Toward an Accurate Numerical Simulation of Radiation Hydrodynamics in Laser Ablation Plasmas

Naofumi Ohnishi[1]

[1]Department of Aerospace Engineering, Tohoku University

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Abstract

Laser ablation plasmas are widely used in not only practical applications such as short-wavelength optical source but also realizing high-speed rarefied flow relevant to laboratory astrophysics. However, some assumptions in conventional techniques of radiation hydrodynamics simulation sometimes break in a low-density plasma because of anisotropic radiation filed and non-continuum flow. A non-locally defined variable Eddington tensor can reconstruct the anisotropic field even in flux-limited diffusion approach with reasonable computational loads. We have developed an efficient method of estimating the variable Eddington tensor using Monte-Carlo photon tracking. Simulation results suggest that emission from laser ablation plasma tends to be anisotropic and affects on the structure of the ablation front. Moreover, we will discuss a precise prediction of free-expanding plasma flow, which is expected to produce a collisionless shock wave in laboratory, by coupling with Direct Simulation Monte Carlo (DSMC) technique.