6th Asia-Pacific Conference on Plasma Physics, 9-14 Oct, 2022, Remote e-conference

Current-sheet Oscillations Caused by the Kelvin–Helmholtz Instability at the Loop Top of Solar Flares

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Current sheets (CSs), long stretching structures of magnetic reconnection above solar flare loops, are usually observed to oscillate; their origins, however, are still puzzled at present. Based on a high-resolution 2.5D MHD simulation of magnetic reconnection, we explore the formation mechanism of CS oscillations. We find that large- amplitude transverse waves are excited by the Kelvin–Helmholtz instability at the highly turbulent cusp-shaped region. The perturbations propagate upward along the CS with a phase speed close to local Alfvén speed thus resulting in the CS oscillations we observe. Though the perturbations damp after propagating for a long distance, the CS oscillations are still detectable. In terms of detected CS oscillations, with a combination of differential emission measure techniques, we propose a new method for measuring the magnetic field strength of the CS and its distribution in height.

Figure 1: The initialization of CS oscillations by the Kelvin-Helmholtz instability.

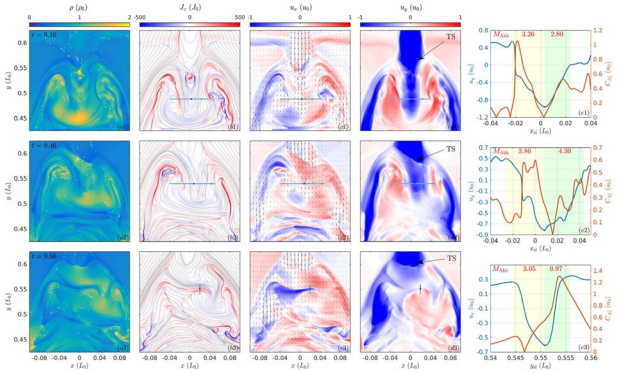
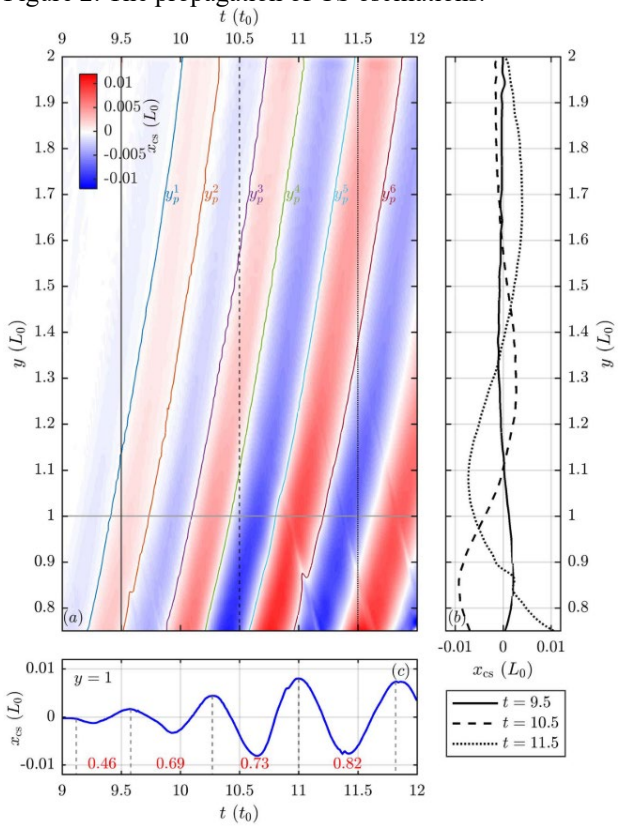


Figure 2: The propagation of CS oscillations.



References

1. Y. Wang, X. Cheng, M. Ding, and Q. Lu, Annihilation of Magnetic Islands at the Top of Solar Flare Loops, Astrophys. J. 923, 227 (2021).
2. Y. Wang, X. Cheng, Z. Ren, and M. Ding, Current-Sheet Oscillations Caused by the Kelvin–Helmholtz Instability at the Loop Top of Solar Flares, Astrophys. J. Lett. 931, L32 (2022).