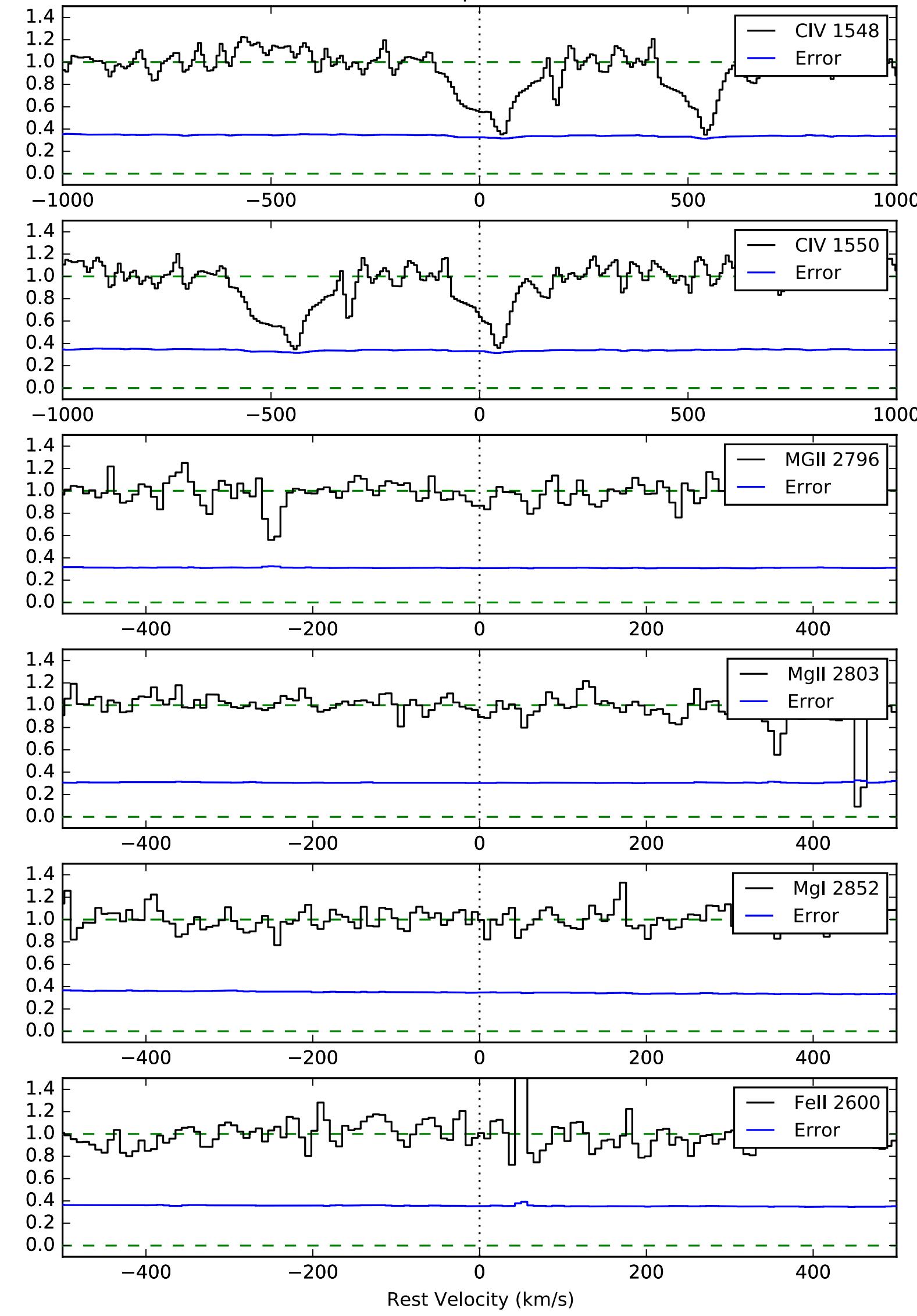
These plots show how far specific gases are redshifted from the systemic redshift of the galaxy.

Peaks and valleys centered at 0 indicate no local redshift.

