Space Science Seminar
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Non-linear Force-Free Modeling of the Coronal Magnetic Field in Spherical Geometry

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The three-dimensional structure of magnetic fields and electric currents in the pre-eruptive coronal volume are requirements for studying solar eruptive events, like flares and coronal mass ejections (CMEs). In order to estimate the free-magnetic energy above the active regions in the corona volume, which powers geo-effective activity, one needs information on the magnetic flux density vector components in three dimensions throughout the solar atmosphere. To understand the role that the magnetic field plays in energizing the solar corona, it is important to calculate the amount of free energy needed to quantify the energy budget in a catastrophic energy release event, as well as for estimating upper limits in forecasting individual events in real-time. Unfortunately, measurements of the magnetic field are restricted to lower layers of the solar atmosphere because of the extremely low density and high temperature of the corona. As an alternative to direct measurements of the 3-D coronal magnetic field, numerical modeling is used to infer the field strength in the higher layers of the solar atmosphere from the measured photospheric magnetic field. Nonlinear force-free field (NLFFF) models are thought to be viable tools for this task. Usually those models use Cartesian geometry. However, the spherical nature of the solar surface cannot be neglected when the field of view is large. In this presentation, I will introduce a Spherical-Optimization procedure that can model the coronal magnetic field above multiple active regions using magnetograph data from HMI/SDO and other ground-based telescopes as boundary conditions.

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