Dust Survival in the M82 Wind with JWST MIRI and NIRCam

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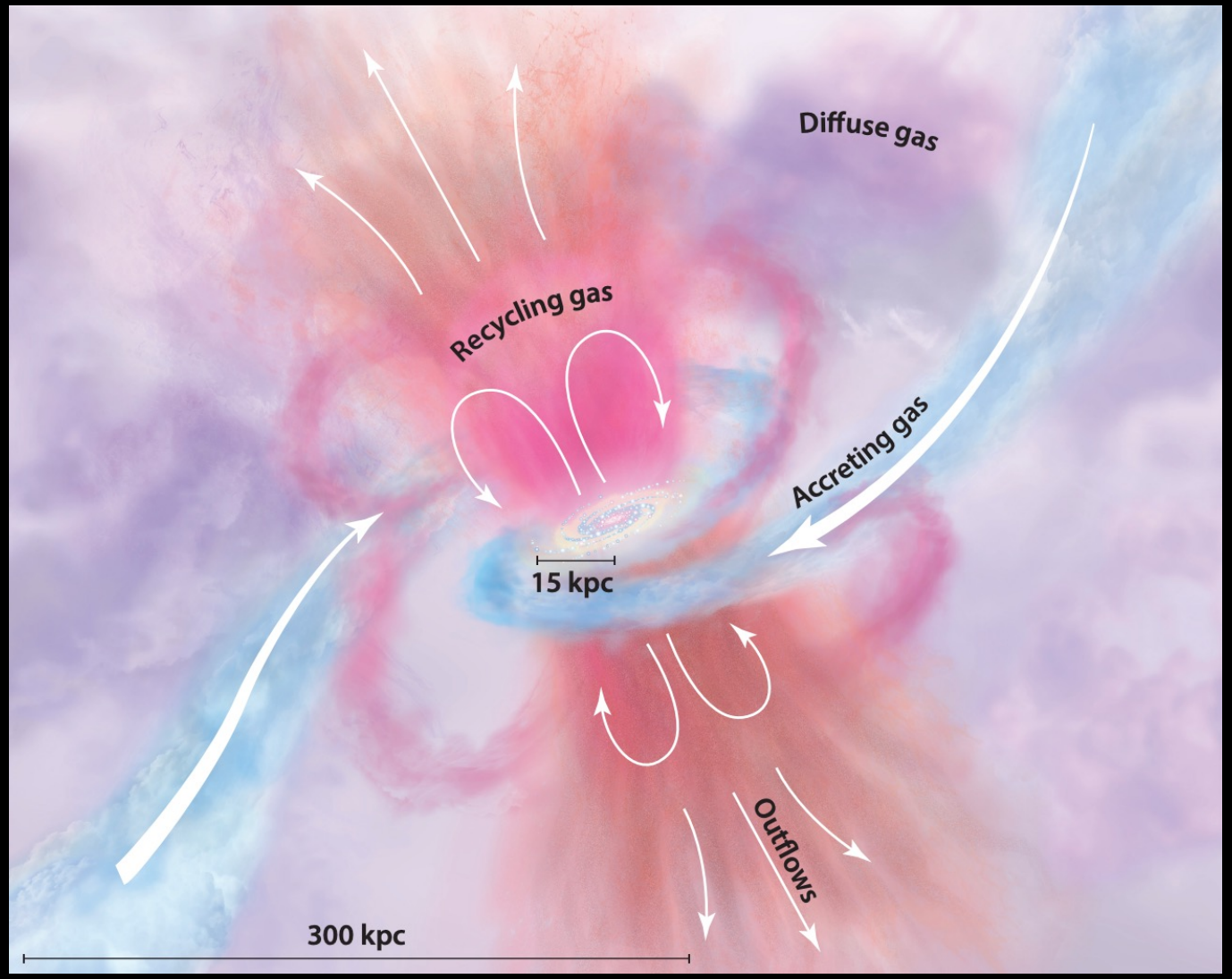
On behalf the JWST Starbursts Collaboration

Dusty Universe 2025: the 5th Pan-Dust Conference – Tucson, AZ

Galactic winds are a critical component of galaxy evolution.



Tumlinson, Peeples, & Werk (2017)

- Regulate star formation activity
- Enrich the surrounding circumgalactic medium with gas and dust

How does cold material survive being launched to large distances?

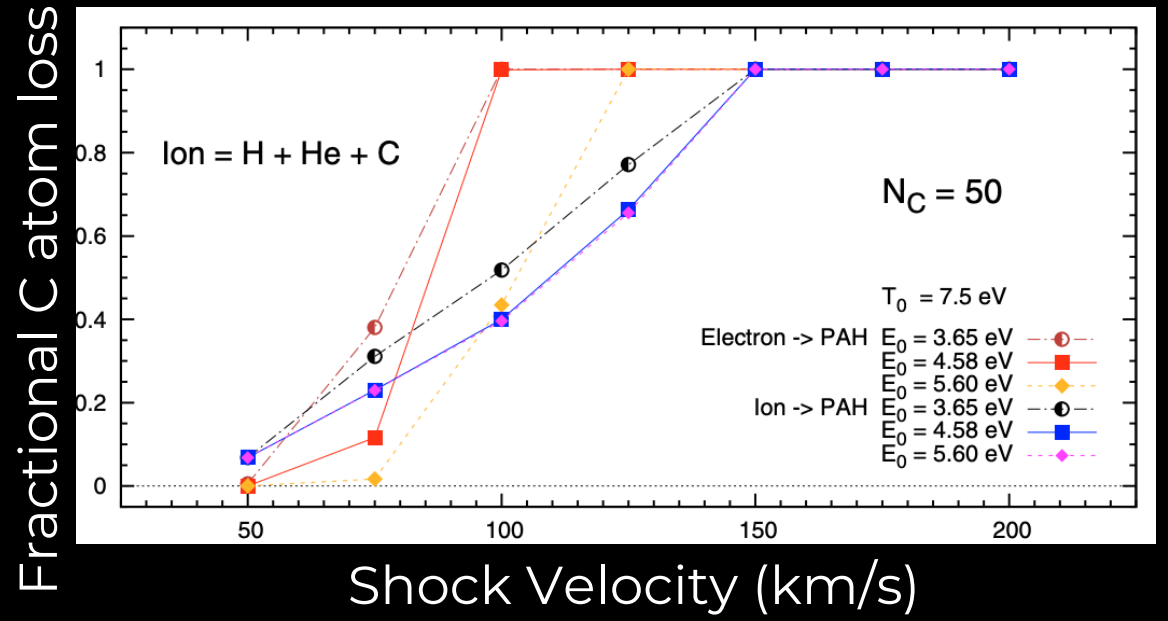
See reviews Heckman+1990, Veilleux+2020, Thompson & Heckman 2024

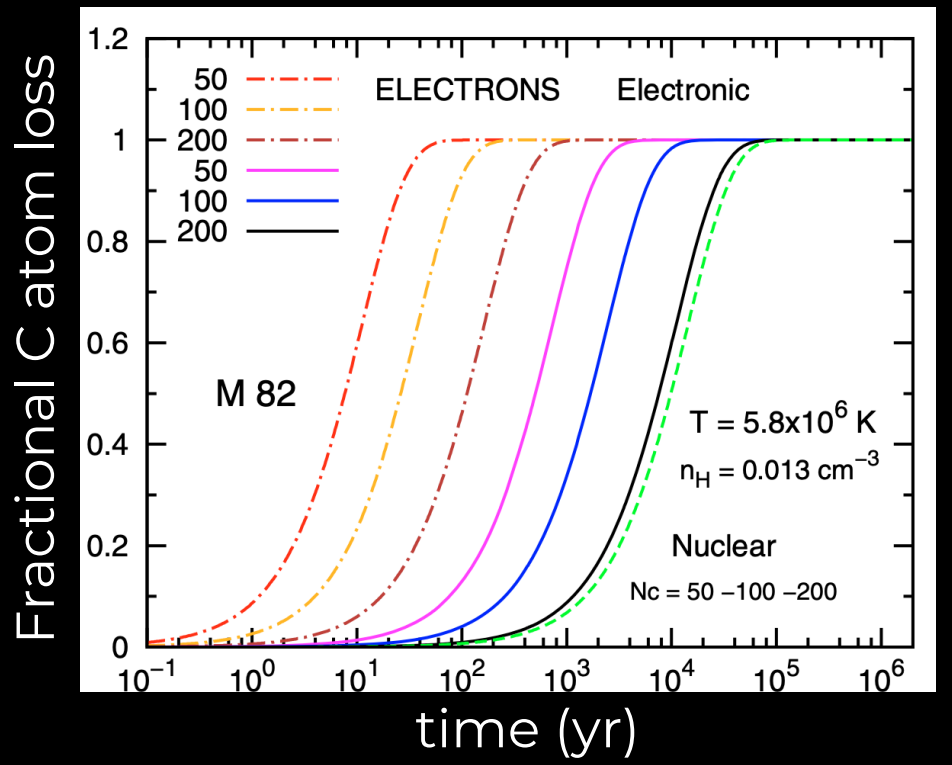
PAHs are tools to observe cooler ($T \lesssim 10^4$ K) phases of galactic winds.

PAHs are destroyed in wind shocks $\gtrsim$ 100 km/s.

In post-shock hot and tenuous gas, PAHs are destroyed in *t* ~ 1000 years.

Simulations of multiphase outflows support these results. **See Helena Richie's talk on Friday!**





Micelotta+2010a,b

Main Science Questions

Where are PAHs in the wind?

How does the cool wind evolve with distance from the starburst?

