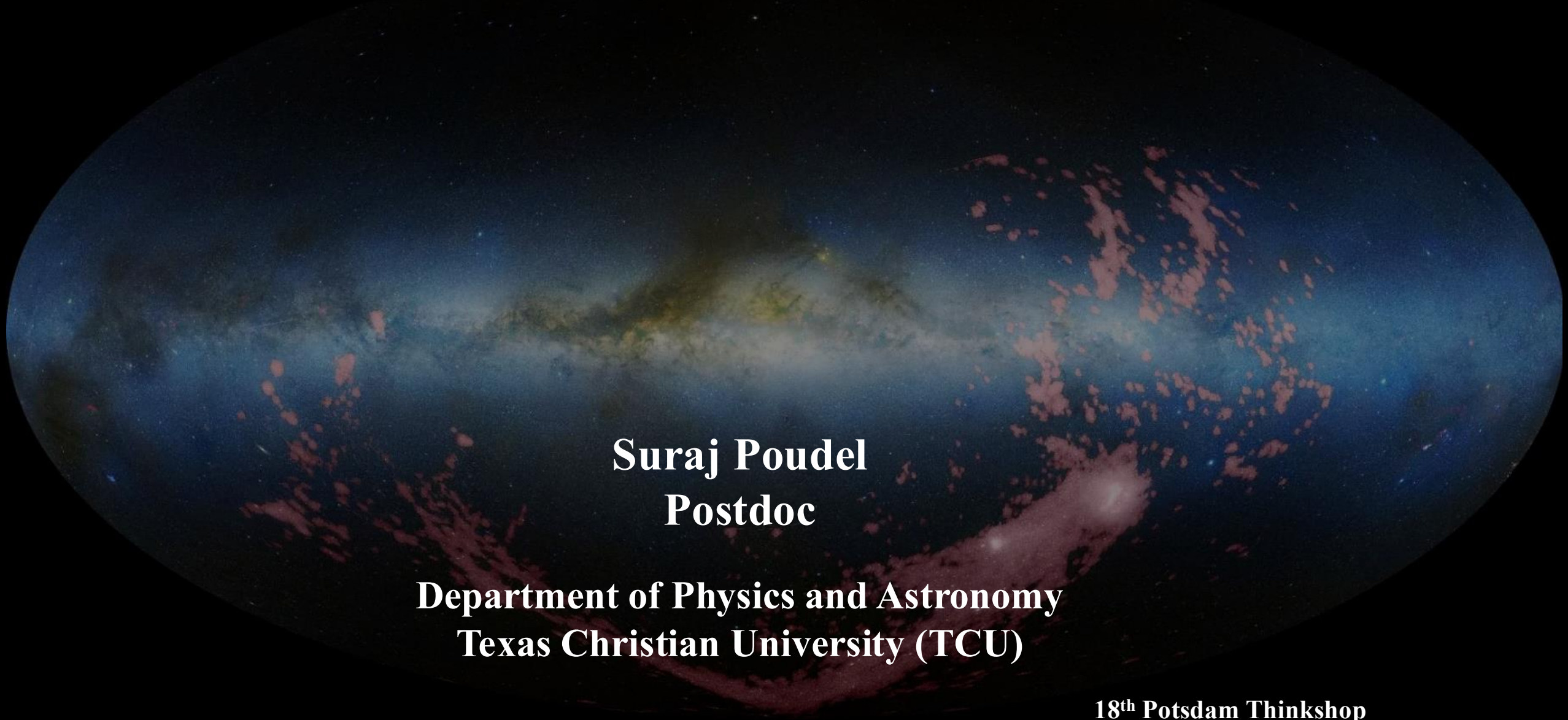
High-Velocity Outflows of the LMC's 30 Doradus Starburst



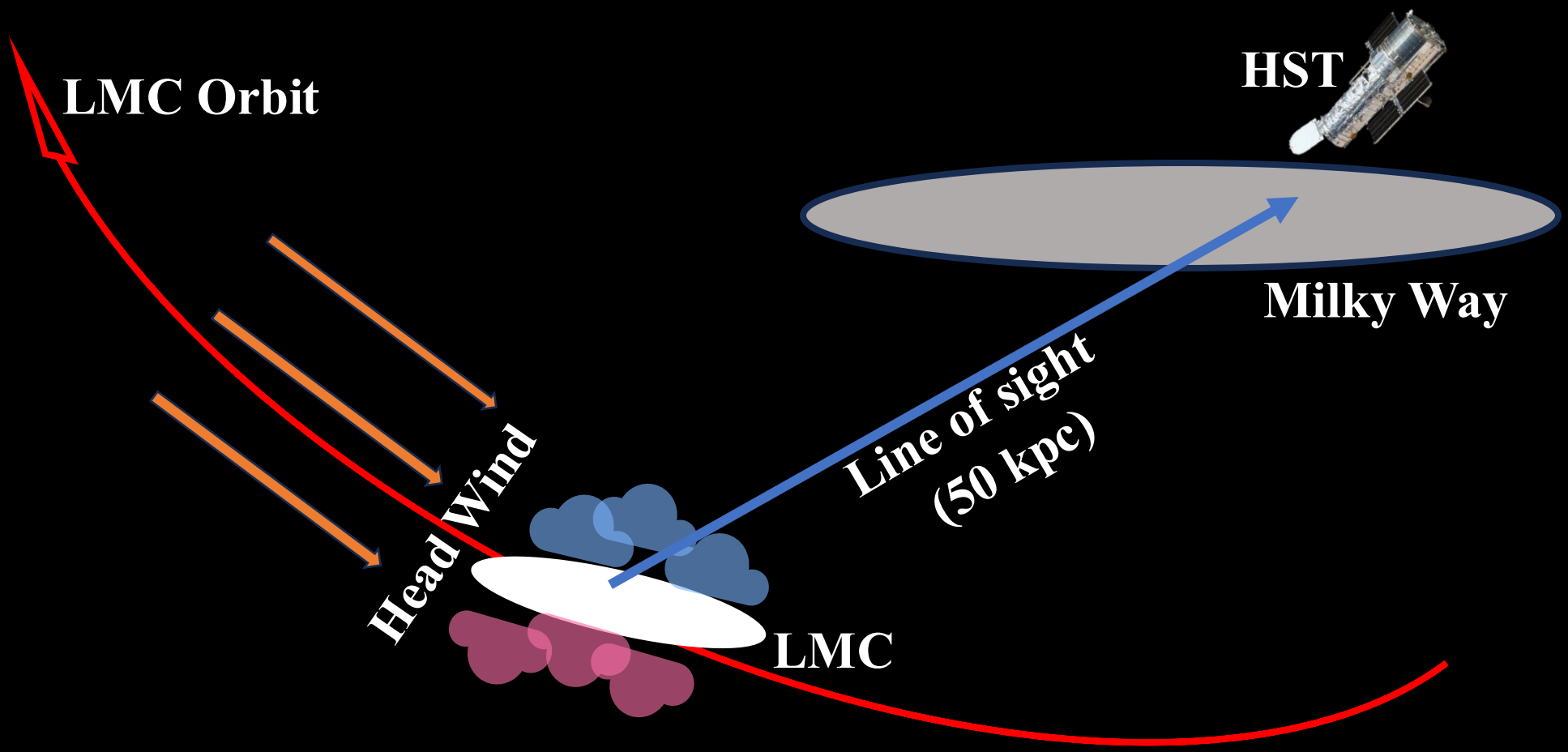
Suraj Poudel
Postdoc

Department of Physics and Astronomy
Texas Christian University (TCU)

