



Surface properties of acoustic power

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Newly Identified Properties of Surface Acoustic Power, Sol. Phys., 2010



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Solar System Research



Background

$$P(x, \nu) = |\Upsilon(x, \nu)|^2$$

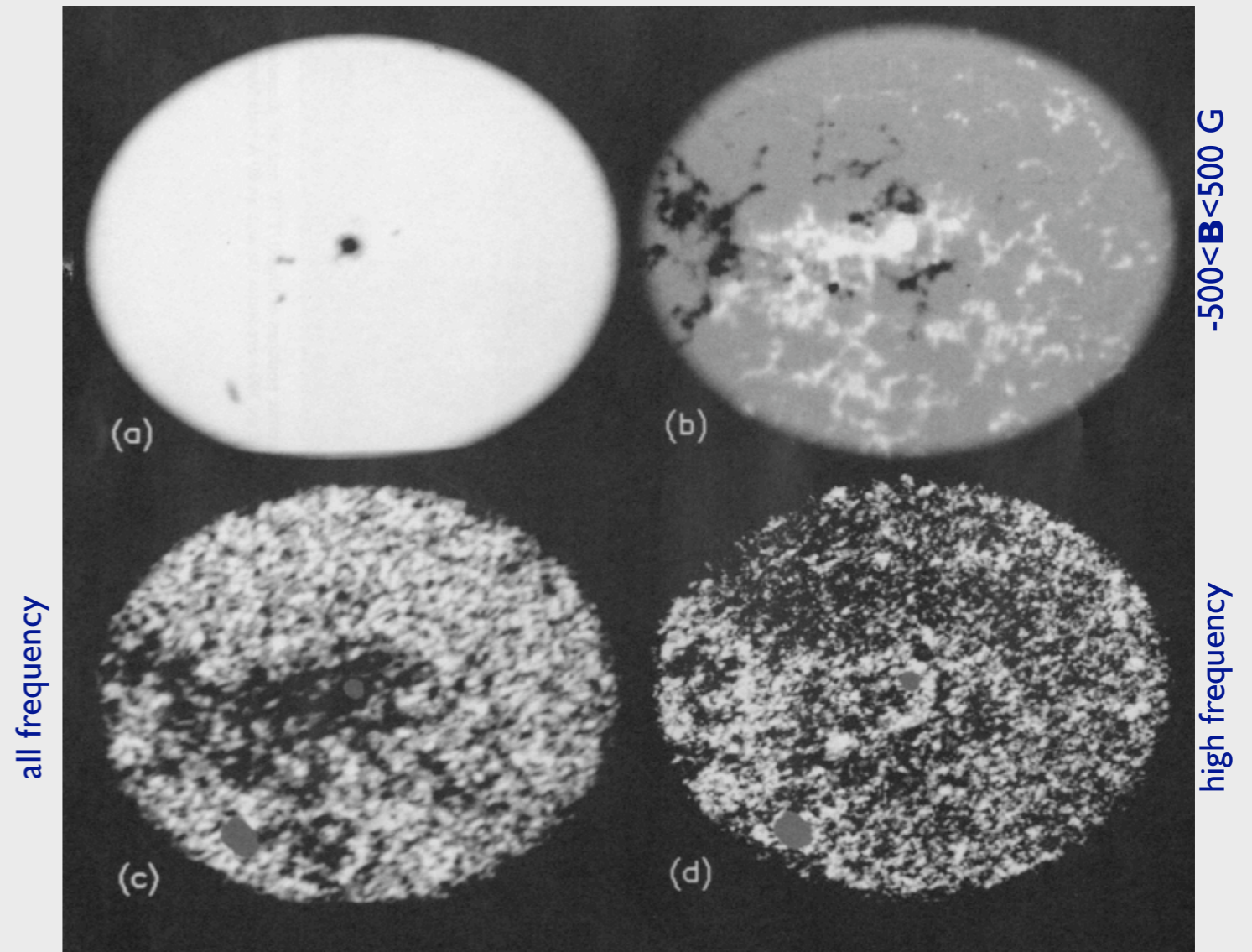
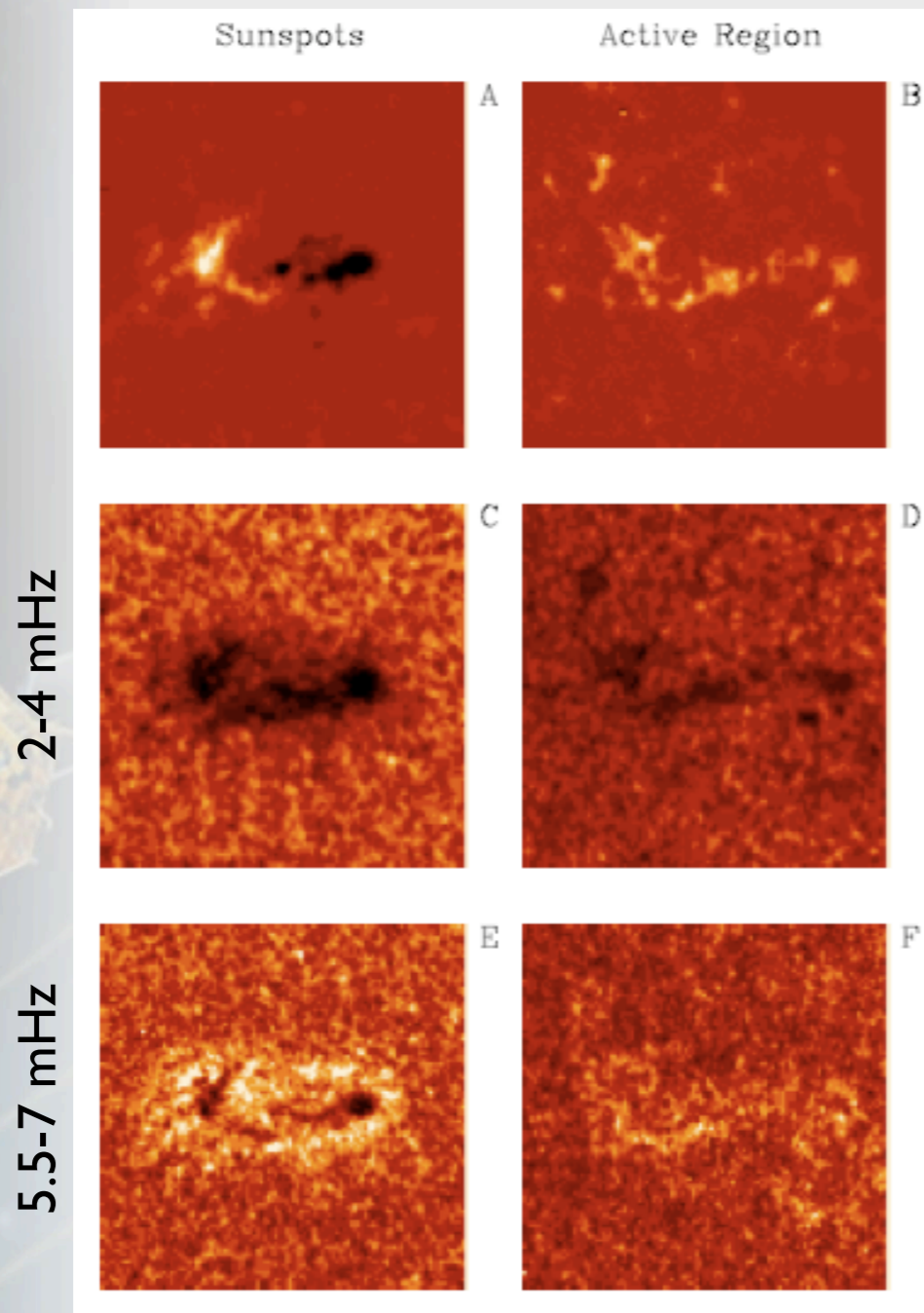