M82: the Prototypical Starburst Galaxy Launching a Wind

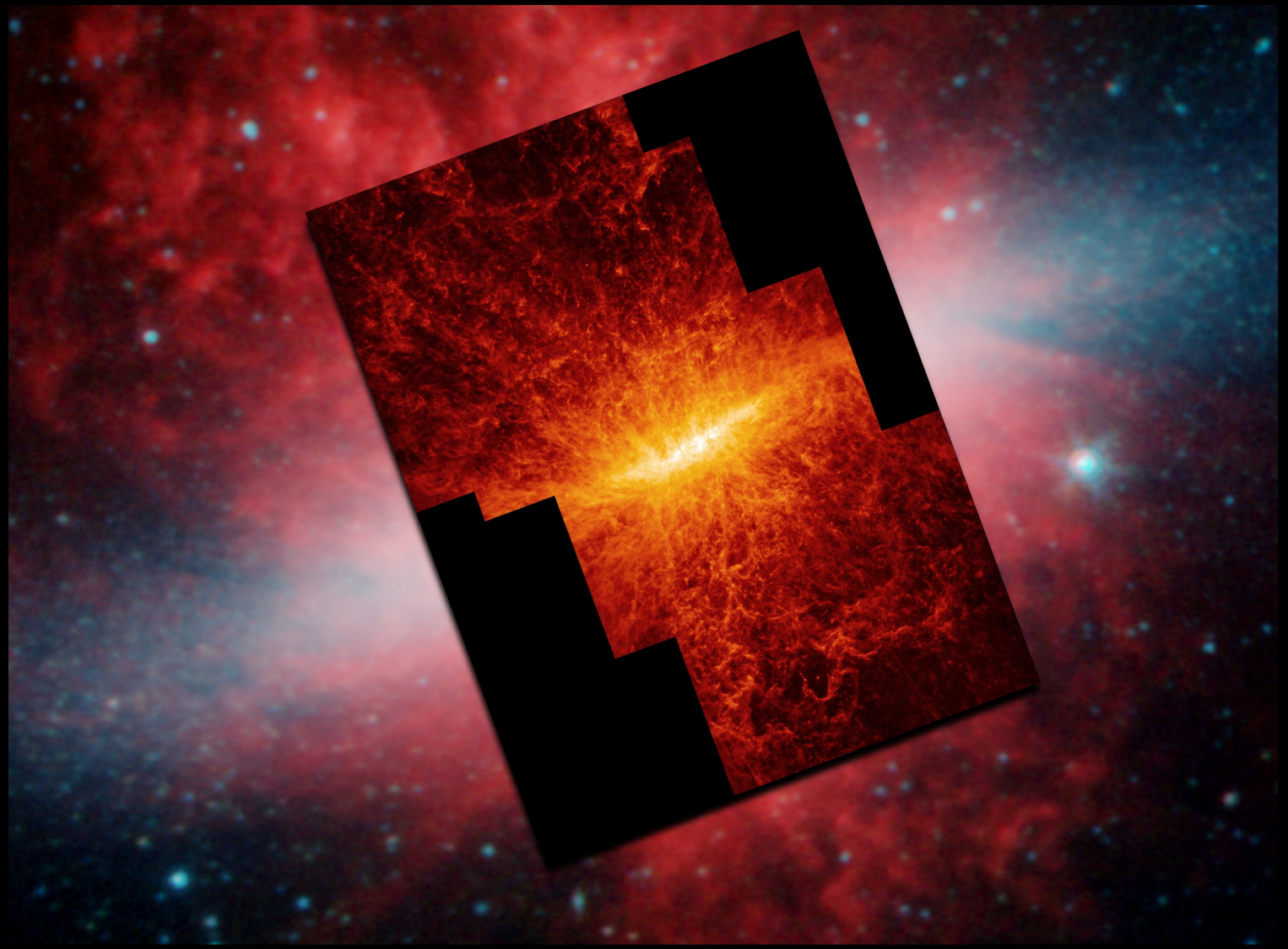
M82 is the perfect laboratory because it is nearby (d~3.6 Mpc) and nearly edge-on

Spitzer 8um image at ~2.5” resolution

Spitzer Image Credit: NASA, JPL/Caltech, C. Engelbracht (U. Arizona)

M82: the Prototypical Starburst Galaxy Launching a Wind

JWST reveals stunning filamentary structure at ~0.4” (~2.5pc) resolution

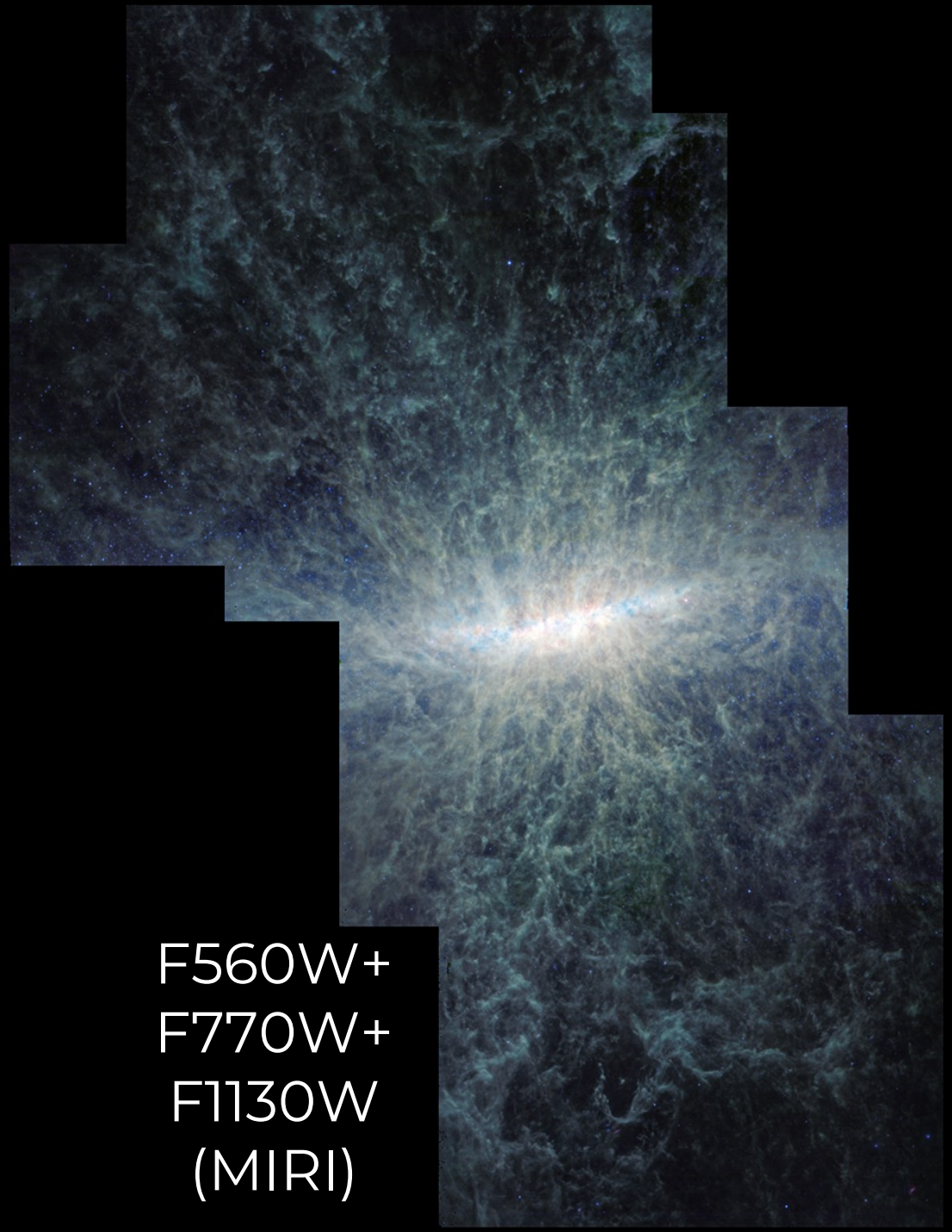


JWST Image:
MIRI F770W (7.7um PAH complex)

JWST GO #1701
PI: A. Bolatto

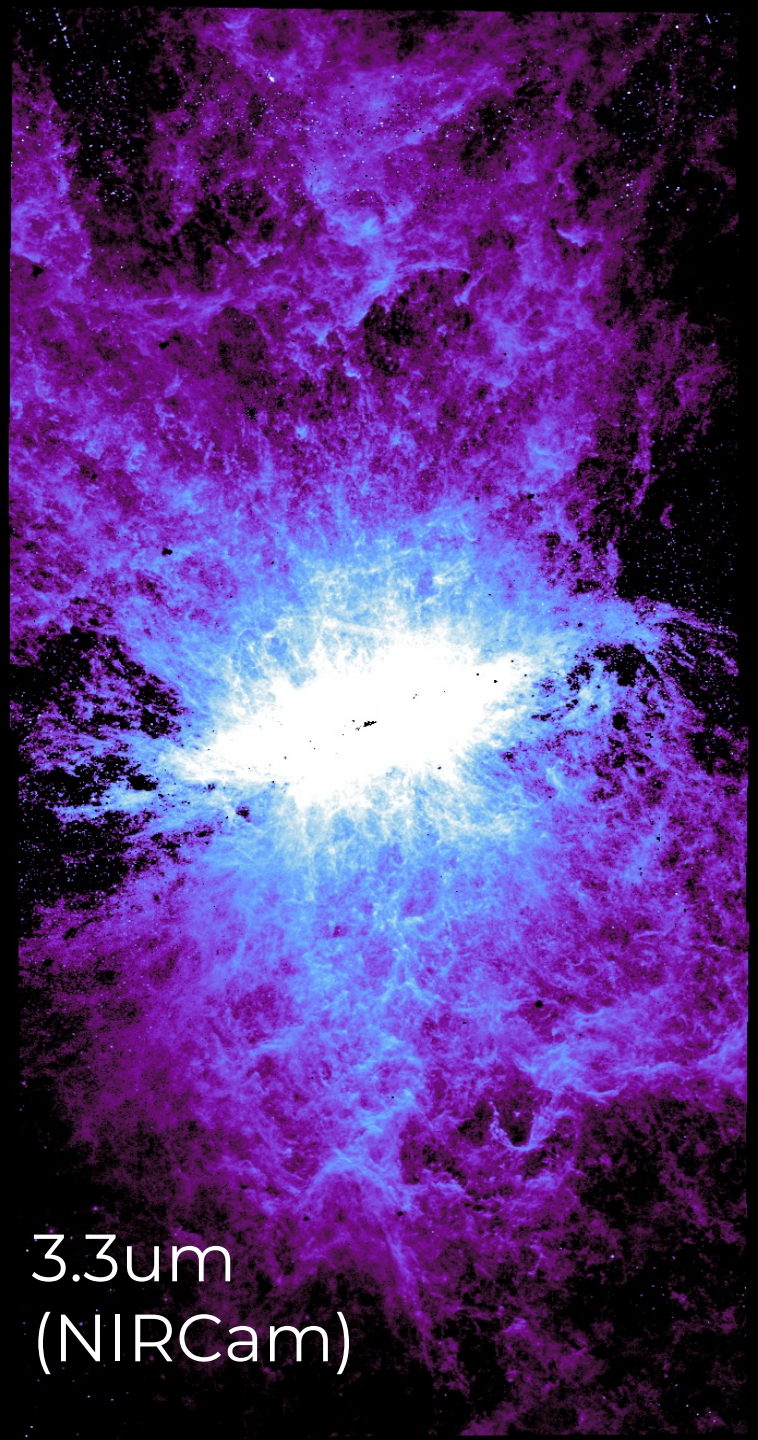
S. Cronin+ 2025, in prep

JWST Image Credit: Alyssa Pagan (STScI)
Spitzer Image Credit: NASA, JPL/Caltech, C. Engelbracht (U. Arizona)



F560W+
F770W+
F1130W
(MIRI)

A. Pagan (STScI)



3.3um
(NIRCam)

Huge thanks to Elizabeth Tarantino, Karl Gordon, & Martha Boyer for NIRCam & MIRI image reduction!!!

