RADIATION MAGNETO-HYDRODYNAMICS SIMULATIONS OF LASER ABLATION PLASMA FROM LOCALLY HEATED TARGET

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High-speed laser ablation plasma is expected to be a test bed for demonstrating astrophysical phenomena in which hydrodynamic instabilities amplify a background magnetic field and then result in creating high-energy cosmic rays [1]. Radiation magneto-hydrodynamics (RMHD) simulations are required for analyzing the experiments since the measured data is insufficient to identify the detailed process in the phenomena. The high velocity field is only obtained by a locally heated target using focused intense lasers, so the ablation plasma expands from the laser-heated site. However, the plasma structure is not formed spherically but is jetted in a wide region due to confinement by the surrounding plasma. As a result, a shock wave propagation driven by the heated site is not easy to be precisely reproduced by conventional numerical schemes for RMHD because of multi-dimensionality and anisotropy of the flow solution [2].

In this study, we have updated our RMHD code for describing a high-speed ablation plasma expanding from a heated site by taking into account anisotropic radiation field in a multi-dimensional space. A hybrid scheme for computing radiative transfer using Monte-Carlo sample photons [3] is coupled with the original RMHD code. The ablation structure is affected by the anisotropic radiation field, and the expanding plasma tends to be collimated. Since the numerical convergence should be obtained for a quantitative conclusion through a careful assessment for various numerical conditions, some test problems are performed for validation of the developed code. Anisotropic radiation field created by a point heat source highly depends on number of the sample photons; however, an appropriate assignment of the emitted photons to the heated site may reduce the total number by eliminating the unimportant samples.

Magnetic field amplification has also been investigated by the developed code, which is induced by a collimated plasma flow via hydrodynamic instabilities [2]. The collimated plasma structure determines the amplification level; therefore, the quantitative prediction of the field amplification requires the sophisticated numerical treatments for the RMHD solution.

[1] Y. Kuramitsu et al., Plasma Phys. Control. Fusion **54**, 124049 (2012).
[2] N. Ohnishi et al., High Energy Dens. Phys., in press.
[3] N. Ohnishi, High Energy Dens. Phys. **8**, 341 (2012).