The Helioseismic & Magnetic Imager on the Solar Dynamics Observatory

The HMI Team – Stanford University, LMSAL, HAO, ++

The HMI investigation will study the origin of solar variability and its effects, relating to leading predictable capability, one of the key elements of the Living With a Star (LWS) program.

The Michelson Doppler Imager (MDI) instrument has made helioseismic and magnetic field observation of the Sun for all solar cycles 23. HMI will continue these important measurements from space into the next solar cycle. The HMI instrument is an evolution of the successful MDI design with key improvements in resolution, image cadence and vector magnetic field measurement capabilities. Measurements of the Fe I spectral line at 617.3 nm with the HMI tunable narrow band filter determine motions of the solar photosphere to study solar oscillations. Measurements of the polarization in this same spectral line enable determination of all three components of the photospheric magnetic field.

See: http://hmi.stanford.edu for more information.

HMI Major Science Objectives

The primary goal of the Helioseismic and Magnetic Imager (HMI) investigation is to study the origin of solar variability and to characterize and understand the Sun’s interior and the various components of magnetic activity. The HMI investigation is based on measurements obtained with the HMI instrument as part of the Solar Dynamics Observatory (SDO) mission. HMI makes measurements of the motion of the solar photosphere to study solar oscillations and measurements of the polarization to study the Sun’s vector magnetic field. HMI will help establish relationships between the internal dynamics and magnetic activity in order to understand solar variability and its effects, relating to leading predictable capability, one of the key elements of the Living With a Star (LWS) program.

The Solar Dynamics Observatory will be placed into an inclined high bandwidth telemetry. Launch is scheduled for fall 2009.

HMI Observables

- Convection zone dynamics and the solar dynamic:
- Origin and evolution of sunspots, active regions and complexes of activity;
- Sources and drivers of solar activity and disturbances;
- Links between the internal processes and dynamics of the corona & heliosphere;
- Properties of solar disturbances for space weather forecasts.

These goals address long-standing problems that can be studied by a number of immediate tasks. The description of these tasks reflects our current level of understanding and will evolve during the course of the investigation.

HMI Recent Progress & Current HMI Activities

- The HMI instrument is complete, integrated onto SDO, tested, ready for launch.
- The first light will be after 30 days, followed by 30-60 days of science commissioning.
- Normal continual science observations will begin 60-90 days after launch.
- Launch is likely before the end of 2010.
- There will be about 6 months of overlap with SOHO/MDI for cross-calibrations.
- All HMI data will be available within a day or so after observation.
- Access to HMI data will be via the HMI/AIA JSOC (see box on far right).

HMI Implementation

The HMI instrument design and observing strategy are based on the highly successful MDI instrument, with several important improvements. HMI will observe the full solar disk in the Fx absorption line at 617.3 nm with a resolution of 1 arc-second. HMI consists of a reflecting telescope, a polarization see-through, an image stabilization system, a narrow band filter, a Lyot filter with one tunable channel, and two tunable polarization-interferometers, each having a tuning range of 600 mA and a 3-hour interferogram profile of 24 MArk.

Images are made in a sequence of tuning and polarizations at a 4-second cadence for each camera. One camera is dedicated to a 5-diopter and has six slit field sequences within the other to a 3x3 vector field sequences. All of the images are downlinked for processing at the HMI/AIA Joint Science Operations Center at Stanford University.

HMI/AIA JSOC (Joint Science & Operations Center)

- Data capture from SDO ground system
- Archive of telemetry and processed data
- Distribution to team and exports to all users
- HMI and AIA processing to “level-1”
- Level-2 and higher level science data products

http://jsoc.stanford.edu

HMI Sun-Track Data Products

- First Dopplergrams
- First Magnetograms

1. A Sound speed variations relative to a standard solar model.
1. D Sunspots and plage contribute to solar irradiance variation.
1. E MHD model of the magnetic structure of the corona.
1. F Dynamic map of the subsurface flows at a depth of 7 Mm.
1. G EIT and magnetic field lines computed from the photospheric field.
1. H. A close regions on the far side of the sun-detected with helioseismology.
1. I Vector field image showing the magnetic connectivity in sunspots.
1. J Sound speed variations and flows in an emerging active region.