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Nonlinear Dynamics of Electrons in Excitation of Whistler Waves with Adiabatic and Non-adiabatic Frequency Chirping

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It has been established by simulations and theories that nonlinear dynamics of electrons play a key role in frequency chirping of chorus waves. A previous study further demonstrated that this nonlinear interaction is in the non-adiabatic regime, where the nonlinear evolution time scale (t_{NL}) is comparable with the wave particle trapping time (t_{tr}). The principle of maximization of wave particle power transfer is connected with this non-adiabatic frequency chirping, and has been used to obtain a relation between the chirping rate and wave amplitude for chorus waves. In this talk, we will report whistler waves with adiabatic frequency chirping, where $t_{tr} << t_{NL}$, and show that the wave particle power transfer is not maximized in this case. Our work should demonstrate the qualitative difference between adiabatic and non-adiabatic frequency chirping, and the importance of identifying the nonlinear wave particle interaction regime in understanding frequency chirping of whistler waves.