Image Credit: *David Nidever, NRAO/AUI/NSF and Mellinger, Leiden/Argentine/Bonn Survey, Parkes Observatory, Westerbork Observatory, and Arecibo Observatory*

18th Potsdam Thinkshop
Leibniz Institute for Astrophysics Potsdam (AIP)

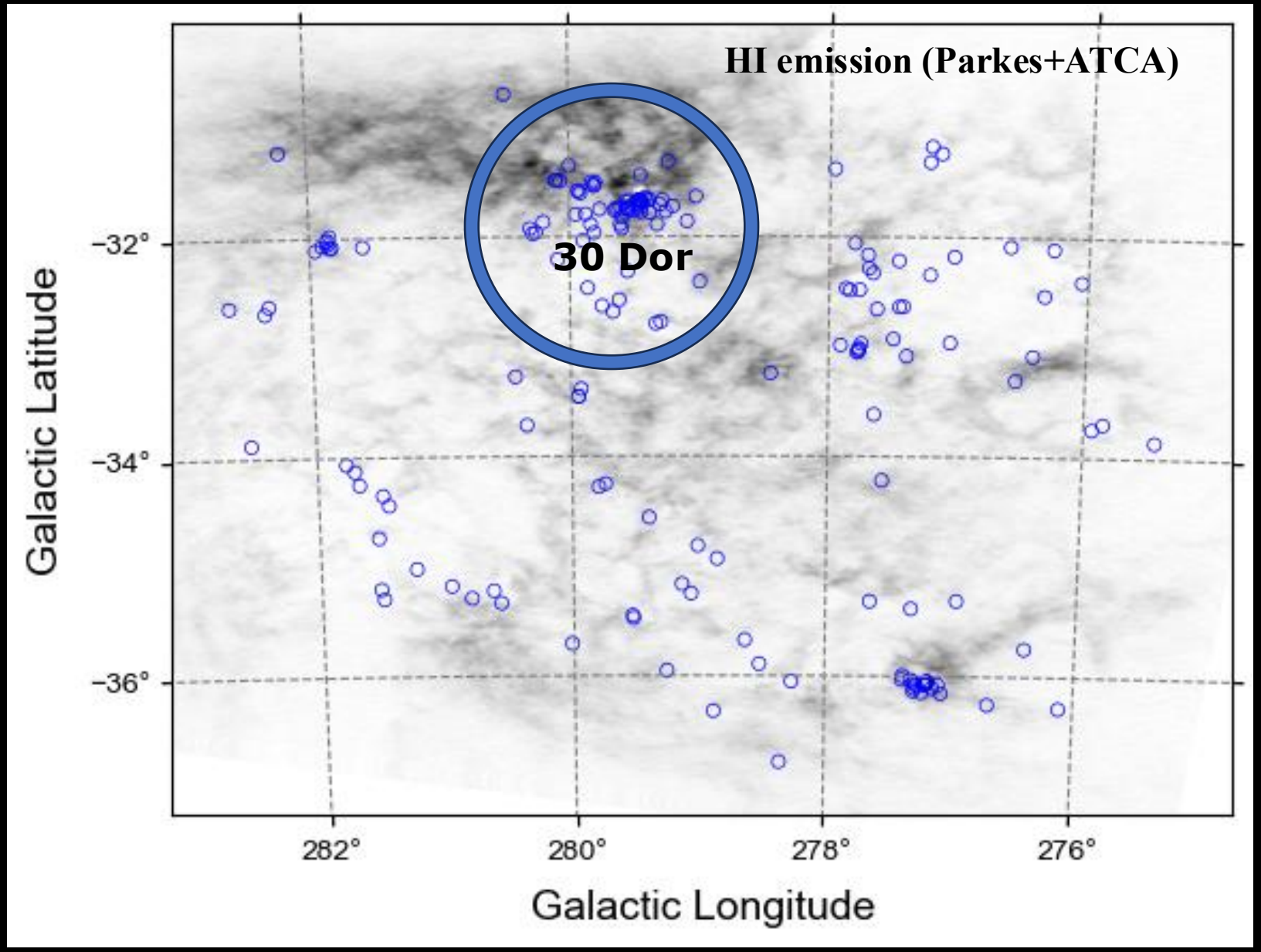
LMC: A Very Good Candidate for Studying Galactic Winds



We utilize the HST UV absorption spectroscopy with HI 21 cm emission line observations from GASS and GASKAP surveys

The LMC's Galactic Wind through the Eyes of ULLYSES

- **Ultraviolet Legacy Library of Young Stars as Essential Standards (ULLYSES: Roman-Duval et al. 2020)**
- **Spectroscopic library of 182 young stars in LMC**



