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Parametric simulations of the propagation of solar jets: investigating the solar origin of switchbacks

The recent discovery of ubiquitous switchbacks, localized magnetic deflections in the nascent solar wind, by the Parker Solar Probe (PSP) has sparked interest in uncovering their origins. A prominent theory suggests these switchbacks originate in the lower corona through magnetic reconnection processes, closely linked to solar jet phenomena. Jets are impulsive phenomena, observed at various scales in different solar atmosphere layers, associated with the release of magnetic twist and helicity. This leads to the question of whether these helical structures can travel into the inner heliosphere and if there is a direct correlation between specific solar jets and the switchback signatures observed by PSP.
To explore this hypothesis, I present parametric simulations using a 3D numerical magnetohydrodynamic (MHD) model of solar-jet-like events. Within the MHD framework, I examine how varying atmospheric plasma beta affects the propagation dynamics of these jets. Employing the ARMS (Adaptively Refined Magnetohydrodynamics Solver) code, I modeled the self-consistent generation of a solar jet based on Pariat et al. (2009).
Producing in-situ velocity and magnetic field measurements, akin to those observed by PSP or SolO, I demonstrated that the magnetic wavefront corresponds to an Alfvénic deflection consistent with switchbacks observations. U-loops, prevalent at jet onset, do not persist in the low-beta corona, hindering the formation of full-reversal switchbacks. This may explain the absence of full reversal switchbacks in the sub-Alfvénic wind. Overall, these simulations unveiled the propagation of magnetic deflections through jet-like events, shedding light on possible switchback formation processes.

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