3D MHD simulation of interchange reconnection in a solar coronal pseudo-streamer

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Résumé

The generation of the slow solar wind is still an open problem of heliophysics. One of the existing theories to explain the observed properties of the slow wind is based on the "interchange reconnection": plasma elements, confined low in the solar atmosphere in closed magnetic field (both fieldline footpoints rooted on the photosphere), are dynamically released into open field (one fieldline end extending toward the interplanetary medium) thanks to magnetic reconnections between open and closed magnetic fields. However, the dynamics of the open-closed magnetic boundary remains ill-understood.

My objective is to study a specific coronal magnetic topological structure, pseudo-streamer, that can generate slow solar winds. I have performed 3D magnetohydrodynamics (MHD) numerical simulations of the solar corona and inner heliosphere using a MHD code with adaptive mesh refinement to model the dynamics of the open-closed coronal magnetic field around a pseudo-streamer. I have highlighted the existence of a complex dynamic at the pseudo-streamer boundary, with distinct scenarios for opening the magnetic field initially closed in the pseudo-streamer structure, from the classical, one-step interchange reconnection to an alternance of opening and closing reconnections near the frontier of the connectivity domains.

This work provides a look at the precise dynamics that opens magnetic field for injecting some coronal plasma in the interplanetary medium. Further studies would provide observables for this outcoming flow, that can be measured by Solar Orbiter and Parker Solar Probe.

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