Simulating ISM polarization from Pencil Code data

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Featured publications

The supernova-regulated ISM. IV. A comparison of simulated polarization with Planck observations

Väisälä M.S., Gent F.A, Juvela M., Käpylä M. (2018); A&A, 614, A101

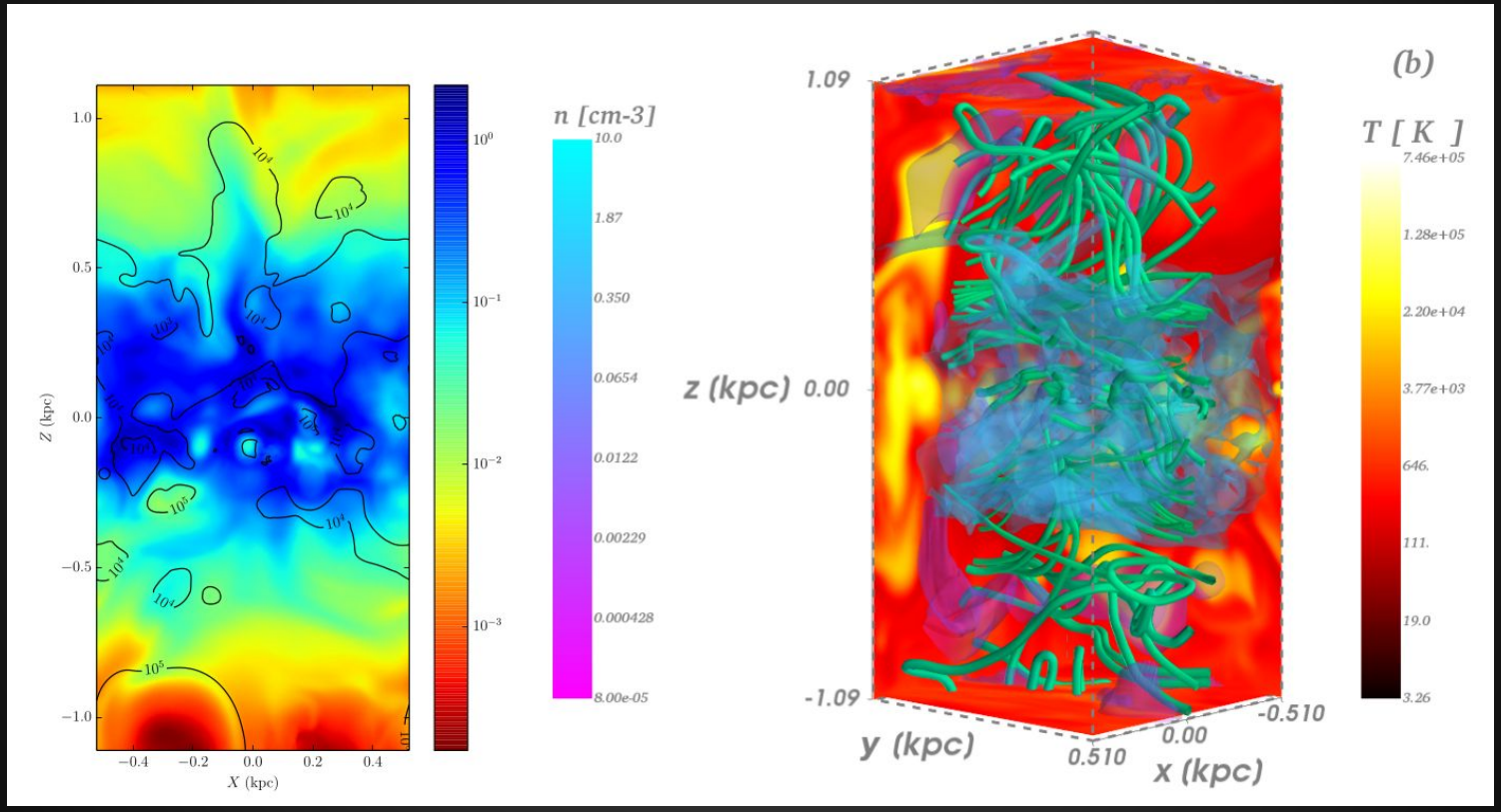
Hereafter VGJK2018

Planck intermediate results. XIX. An overview of the polarized thermal emission from Galactic dust

Planck Collaboration (2015); A&A, 576, A104

Hereafter PlanckXIX

Using data from Gent et al. (2013a,b)



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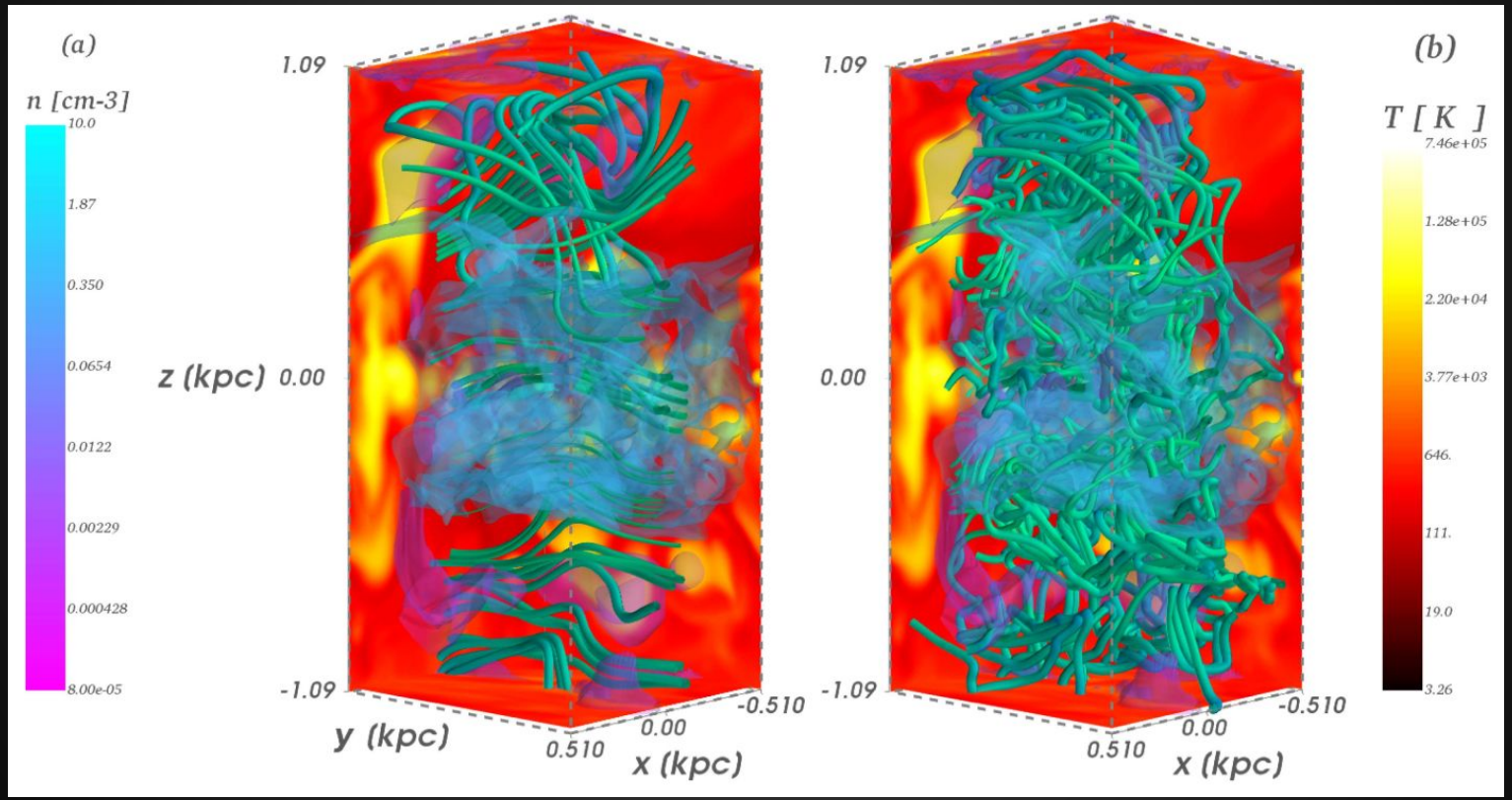
Large- and small-scale components



