SEISMIC STUDY OF THE SOLAR INTERIOR: INFERENCES FROM SOI/MDI OBSERVATIONS DURING SOLAR ACTIVITY

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Final Report

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Principal Investigator

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Work on the structure, asphericity and dynamics of the solar interior from p-mode frequencies and frequency splittings was carried out primarily in collaboration with Dr. Eff-Darwich (University of La Laguna, Tenerife). This ongoing collaboration produced new results for the inversion of the internal solar rotation rate and further development in inversion methodologies (Eff-Darwich et al, 2001a; Eff-Darwich et al, 2001b; Eff-Darwich et al, 2002a; Eff-Darwich and Korzennik 2003; Garcia et al 2003; Garcia et al 2004; Eff-Darwich et al, 2004). It also resulted in inferences on the solar stratification (Eff-Darwich and Korzennik, 2000; Eff-Darwich et al, 2001c; Eff-Darwich et al, 2002b).

Substantial progress towards the characterization of high-degree p-modes has been achieved. In collaboration with Drs. Rabello-Soares and Schou (Stanford University), we have gained a clear conceptual understanding of the various elements that affect the leakage matrix of the SOI/MDI instrument. This work has precise implications on the properties and the characterization of the HMI instrument being developed for thr SDO mission. It was presented at various meetings and published in a lengthy Astrophysical Journal paper (Rabello-Soares et al 2001; Korzennik et al 2003; Korzennik et al 2004;). That paper was characterized by the referee as follows:

> The authors are to be congratulated for undertaking such an exhaustive examination of the difficulties in determining high-degree frequencies from observations obtained with the MDI experiment. This will be a major paper, which will definitely be referred to widely once it is published. [...]

The results of that work also contributed to the study of the energy distribution of solar oscillations (Woodard et al 2001a; Woodard et al 2001b).

Work on inversion methodology for Time-Distance analysis was also carried out. The methodology I developed allows for the inversion of time anomalies to determine the velocity flow and the perturbation of the sound speed and includes the explicit computation of the resolution kernels and the uncertainty of the inferred solution. An

extended analysis of the potential of the methodology has been carried out using two-dimensional artificial data sets (Korzennik 2001; Korzennik and Eff-Darwich, 2001).

Finally, work on mode detection and mode fitting for low frequency at low degree and for very long time series was carried out (Eff-Darwich et al 2001c; Jimenez-Reyes et al 2004; Korzennik 2004).

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