
JOURNAL CLUB

Shear Alfvén Waves in the Laboratory and in Space

by

C. A. Kletzing
University of Iowa

ABSTRACT

Shear Alfvén waves are thought to play a significant role in several regions of near-Earth space including the plasma sheet, magnetopause, and auroral zone. The interesting physics occurs when the waves have narrow perpendicular structure relative to either the plasma skin depth or the ion acoustic gyro radius. In either of these cases (called the inertial and kinetic cases, respectively) particle kinetic effects become important and modify the wave physics such that the usual MHD description of the shear Alfvén wave is no longer valid. For the auroral case, it is shown that these effects lead to component of parallel electric field which can accelerate electrons and produce time-dispersed electron signatures similar to those seen on sounding rockets and satellites. Interestingly, although the dispersion relation for these waves has been derived by several authors, direct experimental measurements to verify the dispersion relation have been few. To rectify this situation, a set of laboratory experiments is described which probe the dispersion relation for perpendicular scales which are of the order of both of these key parameters. The measured wave dispersion is compared with both fluid and fully kinetic dispersion relations, which shows that although the fluid dispersion relation shows the essential character of the dispersion relation, for good agreement the kinetic dispersion relation with finite frequency corrections is required.

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