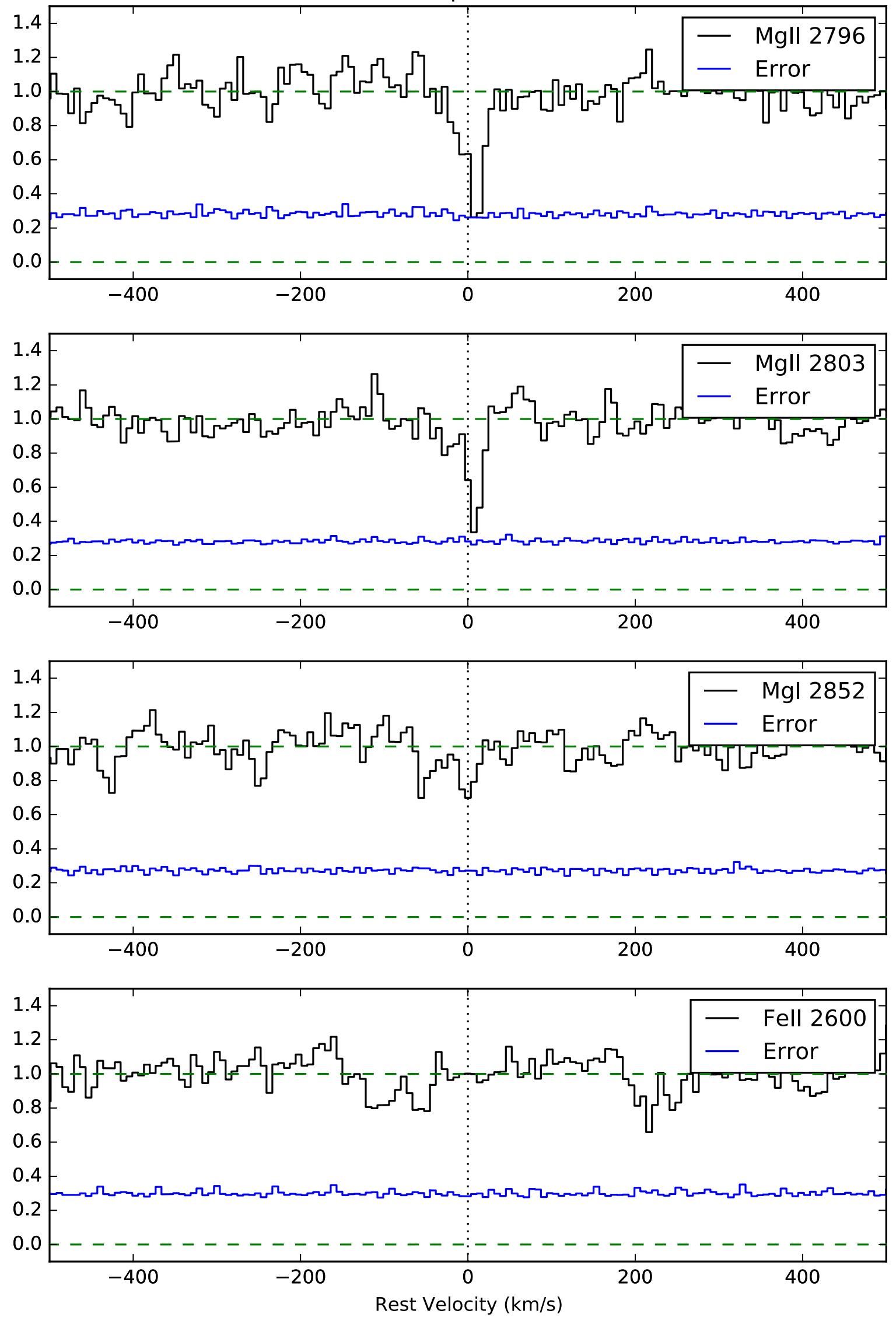
We find no significant redshifts of MgI, FeII, but slight redshifting at MgII 2796



