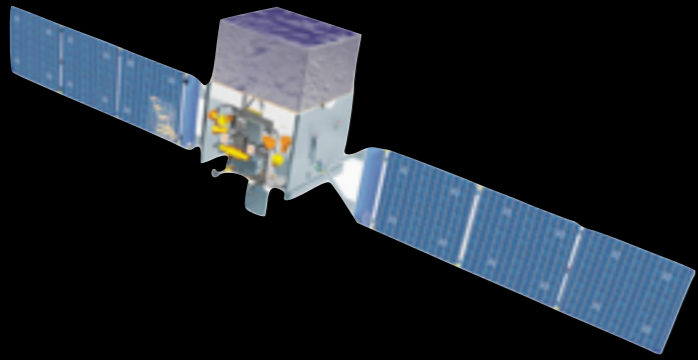


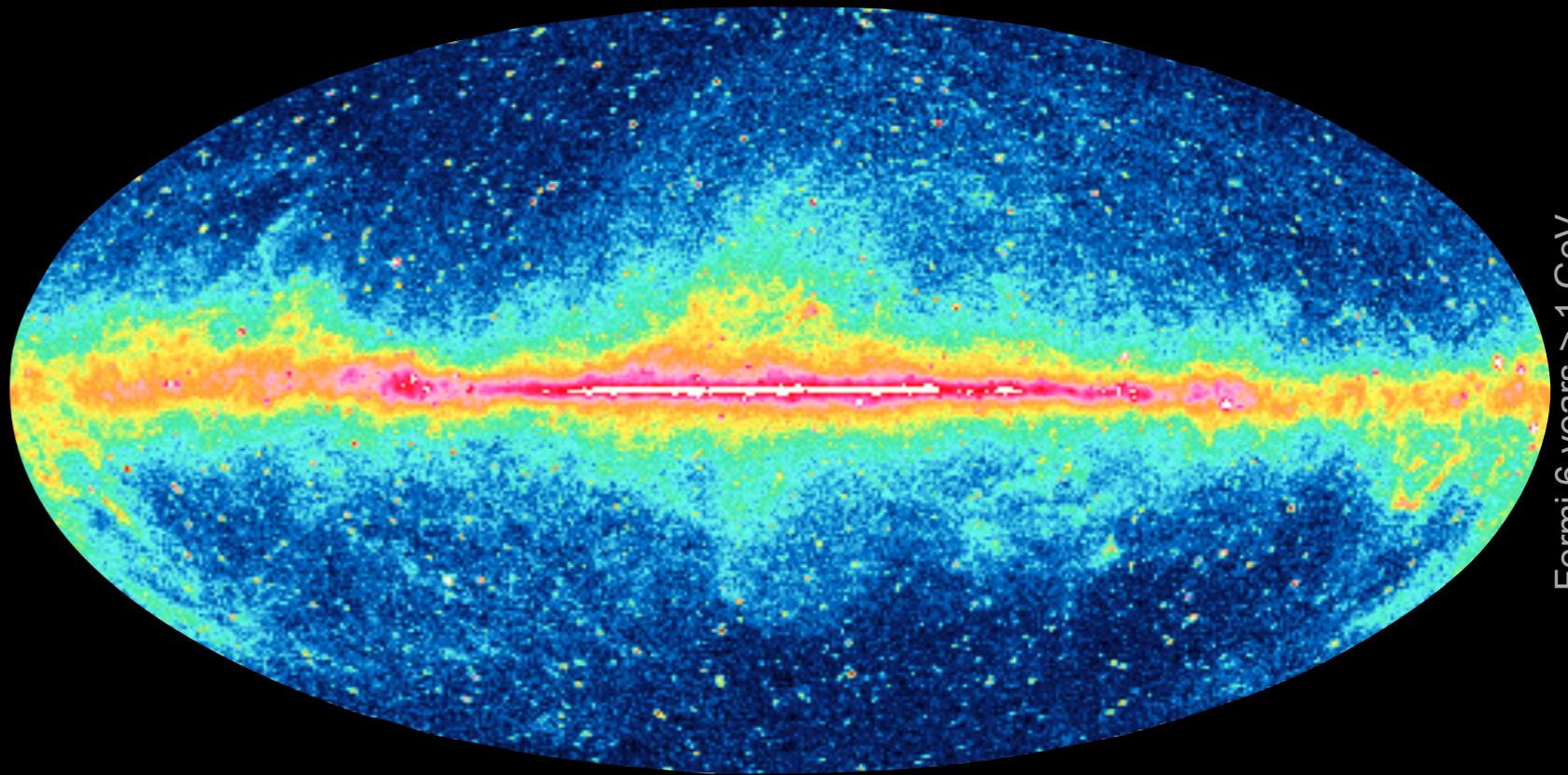
**Gas, dust, & cosmic rays
in nearby clouds
(Cham, Tau, Cal, Per, Cet)**

Isabelle Grenier, Quentin Remy,
on behalf of the Fermi LAT Collaboration
AIM, Université Paris Diderot & CEA Saclay

Fermi-LAT > 1 GeV

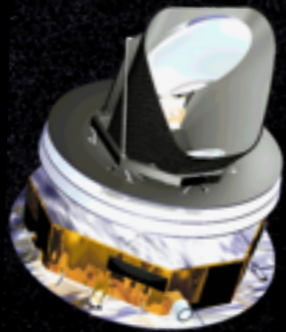


diffuse intensity
 \propto
 $\int n_{\text{gas}} n_{\text{CRs}} dl$

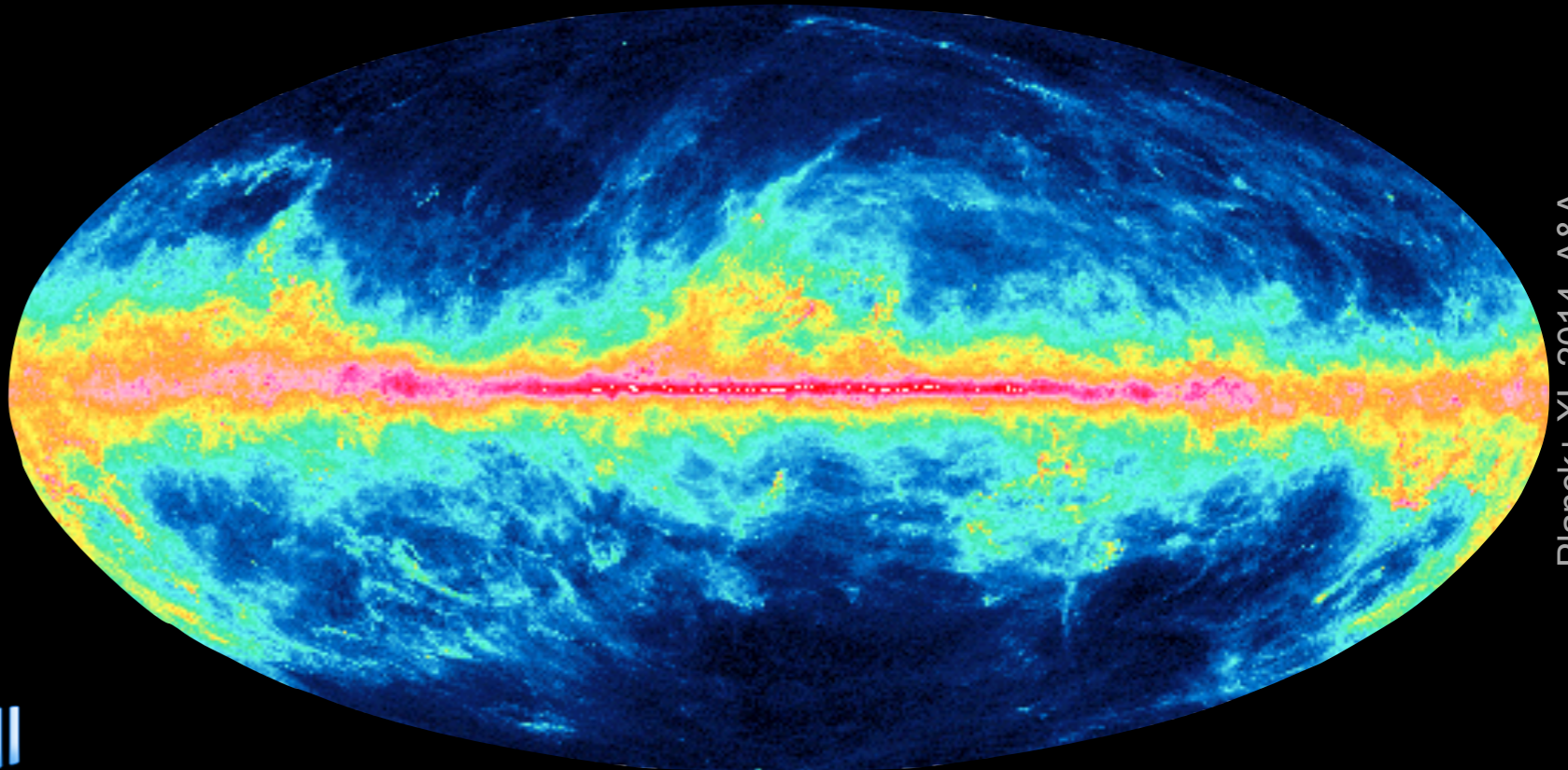


Fermi 6 years > 1 GeV

Planck + IRAS

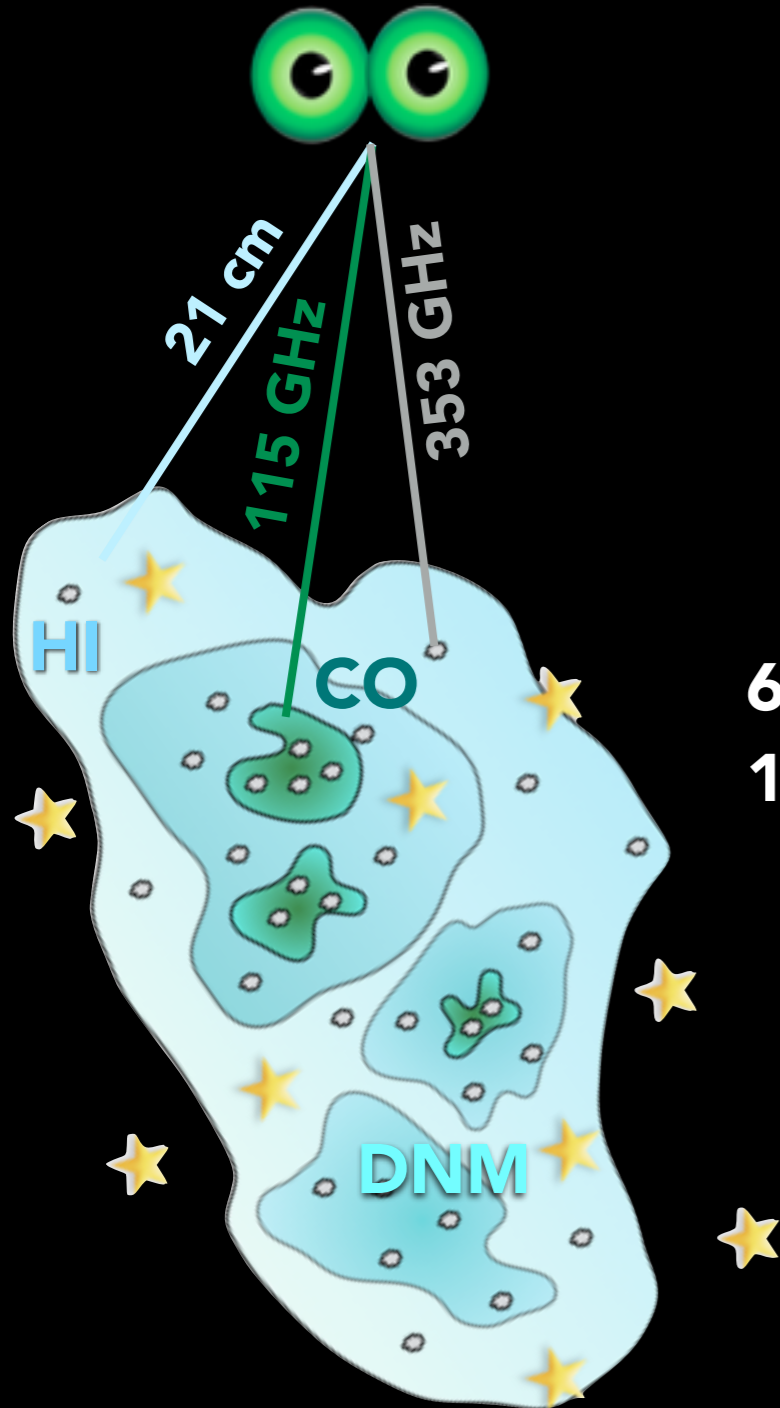


thermal intensity
 \propto
 $\int (M_D/M_{\text{gas}}) K_D n_{\text{gas}} B(T_D) dl$



