



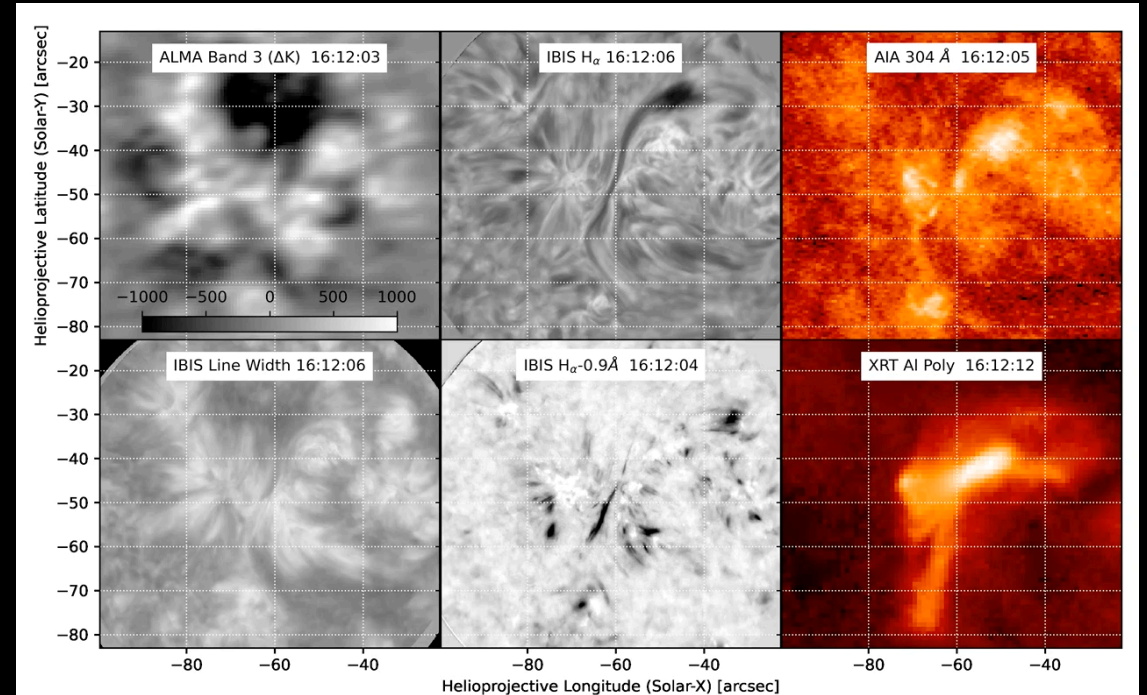
National Aeronautics and Space Administration

Small Events Involve the Entire Solar Atmosphere

Adam Kobelski¹, Sarah Jaeggli², Lucas Tarr²

¹NASA/Marshall Space Flight Center, Huntsville, AL

²National Solar Observatory, Maui, Makawao, HI



Two papers form the basis for this talk:

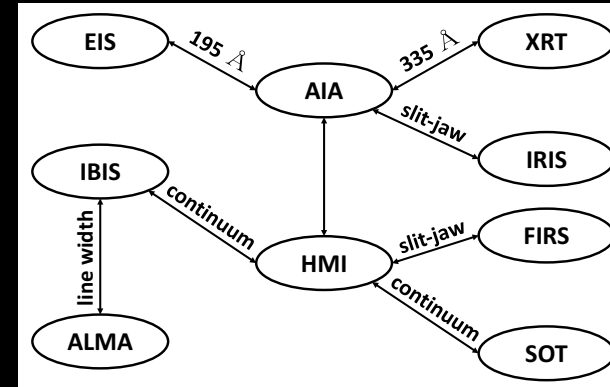
“A Publicly Available Multiobservatory Data Set of an Enhanced Network Patch from the chromosphere to the Corona”

Kobelski, Tarr, Jaeggli, Luger, Warren, Savage

ApJS 2022

Overview of the observations and calibration

Links to download the data



“Spatio-temporal comparisons of the hydrogen-alpha line width and ALMA 3mm brightness temperature in the weak solar network”

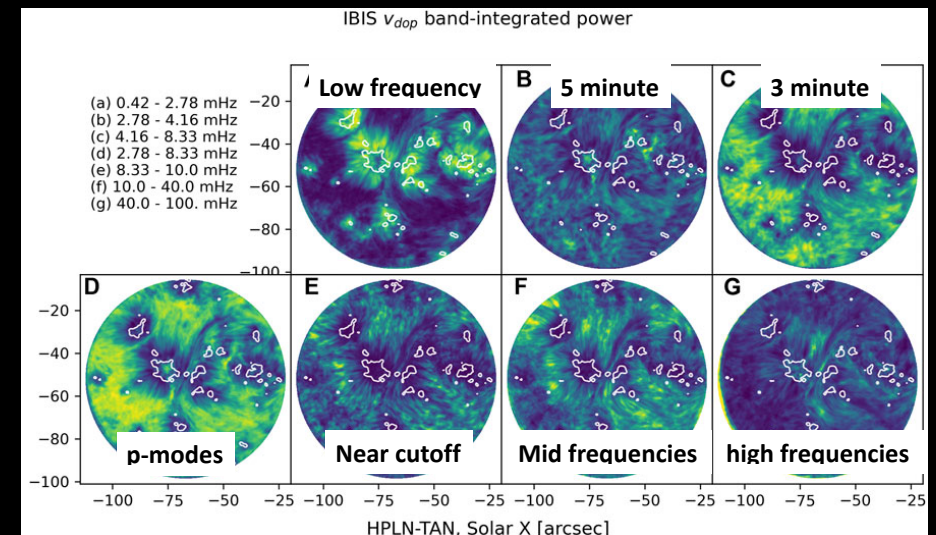
Tarr, Kobelski, Jaeggli, Molnar, Cauzzi, Reardon

