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Ion-scale break of the plasma fluctuation spectra in different large-scale solar wind streams

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Appearance of measurements of the interplanetary medium parameters with high temporal resolution gave rise to a variety of investigations of turbulent cascade at ion kinetic scales at which processes of plasma heating was believed to operate. Our recent studies based on high frequency plasma measurements at Spektr-R spacecraft have shown that the turbulent cascade was not stable and dynamically changed depending on the plasma conditions in different large-scale solar wind structures. These changes was most significant at the kinetic scales of the turbulent cascade. Slow undisturbed solar wind was characterized by the consistency of the spectra to the predictions of the kinetic Alfven wave turbulence model. On the other hand, the discrepancy between the model predictions and registered spectra were found in stream interaction regions characterized by crucial steepening of spectra at the kinetic scales with slopes having values up to -(4-5). This discrepancy was clearly shown for plasma compression region Sheath in front of the magnetic clouds and CIR in front of high speed streams associated with coronal holes. Present study is focused on the break preceding the kinetic scales. Currently the characteristic plasma parameters associated with the formation of the break is still debated. Number of studies demonstrated that the break was consistent with distinct characteristic frequencies for different values of the plasma proton parameter beta βp. Present study consider the ratio between the break frequency determined for ion flux fluctuation spectra according to Spektr-R data and several characteristic plasma frequencies used traditionally in such cases. The value of this ratio is statistically compared for different large-scale solar wind streams. We analyze both the classical spectrum view with two slopes and one break and the spectrum with flattening between magnetohydrodynamic and kinetic scales. Our results show that for the Sheath and CIR regions characterized typically by βp ≤1 the break corresponds statistically to the frequency determined by the proton gyroradius. At the same time such correspondence are not observed either for the undisturbed slow solar wind with similar βp value or for disturbed flows associated with interplanetary manifestations of coronal mass ejections, where βp << 1. The results also shows that in slow undisturbed solar wind the break is closer to the frequency determined by the inertial proton length. Thus, apparently the transition between streams of different speeds may result in the change of dissipation regimes and plays role in plasma heating at these areas. This work was supported by the RFBR grant No. 19-02-00177a