Understanding Solar Eruptions with *SDO*/HMI

Measuring Photospheric Flows, Testing Models, and Steps Towards Forecasting Solar Eruptions

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ABSTRACT

The imminent launch of *Solar Dynamics Observatory* (*SDO*) will carry the first full-disk imaging vector magnetograph, the Helioseismic and Magnetic Imager (HMI), into an inclined geosynchronous orbit. This magnetograph will provide nearly continuous measurements of photospheric vector magnetic fields at cadences of 90 seconds to 12 minutes with 1" resolution, precise pointing, and unfettered by atmospheric seeing. The enormous data stream of $\approx$1.5 Terabytes per day from *SDO* will provide an unprecedented opportunity to understand the mysteries of solar eruptions.

These ground-breaking observations will permit the application of a new technique, the differential affine velocity estimator for vector magnetograms (DAVE4VM), to measure photospheric plasma flows in active regions. These measurements will permit, for the first time, accurate assessments of the coronal free energy available for driving CMEs and flares. The details of photospheric plasma flows, particularly along magnetic neutral-lines, are critical to testing models for initiating coronal mass ejections (CMEs) and flares. Assimilating flows and fields into state-of-the art 3D MHD simulations that model the highly stratified solar atmosphere from the convection zone to the corona represents the next step towards achieving NASA's Living with a Star forecasting goals of predicting "when a solar eruption leading to a CME will occur." This talk will describe these major science and predictive advances that will be delivered by *SDO*/HMI.

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