Frontiers in Astronomy (ALMA specific issue) 2022

Look at power spectra, and

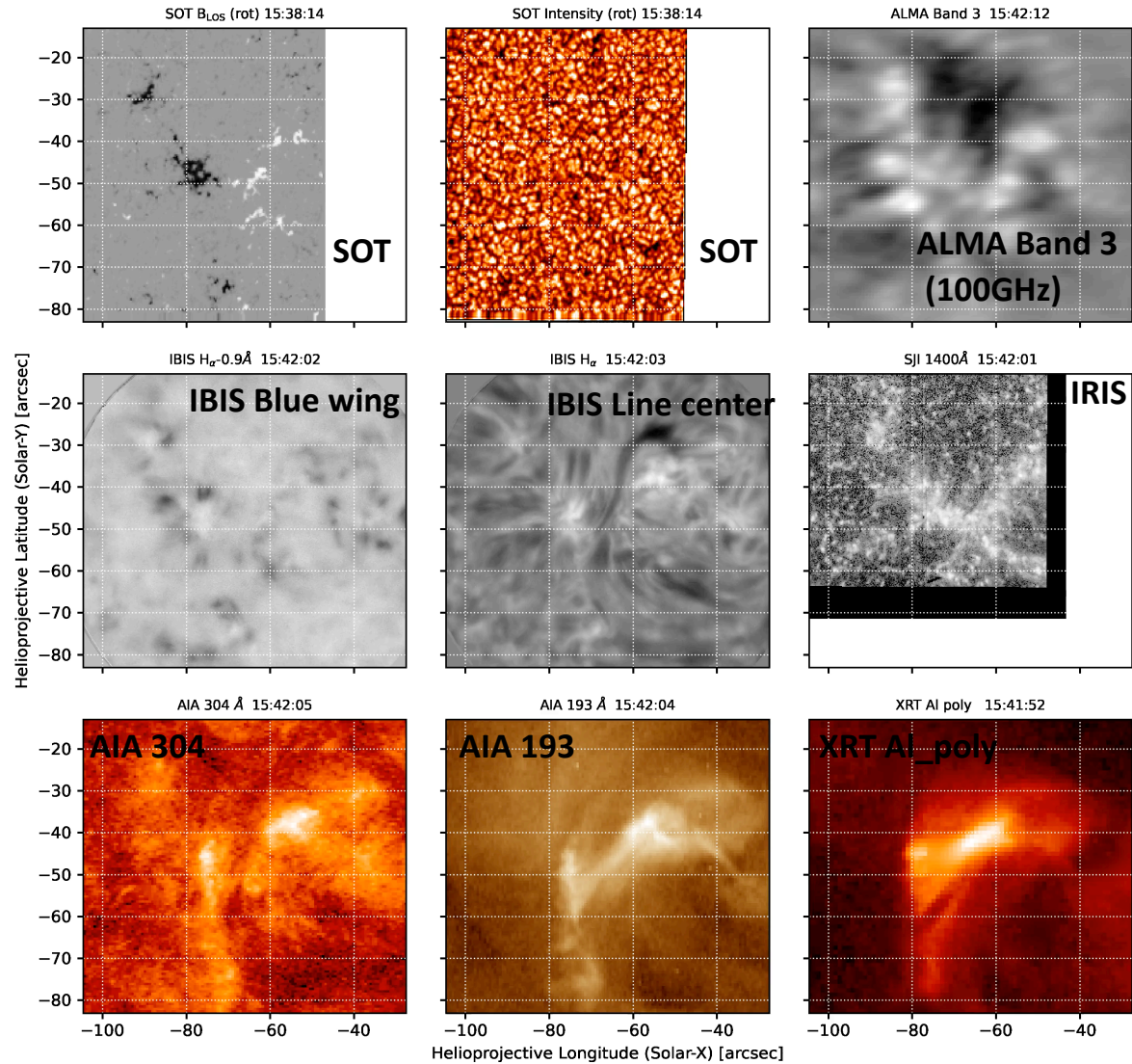
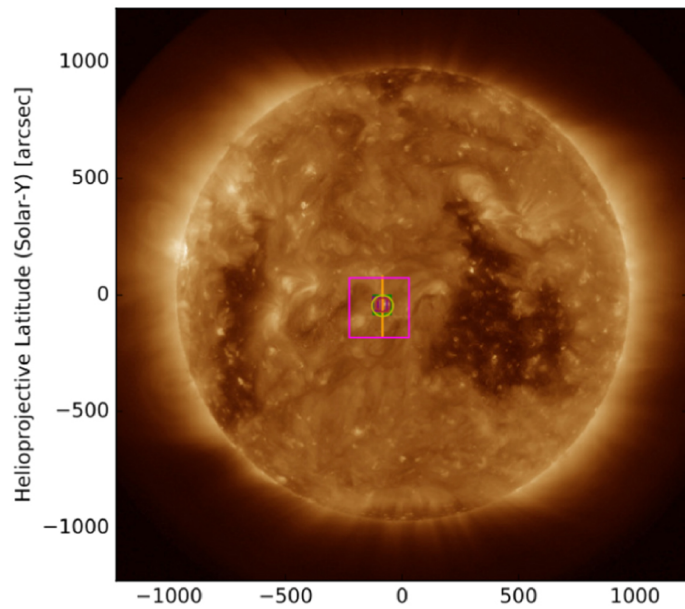
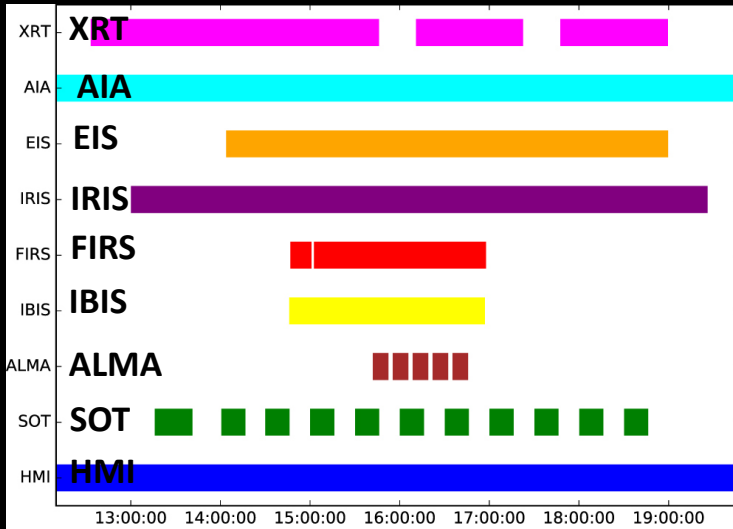
discussions comparing to other results

