Downstream jets at interplanetary shocks: first observations and comparison with the magnetosheath

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Localised dynamic pressure enhancements—jets—are regularly observed downstream of the Earth's bow shock. They drive enhanced particle acceleration, larger amplitude magnetic field variations and reconnecting current sheets. Various shock simulations have also exhibited jets, suggesting that they are not unique to the bow shock.

Here, we report the first observations of jet-like structures downstream of interplanetary shocks. We introduce an analysis approach suitable for such conditions and apply it to Wind spacecraft data using tools developed in the EU-project SERPENTINE. We first demonstrate the methods on a particularly high Mach number interplanetary shock that has properties comparable to the Earth's bow shock. To further our understanding, we also investigate two low beta, low Mach number interplanetary shocks, i.e., conditions that are rare for the bow shock.

The jet-like structures we find are tens of ion inertial lengths in size, and some are observed further away from the shock than in a limited magnetosheath. We find that their properties are similar to those of magnetosheath jets: in the frame of the shock these structures are fast, cold, and most have no strong magnetic field variations. All three interplanetary shocks feature foreshock activity, but no strongly compressive waves. We discuss the implications these findings have for the proposed jet formation mechanisms. The prospects of observing downstream jets in further detail with future missions look promising.