7th Asia-Pacific Conference on Plasma Physics, 12-17 Nov, 2023 at Port Messe Nagoya

Two dimensional simulations showing localized resonance absorption of a high-power microwave energy in plasma aided by inhomogeneous external magnetic field

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The interaction of High-power microwaves with magnetized plasma provides rich, uncharted territory in nonlinear physics. Such nonlinear studies have parallels with laser plasma systems [1,2]. For microwave plasma systems, simpler diagnostics can be adopted as the length and time scales involved are much longer than those for laser-plasma medium [3,4].

Here, we have reported a two-dimensional Particle - In - Cell (PIC) study of a Electromagnetic wave pulse interaction with a under dense magnetized plasma. The magnetic field is inhomogeneous and its profile has chosen in such way that a s-polarized propagating Electromagnetic (EM) wave of frequency (ω_l) observes two resonance layers (i) electron cyclotron resonance (ω_{ce}) and (ii) upper hybrid resonance (ω_{uh}) at two different locations in space. The magnetic field is chosen to be oblique with respect to the propagation vector of the incident EM wave.

A comprehensive analysis of energy absorption at resonance layers for four possible cases of incident EM-wave polarizations have been considered (i) s-polarized (ii) p-polarized (iii) Right circularly polarized (RCP) and (iv) Left circularly polarized (LCP). The Right circularly polarized (RCP) wave shows maximum absorption of around 80% at the electron cyclotron resonance layer. S-polarized wave is partially absorbed at both electron cyclotron resonance and upper hybrid resonance gets 63% absorbed by the plasma. Left circularly polarized wave and p-polarized wave show very little absorption as they do not go through any resonance layer. We have also considered in our studies the role of EM wave intensity and choice of magnetic field profile for efficient energy absorption.

References
[1] Maity, Srimanta, et al. "Mode conversion and laser energy absorption by plasma under an inhomogeneous external magnetic field." *Physical Review E* 105.5 (2022): 055209.

[2] Dhalia, Trishul, et al. "Harmonic generation in magnetized plasma for Electromagnetic wave propagating parallel to external magnetic field." *arXiv preprint arXiv:2302.11342* (2023).

[3] Maity, Srimanta, et al. "Mode conversion and laser energy absorption by plasma under an inhomogeneous external magnetic field." *Physical Review E* 105.5 (2022): 055209.

[4] Vashistha, Ayushi, et al. "Localized absorption of laser energy in X-mode configuration of magnetized plasma." *Plasma Physics and Controlled Fusion* (2022).

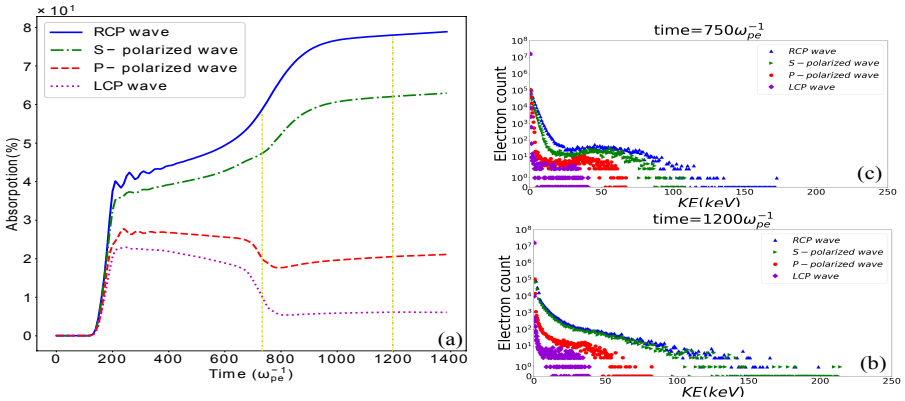

Figure 1 (a) Energy absorbed by electrons in plasma as a high-power microwave interacts with magnetized plasma with time. (b, c) shows electron distribution with kinetic energy at two times t= 750 and 1200ω_{pe}^{-1}.