Check out Tarr+ poster (P87) here for updated info.

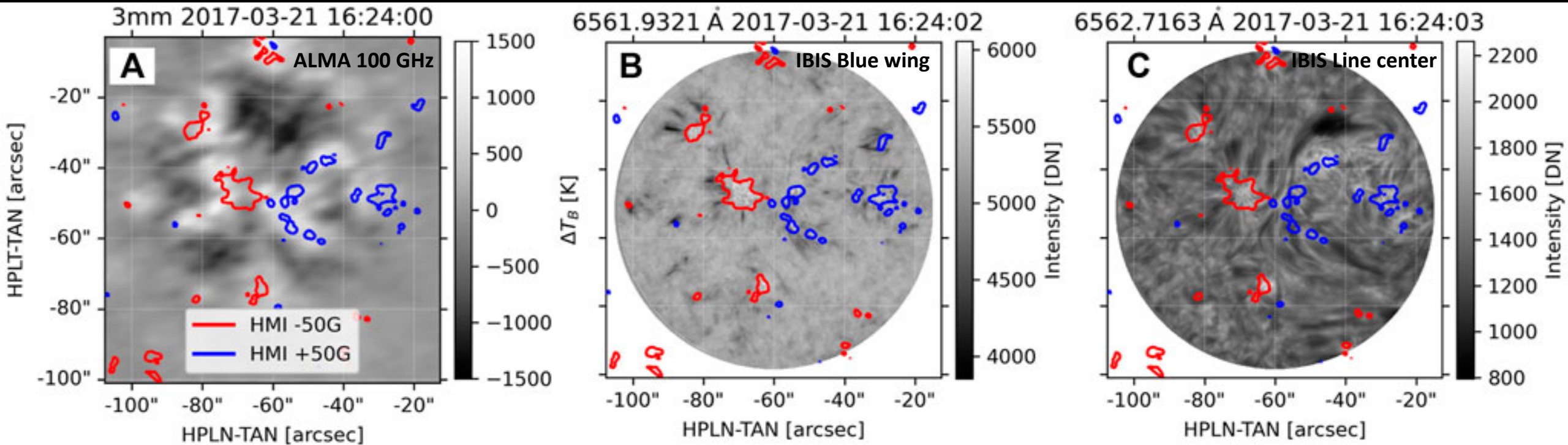


Overview of observations

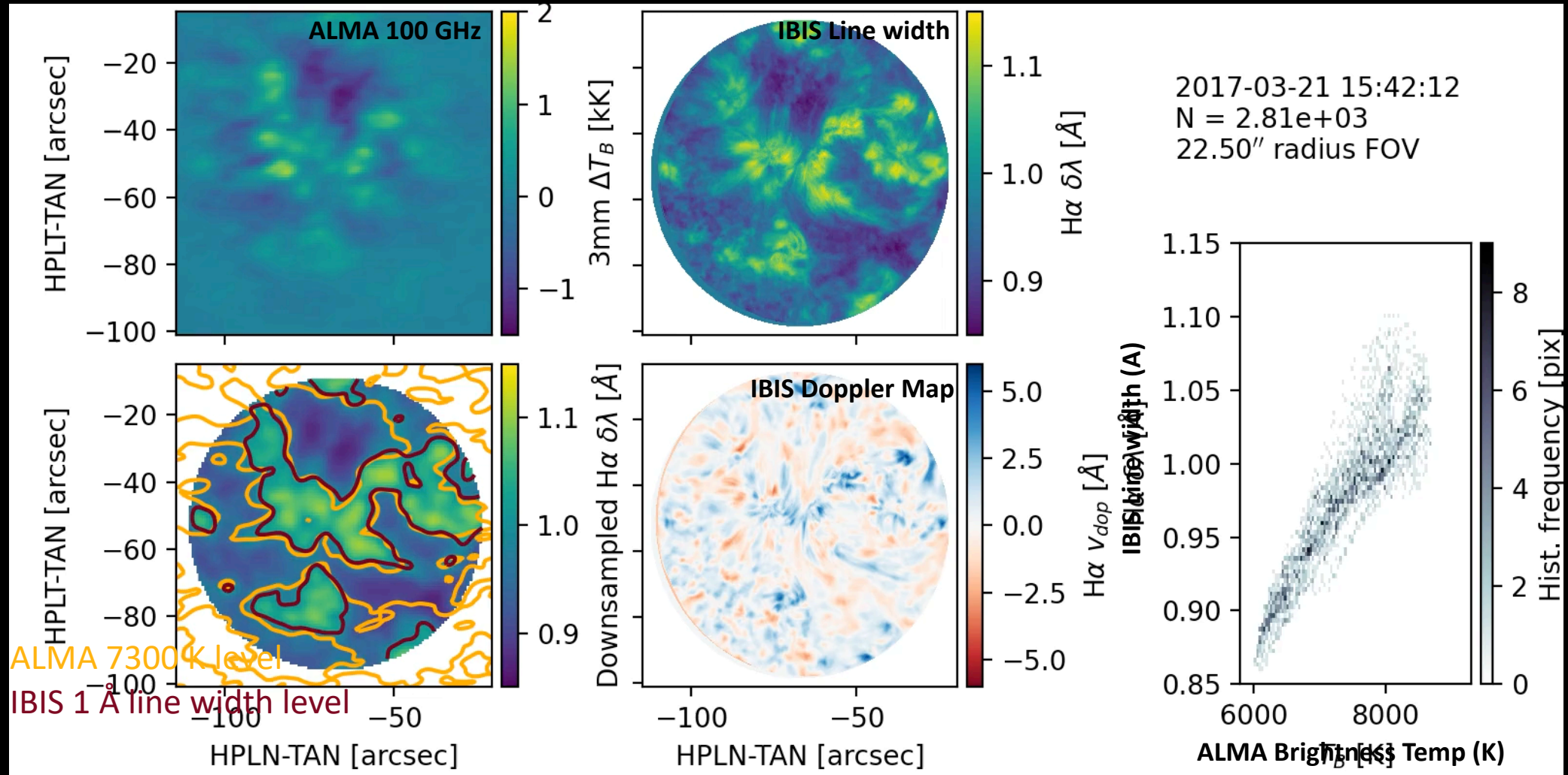
