Large-scale context of a magnetopause Kelvin-Helmholtz event observed by the MMS spacecraft on 8 September 2015

*Hiroshi Hasegawa[1], Takuma Nakamura[2], Naritoshi Kitamura[1], Barbara L. Giles[3], Christopher T Russell[4], Yuri V. Khotyaintsev[5], Robert E. Ergun[6], Yoshifumi Saito[1]

1. Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency, 2. Space Research Institute, Austrian Academy of Science, 3. NASA Goddard Space Flight Center, 4. Department of Earth, Planetary, and Space Sciences, University of California, Los Angeles, 5. Swedish Institute of Space Physics, 6. Department of Astrophysical and Planetary Sciences, University of Colorado

The Kelvin-Helmholtz (KH) instability is known to grow along the Earth’s magnetopause, but its role in transporting solar wind mass and energy into the magnetosphere is not fully understood. On 8 September 2015, the Magnetospheric Multiscale (MMS) spacecraft, located at the postnoon magnetopause, encountered thin low-shear current sheets at the trailing edge of the KH waves, where KH-induced reconnection, one of the plasma transport processes, was occurring [Eriksson et al., 2016; Li et al., 2016]. The event occurred during a prolonged period of northward interplanetary magnetic field, and was characterized by an extended region of the low-latitude boundary layer (LLBL) immediately earthward of the KH unstable magnetopause, which appeared to have been formed through magnetopause reconnection poleward of the cusp. In this LLBL, MMS observed plasma turbulence, another agent for the plasma transport [Stawarz et al., 2016], and cold electrons possibly of ionosphere origin [Wilder et al., 2016], despite that magnetic field lines threading the LLBL would have been detached from the ionosphere a few tens of minute before the observation. In the present study, we revisit this KH-wave event and address the questions of how the KH instability got excited, how the current sheets at the KH wave trailing edges were generated, what is the origin of the turbulence seen within the KH vortices, and how the cold plasma populations got access to and reached the LLBL. Our analysis suggests that MMS was not at most KH-unstable latitudes but on their southern side, and the observed current sheets with a systematic pattern of magnetic field variations result from three-dimensional development of the KH instability.

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