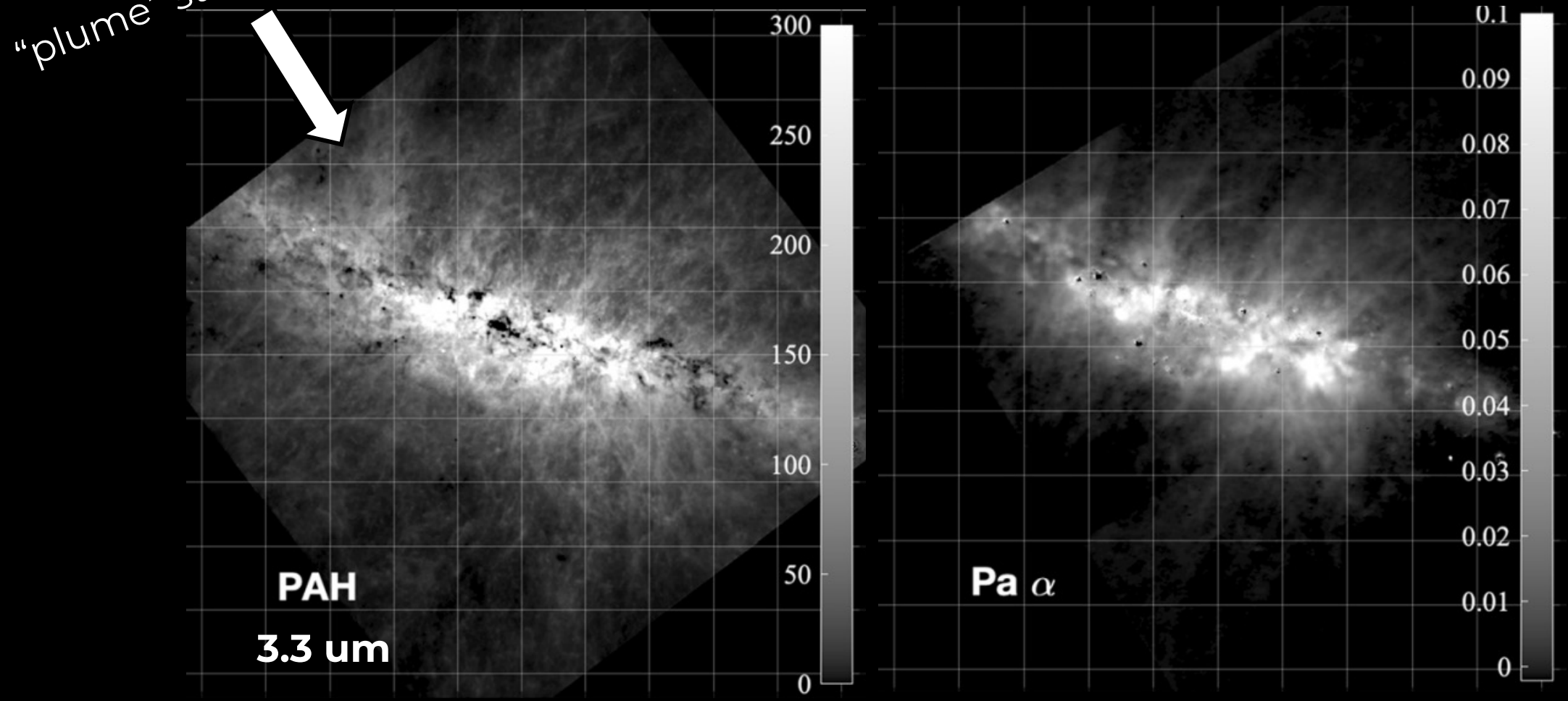
Main Science Questions

Where are PAHs in the wind?

How does the cool wind evolve with distance from the starburst?

PAH emission correlates with ionized gas

…at the base of the wind (out to ~300pc)



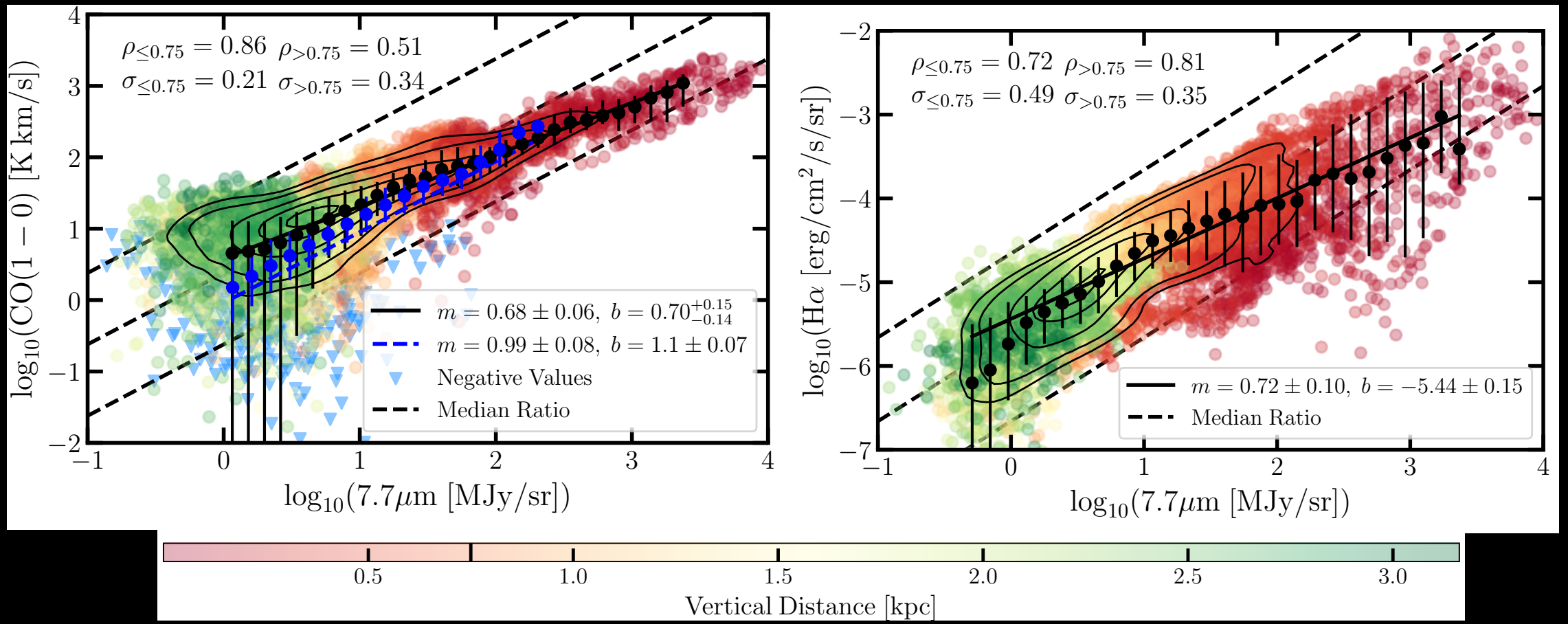
A. Bolatto+2024 (see also D. Fisher+2025)

