

4 - 16 Evolution of Free Electron Density of Laser Plasma*

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Laser-produced plasmas (LPP) have a similar plasma environment to fusion plasma, and the diagnose is essential aspect to understand the plasma's properties. A new laser plasma target has been built in our laboratory and the free electron density varying with time is diagnosed using the high-resolution interferometry.

An optical fiber interferometer (OFI) is applied, which is based on the principle of Mach - Zehnder interference and composed of laser source (1 550 nm and 50 mW), fiber collimators, beam splitter, three photoelectric detectors, and the wide-band oscilloscope^[1]. Figure 1 shows the experimental results, (a) is the change of free electron density with time and (b) is the maximum values of free electron density depending on laser energy.

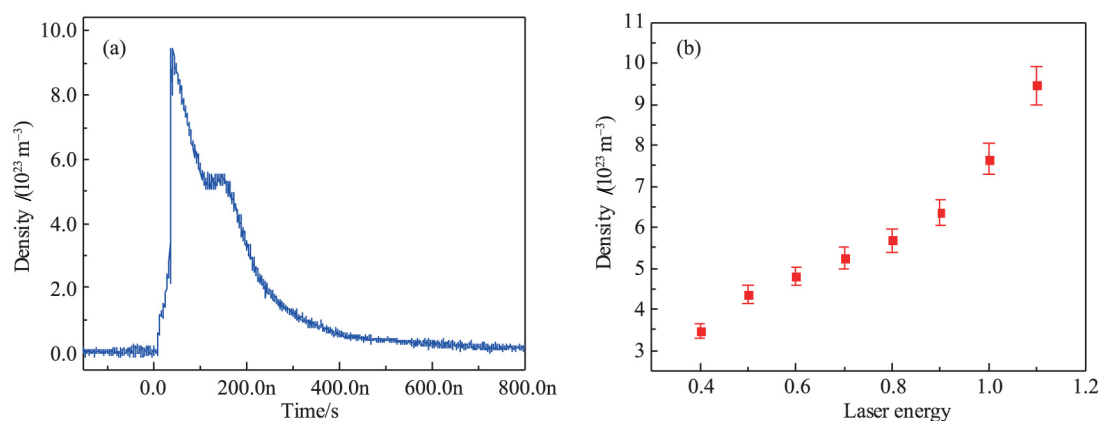


Fig. 1 (color online) The evolution of free electron density with plasma lifetime by OFI (a) and the change of free electron density with laser energy (b).

Figure 1 (a) shows the free electron density of LPP with lifetime with the 1.1 J laser energy. The free electron density increases sharply at the beginning, and reaches the maximum value about $9.23 \times 10^{23} \text{ m}^{-3}$ at 40 ns. Later it decreases slowly and a plateau state is found about 114~150 ns which is believed to be caused by the constraint of the target. The whole plasma lifetime is around 400 ns. The Fig. 1(b) shows the change of maximum value of free electron density with the laser energy, and a linear correlation is presented.

Reference

- [1] S. Zhang, C. Chen, T. Lan, et al., Rev. Sci. Instr., 91(2020)063501.

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