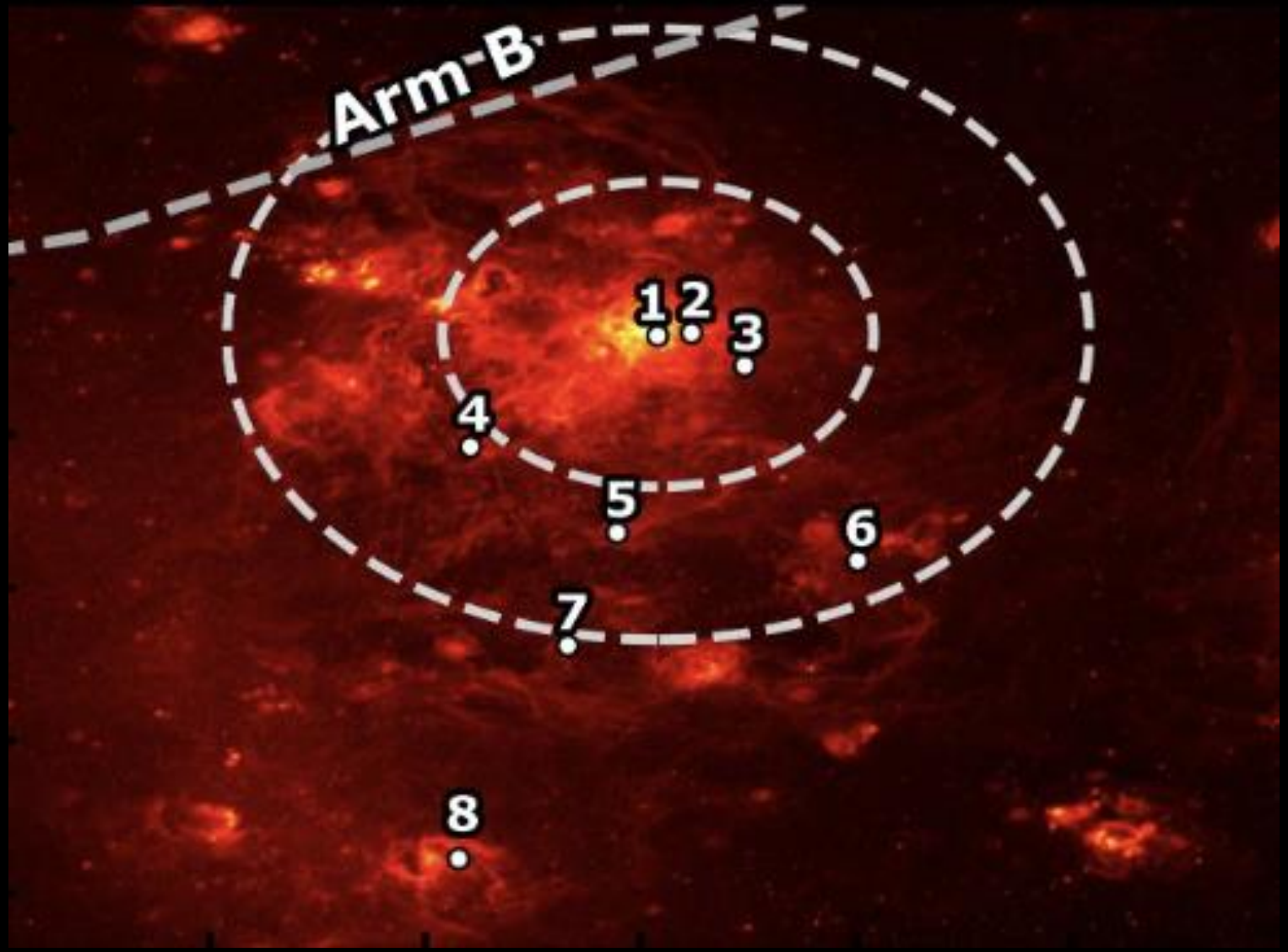
An HST Legacy Archive project

The Team

Suraj Poudel
Kat Barger (PI)
April Horton
Jo Vazquez
Andrew Fox
Frances Cashman
Jason Tumlinson
Nicolas Lehner
Chris Howk
Elena D'Onghia
Scott Luchini
Dhanesh Krishnarao
N. McClure-Griffiths

The 30 Doradus Starburst Region

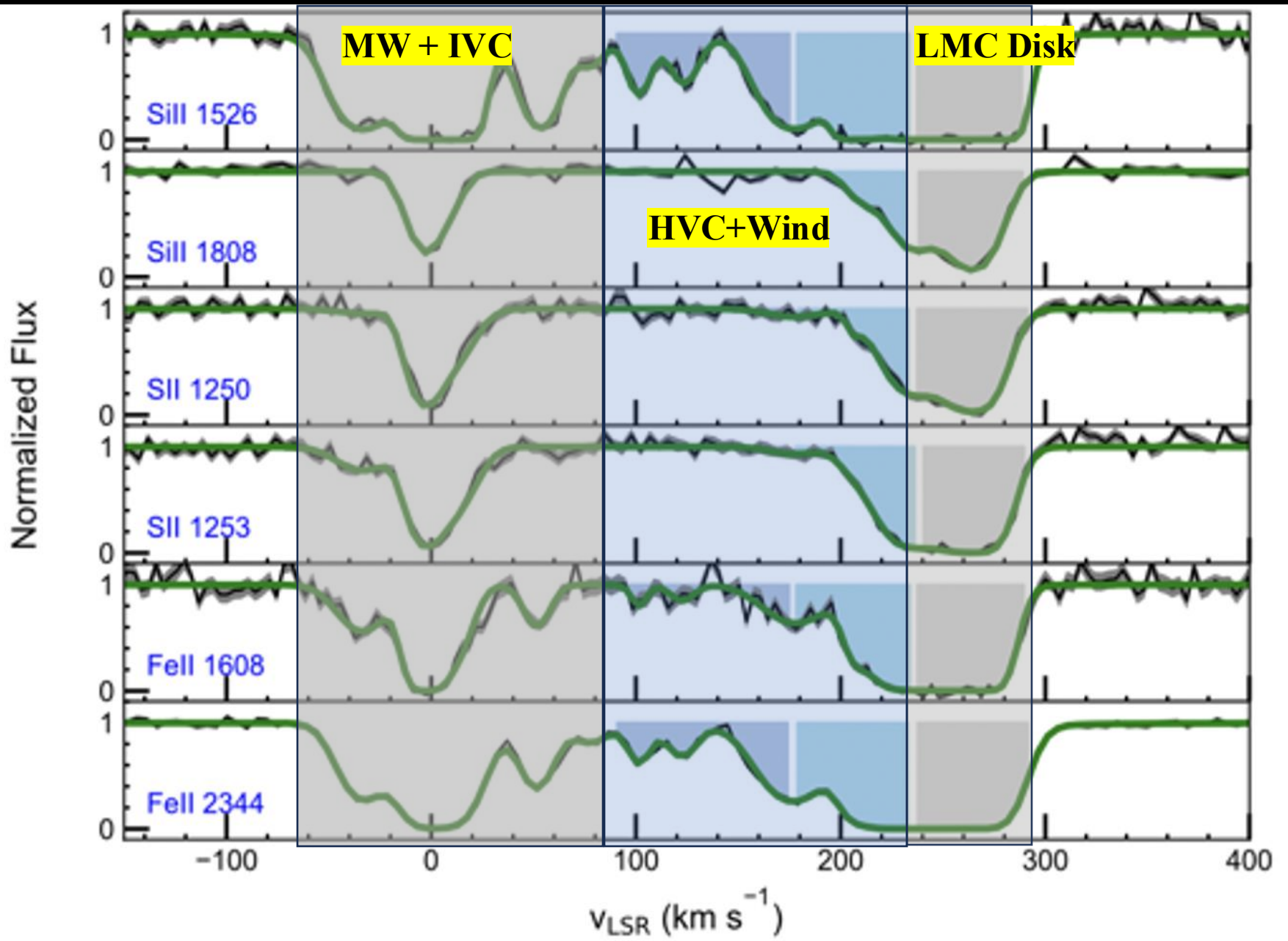
- 8 stellar sightlines with HST/STIS spectra with velocity resolution, FWHM=6.5 km/s
- Within ~1.5 degrees from the center of 30 Doradus
- We only selected the sightlines which are in the opposite side of the gaseous filament



