VAMOS: VELOCITY AND MAGNETIC OBSERVATIONS OF THE SUN

Calibration and Data Analysis

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This poster illustrates the calibration procedure and the analysis pipeline developed for the helioseismology data acquired with the VAMOS (Velocity And Magnetic Observations of the Sun) instrument. The VAMOS, based on the MOF (Magneto-Optical Filter) technology, and its operation are discussed in detail elsewhere (Cacciani et al., 1997 and Moretti et al., 1997).

The data set used in the present work consists of 256 solar Doppler images in the Na I D lines, one per minute, obtained in Napoli on February 20, 1997 starting at 10:38 U.T. The average Sun radius is 226 ± 1 pixels. The spatial resolution is ~ 10 arcsec, i.e. ~ 2 pixels, limited by the 1.5 cm iris diameter.

Calibration has been performed in essentially three steps.
First a theoretical solar image has been constructed containing all the contributions to the Earth-Sun line-of-sight relative velocity for each observing time.
Then the observed Doppler images have been fitted to the simulated velocity images. Because the solar sodium line profiles are center-to-limb dependent, the solar disk has been divided into six concentric rings, and in each of these annuli the observed signal was fitted to the simulated velocity with a second order polynomial.
Finally the Doppler images have been effectively calibrated to produce residual images in absolute velocity units.

The two-dimensional residual images were fitted with the 40401 spherical harmonics having $0 \leq l \leq 200$. The spherical harmonics fit routines, as well as the calibration routines for the VAMOS, have been developed in IDL, version 4.0.1. The resulting fit coefficients for the 256 residual images were Fourier transformed to produce the power spectra plotted in Figure 1.

In the figure, we compare the m-averaged $l - \nu$ diagrams from the VAMOS data and the GONG archive. The GONG data series was obtained on February 19, 1997,

F.-L. Deubner et al. (eds.), New Eyes to See Inside the Sun and Stars, 53–54.

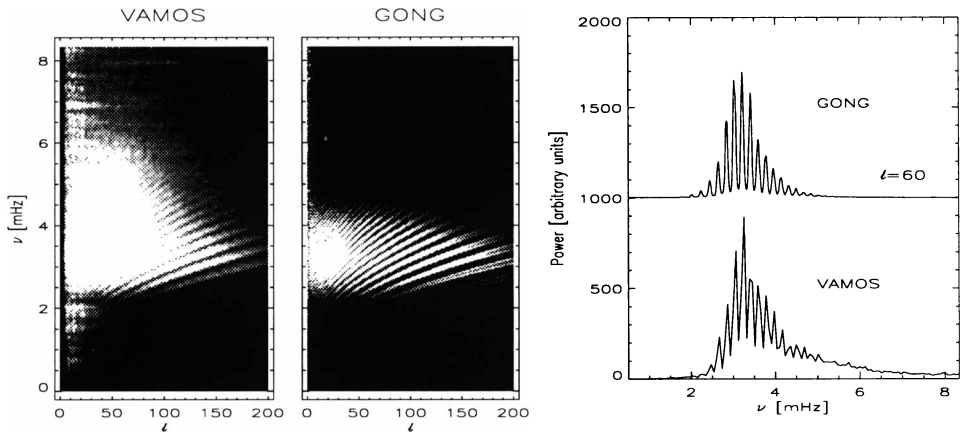

Figure 1. $l - \nu$ diagrams and power vs frequency at $l = 60$ for both VAMOS and GONG.

at Tenerife, and lasts 558 minutes. Therefore, we expect that the GONG frequency resolution is about half of our 65μHz frequency resolution.

In the VAMOS diagram, at least 20 ridges are clearly visible, some of which up to $l = 200$. The low frequency signal was removed by a high pass filtering before applying the Fourier transform.

In the same figure, power is plotted versus frequency, for the value of $l = 60$, again for both VAMOS and GONG. For clarity the GONG data were shifted upward by 1000. The ratio of the highest peak to noise at this l is ~ 30 in the VAMOS data and ~ 140 in the GONG data.

To conclude, on the basis of this data set and with the present, albeit preliminary, setup, the VAMOS is sensitive to p-modes with degree $5 \leq l \leq 200$.

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