Influence of a strong external magnetic field on the interaction of laser radiation with plasma

Abstract: In recent years, there has been great interest in the generation of extremely strong magnetic fields. Magnetic fields of tens of Tesla can now be generated using conventional techniques. At present, it is also possible to create much stronger fields, which usually last a very short time. For example, the interaction of very intense laser radiation with dense plasma makes it possible to create quasi-static magnetic fields with of 100 kT [1]. In this work, we will investigate the interaction between intense laser pulses and strongly magnetized plasma. We will study such strong magnetic fields that the electron cyclotron frequency is comparable and the frequency of the laser. In this case, the magnetic field has a dramatic influence on the processes occurring during the laser-plasma interaction, e.g. [2]. At the same time, we will also study much weaker magnetic fields and try to find the minimum field strength that would affect the interaction. The study will be carried out using computationally intensive particle simulations on powerful computational clusters using kinetic simulations with particle-in-Cell code EPOCH. This research is also related to current experiments at the PALS laser in the Czech Republic and other laboratories abroad, and the research is carried out in collaboration with ELI Beamlines.

[1] https://doi.org/10.1088/1367-2630/ac0573

[2] https://escholarship.org/uc/item/36f419k8

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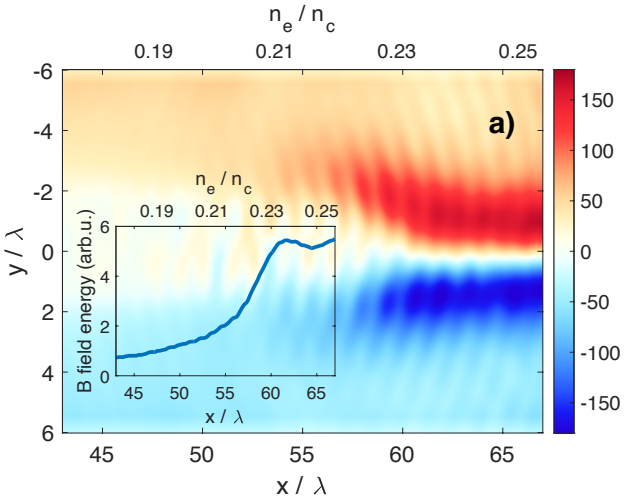

Figure 1: Strong magnetic field resulting from the interaction of the PALS laser beam with the plasma in the critical density region –3D PIC simulation.