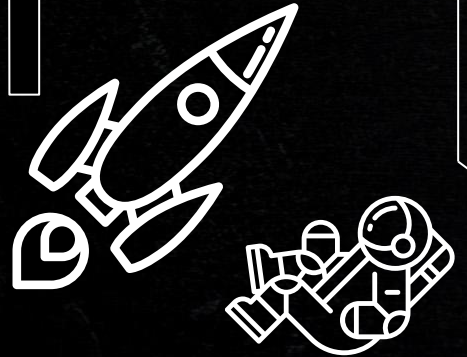
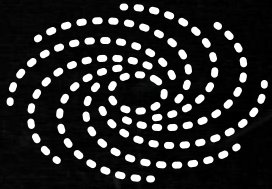


Mapping a Filament in CO Ice

with JWST

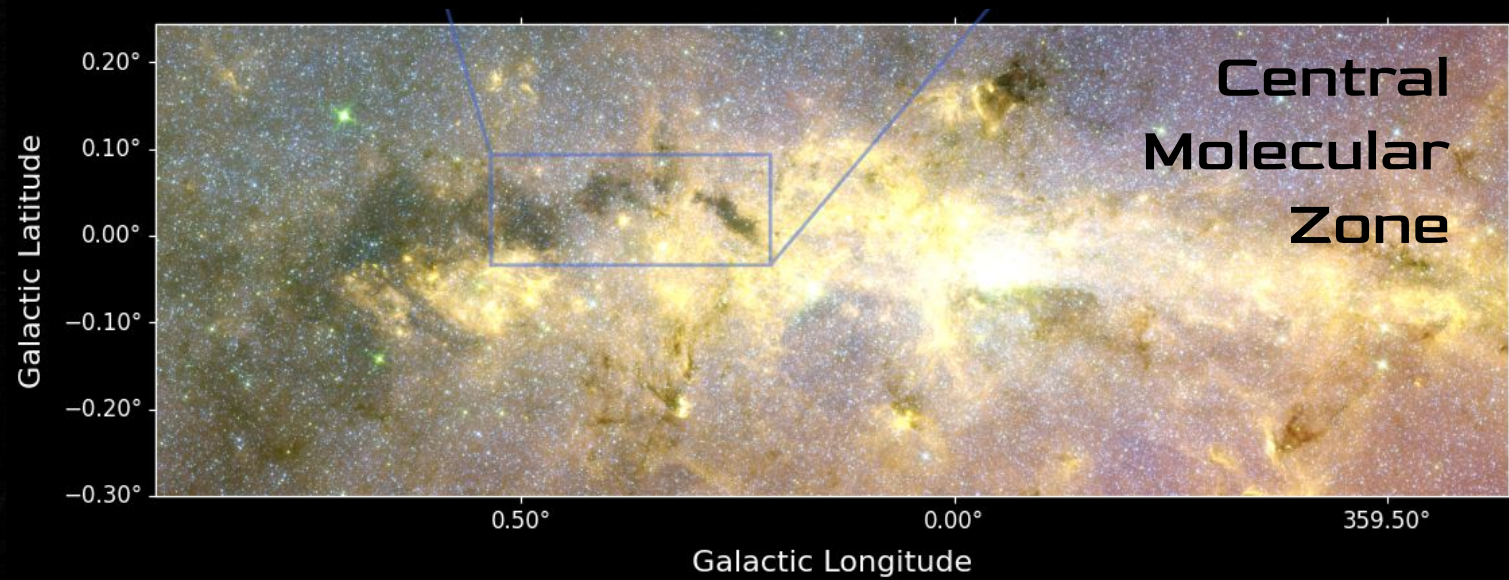
Savannah Gramze
PhD Student at the University of Florida
Advisor - Adam Ginsburg

