[구SE-17] Theoretical construction of solar wind proton temperature anisotropy versus beta inverse correlation

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In situ observations from the Wind spacecraft that statistically analyzed the solar wind proton at 1 AU has indicated that the measured proton temperature anisotropies seems to be regulated by the oblique instabilities (the mirror and oblique firehose). This result is in contradiction with the prediction of linear kinetic theory that the ion-cyclotron (for $\beta_{||}< 2$) and parallel firehose (for $\beta_{||}<10$) would dominate over the oblique instabilities. Various kinds of physical mechanisms have been suggested to explain this disagreement between the observations and linear theory. All of the suggestions consider the solar wind as a unoform magnetized plasma. However the real space environment is replete with the intermediate spatio-temporal scale variations associated with various physical quantities, such as the magnetic field intensity and the solar wind density. In this paper we present that the pervasive intermediate-scale temporal variation of the local magnetic field intensity can lead to the modification of the proton temperature anisotropy versus beta inverse correlation for temperature-anisotropy-driven instabilities. By means of quasilinear kinetic theory involving such temporal variation, we construct the simulated solar wind proton data distribution associated the magnetic fluctuations in $(\beta_{||}, T_{\perp}/T_{||})$ space . It is shown that the theoretically simulated proton distribution and a general trend of the enhanced fluctuations bounded by the oblique instabilities are consistent with in situ observations. Furthermore, the measure magnetic compressibility can be accounted for by the magnetic spectral signatures of the unstable modes.

[구SE-18] Reduced ion mass effects and parametric study of electron flat-top distribution formation

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In particle-in-cell (PIC) simulation studies related to ion-ion two-stream instability, a reduced ion-to-electron mass ratio is often employed to save computation time. But it was not clearly verified how electrons dynamics are coupled with the slower evolution of ion-ion interactions under the external electric field. We have studied the ion beam driven instability using a 1D electrostatic PIC code by comparing different rescaling of parameter with real ion mass from the reference simulation with reduced ion mass. As the external electric field is stronger, the excited unstable mode range was more sensitively affected by the system size with the real mass ratio than the reduced ion mass. The results show that the reduced mass ratio should be used cautiously in PIC code as the electron dynamics can modify the ion instabilities. Additionally we found the formation of electron flat-top distribution in the final saturation stage. Simulation results show that in the early phase electrostatic solitary waves are quasi-periodically formed, but later they are fully dissipated resulting in heated, flat-top distributions. New electron beam components are occasionally formed. These are a consequence of the interaction with solitary wave structures. We parametrically investigate the development of electron phase space distributions for various drift speeds of ion beams and temperature ratios between ions and electrons