Project Details

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Project Title:
A VIRTUAL SOLAR LABORATORY: AN INTEGRATED MODEL TO STUDY THE MAGNETIC ACTIVITY OF THE SUN

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Summary:
We propose a 3-year project to develop a numerical laboratory for solar activity. This will enable the first comprehensive simulation of all photospheric magnetic field that is involved in outer-atmospheric heating and in spectral irradiance changes. Coronal-field extrapolation and model loop atmospheres will be integrated into the code. We will also add field-line rendering and loop-visualization modules. The system will enable quantitative analyses of the entire non-linear and non-local system through comparisons to solar and stellar data to test our model for the full range of magnetic activity. We have three primary research goals. First, to simulate the solar field throughout the history of the Sun; this is used as input to explore the evolution of, e.g., solar spectral irradiance, global dipole field, and activity subject to magnetic braking. Second, to identify the most likely candidate(s) for coronal heating of the quiescent corona, by comparing observations to visualizations of model coronae based on different heating mechanisms. Third, to simulate the spectral irradiance throughout solar history; this is used to validate our results using solar and stellar data and as input to other LWS research topics. The team has extensive expertise in photospheric and coronal studies, in the solar-stellar connection, and in the physics of the upper Earth atmosphere. The segments of the code exist (each already having yielded interesting results), but need to be extended, optimized, and interfaced for efficient, comprehensive simulations. The code will allow coupling to SolarSoft IDL, and with C routines for speed; it will be documented and made available on the web for use by other LWS projects and by stellar physicists. We will actively coordinate with other LWS projects to catalyze our understanding. Simulated images and explanations of the results will be made available on the web (also in Spanish), and published in popular science journals.

Publication References:

no references