The Diffuse & Translucent interstellar medium

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With many collaborators, including the
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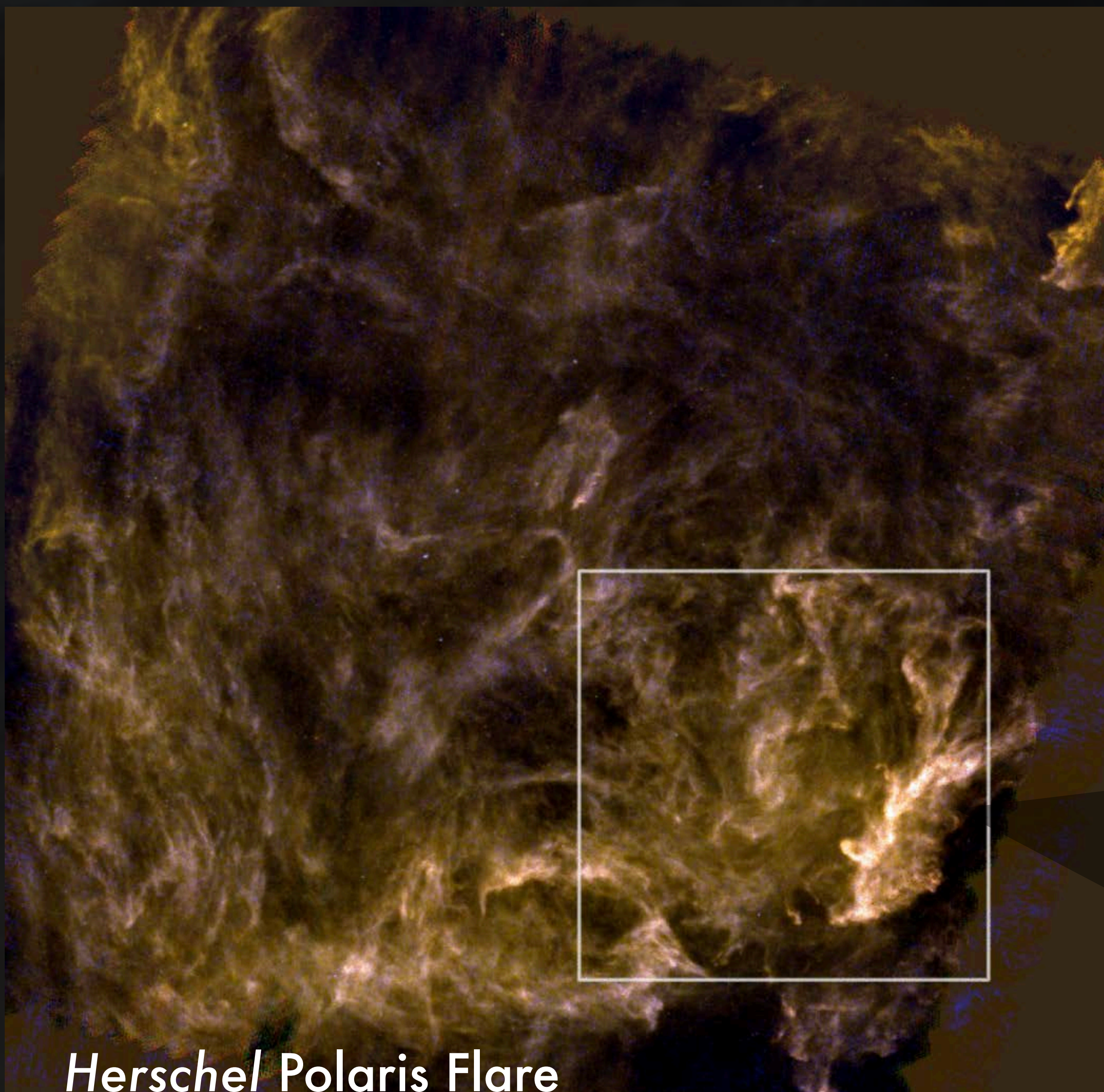
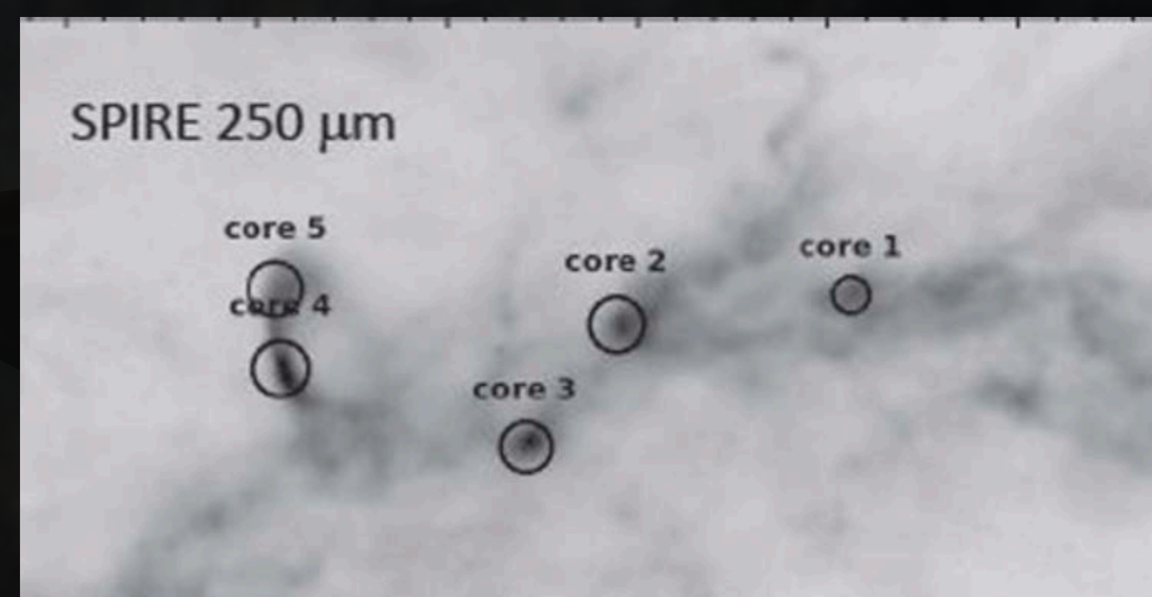
The diffuse and translucent ISM is sculpted by rich multi-scale physics.



Herschel Polaris Flare
Men'shchikov+ 2018

GALFA-HI diffuse HI
Clark 2018a



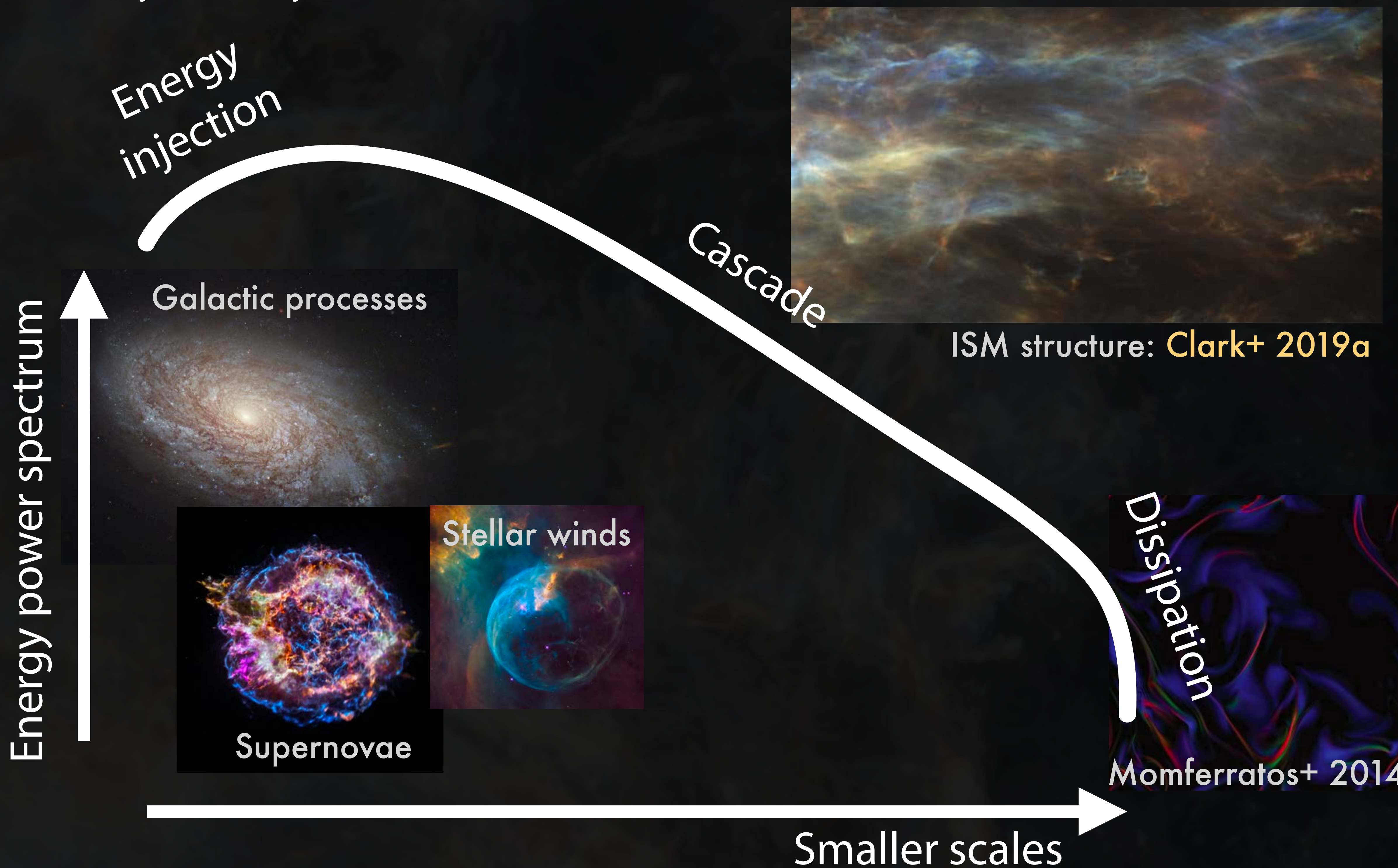
The diffuse and translucent ISM: a few questions

What is the nature of MHD turbulence in the ISM?
What dominates turbulent dissipation?