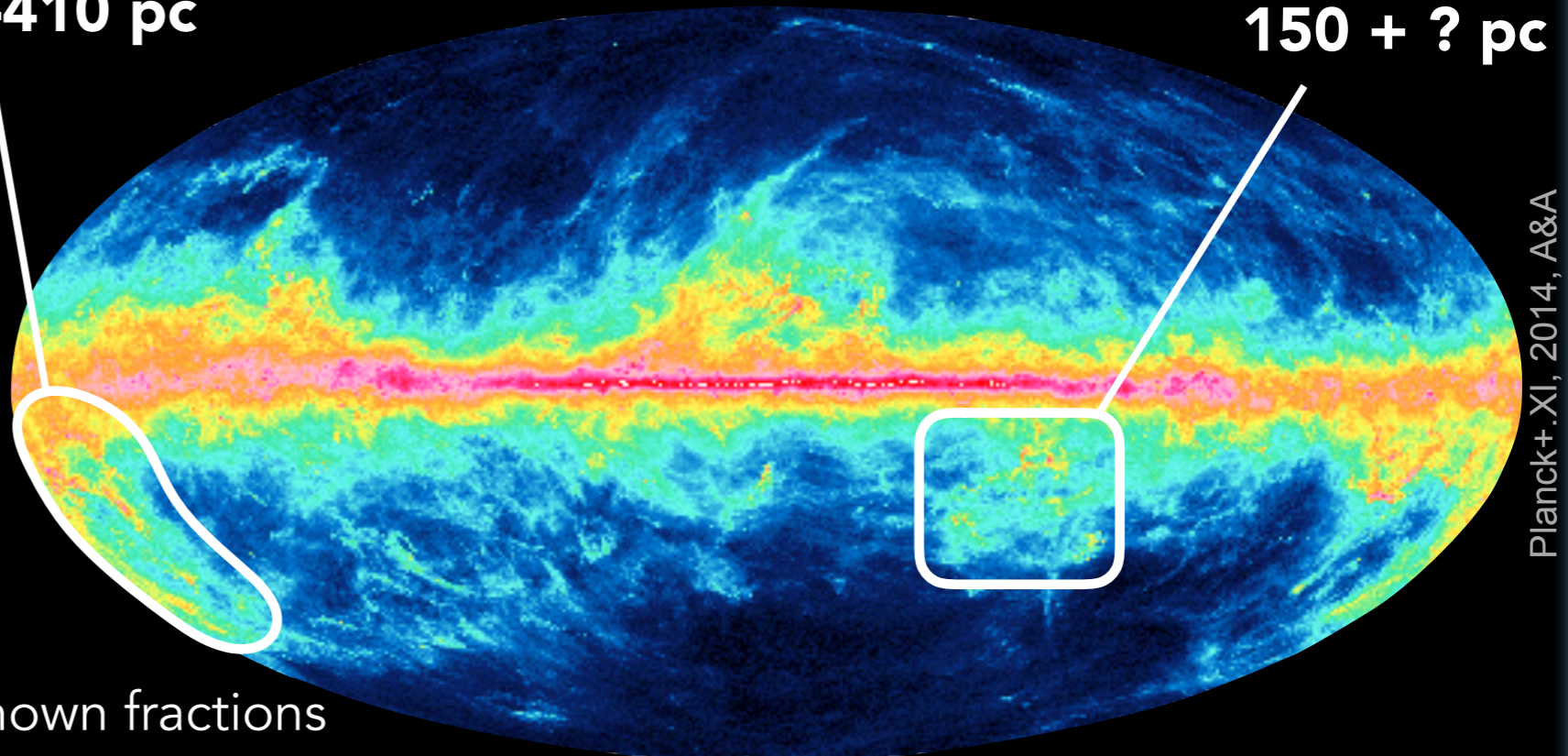
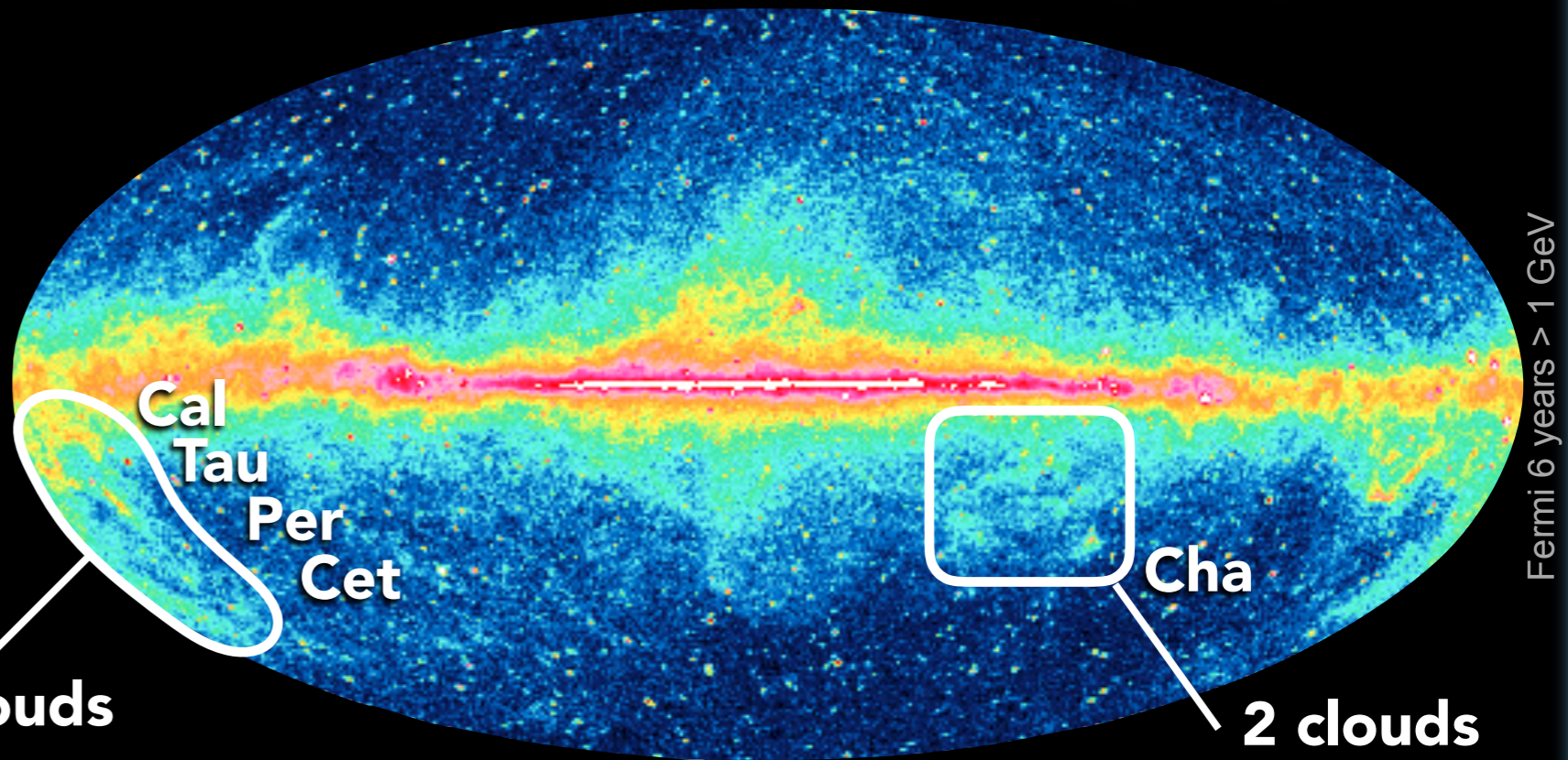
Planck+.XI, 2014, A&A

Fermi-LAT > 1 GeV

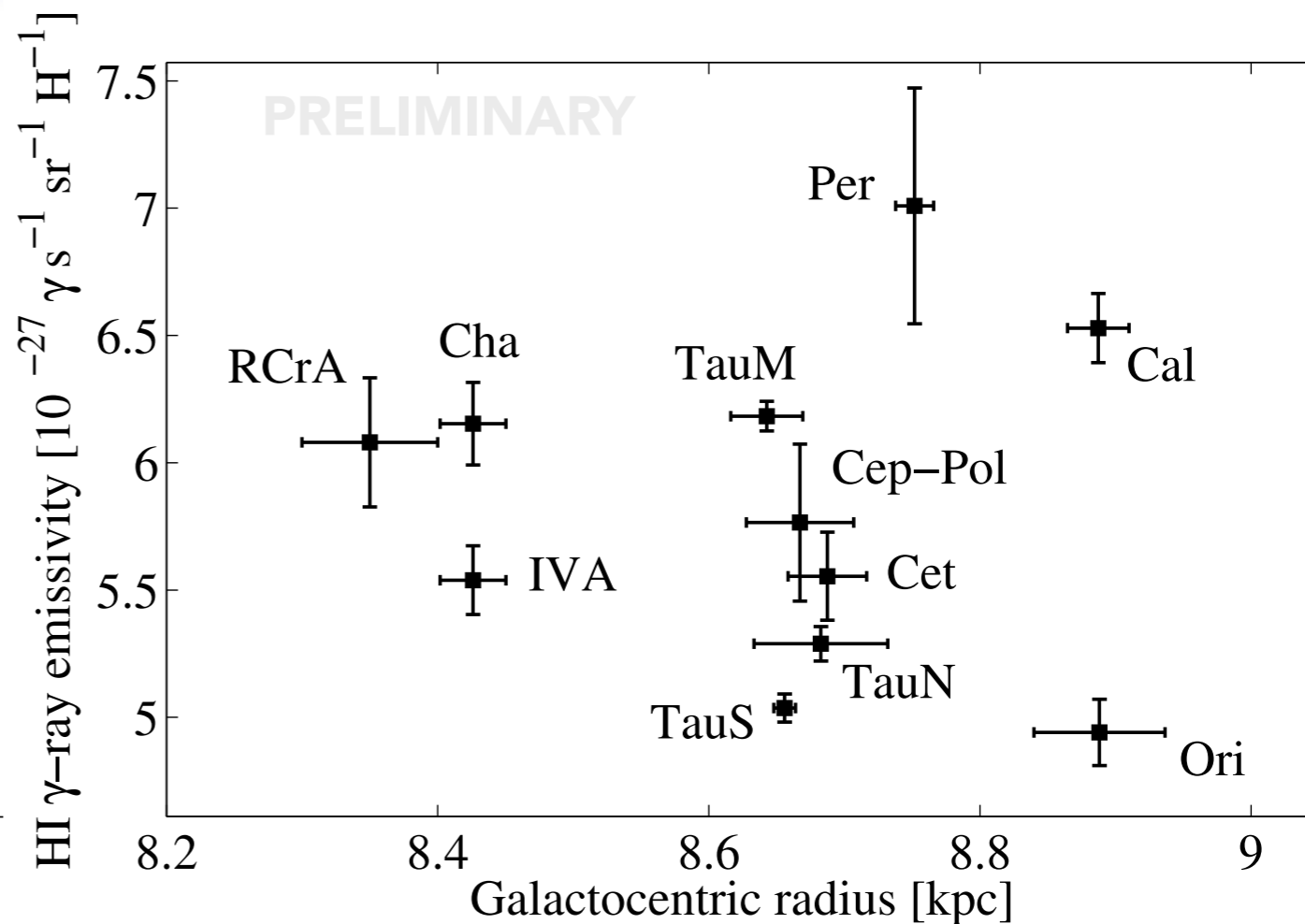
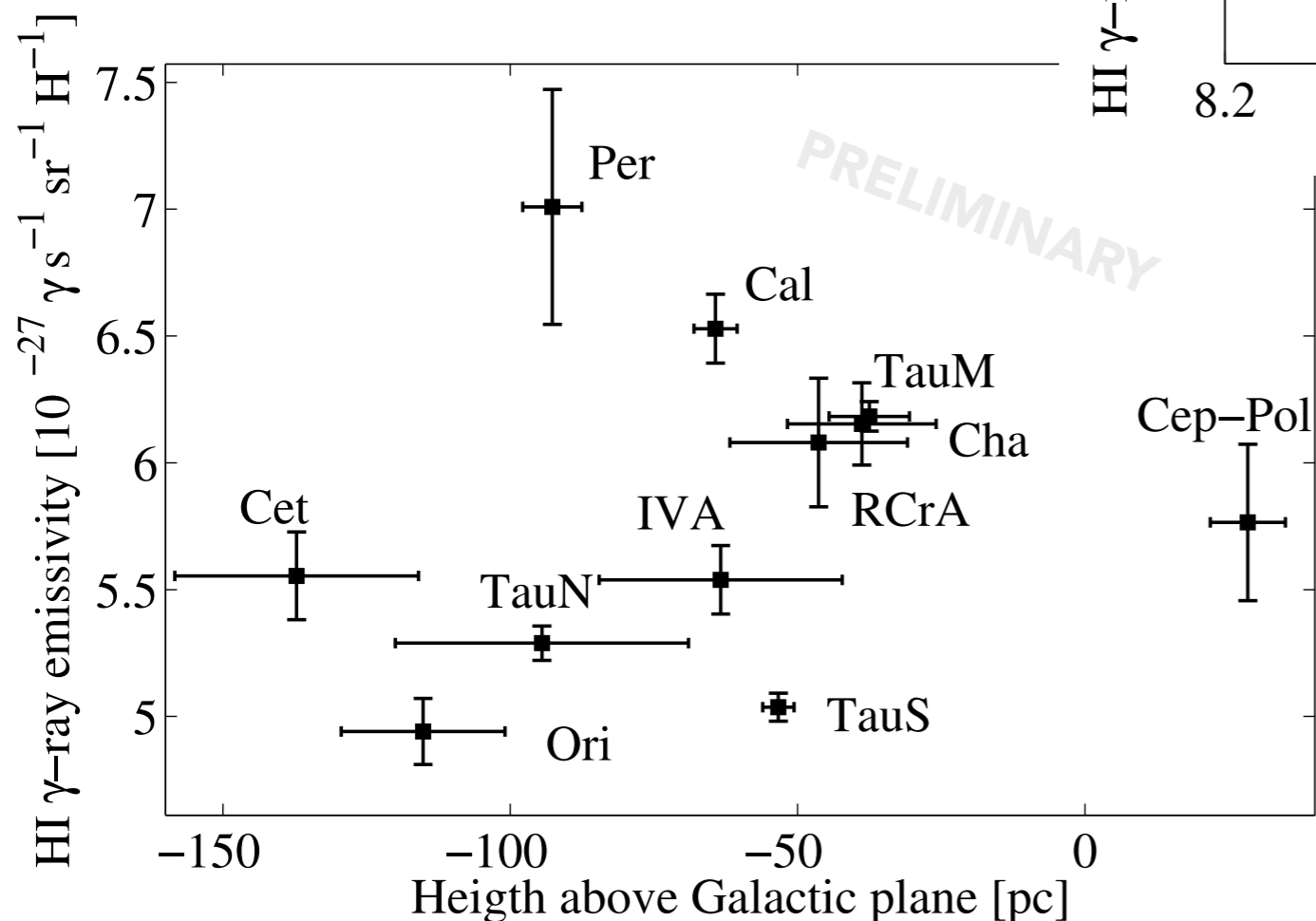


