OBSERVATION OF A COMPLEX SOLAR WIND RECONNECTION EXHAUST FROM SPACECRAFT SEPARATED BY OVER 1800 R_E

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We analyze WIND, ACE and STEREO plasma and magnetic field data in the vicinity of the heliospheric current sheet (HCS) crossed by all spacecraft between 22:15 UT on March 31 and 01:25 UT on April 1, 2007; corresponding to its observation at ST-A and ST-B which were separated by over 1800 R_E (or over 1200 R_E across the Sun-Earth line). Although only WIND and ACE provided good ion flow data in accord with a solar wind magnetic reconnection exhaust at the HCS, the magnetic field bifurcation typical of such exhausts was clearly observed at all spacecraft. They also all observed unambiguous strahl mixing within the exhaust, consistent with the sunward flow deflection observed at WIND and ACE and thus with the formation of closed magnetic field lines within the exhaust with both ends attached to the Sun. The strong dawnward flow deflection in the exhaust is consistent with the exhaust and X-line orientations obtained from minimum variance analysis at each spacecraft so that the X-line is almost along the GSE Z-axis and duskward of all the spacecraft. The observation of strahl mixing in extended and intermittent layers outside the exhaust by STEREO A and B is consistent with the formation of electron separatrix layers surrounding the exhaust. This event also provides further evidence that balanced parallel and anti-parallel suprathermal electron fluxes are not a necessary condition for identification of closed field lines in the solar wind. In the present case the origin of the imbalance simply is the mixing of strahls of substantially different strengths from a different solar source each side of the HCS. The inferred exhaust orientations and distances of each spacecraft relative to the X-line show that the exhaust was likely non-planar, following the Parker spiral orientation. Finally, the separatrix layers and exhausts properties at each spacecraft suggest that the magnetic reconnection X-line location and/or reconnection rate were variable in both space and time at such large scales.

Heliospheric current sheet, magnetic reconnection, counter-streaming suprathermal electrons

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