The Smith Cloud: A Fountain of Stellar Youth

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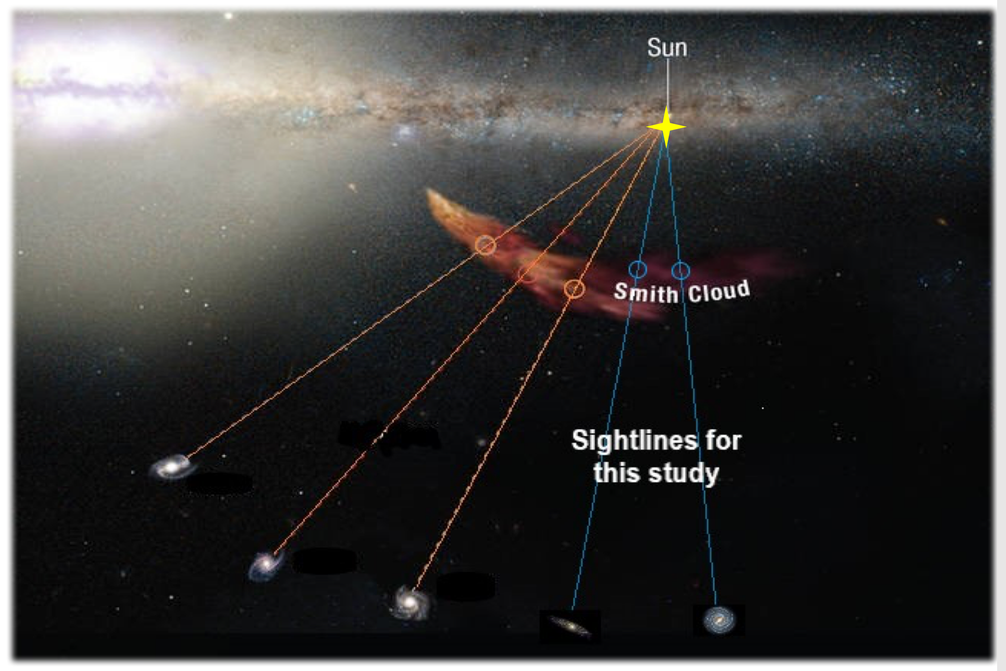
1. Background



Credit: Andrew Fox, Kat Barger

Our Galaxy is running out of gas to make new stars and planets. In order to continue forming these stars and planets, it must grab gaseous material from outside the Galaxy. However, the impact of the processes that disrupt gas on its journey into the galaxies are unknown.

Using the Hubble Space Telescope and Green Bank Telescope, we observed the Smith High-Velocity Cloud. We are using radiative transfer simulations from Ferland *et al* (2013) to calculate its physical properties. This will help us understand how the Smith Coud is being disrupted by the gas surrounding our Galaxy.

2. Observation Methods

- Measure amount of hydrogen
  - Use Green Bank Telescope to detect hydrogen in emission in radio
- Measure amount of heavy elements
  - Hubble Space Telescope to detect heavy elements in absorption in UV