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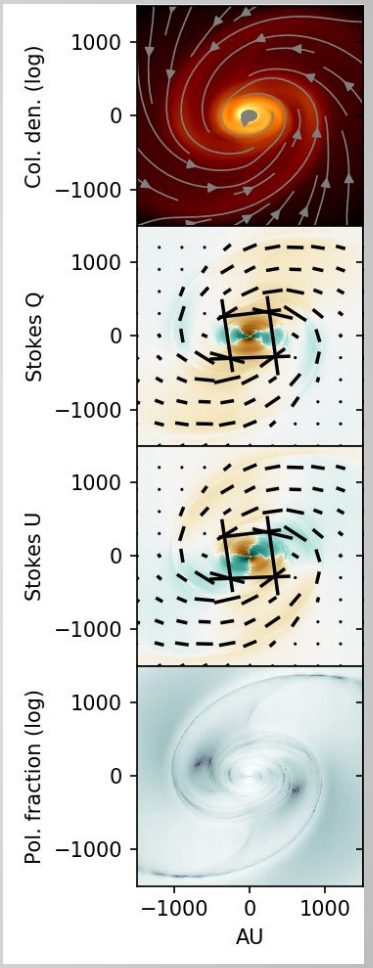
Method

1. HDF5 data from Pencil Code data cubes provided by Fred.
2. A model of stellar radiation field.
3. Radiative transfer simulation with SOC provided by Mika.
    a. Pencil Code data converted to be readable by SOC.
    b. Dust heating by stellar radiation simulated by SOC.
    c. Emission of ISM dust calculated based on dust temperatures .
    d. Polarized emission calculated from magnetic field geometry.
    e. Visualization and analysis with Python + HEALPix.
4. Do this with multiple time steps and observer locations.
5. Comparison with Planck data (Essentially Planck Int. XIX 2015)

What can MHD physics tell us about observed polarization?

(Or inverse)



An example of simple simulated polarization map
in a non-turbulent star forming model
Väisälä, Shang et al. (2019), ApJ, 873, 114

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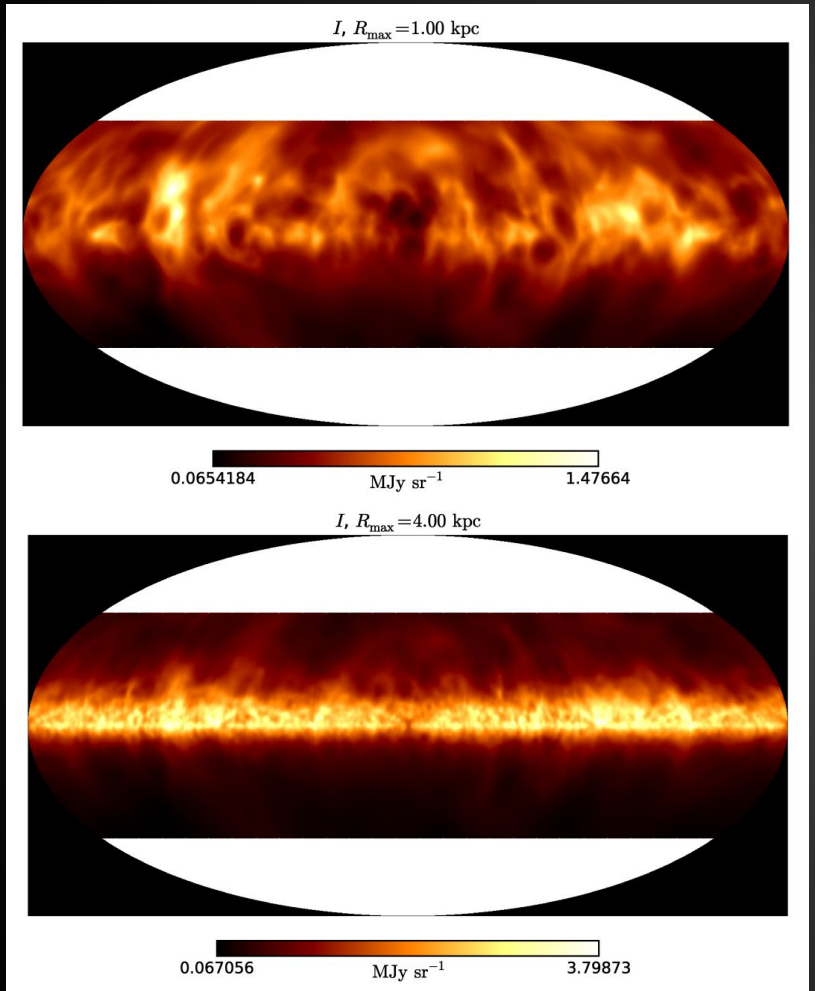
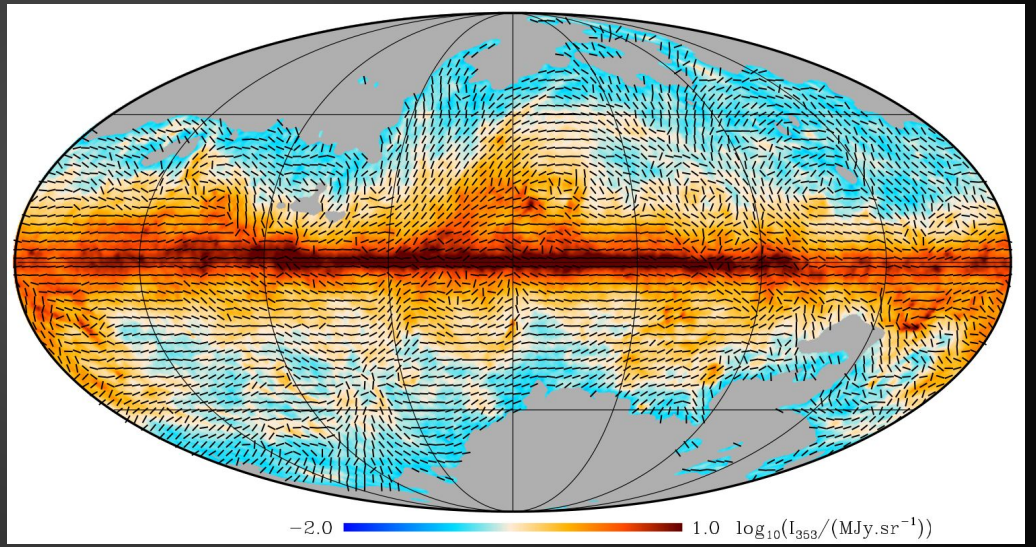


Distribution of dust emission



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Polarization angle dispersion

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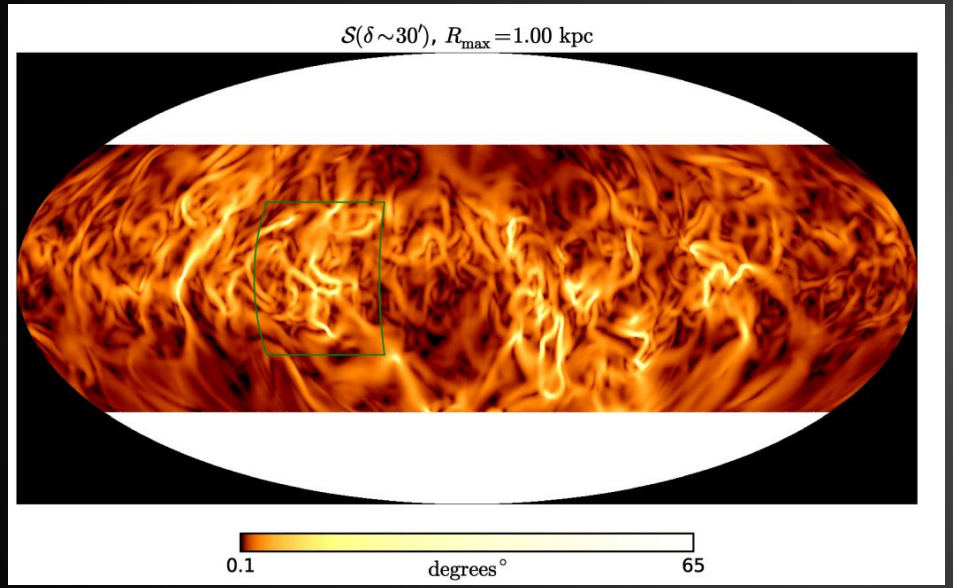

