Role of Kinetic Alfven wave and whistler wave in magnetopause reconnection region turbulence generation

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In literature several studies of turbulence have been carried out based upon Kinetic Alfven waves (KAWs) and whistler wave, which lead to energy transport at a smaller scale and explained turbulent spectrum. Using cluster data, Chaston et al. 2008 have proposed wave modes physics and scaling in the magnetopause region. However, KAWs and whistler waves are also observed in the vicinity of x-line in reconnection site in magnetopause. Therefore, **we have proposed a model to study the evolution of nonlinear (coherent) structures and turbulence generation by taking the powerful KAWs but weak whistler in magnetic reconnection site.** For this study the dynamical evolution equations are derived by taking into account the ponderomotive force driven density modification and magnetic field fluctuations due to shear field modelled by the Harris sheet. Further, governing equations have been solved numerically for magnetopause region parameters. Also, a semi-analytical model has also been developed to estimate the scale sizes of coherent structures. For numerical integrations we have used the pseudospectral method and finite difference method and for semi-analytically Runge Kutta method. Simulated results have shown the evolution of coherent structures or current sheets, which are capable to energy transfer efficiently. These structures have scale size around ion gyroradius as well as electron inertial length as calculated analytically. At a later time the chaotic structures arise in this reconnection site. This gives the signature of turbulence generation. Therefore, the corresponding power spectrum is also evaluated and compared with observational Cluster data based spectra reported by, Chaston et al., 2008 and Matteini et al., 2017. Based on the present model, we conclude that the role of KAWs and Whistler waves in the turbulence generation and reconnection site is very important.

References

Chaston, C. C., J. Bonnell, J. P. McFadden, C. W. Carlson, C. Cully, O. Le Contel, A. Roux, Auster, H. U., K. H. Glassmeier, V. Angelopoulos, and C. T. Russell (2008), Turbulent heating and cross-field transport near the magnetopause from THEMIS, Geophys. Res. Lett. 35, L17S08, doi:10.1029/2008GL033601.
Matteini L., O. Alexandrova, C. H. K. Chen and C. Lacombe (2017), Electric and magnetic spectra from MHD to electron scales in the magnetosheath, MNRAS, 466, 945–951.

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