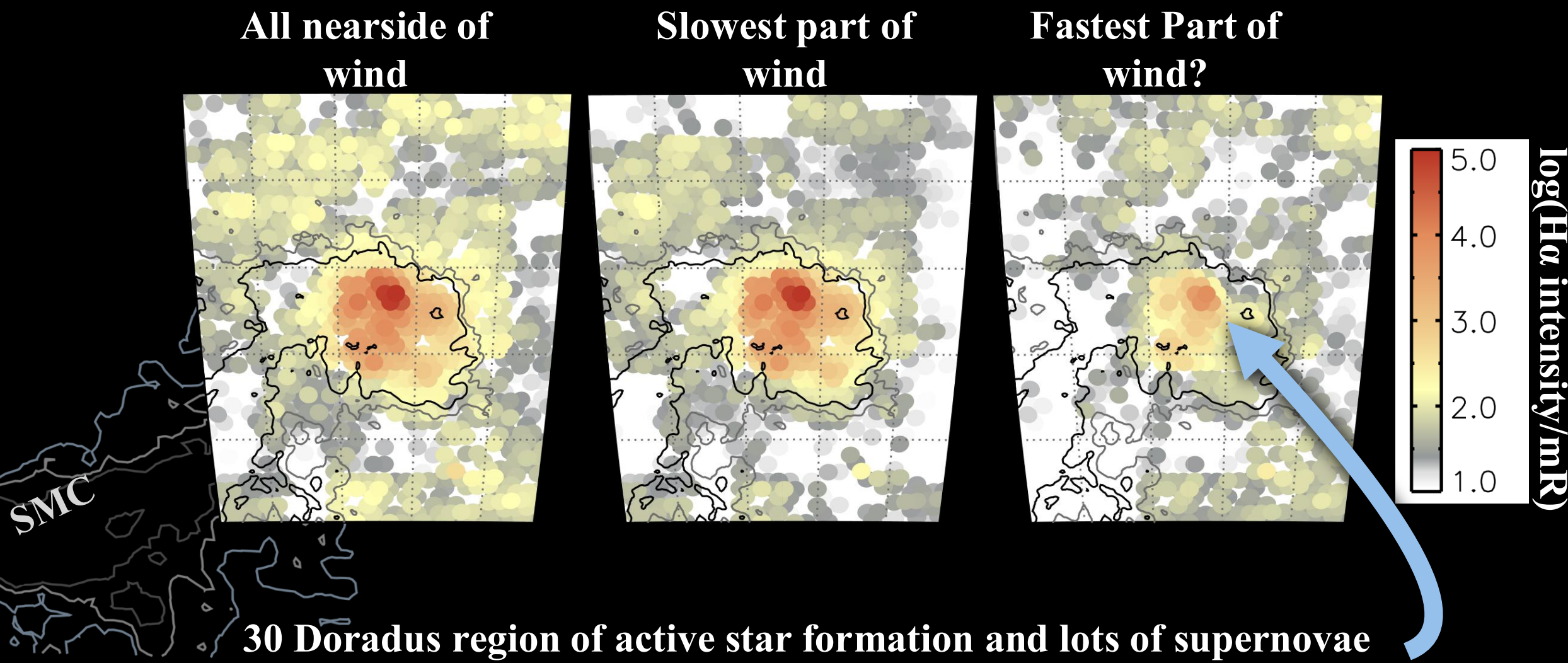
Hα map: Magellanic Cloud Emission-line Survey (MCELS)

Identifying the Absorption from the LMC wind:

- Voigt profile fitting (Lorentzian+Maxwell Boltzmann) to UV lines
- We compare UV absorption with H I-21 cm emission with GASKAP
- High Velocity Clouds (HVCs): +175 > V_{lsr} > +90 km/s



LMC's Nearside Galactic wind in Hα emission



Ciampa + Barger + 2021

MW

HVC at V_{LSR}=150 km/s
(Richter et al. 2015)

