Exploring nonlinear plasma dynamics including switchbacks with Parker Solar Probe observations of the young solar wind

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The solar wind is an exciting natural laboratory where nonlinear astrophysical and space plasma processes can be probed *in situ* large-amplitude waves and turbulence [1, 2]. The solar wind plasma is highly turbulent and intermittent, with a variety of structures (e.g., the heliospheric current sheet, high-speed streams, and solar storms that include magnetic flux ropes and generate shocks) and variability with solar latitude/longitude and with time. Launched in 2018, the Parker Solar Probe (PSP) is mankind's first spacecraft to approach within 0.2 au of our local star, allowing us to examine the solar wind closer to its source. Following a general trend, large-amplitude Alfvén-mode fluctuations are found to be more prevalent closer to the Sun [3]. While domains of Alfvénic fluctuations have a nearly uniform magnetic field magnitude $|B|$, the fluctuations in the field vector **B** can be so strong that the magnetic polarity temporarily reverses, a structure known as a switchback that represents an S-shaped bend in magnetic field lines. After a general introduction to the solar wind and Alfvénic fluctuations, we will summarize PSP observations of switchbacks [4-7], proposed explanations of their origin [8-13], our study of Alfvénic domains in PSP data, and our predictions for future observations when PSP perihelia approach even closer to the Sun [10]. Partially supported by grant RTA6280002 from Thailand Science Research and Innovation.

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