March 17, 2017



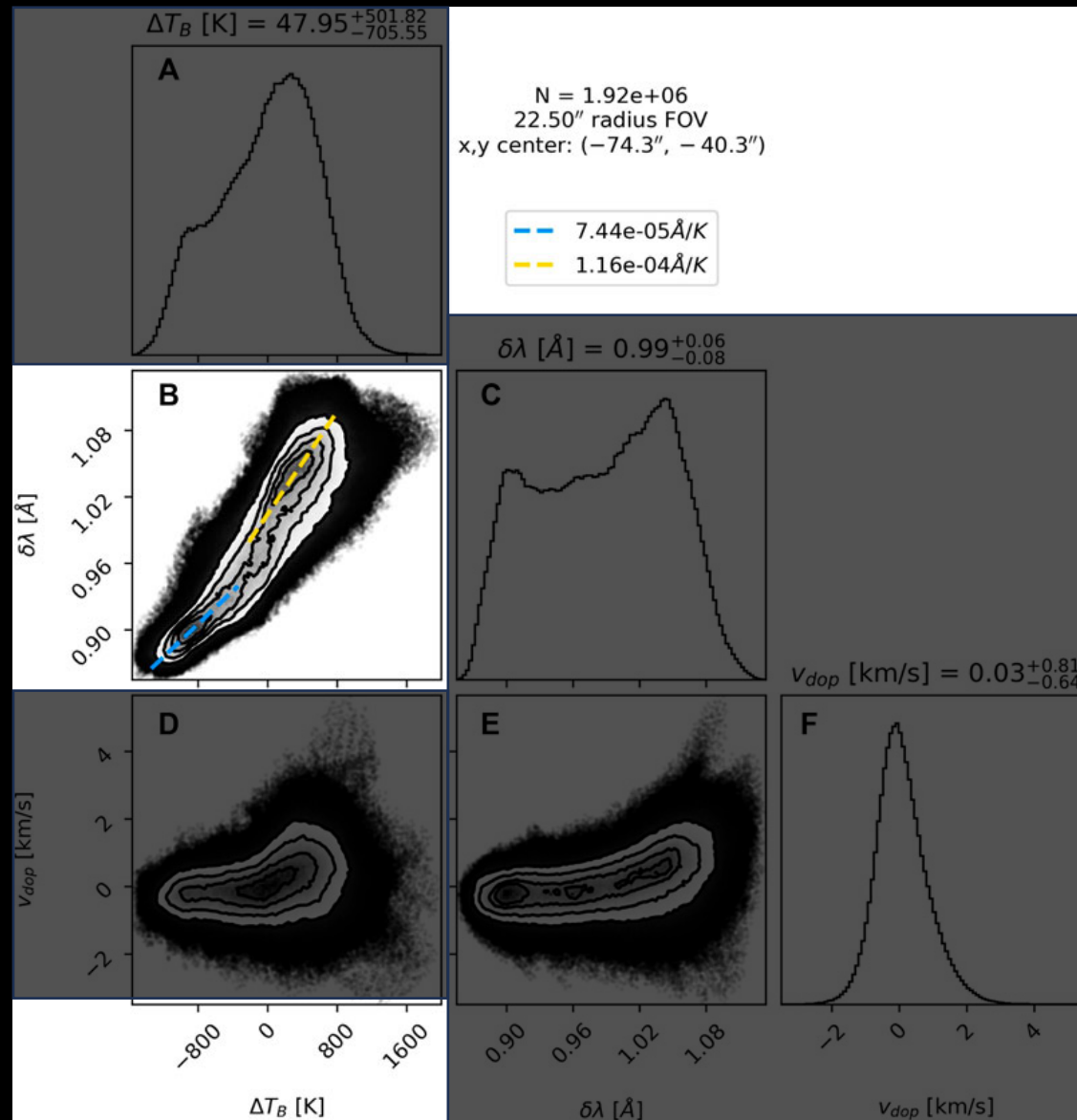
Even for this weak network patch, the upper features follow the magnetic structures until they don't.