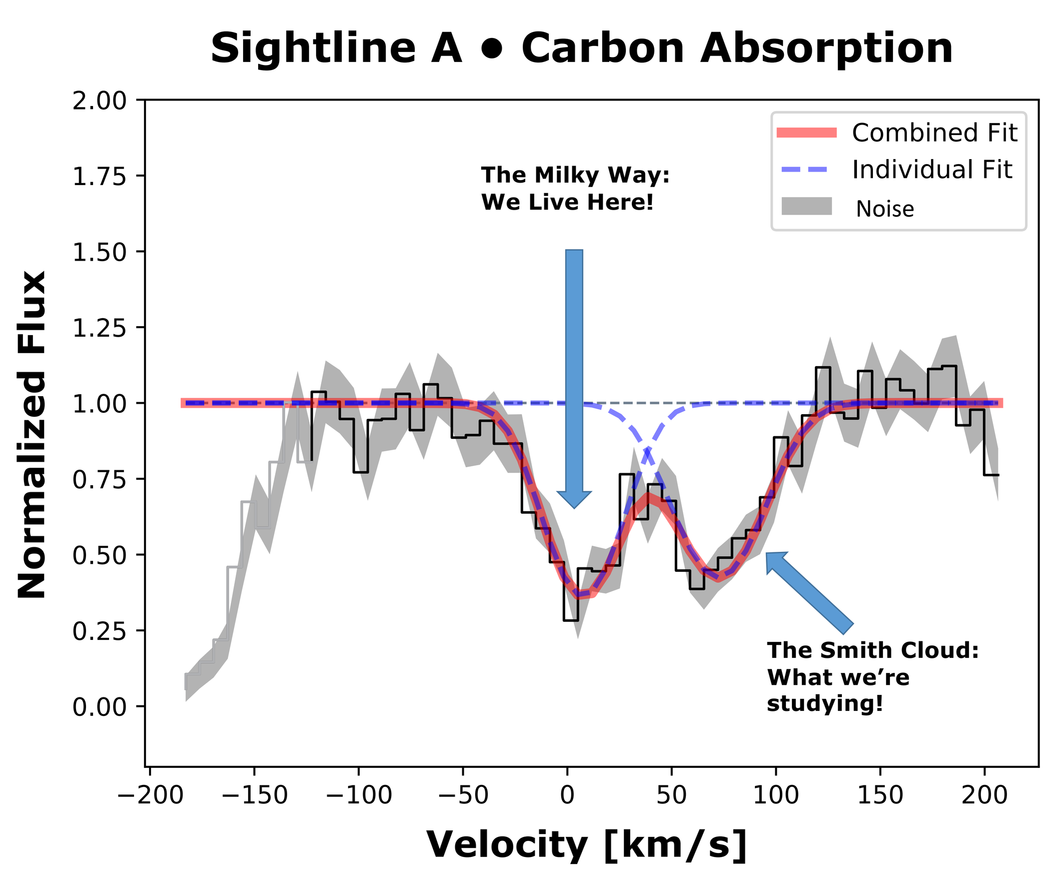
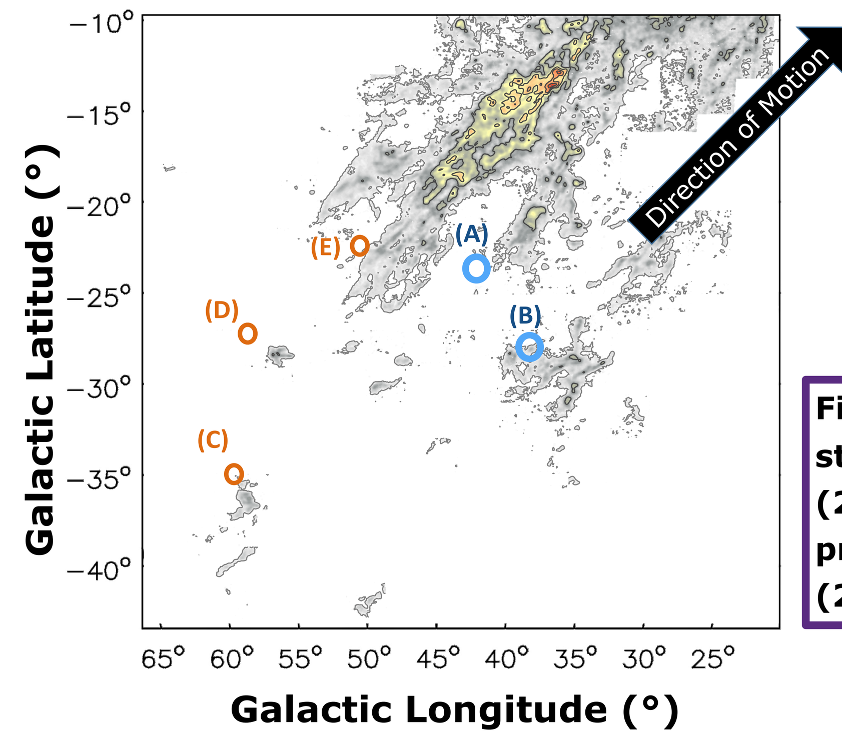


Figure 1: Absorption plot of CII at sightline (A). The data is fitted to multiple Voigt profiles using Krogager's (2018) *VoigtFit* Python library. The velocity is derived from the Doppler shifts from the center wavelength.

