Project Details

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Program Element: Independent Investigation: LWS

Topic: Shock acceleration of solar energetic particles by interplanetary CMEs

Project Title:
The Study of the Changing Solar Interior Using Global and Local Helioseismology

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Summary:
The research we are proposing has the main goal of improving our knowledge of the temporal changes which are occurring in the structure and dynamical motions of the solar interior. Within the past few years, several hints of possible temporal changes that have occurred during the current solar cycle have been obtained through the application of helioseismic techniques to observations made with the Michelson Doppler Imager (MDI) experiment onboard the SOHO spacecraft. These hints have included the discovery of the Solar Subsurface Weather (SSW), and the confirmation of the existence of the torsional oscillations in the sub-photospheric layers. The discovery of the SSW has included a reversal in the meridional circulation beneath the solar surface in the northern hemisphere during the years 1998 through 2001. We have recently verified that the torsional oscillations can be seen in cotemporaneous ground-based observations taken at the Mt. Wilson Observatory (MWO) 60-Foot Solar Tower after the SOHO launch as well as in observations obtained prior to the SOHO mission. We have verified the existence of the torsional oscillations in our 60-Foot Tower data by first transferring two and one-half years of these observations to the MDI Science Center and by then computing the frequency splittings of the solar f-mode oscillations. We have also verified that these same MWO observations can be employed in the generation of the ring diagrams of local helioseismology. We have generated maps of sub-photospheric flows from MWO Dopplergrams obtained during three different Carrington Rotations in 1995, 1996, and 2001.

We propose to search for changes in both the meridional flow and in the torsional oscillations during Solar Cycle 22 using earlier MWO observations since our 60-Foot Tower observations are the only suitable data available during that solar cycle. We also propose to improve the radial resolution of the measurements of the shallow sub-surface layers by incorporating measurements of the frequency-splitting coefficients of the high-degree p-mode oscillations now that we have been able to remove the contamination introduced into those measurements by solar differential rotation. Since the high-degree p-modes are confined to the shallow layers just below the photosphere, the inclusion of their frequency splittings should allow us to improve upon the depth resolution available from the use of the intermediate-degree f-mode splittings alone. We also propose to invert the high-degree frequency splittings in order to provide an independent verification of the zonal velocities which are measured by the ring-diagram methodology.

During the first 28 months of this project we have transferred 1118 days of 60-Foot Tower Dopplergrams containing in excess of one terabyte of data to the MDI Science Center. All of these images are currently available for use by the entire solar community. During our planned continuation of this project, we expect to transfer all of our remaining archive of 60-Foot Tower Dopplergrams to the MDI Science Center. This transfer and our other planned tasks will all extend research which has been supported by NASA Living with a Star Program Grants NAG5-13510 and NNG04GM01G.

Publication References:

Summary: "

Reference: Rhodes, Edward USC - The Study of the Changing Solar Interior Using Global and Local Helioseismology