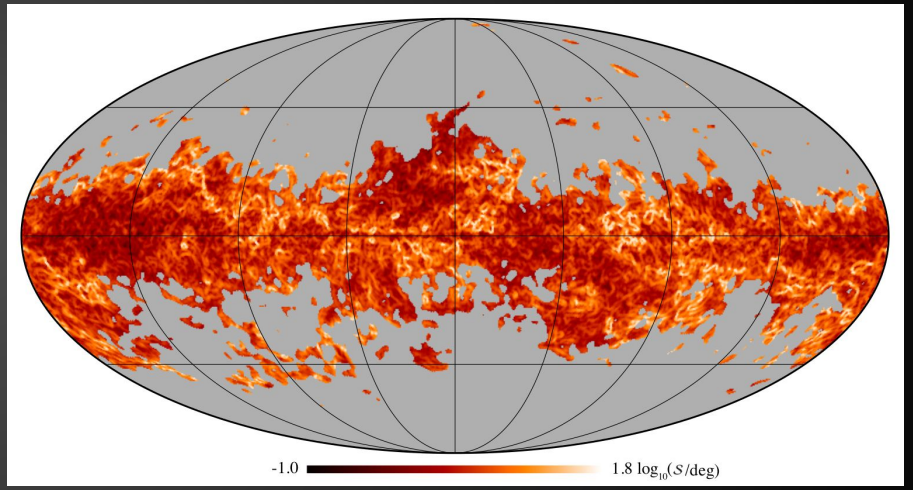

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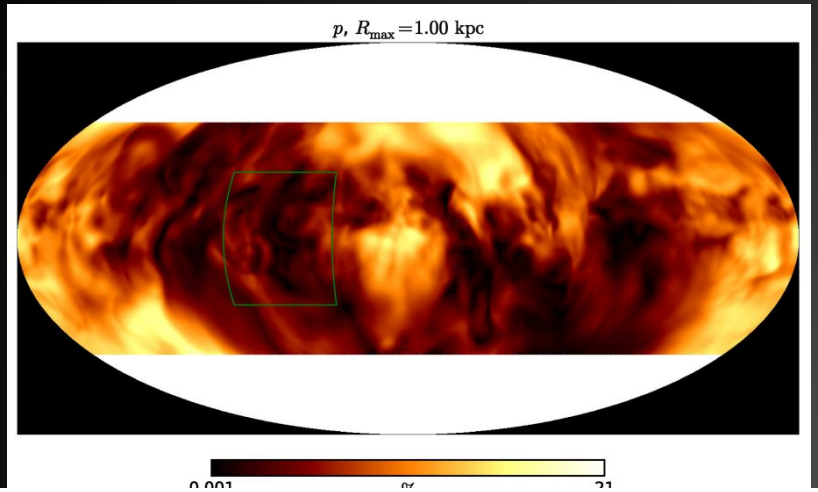
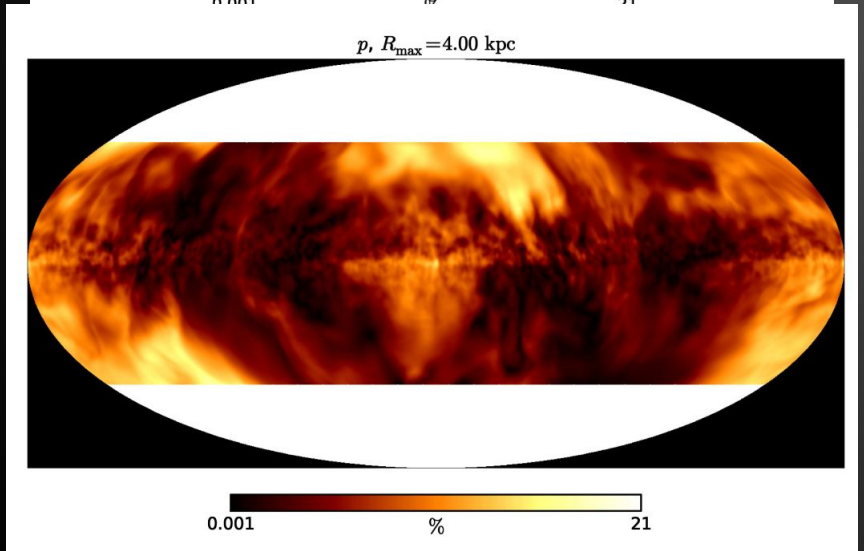
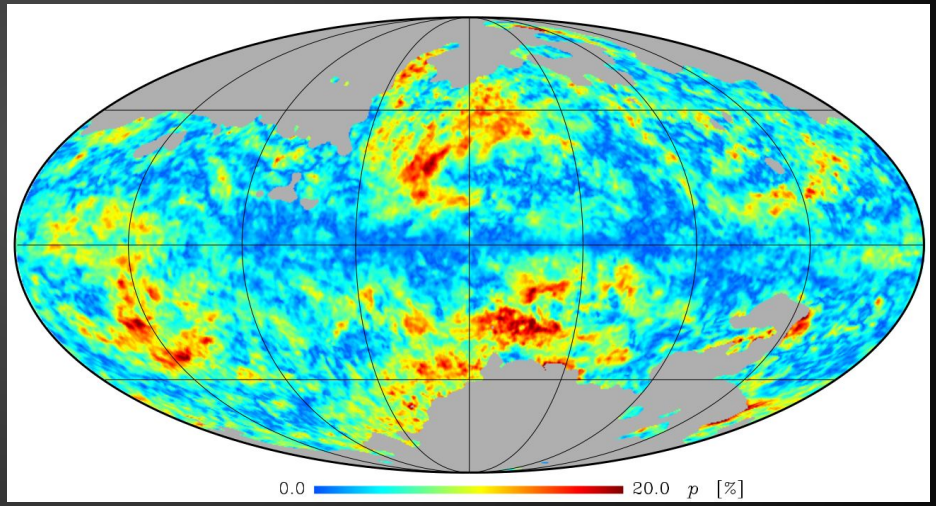
Polarization fraction







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Polarization fraction decreases in column density

