The physics of anomalous doppler effect from quantum theory and numerical certification

Introduction:

The anomalous Doppler effect is a phenomenon which induces electron velocity scattering upon meeting the resonant condition in an electromagnetic field, described by

where represents the wavevector of the electromagnetic wave, is the electron cyclotron angular frequency, is the electron velocity, and is the angular frequency of the electromagnetic wave,. This phenomenon is associated with various effects, including whistler wave excitation, high-energy scattering, and the step-like structure observed in electron cyclotron emission within tokamaks. This phenomenon is quite normal but attractive. Despite ADE has been extensively studied in previous research based on quantum theory on classical mechanical theory, however, the basic physics of ADE still need to answer, such as what causes velocity scattering happen and kind of wave can trigger the ADE. In this study, we will firstly analysis from quantum field and then give a qualitive analysis for classical dynamic analysis of emw .finally ,we will give a numerical simulation to illustrate the correct of our analysis .The electric static field is no include in this paper and this has been talked in paper \*