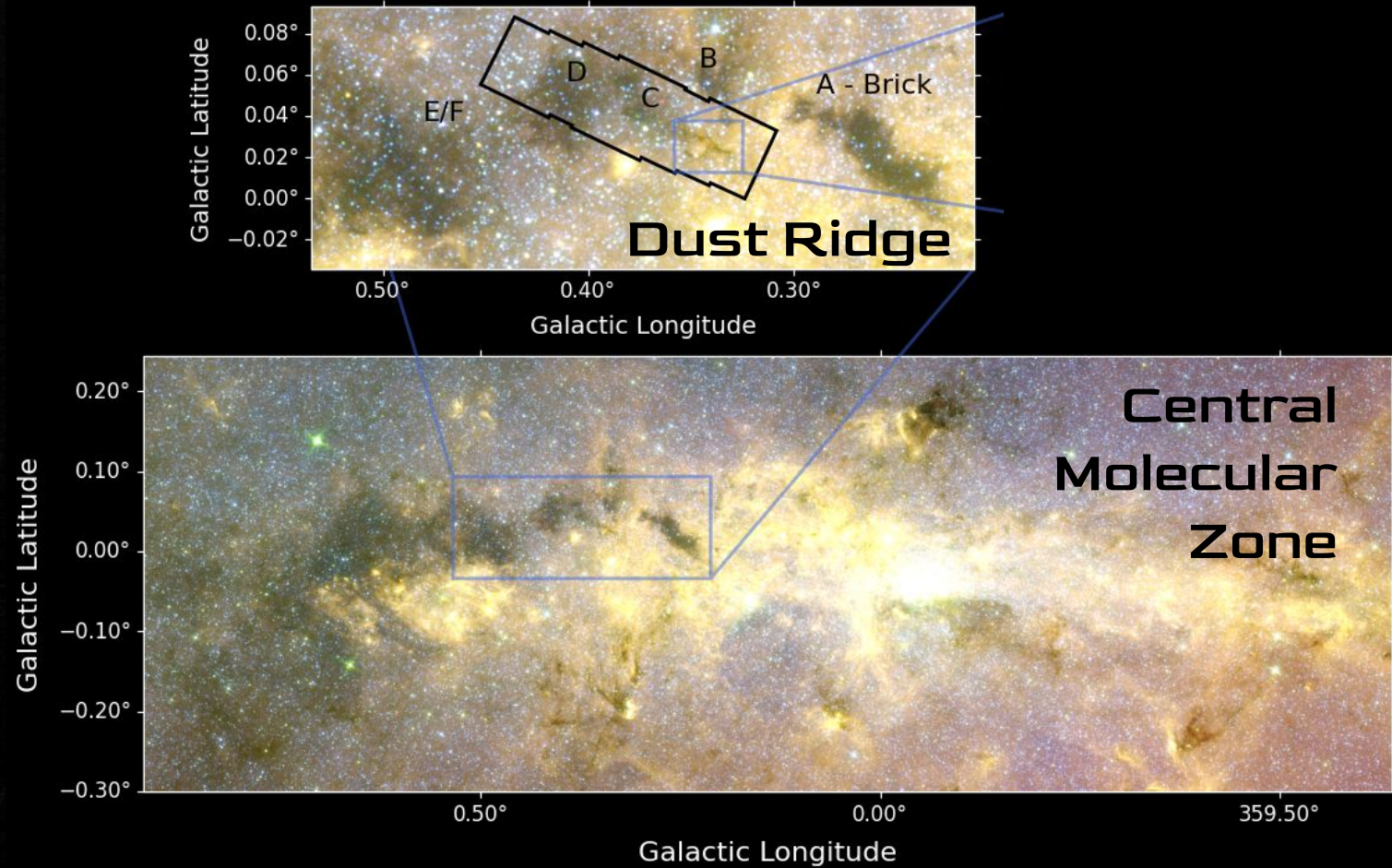


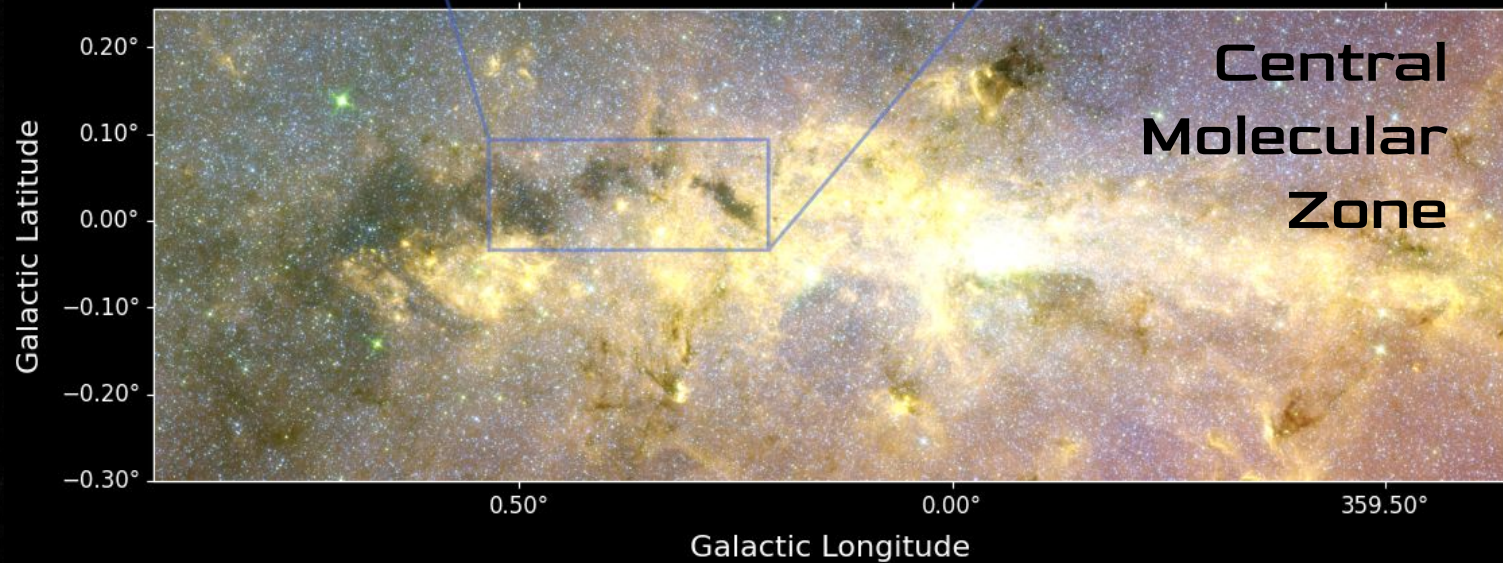
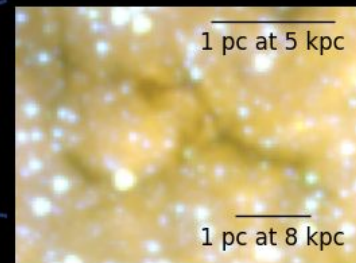
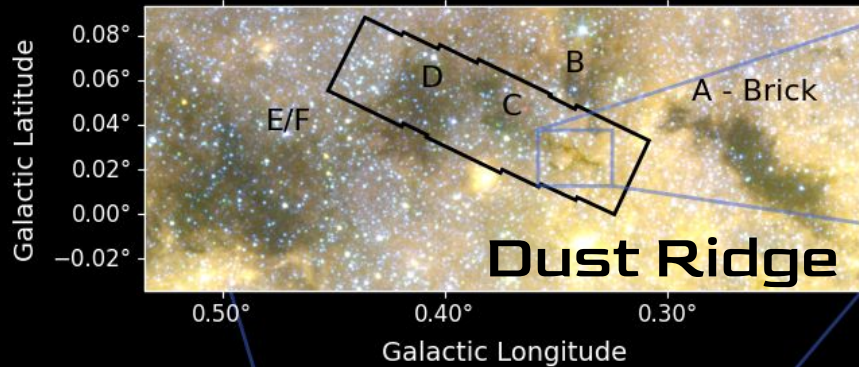


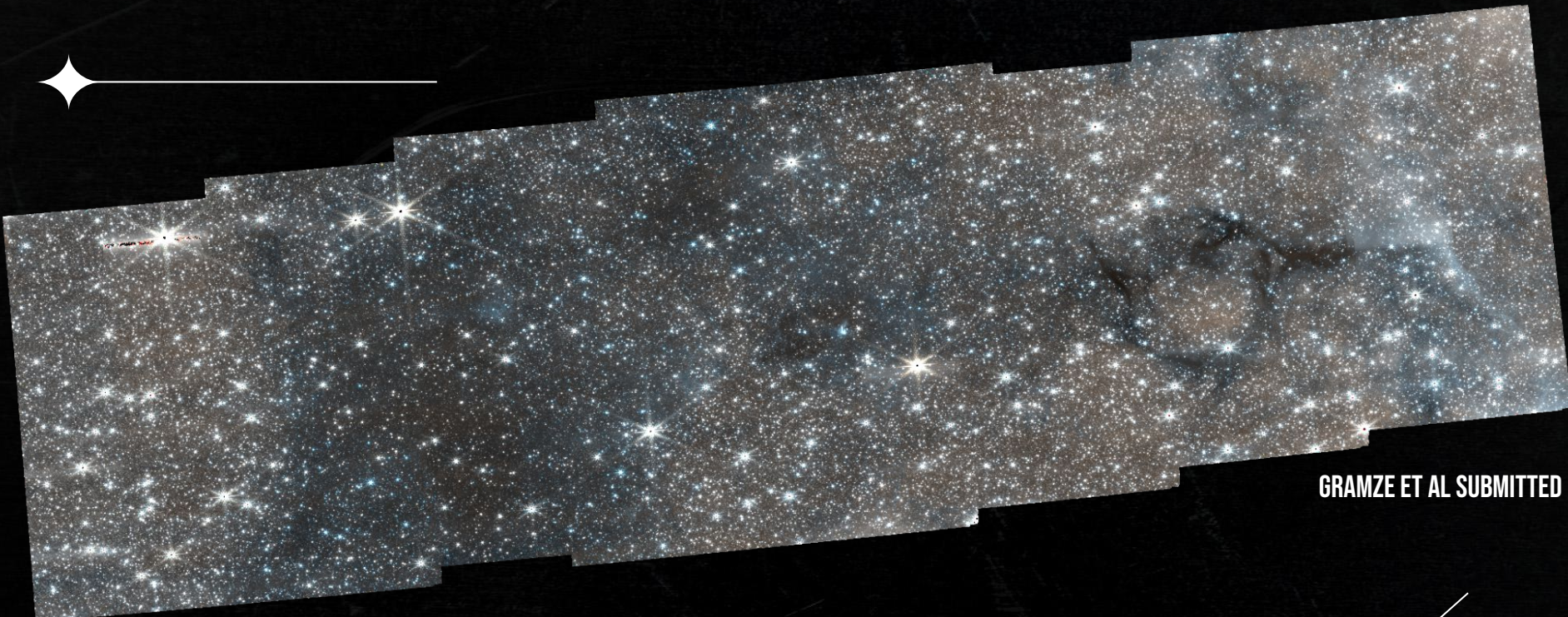
First, Where is the Filament?





