Quasi-perpendicular shocks non stationarity and micro-turbulence

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Abstract

A very important issue of a high Mach number quasi-perpendicular shock is its nonstationary character and several mechanisms issued from simulation and theoretical studies have been proposed to account for it. For instance, one process –the so-called self-reformation - driven by the accumulation of reflected ions at a foot distance from the ramp has been intensively analyzed with simulations. Recent results based on CLUSTER data have clearly evidenced signatures of this self-reformation process for the terrestrial bow shock. One key signature of this self-reformation is that the ramp width is variable in time and can reach a very narrow value covering a few electron inertial lengths only, that is a dispersive whistler scale. A statistical analysis of the shock sub-structures has also shown the signatures of this nonstationarity versus different plasma conditions and shock regimes. While less prominent than for low beta subcritical shocks, whistler waves precursor associated to dispersion at the shock front can also be present in supercritical regime. The properties of such whistler wave packets observed both upstream of the front or in the overshoot of supercritical quasi-perpendicular shocks are presented from a multi-spacecraft analysis. Recent simulation work has shown that large amplitude coherent whistler waves can be emitted in the foot region and dominate the whole shock front dynamics. Some theoretical works also relate nonlinear whistler dynamics with the shock front nonstationarity.

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