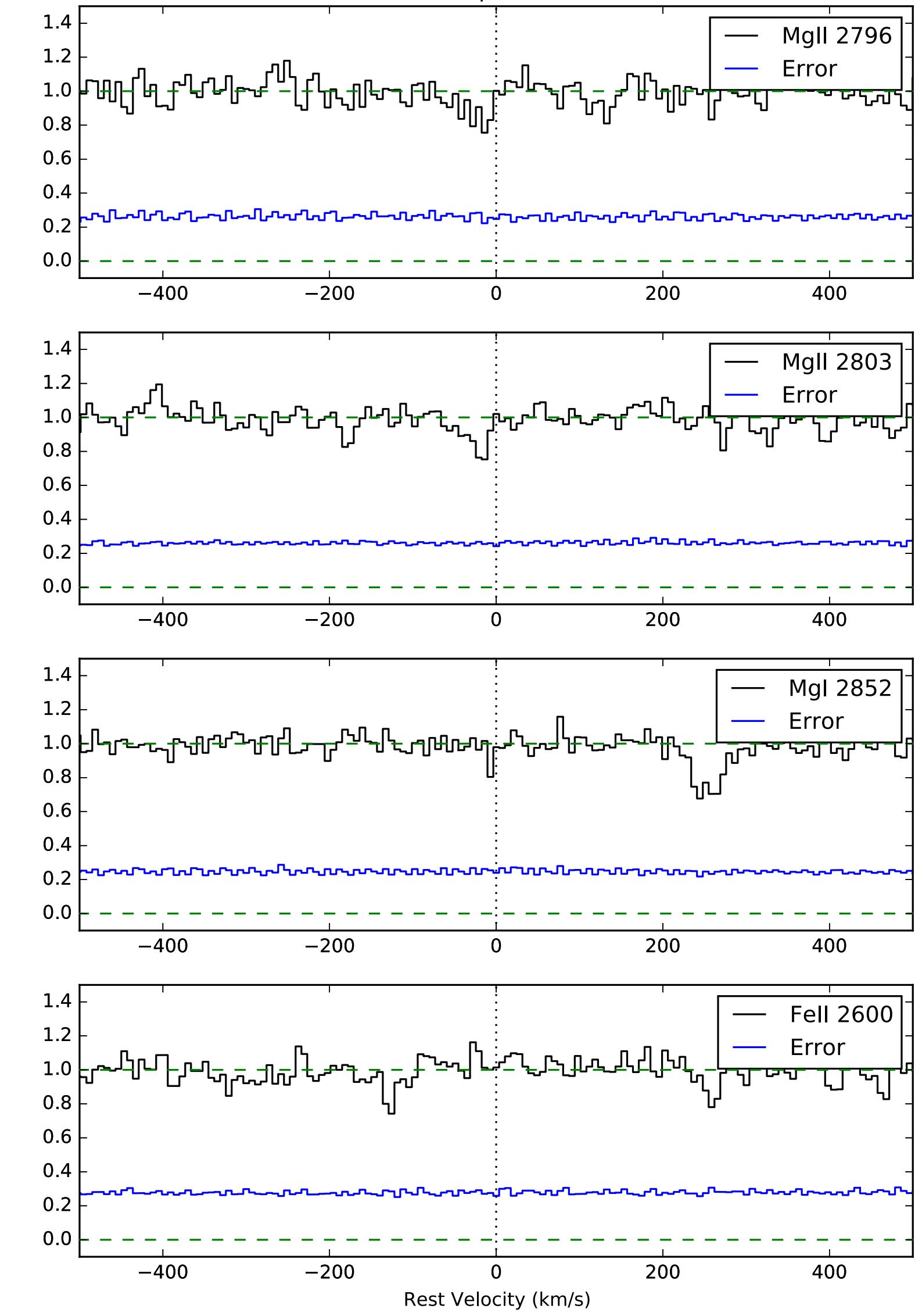
A Spectra



B Spectra



C Spectra



Summary

- There is ionized gas present in the halos surrounding the galaxy
- Majority of gas is not significantly redshifted from the systemic velocity of the galaxy

Future Outlook

- Mapping the motion of gas between the galaxy and its surroundings

Acknowledgements

- **Dr. Hsiao-Wen Chen**
- **The University of Chicago**
- **The Leadership Alliance**