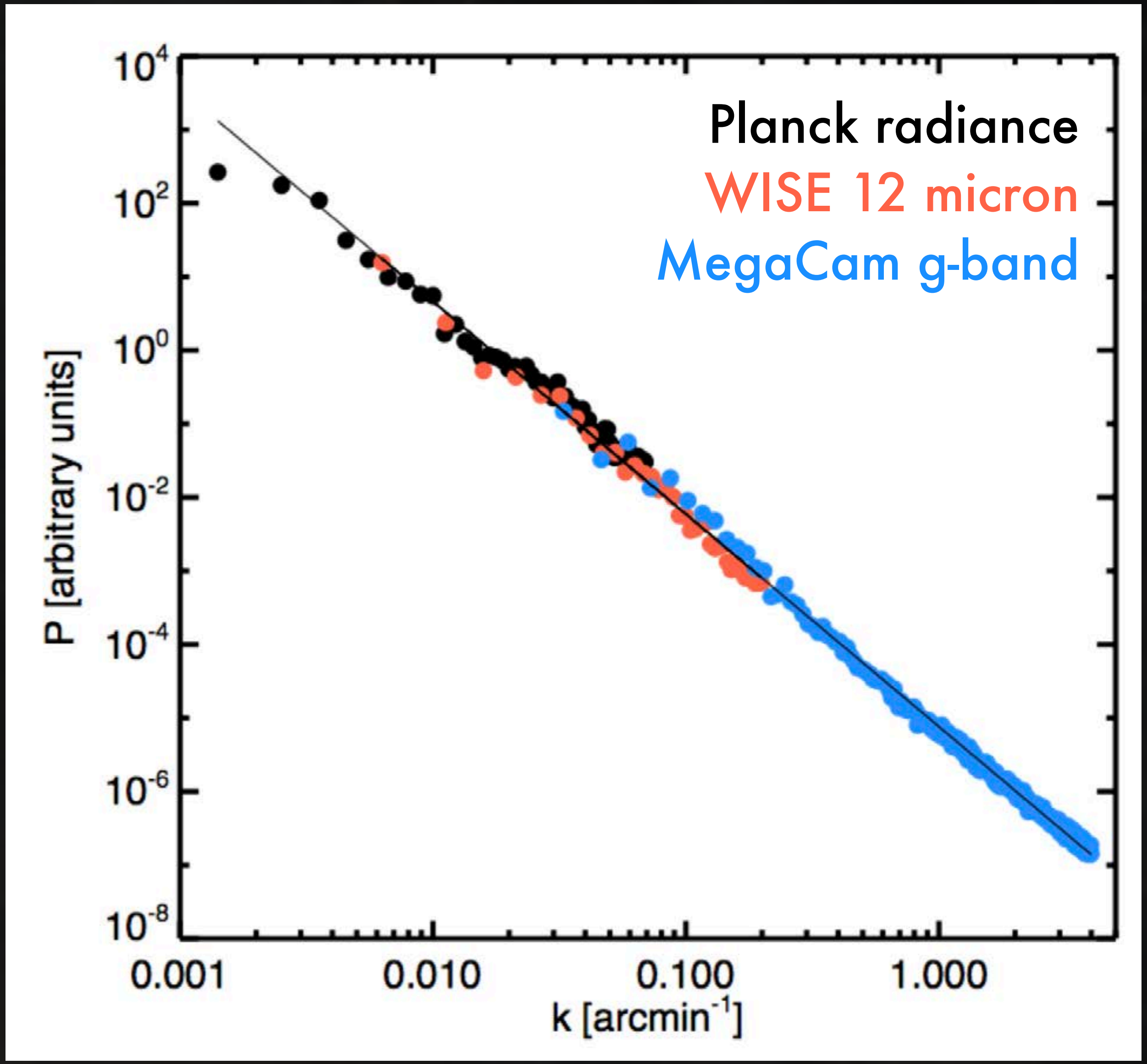
How do magnetic fields affect structure formation in the diffuse medium?

What role do the above play in phase transitions?

What is the nature of magnetohydrodynamic turbulence in the ISM?



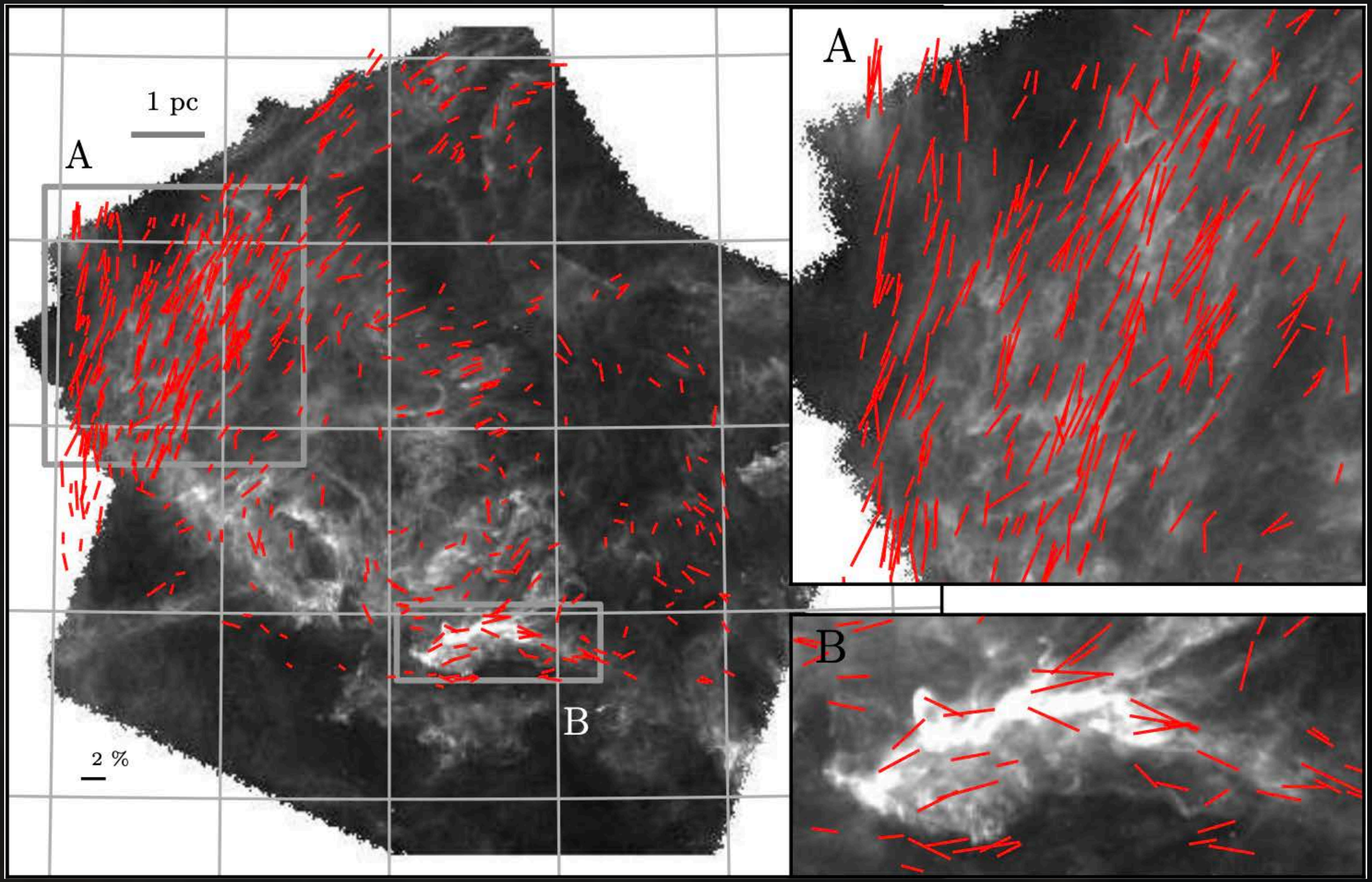
What dominates turbulent dissipation in the ISM?



Miville-Deschenes+ 2016

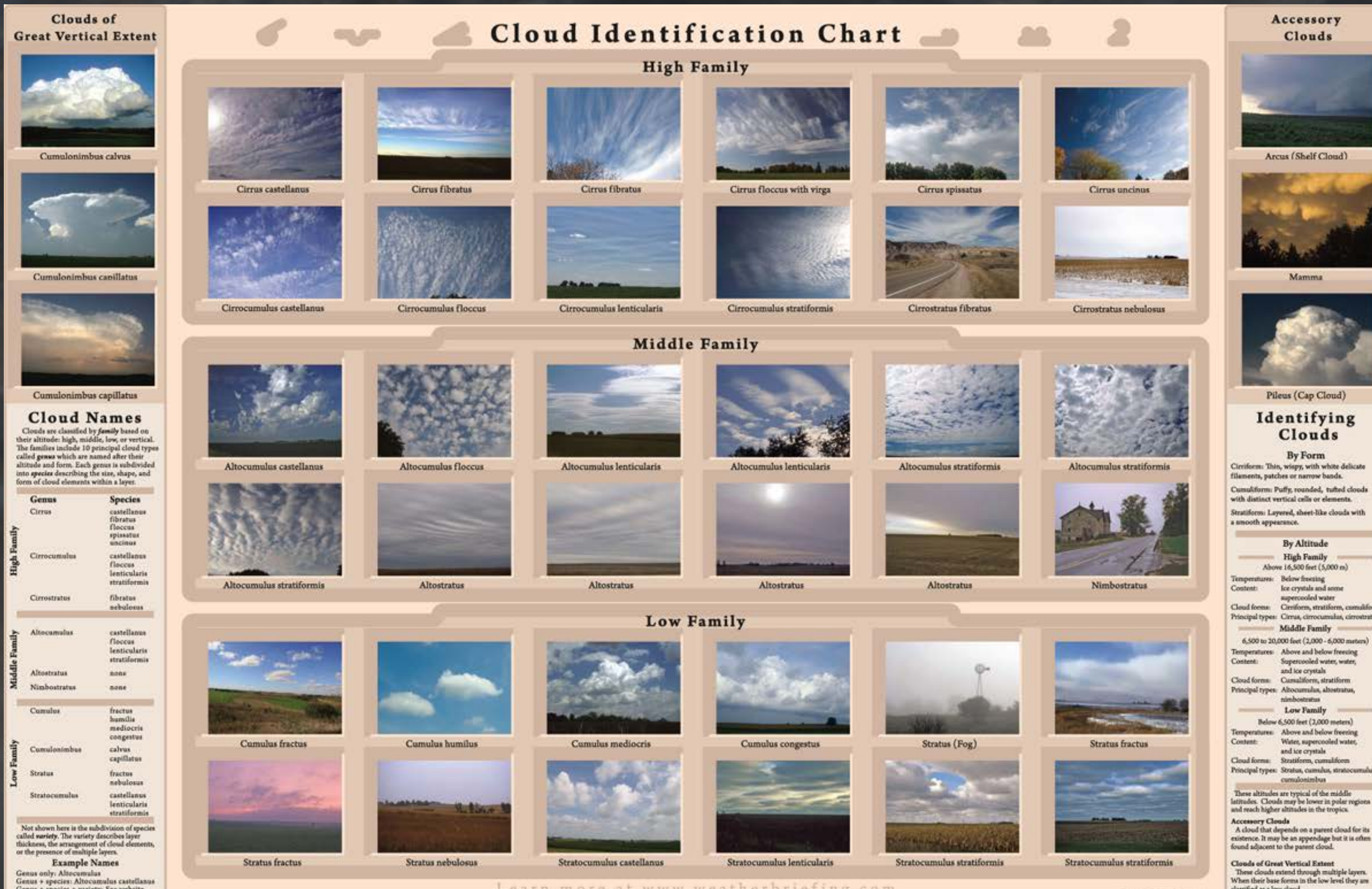
No sign of dissipation at ~0.01 pc in CNM

