Evidence of a Cloud-Cloud Collision from Gas Overshooting the Galactic Center

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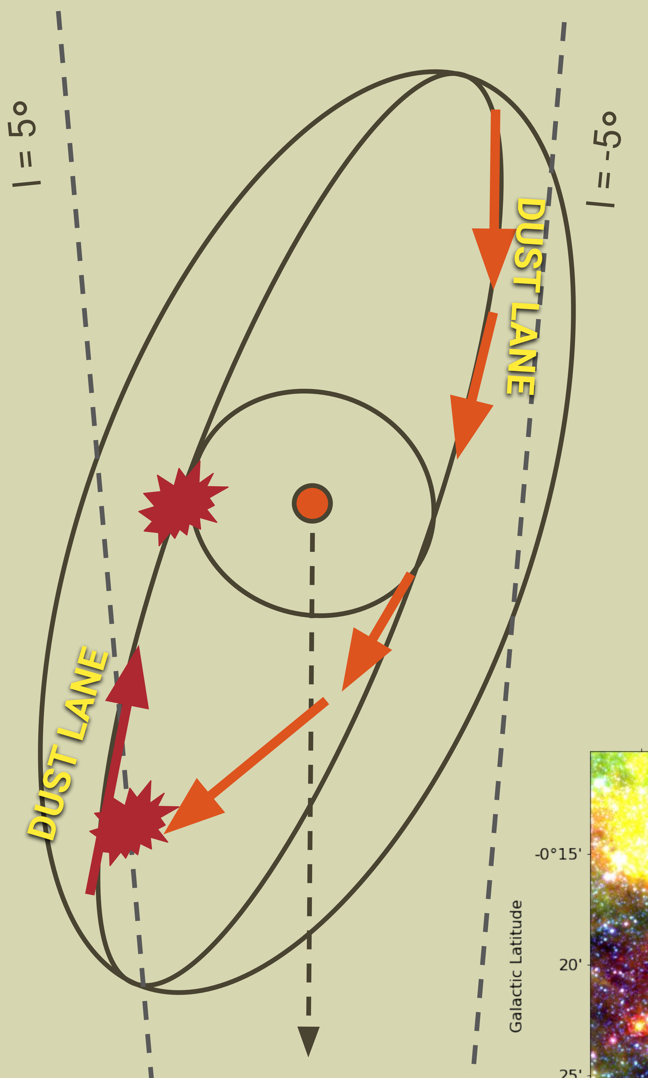
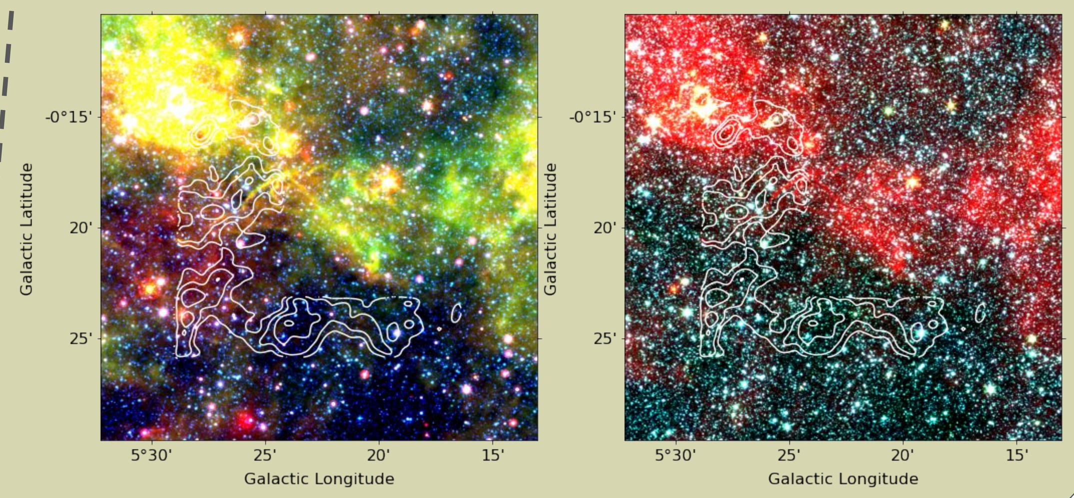
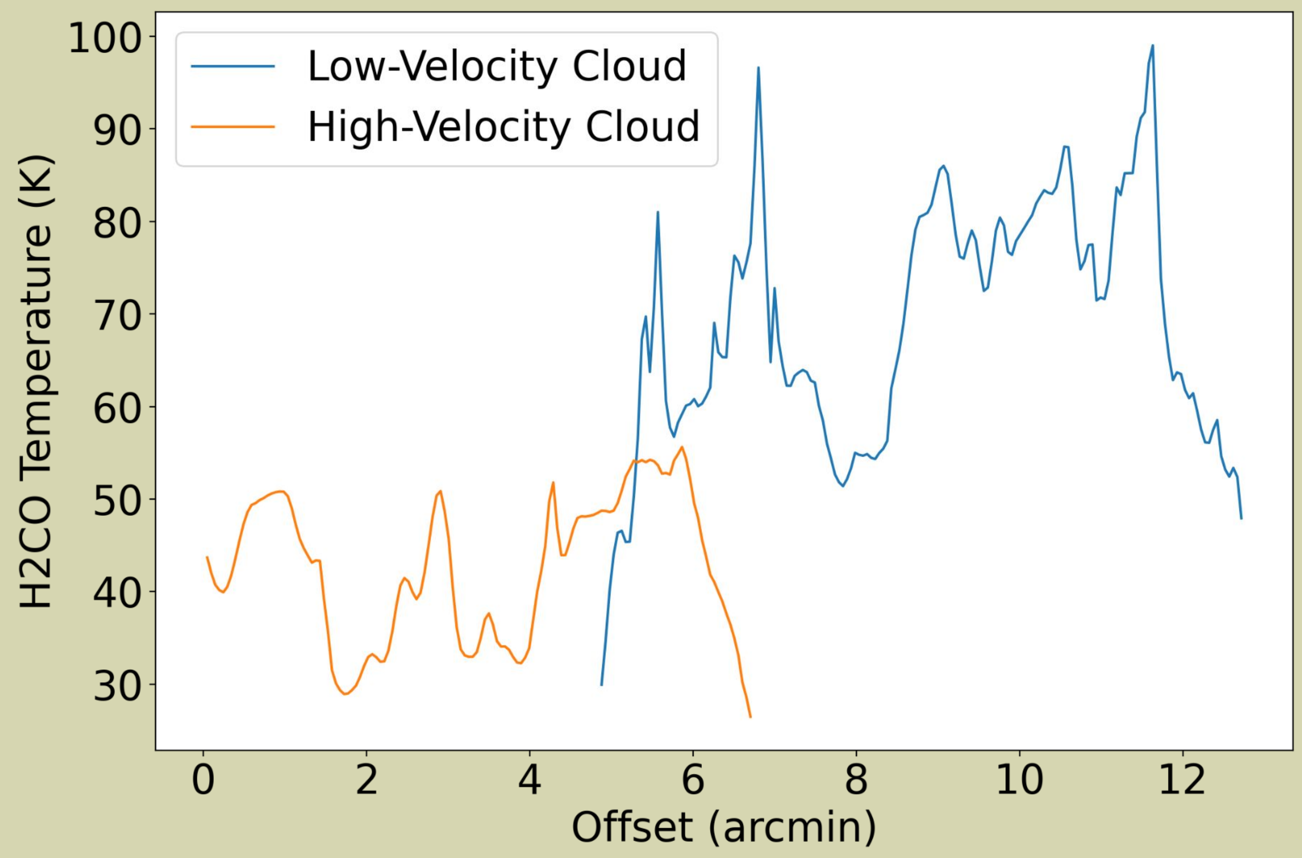


