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Fine structure of the interplanetary shock from the solar wind plasma measurements with high-time resolution

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Fine structure of the oblique interplanetary (IP) shock was studied from the solar wind plasma measurements with a high-time resolution by BMSW instrument operating onboard the SPEKTR-R satellite and MFI magnetometer measurements onboard the WIND. Ion and magnetic scales of ramp and wavelength of precursor waves were obtained. It was determined that both ramp thickness and wavelength of the precursor wave decrease with increasing of angle θBn. From the comparison of the experimentally determined wavelength of the precursor wave with a theoretical estimation of the wavelength it was shown that the dispersion of oblique magnetosonic waves plays a significant role in the formation of the fronts of quasi-perpendicular collisionless IP shocks with low beta β and low Mach numbers MA. The comparison of the Rankine-Hugoniot relations MA(2/1) measured at the fronts of 47 IP shocks with calculations made within the framework of an ideal MHD revealed that the effective adiabatic exponent γ, which characterizes the processes inside the front, is in the range from 2 to 5/3. This fact characterizes the dissipative processes occurring inside the shock as collective and collisionless. Moreover, this is true for all types of shock waves ($0° \leq \theta$Bn $\leq 90°$), for $0 < \beta < 5$, and Mach number of $1 <$ MA < 10.