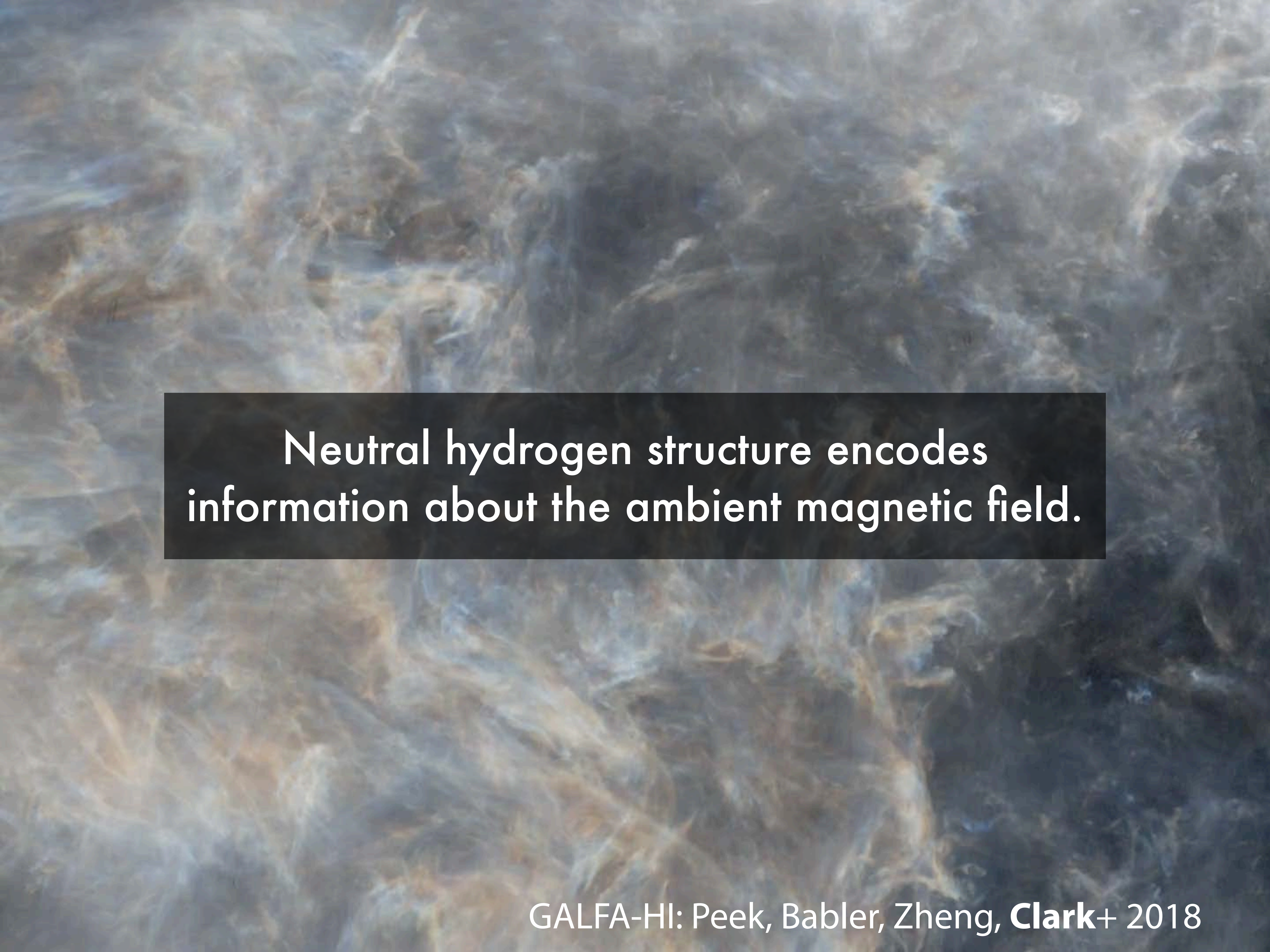
How do magnetic fields affect structure formation in the diffuse and translucent medium?



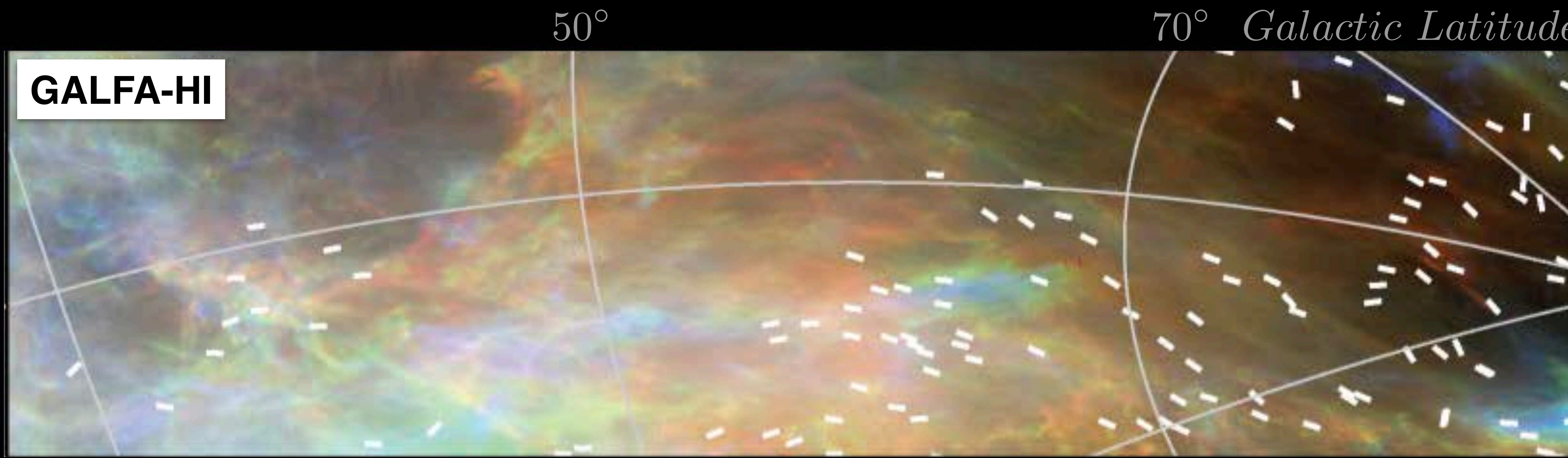
Herschel Polaris Flare
Panopoulou+ 2018

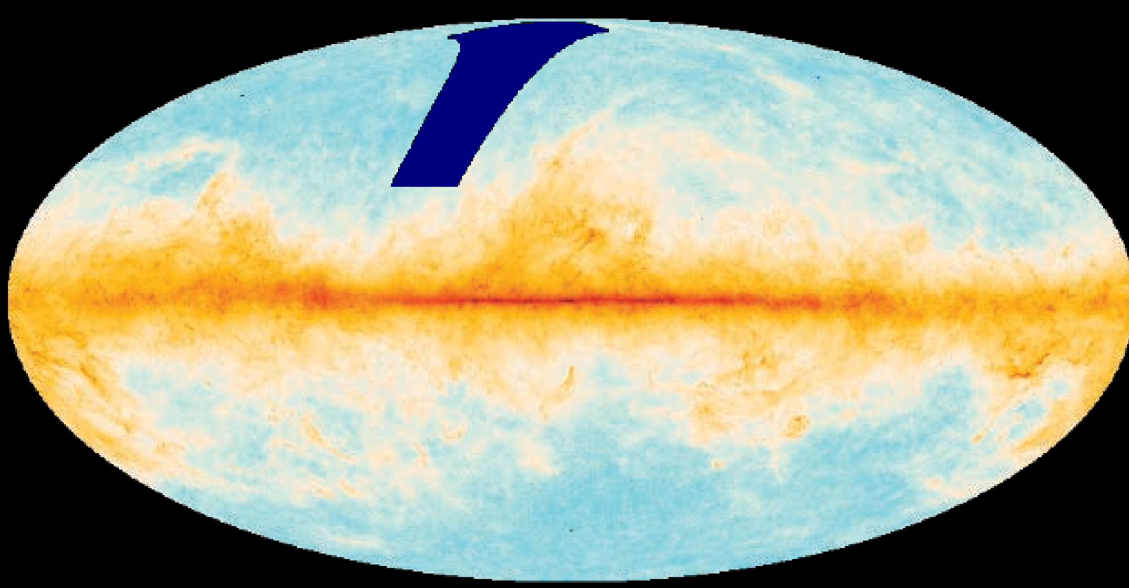
Morphology encodes complex physical information




Neutral hydrogen structure encodes information about the ambient magnetic field.
GALFA-HI: Peek, Babler, Zheng, **Clark**+ 2018

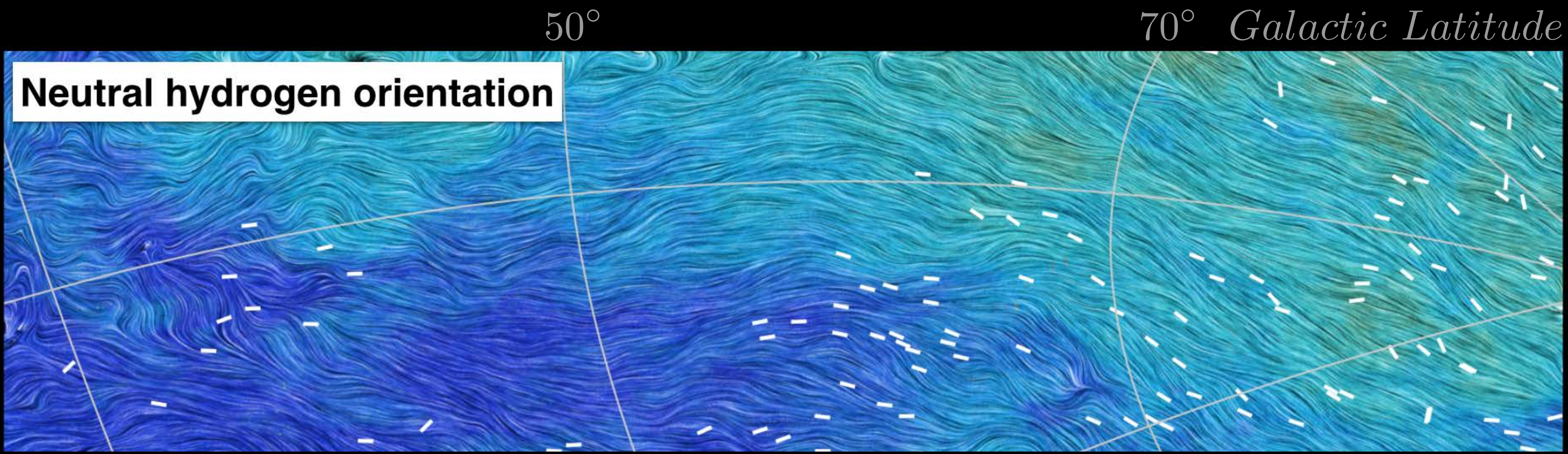
Characterize the orientation of high-latitude GALFA-HI structures.





Clark+ 2015, PRL

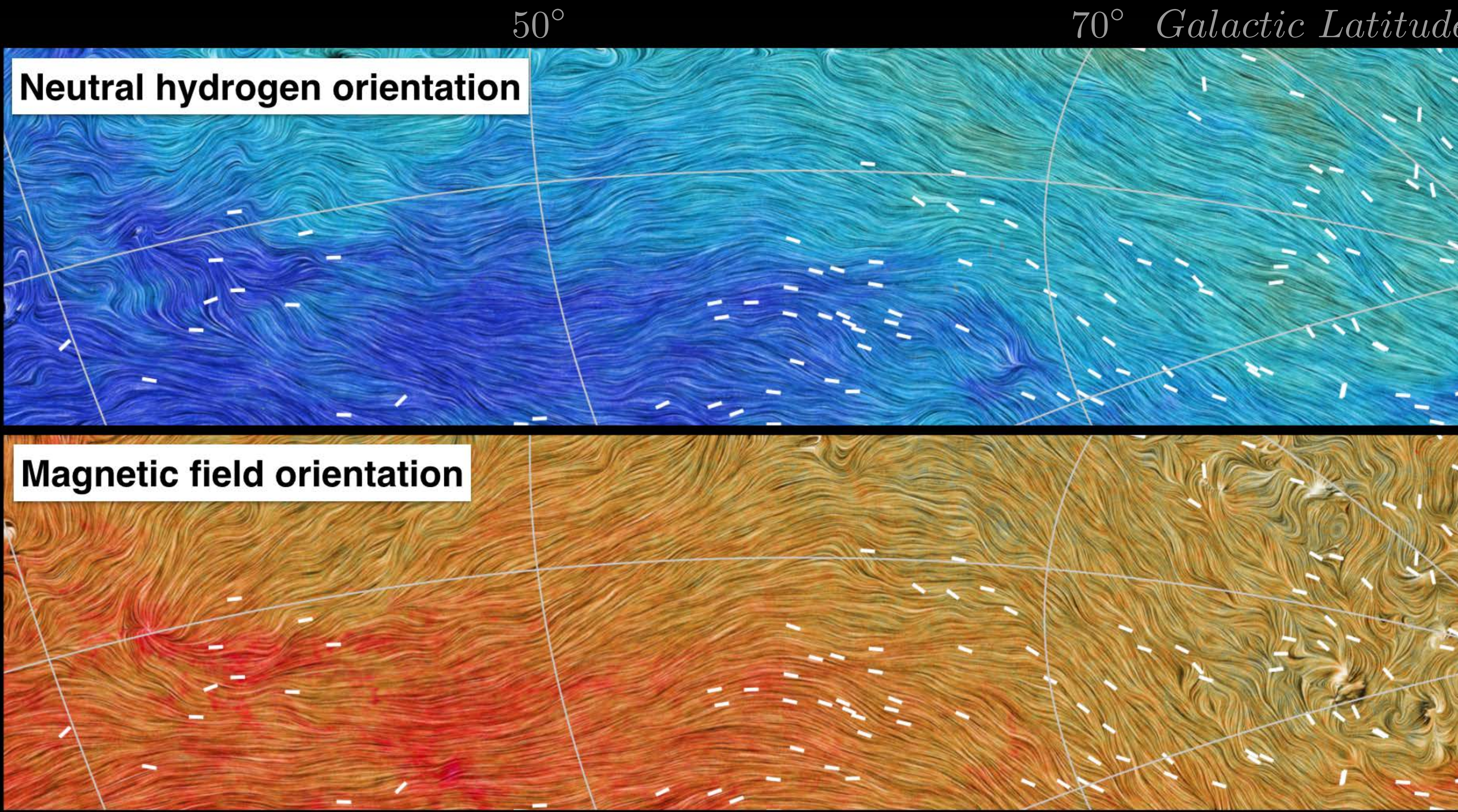
Characterize the orientation of high-latitude GALFA-HI structures.



