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Mode conversion from kinetic Alfven waves to electron acoustic waves in the topside ionosphere

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Kinetic Alfven wave is a major candidate responsible for the auroral electron acceleration. In the topside ionosphere, the density of cold electrons from the ionosphere becomes comparable to the density of hot electrons from the magnetosphere. When kinetic Alfven waves propagate to the transition region, the electron acoustic mode can be generated. From a kinetic model, we capture the mode conversion from inertial Alfven waves to electron acoustic waves.

Figure 1 illustrates the mode conversion from the temporal evolution of the electrostatic potential as a function of altitude. It is evident that when the Alfven waves propagate into the transition region, a wave mode is generated and is then propagated upward. The dispersion relation indicates that the wave mode is due to the coupling between an electron acoustic wave and an Alfven wave and has a speed approximately equal to that of an electron acoustic wave.

The simulations also show that the mode conversion strongly depends on the perpendicular wave length. When the perpendicular wavelength is comparable to the electron inertial length or the ion acoustic gyro-radius, the electron acoustic waves are generated, and gain increasing energy from incident kinetic Alfven waves with increasing $k_\perp$.

Figure 2 shows the ratios of the reflection (black) and generated electron acoustic wave (blue) to the injection of inertial Alfven wave. It indicates that with increasing $k_\perp$, the mode conversion from kinetic Alfven waves to electron acoustic waves becomes significant.

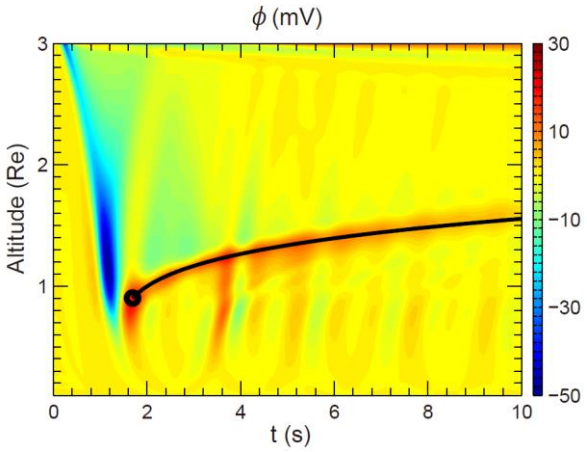

Figure 1: The temporal evolution of the electrostatic potential as a function of altitude. The thick black curve depicts the expected trajectory of the electron acoustic waves.

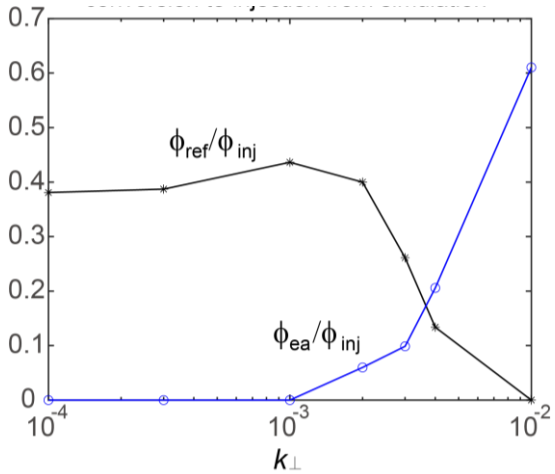

Figure 2: The ratios of reflection (black) and generated electron acoustic wave (blue) to injection of inertial Alfven wave. With increasing $k_\perp$, the mode conversion from kinetic Alfven waves to electron acoustic waves becomes significant.