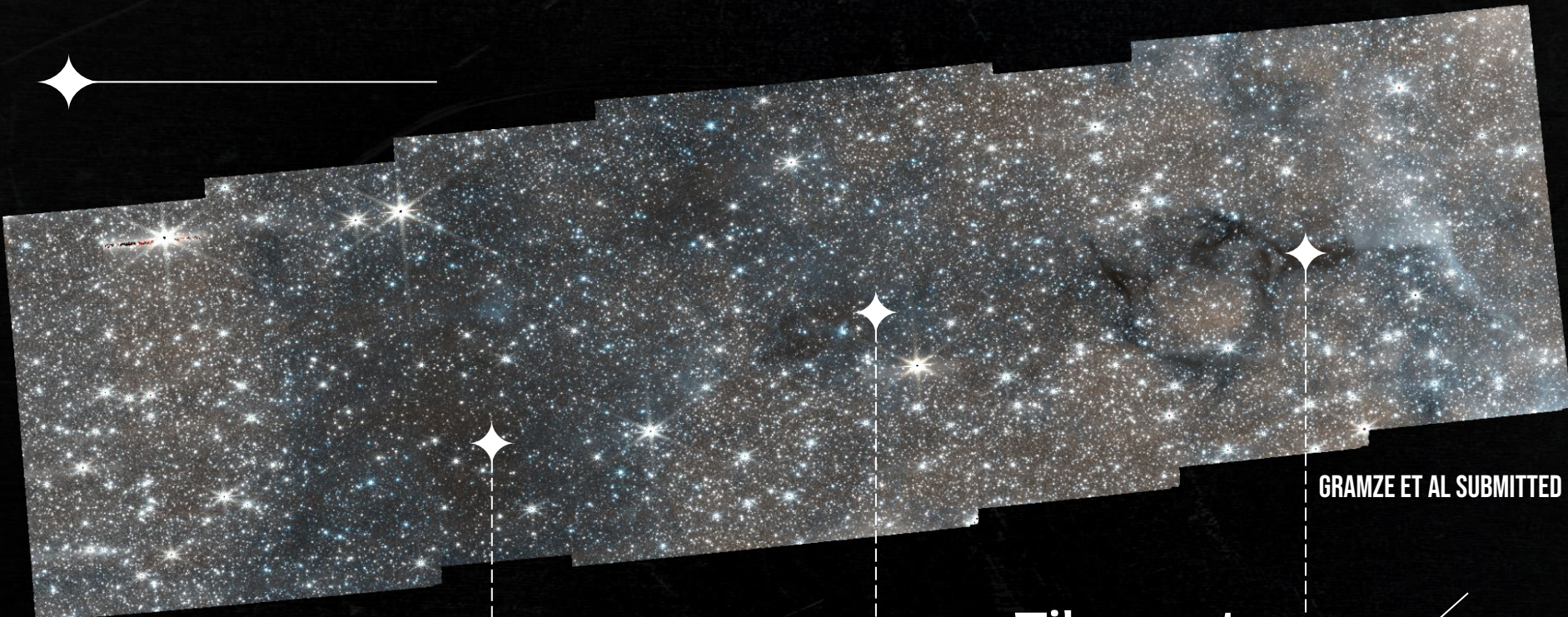






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JWST F405N and F466N



Cloud D

Cloud with no known
Star Formation

Cloud C

Site of High Mass
Star Formation

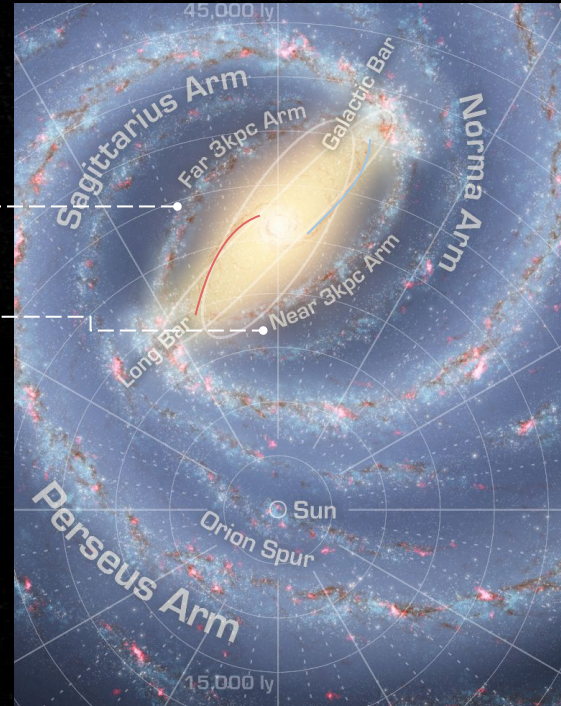
Filament

Star Forming gas in
the 3kpc arm

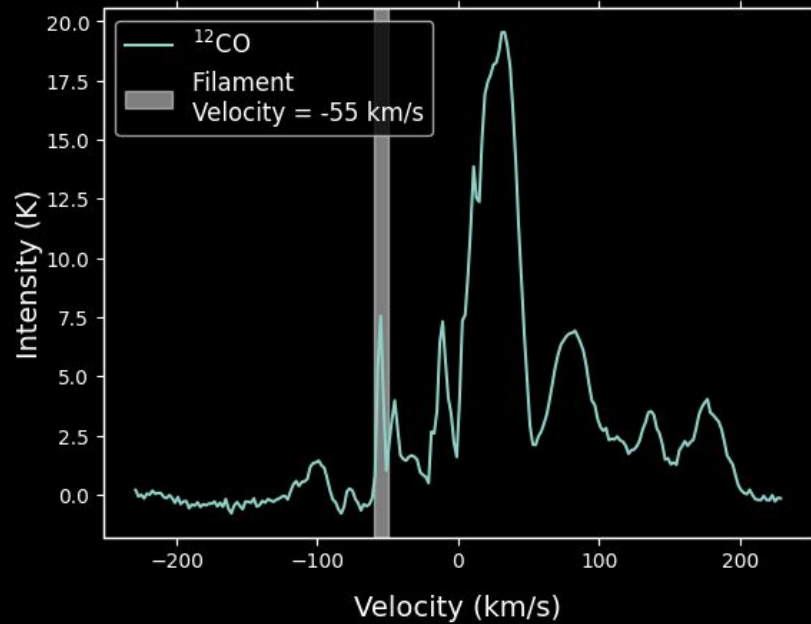
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The Milky Way - 3 kpc Arms

- ★ The Milky Way is a barred spiral galaxy
- ★ Gas and stars orbit along the bar in X1 orbits
- ★ The spiral arms representing these orbits are the 3 kpc arms
- ★ Abnormally high line of sight velocity due to bar dynamics
- ★ Toward the GC, near arm has a velocity of -55 km/s
- ★ Potentially where bar lane gas originates