PAH emission correlates with molecular & ionized gas

...out to ~2.5 kpc above & below the midplane

CO vs. 7.7um

Hα vs. 7.7um

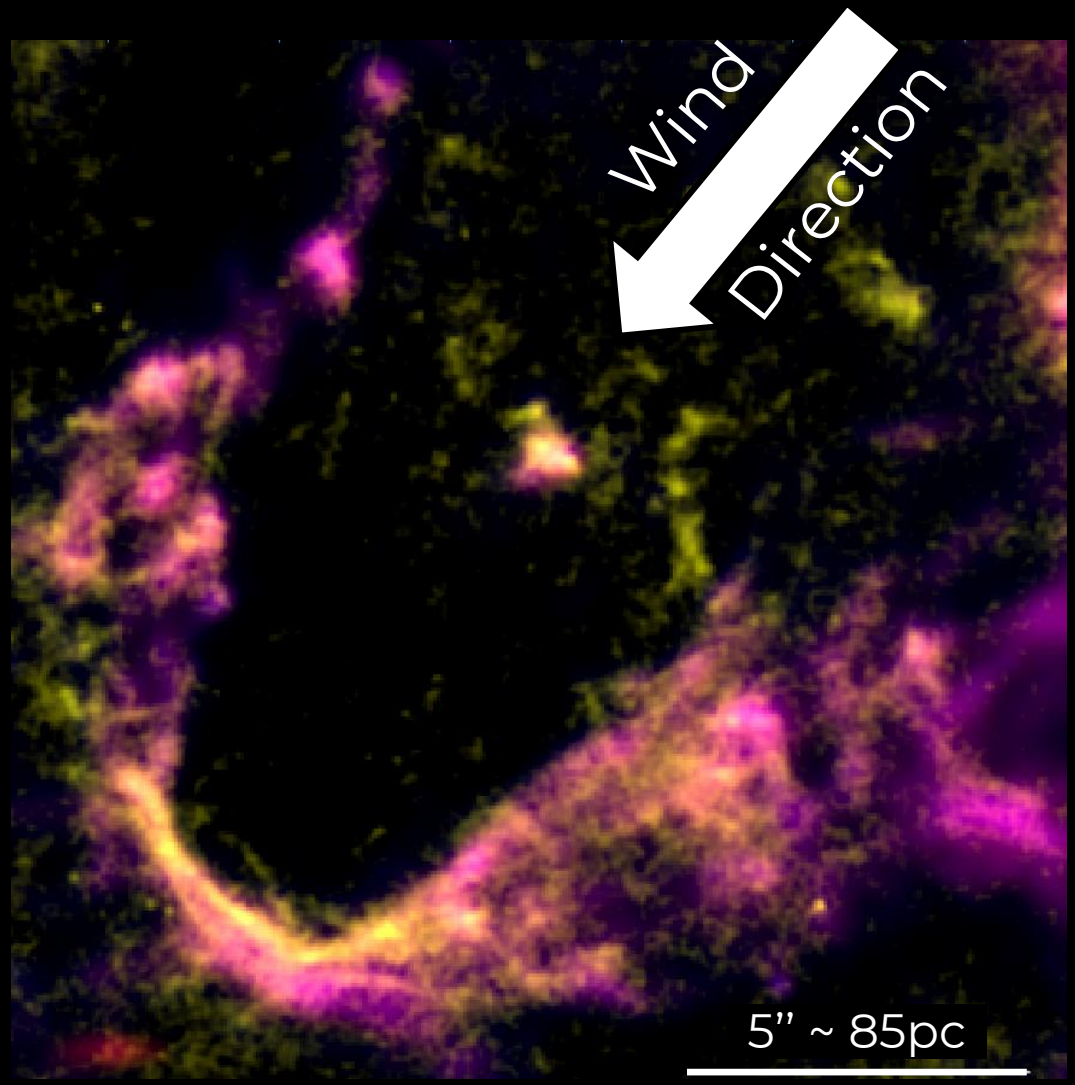


S. Lopez+2025, arXiv:2510.01314 (see also V. Villanueva+2025)

PAHs may trace the surfaces of cold clouds being ionized by UV radiation

Yellow: H-alpha
Purple: PAHs

S. Lopez+2025
arXiv:2510.01314



See also
A. Bolatto+2024,
D. Fisher+2025

Main Science Questions

Where are PAHs in the wind?
surfaces of cold clouds, at the interface of the PDR

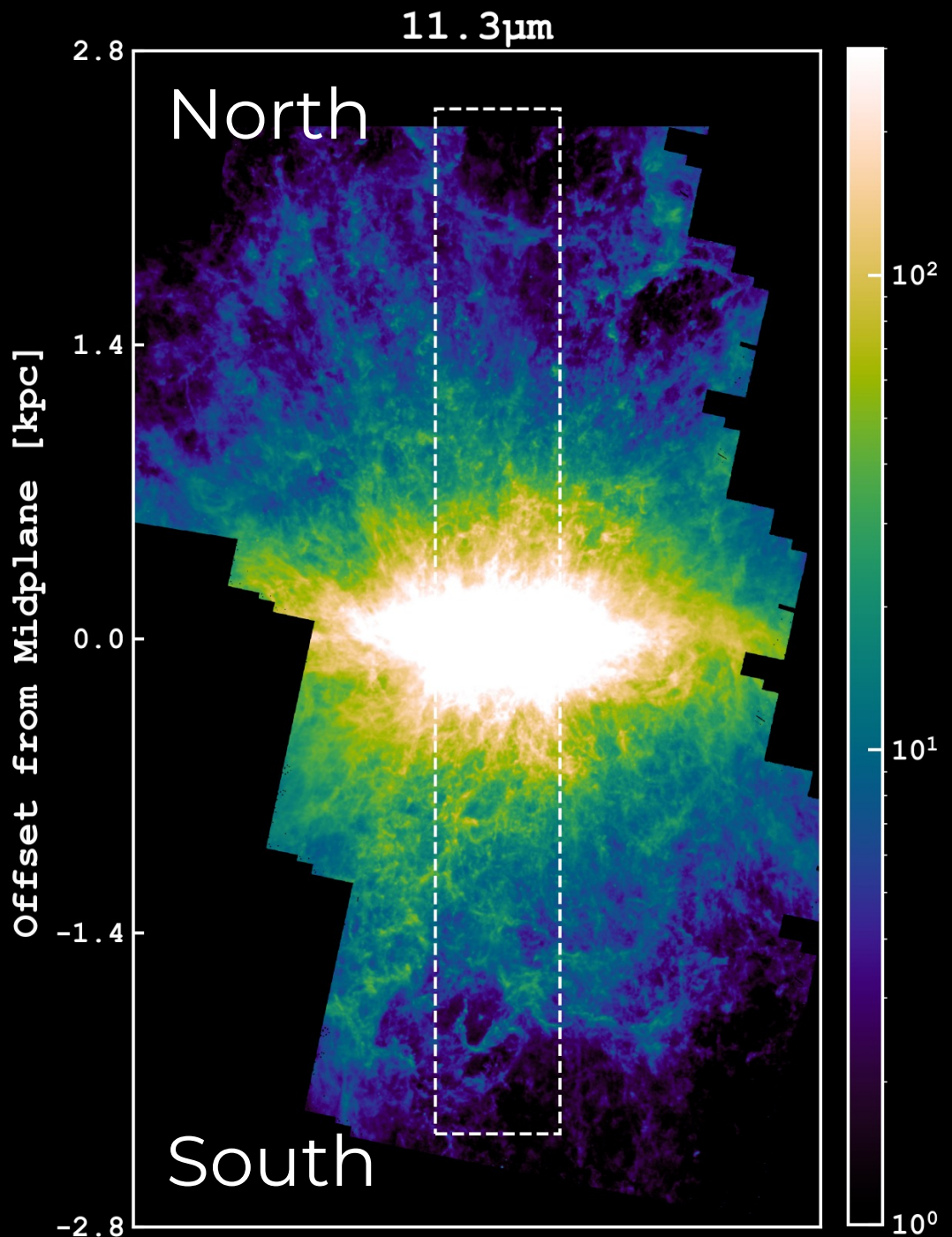
How does the cool wind evolve with distance from the starburst?

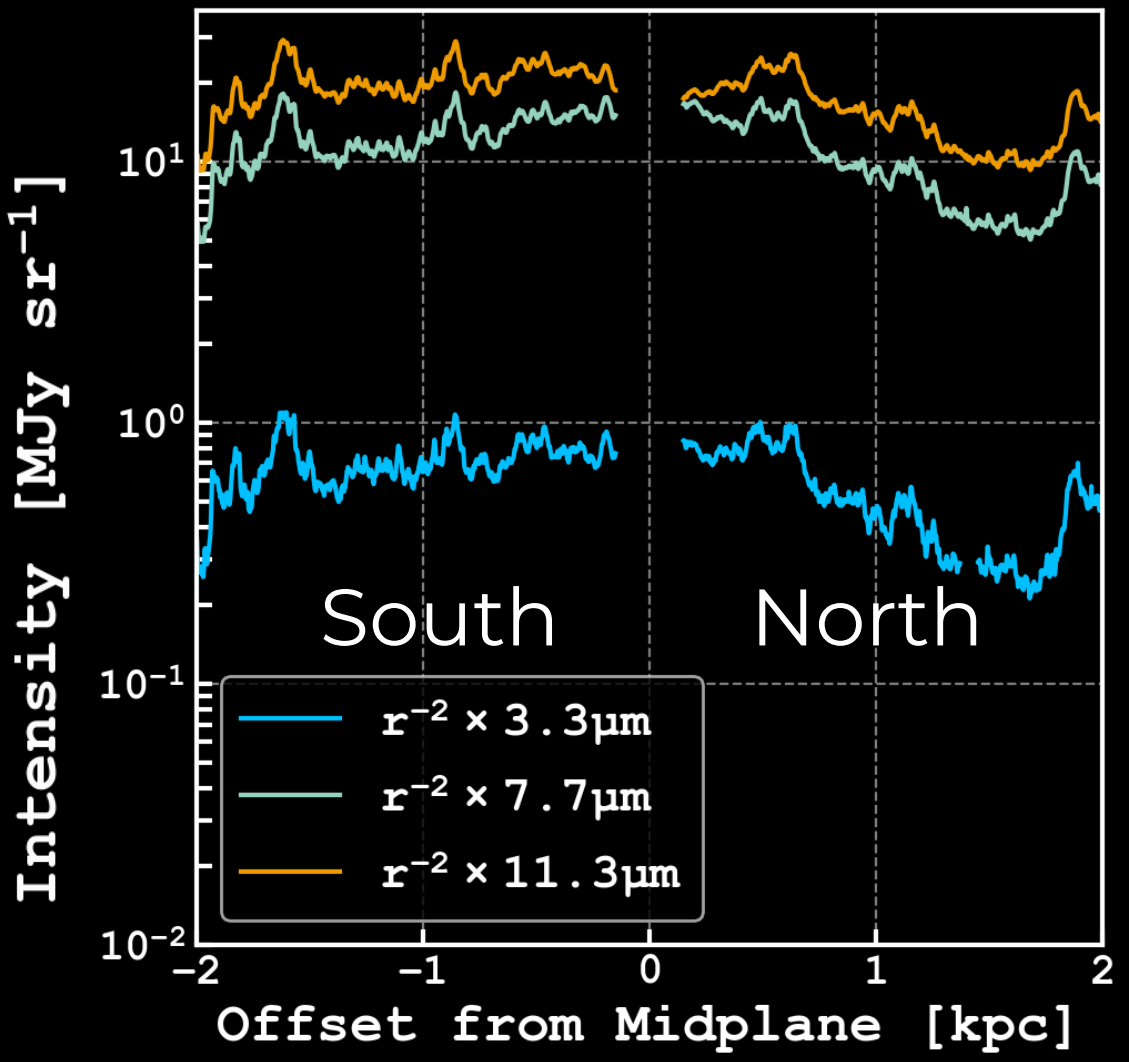
Main Science Questions

Where are PAHs in the wind?
surfaces of cold clouds, at the interface of the PDR

How does the cool wind evolve with distance from the starburst?