github.com/seclark/RHT

Clark+ 2015, PRL

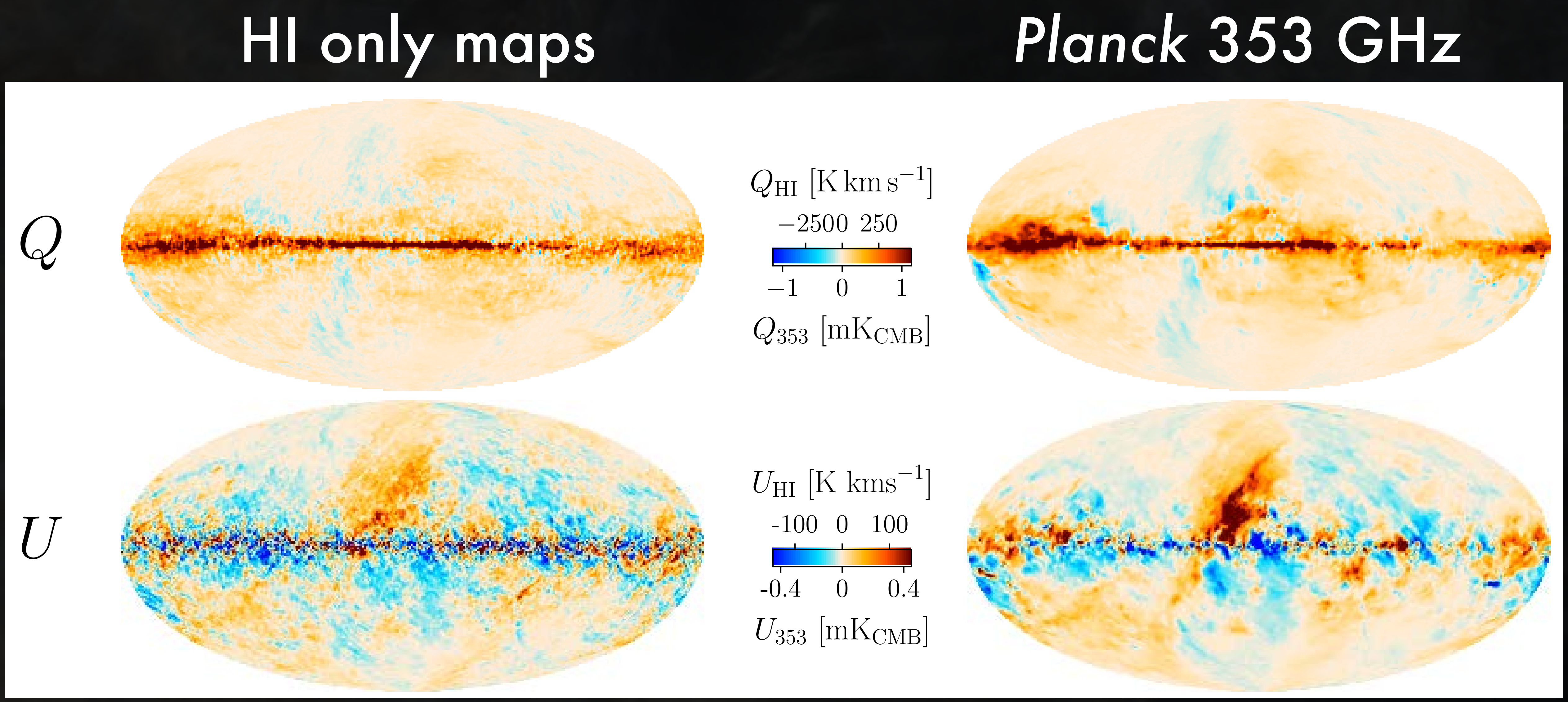
High-latitude GALFA-HI structures are aligned with the *Planck* magnetic field orientation.