Fig 1, Brown et al 1992

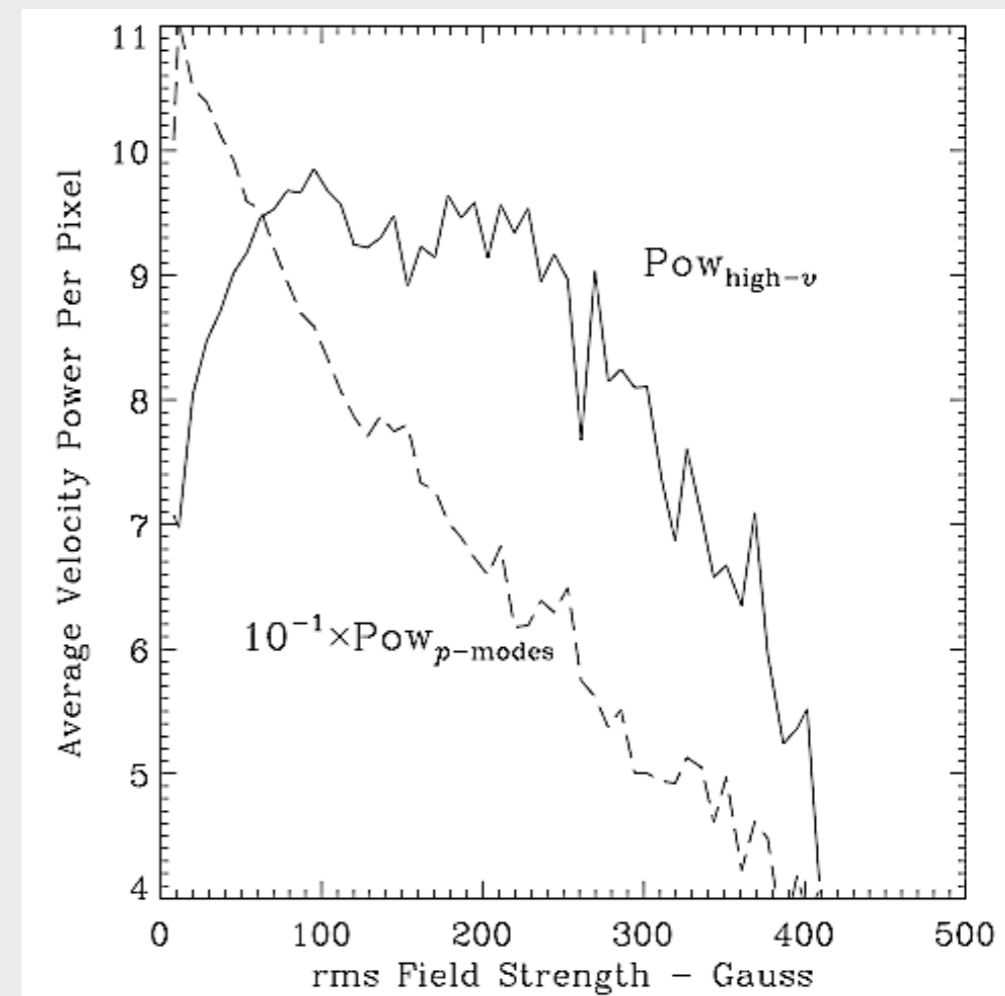
- suppression of power in strong regions of magnetic field
- enhancement of high frequency power, *Acoustic Halo*

Background

- Characteristics of the Acoustic Halo

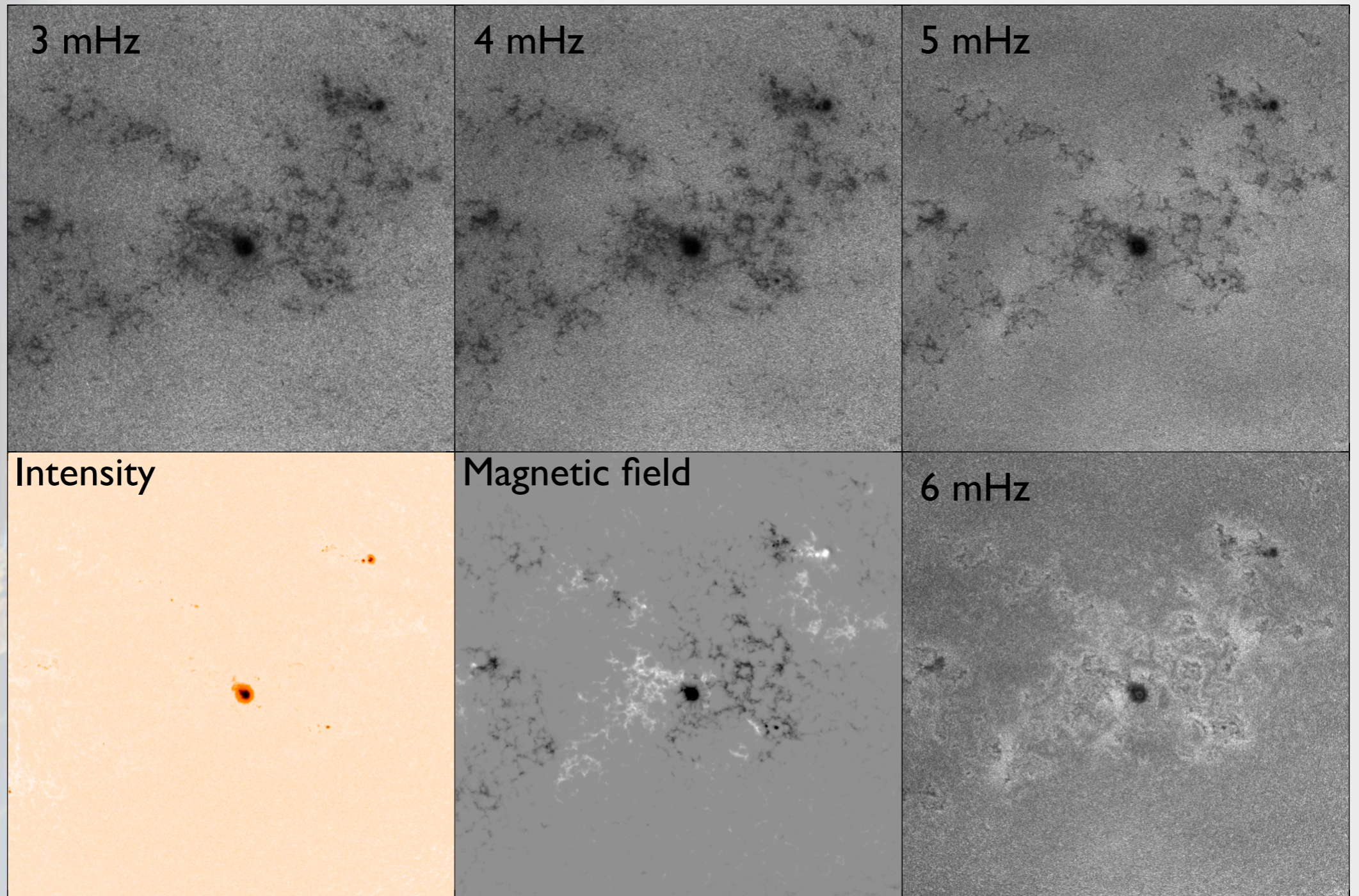
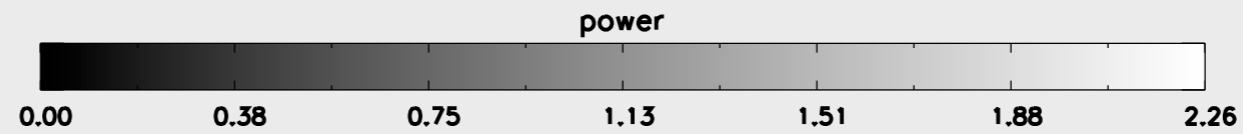