Foreground HVC < 13.3 kpc

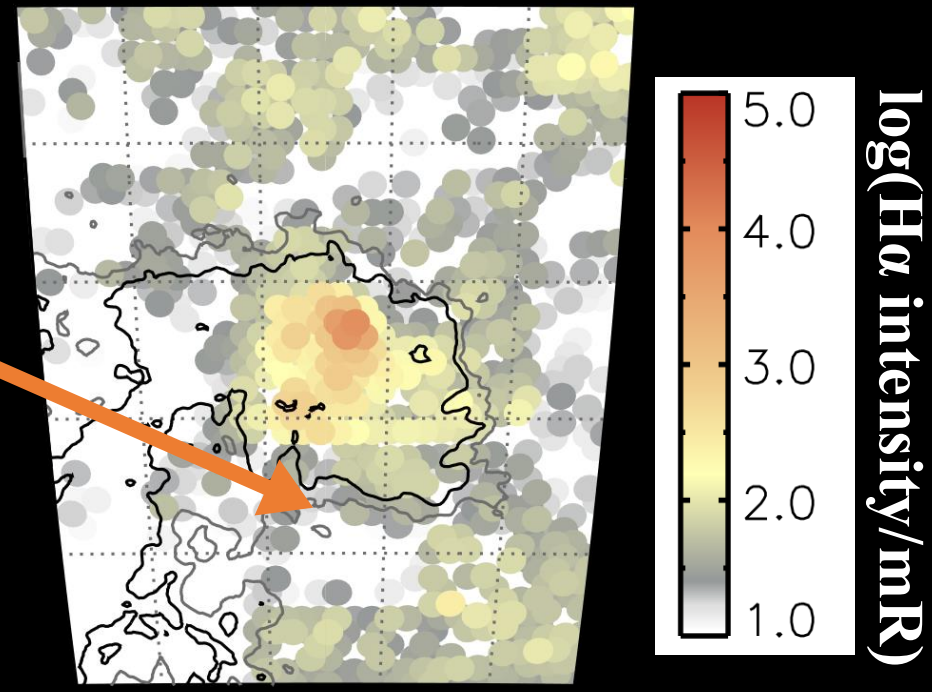
HI emission
de Boer + 1990

LMC

UV absorption
Lehner+2007
Lehner+2009
Barger +2016
Howk+2002
Zheng+2024

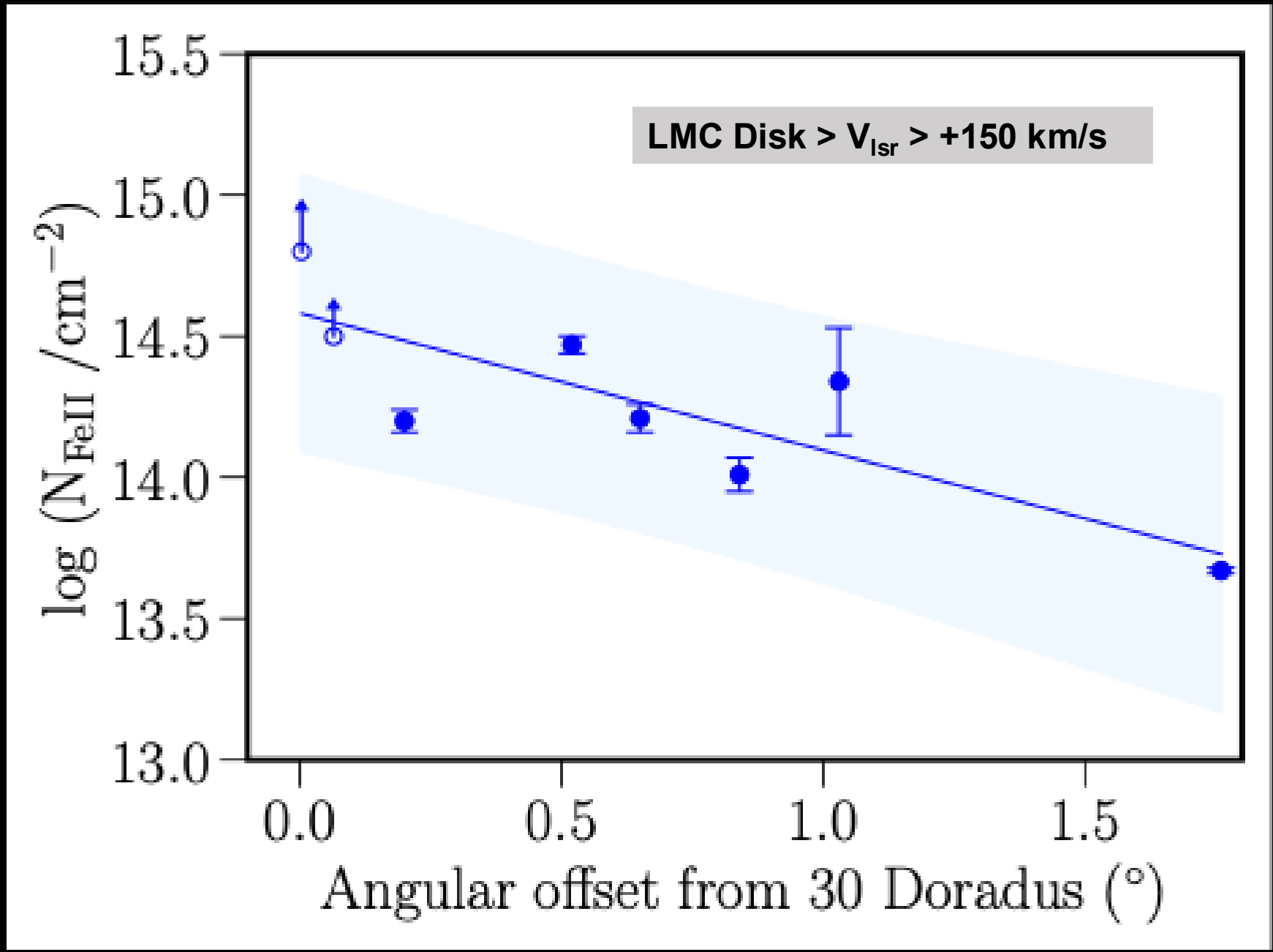
[OIII] emission
Redman+2003

Fastest Part of wind?



Radial Distribution of the Gas

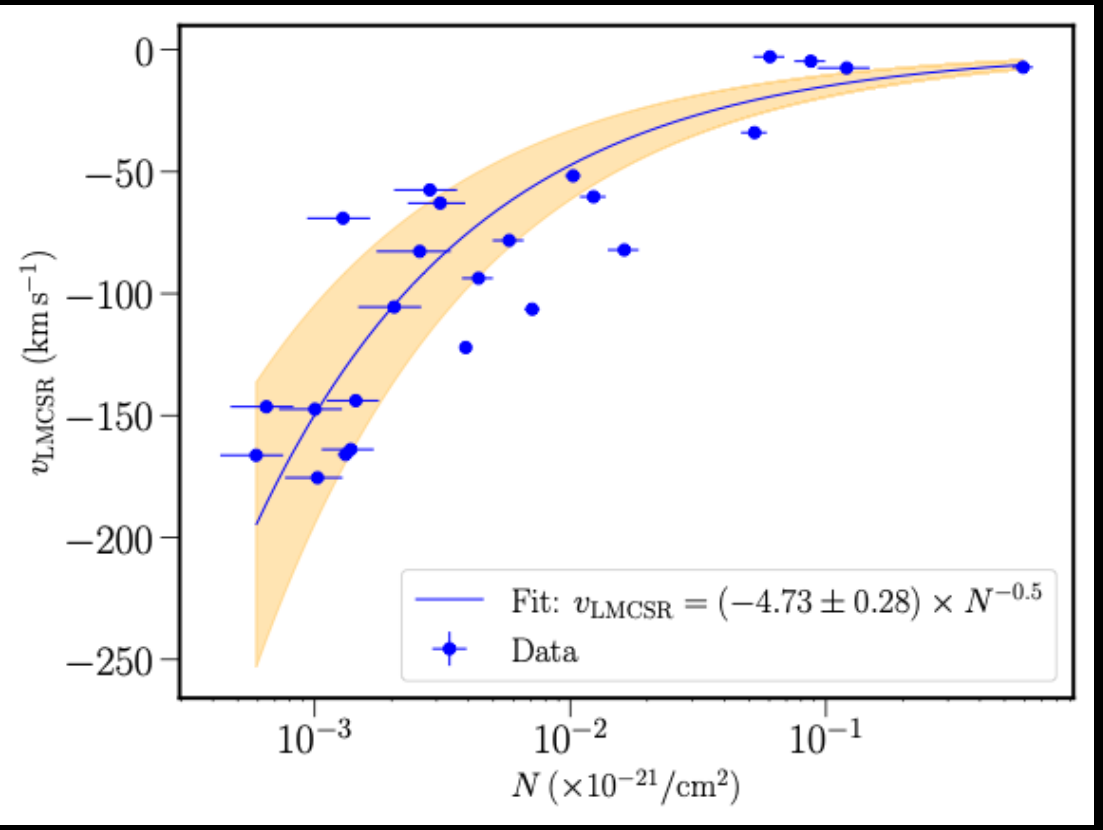
- Radial decline in total integrated column density for Fe II, Si II, and OI ions within (LMC disk) > V_{LSR} > +150 km/s
- However, the radial decline is not very significant for (LMC disk) > V_{LSR} > +100 km/s
- What about the V_{LSR} = 100-150 km/s gas?

