

Comparison of Local Frequency Shifts Between Velocity and Intensity Data

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Motivation

A comparison of GONG velocity (V), intensity (I) and modulation (M) spectra for different ℓ values showed reversal of asymmetry and differences in central frequencies (Harvey, 1998).

The difference in frequency could be as large as 50 μHz close to the acoustic cut-off frequency (Jain, Toner and Hill, 2001)

The difference may arise from

- (1) the details of the source mechanism (location of the source). This can change both the apparent line asymmetry and frequency.
- (2) different spatial leakage signature for different observables due to their different centre to limb variation.
- (3) different levels of solar noise (granulation) in the V and I observables.

Data and Analysis

Standard ring diagram analysis on MDI full disk Doppler-grams and continuum images taken during May 19-28, 1997 is carried out at different locations on the solar disk.

Spectra from each 1664 minutes were combined together to enhance the signal to noise ratio.

Symmetric and asymmetric (Nigam and Kosovichev, 1998) profiles are used

In addition to fitting the 3d spectra, 2-d azimuthal averaged spectra are also fitted.

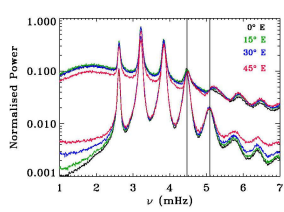


Figure 1: Azimuthally averaged velocity (lower curves) and intensity (upper curves) power spectra at four different positions on the solar disk.

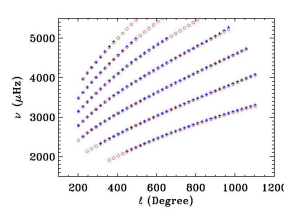


Figure 2: The ℓ - ν diagram for velocity (circles) and intensity (pluses) constructed from the fitted parameters using the symmetric profiles.

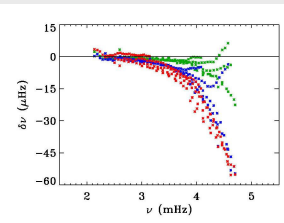
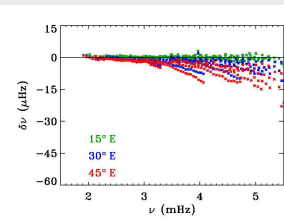


Figure 3: Frequency differences among velocity (left) and intensity (right) modes with respect to disk centre. The frequencies are obtained by fitting the power spectra with symmetric profiles.

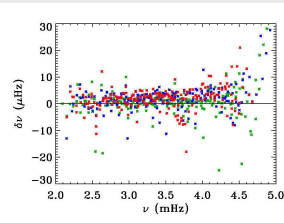
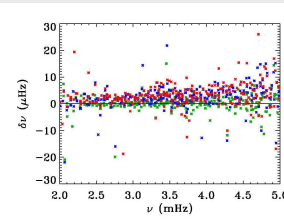


Figure 4: Same as Figure 3 but for asymmetric profiles

References

- Harvey, J.W. et al., 1998 in *New eye to See Inside the Sun and Stars*, eds. F.-L. Deubner, J. Christensen-Dalsgaard, and D. Kurtz, p.49.
 Jain, K., Toner, C., and Hill, F., 2001, *SPD*
 Nigam, R. & Kosovichev, A.G., 1998, *ApJ*, 505, L51

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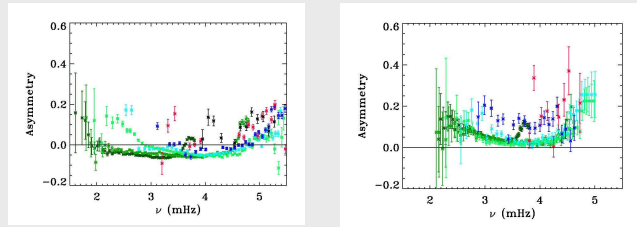


Figure 5: Asymmetry parameter, S , obtained from fits to azimuthally averaged spectra at disk center for velocity (left panel) and intensity (right panel).

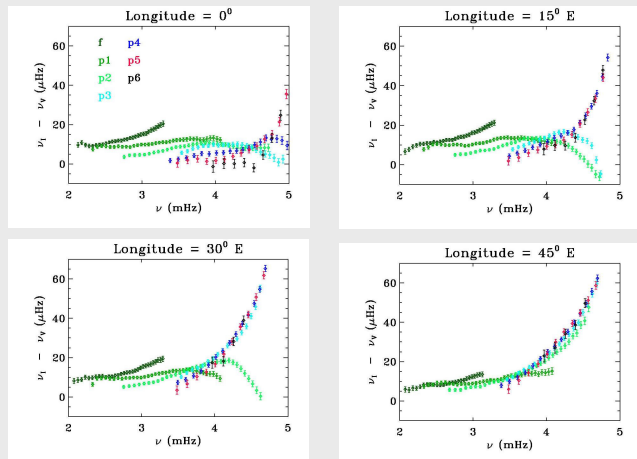


Figure 6: Frequency differences between velocity and intensity spectra fitted using symmetric profiles. The positions are marked on the top of the figure.

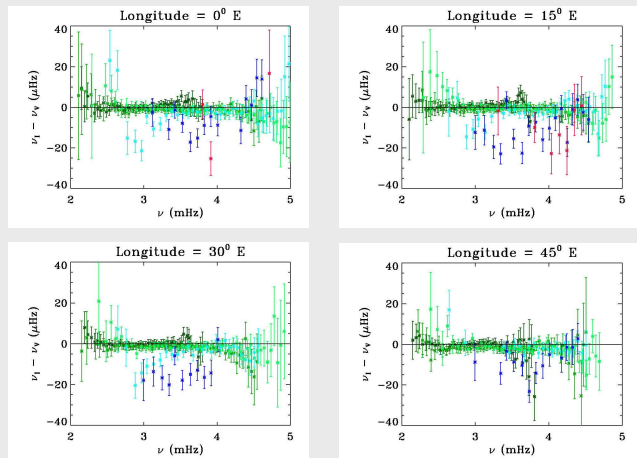


Figure 7: Same as Figure 6 but for asymmetric profiles

Results

- The azimuthally averaged V and I power spectra show a frequency shift in the peak frequency and also reversal in asymmetry.
- The fitted frequencies at different locations on the solar disk derived using symmetric profiles shows a large systematic difference in intensity. The differences are random and small when asymmetric profiles are used.
- The asymmetry parameter, S , obtained from fits to different 3d spectra does not have the correct value. The fits to 2-d spectra have the expected asymmetry.
- The frequency difference between V and I at the same location shows a large difference when symmetric profiles are used. The differences in the 5-minute band are small when the asymmetric profiles are used.