

Reconstruction of Nonlinear Force-Free Fields and Solar Flare Prediction

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A review is presented of methods of calculating nonlinear force-free fields, with emphasis on the optimization and current-field iteration approaches. The prospects for applying the methods to observationally-inferred photospheric and chromospheric vector magnetic field boundary data, including data from a new generation of spectro-polarimetric instruments, are discussed. There are difficulties associated with the substantial uncertainties in the inferred magnetic field values, and with the departure of the field from a force-free state at the level of measurements. Approaches to estimating the magnetic energy of solar active regions described. A new approach to energy estimation, based on a form of the MHD virial theorem taking into account non-zero Lorentz forces, isoutlined. Methods of solar flare prediction are also briefly reviewed, with focus on the need to reproduce observed solar flare statistics.