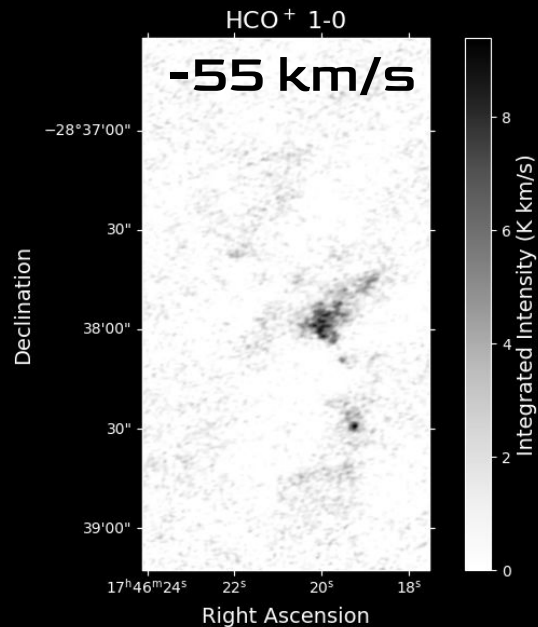
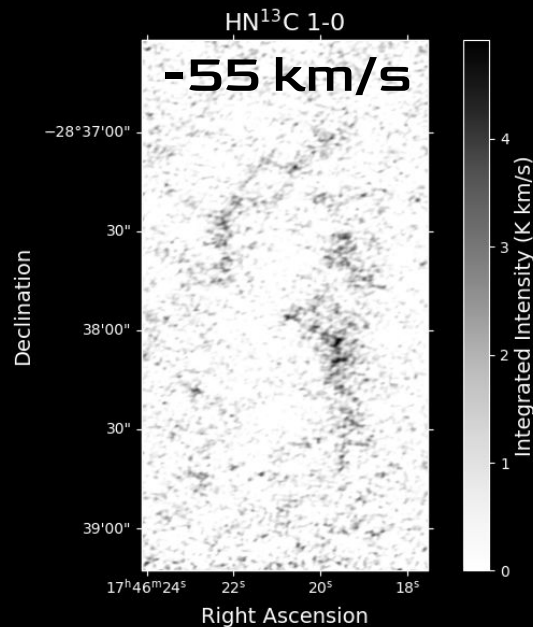
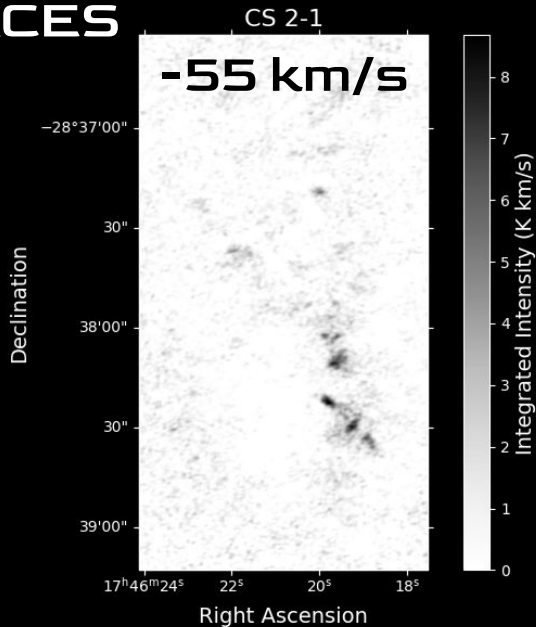
NASA - R. HURT



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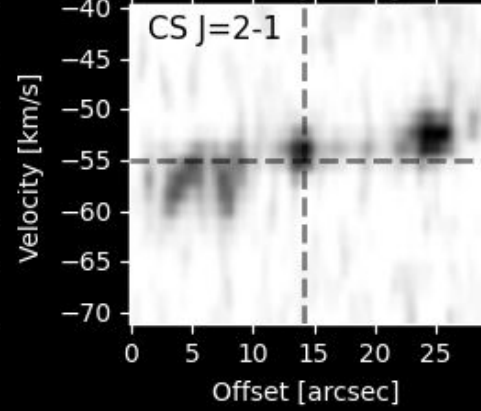
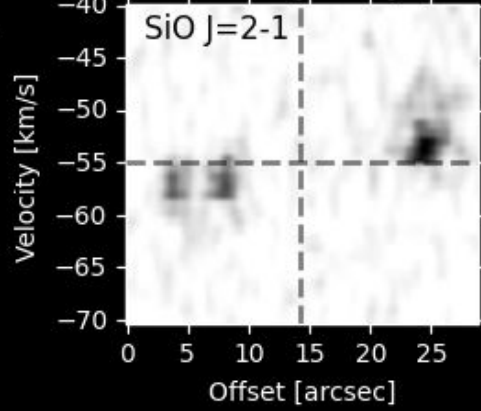
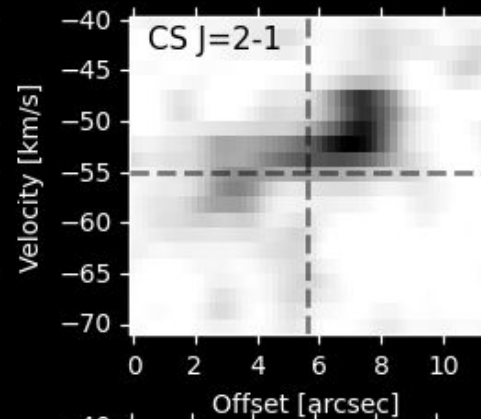
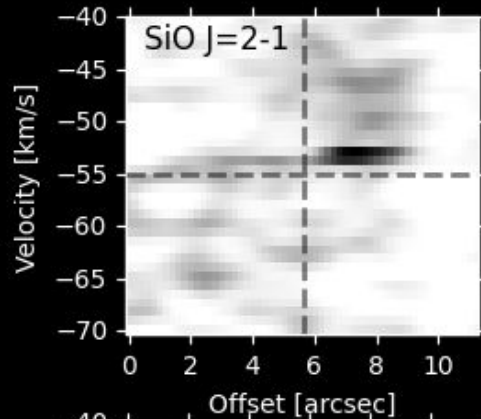
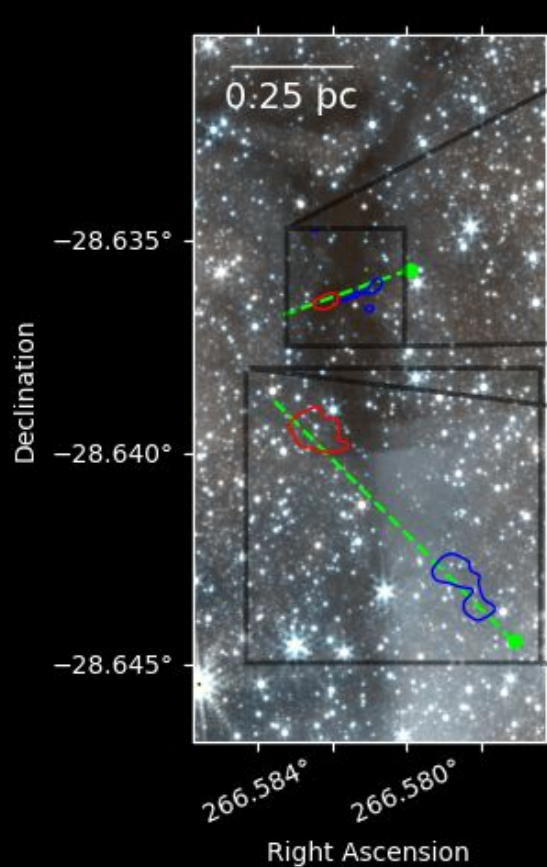
**How do we know the Filament
is in the 3 kpc arm?**

