Electron - Ion Equilibration in Intense Laser Induced Shock Waves

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This paper considers the heating and electron-ion equilibration in a target upon shock wave created in a planar geometry by the ponderomotive force induced by a short laser pulse with intensity higher than 10^{18} W/cm^2. The shock parameters are calculated using the relativistic Rankine-Hugoniot equations coupled to a laser piston model [1]. The temperatures of the electrons and the ions are calculated as a function of time by using the energy conservation separately for ions and electrons. These equations are supplemented by the ideal gas equations of state (with one or three degrees of freedom) separately for ions and electrons. The efficiency of the transition of the work done by the laser piston into internal thermal energy is calculated in the context of the Hugoniot equations by taking into account the binary collisions during the shock wave formation from the target initial condition to the compressed state [2]. It is shown that for each laser intensity there is a threshold pulse duration for the formation of a shock wave. Calculations are done for different target materials .

References

[1] Eliezer et al. , Laser Part. Beams 32, 243 (2014)

[2] Eliezer et al, Laser Part. Beams , published on line 03 April, 2017