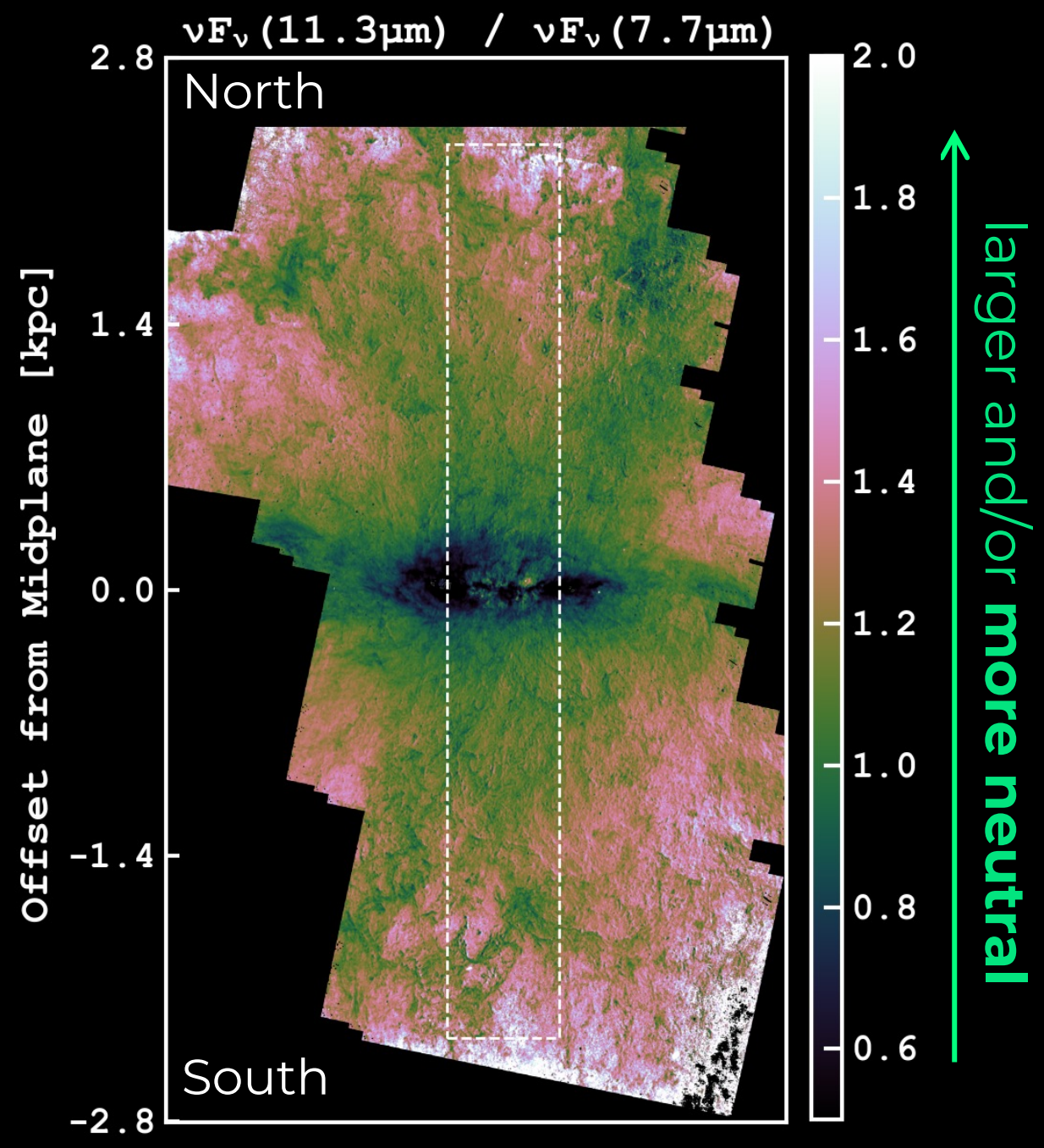
PAH intensity drops with distance from illuminating starburst

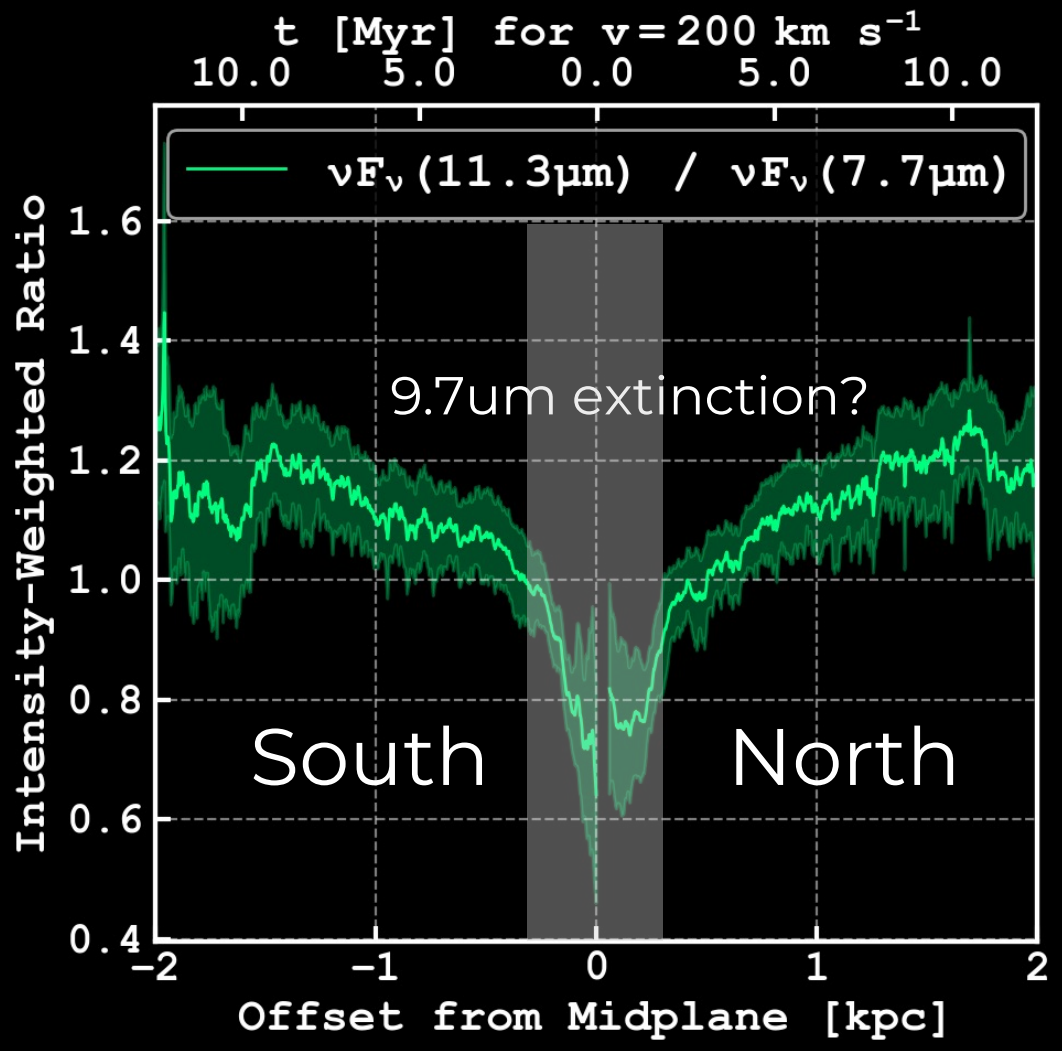




S. Cronin+2025, in prep

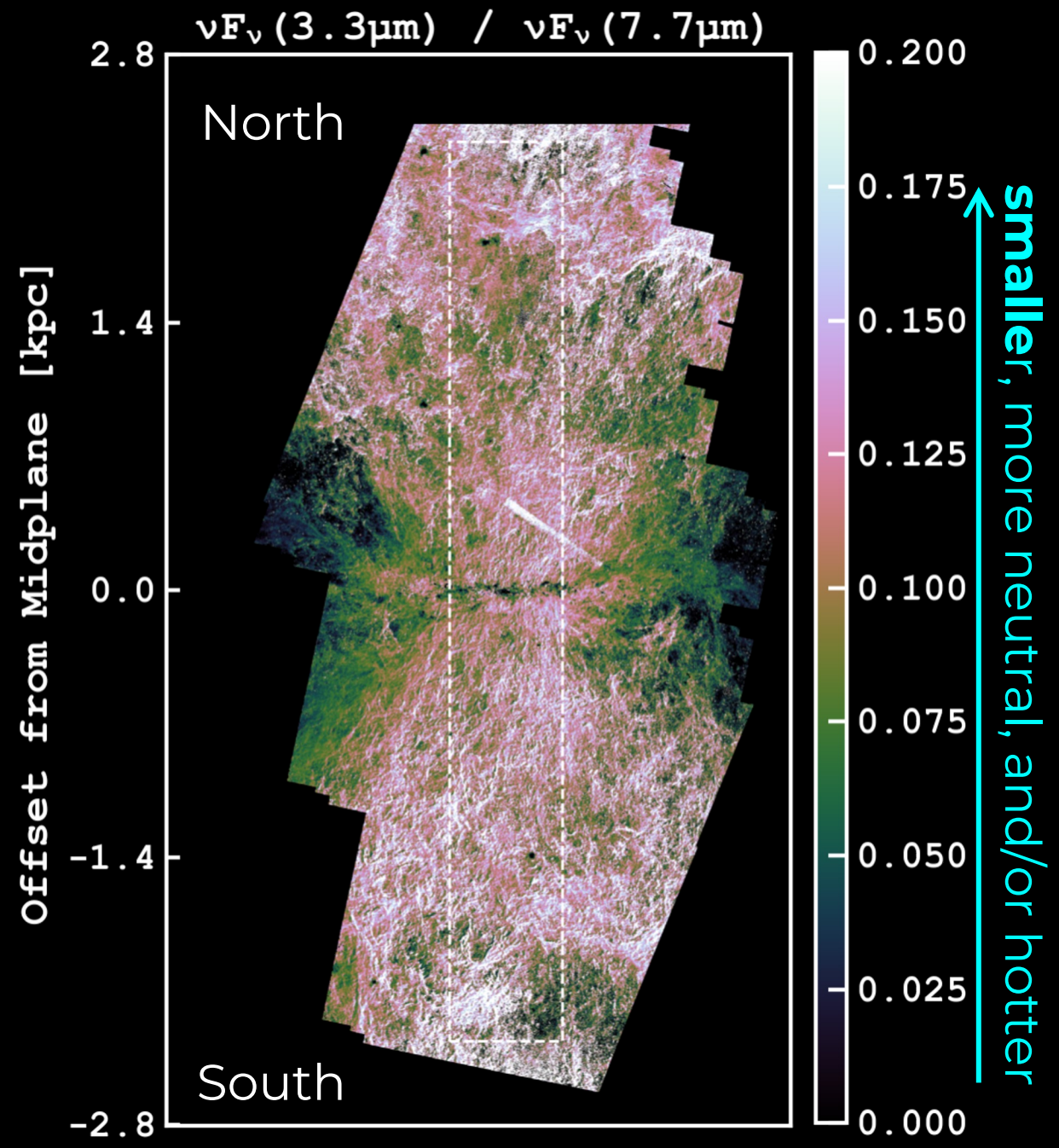
PAH ionization state does not change over 10 Myr.