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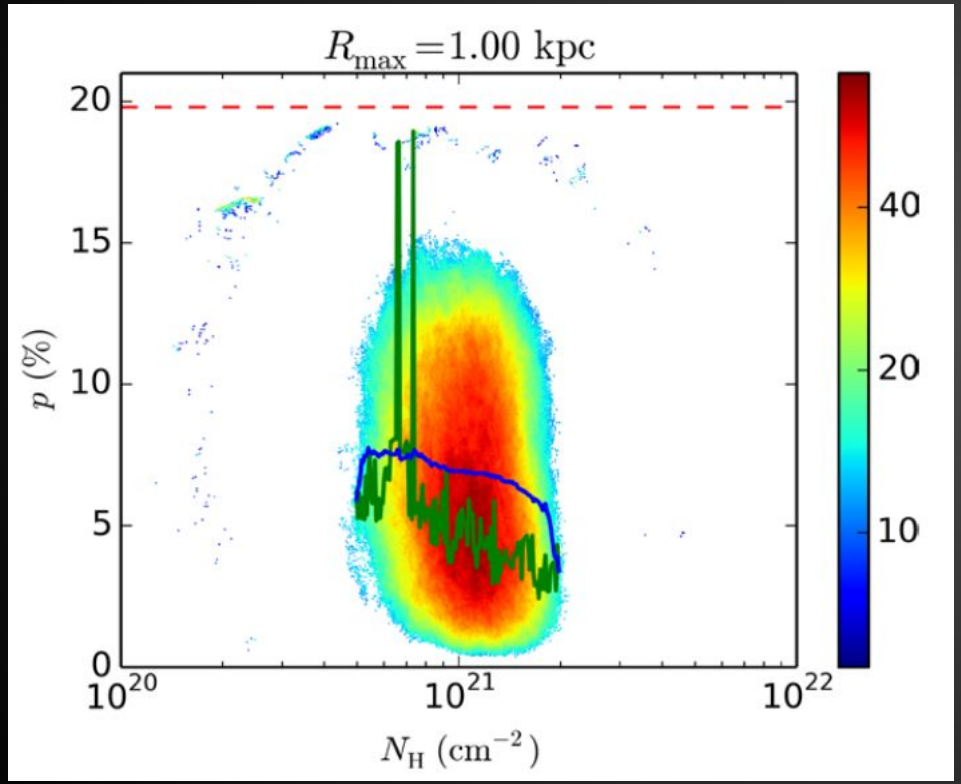
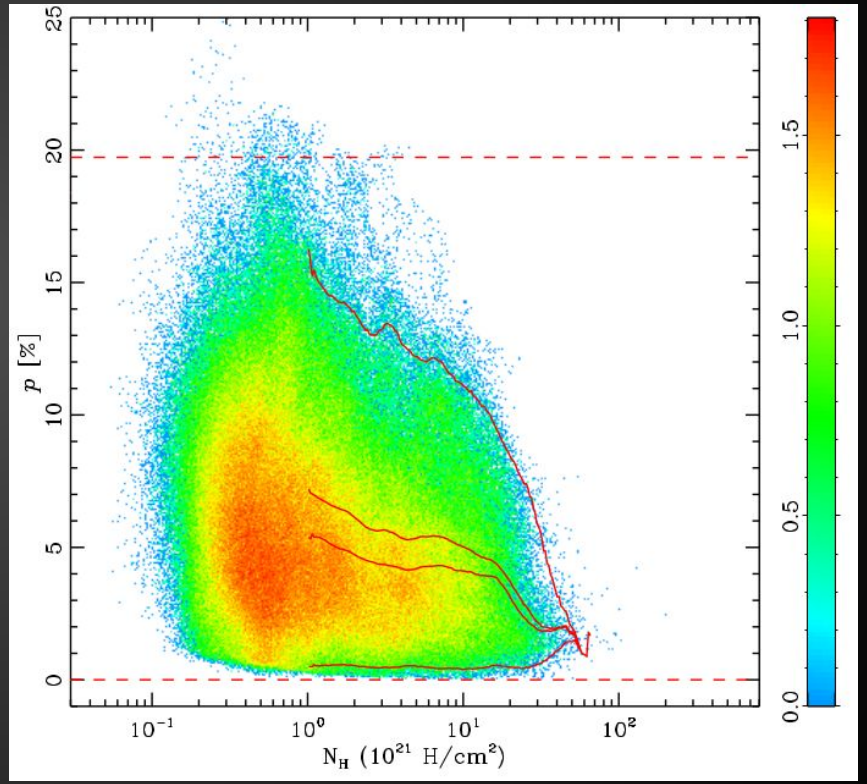
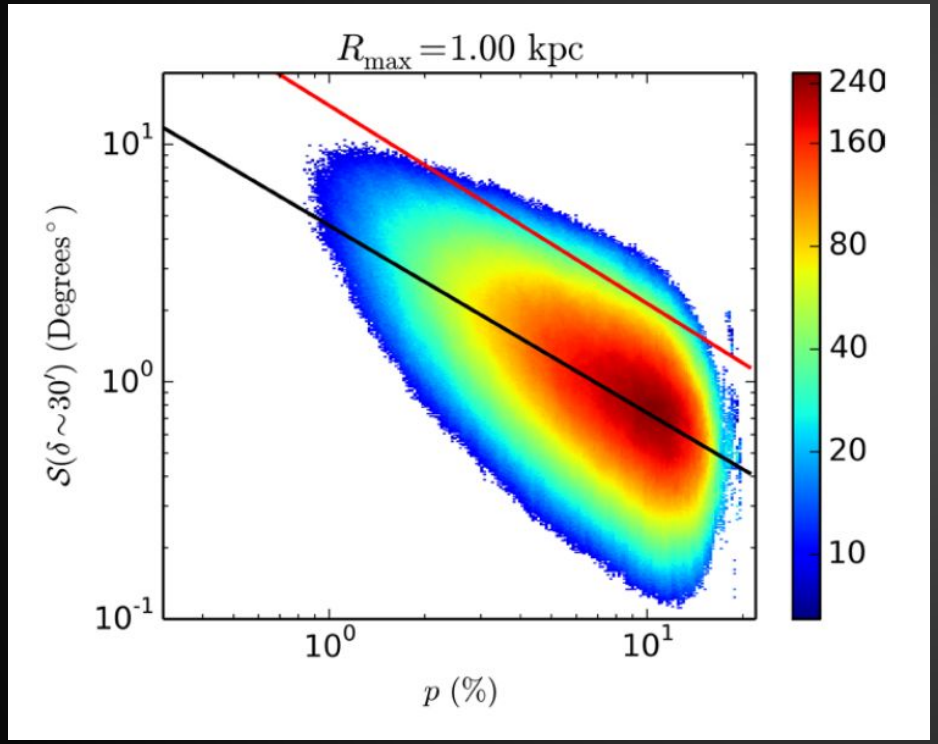
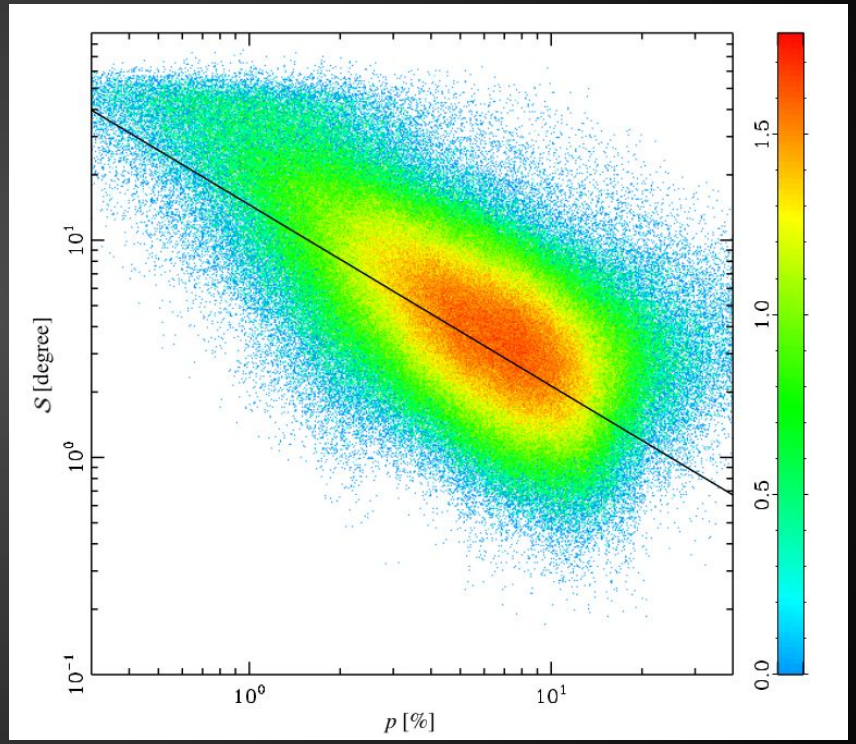




