
MMS Observations of the Velocity-space Signature of Shock-drift Acceleration

Gregory Howes^{*1}, Peter Montag¹, Daniel Mcginnis¹, Arya Afshari¹, Michael Starkey²,
and Mihir Desai²

¹University of Iowa [Iowa City] – United States

²Southwest Research Institute [San Antonio] – United States

Abstract

Collisionless shocks play a key role in the heliosphere at planetary bow shocks by governing the conversion of the upstream bulk kinetic energy of the solar wind flow to other forms of energy in the downstream, including heating of the plasma species, acceleration of particles, and increase of magnetic energy. For a perpendicular collisionless shock with Alfvén Mach number $M_A = 5.5$, we present here the first observational identification of the velocity-space signature of shock-drift acceleration of ions, previously predicted using kinetic numerical simulations, using a field–particle correlation analysis of Magnetospheric Multi-scale observations of Earth’s bow shock. Furthermore, by resolving the ion energization rates as a function of particle velocity, the field–particle correlation technique facilitates a clean quantitative separation of the energization rate of the reflected ions from that of the incoming ion beam, enabling a more complete characterization of the energy conversion at the shock.

^{*}Speaker