Starlight polarization: Heiles 2000

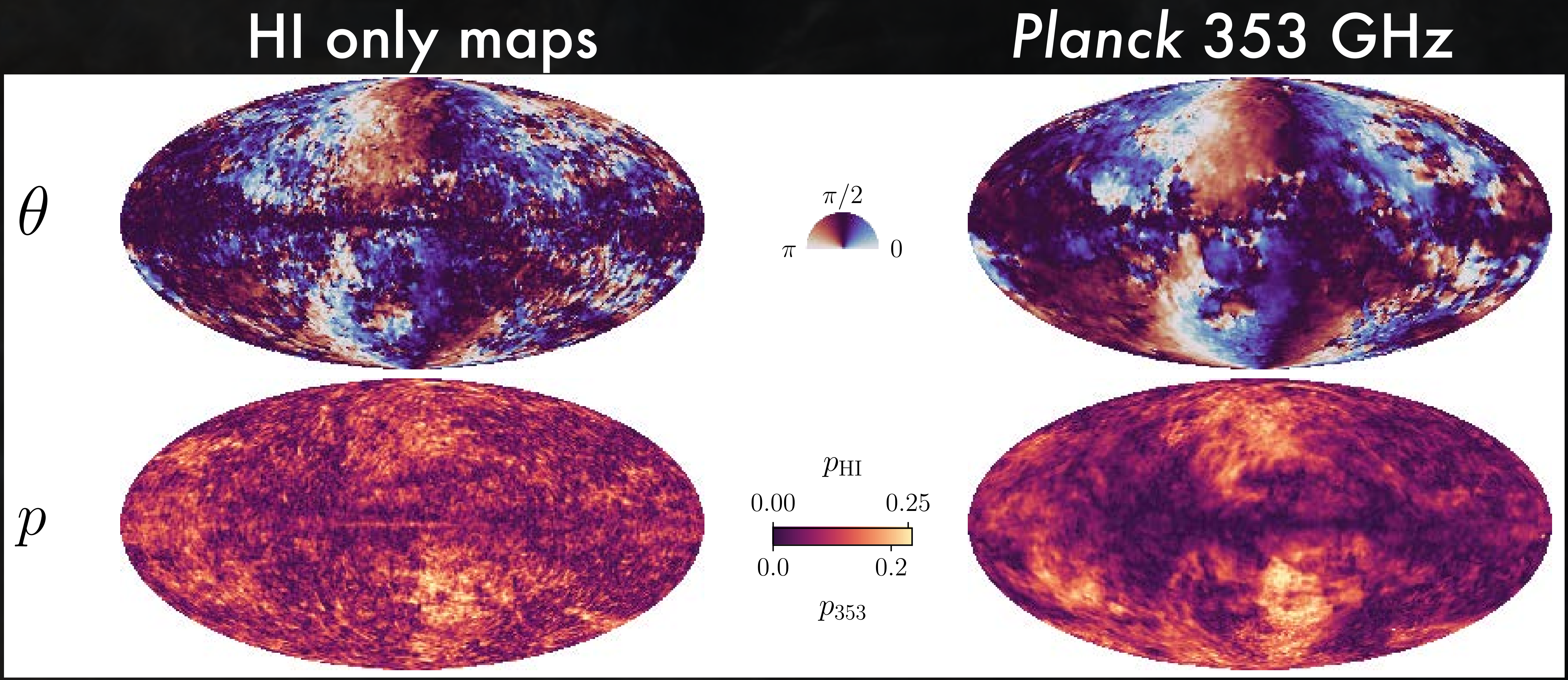
Clark+ 2015, PRL

We can model the polarized dust sky *from HI morphology alone.*



Clark & Hensley 2019

We can model the polarized dust sky *from HI morphology alone.*

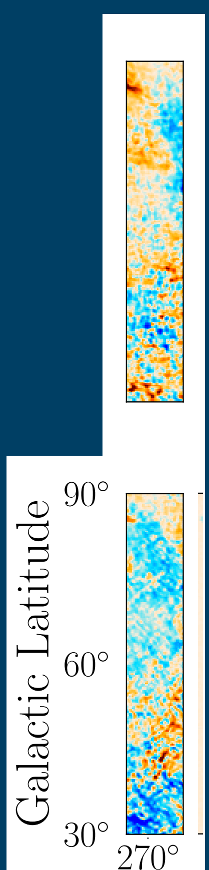


Clark & Hensley 2019

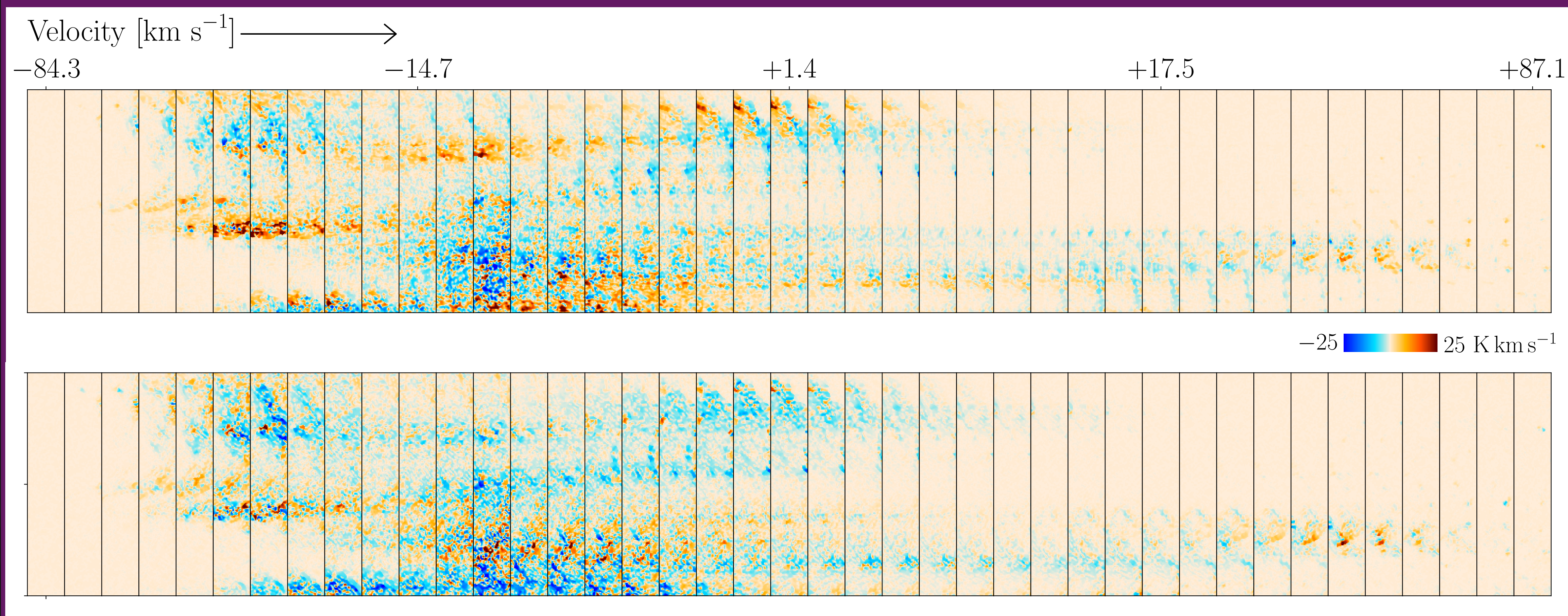
See also Clark 2018, ApJL

We can model the polarized dust sky in 3D *from HI morphology alone.*

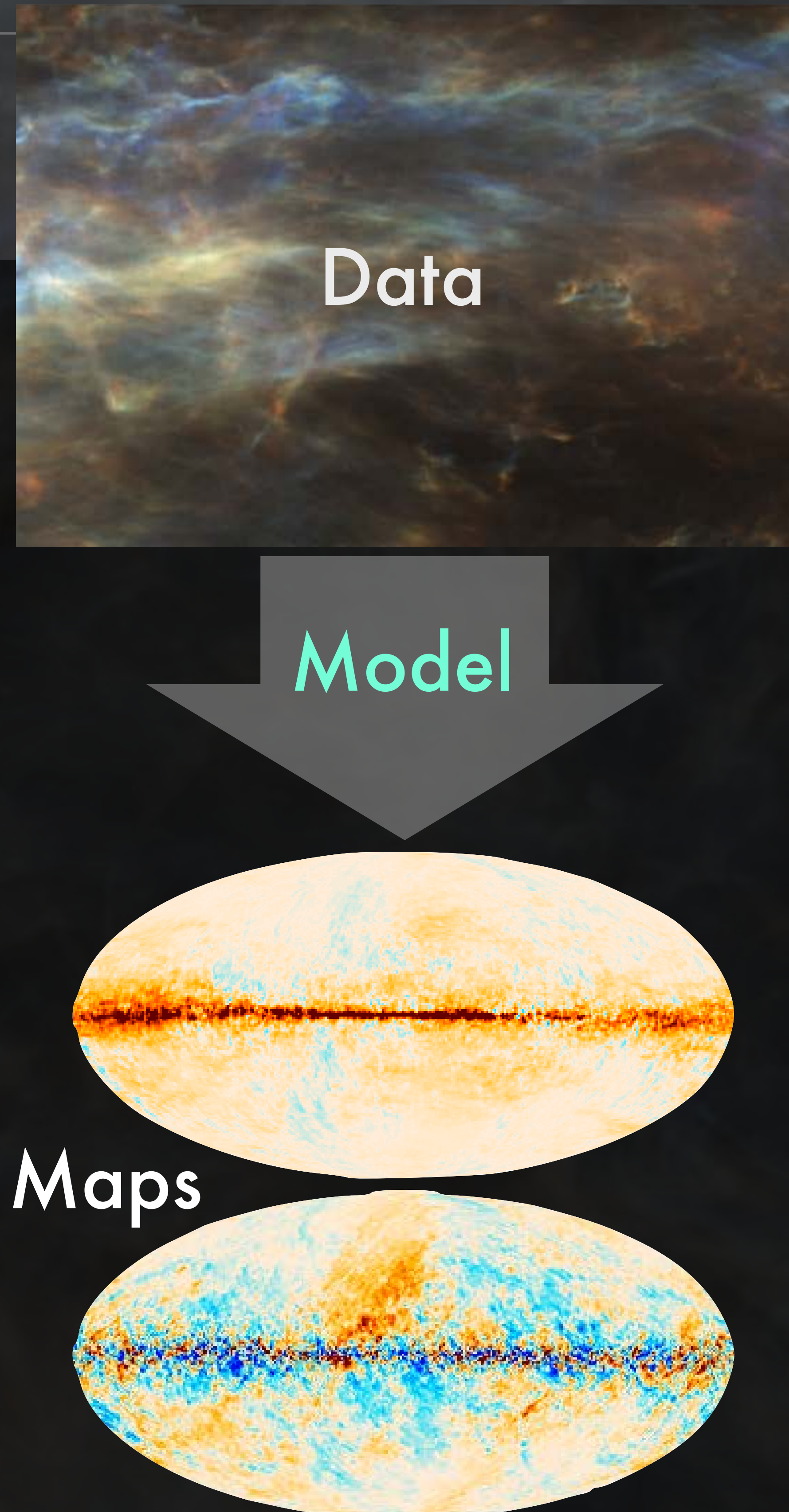
***Planck* view (2D)**



***Clark & Hensley* view (3D)**



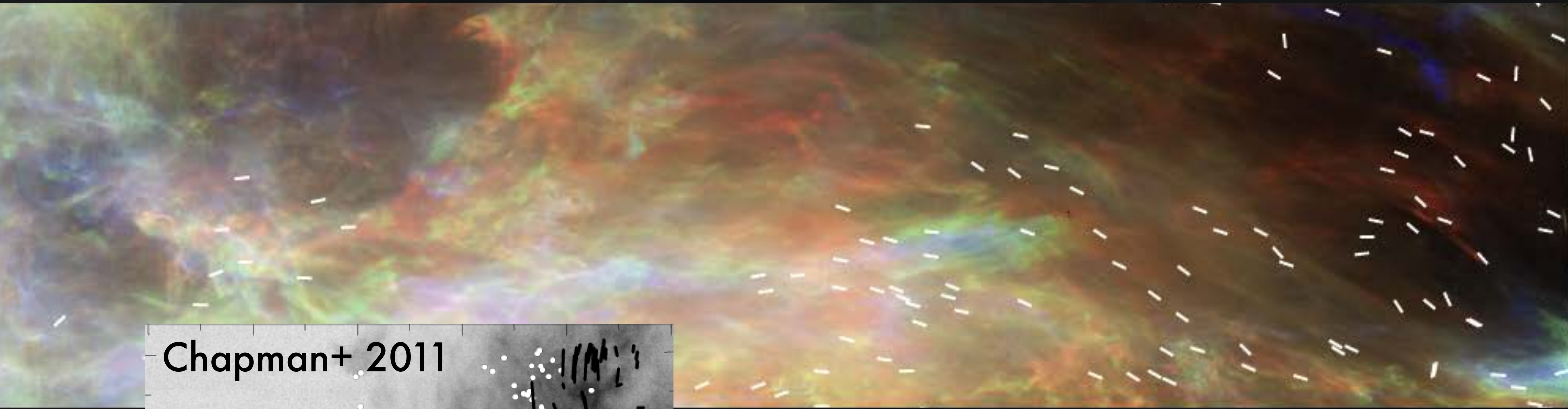
Clark & Hensley 2019



George Halal, Physics graduate student

- How can we build a better HI-based model of the dust polarization?
- What does this teach us about turbulent structure formation in the ISM?

Morphology encodes rich physical information.
What new statistical tools can we devise?

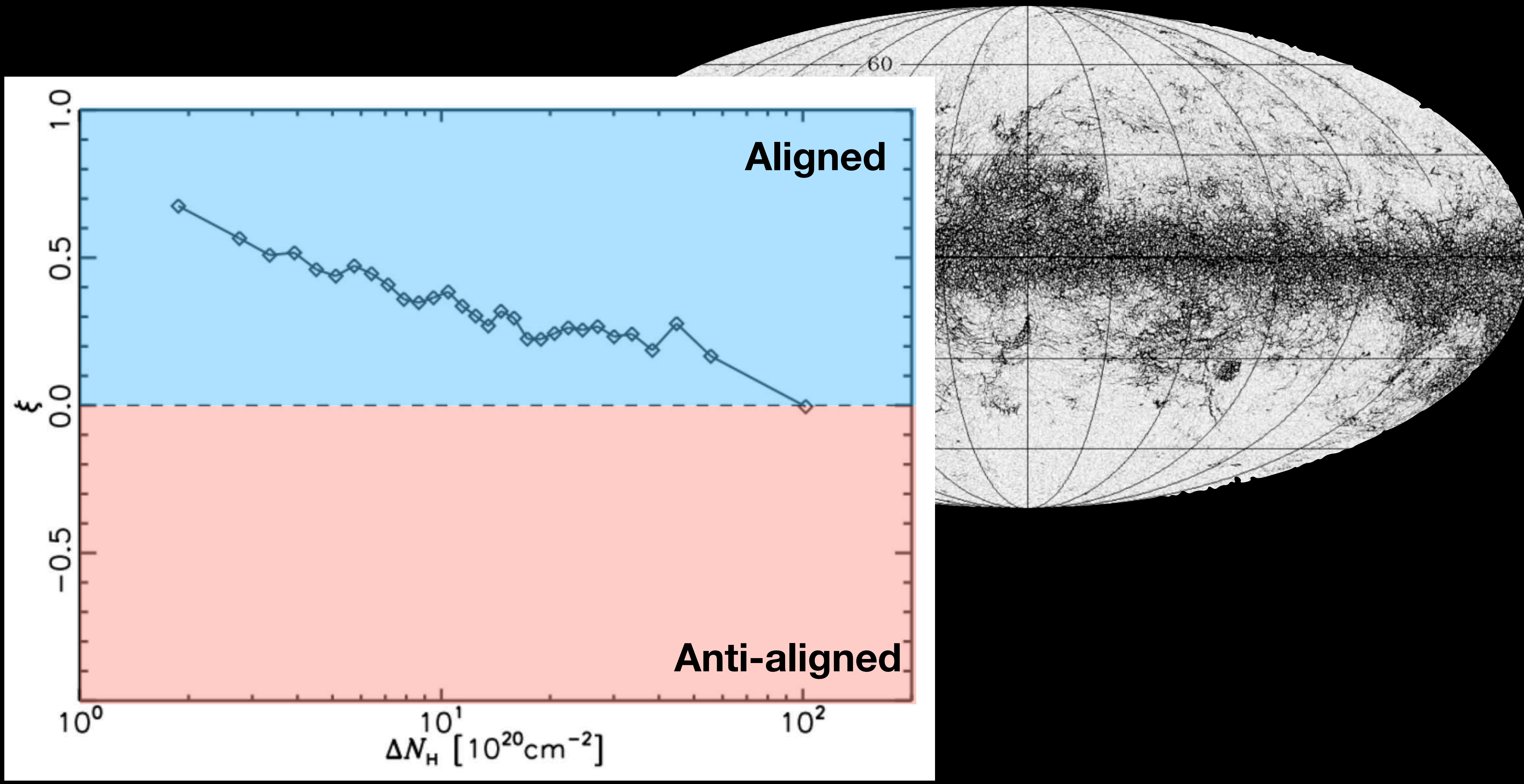


Clark+ 2014, 2015

Diffuse ISM: structures || B-field

Molecular clouds: change in relative orientation

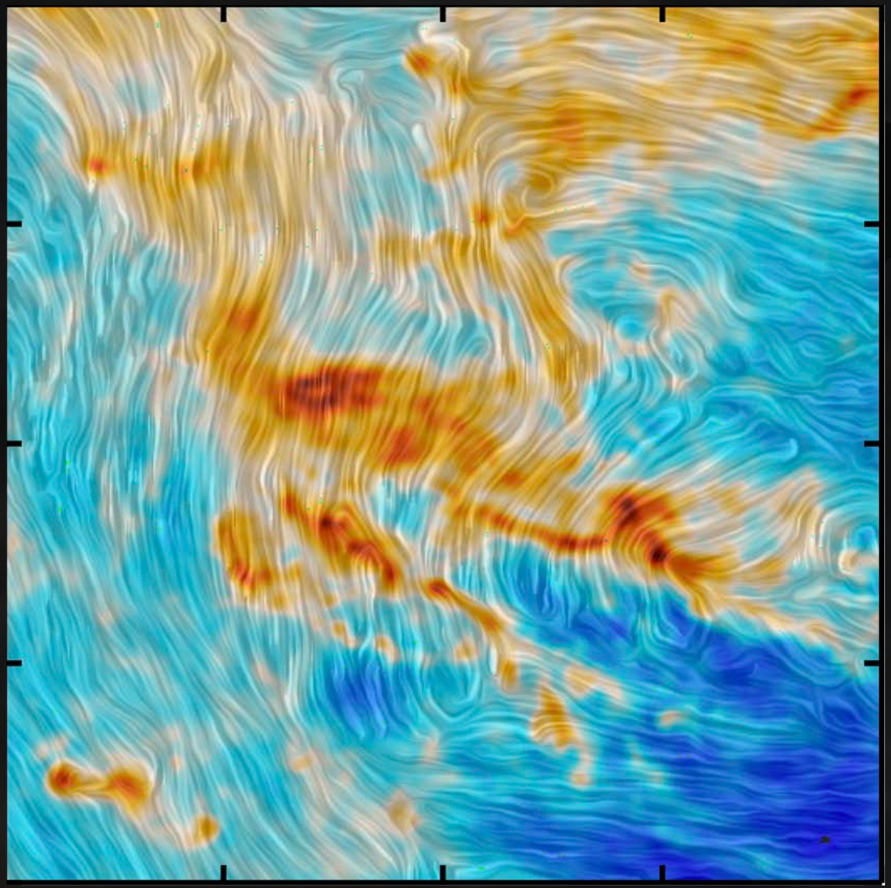
Planck enabled statistical studies of the magnetic field and ISM filaments.