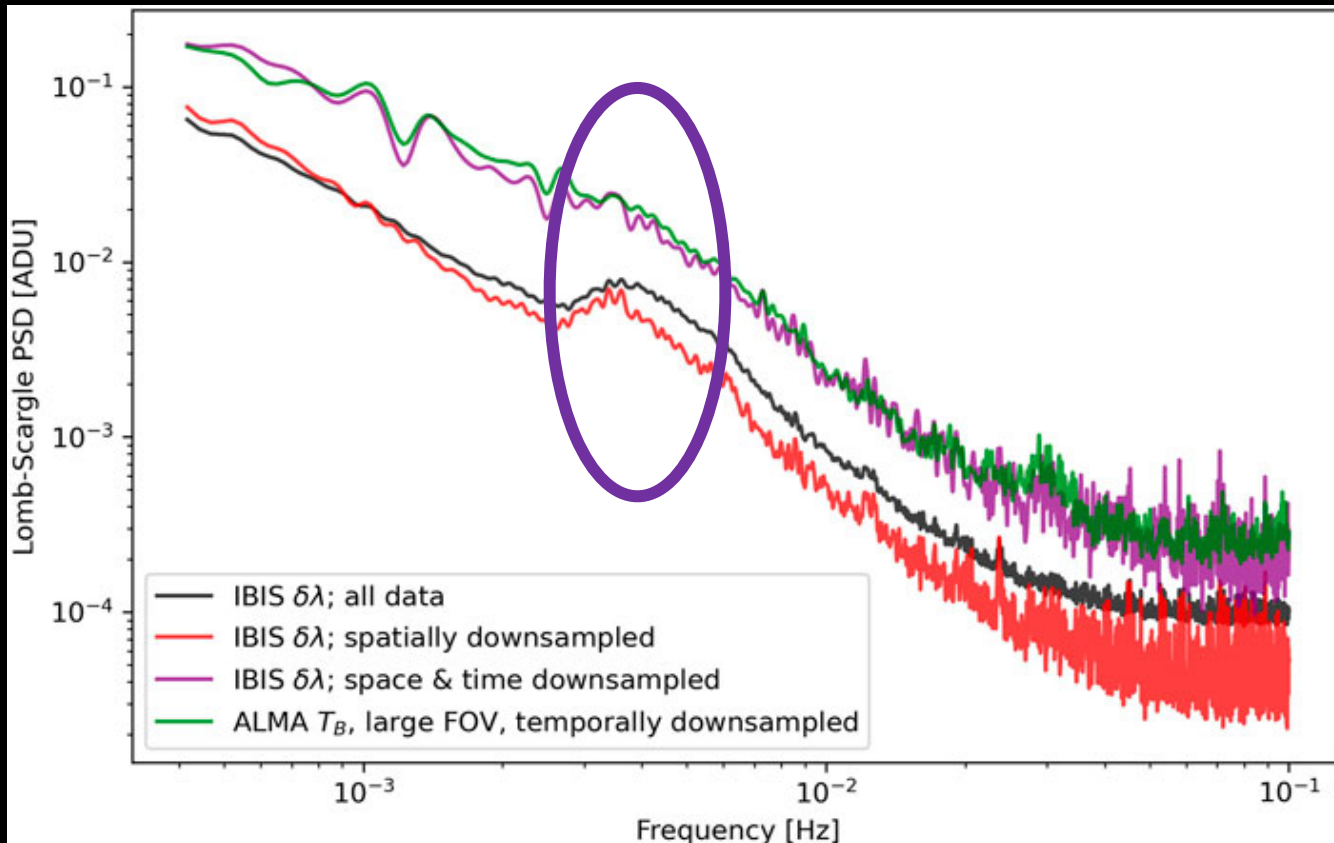
Similar to the results of Molnar+2019, the H_α line width tracks with brightest sub-mm features



Similar to the results of Molnar+2019, the brightest sub-mm features track with H_α line width, and the cooler features with a different slope.



Missing 3-5 Minutes Oscillations?

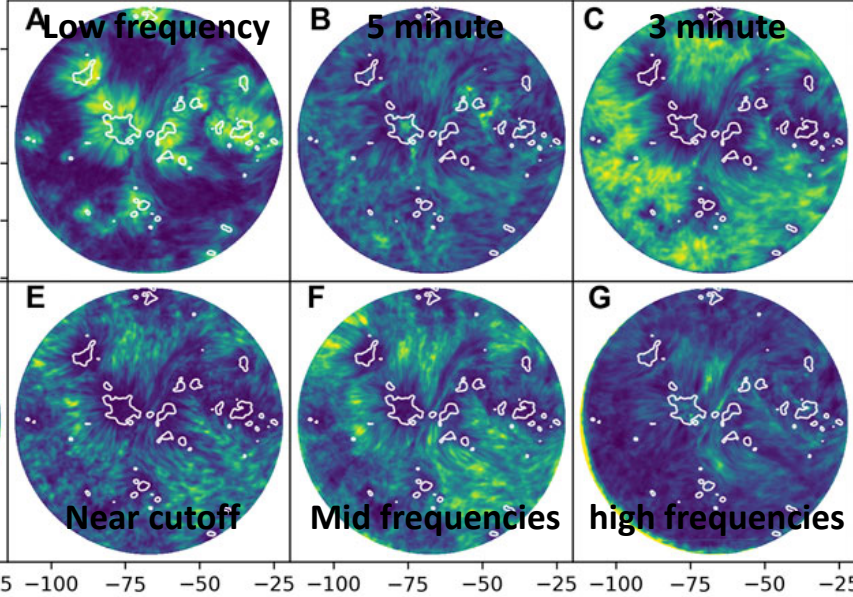


- 3-5 minutes oscillations consistently missing from ALMA data (see Jafarzadeh+2021 for more discussion).
- This may simply be a blind spot due to ALMA calibration windows.
- IBIS also loses these signatures when down-sampled to match ALMA cadence/calibration