Jain & Haber 2002, Fig 1



Hindman & Brown 1998, Fig. 4

HELAS sunspot: NOAA 9787

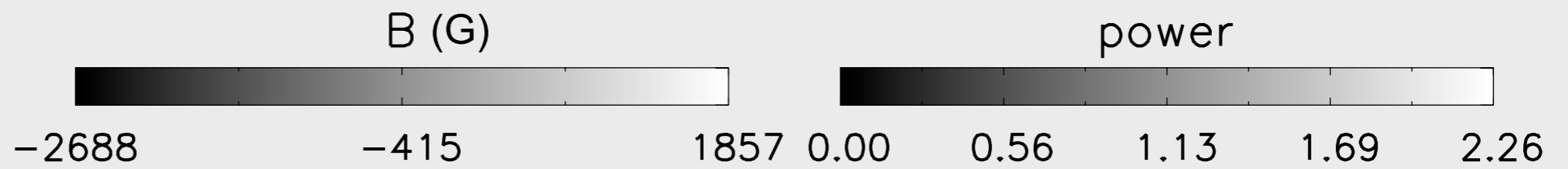


980 Mm

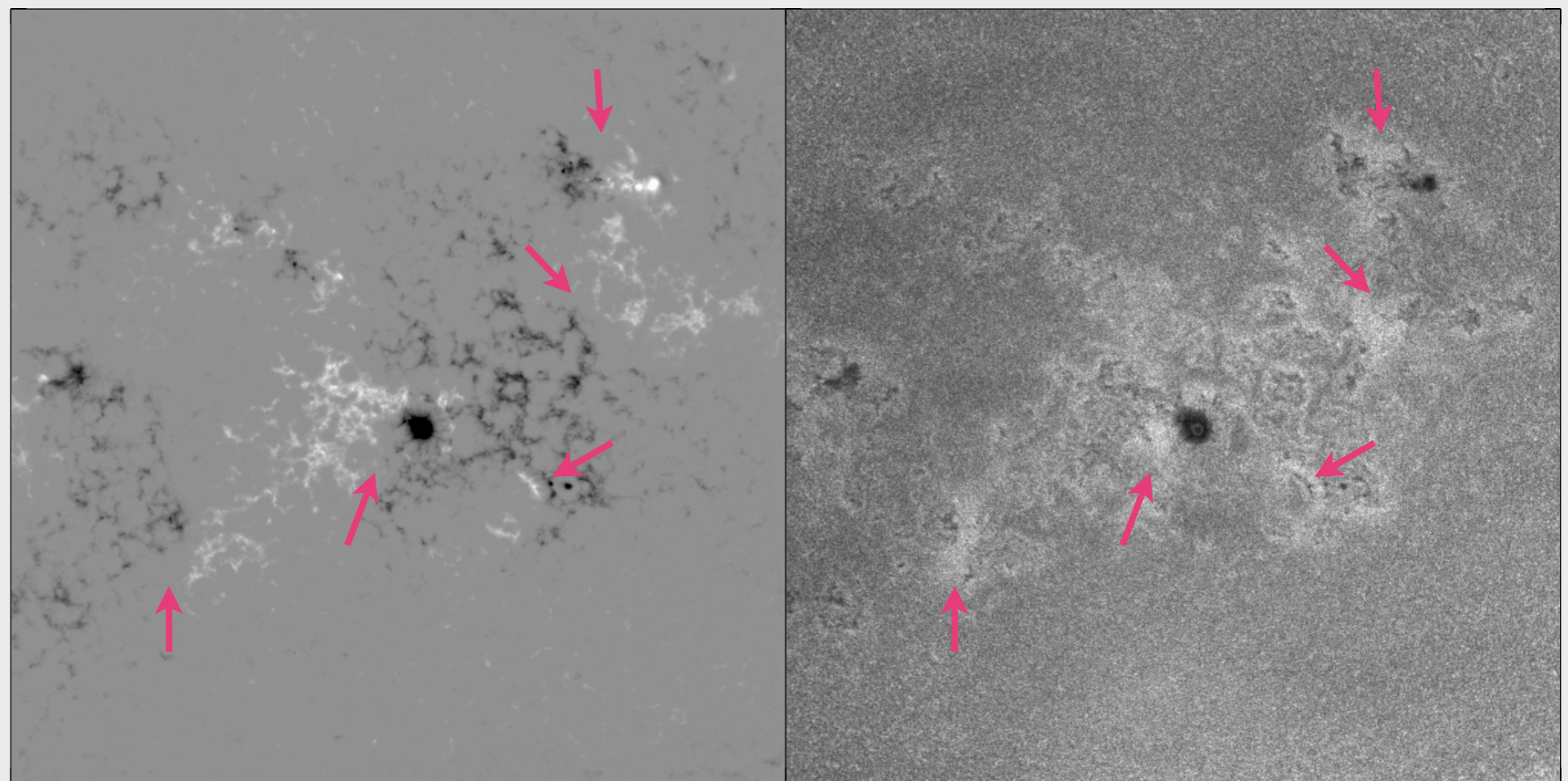
980 Mm

980 Mm

HELAS sunspot: NOAA 9787



980 Mm



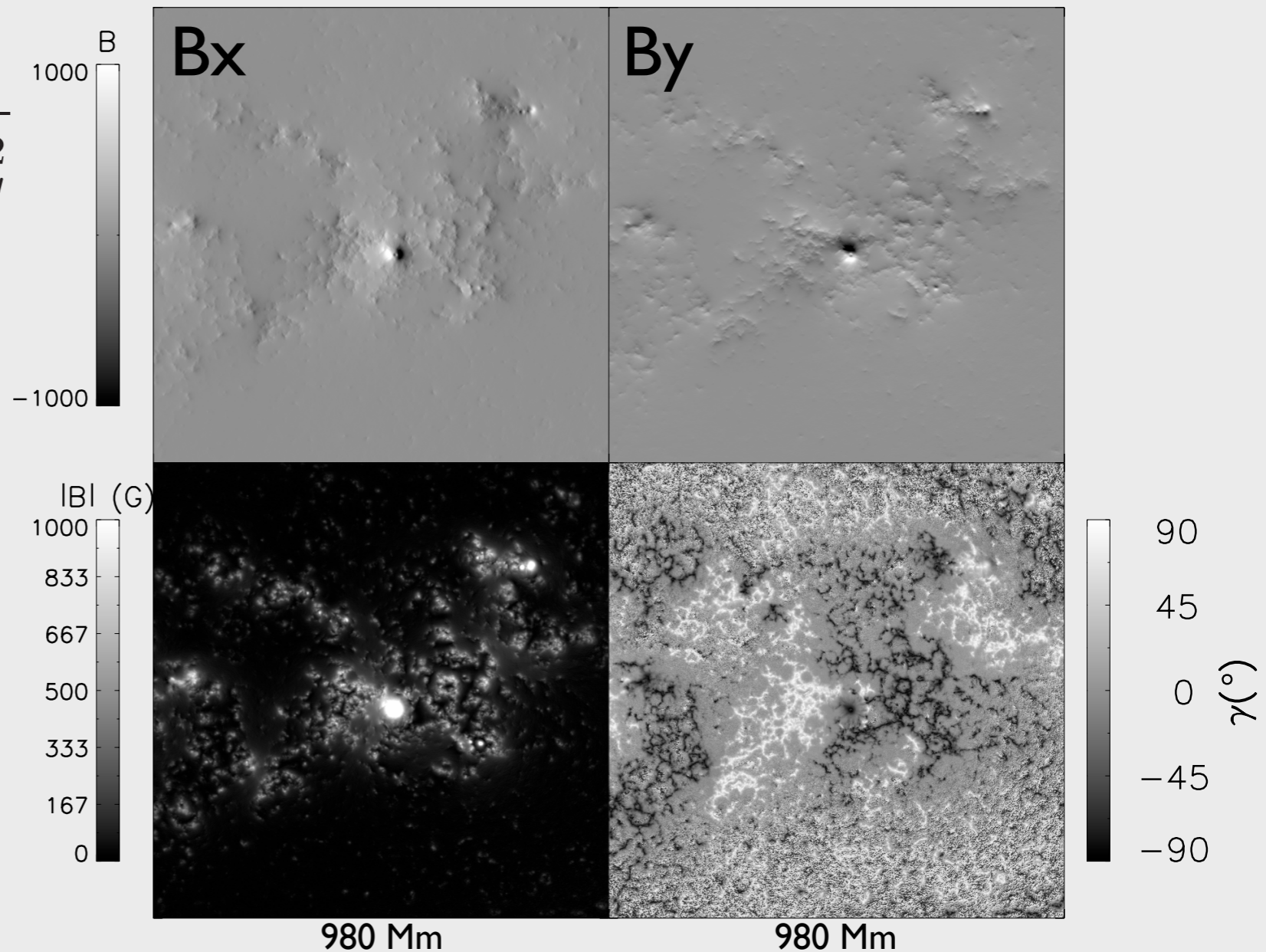
980 Mm

980 Mm

Vector magnetic field

