Investigation of Different Types of Magnetosheath Jets and Their Origin using MMS

S. Raptis[1], T.Karlsson[1], Ferdinand Plaschke[2], Anita Kullen[1], P-A. Lindqvist[1]

[1]Space and Plasma Physics, School of Electrical Engineering and Computer Science, KTH Royal Institute of Technology, Sweden
[2]Space Research Institute, Austrian Academy of Sciences, Graz, Austria

Abstract

Magnetosheath jets are transient and energetic phenomena manifesting in the magnetosheath region. These fast plasma flows are characterized by large amplitude and localized increases of dynamic pressure. Their importance in the magnetospheric environment lies heavily in their association with several phenomena such as magnetopause reconnection, energization of the outer belt electrons and the dayside throat aurora mechanism.

By using Magnetospheric Multiscale (MMS) from 2015 to 2020, a dataset of thousands of magnetosheath jets has been created. The jets of the dataset are classified into different categories depending on their associated bow shock configuration. The key components of their classification are the indirect effects of the foreshock, generated upstream of the quasi-parallel bow shock ($\theta_{Bn} < 45$) , and the absence of such effects in the case of quasi-perpendicular ($\theta_{Bn} < 45$). Other classes of jets include the "boundary" jets found under a switch of IMF from quasi-parallel to quasi-perpendicular or vice versa and the "encapsulated" jets that appear as quasi-parallel structures surrounded by quasi-perpendicular magnetosheath plasma.

By analyzing statistically each subset of jets, we compare the classes and discuss possible generation mechanisms. The overall results, support existing generation theories (e.g. ripples in the bow shock and SLAMS) while indicating that there may be other contributing factors. The continuation of this work consists of analyzing jets found close to the bow shock. Such subset of jets provide an excellent sample to investigate the exact details of their generation. The initial results of these events support furtherly the pre-existing generation mechanism while giving stronger indications to other possible effects that may take place.