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Magnetospheric Response to Solar Wind Forcing: ULF wave – Particle Interaction Scenario

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One of the most important issues in space physics is to identify the dominant processes that transfer energy from the solar wind to energetic particle populations in Earth's inner magnetosphere. Ultra-low-frequency (ULF) waves are an important consideration as they propagate electromagnetic energy over vast distances with little dissipation and interact with charged particles via drift resonance and drift-bounce resonance. ULF waves also take part in magnetosphere-ionosphere coupling and thus play an essential role in regulating energy flow throughout the entire system. This review summarizes recent advances in the characterization of ULF Pc3-5 waves in different regions of the magnetosphere, including ion and electron acceleration associated with these waves.

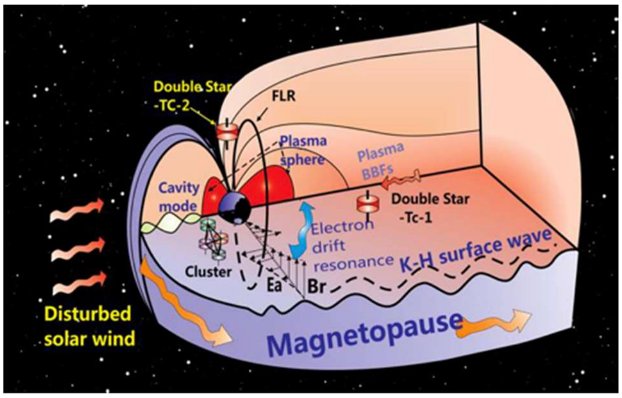

Figure 1. Schematic illustrating that Solar wind disturbances and Kelvin-Helmholtz surface waves can stimulate ULF waves and field line resonances (FLR's) under certain conditions. The regionwhere energetic electrons experience drift-resonances with ULF waves is indicated.

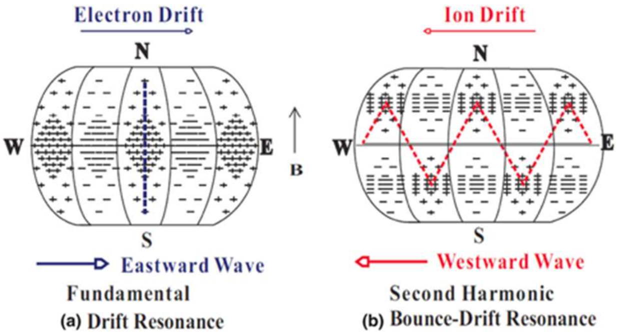

Figure 2: Fast Acceleration of Charged Particles by ULF Waves. Behavior of resonant electrons satisfying (a) the N=0 drift resonance in an eastward propagating fundamental mode standing wave, (b) the N=1 drift-bounce resonance condition in a second harmonic westward propagating standing wave. The westward and eastward electric fields are indicated by plus and minus, with their magnitude indicated by the density of symbols. As illustrated in Figure 2a, an electron in N=0 drift-resonance with an eastward-propagating fundamental mode standing wave will experience continual acceleration because its gradient-B drift motion is synchronized with the speed and direction of propagation of the wave. Figure 2b illustrates that ions in N=1 drift-bounce resonance with a second-harmonic westward-propagating standing wave will also experience continual acceleration.

Reference:

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