Project Details

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Project Title:
Quantitative Connections Between Photospheric Magnetic Field and Global Coronal

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Summary:
The quantitative relationships essential for connecting the EUV and X-ray radiative output from the outer solar atmosphere with the underlying photospheric magnetic field remain poorly defined, even though the pivotal role of the Sun s magnetic field in controlling the brightness of the corona is qualitatively well established. Various scaling laws have been reported from both observation and theory for individual loops and some active region ensembles. It is unclear which, if any, of these is universally applicable to the Sun-as-a-star, and hence for irradiance. This lack of knowledge impedes the ability to model LWS-relevant coronal irradiance variations arising from the photospheric magnetic field. The overall goal of the proposed work is the quantitative connection of the photospheric magnetic field with the global and distributed coronal EUV and soft X-ray brightness. Scaling laws that relate the brightness in closed coronal loop structures with the photospheric footpoint magnetic field strength, B, and the loop length, L, "on average" will be determined by comparing simulations and EIT observations. The spatial distribution and disk-integrated coronal brightness (i.e., radiance and irradiance) will be simulated by extrapolation to two solar radii of the magnetic field in synoptic maps. This extrapolation traces loops of closed magnetic field that connect opposite polarity regions and open fields that extend into the helisophere. The densities, and hence brightness, of the plasma confined within the loops are then estimated by scaling the magnetic footpoint field strength and loop length. Integration of the three-dimensional density distribution along the line of sight to the Earth simulates the coronal brightness distribution across the face of the solar disk visible at the earth and the disk-integrated coronal brightness simulates irradiance. Coronal brightness distributions will be simulated daily from 1996 to the present using a suite of scaling laws of the form of exponents of B and L. Statistical comparisons (correlation, peridogram and complex demodulation analyses) of the corona constructed in this way with the independently observed EIT images permits a robust assessment of the adopted scaling laws that relate the photosphere and corona via magnetic fields in an average sense. A particular focus will be the temperature-dependence of the scaling laws and of density along the loop, made possible by the existence of EIT images at different coronal temperatures.

Publication References:

no references