

Generation of kinetic Alfvén waves by velocity shear instability on auroral field lines

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Ion beams observed in the plasma sheet boundary layer (PSBL), cusp, and on the auroral zone field lines are expected to have spatial gradients in their drift velocity. Recent observations by FAST indicate typical ion beam gradients of 0.5-1.0 keV/km or even more. Generation of kinetic Alfvén waves by velocity shear of the ion beams is discussed. It is shown that a hot ion beam can excite both a resonant kinetic Alfvén wave instability and a non-resonant coupled Alfvén-ion acoustic instability. The cold ion beam, on the other hand, can excite on the coupled Alfvén-ion acoustic instability. For typical parameters, observed on the auroral field lines in the altitude range of 5-7 R_E (where R_E is the Earth's radius), the frequency of the velocity shear modes, in the satellite frame of reference, lie in the ultra low frequency (ULF) range. The noise due to velocity shear driven Alfvén modes is electromagnetic in nature, and has a finite parallel electric field component. Therefore, these modes could be relevant in plasma acceleration and heating, and also play an important role in ionosphere-magnetosphere coupling processes. Further, these modes may explain some properties of the low-frequency electromagnetic waves observed in the PSBL by Polar and Geotail.