Angle Dispersion





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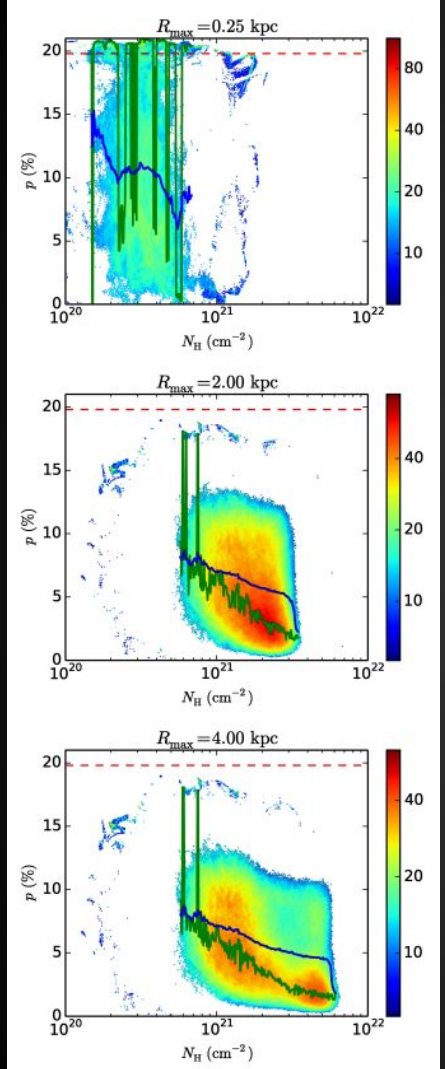

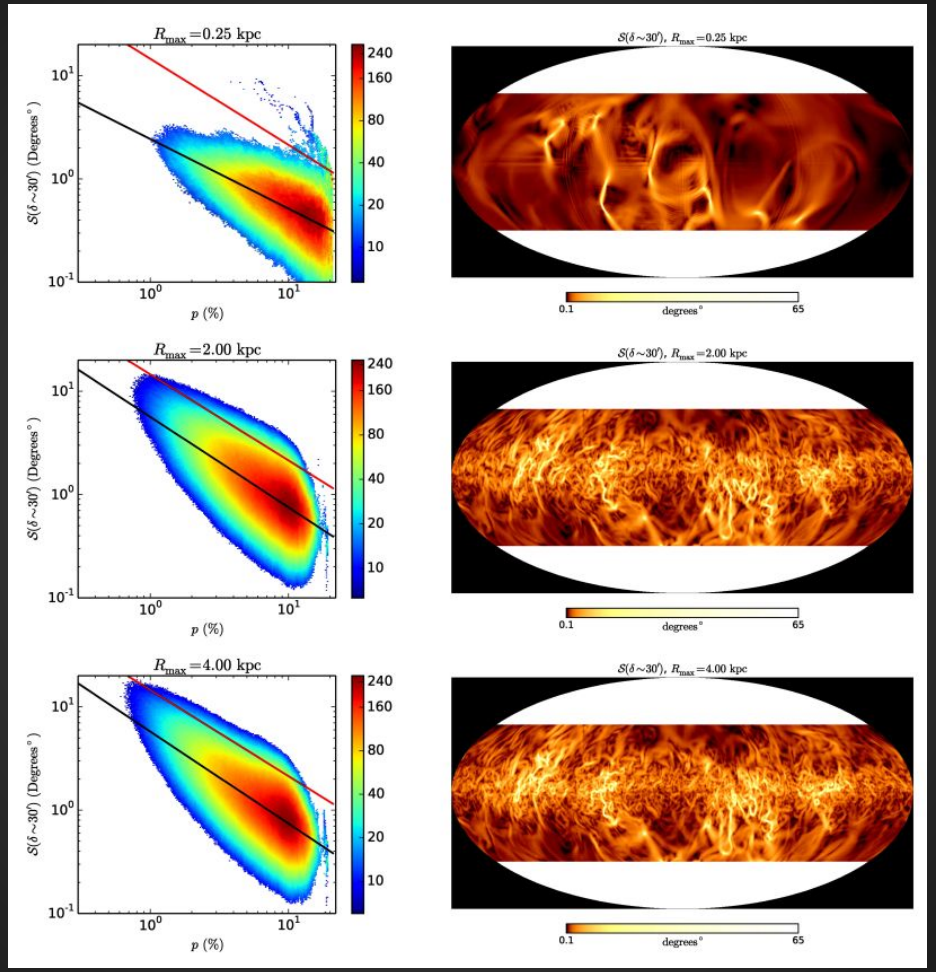

Effect of depth

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Relation to density

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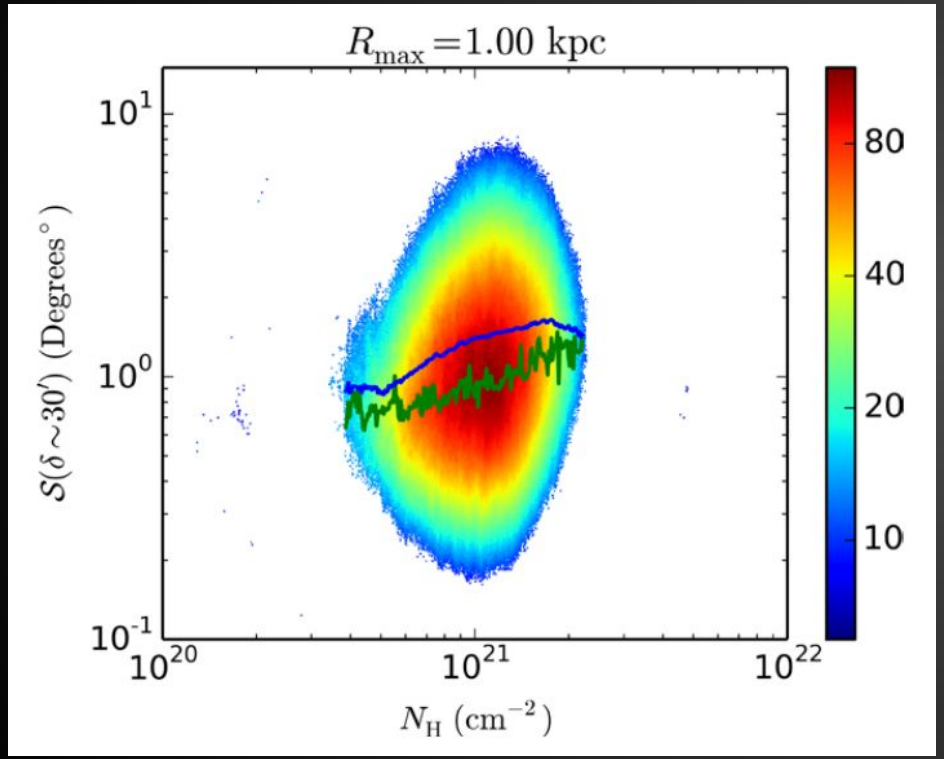

