Studies of fast electrons emitted during intense laser-solid interactions

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High currents of hot electrons are created inside solid targets when irradiated at intensities of $>10^{18}$ Wcm$^{-2}$. The complex transport physics through the target material determines the magnitude and distribution of the sheath fields present on the rear of the target from which ions can be accelerated. For Fast Ignition, either the escaping electrons can be used to directly heat the plasma core or the secondary ions accelerated from the surface can be utilized.

In experimental studies carried out using ps pulses at 1.05 microns, the angular escaping ion and electron fluxes$^1$ were characterized and the total energy content evaluated as a function of intensity. Under varying conditions, the conversion of the incident laser energy into either escaping electrons or ions varies from $<1\%$ to $>10\%$. By decreasing the focal spot area at constant laser drive energy, the intensity can be increased and it was found that the total energy of the escaping electrons reaches a maximum and then decreases. Interestingly, the temperature of the escaping electrons shows a much slower scaling than expected compared to the expected internal temperature. These experimental observation can be understood in terms of the magnitude and area of the sheath field and results will be presented and the implications for future fast ignition experiments considered.

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References