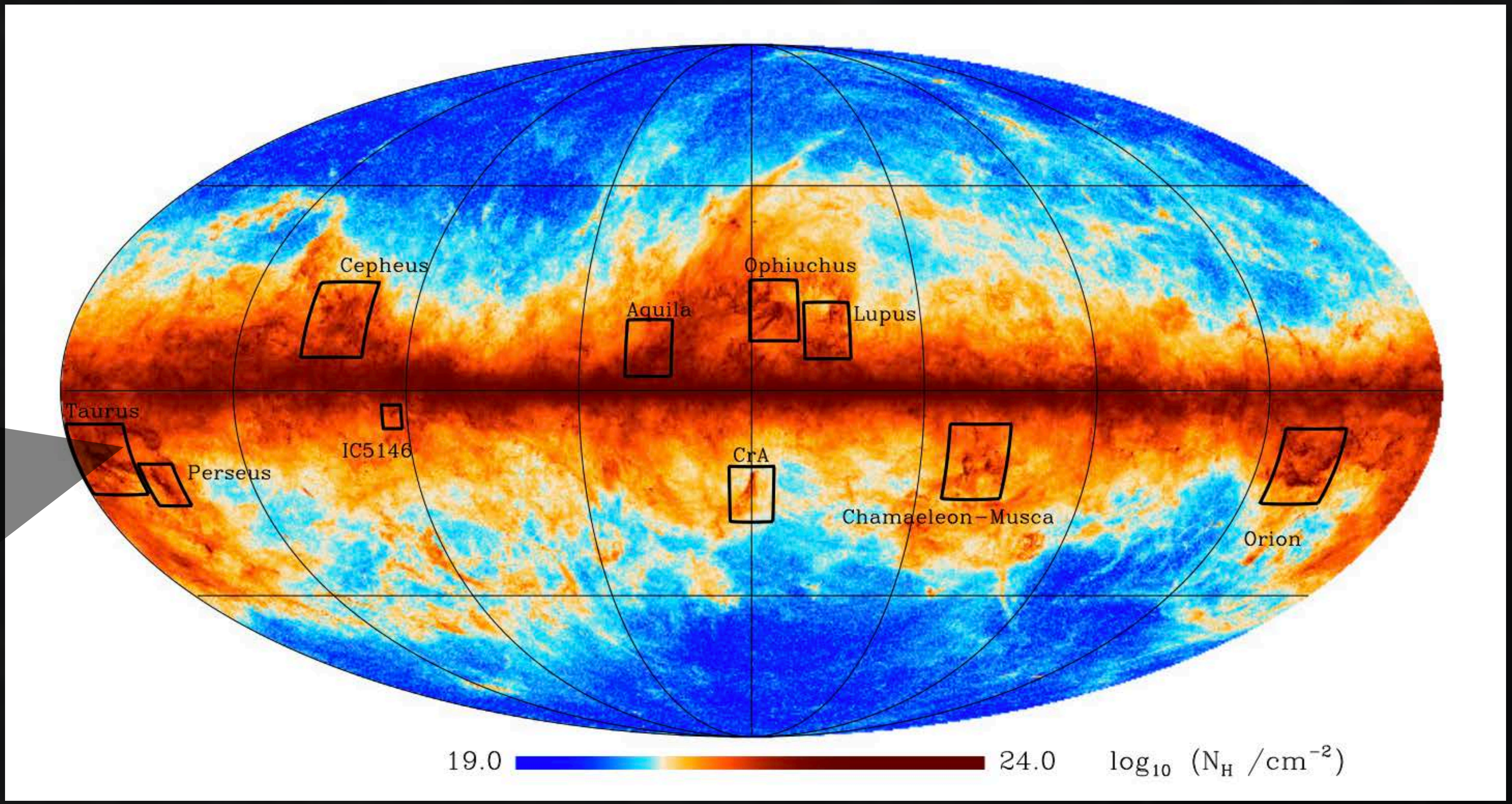


Planck Int. XXXII

See also Alina+ 2019

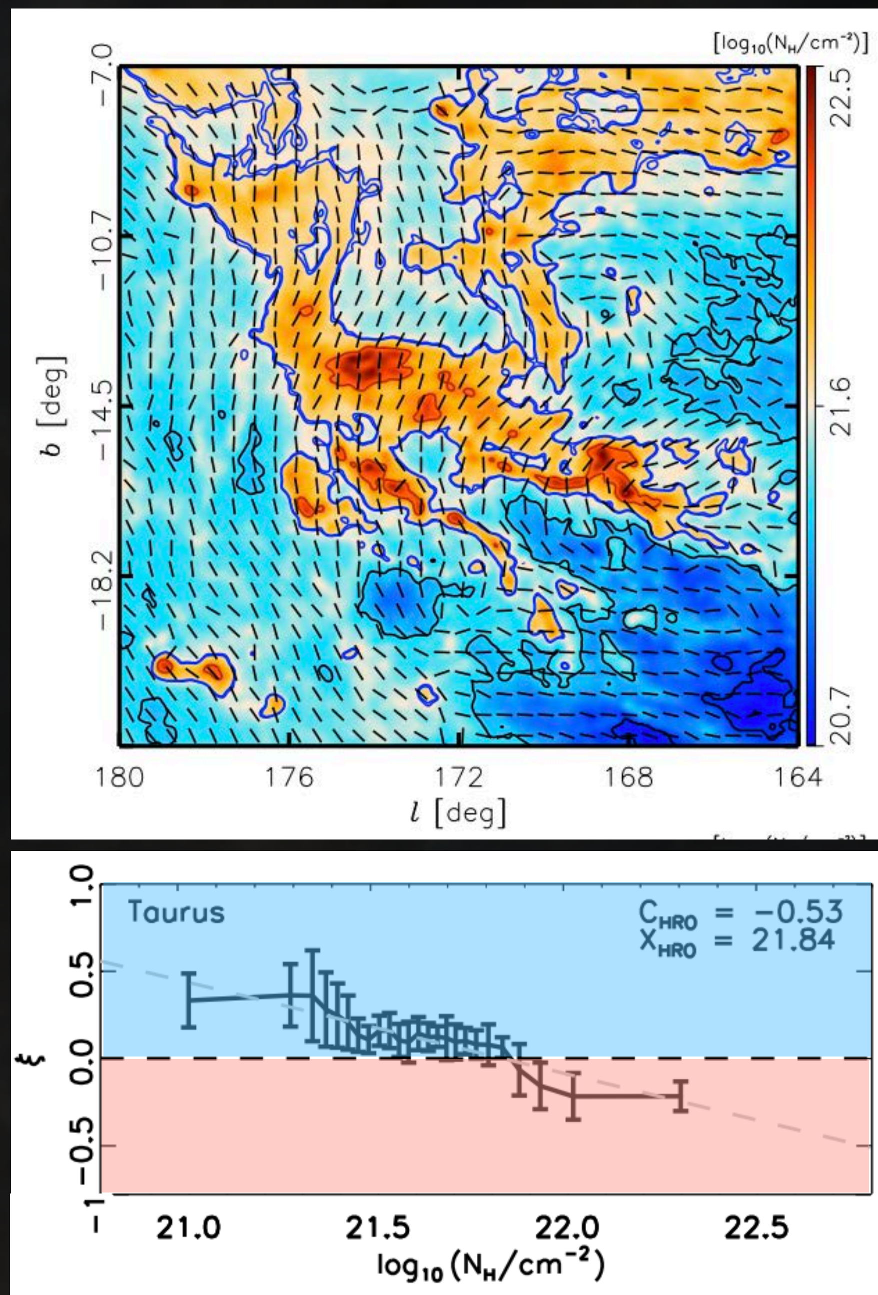
Planck studied this correlation in nearby Gould Belt molecular clouds.



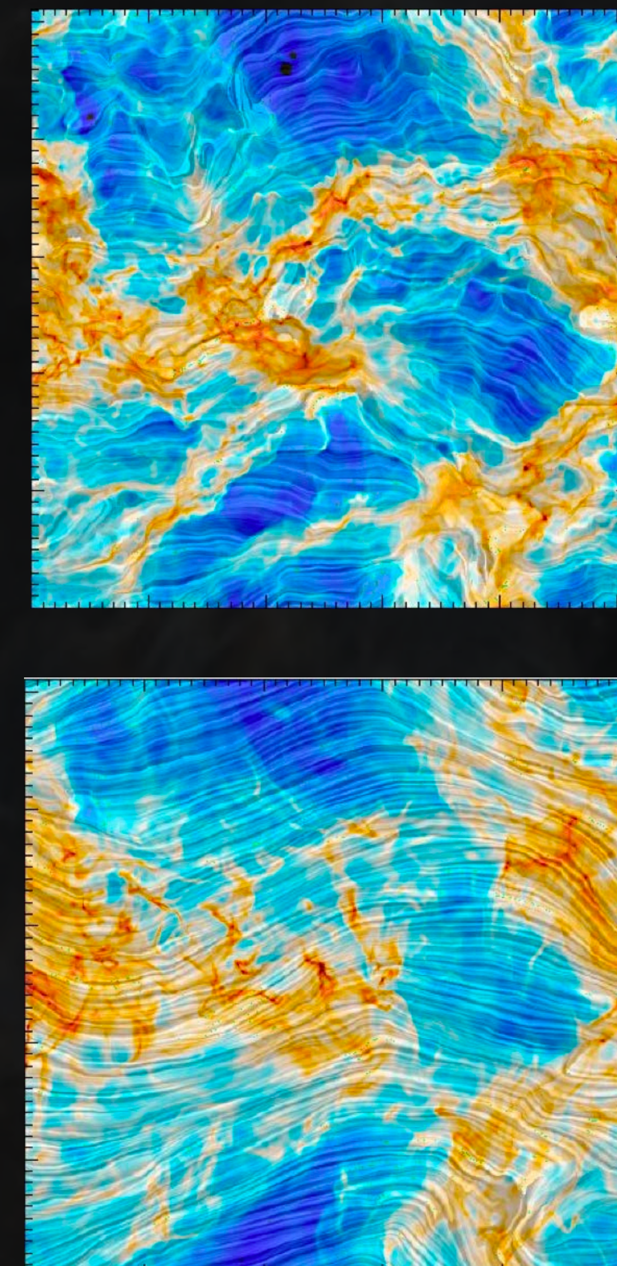


Planck Int. XXXV

Denser cloud structures are perpendicular to the magnetic field orientation.