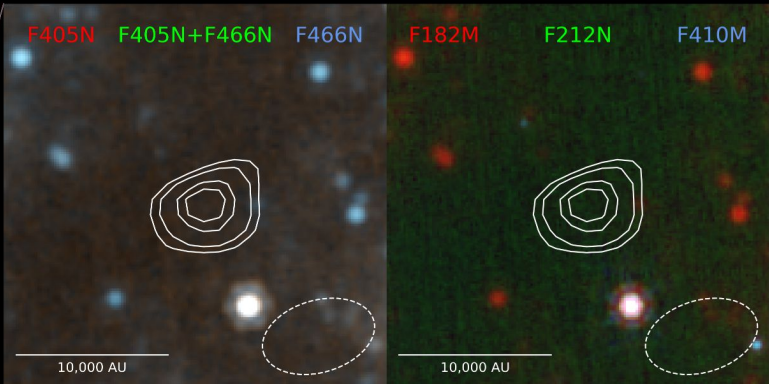
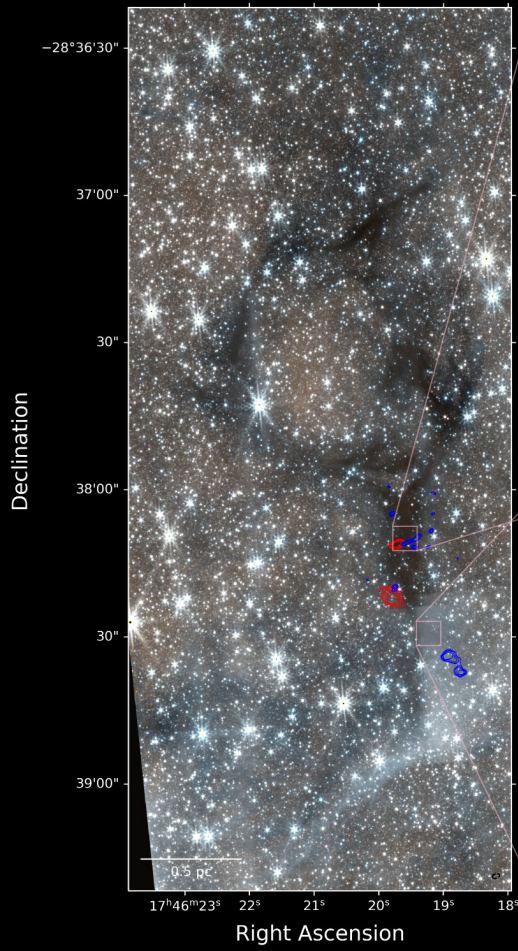
ACES



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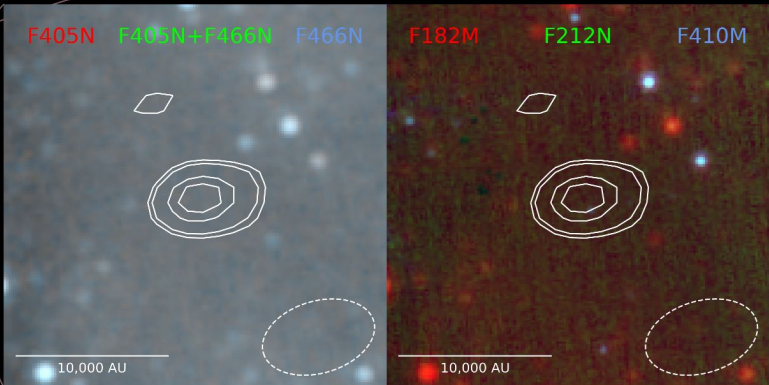
**How do we know the Filament
is in the 3 kpc arm?**





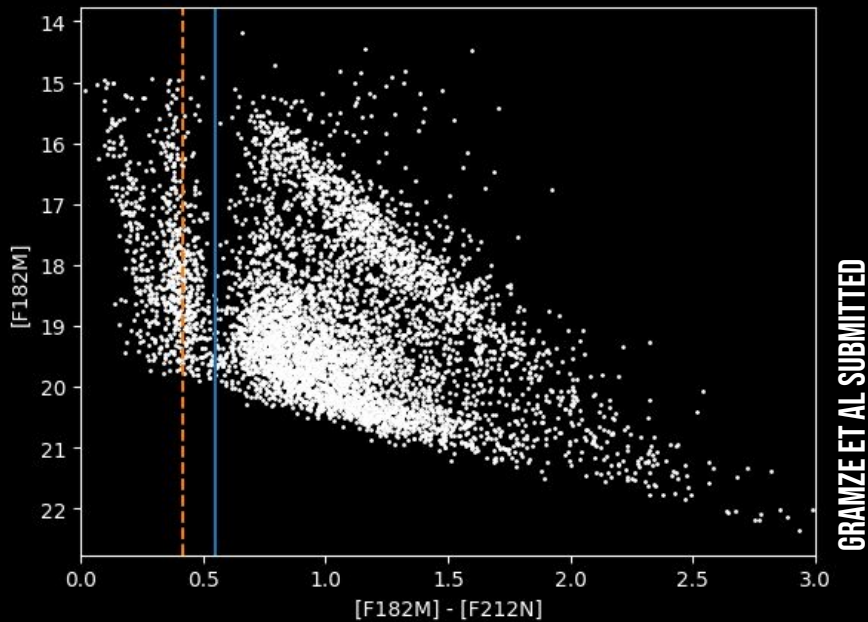
@ 10K
10.5 M_{\odot}

@ 20K
5.3 M_{\odot}



@ 10K
18.4 M_{\odot}

@ 20K
9.2 M_{\odot}

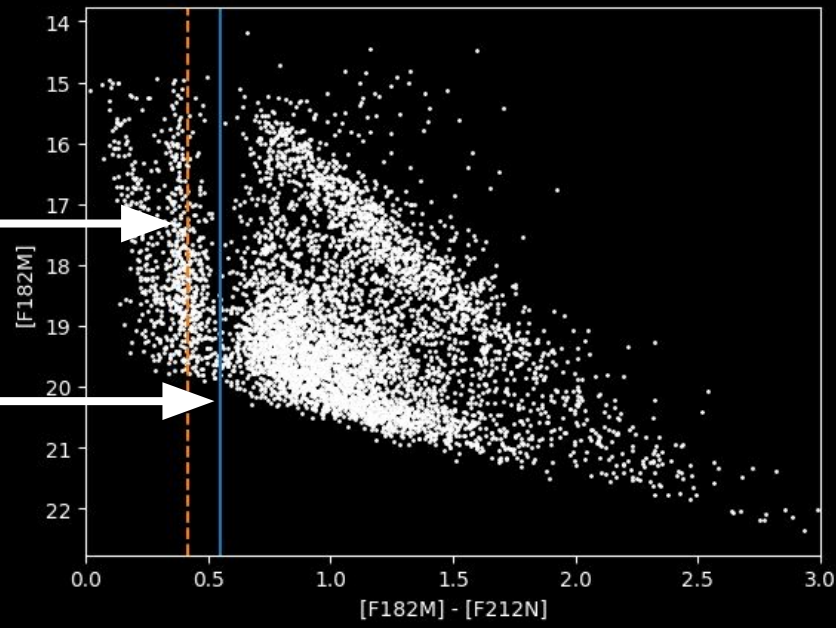


**How do we know the Filament
is in the 3 kpc arm?**



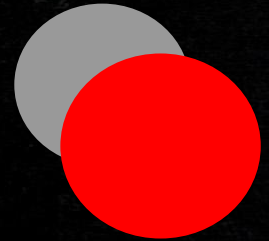
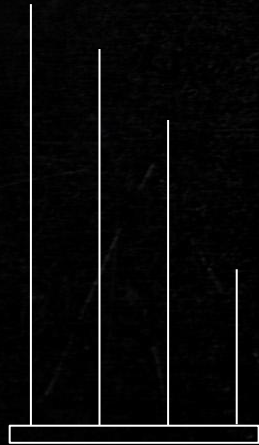
Canonical 3 kpc arm
extinction
(Nogueras-Lara et al
2021)