Bar Dynamics and the Movement of Gas and Dust Around the Galactic Center

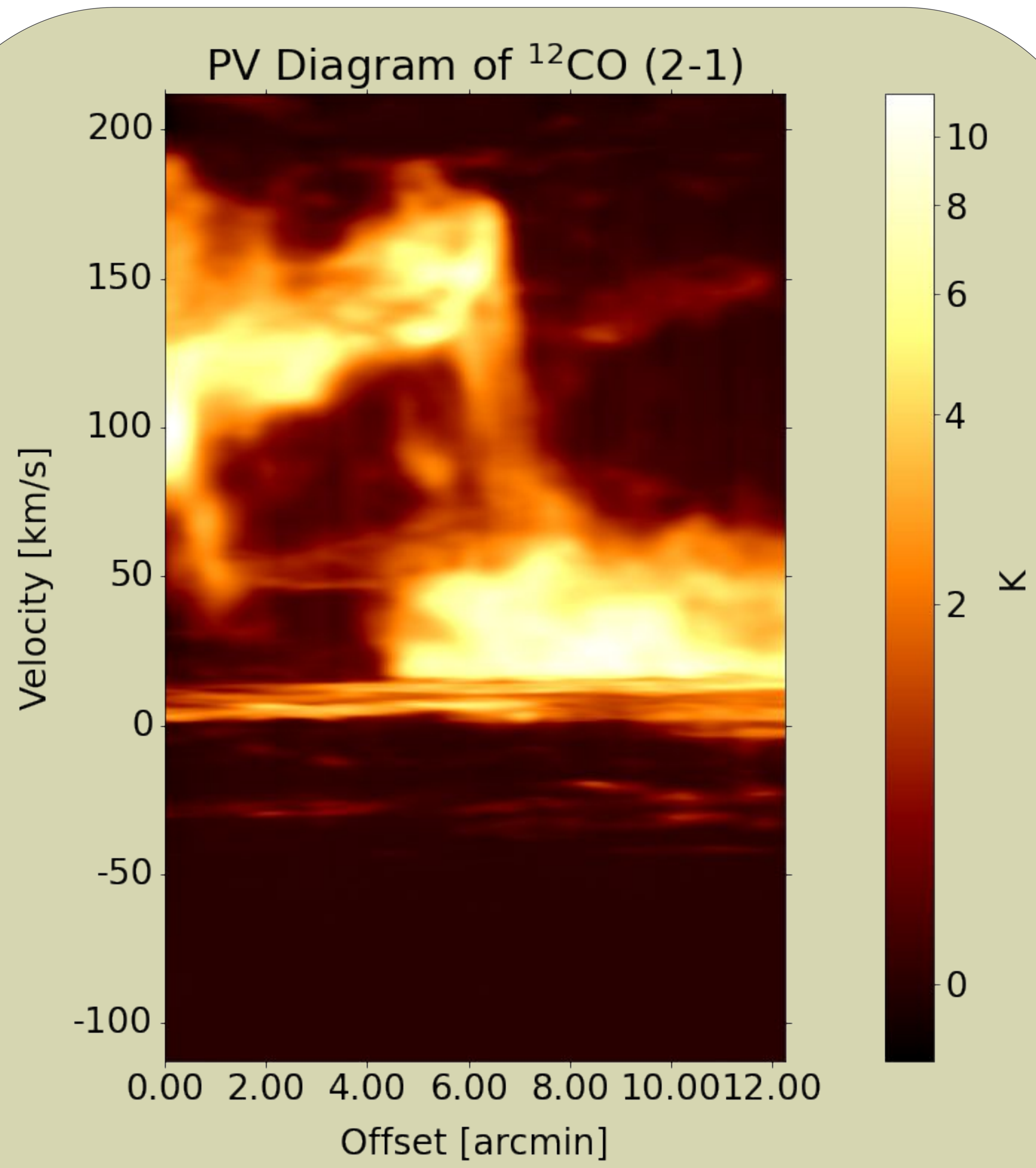
- The Milky Way Galaxy is a barred spiral galaxy, with a central gravitational bar potential.
- In the bar, dust lanes feed the Central Molecular Zone (CMZ), where Sgr A* lives.
- According to Sormani et al 2019's model of the Galactic Bar, some gas and dust overshoots the CMZ and collides with the dust lane on the opposite side of the galaxy.
- The potential location of the cloud-cloud collision is the basis of this research.