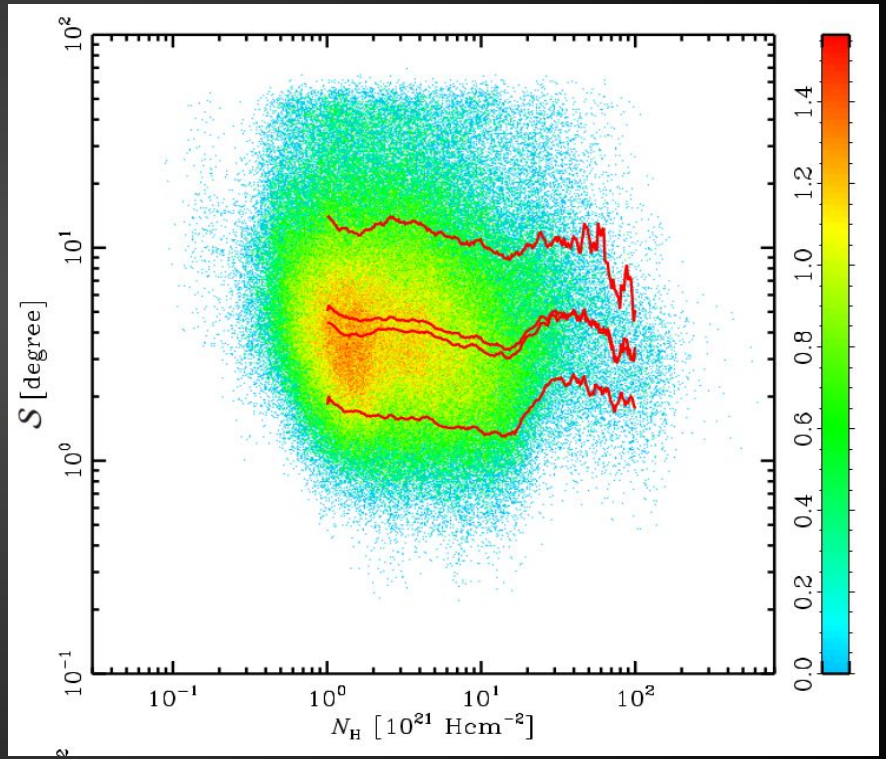

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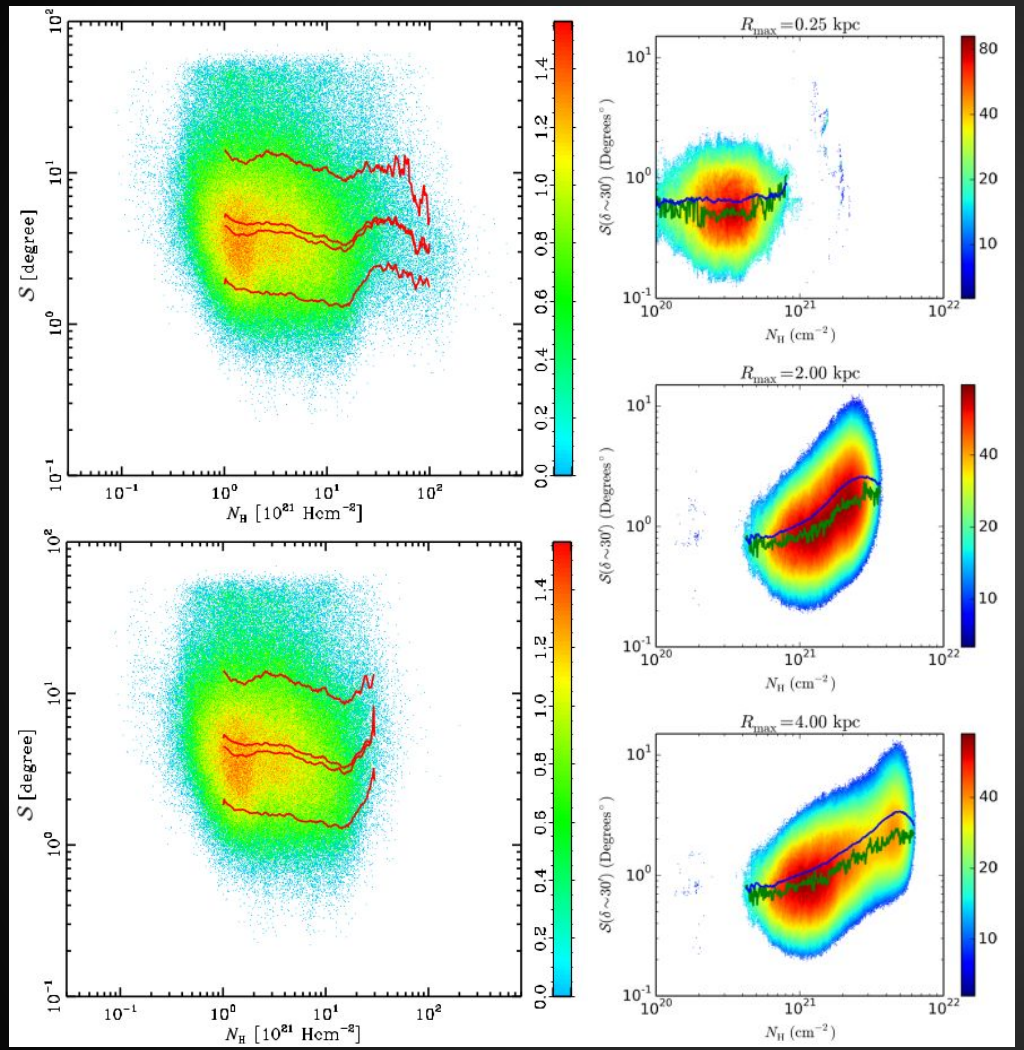

Polarization angle dispersion function growing towards the galactic midplane?

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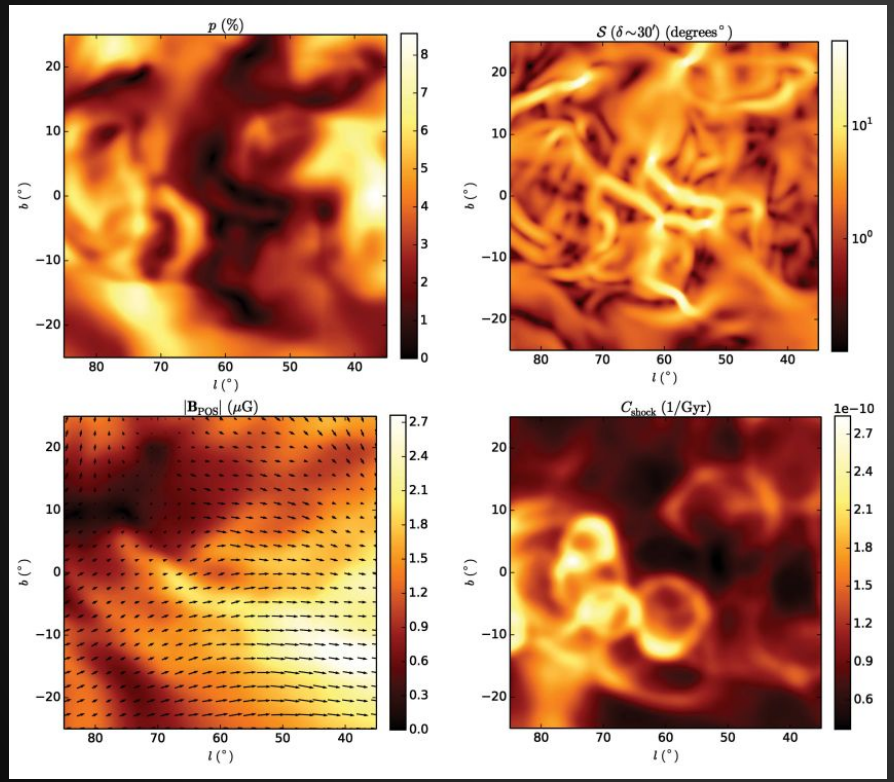
Correspondences



