High-speed Downstream Plasma Jet Generated due to Shock Reformation

S. Raptis[1], T. Karlsson[1], A. Vaivads[1], C. Pollock[2], F. Plaschke[3], A. Johlander[4], H. Trollvik[1], P-A. Lindqvist[1]

[1]*Space and Plasma Physics, School of Electrical Engineering and Computer Science, KTH Royal Institute of Technology, Sweden*
[2]*Denali Scientific, Fairbanks, AK, 99709, USA*
[3]*Institute of Geophysics and Extraterrestrial Physics, Technische Universität Braunschweig, Germany*
[4]*Swedish institute of Space Physics, Uppsala, Sweden*

Abstract

Magnetosheath jets are transient localized dynamic pressure enhancements found behind Earth's bow shock. They have been associated to a variety of phenomena and effects, including, magnetopause reconnection, excitation of ULF waves and direct plasma penetration in the magnetosphere. While the have been observed for several decades, their origin is not yet fully understood.

In this work, we use Magnetosphere Mutliscale (MMS) measurement to show the generation of a high-speed downstream jet resulting from the shock reformation process. The jet appears to be associated to the evolution of the upstream waves found upstream of a Short Large Amplitude Magnetic Structure (SLAMS). As the initial SLAMS eventually continues to form the magnetosheath region, a newly formed foreshock magnetic structure appears, acting as the local bow shock front. This process allows the solar wind to be effectively found downstream of the new local shock front, forming a magnetosheath jet. The limited interaction of the solar wind with the old shock (initial SLAMS) allow the slightly compressed solar wind to retain its initial high velocity, which correspond to a plasma jet relatively to the background.

The formation mechanism we show, does not require any external solar wind related transient phenomena to occur and could provide an answer on how jets could form in situations where strong rippling is not observed in the quasi-parallel bow shock.