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The nature and dynamics of the forest of solar plasma jets

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Millions of solar plasma jets - known as spicules- occupy the atmosphere above the visible solar surface at any given time. These jets sway and spin apart of rising and falling due to ballistic processes. Spicules hold significant promise in transferring energy and momentum to the solar wind. In our recent work[1], we highlight the parallelism between solar spicules from our radiative MHD simulations and numerous jets of polymeric fluid formed by Faraday excitation in the laboratory. We also find that increasing the strength of coronal magnetic field affects the properties of spicules, namely their heights and deceleration [2]. We review our results in the context of the past efforts from the community in terms of similarities and otherwise. By analysing our 3D MHD simulation data sampled at a cadence of 2s, we demonstrate that these jets may not be 1D needle like structure hitherto believed, but rather, thin pleated curtains that rise and fall with the same time scale of 5-10 mins corresponding to lifetime of observed spicules [3]. Furthermore, we find numerous vortex tubes embedded in and around the plasma curtain that interact and exchange energy with the curtain and cause them to spin. A line-of-sight integration of emission from these structures match very well with the observations of spinning solar spicules at the solar limb using Hinode and IRIS data. Finally, we propose an observation technique to verify the pleated curtain prediction.

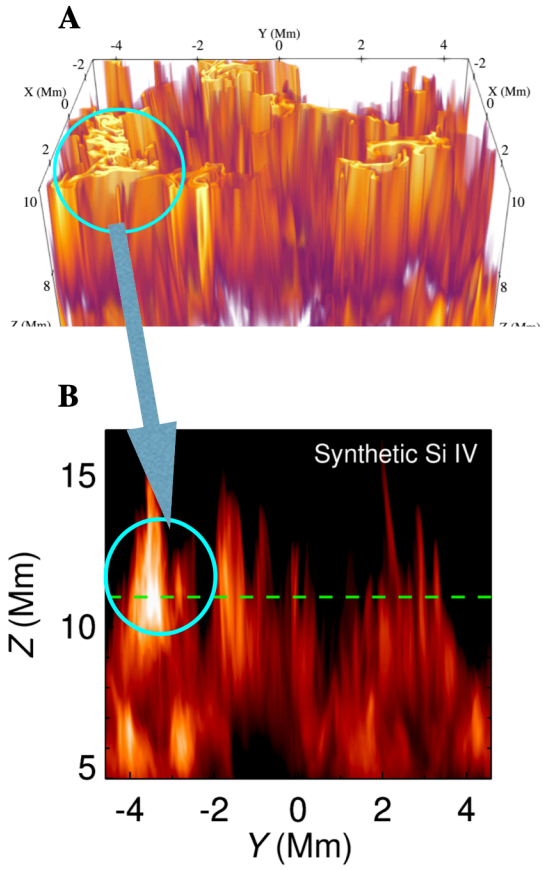

Figure 1: (A) Volume rendering of the Si IV emission resembling a pleated curtain like morphology. (B) When integrated along the line-of-sight (x-axis), we observe spicule like structures. The regions where the curtain is gathered emits more due to more plasma.

References
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[2] Kesri et al. 2024, ApJ (in press), arXiv:2404.10720
[3] Dey, S., Chatterjee, P. & Erdélyi, R., 2024 (under review), arXiv:2404.16096