Nonlocal heat transport under strong magnetic fields in laser ablation region

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Magnetic-field-assisted fast ignition has been actively studied since the successful generation of kilo-tesla magnetic fields using intense laser pulse [1]. In this scheme, externally imposed magnetic field collimates laser-produced relativistic electron beam and is expected to enhance heating efficiency. However, it is known that imposed magnetic field affects implosion symmetry due to anisotropic thermal conductivity in laser ablation region [2]. Aside from externally imposed magnetic fields, non-uniform laser irradiation on target induces self-generation of magnetic field [3], which may affect electron transport.

In laser ablation region during direct-drive implosion, temperature gradient is sharp so that its scale length is comparable to electron mean free path. Therefore, the nonlocality of electron transport needs to be modelled appropriately.

In this study, we conducted collisional particle-in-cell (PIC) simulations to investigate nonlocal heat transport under strong magnetic fields. A plasma with density slope, which imitates laser ablation region, is irradiated by 2×10^{14} W/cm^2 laser in the presence of externally imposed magnetic fields. Two modes of laser propagation are compared: ordinary (O) and extraordinary (X) waves. Nonthermal energetic electrons are generated near the critical surface with the X wave propagation unlike in the cases of O wave as shown in Figure 1. Further discussions will be shown in this presentation.

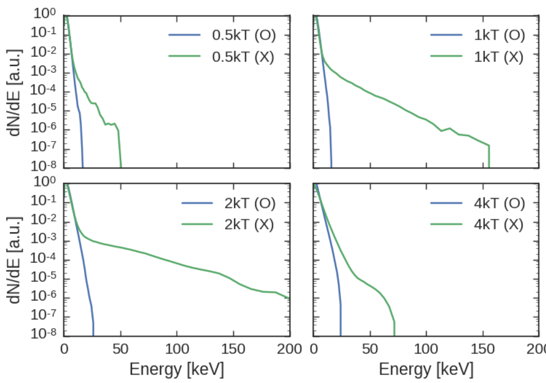

Figure 1: Electron energy spectra in O- and X-wave propagataion under various magnetic field strength

References

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