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# Multiscale magnetosheath turbulence model from mHz to kHz

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We construct a nonlinear whistler wave model under the influence of the ponderomotive force to explain the energy spectra and the waveforms observed in loin roar waves in Earth's magnetosheath region. We use the two-fluid approach to derive the model equations governing the dynamics of ion-acoustic and whistler waves propagating along the ambient magnetic field. On the account of ponderomotive force, nonlinearity arises in the dynamics of ion-acoustic wave which modify the background number density under the steady state condition. Whistler wave nonlinearly interacts with the ion-acoustic wave while propagating through the density inhomogeneity created by the ponderomotive force, and gets modulated and forms localized structures in the magnetic field. Furthermore, we develop a semi-analytical numerical method to compute the magnetic energy spectrum of whistler wave and investigate the spectral features of the spectrum. The magnetic field spectrum shows a spectral break accompanied by the steepening of the spectrum with a spectral index -3.2 at higher wave numbers. In the recent past, the magnetic field fluctuations with the occurrence of lion roar waves are widely investigated in the frequency range from 20 to 1000 Hz in Earth's magnetosheath. The observed lion roar waves show a broadband turbulence spectrum with the spectral slope about -4.5. The present model develop a concept on multiscale magnetosheath turbulence in which turbulence at low frequencies (mHz) is dominated by mirror mode, however at high frequencies (kHz) it is mainly due to the nonlinear whistler waves and the whistler turbulence is embedded inside the mirror mode.