Modeling of the Coronal Magnetic Field and Plasma Heating: New frontiers in the SDO epoch

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Data provided by AIA and HMI instruments onboard the Solar Dynamics Observatory can be used for the comprehensive modeling and assessment of important properties of the solar corona above active regions to provide insight into how magnetic energy is stored and released to produce both flares and quiescent emissions.

In our field modeling, coronal loops observed by AIA in the extreme ultraviolet are used combined with HMI magnetograms to shape the non-potential magnetic field. The resulting model field is demonstrated to reproduce key features of the field of the specific active region modeled, such as the shape of the field bundles, the presence of twisted field in the region's core, and the free magnetic energy that suffices to power the explosive event observed in this region around the time of the modeling effort.

We proceed to test concepts for coronal heating by modeling the emission over the active region and comparing these to observations made in AIA's coronal channels. We use the non-potential model field as foundation for the emission modeling. We avoid simplifications that have had to be made in earlier work, and discuss how such simplifications influence the appearance of the model corona. In our search for the parameters ruling the coronal heating mechanisms, we make no prior assumptions about the shapes of flux tubes, their expansion, the field strength along them, or the shape of their cross-section, but take these from the model magnetic field. We discuss which of the existing heating models best fit the observations.