Velocity distribution functions and non-Maxwellianity of magnetosheath jets using MMS

S. Raptis[1], T. Karlsson[1], A. Vaivads[1], M. Lindberg[1], H. Trollvik[1],

[1]*Space and Plasma Physics, School of Electrical Engineering and Computer Science, KTH Royal Institute of Technology, Sweden*

Abstract

The interaction between the solar wind and Earth's magnetic field results in the formation of a supercritical bow shock. Downstream of this shock wave, the magnetosheath region emerges, in which high-speed plasma flows can be formed. These jets have been connected to several shock and foreshock properties. Moreover, due to their unique properties (i.e., higher density and velocity compared to the ambient flow), they can cause a variety of different phenomena, including magnetopause reconnection, excitation of ULF waves and electron acceleration.

In this work, we use Magnetosphere Multiscale (MMS) mission to demonstrate jets' complex structure by investigating their velocity distribution functions. Specifically, we focus on how their VDFs change over time and on whether they exhibit non-Maxwellian properties. By comparing with the VDFs taken from the background magnetosheath, we show that full particle plasma moments provide an inadequate description of jet plasma properties. Furthermore, we present different metrics to quantify the non-Maxwellian features exhibited by jet observations. Finally, we discuss how the observed kinetic properties of jets may provide insight into jets generation, wave excitation and evolution.