- Potential field extrapolation to get B_x and B_y from B_{los}

$$\tan(\gamma) = B_z / \sqrt{B_x^2 + B_y^2}$$

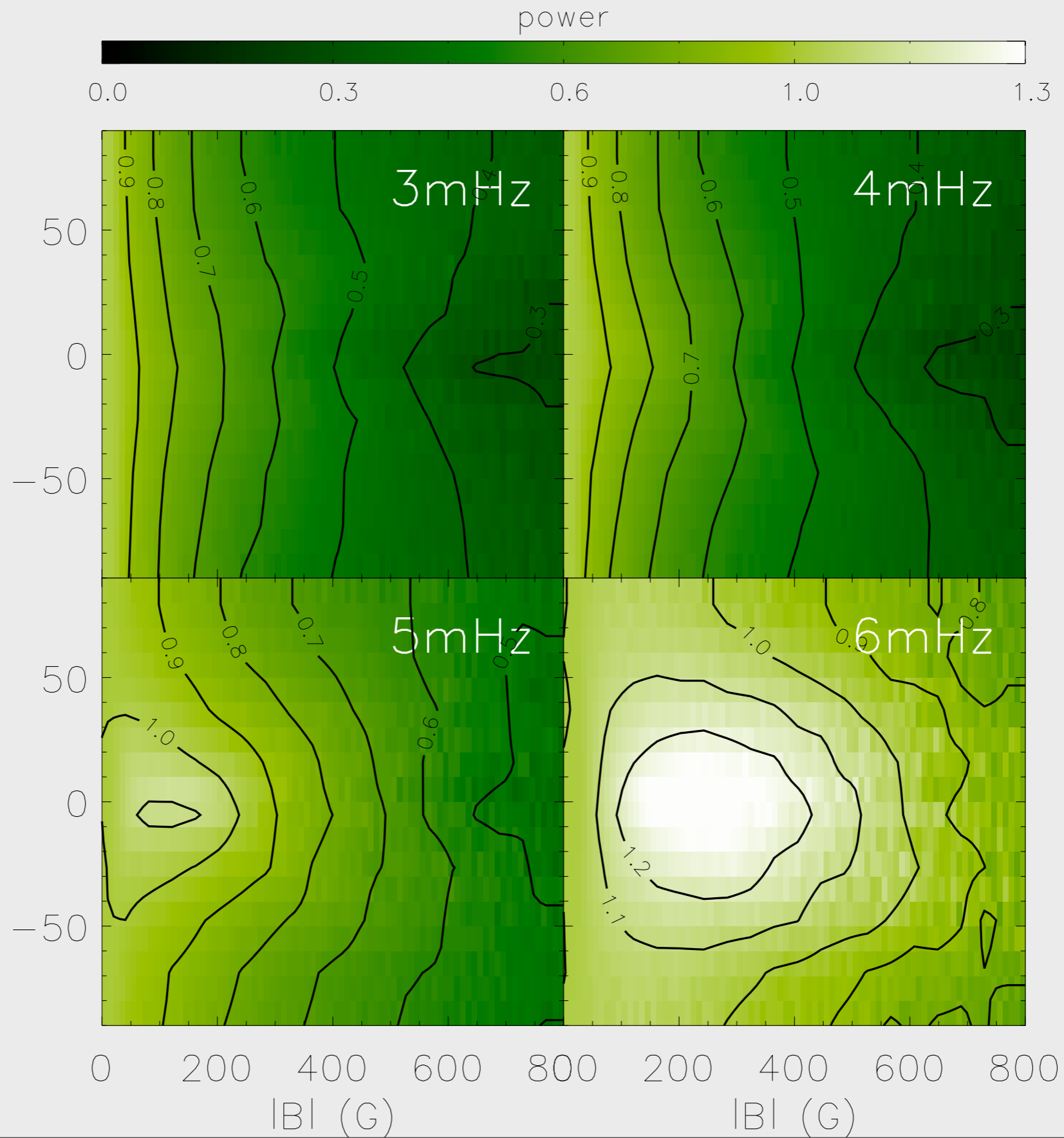


Statistical analysis

FOV B_{los}

27 January 2002

Power, B, γ



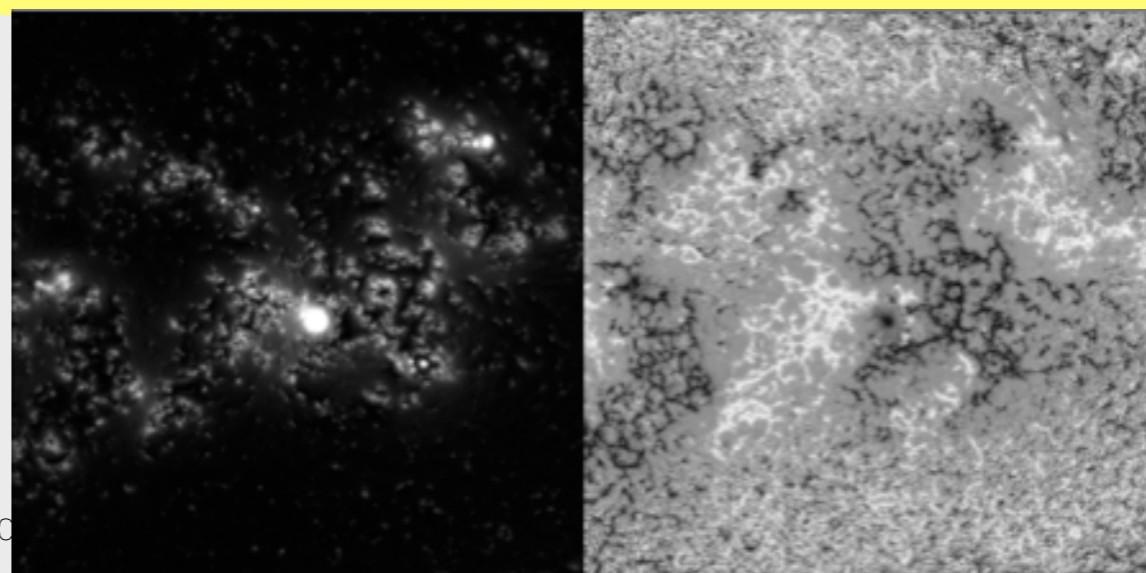
Acoustic power reconstruction

24 Jan 2002

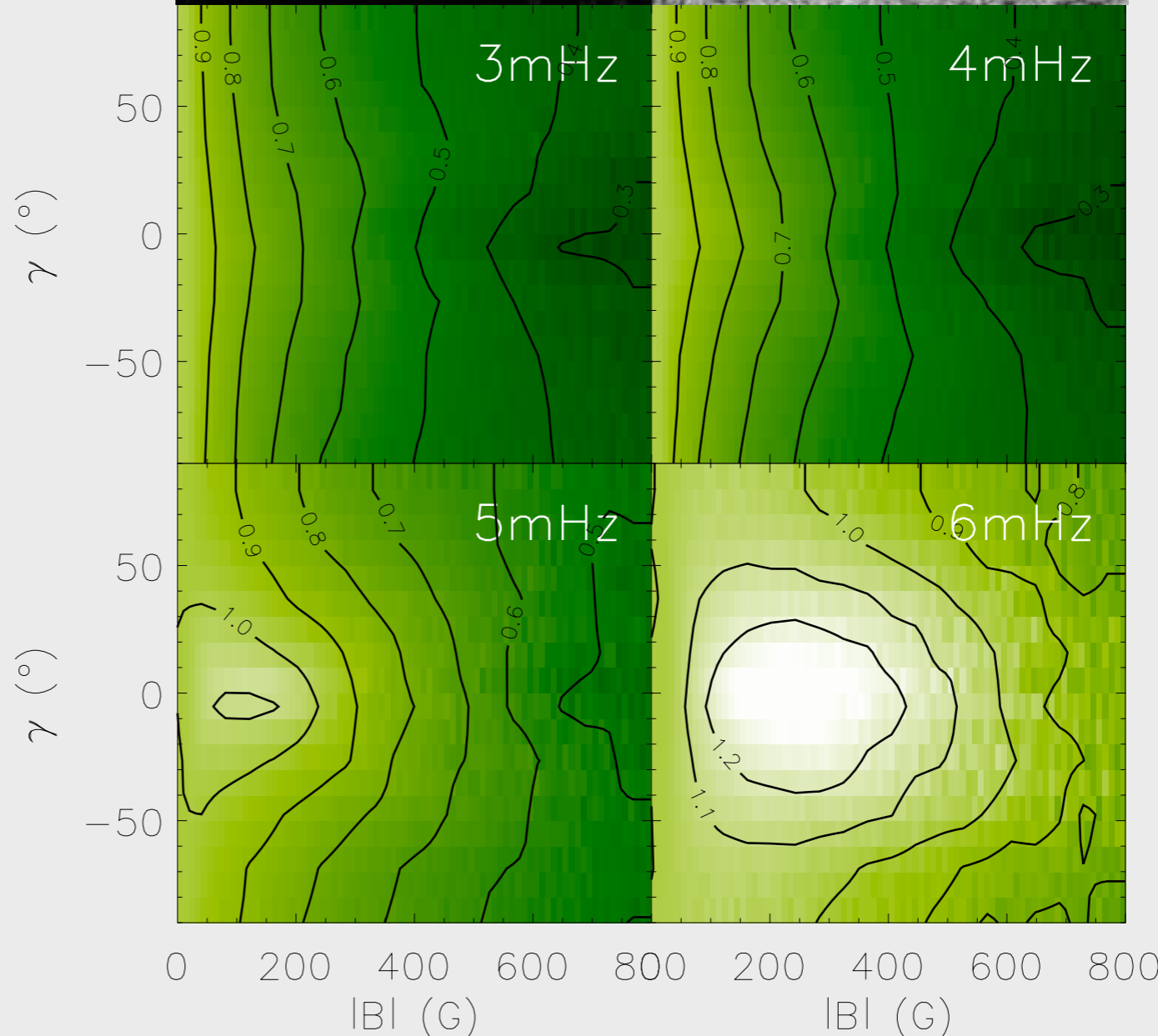
Is it a surface effect?

