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Plasmoid-Fed Prominence Formation

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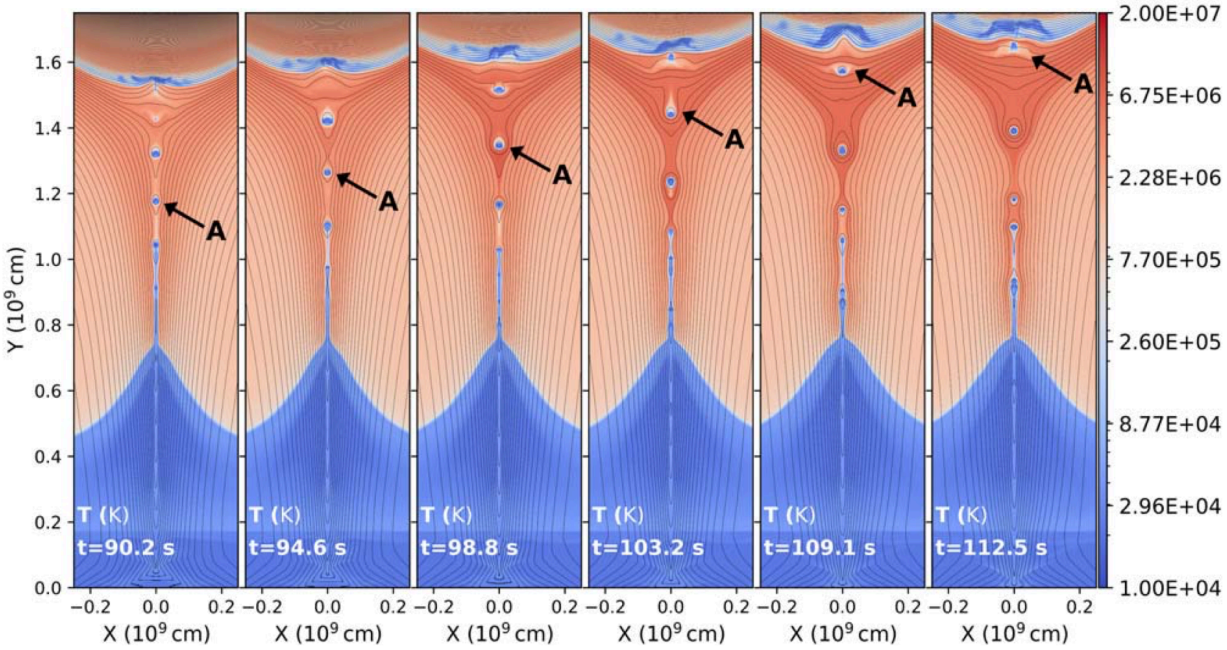
We report a new, plasmoid-fed scenario [1] for the formation of an eruptive prominence, involving reconnection and condensation. We use grid-adaptive resistive two-and-a-half-dimensional magnetohydrodynamic simulations using the open-source MPI-AMRVAC code (http://amrvac.org) [2] in a chromosphere-to-corona setup to resolve this plasmoid-fed scenario. We study a pre-existing flux rope in the low corona that suddenly erupts due to catastrophe, which also drives a fast shock above the erupting fluxrope. A current sheet forms underneath the erupting fluxrope, with chromospheric matter squeezed into it. The plasmoid instability occurs and multiple magnetic islands appear in the current sheet once the Lundquist number reaches a critical value. The remnant chromospheric matter in the current sheet is then transferred to the fluxrope by these newly formed magnetic islands. The dense and cool mass transported by the islands accumulates in the bottom of the fluxrope, thereby forming a prominence during the eruption phase. More coronal plasma continuously condenses into the prominence due to the thermal instability as the fluxrope rises. Due to the fine structure brought in by the plasmoid-fed process, the model naturally forms filament threads, aligned above the polarity inversion line. Synthetic views at our resolution of 15 km show many details that may be verified in future high-resolution observations. A view on the plasmoid-fed prominence formation process is provided in the figure.



A zoomed view on the current sheet below an erupting fluxrope (due to catastrophe): chromospheric matter gets squeezed in the sheet, plasmoid formation sets in, and cold, dense matter trapped in the islands moves up to seed a prominence formed during eruption.

References
[1] `Plasmoid-fed prominence formation (PF^2) during flux rope eruption', X. Zhao & R. Keppens, 2022, ApJ **928**, 45 (11pp), doi:10.3847/1538-4357/ac54a4
[2] `MPI-AMRVAC: a parallel, grid-adaptive PDE toolkit', R. Keppens, J. Teunissen, C. Xia & O. Porth, 2021, Computers & Mathematics With Applications **81**, 316-333, doi:10.1016/j.camwa.2020.03.023