A COMPARISON OF LOW-DEGREE SOLAR P-MODE FREQUENCIES FROM BISON AND LOI

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1. OBSERVATIONS

Here, we compare the low-degree solar p-mode frequencies returned from the analysis of two, contemporaneous, independent helioseismological data sets collected during 1996. The first comprises Doppler velocity observations of the 770-nm line of potassium, made in integrated sunlight by the six-station, terrestrial Birmingham Solar-Oscillations Network (BiSON). The second consists of irradiance distribution measurements of the solar disc, made at 500 nm, by the Luminosity Oscillations Imager (LOI), which is part of the VIRGO experiment on the ESA/NASA SOHO satellite. The starting date is 27 March 96. The power spectra corresponds to an 8-month time series. Shorter time series of 4 months were also used to verify the starting dates and the temporal behaviour of the p modes.

2. RESULTS

Fitting of p-mode spectra is performed assuming that the statistic is a χ^2 with 2 degrees of freedom. Each degree is a superposition of m for which $l+m$ is even; the relative amplitude of the m's is that of integrated sunlight instrument. The BiSON time series has a duty cycle of 75%, and consequently the first temporal aliases were included for fitting these data. The power spectra of the 2 data sets were analysed by 2

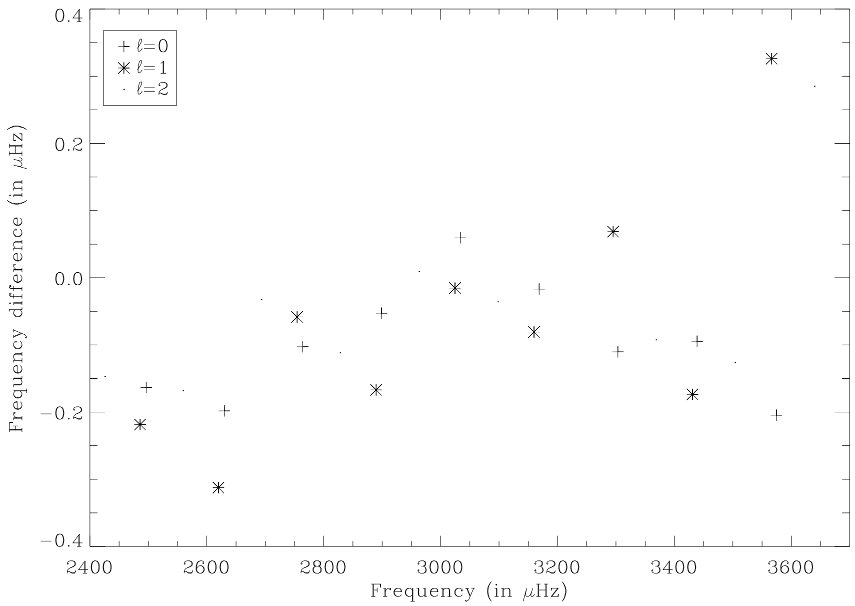

Figure 1. Frequency difference between BiSON and LOI for $l = 0 - 2$ as a function of frequency. The typical error bar on the measurement of a single mode frequency ranges from 0.10 μHz to 0.15 μHz.

different fitting routines (Chaplin's and Appourchaux's). We compared the frequencies returned by the 2 routines on the same data set and found that the differences were about a few nHz over all the degrees. We then compared the frequencies of the LOI and BiSON sets using Appourchaux's routines. Figure 1 shows the result of this comparison. These differences agree with the result of Toutain et al, (1997) (Sol. Phys., in press) showing there are systematic differences between the frequencies of the modes detected in intensity and velocity. Similar frequency differences have been found using GONG and SOHO/LOI data (Appourchaux, 1997, private communication). In addition, Fig. 1 shows that the difference is parabolic with a maximum at about 3000 μHz, and independent of degree.

3. DISCUSSION

The source of the systematic difference is yet to be found. The fact that the difference is independent of degree leads us to conclude that the difference could be due to a surface effect that creates a distortion of the line profile depending on the signal observed. The distortion may create either different asymmetries or different line profiles. The implications for structure inversions are obvious: the inverted internal structure of the Sun will depend upon the signal used for deriving the p-mode frequencies. This was already mentioned by Appourchaux et al (1996) using the VIRGO data (IAU 181, Nice). Further work will be needed to make the intensity and velocity structure inversions agree with each other.