Planck Int. XXXV



$\beta = 100$

Soler+ 2013

$\beta = 0.1$

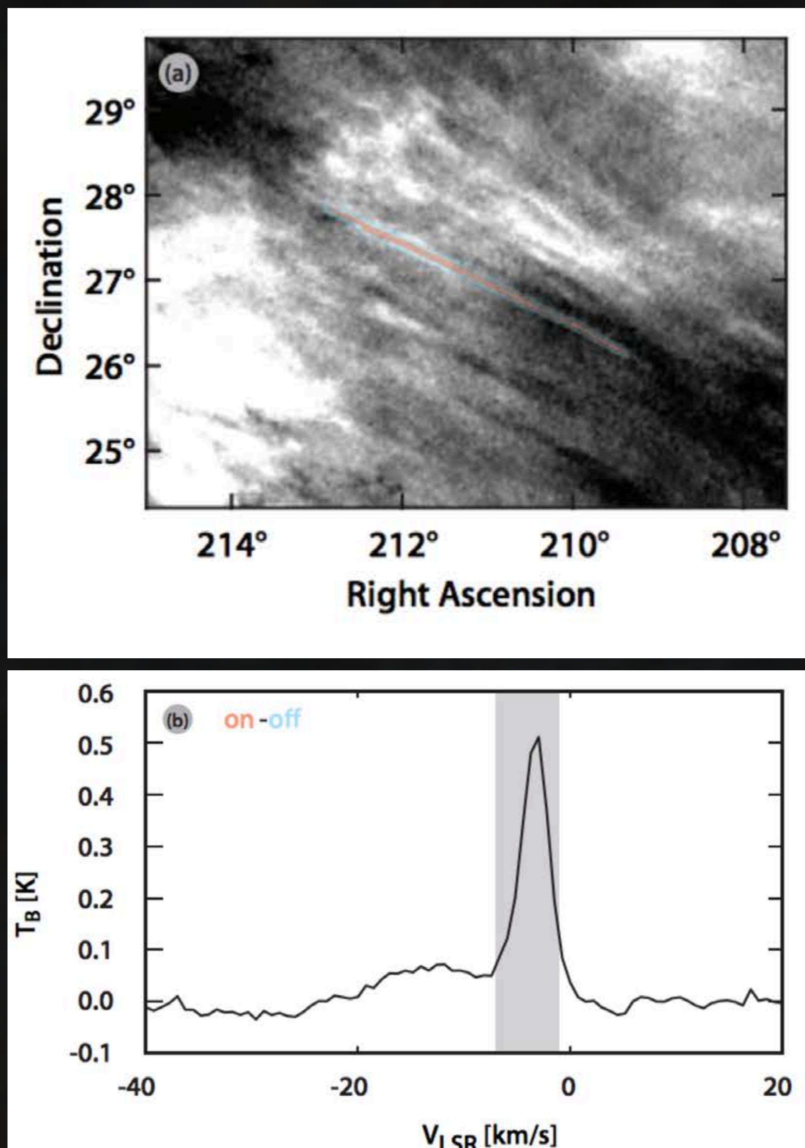
See also Mocz & Burkhart 2018, Seifried+ 2020

See also Jow+ 2018, Fissel+ 2019

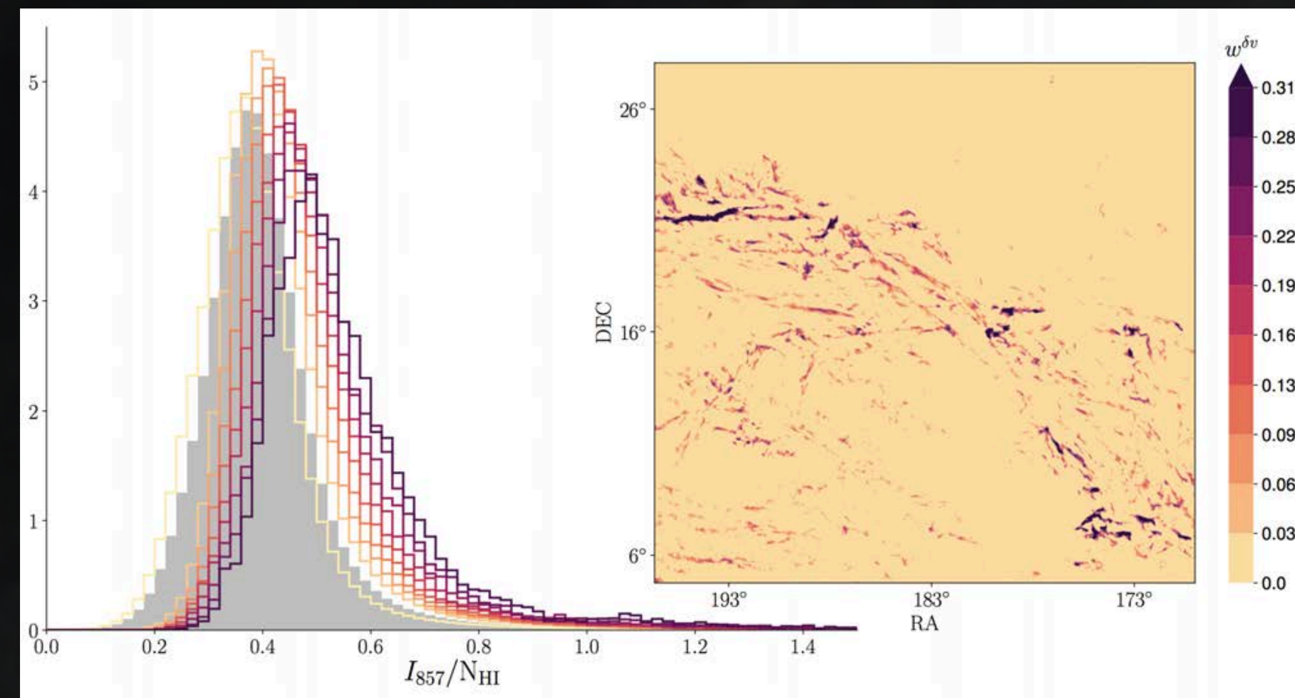
Clark+ 2019

What is driving the measured magnetic alignment of diffuse HI structures?

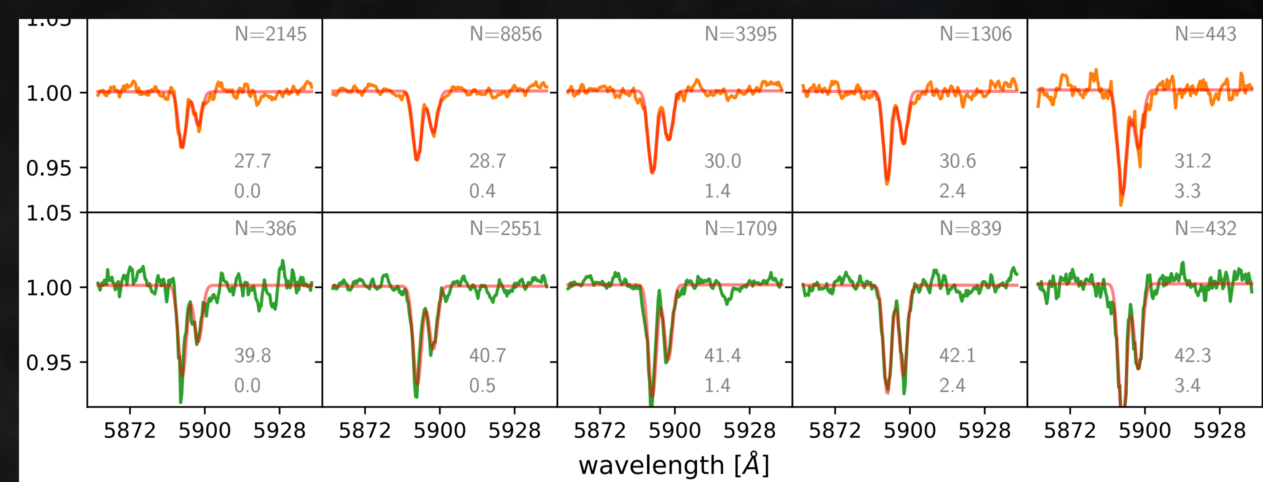
Linewidth measurements, FIR/N_{HI} correlations, and Na I D absorption are all consistent with cold density structures.



Clark+ 2014



Clark+ 2019

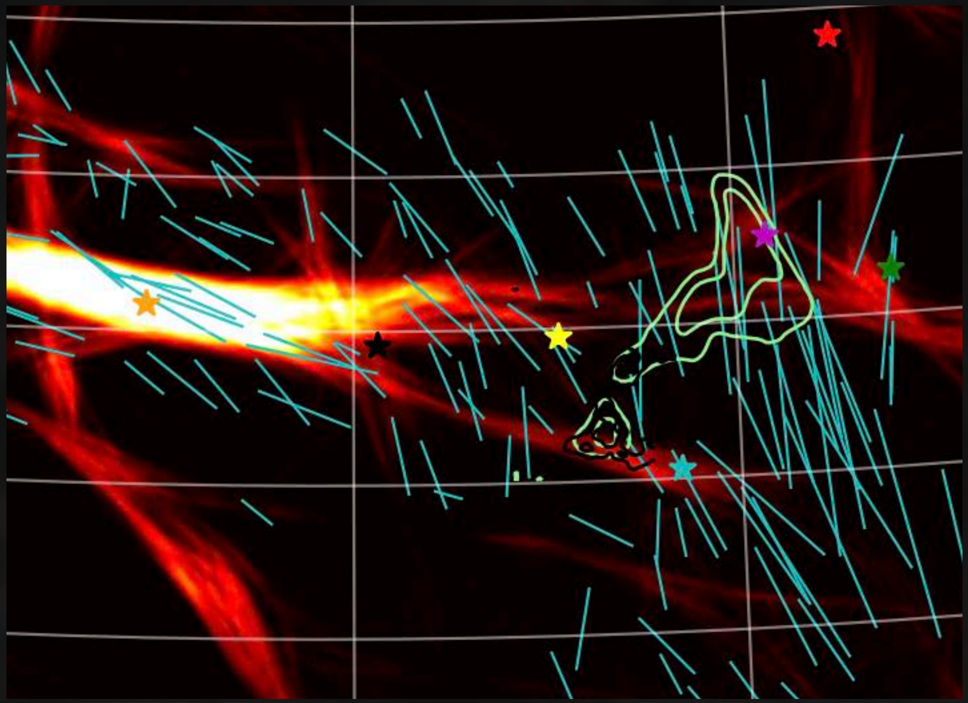


Peek & Clark 2019

See also: Kalberla+ 2016
Murray+ 2020

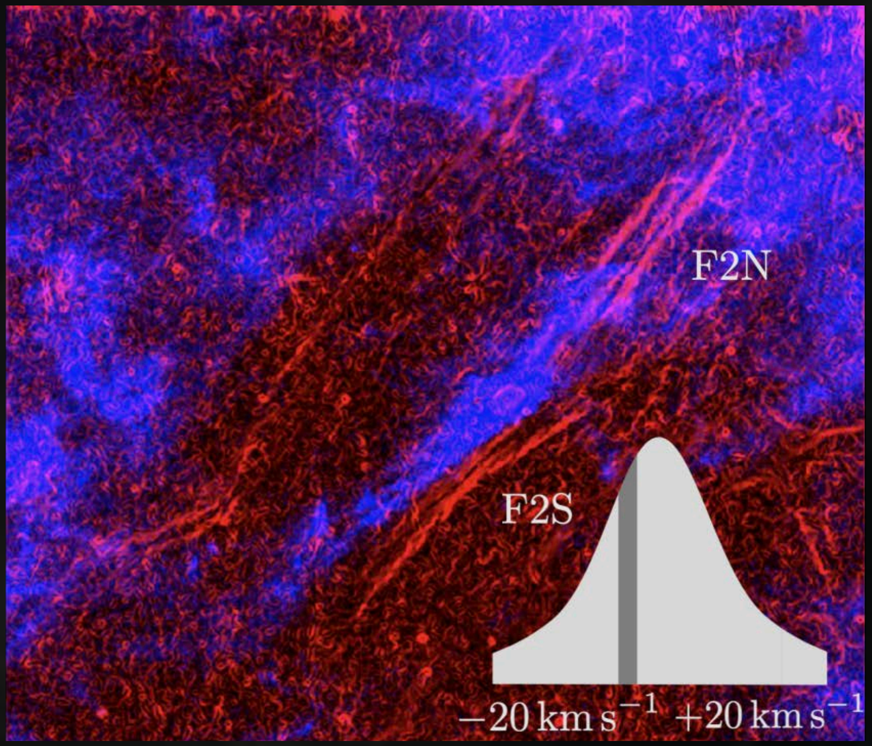
Promising directions for the multi-phase, magnetic, diffuse ISM: multi-tracer data