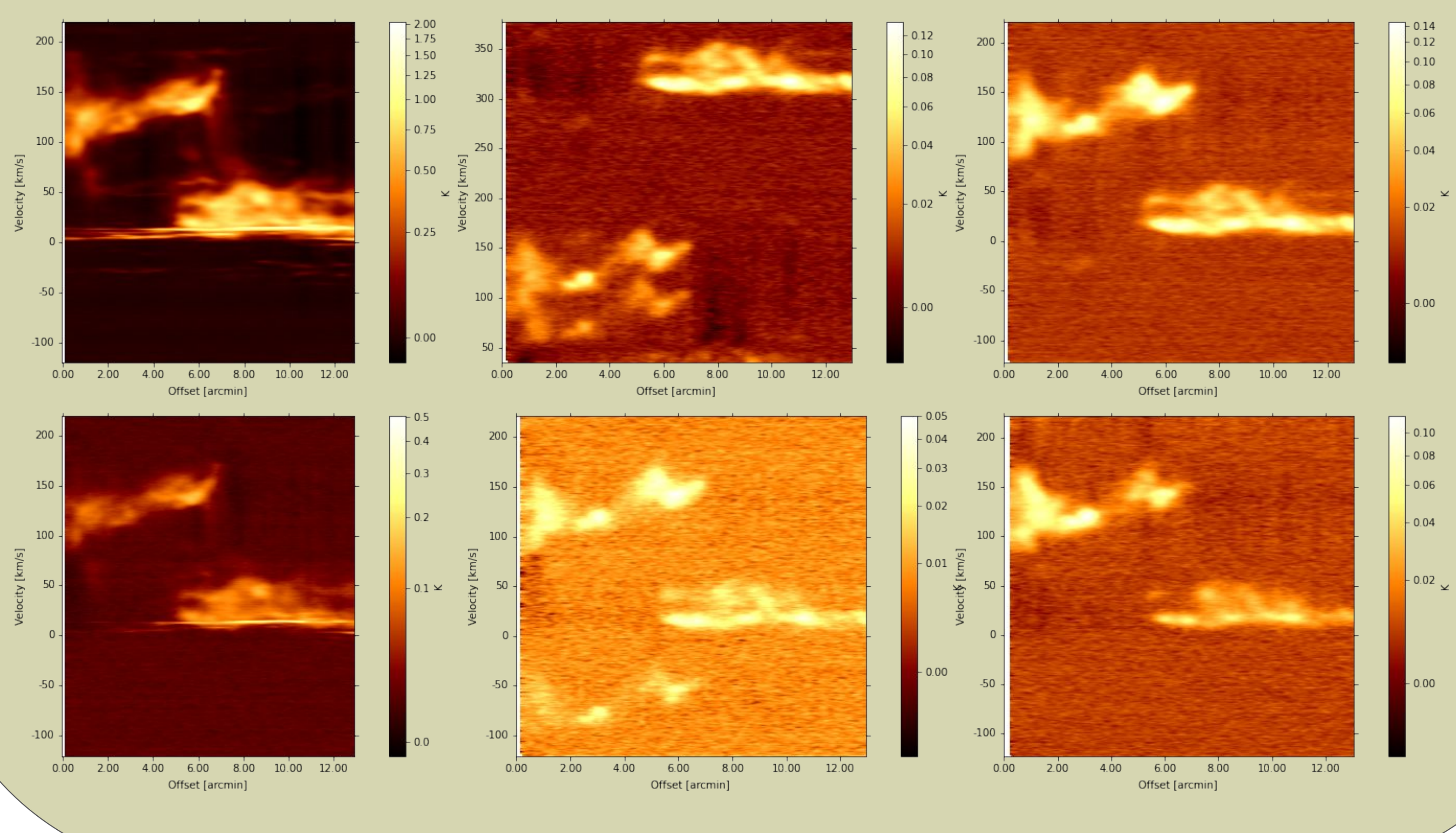
Temperature

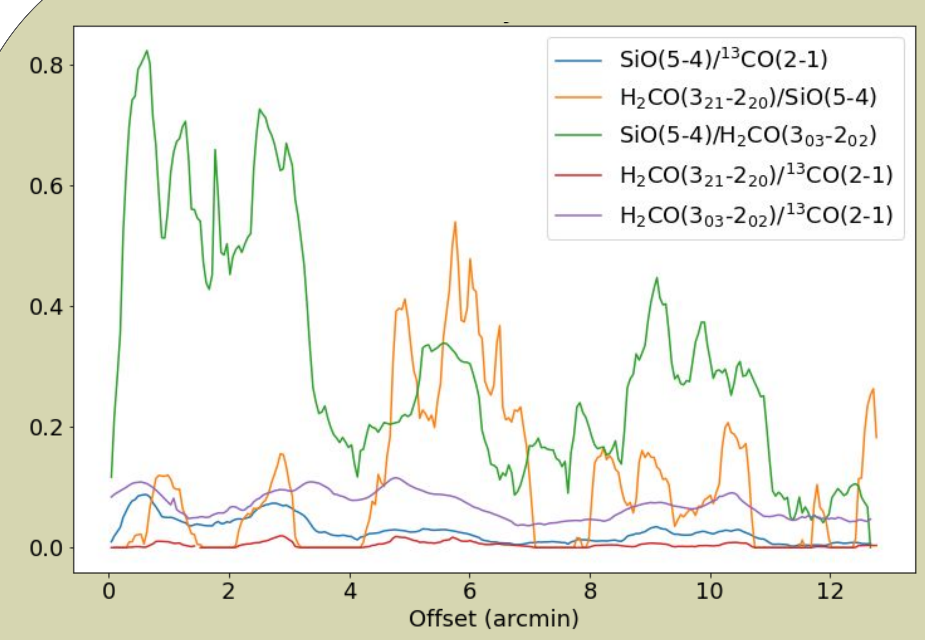
- The H2CO temperature was found using ratios of H2CO (3_{21}-2_{20}) to H2CO (3_{03}-2_{02}), which were then put into a quadratic fit of the temperature-ratio relation found in Ginsburg et al. 2016.
- To find the temperature of the two clouds separately, integrated intensity maps were taken individually for the two clouds from 0 to 75 km s-1 and from 75 to 200 km s-1, and masked with a 6.5 sigma noise mask.
- The average temperature of the High-Velocity Cloud (left) is **42.5 K**.
- The average temperature of the Low-Velocity Cloud (right) is **68.7 K.**



