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A solar source of Alfvenic magnetic field switchbacks: pressure-balanced remnants of transition region structure on supergranulation scales

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One of the striking observations from the NASA Parker Solar Probe (PSP) spacecraft is the prevalence in the inner heliosphere of large amplitude, Alfvenic magnetic field reversals termed 'switchbacks'. These $\delta B_R/B \sim \mathcal{O}(1)$ fluctuations occur on a range of timescales, are spherically polarized, and occur in "patches" separated by intervals of more quiet, radial solar wind magnetic field. Neither the source region, generation mechanism, nor the role in solar wind evolution are well-understood, with some models suggesting a fundamental role in solar wind heating and energization. We use measurements from the FIELDS and SWEAP instrument suites on PSP to demonstrate that patches of magnetic field switchbacks are localized within stable solar wind extensions of structures originating at the base of the corona. These structures are characterized by an increase in alpha particle abundance, Mach number, plasma β and pressure and by depletions in the magnetic field magnitude and electron core and strahl temperature. These intervals are in local pressure-balance, which implies stationary spatial structure, and the central magnetic field depressions are consistent with overexpanded flux tubes. The structures are asymmetric in longitude with the leading edge being steeper and with a small ($\sim 1^\circ$) edge of hotter plasma and enhanced magnetic field fluctuations. The structures are separated in Carrington longitude by angular scales associated with supergranulation and chromospheric network magnetic field. This implies both an origin of the streams and suggests that these switchbacks originate within and near the leading edge of the diverging magnetic field funnels associated with the photospheric network magnetic field.

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