Simulation study of magnetic field effect on nonlocal heat transport in laser ablation plasma

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Nonlocal heat transport plays an important role in energy transport from critical surface to ablation front when $10^{14\text{-}15}$ W/cm^2 laser irradiates a solid target. Due to laser energy deposition on critical surface, temperature gradient becomes steep so that its scale length is comparable to electron mean free path. In such conditions, peak heat flux is inhibited[1] compared to local thermal conduction models, such as Spitzer[2] and Braginskii[3], while hot electrons travel their long mean free path into cold dense area, which results in nonlocality.

Laboratory generation of strong magnetic fields has been an attractive topic in high energy density physics including laboratory astrophysics. However, magnetic field effect on nonlocal heat transport, coupled with relatively complex laser-plasma interaction, has been rarely discussed.

In this study, we performed collisional particle-in-cell simulations in which the density-sloped magnetized plasma is irradiated by intense laser in the presence of kilo-tesla magnetic field to simulate nonlocal heat transport. We compared the results of ordinary (O) and extraordinary (X) laser waves. Significantly energetic electrons are generated near the critical surface with X wave injection. Further discussions on its effect on heat flux will be presented.

References:

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