How correlated are they?

|B|

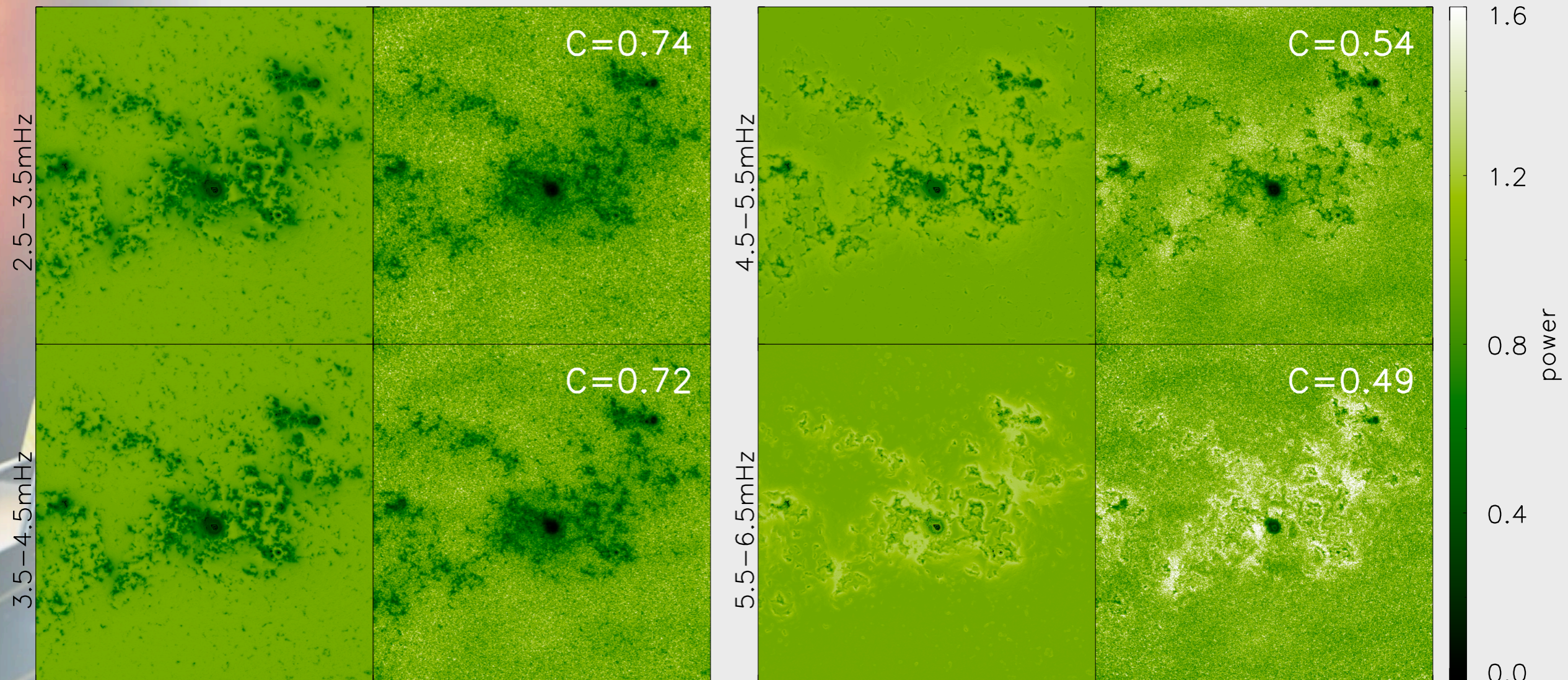


γ



Reconstructed power maps

- Using 24 Jan 2002 vector magnetic field



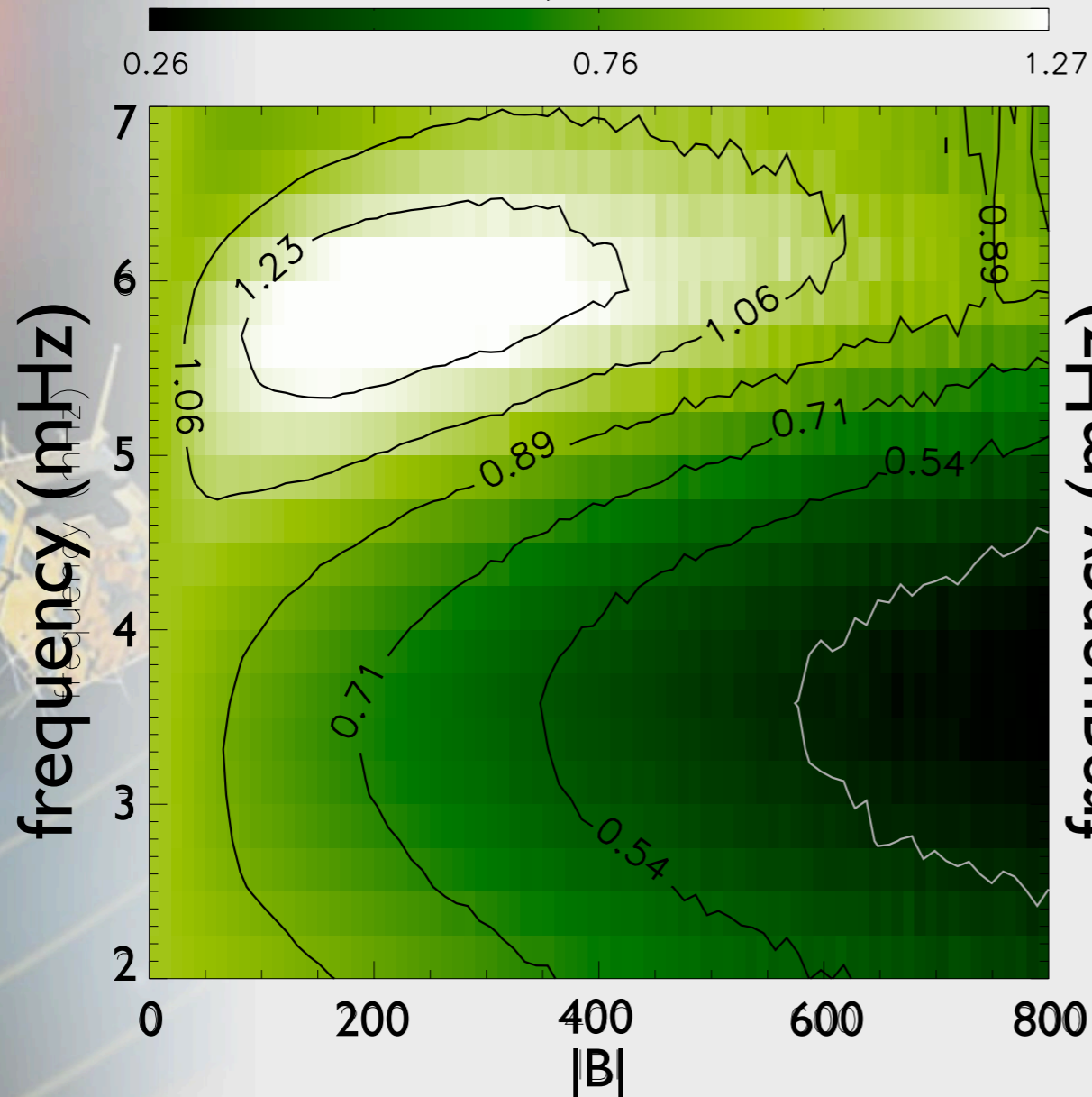
- Predominantly a surface effect

Power, B, γ

- 5.5 - 6.5 mHz and $100 < |B| < 400$ G

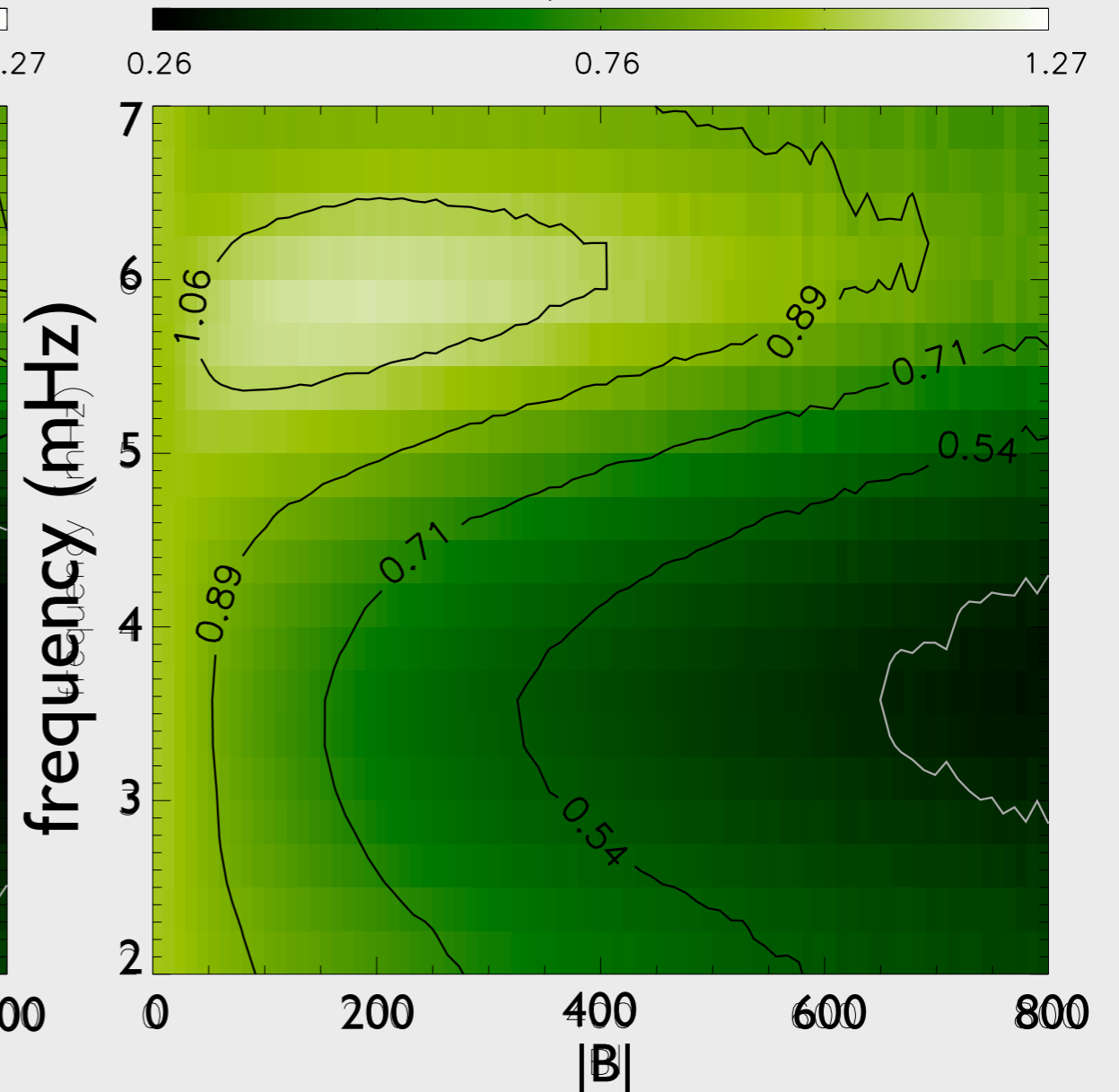
$$|\gamma| < 30^\circ$$

power



$$30^\circ \leq |\gamma| < 90^\circ$$

power



Power spectra: QS comparison



20 Oct 2003