Position-Velocity Diagram

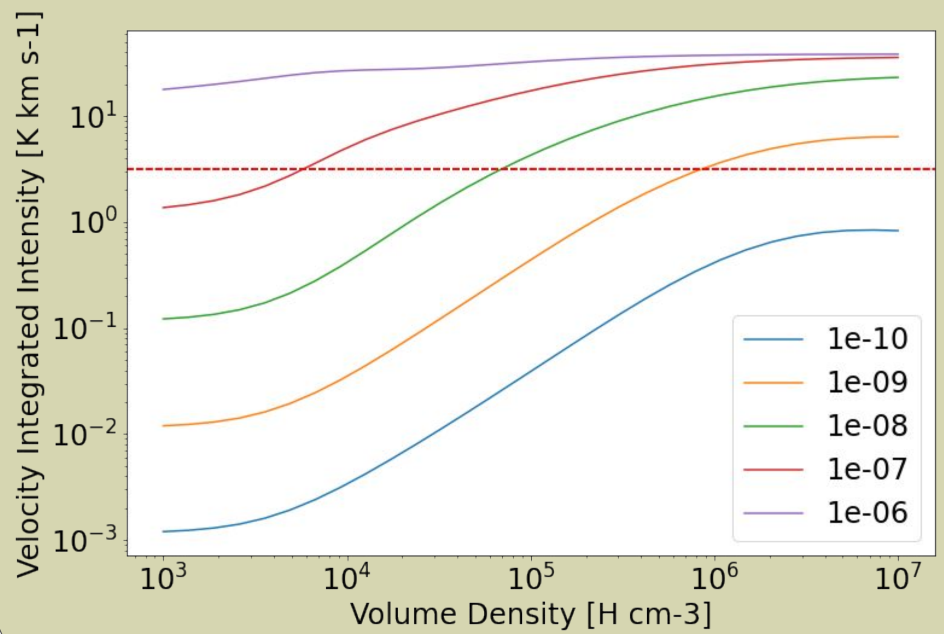
- A Position-Velocity (PV) Diagram were taken across the field, with a width of 15".
- Two prominent features of the PV Diagram are the two clouds at 50 and 150 km s-1.
- Between the two clouds at offset 6' from 50 to 150 km s-1 is a bright feature connecting the two clouds, a Velocity Bridge which is evidence of a Cloud-Cloud collision.
- The High-Velocity Cloud is from the offset of 0' to 6', from velocities of ~75-200 km s-1.
- The Low-Velocity Cloud is from the offset of 6' to 12', from velocities of ~0-75 km s-1.
- The lower velocity-dispersion features near 0 km s-1 are other clouds along the line of sight.





