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Sheath-like solar wind deflection in the foreshock during radial IMF: Comparison with Hybrid–Vlasov Simulations

Olga Gutynska (1), Lucile Turc (2), Yann Pfau-Kempf (2), Jana Safrankova (1), Zdenek Nemecek (1), Minna Palmroth (2,3)

(1) Charles University, Faculty of Mathematics and Physics, Prague, Czech Republic (olga.gutynska@mff.cuni.cz), (2) University of Helsinki, Department of Physics, Helsinki, Finland, (3) Finnish Meteorological Institute, Helsinki, Finland

Particle reflection at the bow shock provides a source of free energy to drive local instabilities and turbulence within the foreshock. A variety of low-frequency fluctuations (up to 16 mHz) results from the interactions of back-streaming ions with the oncoming solar wind flow. We report observations of quasi-sinusoidal and quasi-monochromatic variations of the ion velocity with typical large amplitudes in the range of 0.01–0.02 Hz observed during intervals of a radial interplanetary magnetic field (IMF) in the foreshock. A case study of simultaneous dual Time History of Events and Macroscale Interactions during Substorms (THEMIS) spacecraft observations of asymmetrical fluctuations in VY is complemented by a statistical study of similar solar wind deflections in the foreshock. We compare observations of these fluctuations with results from Hybrid-Vlasov Simulations to reveal how the deflections are being generated. The observations indicate that, in addition to ion heating, ultra low-frequency (ULF) waves participate in the magnetosheath-like plasma flow deflection in the foreshock during periods of small IMF cone angles.