M11b A unified model of solar prominence formation

Huang,C.J.(Kyoto University)et al.

Solar filaments are cool and dense plasma suspended in the hot and tenuous corona above the photospheric magnetic neutral lines. They appear dark against the solar disk, but look bright above the solar limb, where they are called solar prominences. Several mechanisms have been proposed to account for the formation of solar prominences or filaments, among which direct injection and evaporation–condensation models are the two most popular ones. In the direct injection model, cold plasma is ejected from the chromosphere into the corona along magnetic field lines; in the evaporation–condensation model, the cold chromospheric plasma is heated to over a million degrees and is evaporated into the corona, where the accumulated plasma finally reaches thermal instability or non-equilibrium so as to condensate to cold prominences. In this work, we try to unify the two mechanisms: The essence of filament formation is the localized heating in the chromosphere. If the heating happens in the lower chromosphere, the enhanced gas pressure pushes the cold plasma in the upper chromosphere to move up to the corona, such a process is manifested as the direct injection model. If the heating happens in the upper chromosphere, the local plasma is heated to 1–2 million degrees, and is evaporated into the corona. Later, the plasma condensates to form a prominence. Such a process is manifested as the evaporation–condensation model. With 1D radiative hydrodynamic simulations we confirmed that the two widely accepted formation mechanisms of solar prominences can really be unified in such a single framework. A particular case is also found where both injection and evaporation–condensation processes occur together