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Coronal heating and dynamics in a 3D magneto-hydrodynamic model

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Observations of the solar corona show a highly dynamic plasma at around one million degree and hotter. Its dynamics is driven by the motions in the solar photosphere which shuffle around the magnetic features, e.g. active regions and bright points. These mechanism leads to free magnetic energy in the upper atmosphere in the form of currents which will be then used to heat the plasma by their dissipation. We try to understand in detail temporal and spatial distribution of the dissipated heat and show results of 3D magneto hydrodynamic simulations of the solar corona. These numerical experiments cover a wide range of densities and temperatures over several orders of magnitude, including the solar atmosphere from the photosphere to the corona.

They show a highly intermittent heating of the plasma and result in flows on small and large scales producing e.g. the observed persistent redshifts of transition region emission lines. These time-dependent simulations validate the long-known scaling laws originally derived from simplistic model considerations, though in slightly modified form.