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High-frequency waves associated with quasi-perpendicular interplanetary shocks

Oleksandr Goncharov (1), Jana Safrankova (1), Zdenek Nemecek (1), Lubomir Prech (1), Alexander Pitna (1), and Georgy Zastenker (2)

(1) Charles University, Faculty of Mathematics and Physics, Department of Surface and Plasma Science, Prague, Czech Republic (goncharov.oleksandr@gmail.com), (2) Space Research Institute of Russian Academy of Science, Moscow, Russia

Interplanetary shocks are frequently associated with high-frequency (several Hz) wave packets in upstream and downstream regions. These waves can be resolved in fast magnetic field data but the time resolution of plasma instruments is insufficient for their detection. The BMSW instrument onboard the Russian Spektr-R spacecraft measures solar wind parameters with a unique resolution of 32 ms and open new ways to detailed analysis of these waves.

In this paper, we present a study of the waves in regions adjacent to interplanetary shocks observed in course of the 2011–2013 years. We have identified about 25 IP shocks with clear high-frequency wavy signatures in plasma parameters. In our list, shocks are quasi-perpendicular ($\theta_{Bn} > 60^{\circ}$) and have low magnetosonic Mach numbers ($M_{ms} \leq 3$). Since the magnetometer onboard Spektr-R is not in operation, we compare BMSW observations with Wind fast magnetic field measurements. We conclude that (1) density variations observed by the BMSW instrument are similar to those observed by the Wind magnetometer, and (2) the best scaling parameter for their wavelength is the proton thermal gyroradius. It suggests that these waves would be of kinetic nature.