Structure-magnetic field correlations in transition regions



Skalidis+ 2021

Multi-tracer analyses that probe magnetic fields in different phases

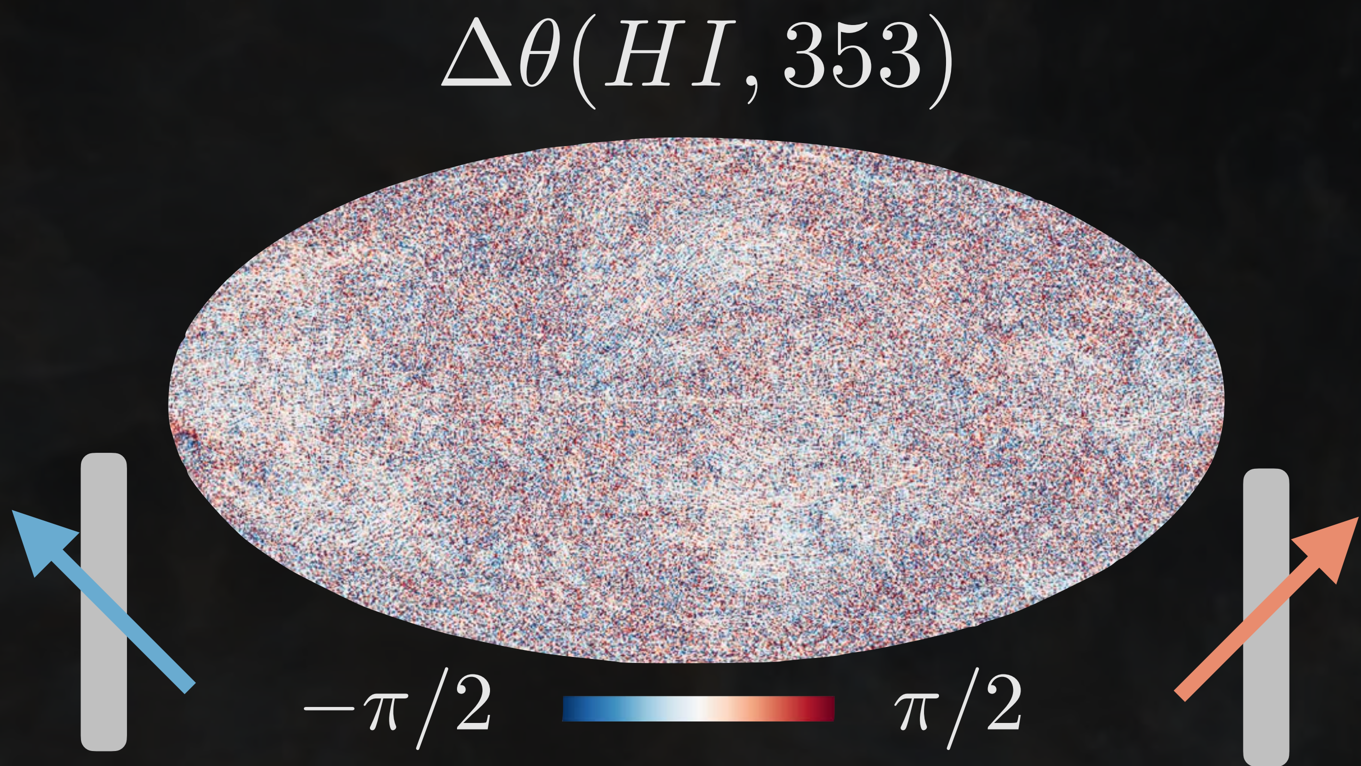


Campbell+ 2021

+ the talks in this session!

Promising directions for the multi-phase, magnetic, diffuse ISM: new statistics

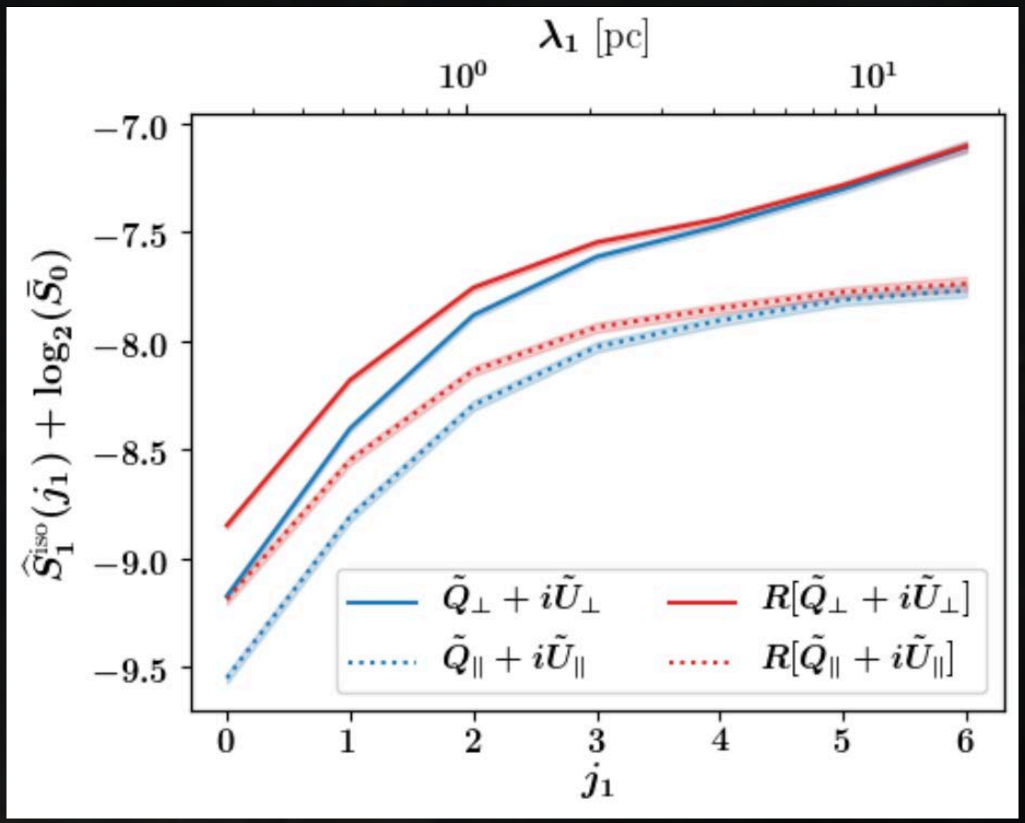
Parity-odd quantities trace magnetic misalignment



Clark+ 2021

Cukierman+ in prep

Non-Gaussian statistics



Regaldo-Saint Blancard+ 2020

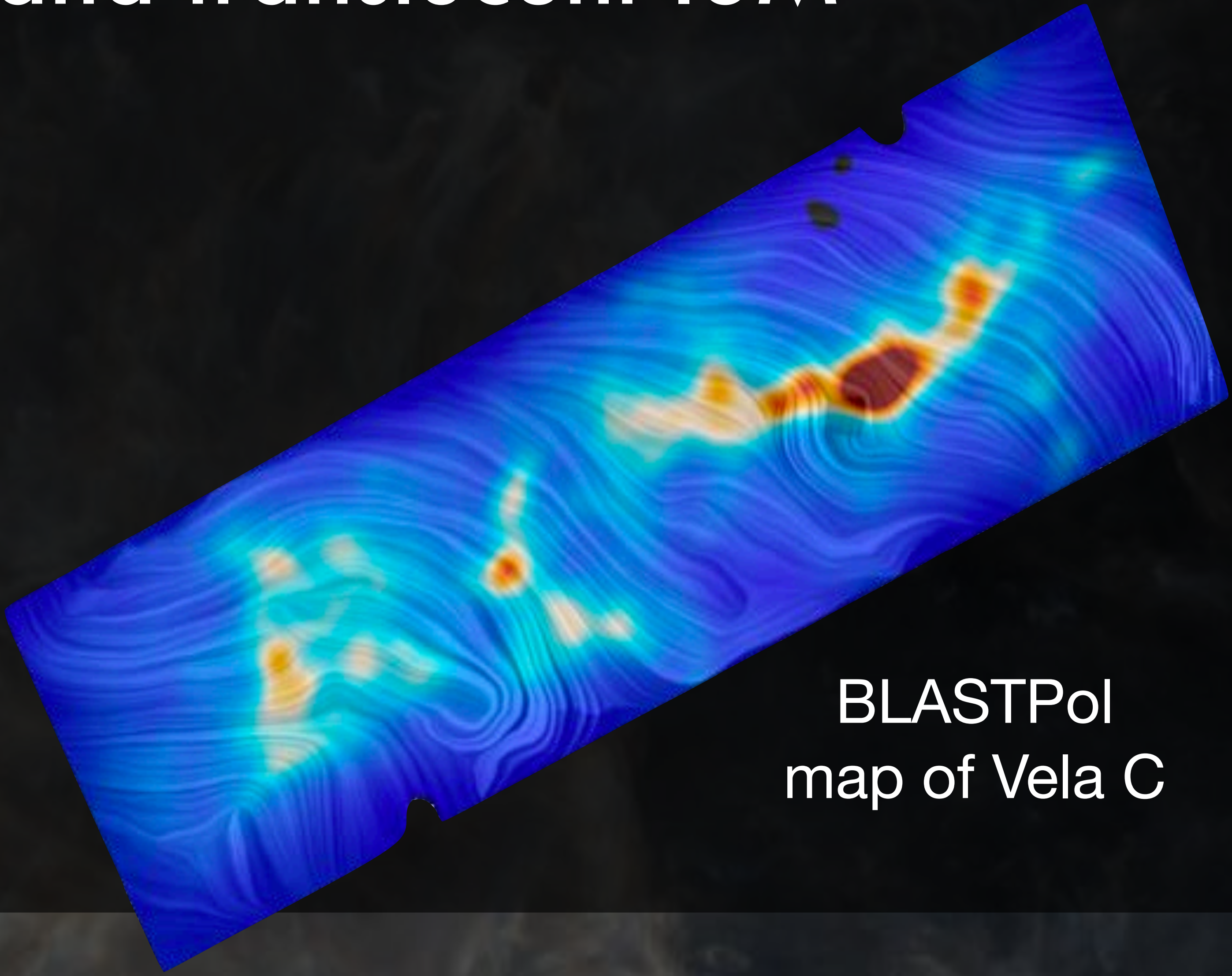
Ongoing work by Minjie Lei

The Balloon-Borne Large Aperture Submillimeter Telescope (BLAST) Observatory

Spatially resolved FIR polarimetry over 100 sq. deg. regions of diffuse and translucent ISM

Plus nearby molecular clouds, Galactic plane, LMC/SMC, and shared risk obs!

Lowe+, SPIE arXiv:2012.01376



BLASTPol map of Vela C

The diffuse and translucent ISM: a few questions

What is the nature of MHD turbulence in the ISM?
What dominates turbulent dissipation?

How do magnetic fields affect structure formation in the diffuse medium?

What role do the above play in phase transitions?

The diffuse and translucent ISM: a few ^more questions

ISM morphology carries rich information. How do we optimally extract the physics?

These are high dynamic range problems spanning physical states. How do we combine tracers?

What other opportunities can we identify?

The diffuse and translucent ISM: some recent progress

Clark+ 2015

The diffuse ISM is structured by the ambient magnetic field.

Magnetic alignment in the HI is driven by anisotropic, cold density structures.

Clark+ 2019

Rich opportunities to combine tracers and quantitative morphological analyses

Stay tuned: clarkgroup.stanford.edu