# Expanding box model of quasilinear theory including the anisotropy-driven instabilities and collisional dissipation

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Measurements in situ of proton temperature anisotropy were found to be bounded by the marginal stability conditions of the kinetic instabilities driven by proton temperature anisotropies. This implies that these instabilities are indeed active and play an important role in limiting the range of temperature anisotropies observed in the expanding solar wind. However, the vast majority of the observed data distribution in the parameter space, denoted by proton temperature anisotropy and parallel beta, are found near isotropic state instead of being near the instability thresholds, so that they could not be explained by the local kinetic instability alone. Since the solar wind itself expands in inhomogeneous interplanetary space, the solar wind expansion would lead to a development of excessive parallel temperature anisotropy. Moreover, the binary particle collisions are thought to contribute to the temperature isotropization of the solar wind plasma. In order to understand the measured proton properties in the solar wind, various kinetic processes responsible for the global dynamics, such as the solar wind expansion and binary collisions, and the local kinetic instabilities should be taken into account. In the present work, we employ quasilinear theory of the expanding box model to investigate how the solar wind expansion and the instability driven collisionless dissipation as well as the collisional dissipation affect the dynamic evolution of the solar wind proton.

Keywords: solar wind proton, temperature anisotropy-driven kinetic instability, expanding box model of quasilinear theory, collisional dissipation