Collective Thomson Scattering Measurements at 100 TW Laser Facility of NCU to Study Reflected Particles of Upstream Shocks

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Collisionless shocks enable to accelerate cosmic rays with the standard model of diffusive shock acceleration [1]. Since such shocks are found beyond the solar system, it is quite impossible to resolve the local structures. In this case, laboratory plasmas experiments reproduce them in a small scale with laser produced plasmas (LPP) by using high-power and high-intensity lasers [2].
As ions pass through a shock region, they might reflect to the upstream shock, excite the plasma waves, and accelerate the particles. The number of reflected particles depends on the shock potential ($< kT_e/e$) and the ratio of electron to ion temperature (T_e/T_i) in front of the shock. The shock velocity determines the energy of reflected particles and depends on the electron temperature. Hence, the measurements of electron and ion temperature are quite important. The local quantities of the ion feature have been obtained by using collective Thomson scattering (CTS) diagnostics [3]; however, the strong background self-emission of LPP and the weak signal of the electron feature compared with the ion feature make trouble to measure the electron feature. To solve the problem, we are motivated to use the 100 TW laser facility of NCU as a repetitive main laser with the repetition rate of 10 Hz to excite the shocks. We designed and constructed a CTS diagnostics system for the electron feature with the spectral resolution of 0.18 nm. The system collects the scattered signals of CTS to improve the signal to noise ratio. By measuring the local electron temperature and drift velocity, the reflected particles and particle acceleration are investigated. An electron-ion spectrometer is employed to measure the reflected particles.

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