Doppler shift

IBIS v_{dop} band-integrated power

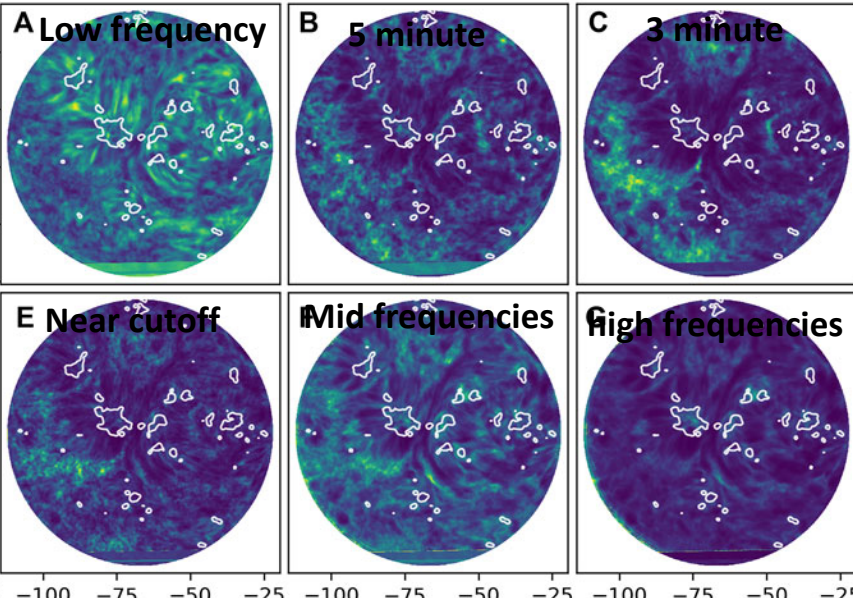
- (a) 0.42 - 2.78 mHz
- (b) 2.78 - 4.16 mHz
- (c) 4.16 - 8.33 mHz
- (d) 2.78 - 8.33 mHz
- (e) 8.33 - 10.0 mHz
- (f) 10.0 - 40.0 mHz
- (g) 40.0 - 100. mHz



Line Width

IBIS $\delta\lambda$ band-integrated power

- (a) 0.42 - 2.78 mHz
- (b) 2.78 - 4.16 mHz
- (c) 4.16 - 8.33 mHz
- (d) 2.78 - 8.33 mHz
- (e) 8.33 - 10.0 mHz
- (f) 10.0 - 40.0 mHz
- (g) 40.0 - 100. mHz

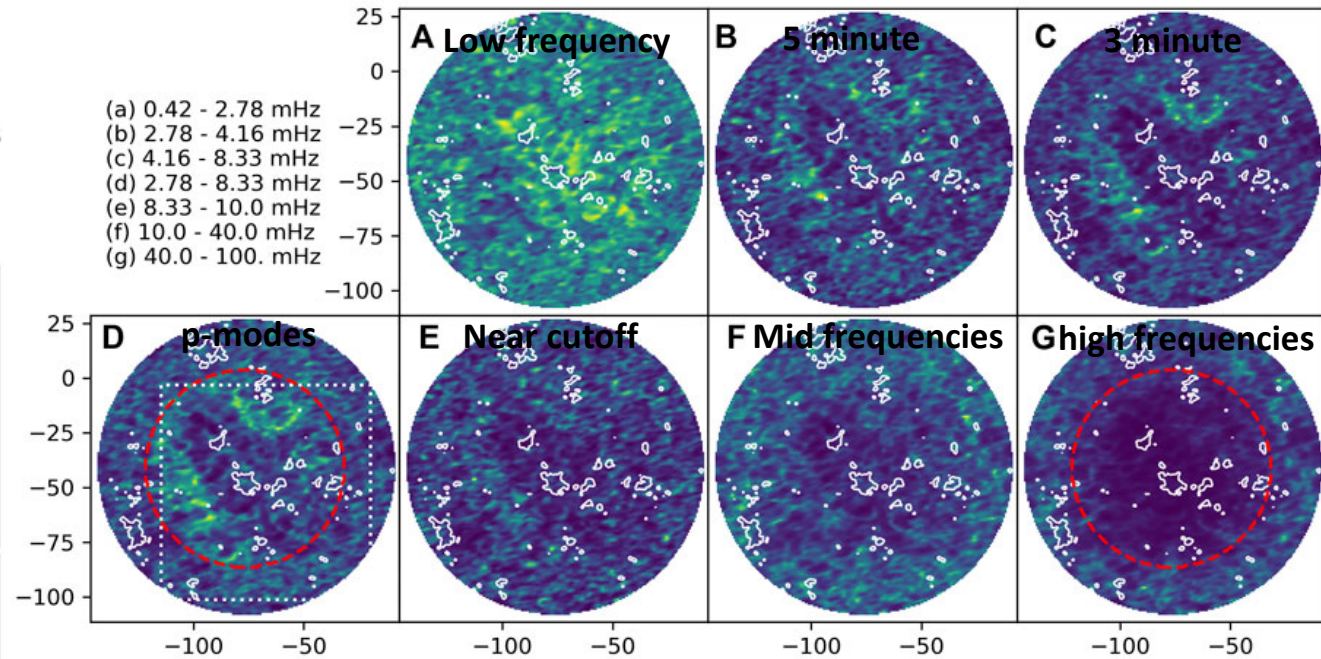


Spatial variation of power spectral density across multiple diagnostics:

