4th URSI AT-RASC, Gran Canaria, 19-24 May 2024

Test Models of Chorus Wave Frequency Chirping

Xin Tao

University of Science and Technology of China, Hefei, China, e-mail: xtao@ustc.edu.cn

Chorus waves are known to play a crucial role of radiation belt electron acceleration and loss. However, the physical mechanism of chorus wave frequency chirping remains a challenging fundamental problem in space plasma physics. Various models, such as the sequential triggering model and the "Trap-Release-Amplify" (TaRA) model, have been proposed to understand why chirping occurs and how to estimate the chirping rate. In this work, we will present a simple particle simulation as a test to differentiate between the TaRA model and the sequential triggering model. The TaRA model uses the multi-wave approach and is based on that the background plasma supports a nearly continuous spectrum of whistler mode waves. Frequency chirping of chorus results from the selective amplification of narrowband emissions out of the continuous spectrum of the broadband background whistle waves. The selection process corresponds to the maximization of power transfer from energetic electrons to waves. On the other hand, the sequential triggering model of chorus is based on the a single-wave approach and explains the chirping by the frequency shift caused by the resonant current parallel to the wave magnetic field. A test about the two models, therefore, is not only important for understanding the key mechanism of chorus frequency chirping, but also has significant implications for similar basic plasma physics problems where theoretical models using both multi-wave and single-wave approaches have been considered.