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Fast plasma measurements in the solar wind: Lessons from Spektr-R and implications for THOR

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The paper discusses achievements of rapid measurements of solar wind parameters by the BMSW instrument onboard the Spektr-R spacecraft. The main advantage of these measurements is their speed that can reach 32 Hz. We present the examples of significant results concentrated on (1) the IP shock ramp thickness that is observed to be comparable with the ion gyroradius even for low-Mach number shocks; (2) wave trains connected with the IP shock and an evolution of the ion velocity distribution within these wave trains; (3) plasma turbulence around the ion spectral break, and (4) a study of variations of the He abundance on short timescales (3–30 s) and their relations to in-transit turbulence. Based on BMSW experience, we present further progress in development of a new variant of BMSW that includes simultaneous measurements of a full energy distribution function (with 2-s time resolution) and plasma moments with the time resolution of 32 Hz or better under a Maxwellian approximation. A new configuration of the set of Faraday cups allows us a perfect in-flight calibration, a special regime for helium abundance determination and quick onboard information about the solar wind bulk speed.