Contribution ID: **618** Type: **Regular Poster**

Electron ion inverse bremsstrahlung absorption in laser fusion magnetized plasma

Wednesday 12 May 2021 18:25 (20 minutes)

Laser Magneto-Inertial fusion is a recently developed approach for the thermonuclear fusion. It consists in applying to the laser inertial fusion plasma a strong magnetic field whose the role is to limit the diffusion of the formed plasma during the impact of an intense laser pulse with a target containing the thermonuclear fuel, as well as the confinement of produced alpha particles by the fusion reaction. This permits to reduce the energy losses and even improves the compression conditions.
In this paper, the electron-ion (e-i) inverse bremsstrahlung absorption (IBA) of the laser energy in magnetized plasma in the frame of the MIF is analytically studied. We have considered a cylindrical scheme where the laser wave, circularly polarized, propagates in the direction of magnetic field (parallel mode).
The interaction of the laser pulse with the magnetized plasma is described by the Fokker-Planck (FP) equation with a Landau collision term. In order to resolve the FP equation, we have considered two scales of time evolutions for the distribution function: a fast scale time evolution following the laser wave time variation and a slow hydrodynamic scale time. The electron velocities distribution, developed on the spherical harmonics is analytically calculated.
The e-i IBA, <E.j>, is analytically calculated using the found expression of the distribution function. It is explicitly expressed as function the parameters of plasma, laser pulse and the applied magnetic field.
The numerical analysis of model equation shows the variation of the IB absorption with the different physical parameters. We point out in this context that the absorption is affected by the magnetic field and this depends to the polarization of the laser wave, increasing for the left polarization and decreasing for the right polarization.
Practical scaling laws are established for the MIF scheme and for the Magnetic confinement plasma heated by the radio-frequency wave.
The obtained results in this study permit to optimize the laser and plasma parameters in order to obtain good efficiency of the IB absorption in MIF experiments.

Keywords: Laser, Plasma, Magneto-inertial fusion; Inverse bremsstrahlung absorption; Fokker-Planck equation, scaling laws, time scales

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Session Classification: P4 Posters 4

Track Classification: Inertial Fusion Energy