The Near-Sun Streamer Belt Solar Wind: Turbulence and Solar Wind Acceleration

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The fourth orbit of Parker Solar Probe (PSP) reached heliocentric distances down to 27.9 Rs, allowing solar wind turbulence and acceleration mechanisms to be studied in situ closer to the Sun than previously possible. The turbulence properties were found to be significantly different in the inbound and outbound portions of PSP’s fourth solar encounter, likely due to the proximity to the heliospheric current sheet (HCS) in the outbound period. Near the HCS, in the streamer belt wind, the turbulence was found to have lower amplitudes, higher magnetic compressibility, a steeper magnetic field spectrum (with spectral index close to -5/3 rather than -3/2), a lower Alfvénicity, and a "1/f" break at much lower frequencies. These are also features of slow wind at 1 au, suggesting the near-Sun streamer belt wind to be the prototypical slow solar wind. The transition in properties occurs at a predicted angular distance of ~4 degrees from the HCS, suggesting ~8 degrees as the full-width of the streamer belt wind at these distances. While the majority of the Alfvénic turbulence energy fluxes measured by PSP are consistent with those required for reflection-driven turbulence models of solar wind acceleration, the fluxes in the streamer belt are significantly lower than the model predictions, suggesting that additional mechanisms are necessary to explain the acceleration of the streamer belt solar wind.