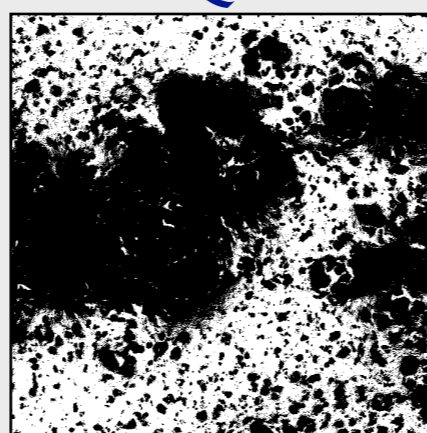
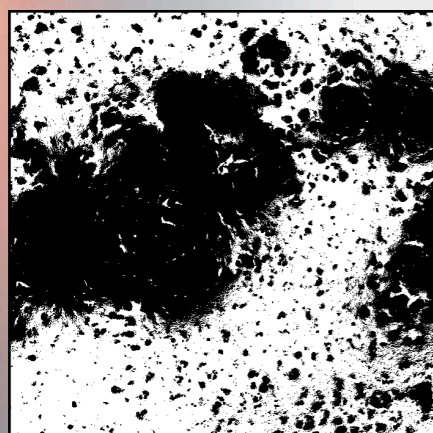
	2003 Obs
	24 Jul
	25 Jul
	26 Jul
	27 Jul
	18 Oct
	19 Oct
	20 Oct

Power spectra comparison

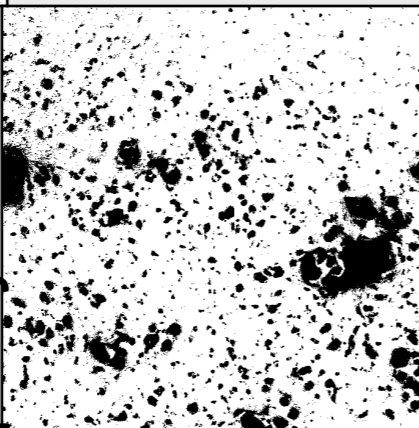
- Quiet Sun Mask: $|B| < 30$ G in both sets
- Halo Mask: $100 < |B| < 350$ G and $|\Upsilon| < 20^\circ$ in 2002
Obs and $|B| < 30$ G in 2003 Obs

QS

22 Jan 2002

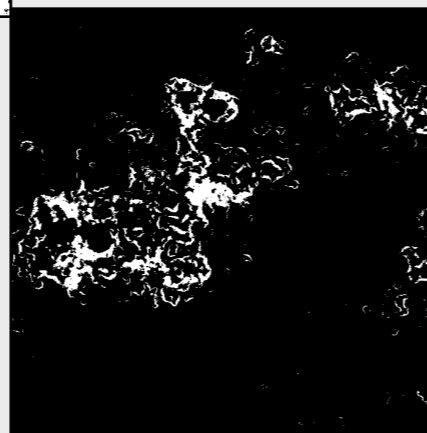
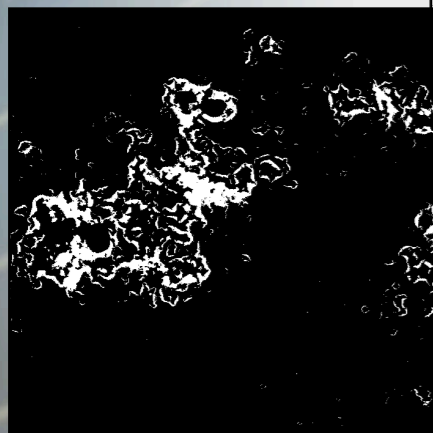