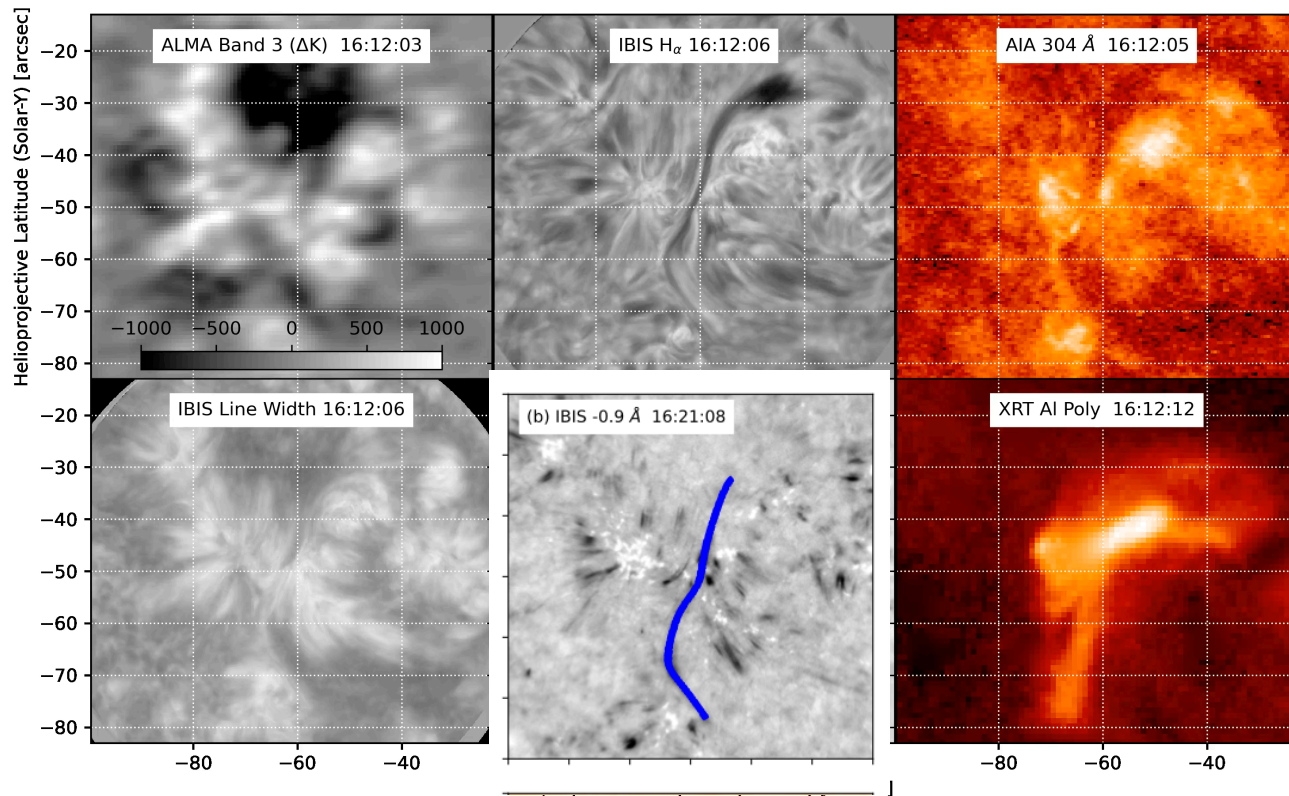
Sub-mm

ALMA 3mm T_B band-integrated power

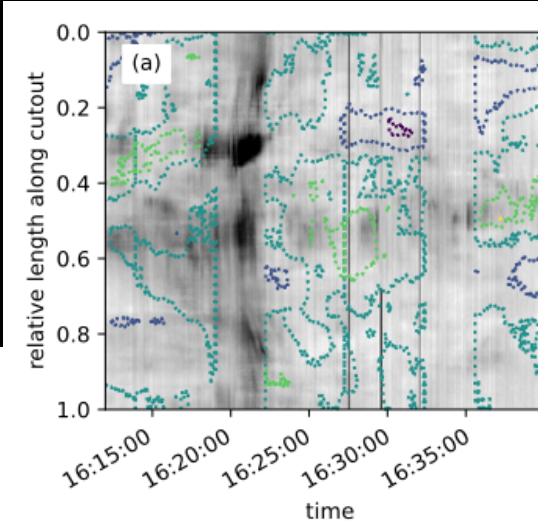
- (a) 0.42 - 2.78 mHz
- (b) 2.78 - 4.16 mHz
- (c) 4.16 - 8.33 mHz
- (d) 2.78 - 8.33 mHz
- (e) 8.33 - 10.0 mHz
- (f) 10.0 - 40.0 mHz
- (g) 40.0 - 100. mHz



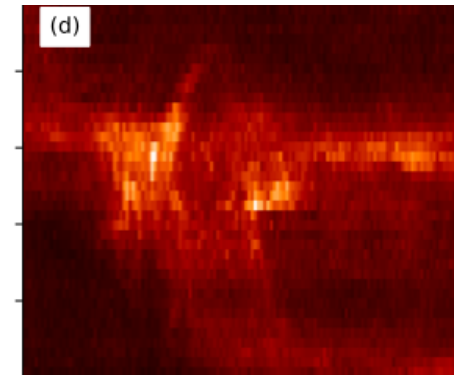
small transients involve the entire atmosphere



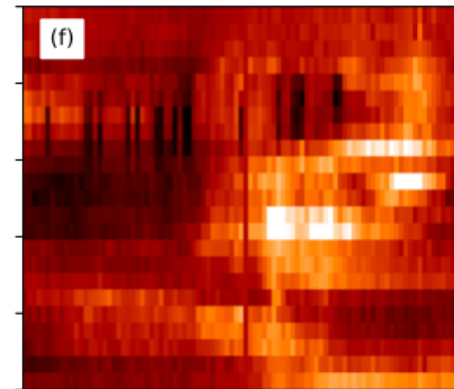
Kobelski et al (in prep)



