
A statistical study of dipolarization fronts observed by MMS

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Résumé

In the present work, we consider 49 dipolarization fronts (DF) detected by the Magnetospheric Multiscale (MMS) mission on 2017, near the Earth's magnetotail equator ($-B_x < 5\text{ nT}$). Criteria for selecting DF using an AIDAp routine are based on difference of maximum and minimum values computed with a 306 s sliding window. They request a Bz increase, an ion velocity increase and a density decrease. This first automatic selection is then adjusted manually with the following criteria : Bz increase larger than 5 nT, ion velocity larger than 150 km/s, density decrease and both ion and electron temperature increases. All these events belong to the most common category (A) defined by Schmid et al., 2015 in term of density decrease and temperature increase at the DF. However, based on a superposed epoch analysis of DF basic properties (magnetic field, density, velocity, ...) we distinguish two subcategories of events depending on the shape of the DF. The first subcategory (55.1%) corresponds to a slow decrease of the magnetic field after the DF and is associated with smaller ion velocity and hotter plasma. The second subcategory (44.9%) has the same time scale for the rising and the falling of the magnetic field (a bump) associated with a decrease of ion and electron

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pressures and faster velocity as shown in Alqeeq et al. 2021. For both categories we found that ions are mostly decoupled from the magnetic field by the Hall fields. The electron pressure gradient term is also contributing to the ion decoupling and likely responsible for an electron decoupling at DF. We also analyzed the energy conversion process. For the first subcategory we found that the energy in the spacecraft frame is transferred from the electromagnetic field to the plasma ($\mathbf{J} \cdot \mathbf{E} > 0$) ahead or at the DF. For the second subcategory, we found the same behavior ahead or at the DF whereas it is the opposite ($\mathbf{J} \cdot \mathbf{E} < 0$) behind the front. In the fluid frame, we found that the energy is mostly transferred from the plasma to the electromagnetic field ($\mathbf{J} \cdot \mathbf{E} < 0$) ahead or at the DF for both subcategories but energy dissipation ($\mathbf{J} \cdot \mathbf{E} > 0$) only occurs behind the front for the second subcategory. The possible origin of these two subcategories is discussed.