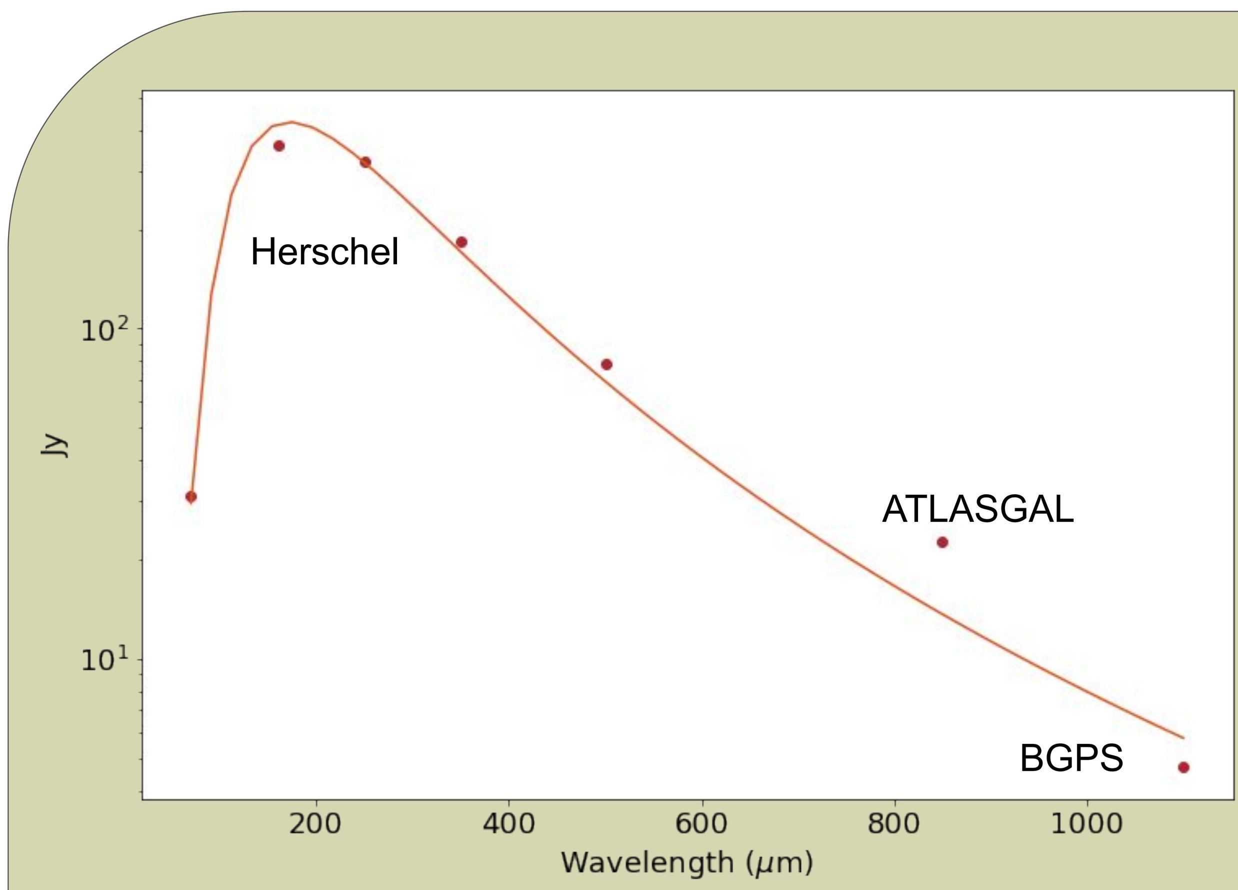
Chemistry

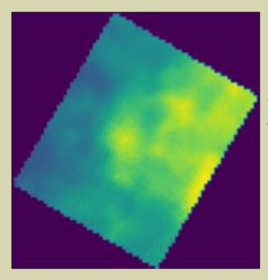
- SiO (5-4) was observed as a shock tracer.
- H_2CO (3_{03}-2_{02}) is not thought to be enhanced in shocks, so the green line plot of them above shows where SiO might be enhanced.
- The H_2CO (3_{21}-2_{20}) was used with the other H_2CO line to find the formaldehyde temperatures .
- ^{13}CO is an isotopologue of CO, and serves a similar role as a gas tracer.



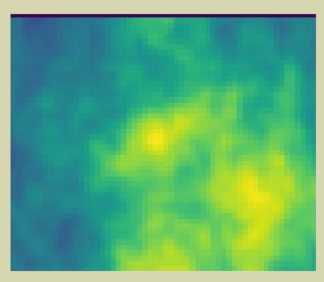
Non-LTE SiO Line Modeling

- Non-Local Thermal Equilibrium modeling was done for SiO (5-4) using Despotic (Krumholz 2014).
- Each line on the legend is for a different abundance of SiO to H_2. Abundances of 10^{-7} - 10^{-6} are considered enhanced in stellar outflows with shock speeds of 60 km s-1 (Schilke et al. 1997).
- The red dotted line is the observed integrated intensity of SiO.
- The abundance of SiO is above ambient (10^{-11}), but it is uncertain if the levels are evidence of strong shocks.

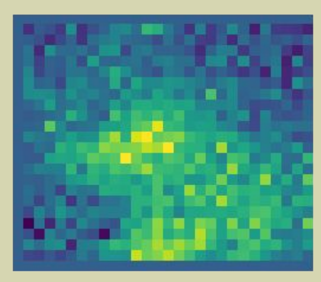




Herschel 160 μm



ATLASGAL 850 μm



BGPS 1.1 mm

Mass Estimate

- We created a Spectral Energy Distribution (SED) from Herschel, ATLASGAL, and BGPS data.
- We selected a 8.9 arcmin^2, or 37pc^2, region around the interaction of the GMCs.
- The blackbody spectrum fit to the data produced a column density of **4.75×10^{21} cm-2**
- The mass of the region is **~3900 M$_\odot$**
- An average integrated intensity of **466 K km/s** was taken from observations of 12CO (2-1) of the region.
- The CO-to-H_2 conversion factor is **X_{CO} = 1.02×10^{19} cm-2 / (K km s-1)** for the selected region.

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