Magnetosheath jets using MMS: classification and generation mechanisms

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Abstract

Magnetosheath jets are fast plasma flows characterized by localized, large amplitude and transient increase of dynamic pressure. They are a vital component to the couples system of Solar wind and magnetosphere. Jets may contribute to various space related phenomena. It has been shown that they can trigger local magnetic reconnection, drive compressional waves and even penetrate the magnetopause. Furthermore, they can affect the radiation belts through affecting the electrons of the outer belt and affect the aurora via the "dayside throat aurora" mechanism.

Using Magnetospheric Multiscale (MMS) data, we find and classify magnetosheath jets from 2015 to 2020. An algorithm is utilized, using in-situ MMS measurements to classify jets into different categories. Jets found behind the quasi-parallel (θ_{Bn}<45) bow shock are referred to as quasi-parallel, while jets appearing behind the quasi-perpendicular (θ_{Bn}<45) bow shock, as quasi-perpendicular jets. The jets that occur at the boundaries between quasi-parallel and quasi-perpendicular magnetosheath are called boundary jets. Finally, we introduce encapsulated jets, which have similar characteristics to quasi-parallel jets while the immediate surrounding plasma is of quasi-perpendicular nature.

In this work, we show the first statistical results of the derived classified jet database and provide comparative statistics for every class. Our results support existing generation theories, such as the bow shock ripple and SLAMS-associated mechanisms while indicating that other factors may contribute as well.

To investigate more thoroughly the connection of jets to a generation mechanism, we proceed to statistically analyze jets that are found very close to the bow shock. It is shown that these jets offer an excellent subset to draw conclusions regarding the supported mechanisms of SLAMS and bow shock ripple. Initial results provide strong support connecting the jets found close to the subsolar bow shock with the existing generation mechanism while introducing new clues regarding their origin.