OBSERVATION OF LOW-DEGREE MODES FROM SOHO/MDI USING OPTIMAL MASKS

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Introduction

The overlap of peaks of split multiplets in oscillation power spectra and the leakage of other degree modes significantly affect the measurements of the rotational frequency splitting. We have developed optimal masks which allow to isolate individual components of the multiplets. The method has been applied to the Michelson Doppler Imager Low-l data, and the results of the measurements of the mode frequencies are reported.

Optimal masks

The MDI instrument provides, among others, a LOI-proxy velocity signal (Scherrer et al.(1995)) consisting of 180 mean velocities, one for each bin of the CCD detector. The signal gathered over 1 year (May 96 to april 97) has a duty cycle better than 99%. Because we are interested only in very low degree modes ($l \leq 3$) we reduce the time series by binning up the 180 pixels to get to the 12 scientific pixels of the LOI (Appourchaux et al., 1997). Instead of applying spherical harmonic masks to the time series we follow Kosovichev (1986) and apply a Singular Value Decomposition technique to get optimal masks. Figure 1 shows a l=1 m-ν diagram obtained using optimal masks. Crosstalks between modes have disappeared making the fitting of lines easier. Modes are fitted in the Fourier domain, as described by Appourchaux and Gizon(1997). Table I gives the central frequencies we obtained.

References:

Appourchaux T. et al., 1997, Sol. Phys. **170**, 24
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Kosovichev, A.G. 1986, Bull. Crimean Astrophys. Obs.**75**, 19
Scherrer,P.H.,et al., 1995, Sol. Phys. **162**, 129

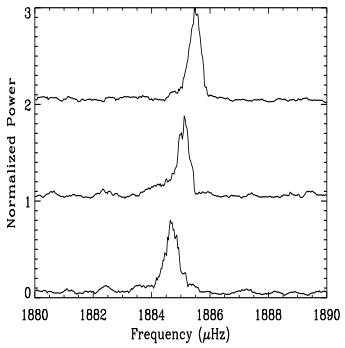

Figure 1. Smoothed m-ν diagram for l=1 using optimal masks on the 1-year MDI time series

TABLE 1. Central frequencies (in μHz) with their 1-σ error bars

order	l=0	l=1	l=2	l=3
10	1548.31 ± 0.07		1674.51 ± 0.20	1729.06 ± 0.03
11	1686.58 ± 0.04	1749.26 ± 0.06	1810.27 ± 0.04	1865.28 ± 0.03
12	1822.20 ± 0.05	1885.06 ± 0.03	1945.76 ± 0.03	2001.19 ± 0.04
13	1957.40 ± 0.05	2020.76 ± 0.03	2082.08 ± 0.03	2137.75 ± 0.03
14	2093.46 ± 0.05	2156.78 ± 0.04	2217.60 ± 0.03	2273.34 ± 0.03
15	2228.67 ± 0.06	2291.92 ± 0.04	2352.22 ± 0.03	2407.56 ± 0.03
16	2362.74 ± 0.06	2425.46 ± 0.03	2485.80 ± 0.03	2541.53 ± 0.03
17	2496.06 ± 0.06	2559.06 ± 0.04	2619.51 ± 0.03	2676.13 ± 0.03
18	2629.81 ± 0.06	2693.26 ± 0.03	2754.46 ± 0.03	2811.47 ± 0.03
19	2764.10 ± 0.06	2828.06 ± 0.04	2889.58 ± 0.03	2947.00 ± 0.03
20	2898.91 ± 0.03	2963.24 ± 0.03	3024.70 ± 0.03	3082.19 ± 0.03
21	3033.73 ± 0.07	3098.04 ± 0.04	3159.76 ± 0.03	3217.66 ± 0.03
22	3168.57 ± 0.06	3233.02 ± 0.04	3294.93 ± 0.04	3353.41 ± 0.04
23	3303.36 ± 0.07	3368.64 ± 0.05	3430.66 ± 0.05	3489.44 ± 0.06
24	3438.88 ± 0.08	3504.06 ± 0.07	3566.73 ± 0.07	3625.93 ± 0.07
25	3574.40 ± 0.18	3640.25 ± 0.10	3702.90 ± 0.12	3762.67 ± 0.10
26	3710.36 ± 0.22	3776.31 ± 0.20	3839.57 ± 0.20	3899.53 ± 0.15
27	3846.96 ± 0.33	3912.85 ± 0.20	3976.31 ± 0.28	4174.71 ± 0.35