Dark Neutral Medium:
opt. thick HI + CO-dark H₂, unknown fractions

Planck + IRAS

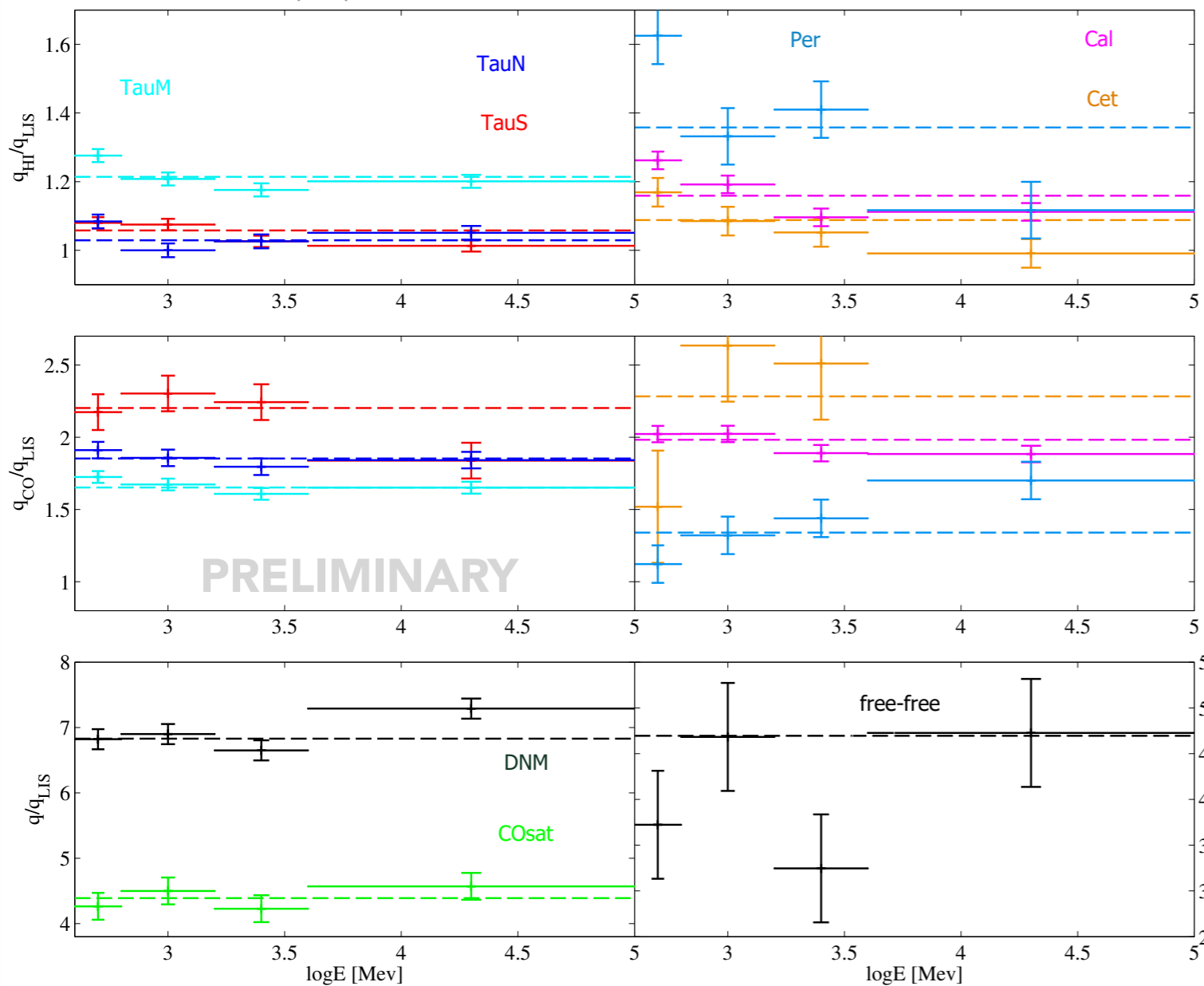


- 30% variations locally
- consistent with uncertainties in the derivation of HI column densities
- no trend with radial distance in the Galaxy (too short a span)
- no trend with altitude above/below the Galactic plane

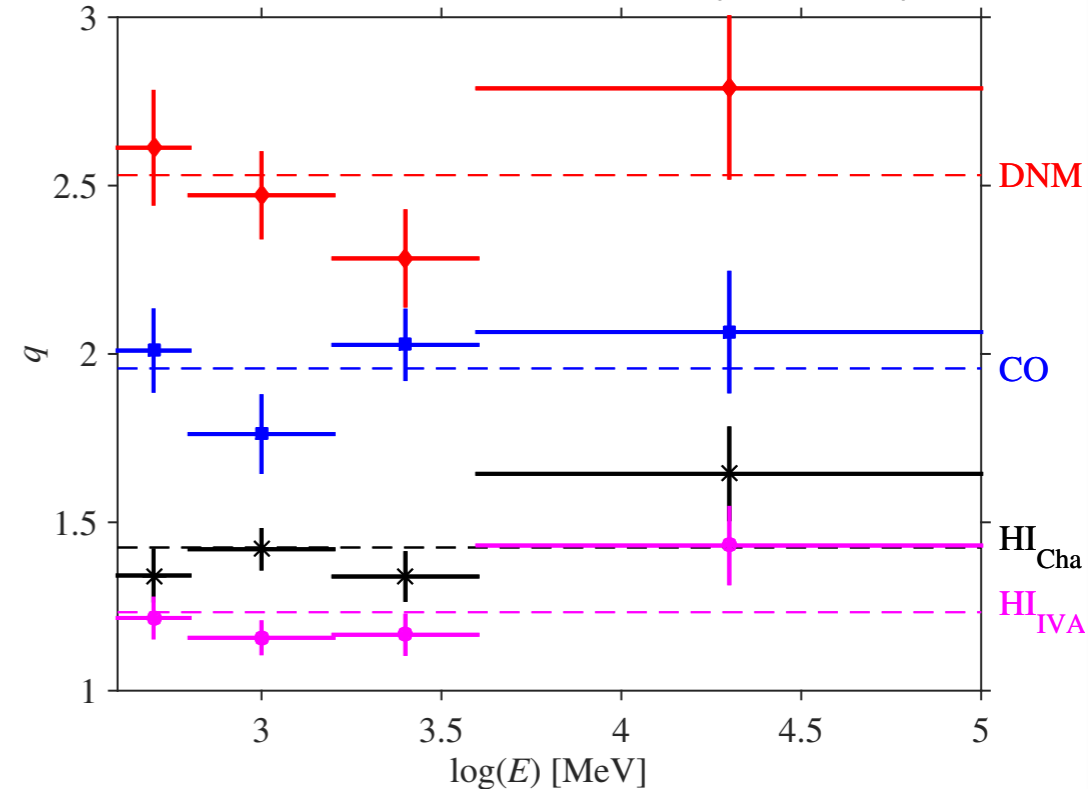


- no spectral deviations across the HI, DNM, and H₂ gas phases, down to pc scale
- ≈ uniform CR penetration at the current precision