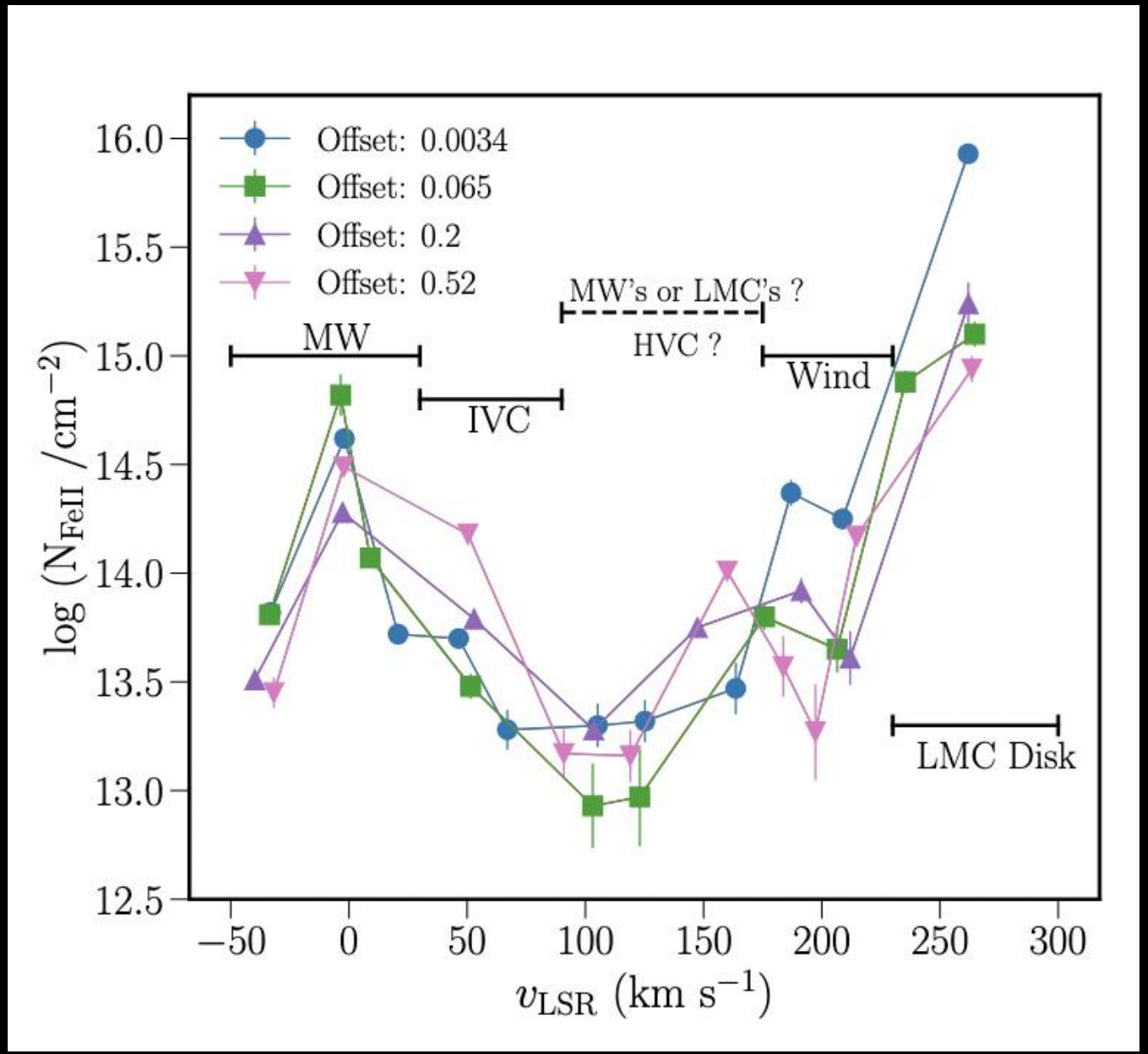


Kinematic Distribution of the Gas

More diffused clouds (less column density) move faster?

Seems consistent with the galactic wind model (Heckman et al. 2002) that relates $V_{cloud} \propto 1/\sqrt{N}$