Gap left by the
Filament



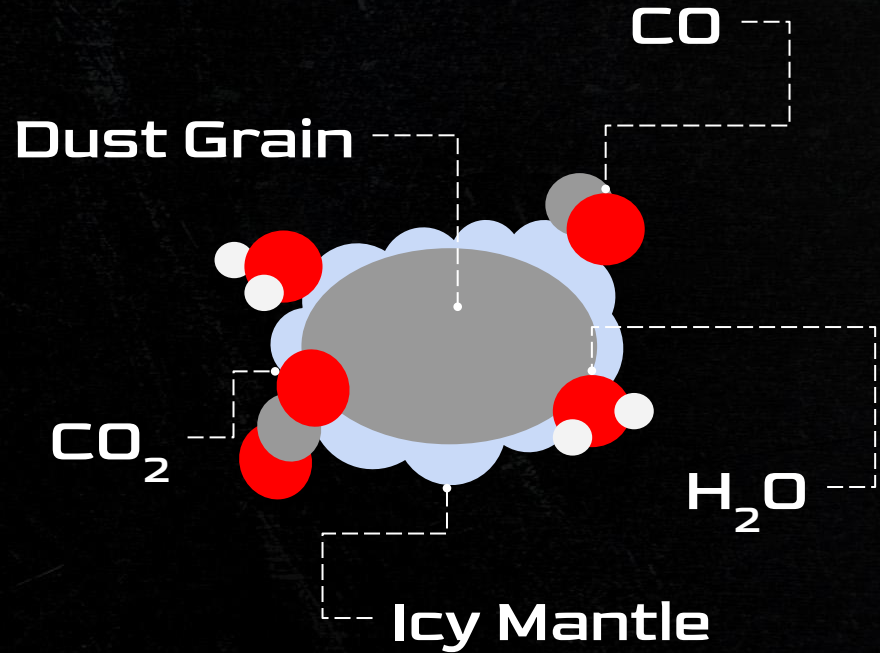
How do we know the Filament is in the 3 kpc arm?

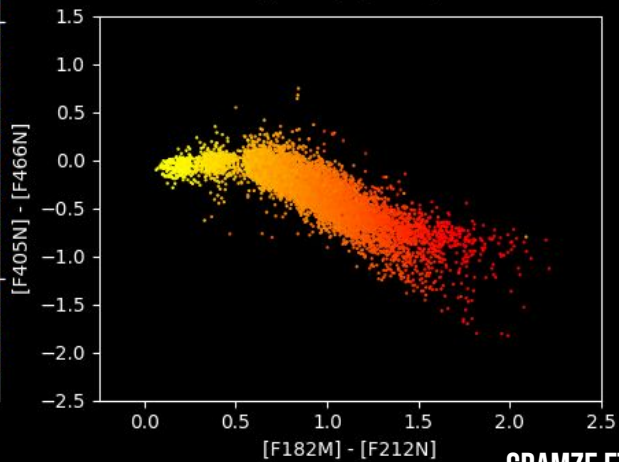
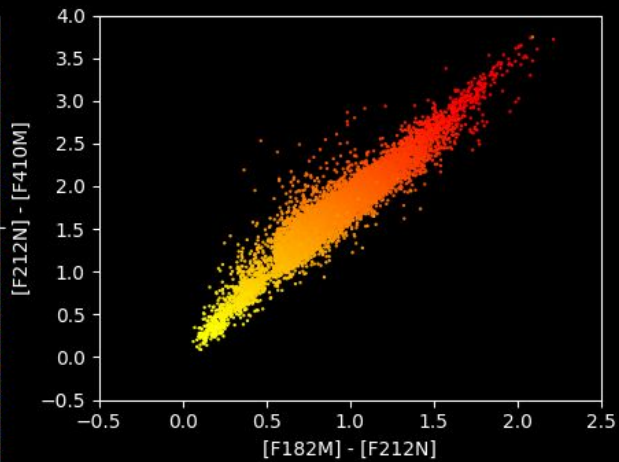
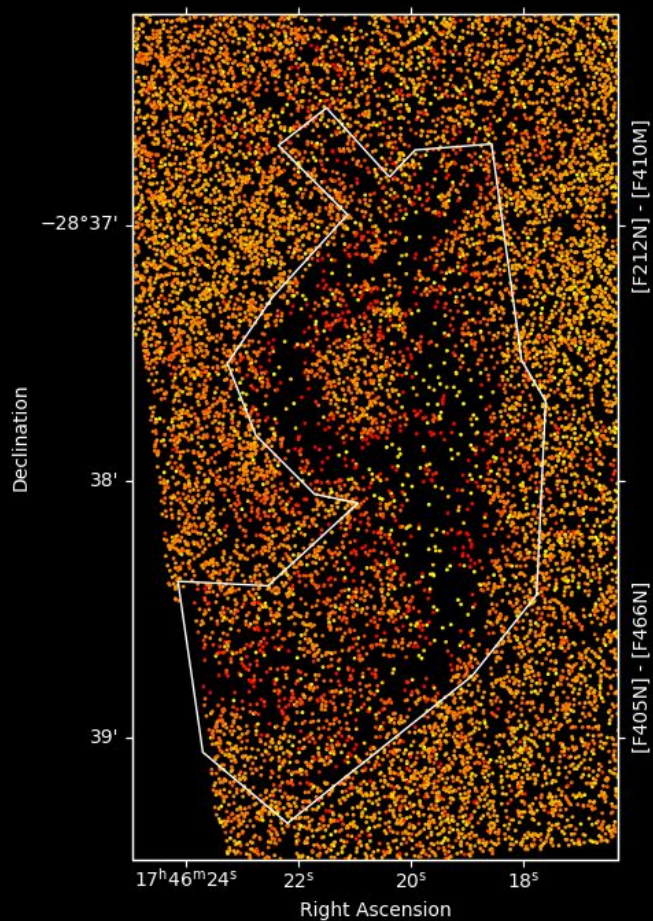
Mapping CO Ice



