Project Details

ROSES ID: NNH08ZDA001N
Selection Year: 2009
Program Element: Focused Science Topic

Topic: Measure the properties of the solar dynamo that affect solar irradiance and active region generation.

Project Title:
Helioseismology of the Solar Dynamo

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Summary:
We propose to improve current measurements of solar meridional and zonal flows

by analyzing the nearly continuous 12-year sequence of Dopplergrams from the

SOHO/MDI medium-l helioseismology program.

The analysis technique we will use is based on measuring a mode-leakage

matrix which is sensitive to the distortion of mode eigenfunctions by flows

Significant effort will be devoted to identifying, understanding, and

modeling instrumental error.

We are proposing (1) to model and correct for instrumental and

radiative transfer effects, (2) to model the theoretical effect of differential

rotation and meridional circulation on the leakage matrix, (3) to develop

and verify codes to fit the leakage model to helioseismic data, and to

run the fitting codes on MDI data and, (4) to invert measurements of the

leakage matrix for meridional and zonal flows.

The resulting measurements of deep flows are anticipated to be accurate

enough to impact our understanding of the solar dynamo, as meridional flow

is a critical component of flux-transport dynamos. In addition, the

leakage matrix measurements we will carry out will be useful to other

areas of helioseismology.

The goals and measures of success of Focused Science Topic (a) -- "Measure the properties of the solar dynamo that affect solar irradiance and active region generation" -- include "improved measurements of critical subsurface flows, including the expected deep meridional flow." The detection of sub-surface meridional flow promises to facilitate our understanding of, and perhaps predict, the generation, emergence, and evolution of magnetic regions. This research is therefore critical to the TR&T Focused Science Topic and NASA's Strategic Subgoal 3B through Research Objective 3B.1: "Understand the fundamental physical processes of the space environment from the Sun to Earth .. ", which addresses NASA's Science Question, "How and why does the Sun vary?" from Strategic Subgoal 3B.

Publication References:

Summary: no summary

Reference: Woodard, M. F.; (2009), Seismic Detection of Solar Mesogranular-Scale Flow, The Astrophysical Journal Letters, Volume 706, Issue 1, pp. L62-L65, doi: 10.1088/0004-637X/706/1/L62

Summary: no summary

Reference: Woodard, M.; Schou, J.; Birch, A. C.; Larson, T. P.; (2013), Global-Oscillation Eigenfunction Measurements of Solar Meridional Flow, Solar Physics, Volume 287, Issue 1-2, pp. 129-147, doi: 10.1007/s11207-012-0075-9

Summary: no summary

Reference: Woodard, M.; (2014), Detectability of Large-Scale Solar Subsurface Flows, Solar Physics, Volume 289, Issue 4, pp.1085-1100, doi: 10.1007/s11207-013-0386-5