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Hot electron energy coupling in cone-guiding fast ignition[1]

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A critical issue for the fast ignition of inertial fusion targets, where compressed fuel is ignited by injection of an intense short laser pulse, is whether the hot electrons produced in the interaction are in an energy range conducive to efficient heating of the core. The required in-tensity of the ignition laser light becomes greater than 10^{20} W/cm^2 to meet the ignition condition. In this talk, we present the result of a "numerical" experiment of Cone Guided Fast Ignition with a super-intense laser pulse using a collisional PIC code, *PICLS* and challenge this critical issue. Our numerical experiment is the first simulation, which evaluates the complete physics underlying FI self-consistently, excluding nuclear reactions. In particular, this simulation accounts for hot electron generation, fast ion acceleration, energy transport in large density scale coronal plasmas, and collisional energy coupling to the core, i.e. we study a model situation that is as comprehensive and self-consistent as possible today. We found that the while electromagnetic instabilities appear around the cone target where the plasma density is less than a few hundred times critical density, no significant fields are found near the core. This indicates that core heating is mainly provided by collisional processes. In particular, the predominant core heating mechanism has been identified as drag heating between hot and bulk electrons. We also found that after the preplasma inside the cone was blown away, the hot electron temperature observed in the simulation is lower than the ponderomotive scaling. A simple analytic scaling law for the hot electron temperature is obtained which agrees with our simulation results. This temperature scaling indicates that it may be possible to tune the temperature of the hot electrons generated by the super-intense ignition pulse for optimal core heating by manipulating the properties of the material inside the cone target.

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