Remy et al., in prep

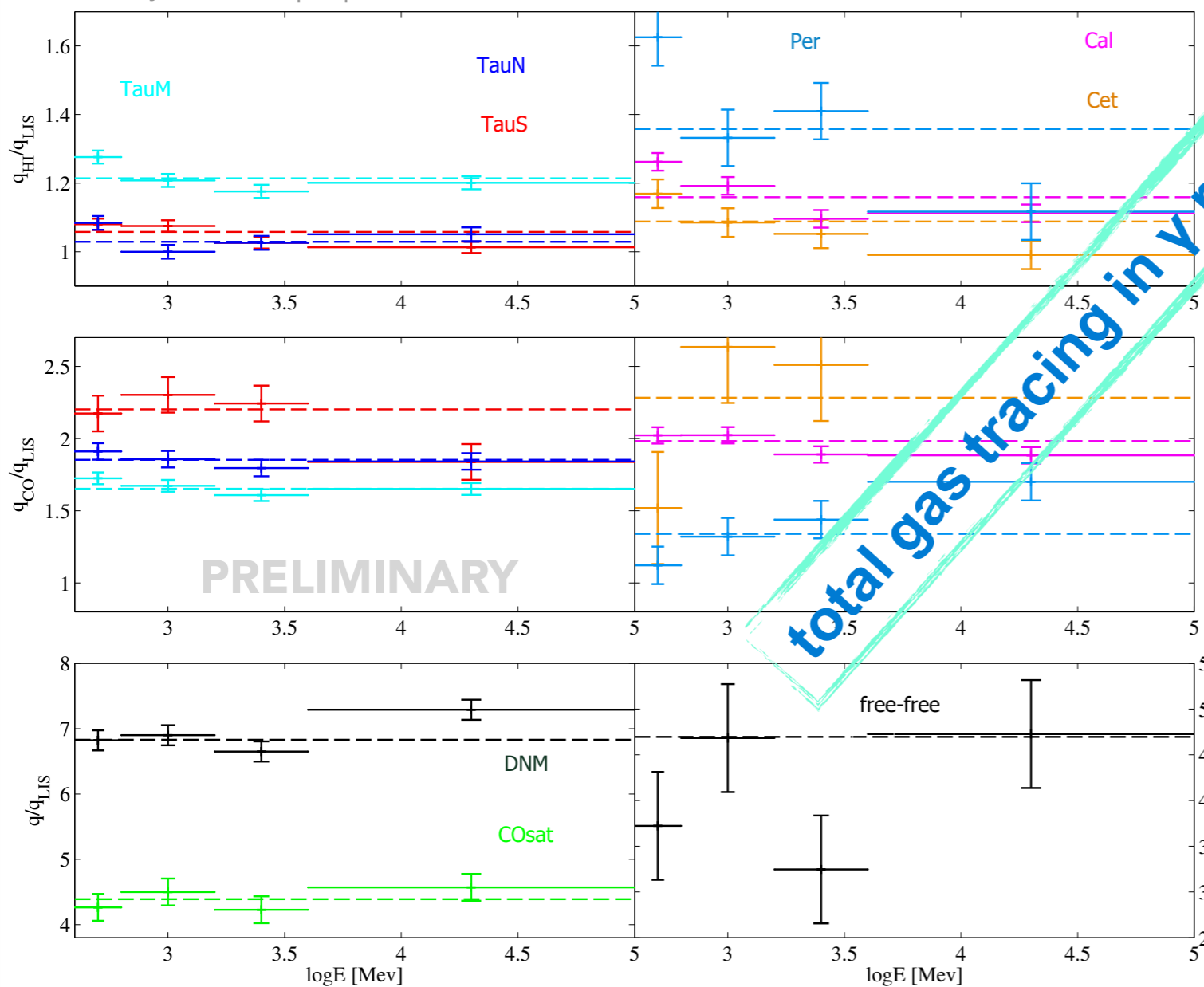


Planck+Fermi '15, A&A 582, 31

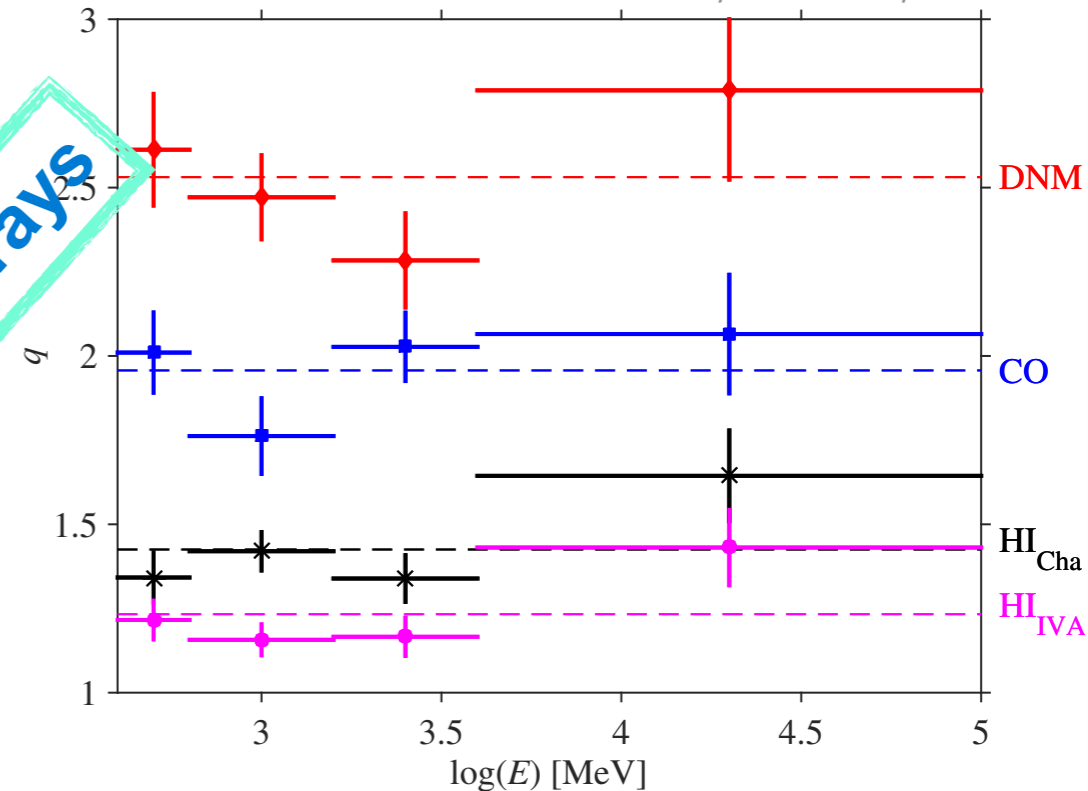


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Remy et al., in prep



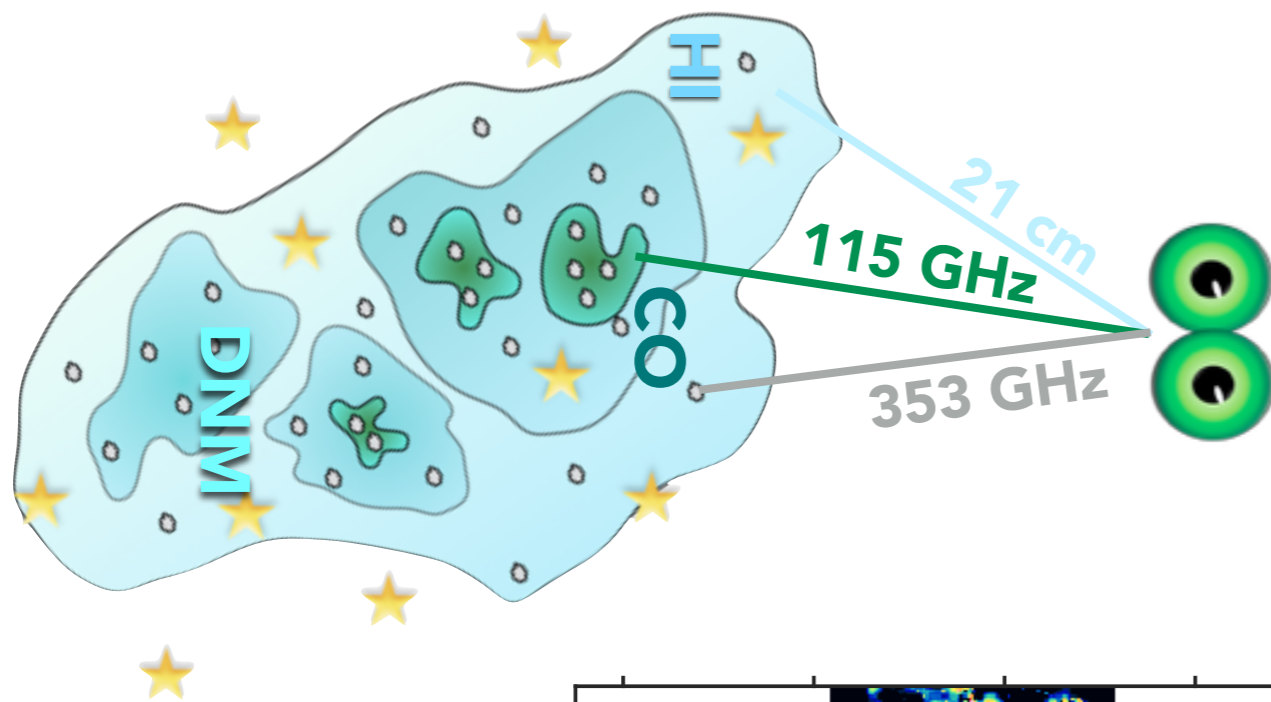
Planck+Fermi '15, A&A 582, 31



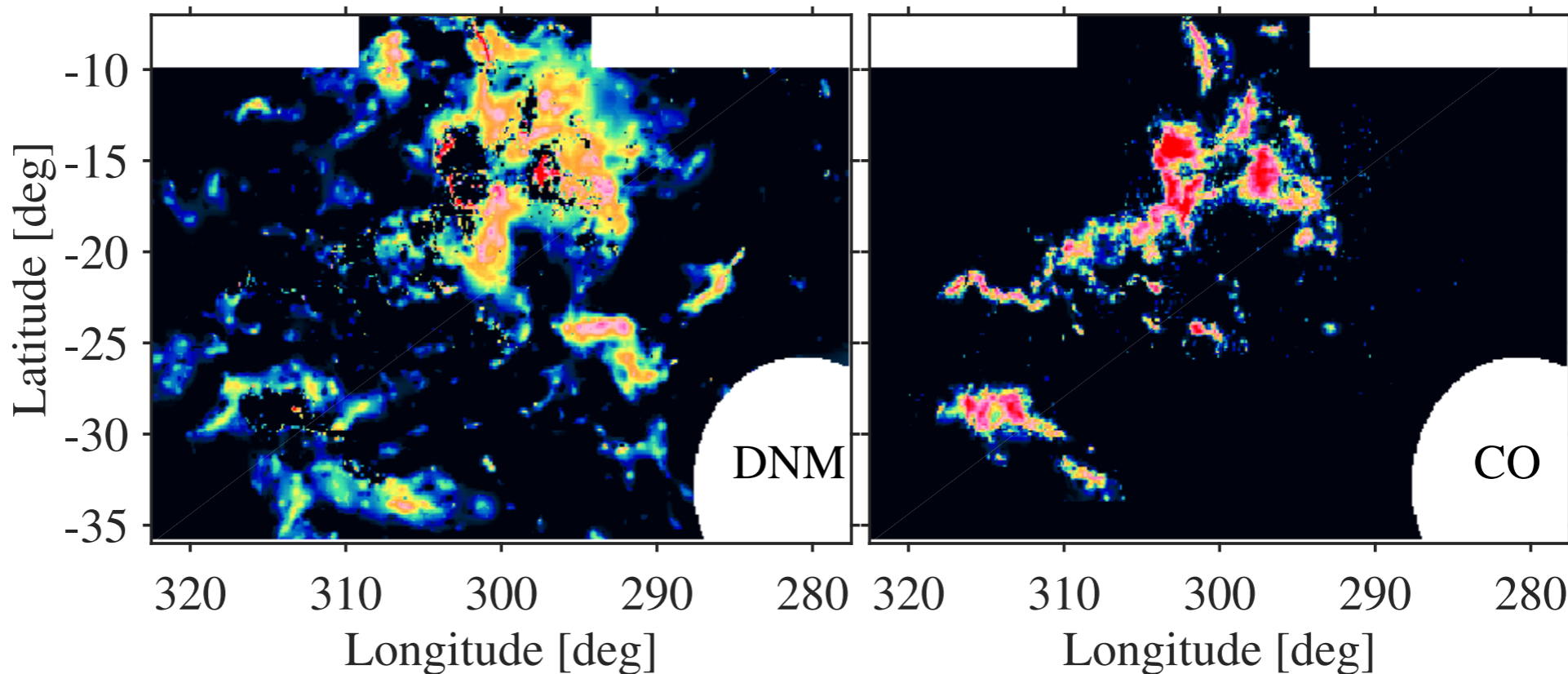
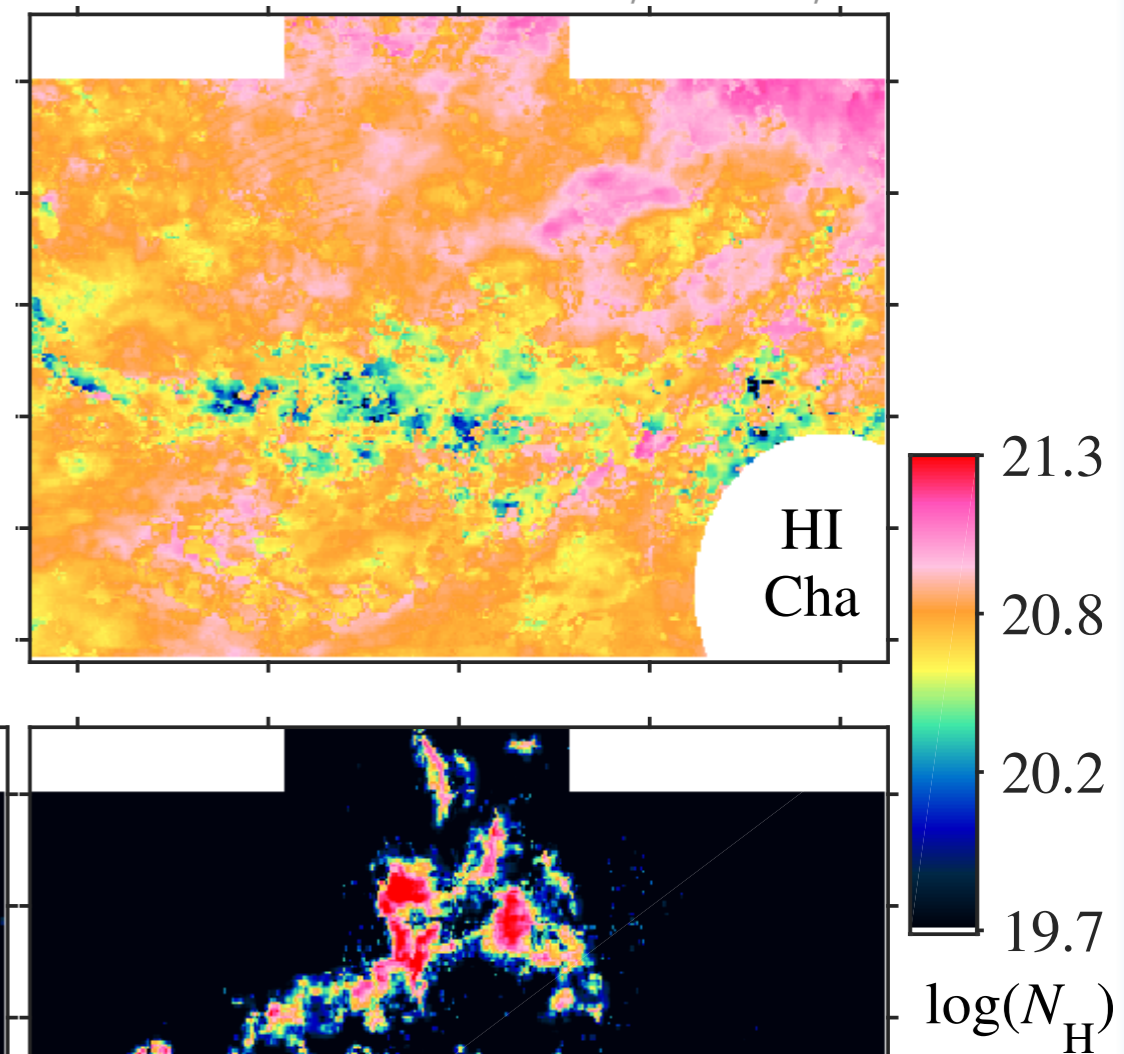
total gas tracing in γ rays

- DNM traced by CR & dust correlation
- DNM mass if same CR flux in the HI & DNM phases

