Turbulent magnetic reconnection in the solar wind

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In the process of magnetic reconnection, magnetic field lines on both sides of the current sheet move inward to form an X-line magnetic topology. In the terrestrial magnetosphere, reconnection is generally bursty with many magnetic flux ropes, and magnetic energy is rapidly released in the vicinity of the X-line region and the resulting bursty flows affect large volumes. In contrast, previous observations show that the reconnection is quasi-steady-state in the solar wind and the energy is primarily dissipated via slow-mode shocks bounding the exhausts, i.e., the Petschek-like reconnection. The reason for such difference is elusive. Here, we present direct measurement of bursty and turbulent reconnection in the solar wind and a preceding crossing of exhausts bounded by a pair of slow-mode shocks near the switch-off limit. The X-line region is filled with filamentary currents and magnetic flux ropes which are rapidly evolving and closely interacting as they are being ejected away. The plasma is more efficiently heated in the diffusion region than across the shocks and the bulk flow enhancement is primarily accomplished in the exhausts rather than the diffusion region. A statistical analysis shows that the bursty reconnection can be intrinsic in the solar wind and largely contributes to the solar wind acceleration and heating.

References

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