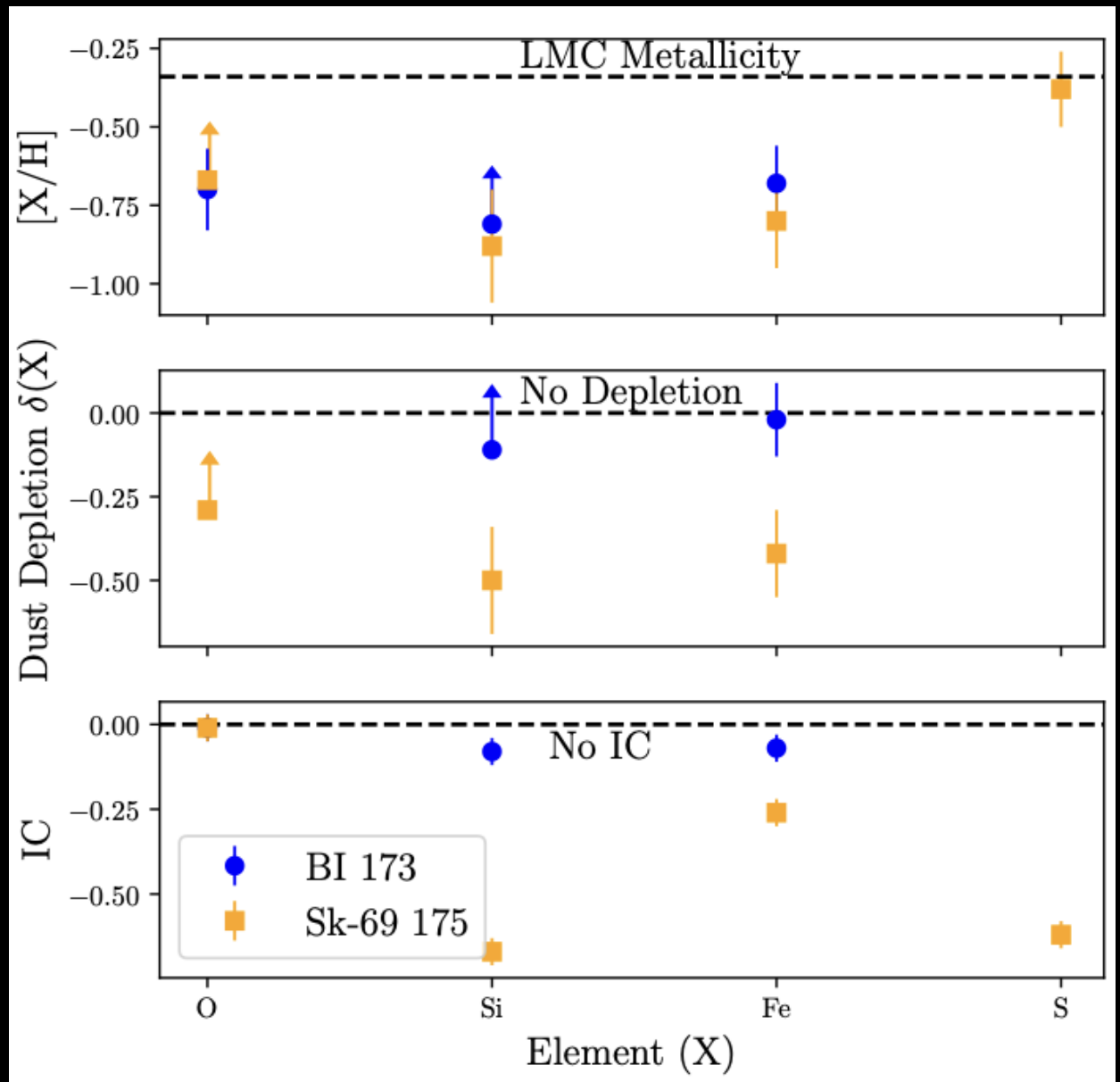
Mass outflow rate: >0.02 $M_\odot$ yr^{-1}

Insights from Metallicity and Dust

Photoionization modelling was available only for two sightlines at V_{LSR}~115 km/s

BI 173

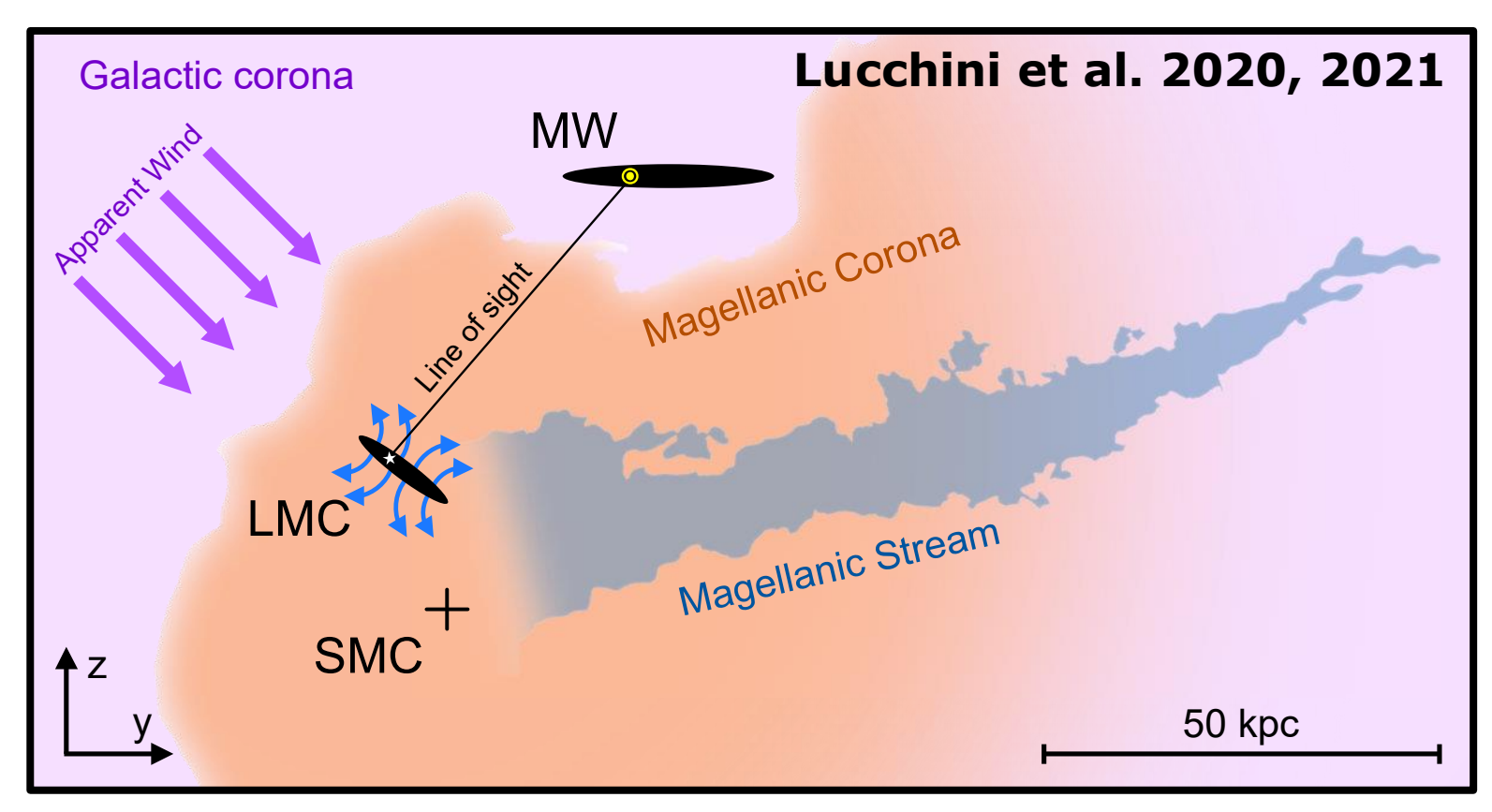
-Lower metallicity
-No dust
-Mostly neutral
-Most likely a MW's HVC