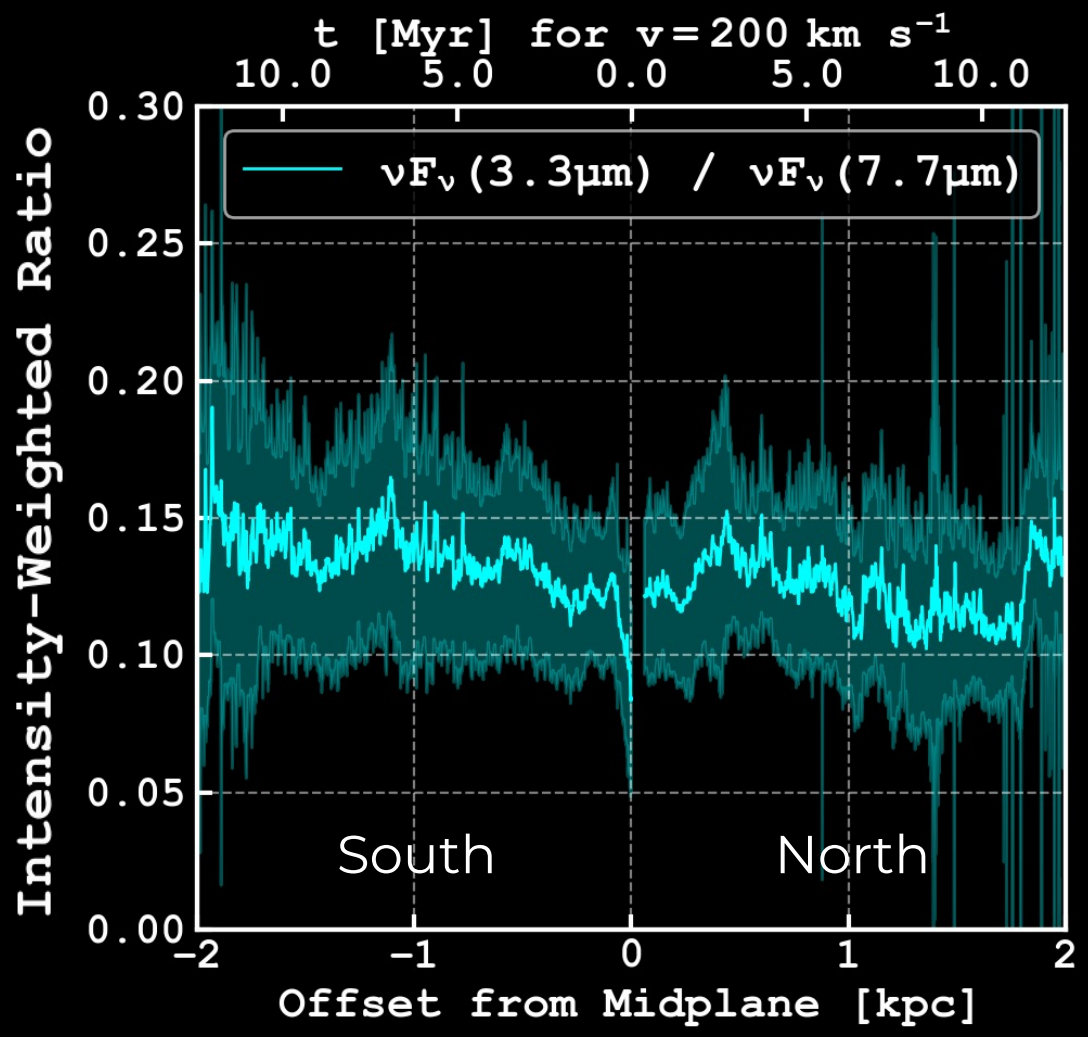




S. Cronin+2025, in prep

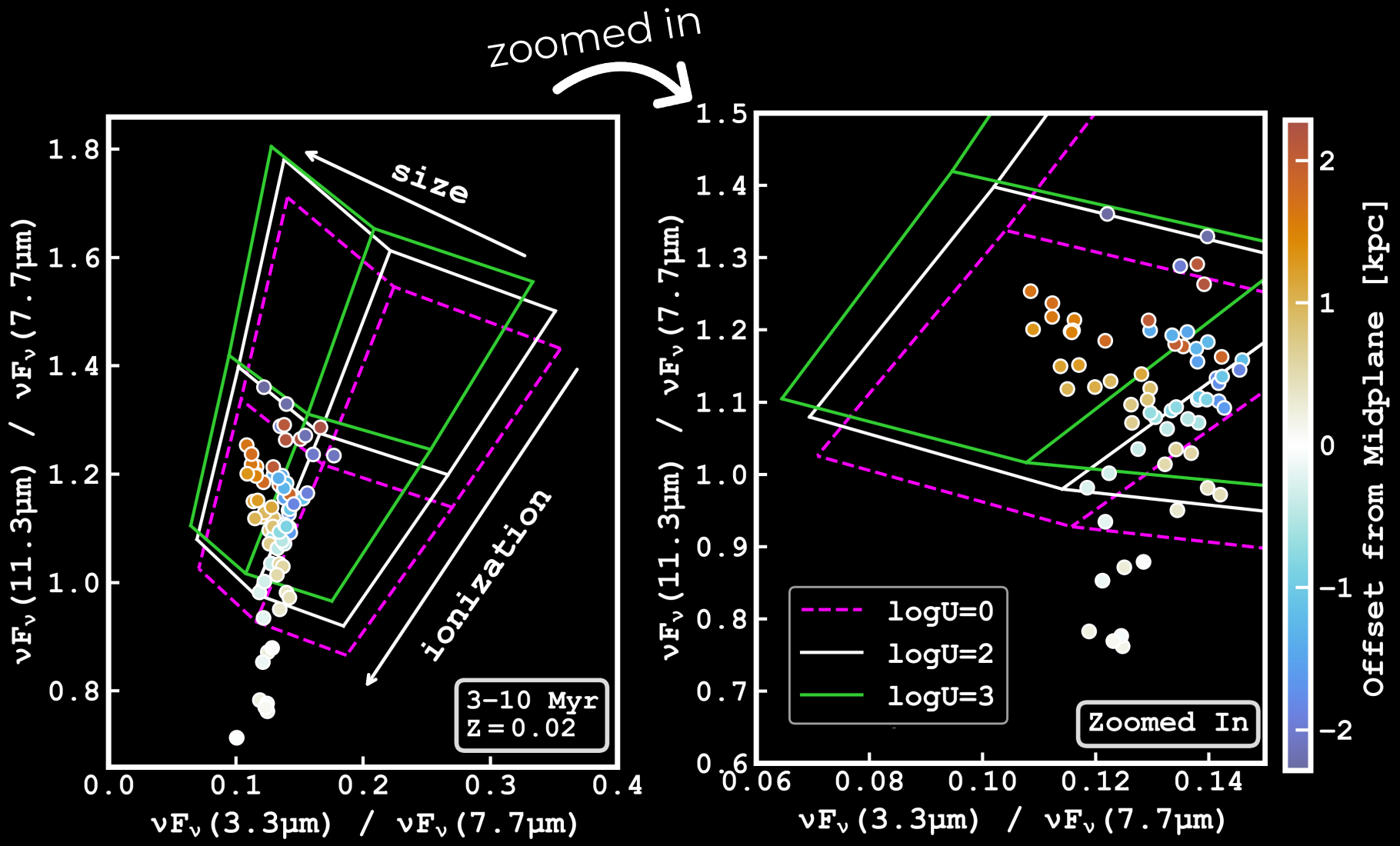
PAH size distribution does not change over 10 Myr.





