Coherent control of the THz radiation in an inhomogenous plasma channel

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Synopsis The effective control on the intensity, polarization and the beam width of the THz radiation based on laser-plasma interaction is realized in a magnetized rippled density plasma channel.

Teraherta (THz) radiation based on laser-plasma interaction is of widespread interest for a variety of promising applications in the physics, biology and medicine [1]. Due to the material breakdown and low conversion efficiency of the non-plasma based schemes, the laser-plasma interaction as a key method for the THz radiation has been observed and discussed widely. In addition to frequency and amplitude of the THz radiation, how to control the polarization and the beam width of the THz radiation is the key issue to the applications of the THz science [2, 3, 4]. In previous works, the polarization of the THz radiation is controlled mainly by adjusting the location of the β-barium borate (BBO) crystal [3]. For the beam width control of the THz radiation, some rough methods (limiting the detection area with an aperture, the different parabolic metal mirror) are suggested [2]. Particularly, the control of the beam width of THz radiation via the laser-plasma interaction has never been discussed. So it's still an opening subject to design an efficient scheme for coherently manipulation the polarization and the beam width of the THz radiation.

In this paper, based on laser-plasma interaction, we propose an efficient new scheme for the control of the THz radiation generation by beating of two color lasers in a a magnetized plasma channel. The effects of the magnetic field and the rippled density plasma channel on the THz radiation are discussed in detail. We find that the coherent control of the polarization of the THz radiation is realized completely by adjusting the direction of the magnetic field, while the intensity and the beam width of the THz radiation can be controlled by changing the plasma channel generated by the super-Gaussian lasers and the strength of the magnetic field effectively. Particularly, the intensity of the THz radiation can forms a platform across the channel and the beam of the THz radiation shows a focussing feature, which can be controlled by adjusting the rippled density plasma channel and the strength of the magnetic filed. Figure 1 depicts the key results of the THz field (MV/cm) controlled by the plasma channel and the magnetic field direction. Such powerful and simple THz control techniques pave the way for promising THz applications.

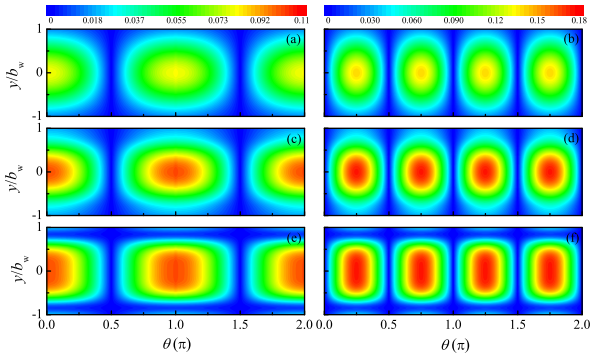

Figure 1. (Color online) Variation of $E_{0\mathrm{y}}$ (the left column) and $E_{0\mathrm{x}}$ (MV/cm) (the right column) against the plasma channel and the angle of the magnetic field θ.

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References

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