Proton temperature-anisotropy-driven instability: Quasi-linear kinetic theory

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Abstract

The proton temperature-anisotropy-driven instabilities have received attention because they may be applicable to a variety of space plasma environments. For instance, in-situ measurements of the solar wind and the Earth's magnetosheath have shown that these instabilities could play an important role in regulating the unlimited growth of the temperature anisotropy. Indeed, it has been shown that the solar wind proton temperature anisotropies are regulated by the marginal stability conditions obtained from linear Vlasov analysis of the kinetic instabilities [1]. In the literature [2-4], numerical simulations have been carried out to study the fundamental properties and investigate how the instabilities affect the solar wind dynamics. Recently, a series of papers [5-7], which employed the quasi-linear kinetic theory for several kinetic instabilities, successfully have explained the observed temperature anisotropy upper bound in the solar wind. In the present study, we will discuss the validity and limitation of the quasi-linear treatment for various kinetic instabilities and show some recent results that describe the expanding box model of quasi-linear theory as an application to a kinetic model of the solar wind.

References

[1] P. Hellinger, P. M. Travnicek, J. C. Kasper, and A. J. Lazarus, *Geophys. Res. Lett.* 33, L09101, doi:10.1029/2006 GL025925 (2006).

[2] L. Matteini, S. Landi, P. Hellinger, and M. Velli, *J. Geophys. Res.* 111, A10101, doi:10.1029/2006JA011667 (2006).

[3] P. Hellinger and P. M. Travnicek, *J. Geophys. Res.* 113, A10109, doi:10.1029/2008JA013416 (2008).

[4] P. M. Travnicek, P. Hellinger, Matthew G. G. T. Talor, C. P. Escoubet, I. Dandouras, and E. Lucek, *Geophys. Res. Lett.* 34, L15104, doi:10.1029/2007GL029728 (2007).

[5] J. Seough and P. H. Yoon, *J. Geophys. Res.* 117, A08101, doi: 10.1029/2012JA017645 (2012).

[6] P. H. Yoon and J. Seough, *J. Geophys. Res.* 117, A08102, doi: 10.1029/2012JA017697 (2012).

[7] J. Seough, P. H. Yoon, K-H Kim, D-H Lee, Phys. Rev. Lett. 110, 071103 (2013).