S. Cronin+2025, in prep

PAHs remain large and ionized throughout the wind



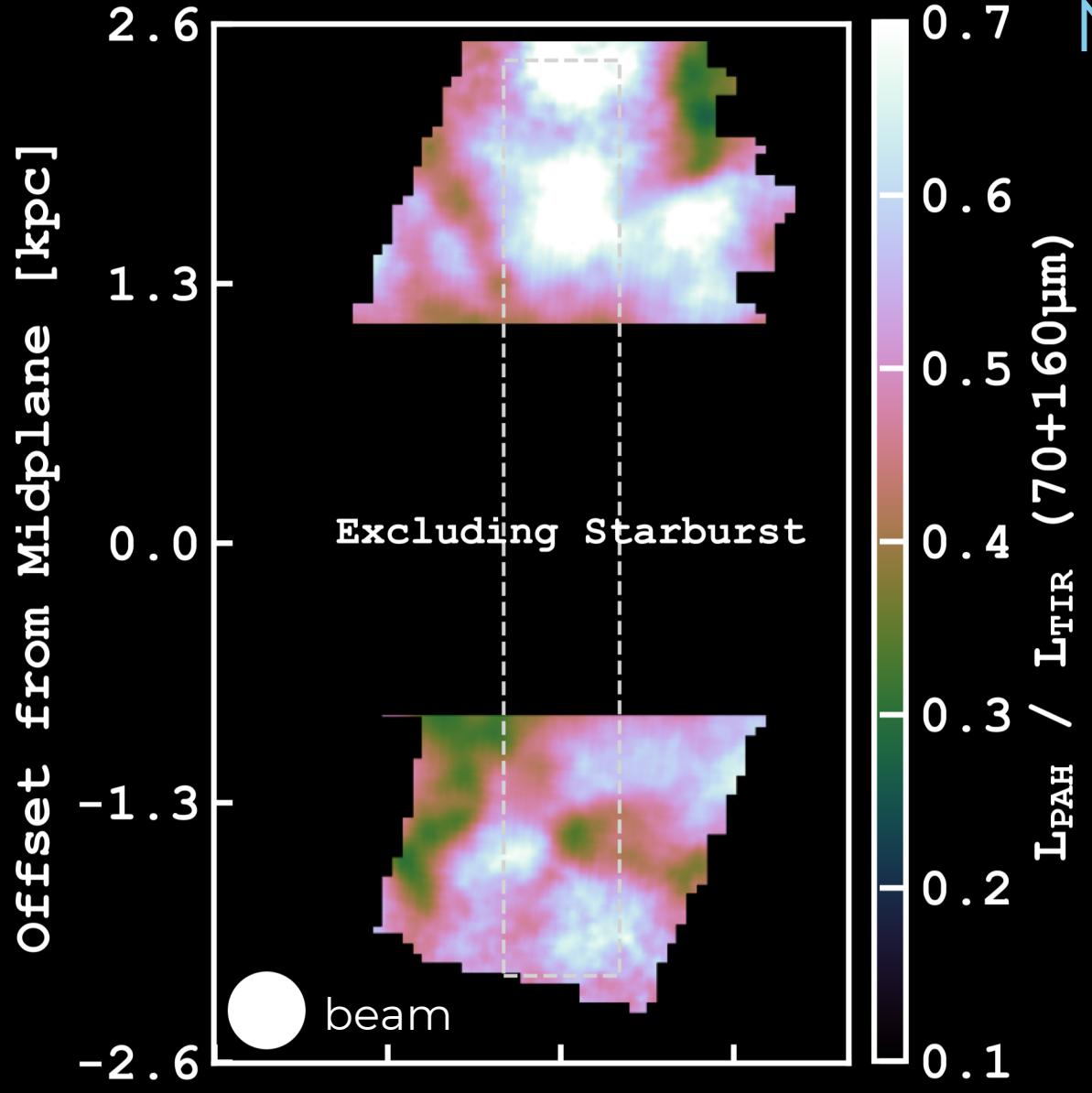
Grids calculated from Draine+2021.

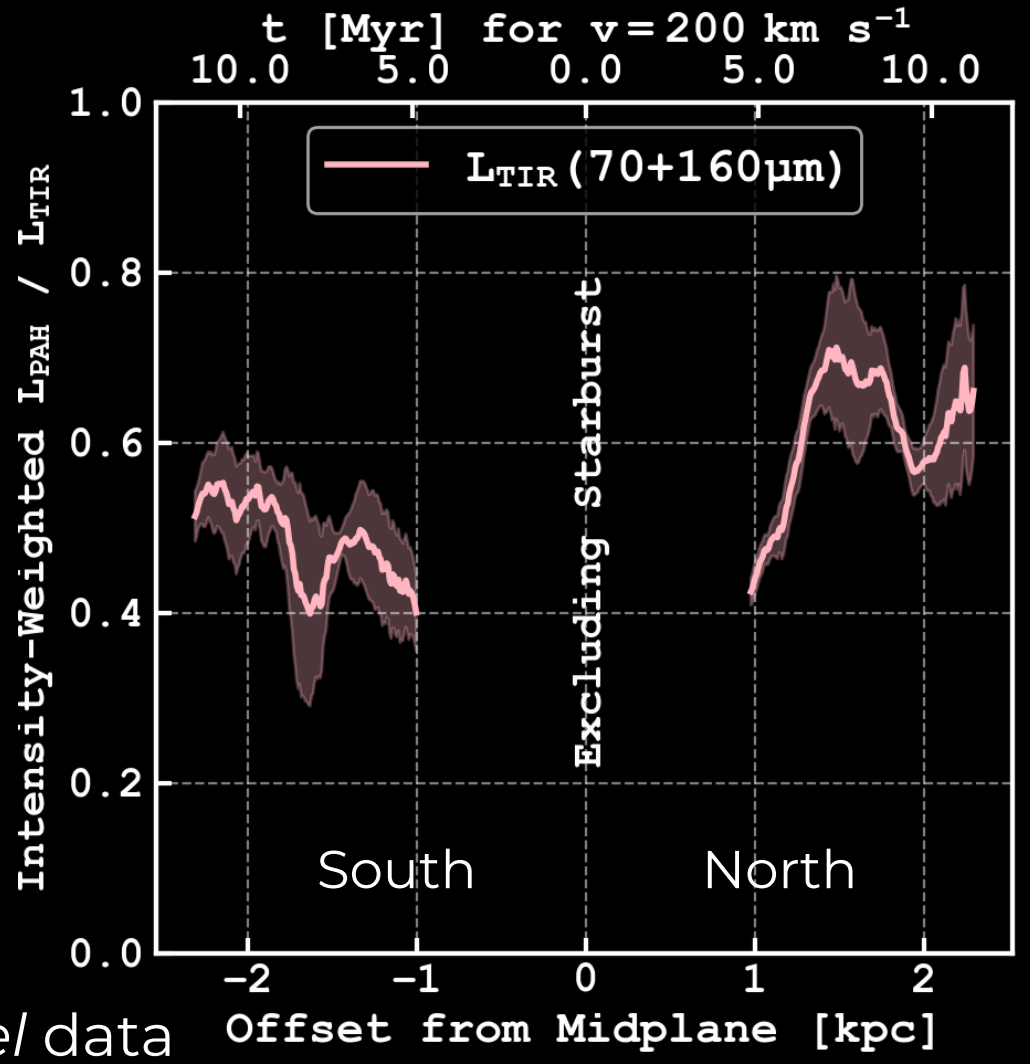
Results robust to 3 or 10 Myr starburst model.

Results consistent with grids using 3.3/11.3um ratios.

S. Cronin+2025, in prep

No clear change in PAH fraction (proxy for q_{PAH}) over 10 Myr.





S. Cronin+2025, in prep

TIR proxies from 70um and 160um *Herschel* data (Roussel+2010) with Galametz+2013 calibrations.

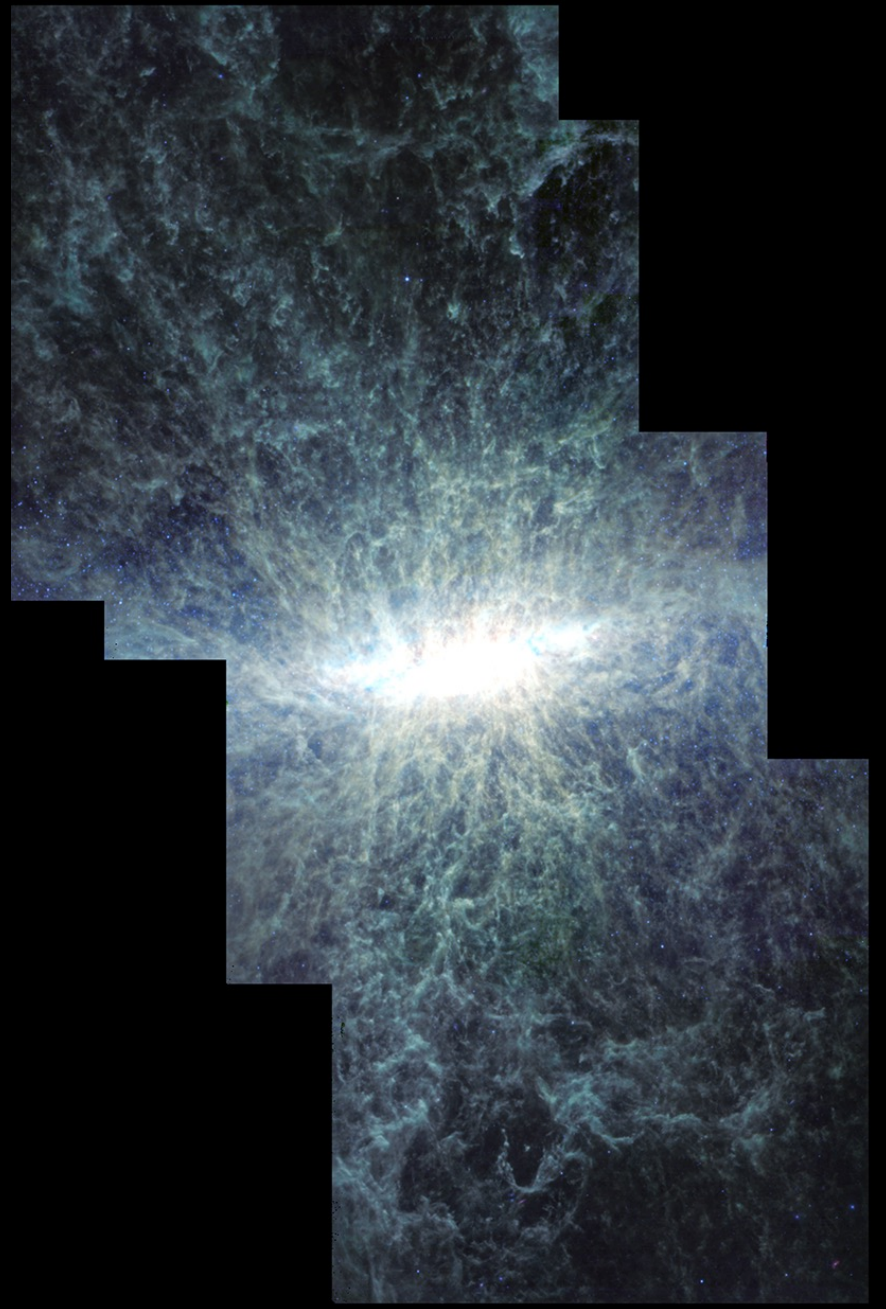
Main Science Questions

Where are PAHs in the wind?
surfaces of cold clouds, at the interface of the PDR

How does the cool wind evolve with distance from the starburst?
No clear evolution over 10 Myr. PAHs may be protected from hot wind.

