Nonlinear drift resonance between electrons and ULF waves under the convection electric field

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In the Earth's inner magnetosphere, charged particles can be accelerated and transported by ultralow frequency (ULF) waves via drift resonance. We study the effects of the convection electric field on the nonlinear drift resonance process, which provides an inhomogeneity factor defined as the ratio of the driving amplitude to the square of the pendulum trapping frequency. The factor varies with magnetic local time and oscillates quasi-periodically at the particle drift frequency, which can externally drive the pendulum equation that describes the particle motion in the ULF wave field. To better understand the particle behavior governed by the driven pendulum equation, we carry out simulations to obtain the evolution of electron distribution functions in energy and L-shell phase space. We find that resonant electrons can remain trapped by the low-*m* ULF waves under strong convection electric field, whereas for high-*m* ULF waves, the electrons trajectories can be significantly modified. More interestingly, the electron drift frequency is close to the nonlinear trapping frequency for intermediate-*m* ULF waves, which result in chaotic motion of resonant electrons. These findings provides improved understanding of the nature of coherent and diffusive transports of particles in the inner magnetosphere.

Keywords: driven pendulum equation, ULF waves, convection electric field, drift resonance

