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Evolution of Velocity and Density Fluctuations within the Terrestrial Foreshock

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Terrestrial foreshock, a region upstream of the Earth's bow shock that is magnetically connected to it, is a unique laboratory for a study of various nonlinear phenomena. It has been investigated for decades and, due to availability of fast magnetic field measurements, many processes have been observed and theoretically described, including observations of many types of waves generated through instabilities triggered by counter-streaming particle populations. Moreover, high-amplitude plasma fluctuations lead to nonlinear processes such as parametric instability decay or magnetohydrodynamic turbulence that can take place within the foreshock. Our study of an evolution of velocity and density fluctuations from inertial up to characteristic kinetic scales is based on high resolution (31 ms) plasma data coming from the BMSW instrument onboard the Spektr-R spacecraft. We observe an enhancement of the fluctuation power within the inertial range of turbulence, as well as at and below ion characteristic scales. The enhancement is frequency dependent and varies with a distance from the bow shock and with a particular position within the foreshock. We discuss the role of different processes that could explain the shapes of the power spectra.