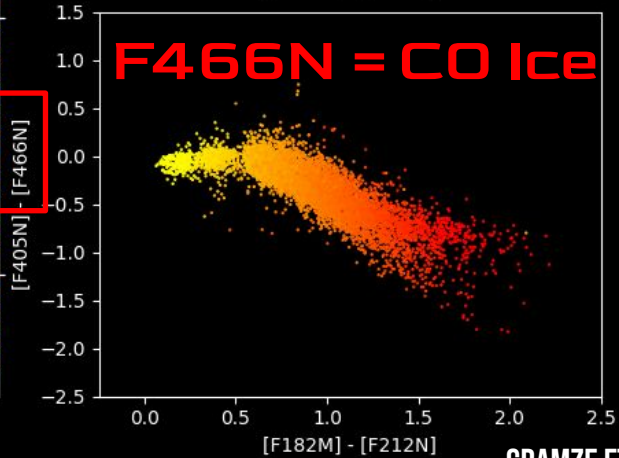
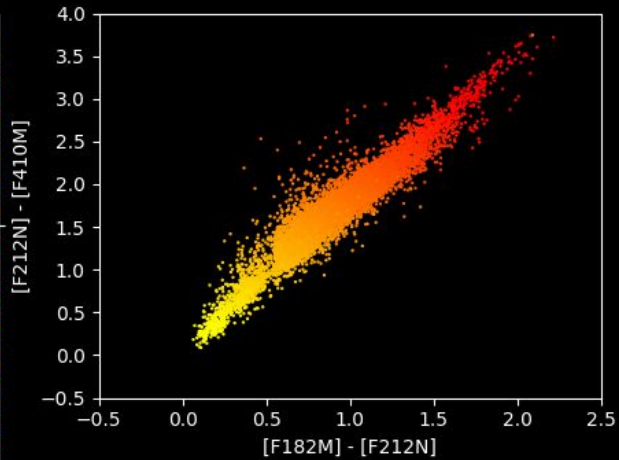
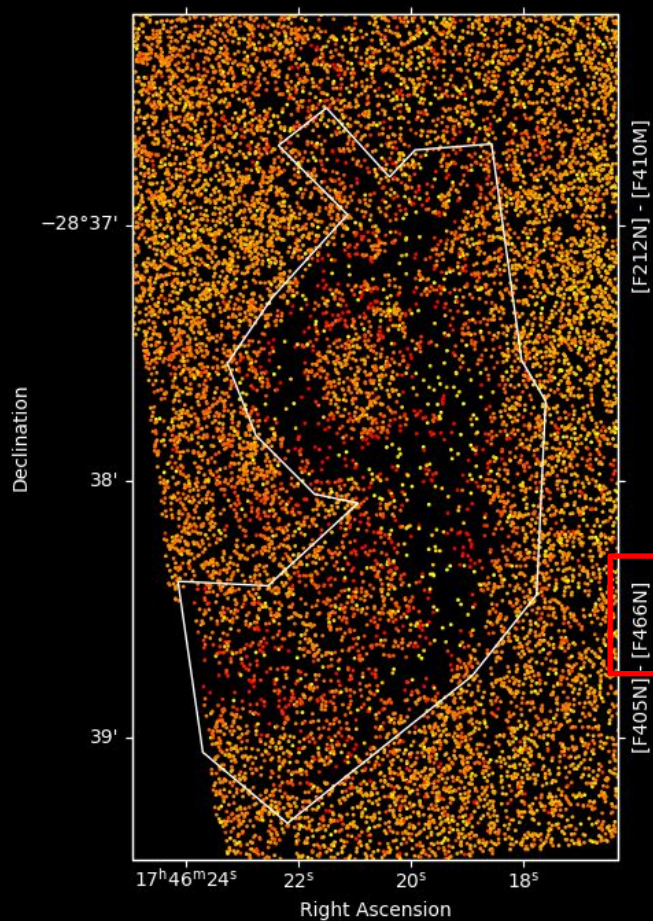
Interstellar Ice

- ★ In cold, dense parts of the interstellar medium, icy mantles form on dust grains.
- ★ Complex organic molecules are formed here
- ★ Same place where stars form
- ★ CO molecules freeze out of the gas phase





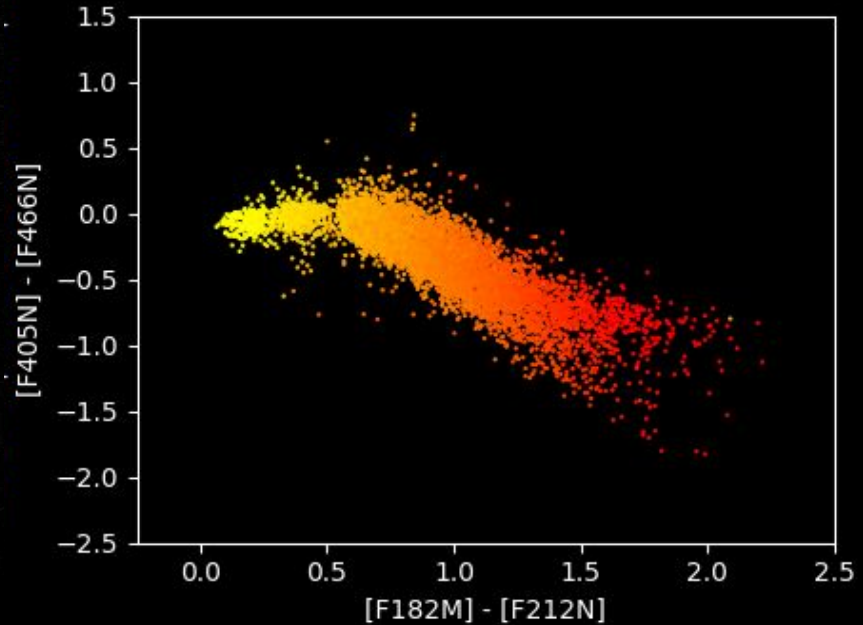
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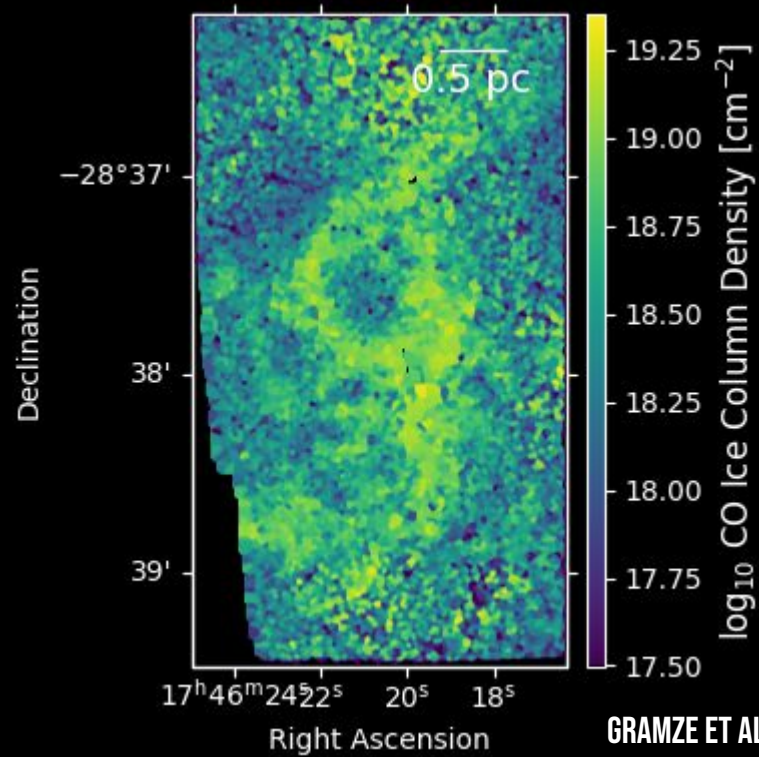
Measuring CO Ice Column Density

