MHD simulations on solar prominence oscillation and eruption by evaporation—condensation mechanism

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The evaporation-condensation model plays a crucial role in elucidating the formation of solar prominences by addressing plasma circulation between the solar chromosphere and corona. This model is based on the occurrence of localized heating at the footpoint of the prominence, which leads to evaporation and subsequent mass supplementation of the prominence, as well as the triggering of thermal instability.

In our recent research, we have made a significant finding that localized heating can induce substantial stretching of local magnetic field lines, thereby propelling the prominence upward. Utilizing our simulation code, MPI-AMRVAC, we have successfully demonstrated that cyclic evaporation-condensation, accompanied by magnetic stretching, can reproduce the behavior of a winking filament. This phenomenon entails periodic appearances and disappearances of prominences in H-alpha line wing images, and the simulation results align well with observations, as verified through forward modeling in spectral analysis.

In a separate simulation, employing continuous heating rather than periodic heating, the prominence initiates an ascent and subsequently undergoes eruption. Distinct from previous eruption mechanisms that primarily emphasize magnetic field instability, the presented simulation focuses more on the plasma dynamics. These simulations significantly contribute to our enhanced comprehension of plasma dynamics in the solar corona

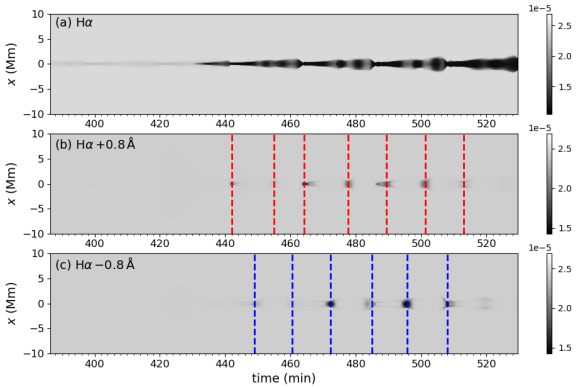

Figure 1. Simulation showing the winking of the filament.

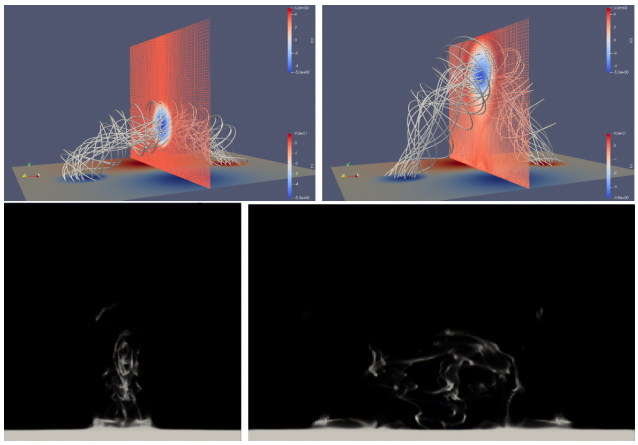

Figure 2. Simulation showing the eruption of the filament.