3. Locations



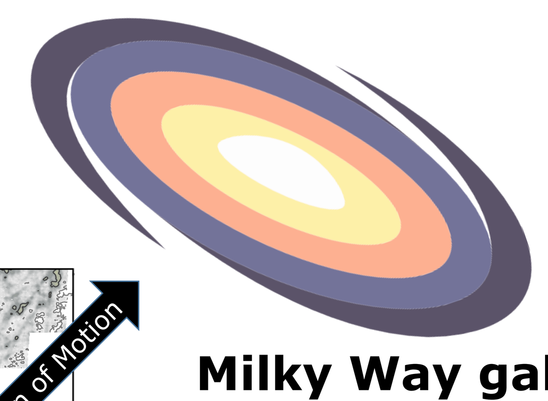


Figure 2: Sightlines on the Smith Cloud in our study. Sightlines (C), (D), (E) are from Fox *et al* (2016). Sightlines (A), (B) are new to the project. Hα Color Map provided by Hill *et al* (2009).

4. Simulation Methods

- *Cloudy* photoionization, Ferland *et al* (2013)
- Compare ionizing light density/hydrogen density (n_γ/n_H) to measured density ratio of SiIII/SiII
- Compare calculated (n_γ/n_H) to ionization correction
- Determine heavy element concentration from ionization correction
- Use calculated heavy element concentration to find density, temperature, pressure, ionization.

$$[S/H] = [SII/HI] + \text{Ionization Correction}$$
$$[SII/HI] = \log(SII/HI) - \log(S/H)_{Sun}$$

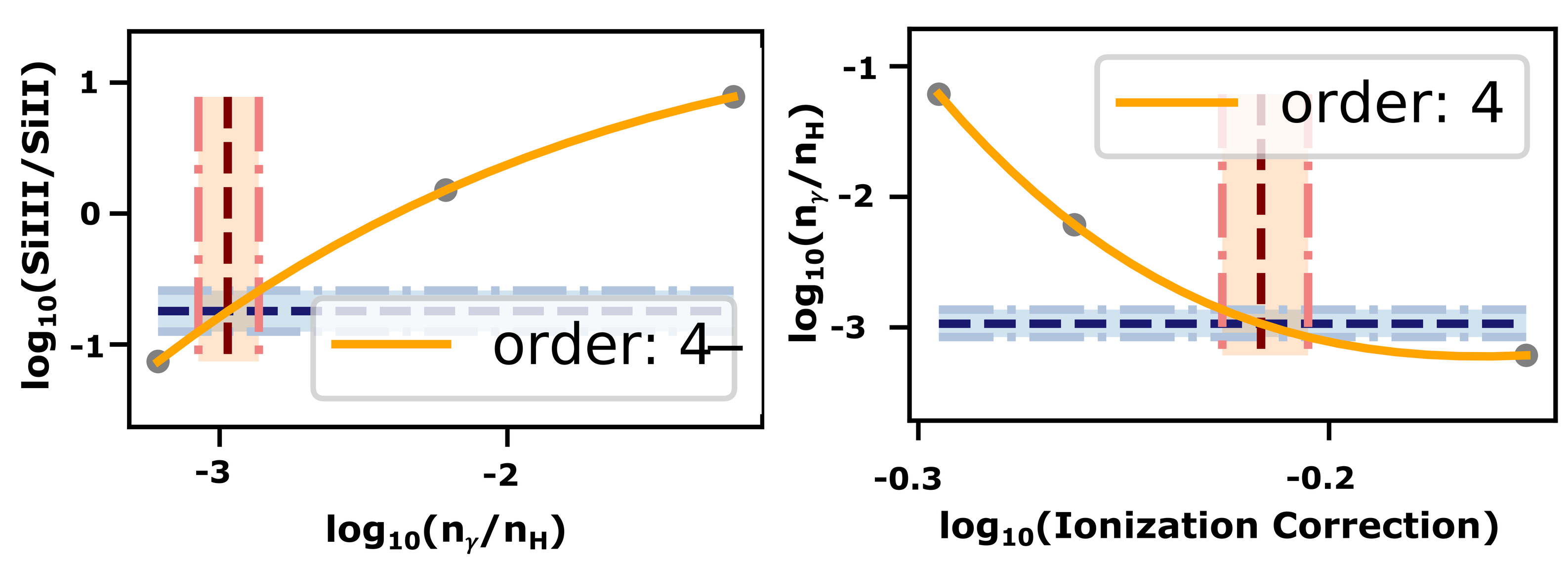


Figure 3: Three *Cloudy* Simulations run at solar heavy element concentration of Z=0 and a grid of (n_γ/n_H) values. We use these (n_γ/n_H) values to estimate the ionization correction, which we then use to find heavy element concentration.

