
Quantifying MP boundary layers during the MMS string of pearls campaign in 2019

Kristie Llera^{*1}, Stephen Fuselier², Sarah Vines², S. Petrinec³, Karlheinz Trattner⁴, Bayane Michotte De Welle⁵, James Burch², and Daniel Gershman⁵

¹Southwest Research Institute – United States

²Southwest Research Institute [San Antonio] – United States

³Lockheed Martin Advanced Technology Center – United States

⁴Laboratory for Atmospheric and Space Physics [Boulder] – United States

⁵GSFC Heliophysics Science Division – United States

Abstract

In early 2019, the Magnetospheric Multiscale (MMS) mission adopted a "string-of-pearls" configuration, where the inter-spacecraft separations increased logarithmically. On January 27, 2019, MMS was inbound when the magnetopause (MP) moved inward. Around 12:30 UT, the spacecraft separations fortuitously spanned many of the critical regions/boundaries of the magnetopause including the ion edge of the low-latitude boundary layer (LLBL), electron edge of the LLBL, and the magnetopause current sheet. This allowed us to determine the thicknesses of multiple boundary layers nearly simultaneously. Using accelerated cold plasmaspheric ions, we derived a time series of the local magnetopause motion, integrating their normal velocities in LMN coordinates. These cold ions are detectable due to their relative motion, frozen to the magnetic field. Their detection enabled us to track the boundary up to $\sim 1-2$ Earth radii away. We distinguished local vs. global boundary evolution by comparing spacecraft-derived distances to the magnetopause and deviations between observed and expected crossings of the critical regions/boundaries. The two techniques, one multi-spacecraft and one single spacecraft, yielded comparable results. This technique also provided insights into boundary thickness variations relative to the distance from the reconnection X-line. Looking ahead, while this event was primarily along the GSE X-axis, a future campaign with greater Y-axis separation would allow study of Kelvin-Helmholtz Instabilities (KHI) and other waves/boundary motion across a large fraction of the dayside magnetopause, transitioning from the subsolar point toward the terminator, enabling new insights into wavelength evolution and boundary turbulence.

*Speaker