Key Takeaways

- PAH emission may arise from the surfaces of cold clouds exposed to UV radiation.
- PAHs state and fraction hint at little evolution of the cool phase over ~2kpc or 10 Myr. *See Helena Richie's talk on Friday to see what simulations say!*
- Do PAHs survive out to the CGM? *If only we had a bigger JWST image!!!!*



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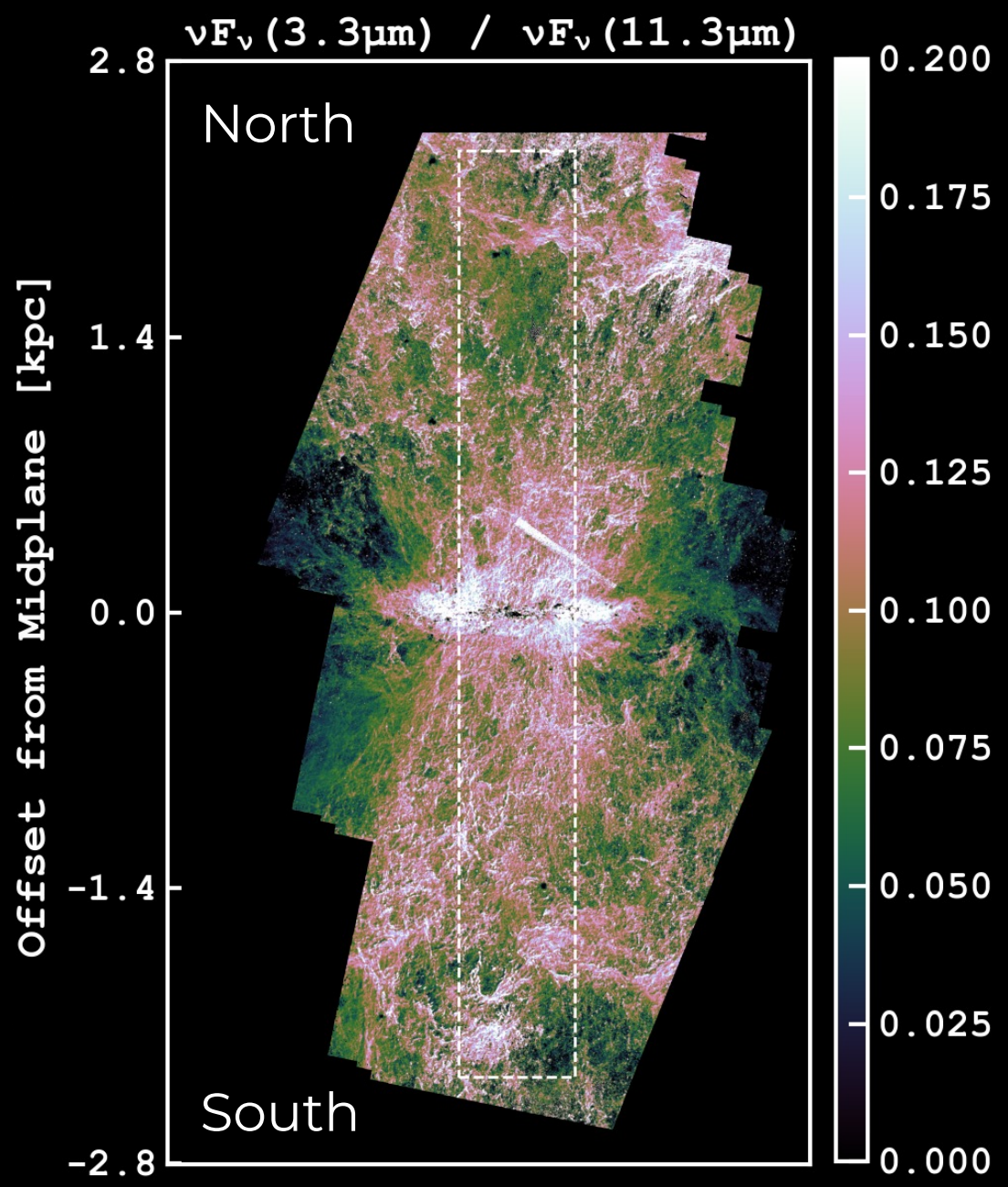
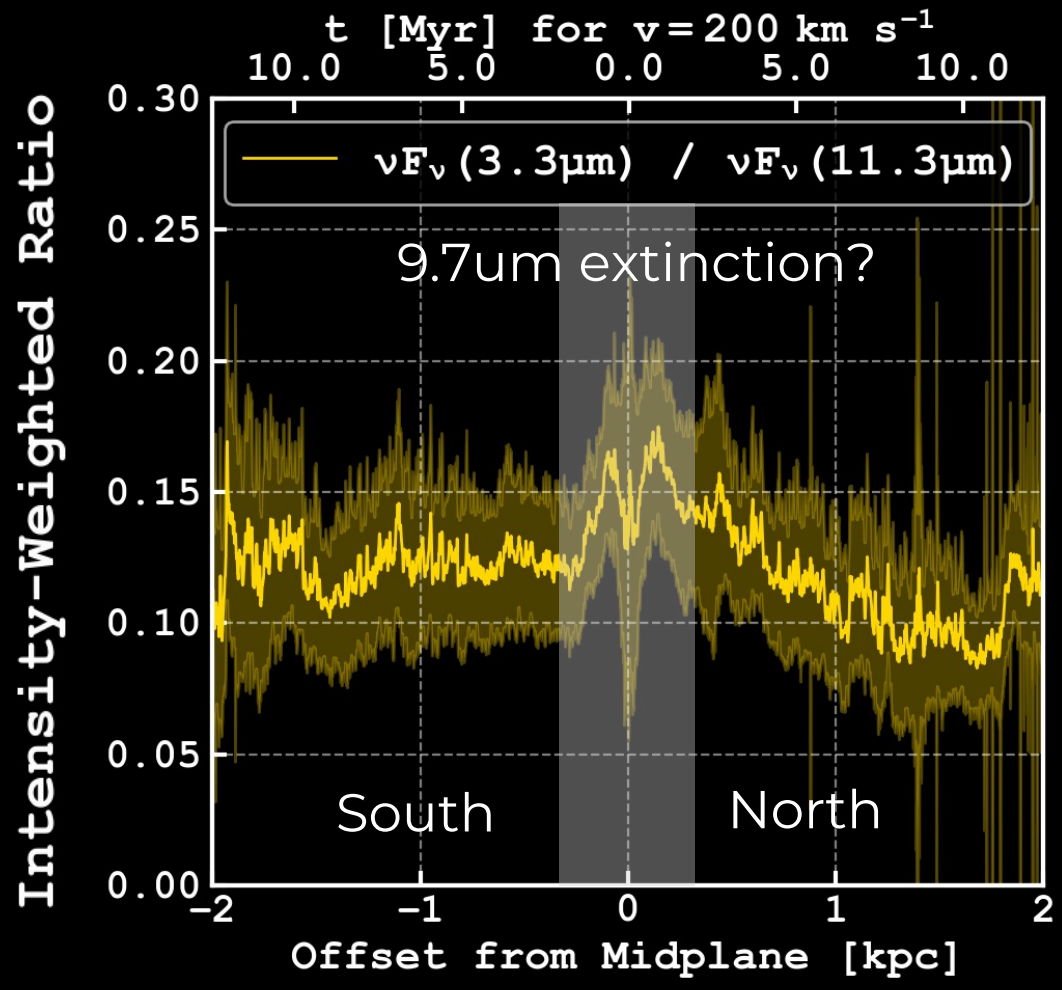
MIRI Image Credit: Alyssa Pagan (STScI)

extra slides

PAH ratios show little evidence of cool-wind processing





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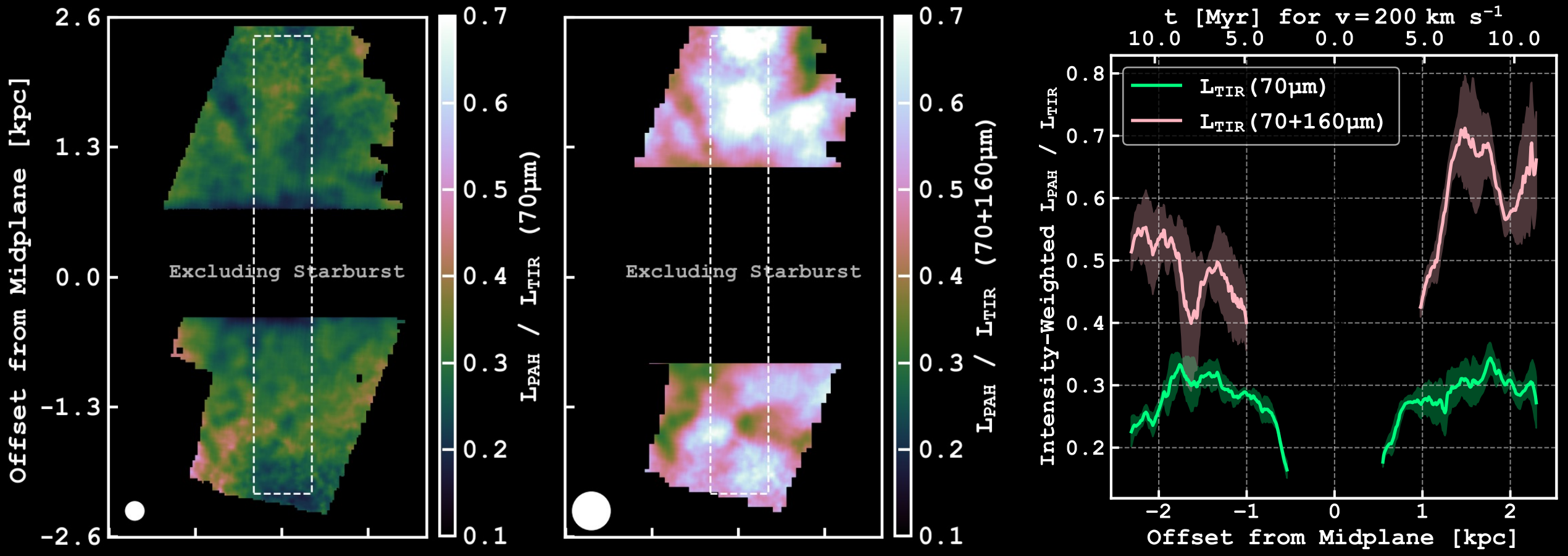
Little change in fraction of dust mass found in PAHs (L_{PAH}/L_{TIR})



LTIR proxies from 70um and 160um *Herschel* data (Roussel+2010) and adopting Galametz+2013 calibrations.

S. Cronin+2025, in prep