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On the Conspiracy of Ion Reflection and the Local Structure of the Earth's Bow Shock: A multi-scale study.

Harald Kucharek (1), Eberhard Moebius (1), Bin Miao (2), Mats Andre (3), and Hiroshi Matsui (1)

(1) University of New Hampshire, Space Science Center, Durham, United States (harald.kucharek@unh.edu, +1 603 862 0311), (2) University of Alabama in Huntsville, CSPAR, Huntsville Alabama, USA, (3) Swedish Institute of Space Physics, IRF Uppsala, Sweden

Kinetic numerical simulation provided strong evidence that collissionless shocks such as the Earth's bow shock may have local shock structure that is determined by instabilities created by back-streaming and gyrating ion populations interacting with solar wind ions streaming against the shock. Cluster spacecraft data provided many new insights into the structure of the foreshock region, the local structure of the bow shock, its downstream region, and the associated physical processes. Using multi-spacecraft techniques such as timing analysis, Cluster data opened a new window to study the local structure of the Earth's bow shock. There is strong observational evidence of so-called shock ripples and shock reformation. Theoretical predictions on how the wavelength or wave amplitude may change when solar wind conditions have recently been confirmed by field-aligned ion beam observations. A remote sensing model have been developed that not only allows to successfully study the local structure but also provides access to kinetic processes such as ion reflection. Solar wind ions can reflected by the magnetic field (magnetic reflection) or by the shock potential created by electron ion dynamics. In this presentation we will provide new results of a clearly cross-scale study that provides new insights into the conspiracy of the shock structure, ion reflection, shock potential and magnetic field gradients to understand ion reflection at collissionless shocks.