- DNM spatial extent between the diffuse HI and compact CO

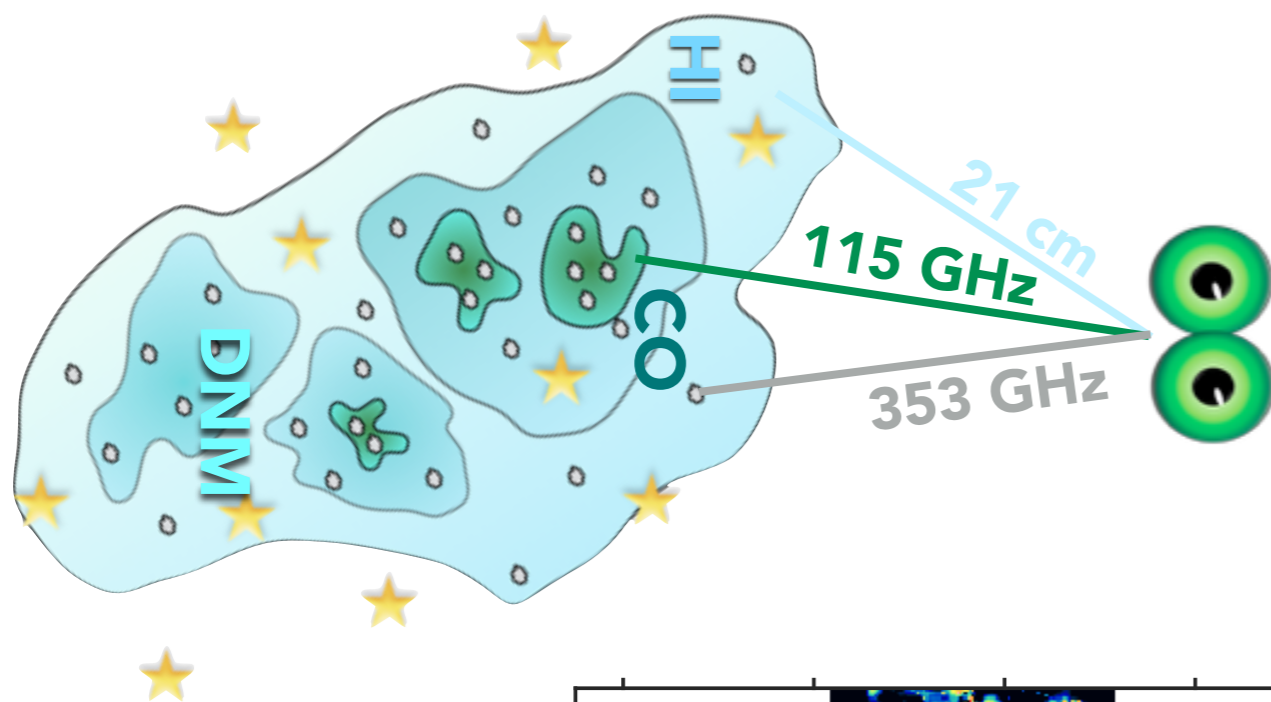


Planck+Fermi '15, A&A 582, 31

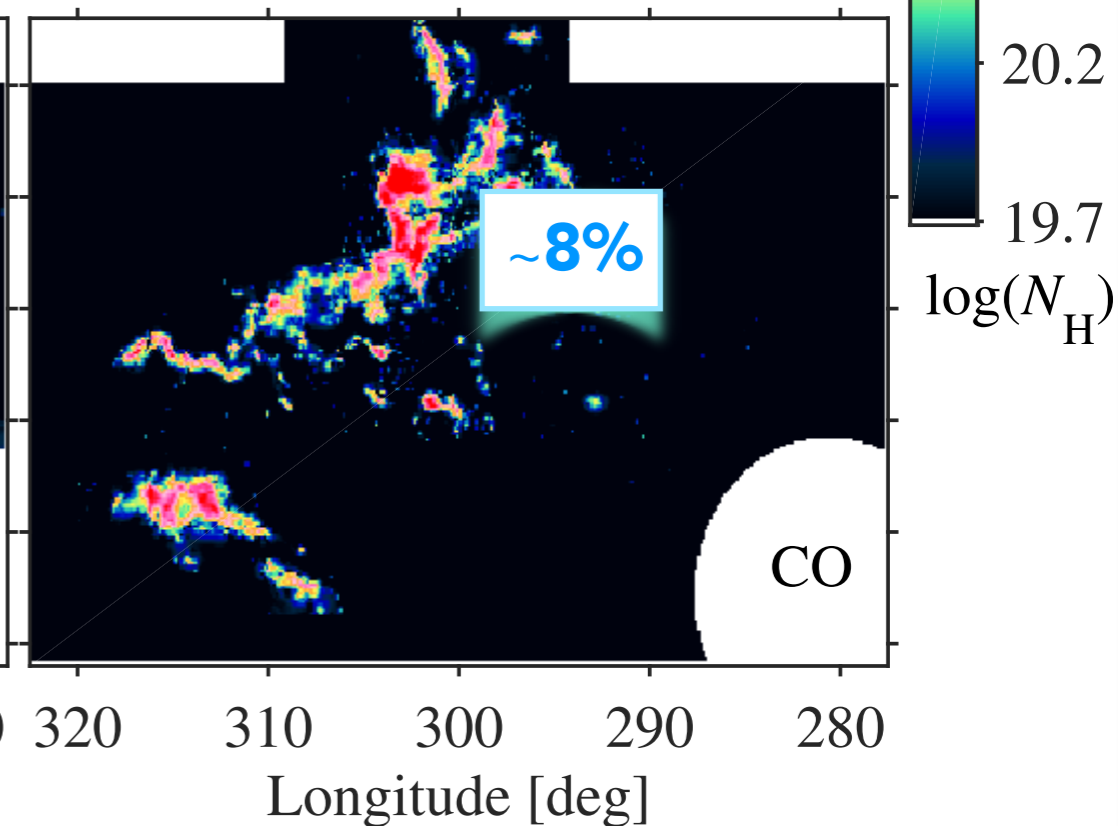
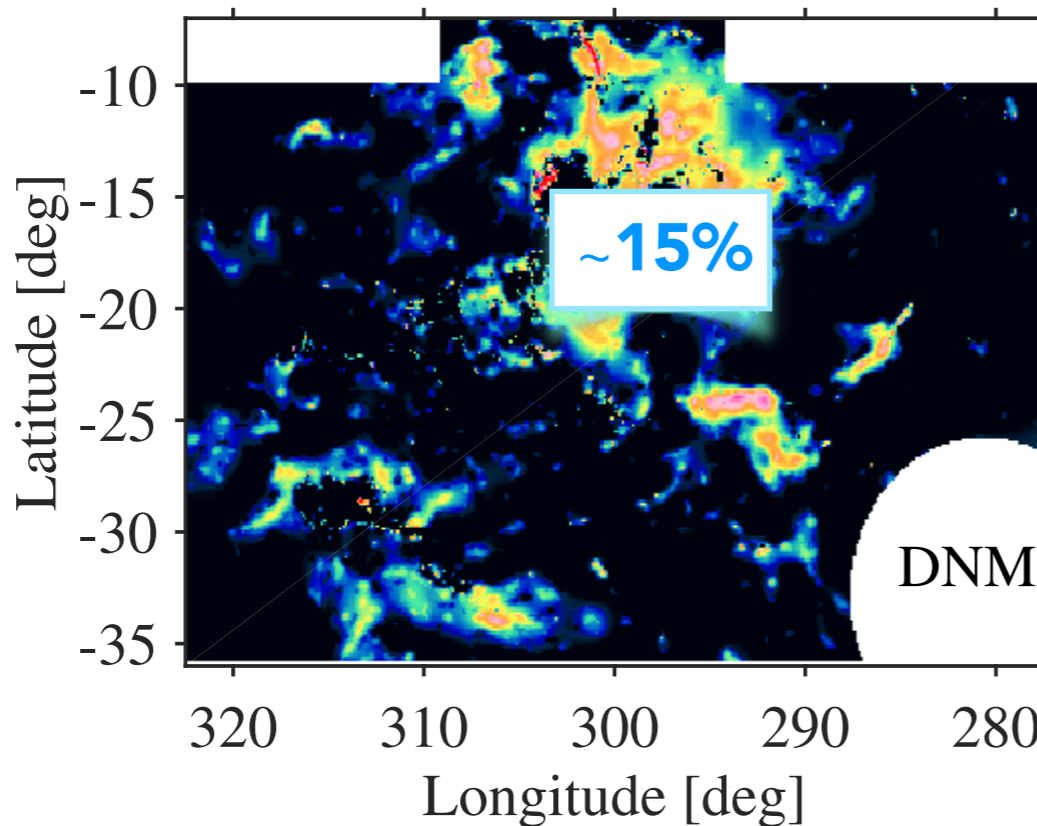
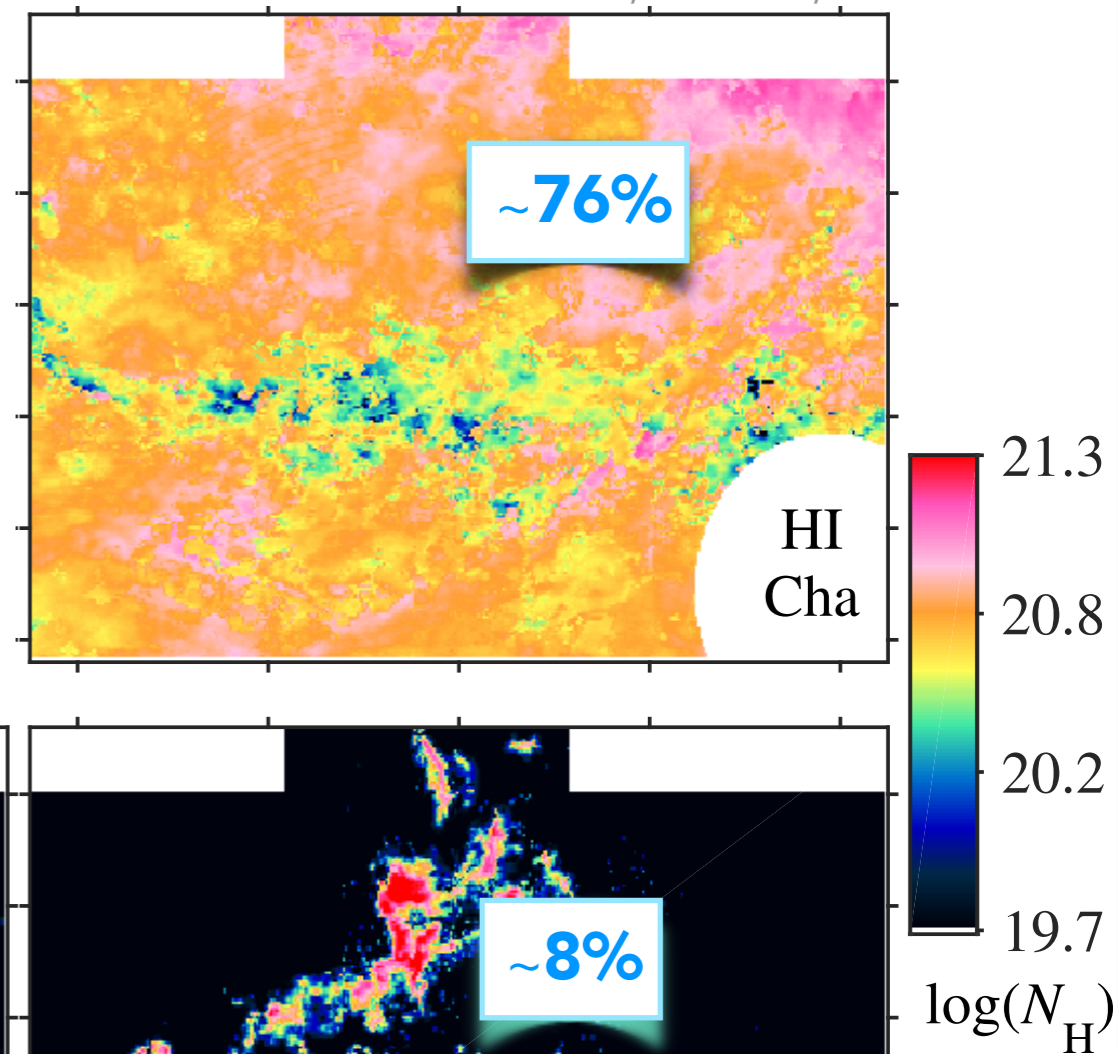


