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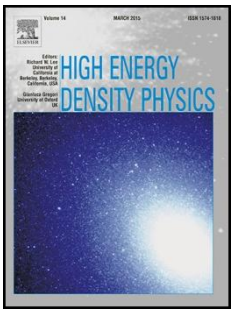

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Enhancement of laser to X-ray conversion by counter-propagating laser beams irradiating thin gold targets

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Abstract

X-ray emission from laser irradiating solid target is an important X-ray source for variously potential applications. Counter-propagating (C-P) laser beams configuration is proposed to enhance the laser to X-ray conversion efficiency (CE) from laser irradiating solid targets. One-dimensional radiation hydrodynamics simulations show that the total X-ray CE for the C-P lasers case is as high as 65%, which has a 13% improvement compared with the single laser case. The improvement is mainly caused by the enlarged radiation region, and the enhancement of X-ray emission is from soft X-ray. Detailed energy terms distributions and influences of the foil thickness on the X-ray CEs for both cases are presented. It is found that the enhancement of radiation is attributed to lower thermal and kinetic energy of the C-P lasers scheme.

Keywords: Laser to X-ray conversion, radiation hydrodynamics, inertial confinement fusion

1. Introduction

Laser-produced plasmas as intense X-ray sources have attracted extensive attentions for its potential applications in many fields, such as the advanced lithography[1, 2], X-ray backlighter imaging[3], high energy density physics[4, 5], and inertial confinement fusion (ICF)[6-10]. Two major characters of laser to X-ray conversion are the X-ray CE and the X-ray emission spectrum[11, 12]. Enhancement of laser to X-ray CE can improve the laser energy efficiency, and lower the demand for laser facility consequently. For the X-ray emission spectrum, attentions are always paid to improve the soft X-ray emission and reduce the M-band X-ray emission, since the preheating of the target should be suppressed in the indirect-driven ICF[13].

In order to achieve higher laser to X-ray CE, considerable work has been carried out by adjusting and optimizing target parameters, which includes the materials, the thickness, the density, and the target structure[14]. Many kinds of materials have been utilized to improve the laser to X-ray conversion, such as the traditional solid, the gas[15], the doped materials, the foam[16], and the aerogel[17]. The ordinary structures of targets consist of the planar targets, the spherical targets, the metallic thin foil targets[12], and the cavity targets[19]. Recently, several novel structures are proposed to enhance the X-ray CE, such as the double-foil target[14] and the multi-layer thin foil[19], etc. However, these innovative structures are hard to