5. Preliminary Results

- Absorption fits: center velocities, velocity dispersions, particle surface densities

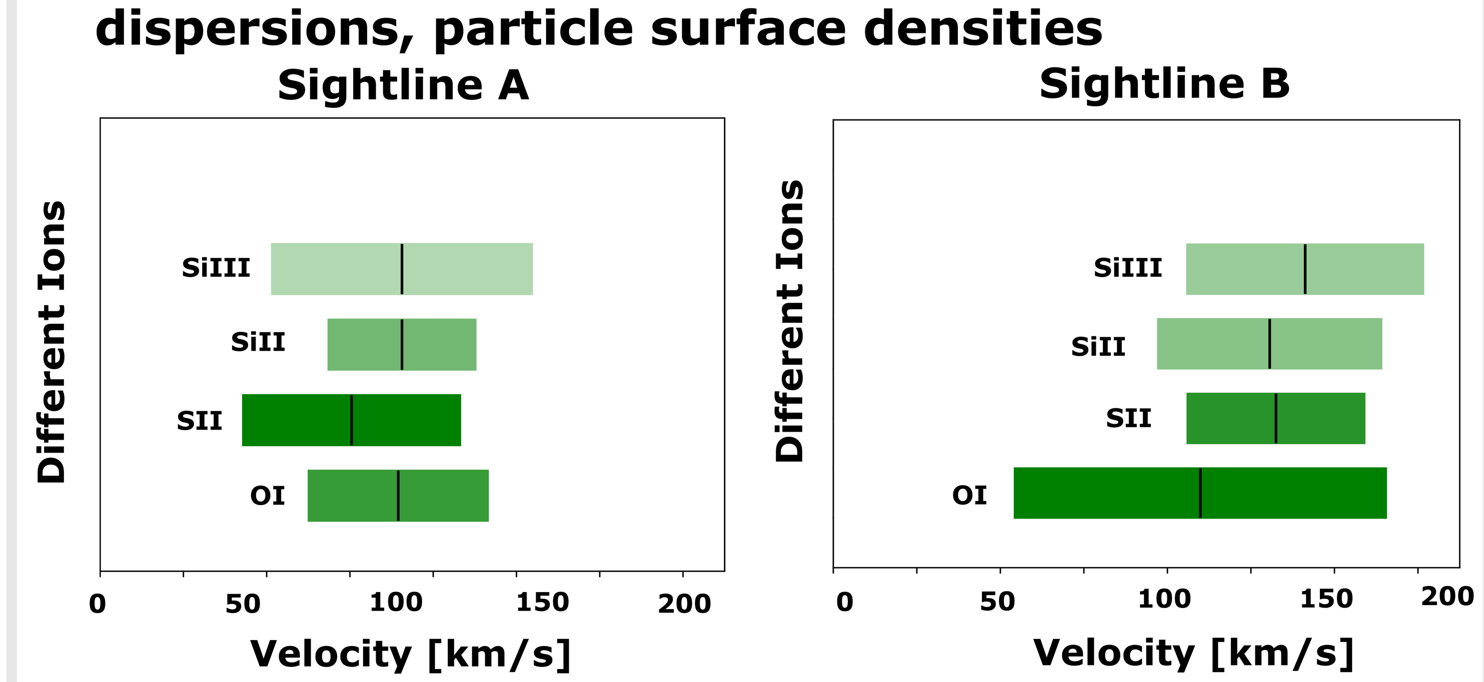


Figure 4: Absorption best-fit values for sightlines A and B. The central velocity is marked with a vertical black line with a width of twice the Gaussian velocity dispersion ($w=2\sigma_v$). Lighter shades of green mean lower ion surface density.

6. Future Work

- Characterize observational lower/upper limits.
- Replicate Fox *et al* 2016's findings.
- Finalize heavy element concentration calculations on both new sightlines.
- Run simulations to determine physical properties on <u>all</u> sightlines, including those in Fox *et al* 2016.

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Using the Hubble Space Telescope, we are investigating a gargantuan gas cloud on a collision course with our Galaxy. As this high-velocity cloud speeds through the outskirts of our Galaxy, it is being torn apart by the Milky Way's outer layers. We are using simulations and the chemistry of the cloud observed from Hubble to better understand the physical processes inside this cloud that are disrupting its ability to seed the Milky Way's next generation of stars.

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References

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Acknowledgments

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