THz laser plasma diagnostic

Guoqian Liao
Institute of Physics, Chinese Academy of Sciences
E-mail : gqliao@iphy.ac.cn

Fast (or hot) electrons are fundamental for ultraintense laser-plasma interactions, due to their key roles played in many applications such as the fast ignition scheme for inertial confinement fusion, secondary ultrafast radiation, and high-energy ion acceleration. A number of techniques have been used to diagnose the energy spectral and spatial distribution of fast electrons, while the temporal property of fast electrons, like the bunch duration, and dynamics during the transport in dense targets, is much less studied. Recent experiments have demonstrated that, ultraintense laser interactions with a foil target can produce record extreme terahertz (THz) radiation [1,2]. The THz radiation offers an alternative probe-free temporal diagnosis of fast electrons. We have studied the physical mechanisms underpinning the THz generation at the solid target rear, and developed single-shot ultrabroadband THz spectrum and waveform measurement systems. Based on the THz generation model and the experimentally measured THz properties, we have diagnosed the fast-electron temporal information including the electron bunch duration and the sheath decay time at different laser and target parameters [2]. Results show a clear manifestation of the fast-electron transverse refluxing and longitudinal recirculation effects. Other applications of THz radiation in the laser-plasma diagnosis will also be reviewed and prospected in the talk.

References

[1] Guoqian Liao *et al.*, Proc. Natl. Acad. Sci. U.S.A. **116**, 3994 (2019).
[2] Guoqian Liao *et al.*, Phys. Rev. X **10**, 031062 (2020).