

Resonant Absorption of a Planar Alfvén Wave in a Cross-Field Pressure-Balanced Structure

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We examine the evolution of a low-frequency (much less than the proton gyrofrequency), planar (body) and shear Alfvén wave propagating within a smoothly varying cross-field pressure-balanced structure which provides a wave-speed gradient. Hybrid numerical simulations with particle protons and fluid electrons are used. We consider wave propagation directions starting at 90° , which resembles the case of a surface wave, and less than 90° with respect to the gradient direction. We find that the planar Alfvén wave undergoes resonant absorption. When the propagation direction is less than 90° , we show that there are resonant field lines which can actually lose wave energy to other neighboring resonant field lines, which is a situation that has not been seen with surface waves. A consequence of this process is an overall faster development time for smaller scales perpendicular to the magnetic field through phase mixing and potentially faster dissipation of these generated scales in coronal and solar wind plasma. In our collisionless simulations, dissipation is generally through the Landau resonance. We will also show that absorption perseveres under the nonlinear movement of the gradient by the wave. When the cross-field structure has a scale smaller than about 20 proton inertial lengths and undergoes significant displacement from the wave, proton cyclotron resonant damping and heating can also occur.