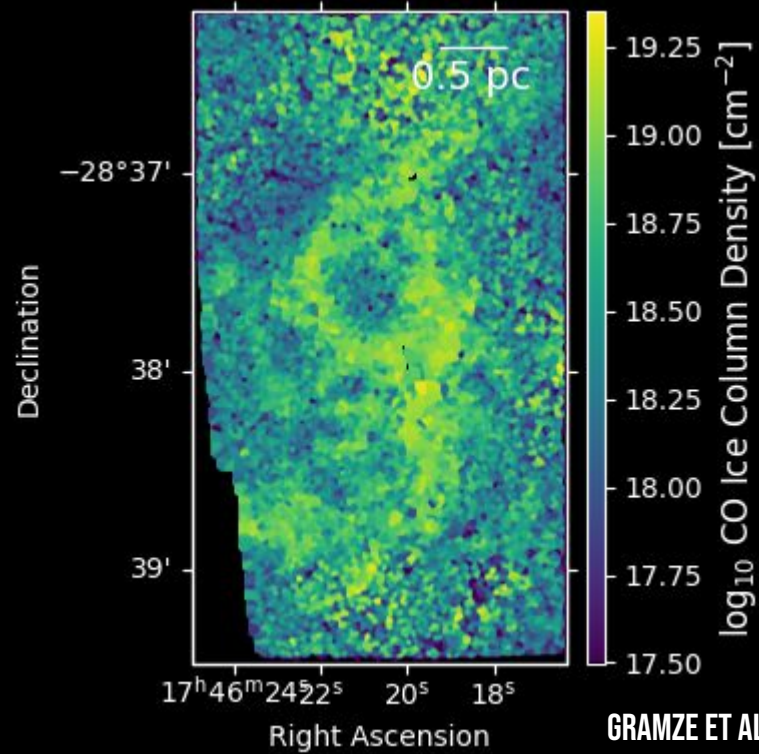
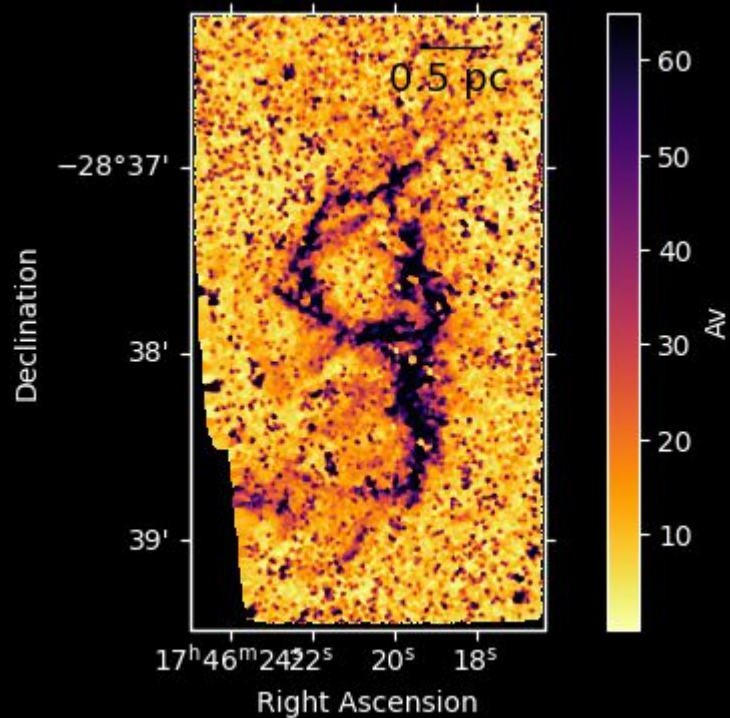
- ★ Based on laboratory ice opacity measurements
- ★ Model effect of CO ice on starlight in F405N-F466N color
- ★ As CO ice builds up along line of sight, [F466N] dims, color becomes "bluer"



Mapping CO Ice

- ★ By modeling the impact of CO ice on starlight using laboratory models, we can measure CO ice column density
- ★ Interpolate between the measurements and make a map



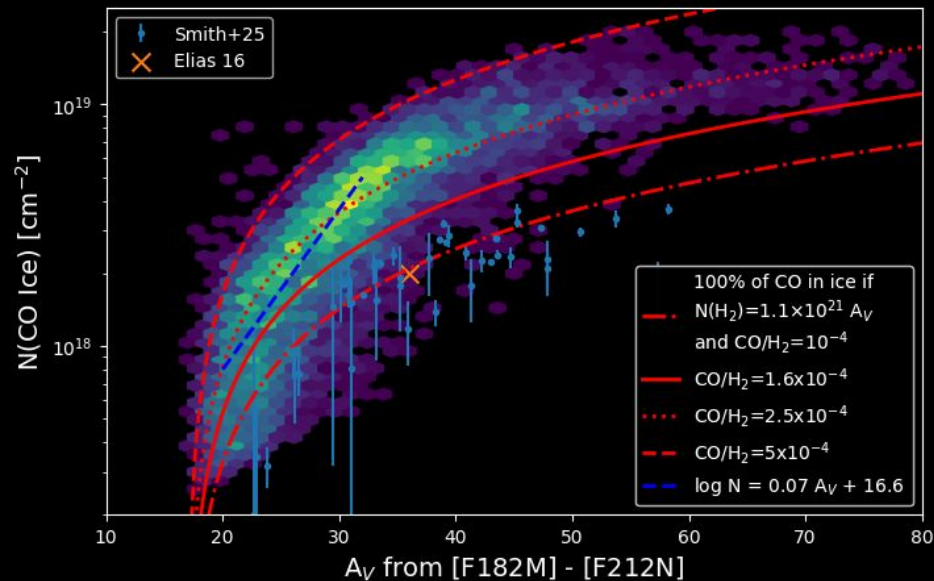


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CO

Abundance

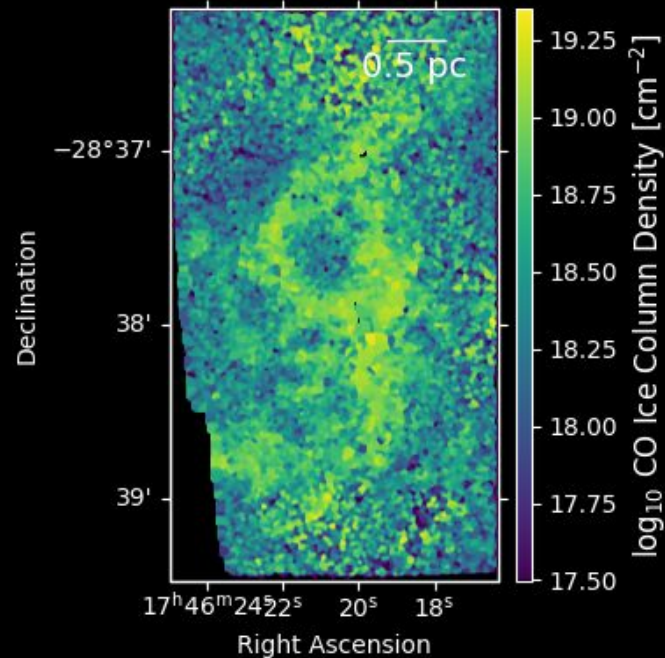
- ★ Dust extinction vs CO ice column density
- ★ Catastrophic Freezeout = Red Lines
- ★ CO Ice columns imply higher CO abundance in filament relative to local gas
- ★ Tracing higher gas metallicity toward center of Galaxy
- ★ Higher gas metallicity = more Carbon = more CO



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Conclusions

- ★ Star-forming filament in the 3 kpc arm
- ★ Detecting CO freezeout by measuring CO ice column density
- ★ 84-95% of the N_{CO} is frozen in the filament (50-88% CO-derived H_2 mass)
- ★ Ice column density is higher than expected for solar abundances of CO
- ★ Tracing CO abundance/metallicity differences in the gas



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Thank You!

