THz Radiation from Laser Created Plasma by Applying a Transverse Static Electric Field

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Terahertz (THz) radiation, which is emitted in narrow cone in the forward direction form femtosecond laser pulse created plasma has been observed by N.Yugami *et al* [1]. Additionally, A.Houard *et al*. have observed that a significantly increased THz emission intensity in the forward direction when the transverse static electric field is applied to the plasma [2]. They have proposed that the radiation source is the electron current, which depend on plasma frequency decaying in a few electron collision time. However, we have been measured the sub-THz radiation, whose frequency is much lower than the plasma frequency. The purpose of our study is to derive the mechanism of the THz radiation from laser created plasma by applying the transverse static electric field.

To study the radiation mechanism, we conducted both experiments and 2D-PIC simulation. In the experiments, we measured the characterization of THz radiation by using 10 Hz Ti:sapphire chirped pulse amplification laser system, witch provides 120 fs laser pulses at 800 nm pulse duration (full width at half maximum: FWHM) at a maximum pulse energy of 40 mJ. We observed the forward orientation of the emission whose angular pattern becomes sharp as the frequency increases. The radiation amplitude is proportional to the external electric field. In the simulation, we used 2D-PIC simulation code. We observed an intense sub-THz single cycle pulse, whose amplitude linearly scales with an external electric field. With the external electric field of 20 kV/cm and electron density in the plasma of 10^{18} cm^{-3}, we obtain 1.2 THz radiation, whose intensity is 1.3×10^5 W/cm^2. The magnetic field called “picket fence mode” is generated in the laser created plasma when applying the external electric field. We conclude that the temporal behavior of the magnetic field in the plasma radiates the THz wave.

References

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[2] Aurélien Houard *et al*., Phys. Rev. Lett. **100**, 255006 (2008).