25 Jul 2003



Halo

22 Jan 2002

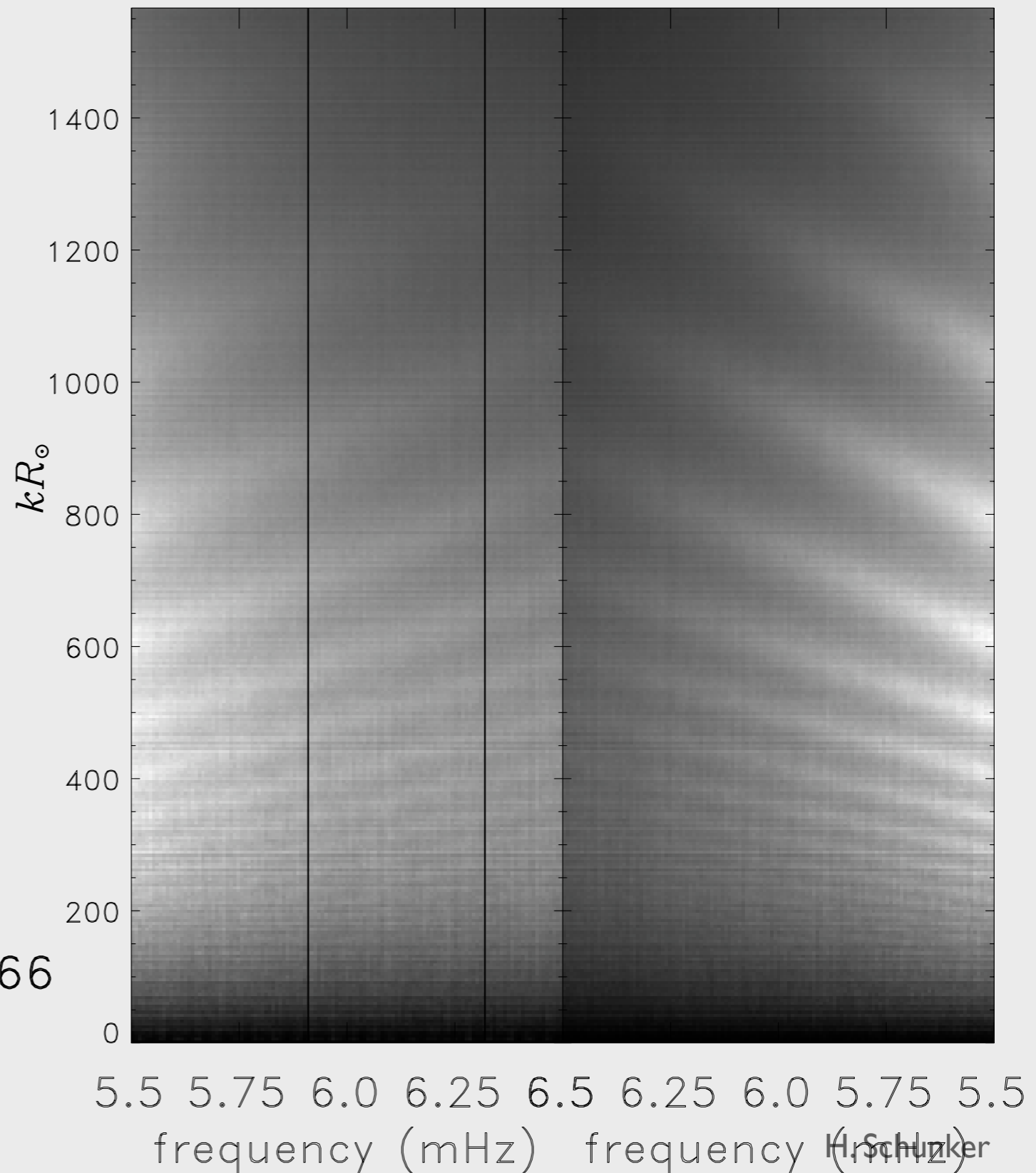
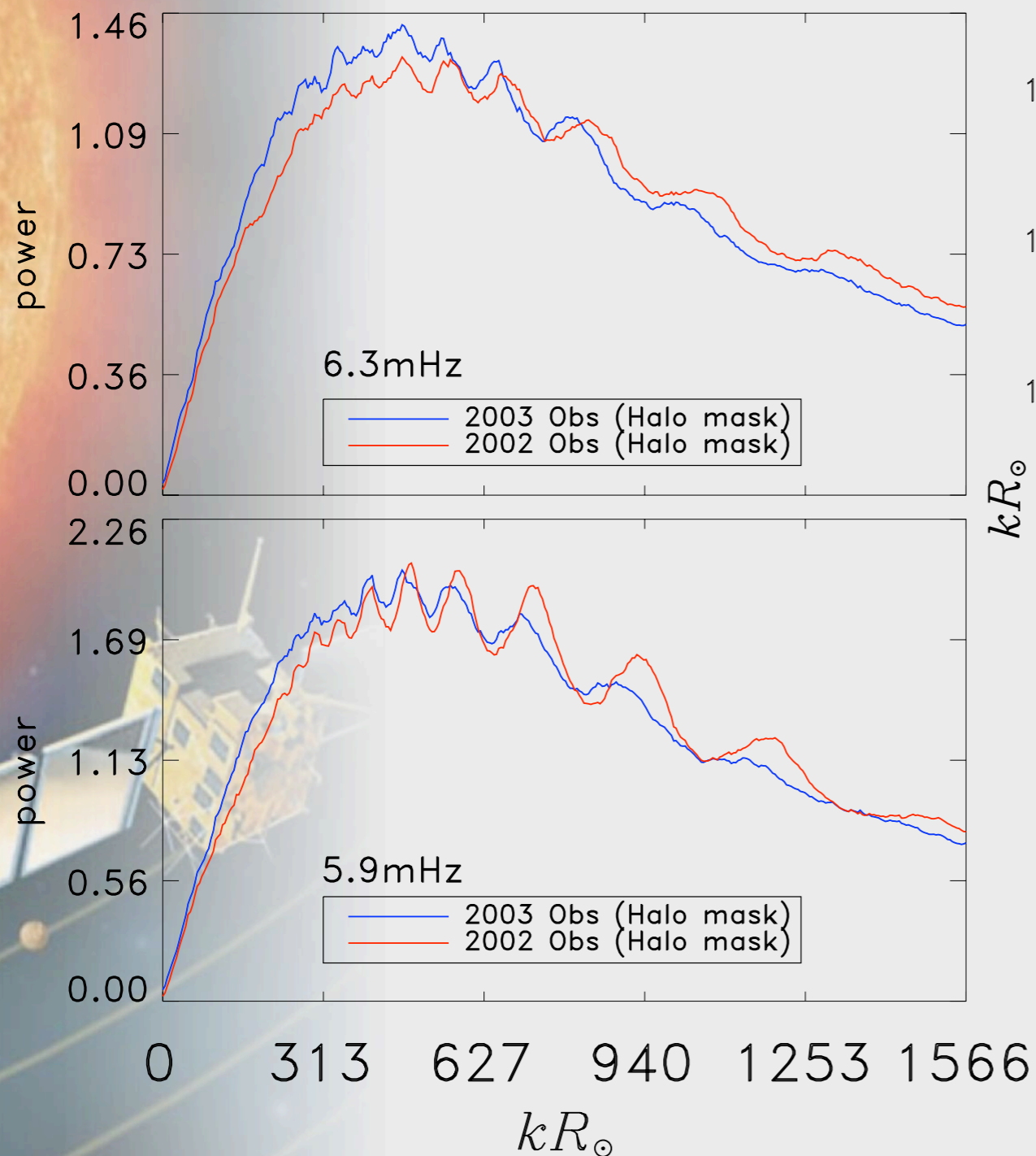