SK-69d175

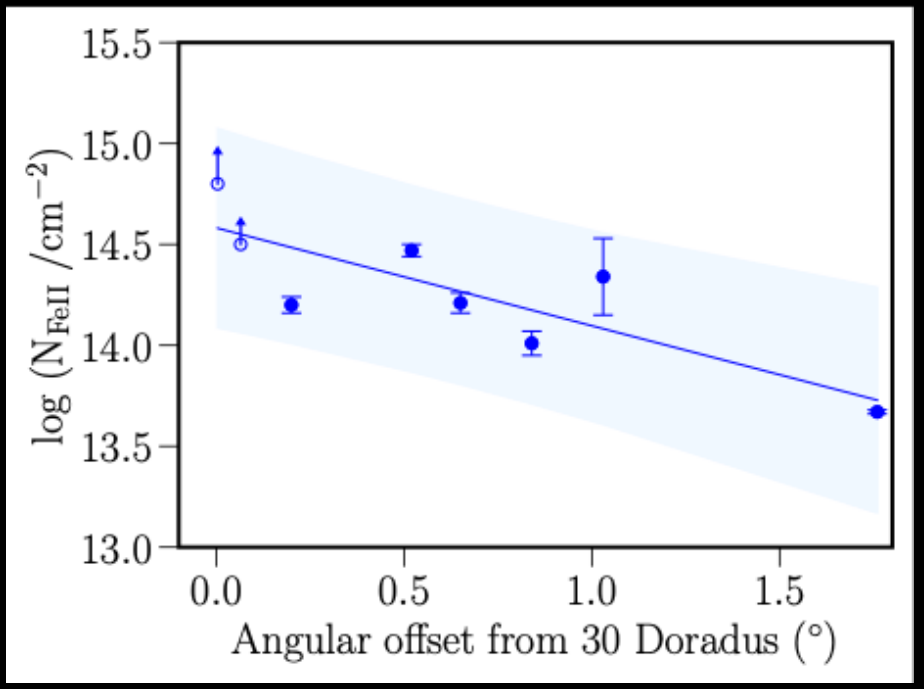
-LMC metallicity
-Dusty
-Likely LMC wind?

How the Outflows Survive the Head Wind?

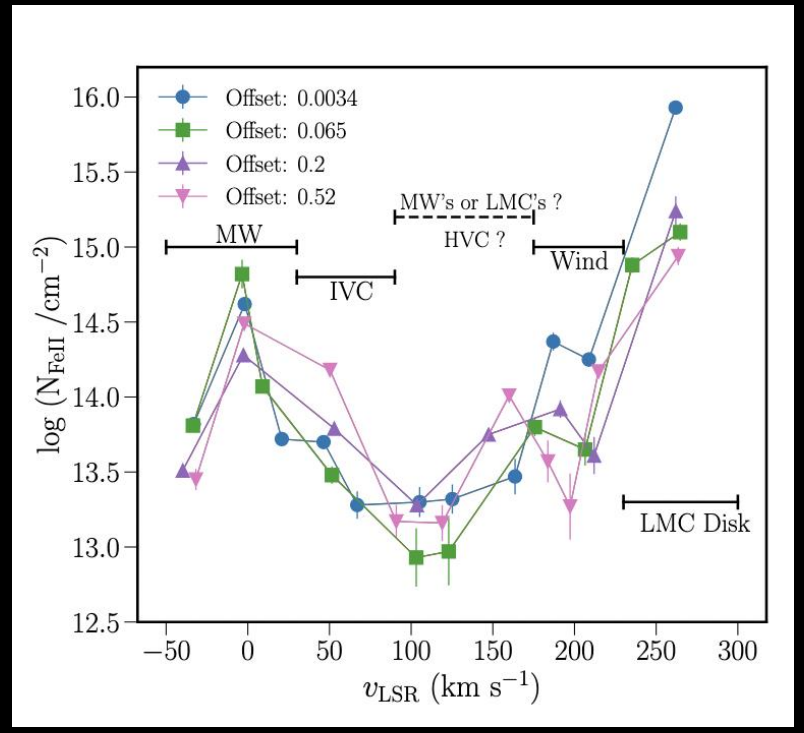


Magellanic Corona providing shielding
from the ram-pressure effects of the MW's gaseous halo!

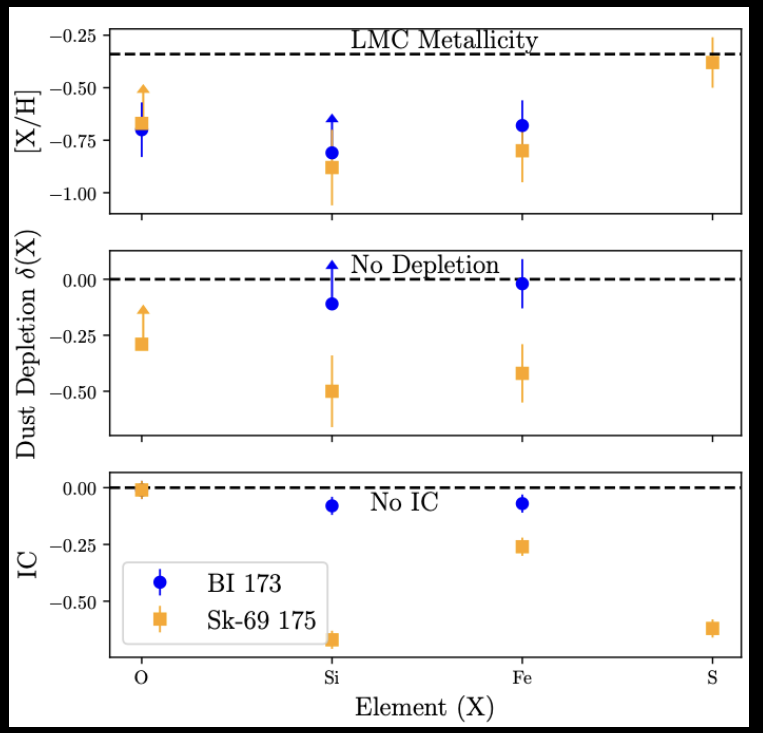
Summary



- Absorption within 150 < V_{LSR} (km s^{-1}) < LMC disk: Mostly the LMC wind
- $M_{outflow} \gtrsim 5.7\text{-}8.6 \times 10^5\ M_\odot$
- $dM/dt > 0.02\ M_\odot\ yr^{-1}$



- Absorption within 100 < V_{LSR} (km s^{-1}) < 150: Wind+HVC



- Metallicity and dust for V_{LSR} ~ 115 km s^{-1} for one sightline consistent with LMC origin and other sightline with MW origin