Main questions

Reviewer1:

1. the analysis performed in the paper is not sufficient to give a significant contribution in this area. The point is that injected waves in anomalous Doppler resonance reduce electron parallel momentum in case of stimulated emission, but they do the opposite in case of absorption.

For this reason, single-particle analysis is not sufficient: the net wave effect should be evaluated in the presence of realistic distribution functions of runaway electrons, as well as of collisional wave damping.

1. The theoretical part is not new, in particular the quantum description of the anomalous Doppler effect is published in Coppi et al, Nucl. Fusion 16 30

Suggestions:

1. Title. “parallel energy”: energy is a scalar quantity; parallel could be appropriate for a vector (momentum) or for a tensor (pressure)
2. Page 1. “In the beginning of burning plasma device discharge (current ramp up phase), the magnetohydrodynamic (MHD) instabilities and disruption“: disruptions can occur in any phase of the tokamak discharge.
3. Page 1. “improves discharge performance by reducing the consumption of ohmic field energy “ not true, as plasma impedance increases when parallel momentum of runaway electrons decreases.
4. Figure 4. Consider that electrons with continuously increasing perpendicular momentum can be trapped in magnetic ripple and quickly drift to the walls.

Reviewer2:

1. In my opinion, the manuscript is a toy-model exploration of the phenomena of wave-particle interactions via Anomalous Doppler resonance, which has already been well-established in literature and has been proposed to be to be used as a way of mitigating RE beams with intentionally launching EM waves in tokamak plasmas via performing experiments and simulations.
2. Besides, the manuscript lacks in fundamental understanding and explanation of the physics concepts and comes nowhere close to simulating the complicated dynamics between runaway electrons and EM waves in a tokamak.
3. Therefore, there are no new results mentioned in this manuscript and no detailed analysis that backs up the claims made by authors in the abstract.
4. There is a whole series of seminal theoretical papers in different research fields discussing how the different polarization of waves may lead to different types of interactions with electrons, i.e., whether it will be normal, anomalous Doppler resonance or Cherenkov resonance, hence, I do not see any new results presented by the authors in this paper. Even the equations 21-23 derived in the appendix are well established in the literature.
5. The authors mention the impact of Anomalous Doppler effect to be “the transfer of the parallel electron energy to the rotational energy of the electron”, which is completely wrong, since the scattering of electrons due to EM waves leads to a change in perpendicular velocity of the electrons and hence, may increase just the gyro-radius of the electron, not the rotational energy which is related to the spin of the electron not the perpendicular energy given by “v\_\perp”.
6. The word “cyclotron electron” has been repeatedly used in the manuscript, what do the authors mean by this term? Do they mean an electron carrying out gyro-motion in the presence of a magnetic field?
7. The authors give no description of the form of the EM wave that they have used for their simulations in section II and III and how are they separating the different components viz. Left-handed, right-handed and circularly polarized wave from it during the simulations? Hence, the correctness of their simulations can’t be judged.
8. The authors further try to connect the simulations in section II and III with the tokamak conditions by amplifying the magnetic field in the simulations to 2 Tesla, however, the tokamaks have very complex helical magnetic fields a toroidal geometry. Hence, the simulations are way too simple to draw assertions for a tokamak plasma.

Reviewer 3

1. Most, if not all, the general results presented in the paper (see Secs. II – IV in particular) have already been presented and analyzed in detail in the literature, and reported even in textbooks.
2. Section II presents the numerical simulation framework in an incomplete way (e.g., the chosen expression for E.M. wave is not given), and the used parameters are not relevant for tokamak experiments. The discussion of the results is qualitative, no theoretical expression is derived or presented, so that the general validity is limited and application to a realistic case cannot be made.
3. In Sec.VI, the cold dispersion relation in a magnetized plasma is reported in detail, and the various wave-particle resonances are listed. All this part is well-known since many decades!
4. In Sec. V, it is proposed to launch extraordinary waves from the high field side of the tokamak to mitigate runaway electrons via ADE. This looks like speculation, not supported by a serious analysis, and also quite difficult if not impossible to realize in practice in a reactor. This proposal would deserve a detailed investigation of various complex physical processes not even mentioned in the paper.

Summary:

1. Simple model, full explored by other people, no new results, no fully analysis for wave and runaway interaction.