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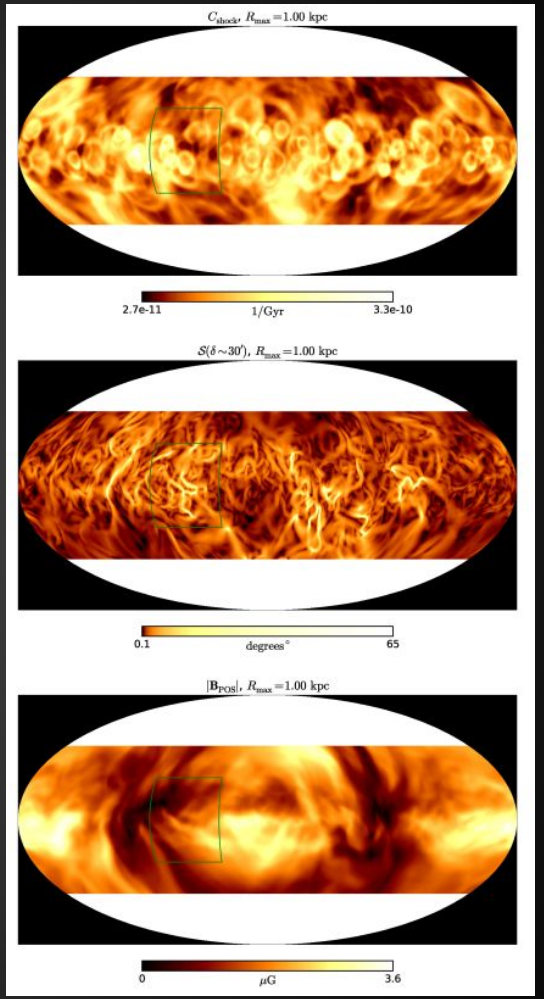
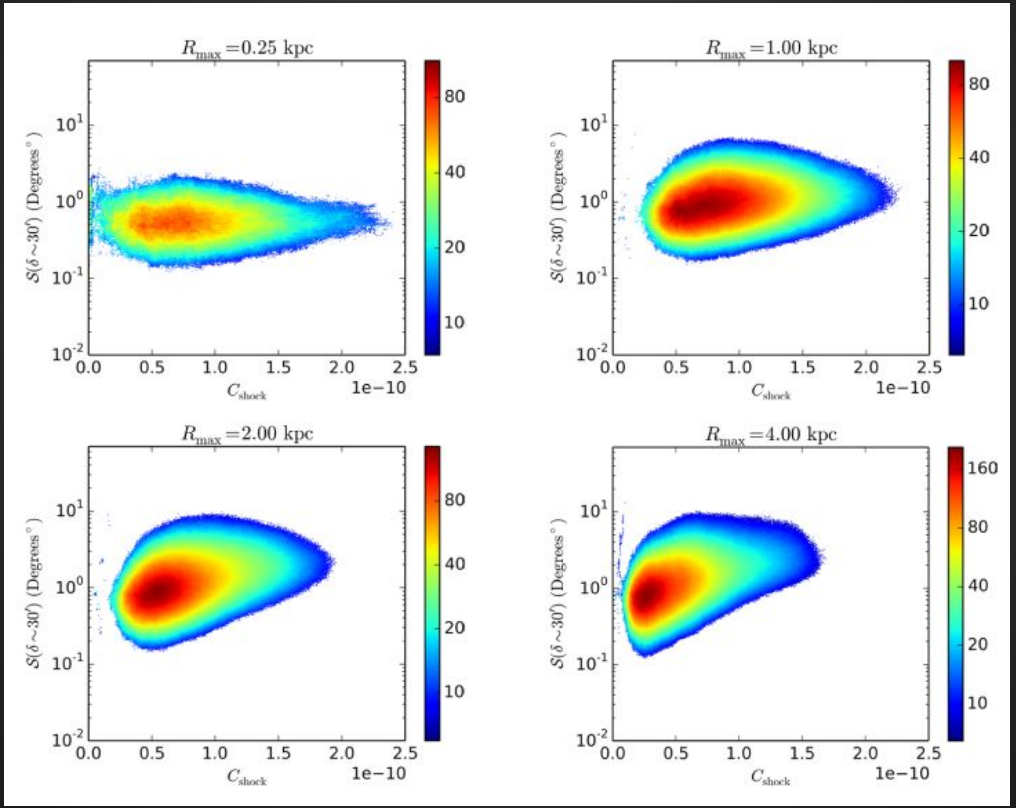


No shock correlation



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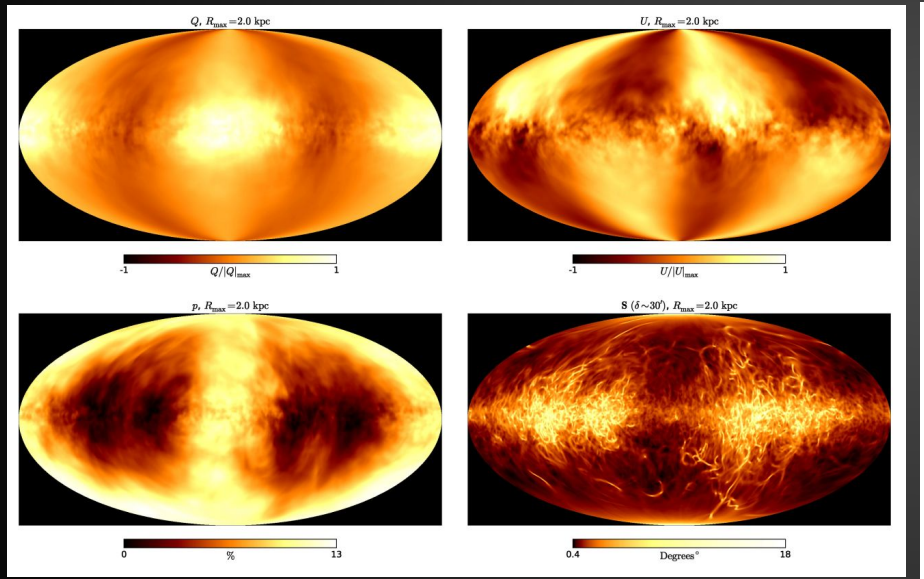
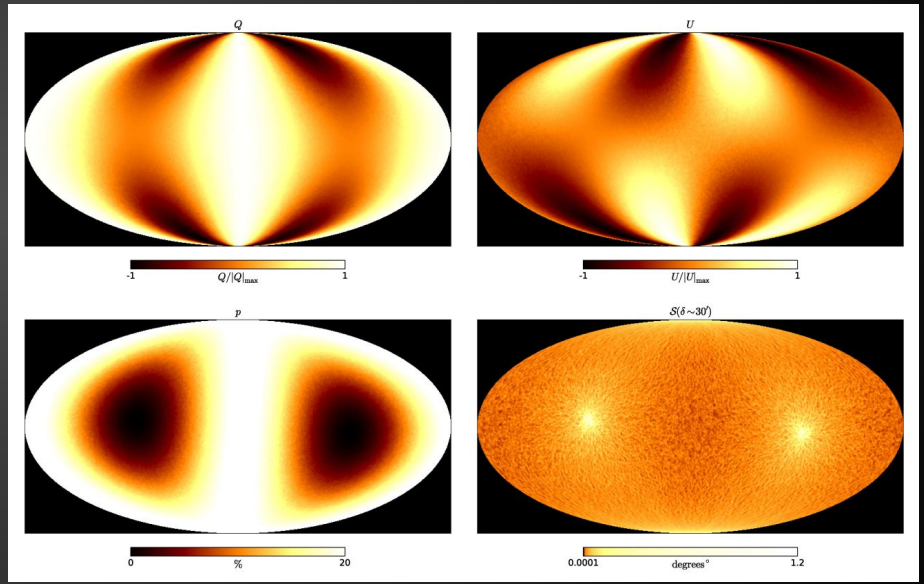
Effect of large-scale magnetic field