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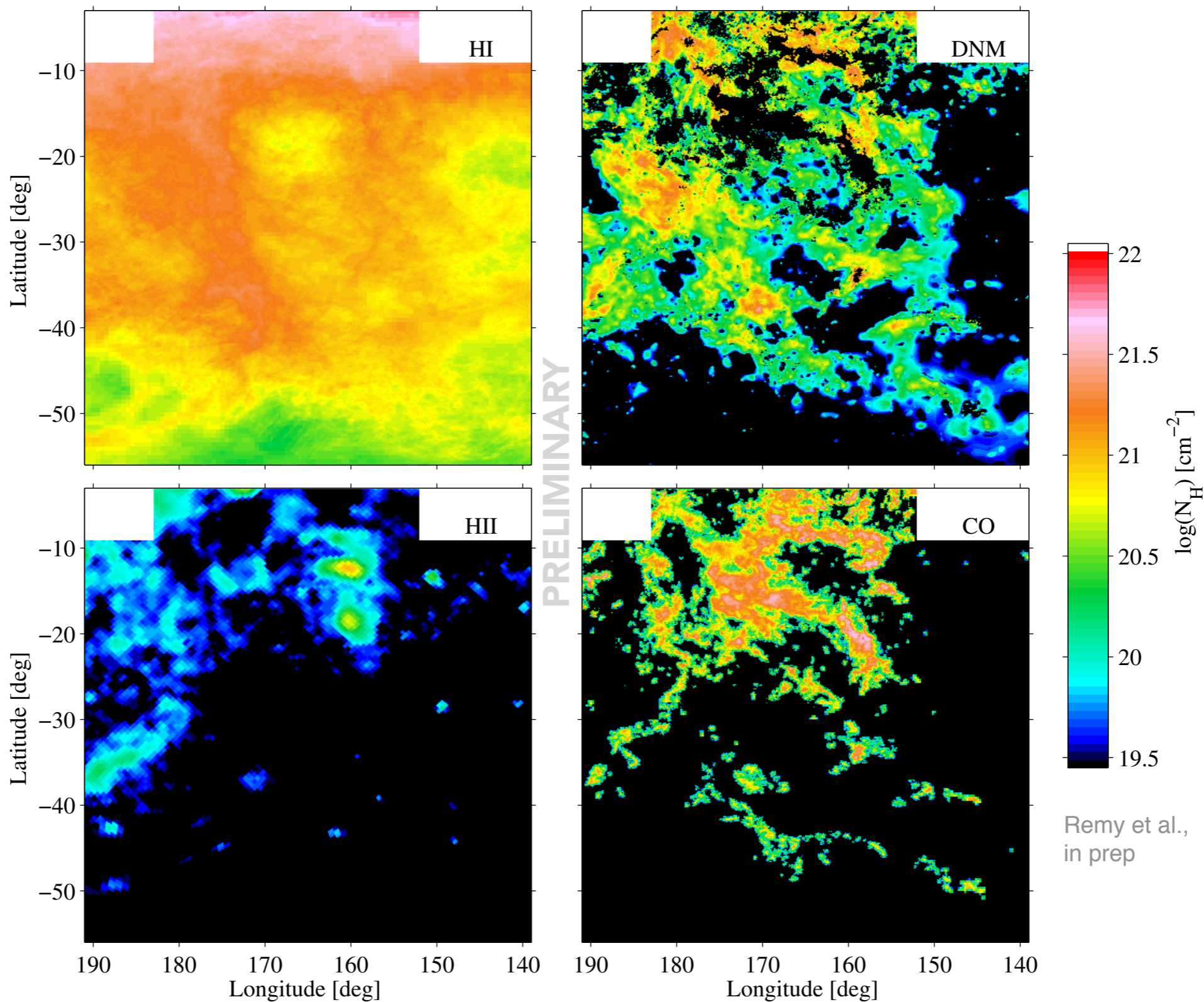


Planck+Fermi '15, A&A 582, 31



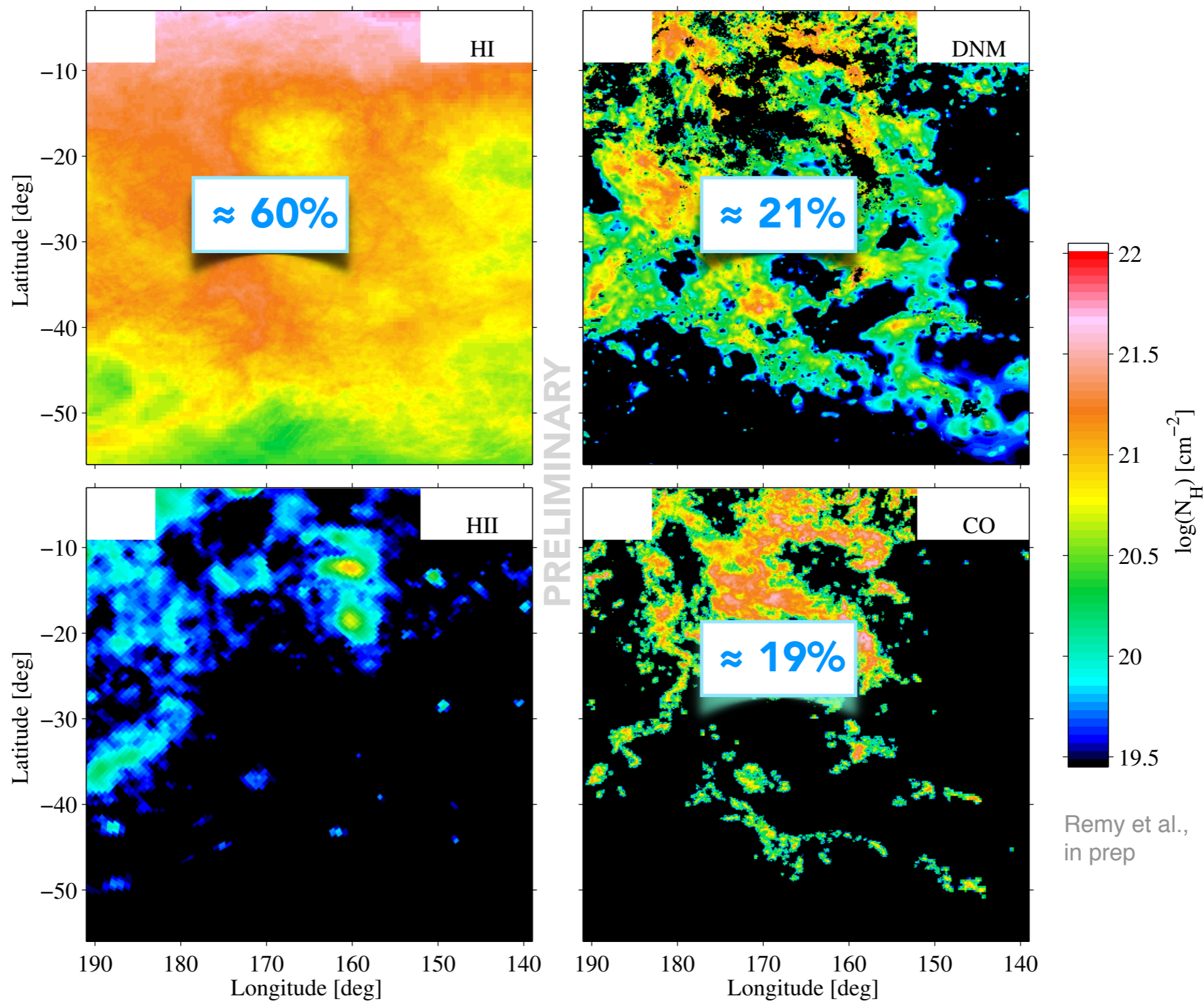
☉ M_{DNM} only assumption: $q_{\text{HI}} = q_{\text{DNM}}$

☉ DNM spatial extent between the diffuse HI and compact CO



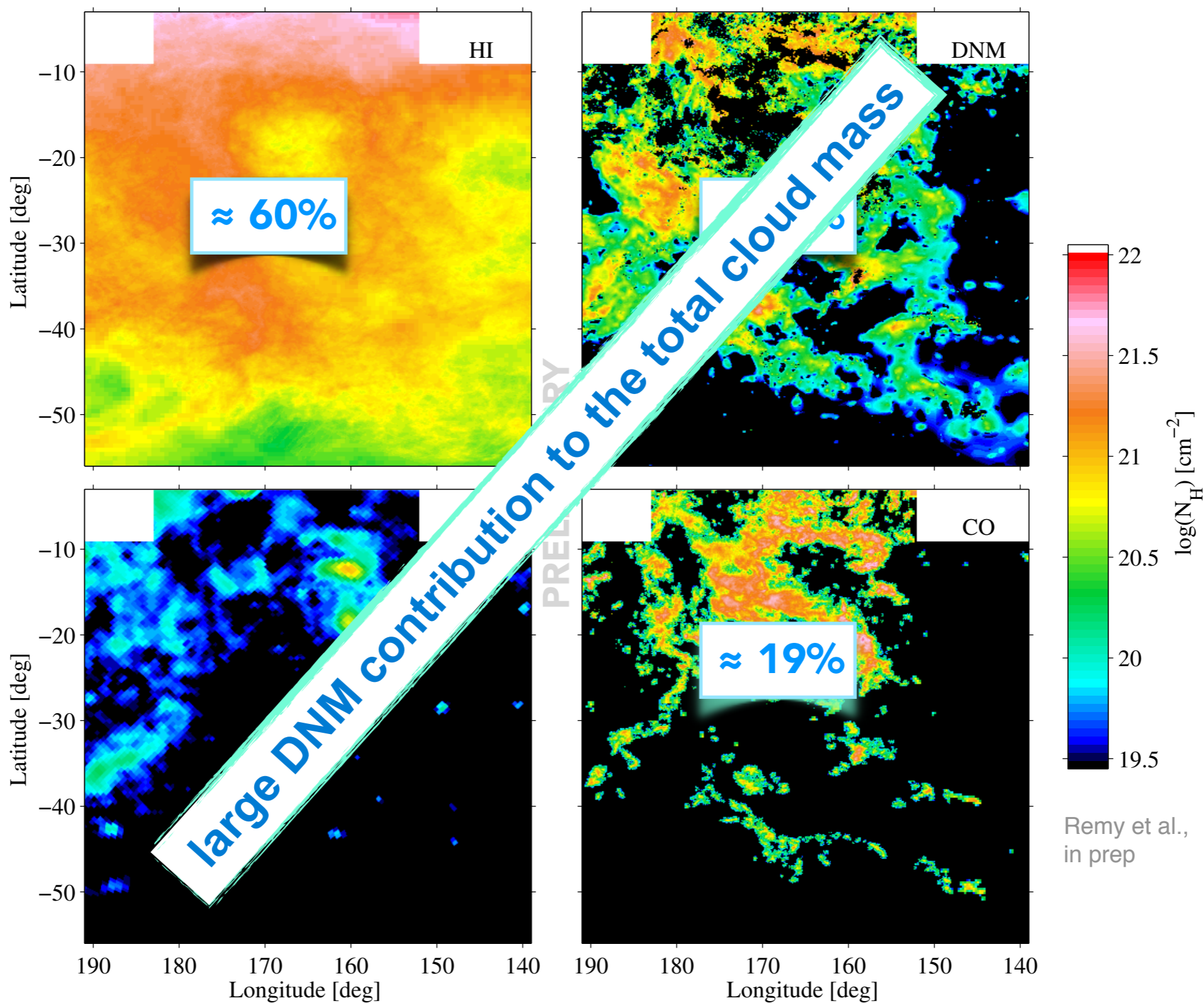
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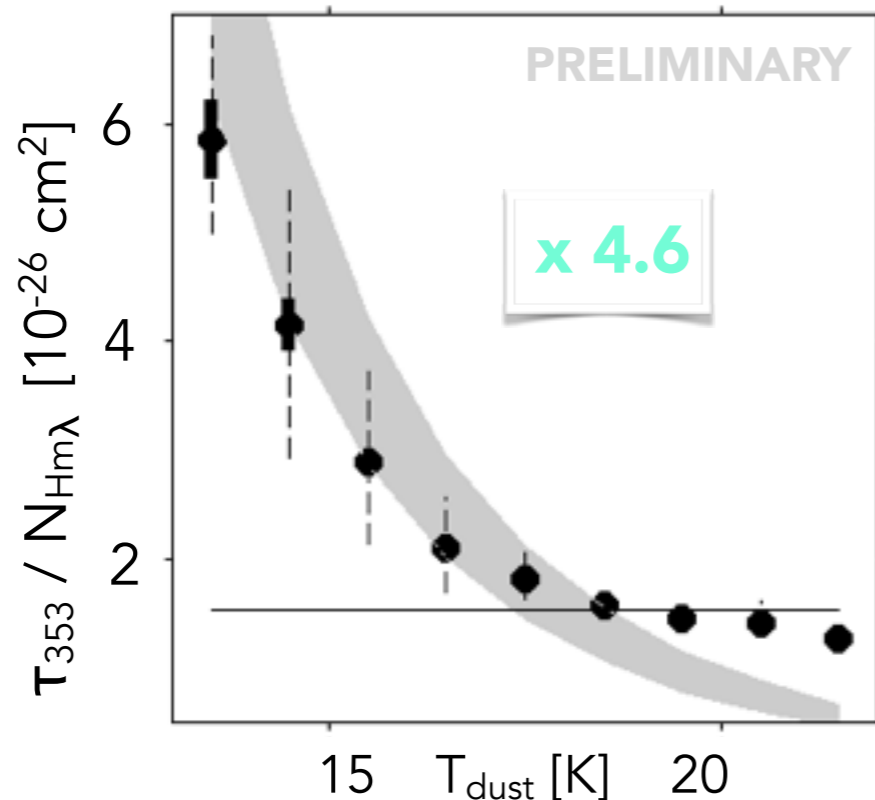


