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Steep power-law spectrum of whistler turbulence controlled by dissipation effect: Particle-In-Cell simulations

Shinji Saito[1*], S. Peter Gary[2]

[1]STE Laboratory, Nagoya University, [2]Los Alamos National Laboratory

Two-dimensional particle-in-cell simulations in homogeneous collisionless plasmas have been carried out to study whistler turbulence under different plasma beta conditions. Magnetic fluctuation energy of whistler turbulence cascades to shorter scales and forms an anisotropic wavenumber spectrum that has more fluctuation energy at a given wavenumber perpendicular to the background magnetic field than parallel. Our finding is that the wavenumber spectrum becomes steeper as the plasma beta increases. At low beta values, the power-law index of wavenumber spectrum closes to an asymptotic value -7/3 which is predicted by EMHD simulations (e.g. Biskamp et al. PRL 1996) and a theoretical model (Narita et al. submitted in PoP). At larger beta conditions, the wavenumber spectrum tends to be steeper. The damping of whistler fluctuations generally increases with increasing beta, so we are studying our results to determine whether the increasing steepness of the spectrum is due to the increase in damping.

Keywords: plasma turbulence