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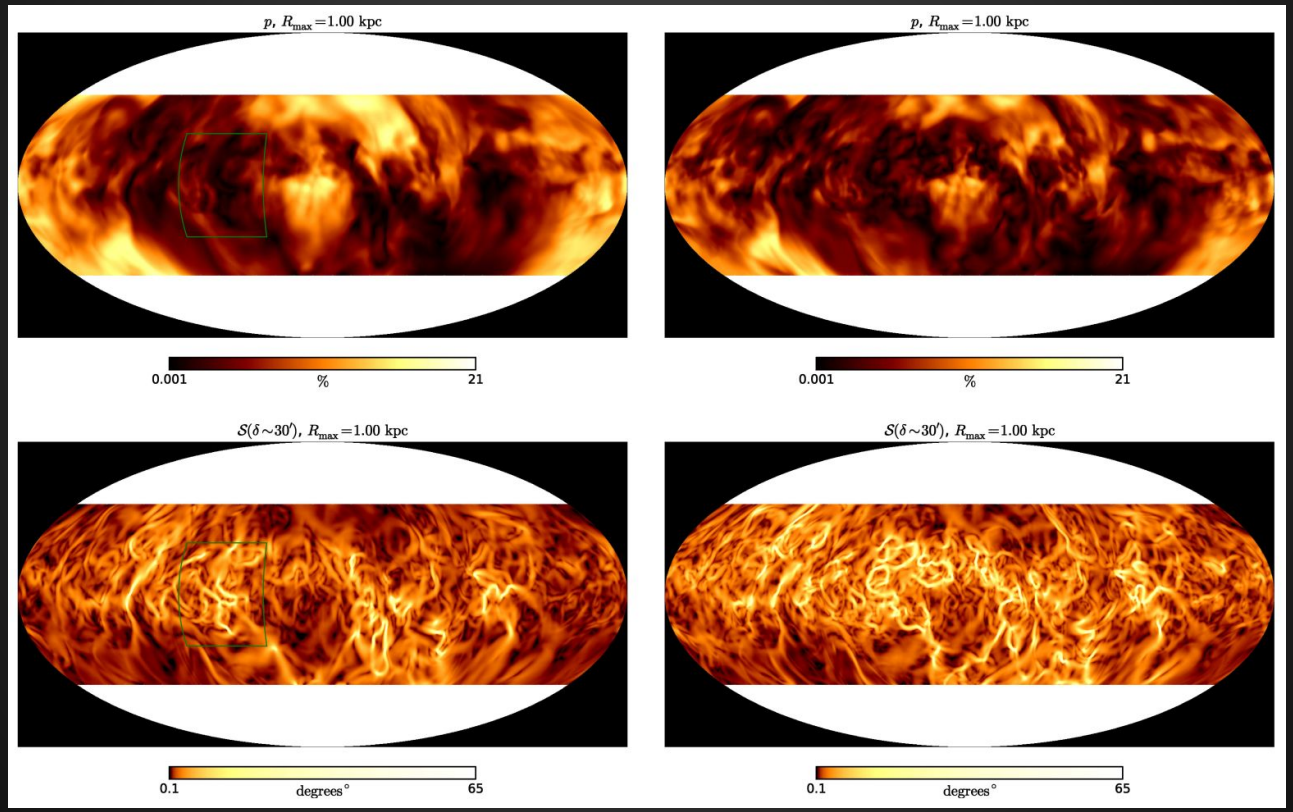
Effect of increasing the strength of fluctuations



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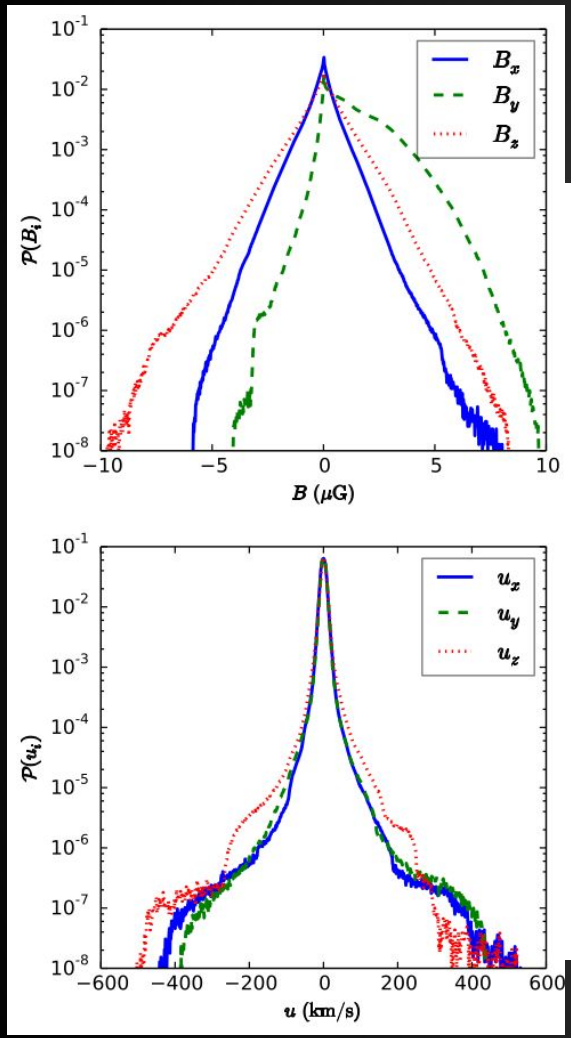
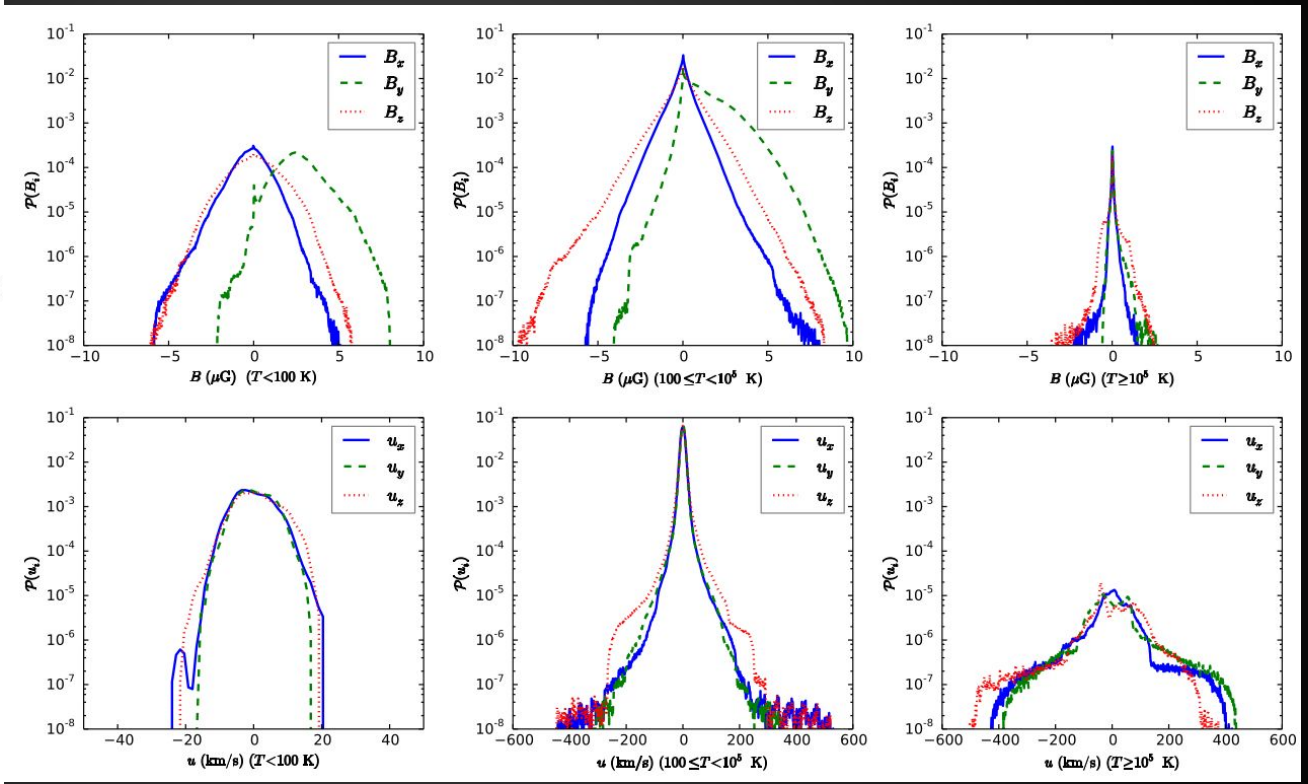
Distribution of turbulent magnetic field





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A question to Pencil Code community:

What Pencil Code models would benefit from radiative transfer analysis?