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A comparative study of coronal microjet numerical modelling under the influence of p-modes

A. Ramada C. Sukarmadji[1,2], Victor Reville[1], Bahaeddine Gannouni[1], Alexis Rouillard[1], Chuanpeng Hou[3], Jean Kempf[1]
[1] Institut de Recherche en Astrophysique et Planétologie, France,
[2] Northumbria University, UK,
[3] School of Earth and Space Sciences, Peking University, China
e-mail (speaker): asukarmadji@irap.omp.eu

Magnetic inversions known as switchbacks and velocity spikes have been ubiquitously observed in observations of the solar wind from the Parker Solar Probe and Solar Orbiter [1, 2]. Previous studies have suggested that they are formed due to interchange reconnection in the solar corona, such as in jetlets originating from small bipoles at the base of coronal plumes. The observed velocity spikes from remote sensing instruments have also been found to have periodicities on the order of minutes, but the underlying mechanism that produces these periodicities remains unclear. P-modes have been commonly observed in the solar corona with similar periodicities on the order of minutes, which raises the question of whether they play a role in influencing the periodicities of the observed velocity spikes.

In this study, we present 2.5D MHD numerical modelling results using the IDEFIX code [3] of a magnetic bipole emergence leading to microjets and investigate the effects of a p-mode-like driver at one of the bipoles, following ref [4]. P-modes have been commonly observed in the solar corona with similar periodicities on the order of minutes, which raises the question of whether they play a role in influencing the periodicities of the observed velocity spikes. The emergence leads to a spine-fan structure with outflows from the base of the jet. We show the results comparing the emergence dynamics and resulting velocity spikes from reconnection at the base of the jet with and without the p-mode driver.

The emergence-only model produces numerous plasmoids and velocity spikes from the reconnection events, whereas the model with the p-mode driver also produces similar results but with periodic velocity spikes on the order of 5 minutes, which is the period of the p-modes themselves and similar to the in-situ observations. In both cases, the reconnection occurs repeatedly during the quasi-steady state. We will further discuss how our results may be linked to the periodic velocity spikes observed with the in-situ data.

References

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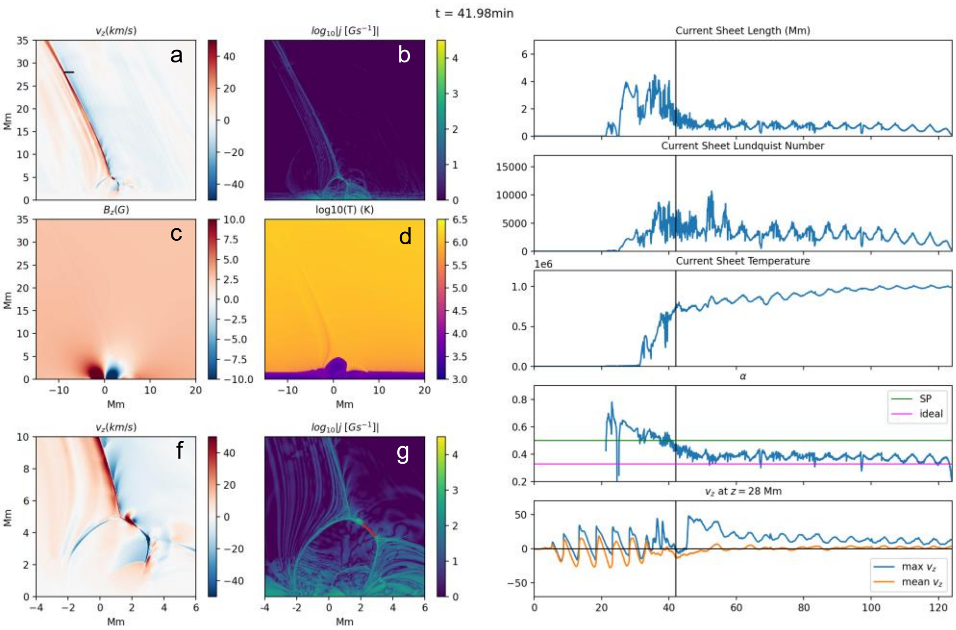

Figure 1. The model with the p-mode-like driver. Panels a, b, c, and d show the vertical velocity, current density, vertical magnetic field, and temperature, respectively, of the domain during the emergence phase, when the jets are formed. Panels f and g show a zoomed-in portion of panels a and b, where a current sheet is marked in red for panel g. The left column (top to bottom) shows the longest current sheet identified, its Lundquist number, temperature, the power-law index, and vertical velocities (maximum and mean, its position marked in panel a with a black line) at z=28 Mm.