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# MHD simulations on the origin and dynamics of solar prominence plasma

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Solar prominences are one of the most common activities in solar corona. The formation of magnetic and plasma structures of prominences is far from fully understood. Observations and theoretical studies suggest that typical prominences are hosted in helical magnetic flux ropes. With the aid of multidimensional magnetohydrodynamic (MHD) simulations, we provide numerical models to explain the formation of flux ropes driven by photospheric motion and magnetic reconnection at footpoints of sheared magnetic loops. The physical mechanism responsible for prominence plasma formation is believed to be thermal instability, which may be triggered by thermal nonequilibrium process with strong heating and chromospheric evaporation near footpoints of magnetic loops or by compression resulted from topological change of magnetic field via coronal reconnection. Both scenarios are presented by multidimensional MHD simulations. The observed ubiquitous dense downflows and light upflows in quiescent prominences are difficult to interpret as plasma with high conductivity seems to move across horizontal magnetic field lines. Multidimensional MHD simulations on a local portion of prominence with parallel field lines, suggest magnetic Rayleigh--Taylor instability is responsible for the phenomenon. Our full prominence model, as a result of in-situ plasma condensations in a magnetic flux rope driven by continuous plasma evaporation from chromosphere, reproduced a fragmented, highly dynamic state with continuous reappearance of multiple blobs and thread structures that move mainly downward dragging along mass-loaded field lines, which may explain the dense downflows of quiescent prominences. With steady footpoint heating, the modelled prominence established dynamic balance between the drainage of prominence plasma back to the chromosphere and the formation of prominence plasma via continuous condensation.

References

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