2002 Obs	2003 Obs
21 Jan	24 Jul
22 Jan	25 Jul
23 Jan	26 Jul
24 Jan	27 Jul
25 Jan	18 Oct
26 Jan	19 Oct
27 Jan	20 Oct

Power spectrum: Halo masks

2003 Obs: QS

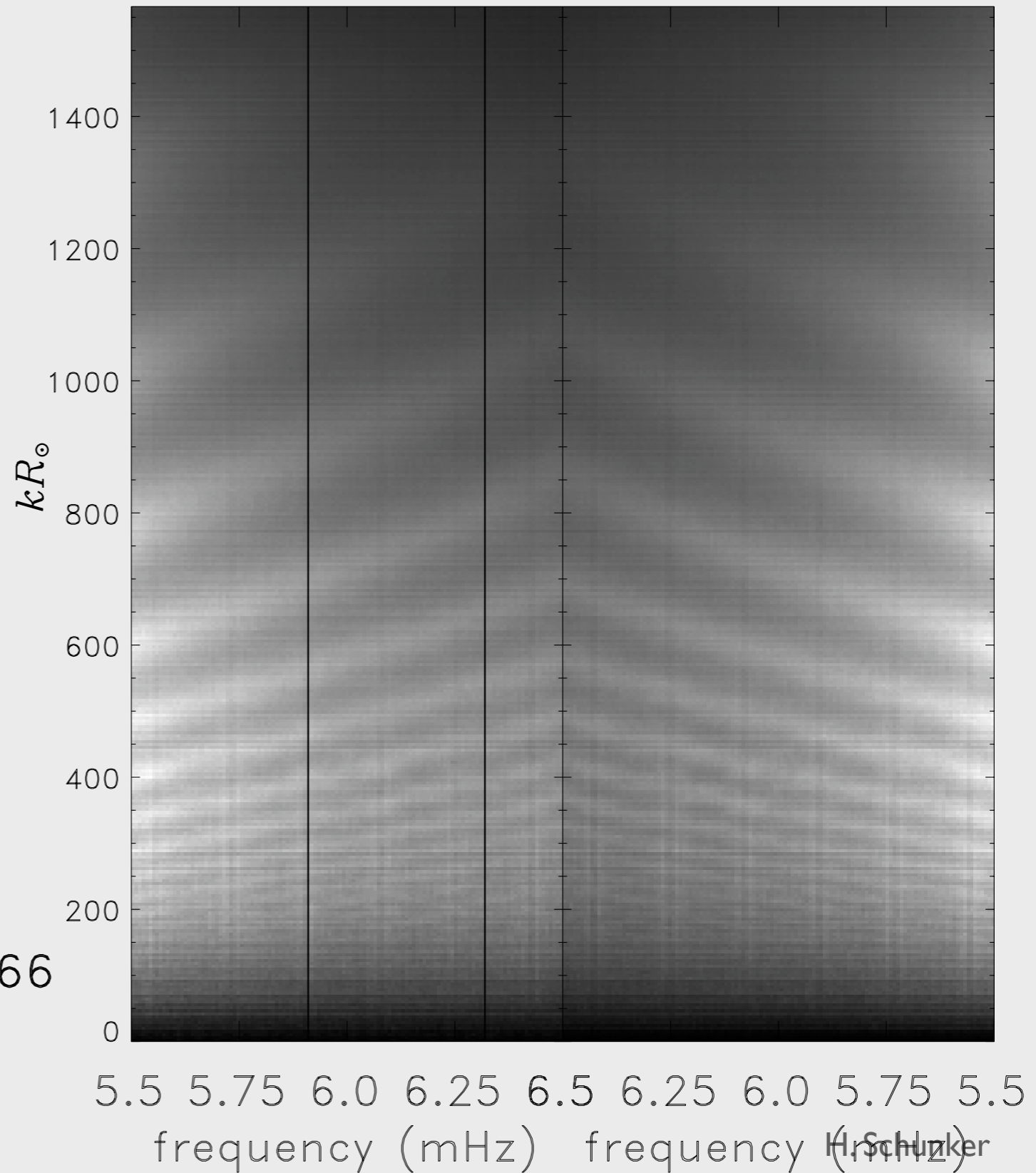
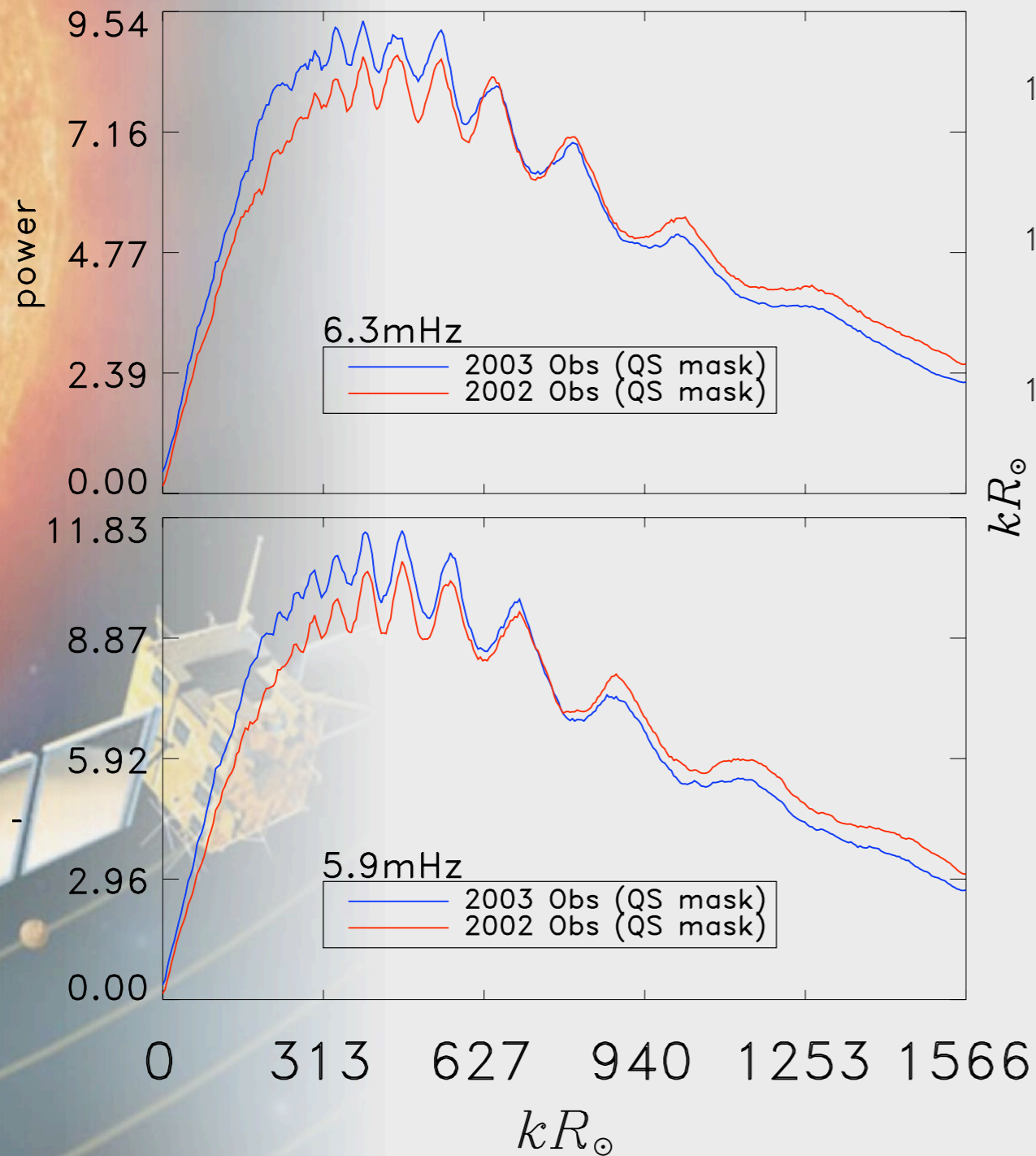
2002 Obs: Halo



Power spectrum: QS masks

2003 Obs: QS

2002 Obs: Halo

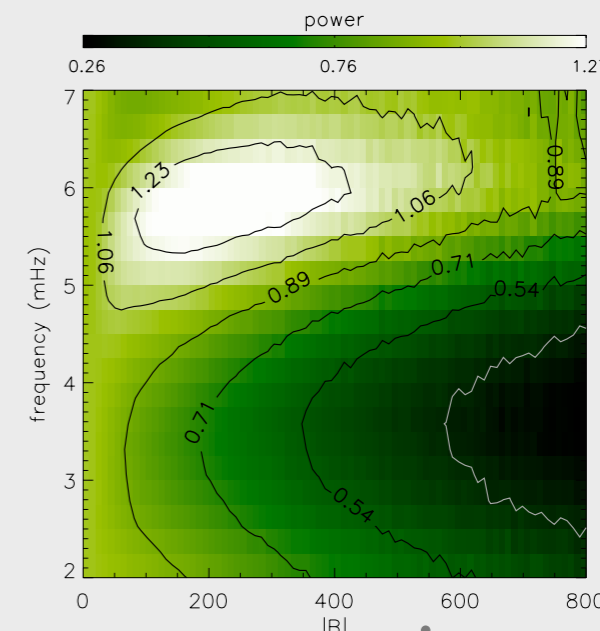


Cause?

- Enhanced emission (*Braun et al 1992; Brown et al 1992*) and changes in convection properties (*Jacoutot et al 2008*)? Intensity (*Hindman & Brown 1998; Donea et al 2000*)
- Scattering (*Hanasoge 2009*)?
- High frequency fast wave reflection (*Khomenko & Collados 2009*)?
- Poster, *Nutto et al*:
- Waves trapped in the solar canopy (*Muglach et al 2005; Kuridze et al 2008*)?
- Global mode observations (*Simoniello et al 2010*)

Summary

1. Halo characteristics: power $\leq 140\%$, $B < 350$ G, $|\Upsilon| < 30^\circ$
2. Frequency \propto field strength
3. Shift of wavenumber in these regions, most prominent at higher wavenumber.



- Occurs near the surface
- Longer path length; slower wave speed?
- Cause?
- Additional constraint for models

