Creation & Classification of Magnetosheath Jet Database using Magnetospheric Multiscale (MMS)

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Abstract

Magnetosheath jets are flows that manifest as localized, large amplitude and transient increases of dynamic pressure. They are fast plasma flows generated after solar wind interacts with the bow shock, making them a valuable component, connecting solar wind and magnetospheric environments. Jets are associated with several space weather phenomena such as, radiation belts, ionospheric flow enhancements, magnetic reconnection and auroral features.

In this work, we present a database of several thousands of magnetosheath jets along with various of their characteristics. We organize the dataset into several subsets depending on their properties, while each jet holds information regarding general properties (position, duration etc.), plasma moments (density, velocity, temperature etc.) and field (electric & magnetic) measurements as observed by MMS. Each jet was also associated with solar wind plasma parameters from High Resolution OMNI (HRO) database.

Finally, we classify the jets into different classes depending on the angle between the Interplanetary Magnetic Field (IMF) and the bow shock's normal vector (θ_{Bn}). This creates subsets of jets found in the Quasi-parallel magnetosheath ($\theta_{Bn} < 45°$) and in the Quasi-perpendicular ($\theta_{Bn} > 45°$).

The dataset has been derived by using in-situ measurements of various plasma quantities and magnetosheath magnetic and electric field as measured by the Magnetospheric Multiscale (MMS) mission during 09/2015 – 06/2019.

The importance of the presented magnetosheath database is directly relevant to space weather research. Magnetosheath jets have been associated with several geoeffective phenomena and a lot of insight can be achieved through associating specific events with other space and solar phenomena such as CMEs, solar wind flows, ionospheric flow enhancements and geomagnetic storms.