☉ M_{DNM} only assumption: $q_{\text{HI}} = q_{\text{DNM}}$

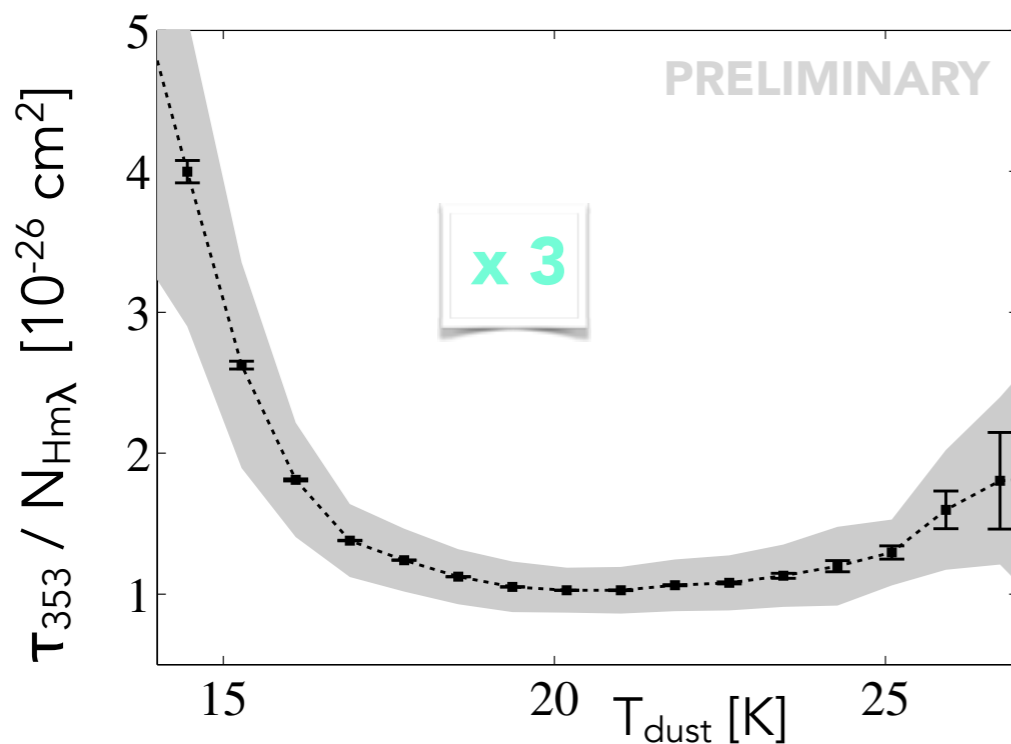
☉ DNM spatial extent between the diffuse HI and compact CO



- significant increase in grain emission cross section
- grain evolution across all phases, more pronounced in CO

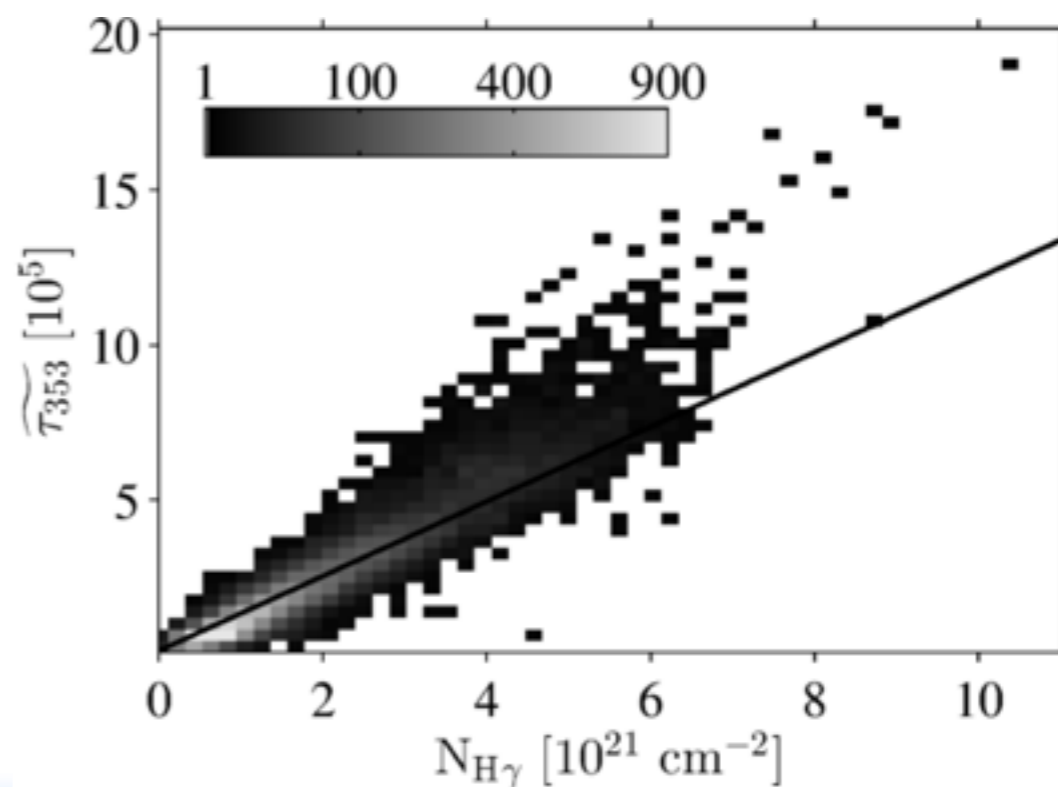
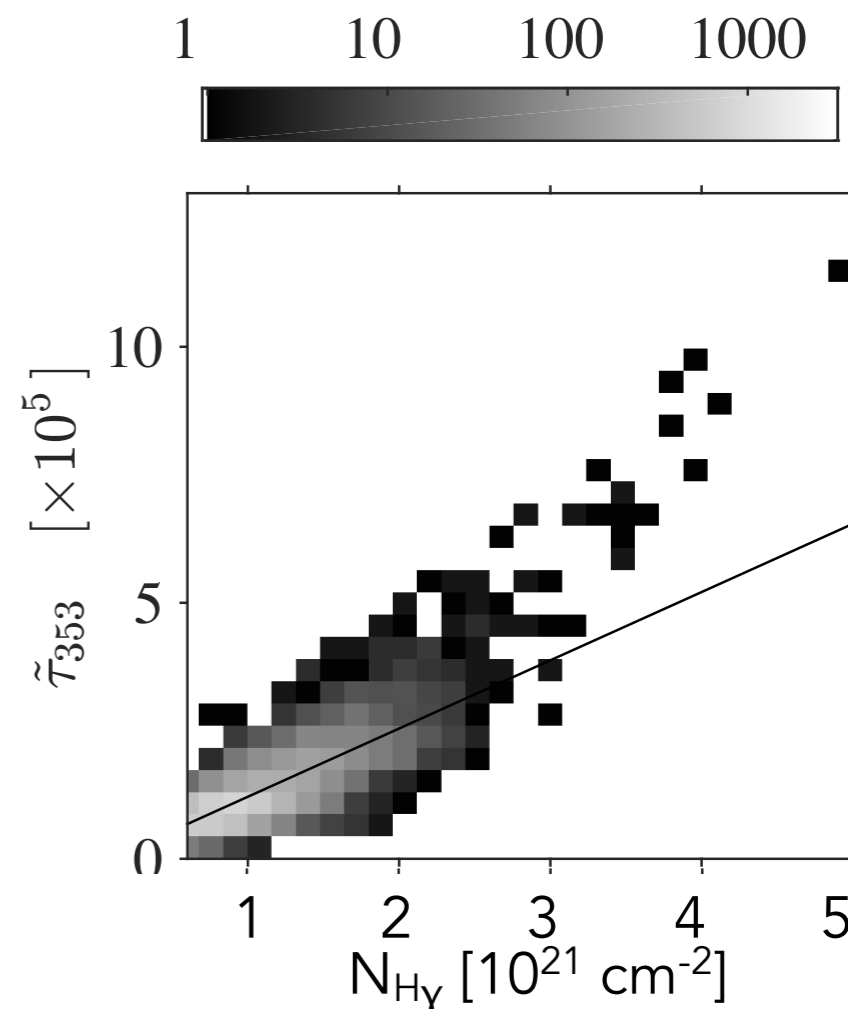