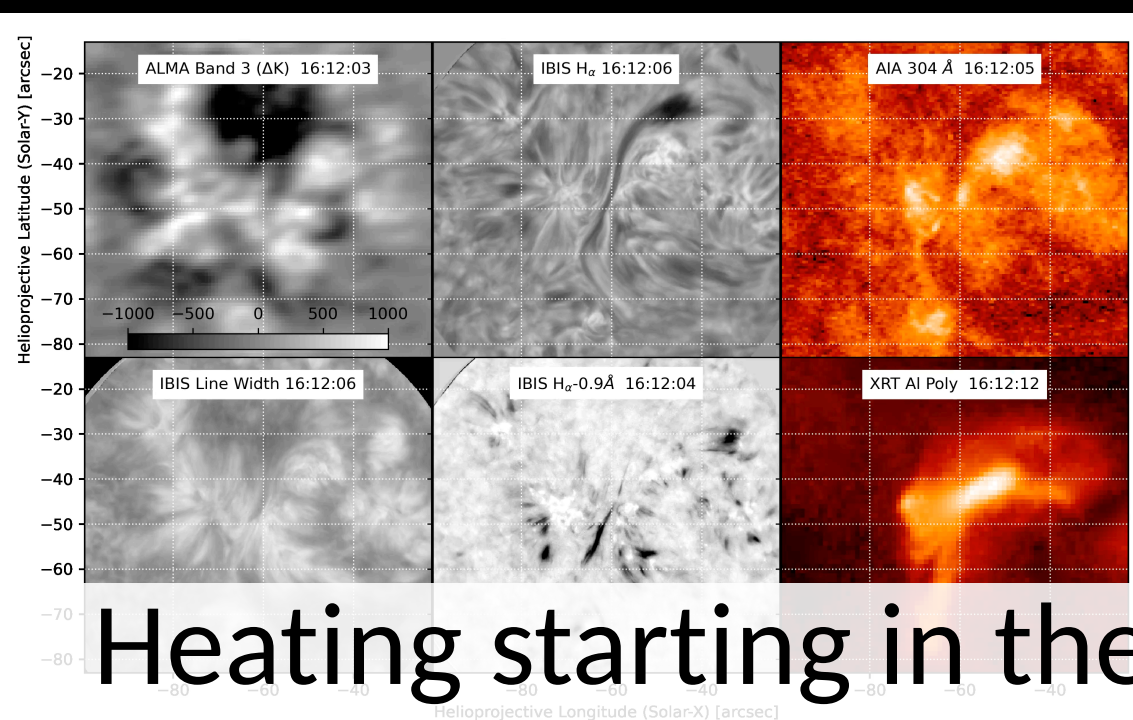
(a) the IBIS blue wing with ALMA contours,



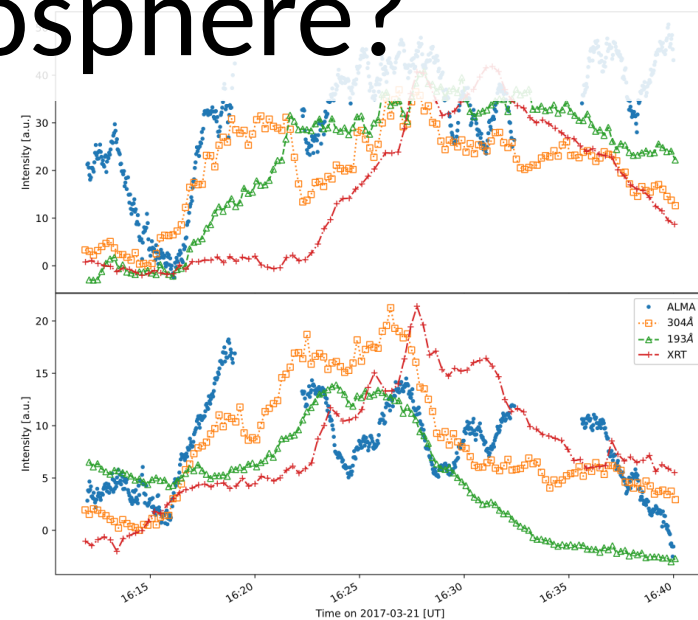
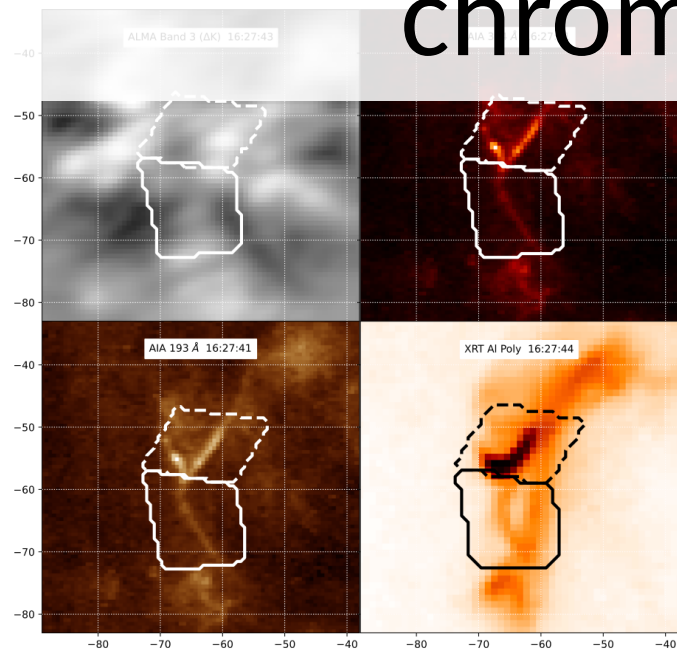
(d) AIA 304 Å.



(f) XRT AL/Poly



Heating starting in the chromosphere?



Thank you.

- Co-aligned data set is ready for you to use (links in Kobelski+2022 and Tarr+2023)
- ALMA provides a unique new chromospheric diagnostic
- Even small events can be traced throughout the entire atmosphere