



## **Characteristics of energy dispersion of ions and electrons in the PSBL flows during substorms**

Simon Wellenzohn (1), Rumi Nakamura (1), Victor Sergeev (2), Ali Varsani (3), Sergey Apatenkov (2), James L. Burch (4), Barbara L. Giles (5), and Roy B. Torbert (6)

(1) Space Research Institute Graz, Space Plasma Physics, Austria (simon.wellenzohn@oeaw.ac.at), (2) St. Petersburg State University, St. Petersburg, Russia, (3) Mullard Space Science Laboratory, University College London, Dorking, UK, (4) Southwest Research Institute, San Antonio, TX, USA, (5) Heliophysics Science Division, NASA Goddard Space Flight Center, Greenbelt, MD, USA, (6) University of New Hampshire, Durham, NH, USA

The plasma sheet boundary layer (PSBL) is the transition region between magnetotail lobes and the plasma sheet. Its most important feature are field-aligned beams of hot ions and electrons accelerated in the reconnection region. We report on signatures of energy dispersion of these ion and electron beams in the PSBL during two substorms, on the 12th and 24th of July 2018.

A substorm ( $AL \sim -400$  nT) commenced at 10 UT on the 24th of July 2018 when MMS was located at a distance of 24 RE downtail. Based on the high-time-resolution measurements from MMS, we are able to resolve the dispersion in the tailward flowing electrons.

By interpreting the energy dispersion of the electrons and ions due to the time-of-flight effect, we infer that an active X-line was located earthward of the spacecraft.

This type of event is rare to find in the burst mode intervals of MMS, therefore this event will provide a unique opportunity to study dispersion signatures of the tailward plasma flow in the PSBL. We discuss the electron energy distribution, velocity distribution and pitch angle distribution in context of the multiple reconnection events that happened that day. The active X-line location and timing is calculated and compared for each spacecraft and plasma species.

During the 12th July 2018, 08 UT substorm, clear dispersion in the earthward moving electrons that are coming from an active tailward reconnection were found. We compare the energy dispersion of this earthward event to the aforementioned tailward event and examine the difference on the electron scale between earthward and tailward flows in the PSBL.