Chamaeleon

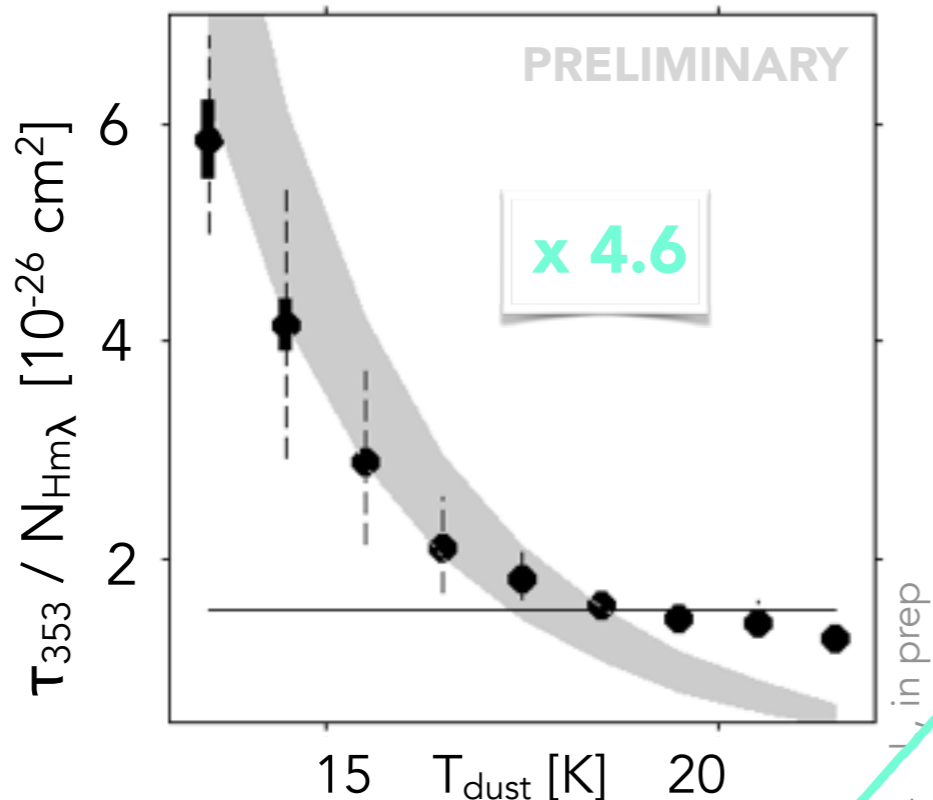


Taurus-Perseus-California

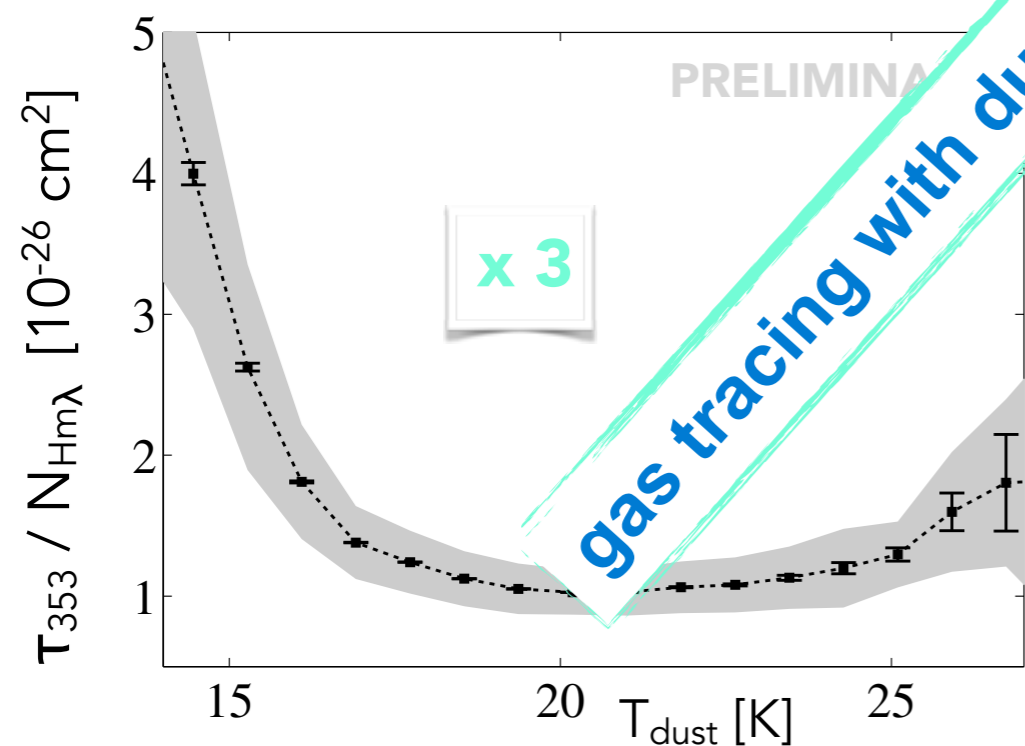
Remy et al., in prep



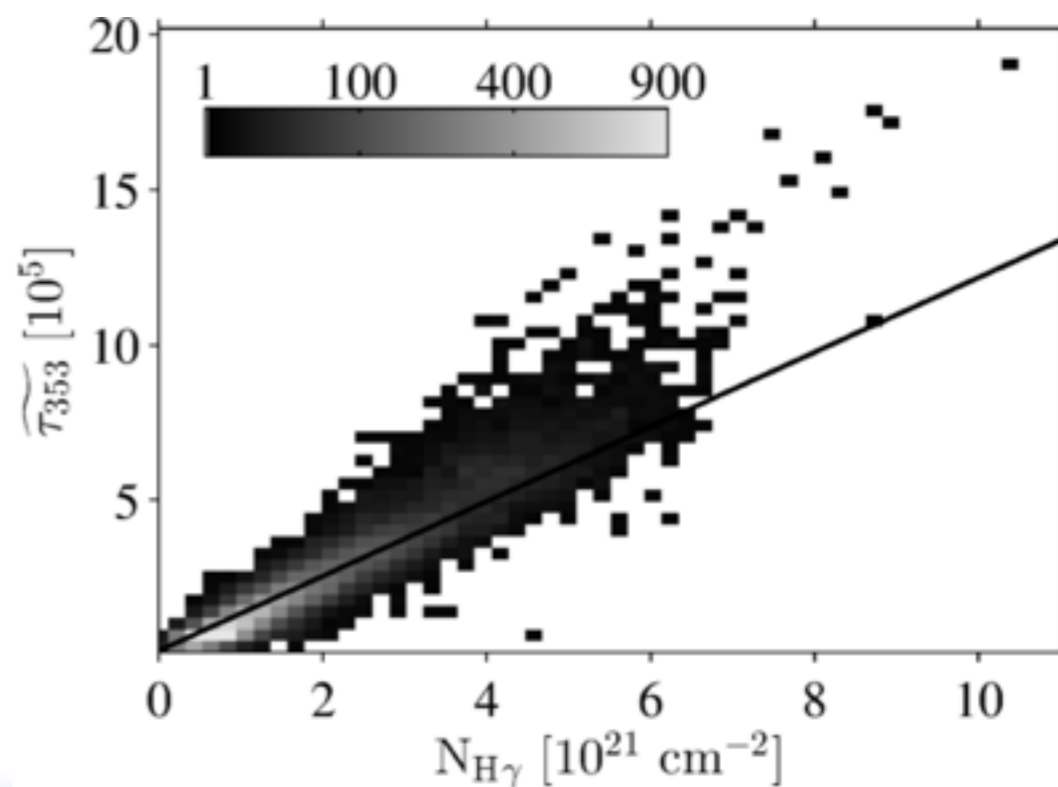
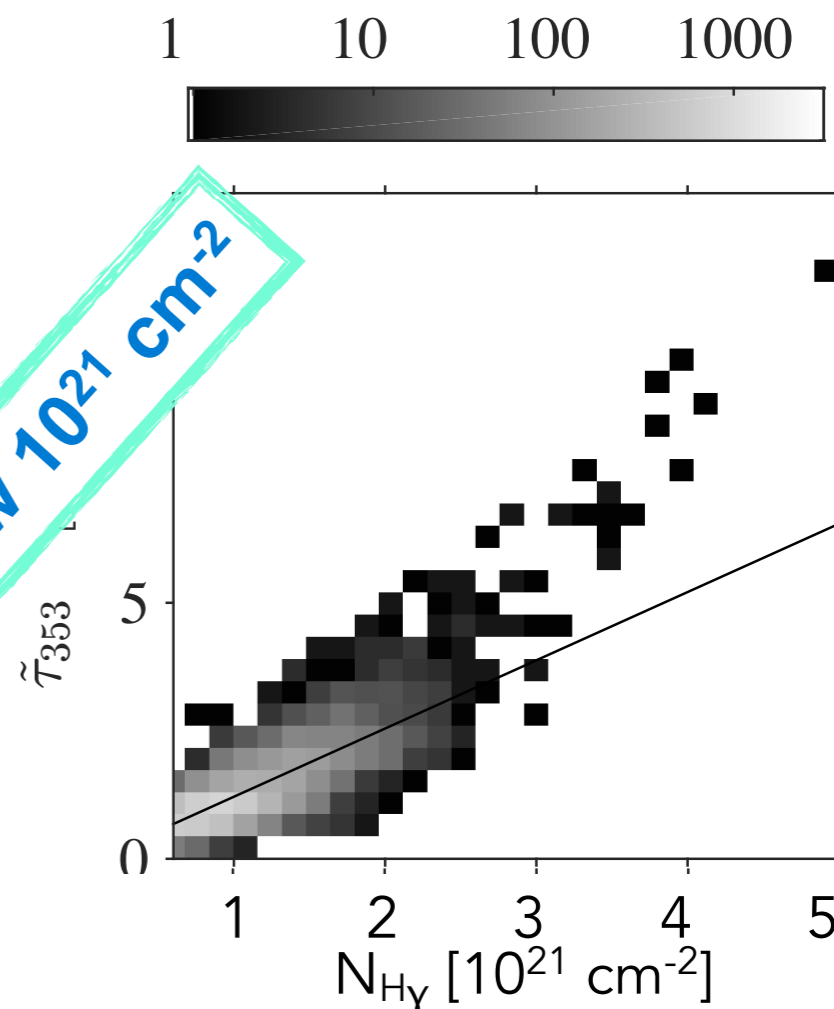
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Chamaeleon

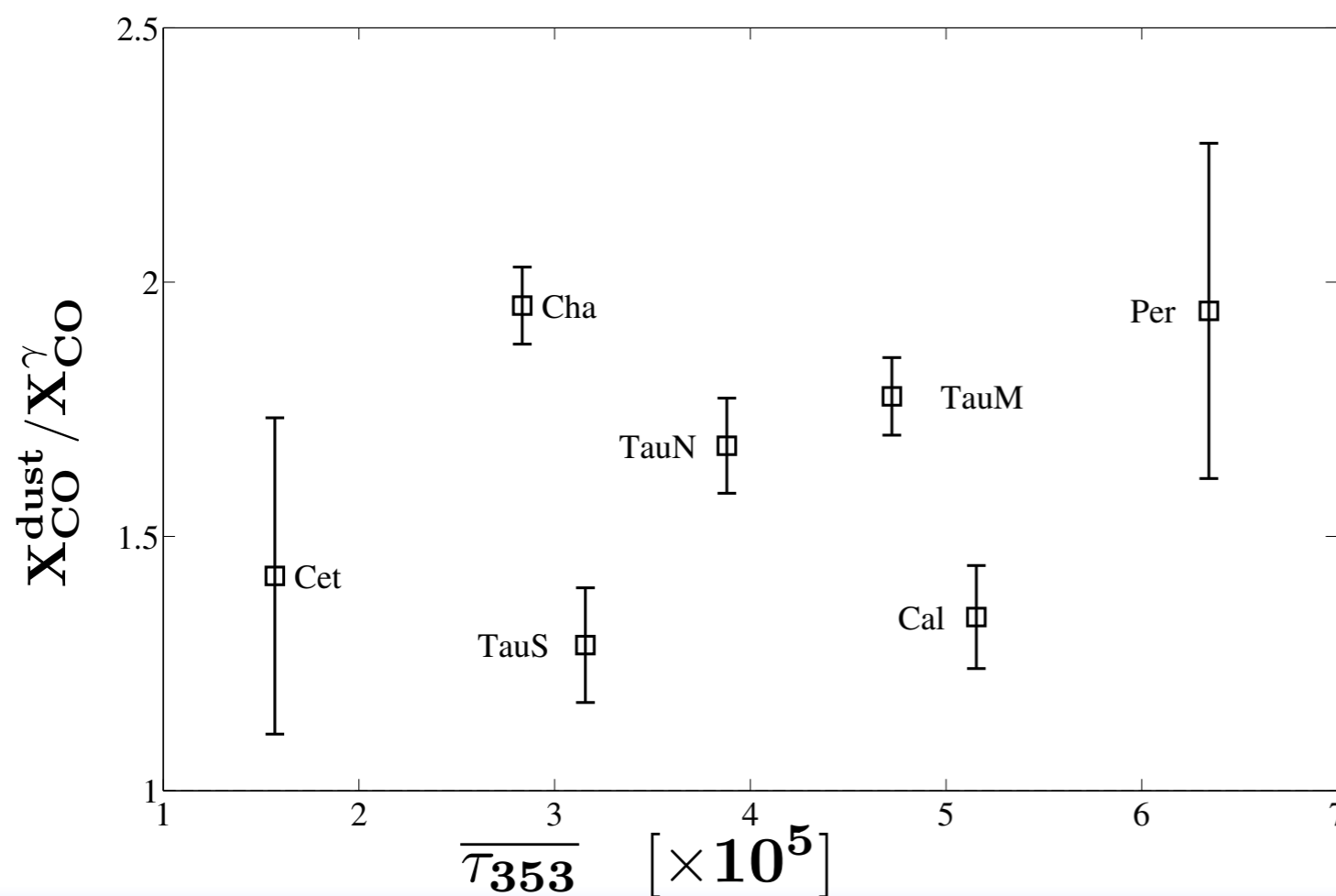
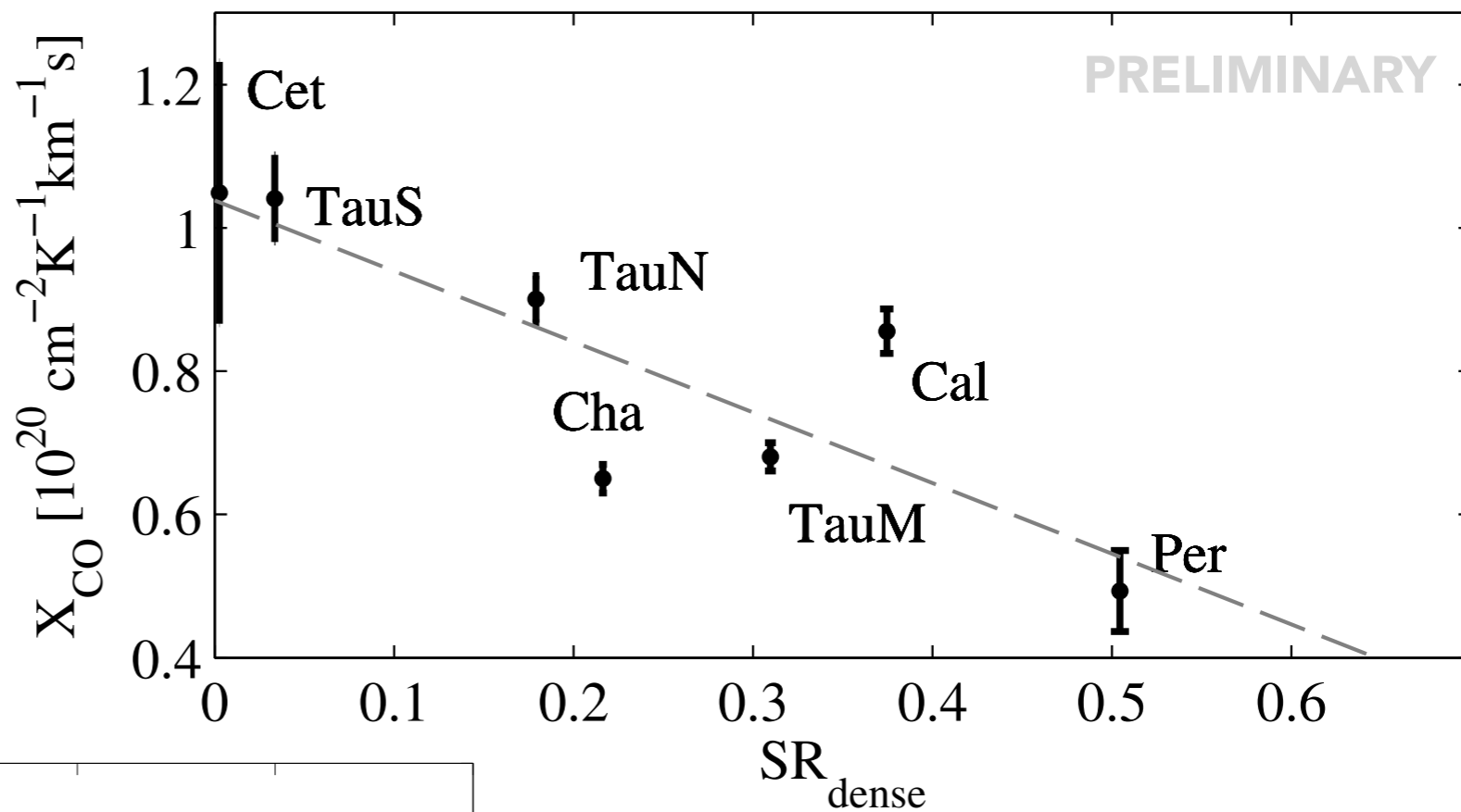


Taurus-Perseus-California




gas tracing with dust emission if $N_{\text{H}} < \text{few } 10^{21} \text{ cm}^{-2}$

- hints that X_{CO} increases from dense cores to diffuse envelopes of the clouds
- $X_{\text{CO}}(\text{dust})$ systematically larger than $X_{\text{CO}}(\gamma)$ because of grain evolution in CO



$$SR_{\text{dense}} = \frac{S_{W_{\text{CO}} > 7 \text{ K km/s}}}{S_{W_{\text{CO}} > 1 \text{ K km/s}}}$$





in-depth study
of other clouds
underway