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Calculation of fusion gain in fast ignition with magnetic target by relativistic electrons and protons

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Abstract

Fast ignition is a new method for inertial confinement fusion (ICF) in which the compression and ignition steps are separated. In the first stage, fuel is compressed by laser or ion beams. In the second phase, relativistic electrons are generated by pettawat laser in the fuel. Also, in the second phase 5-35 MeV protons can be generated in the fuel. Electrons or protons can penetrate in to the ultra-dense fuel and deposit their energy in the fuel . More recently, cylindrical rather than spherical fuel chambers with magnetic control in the plasma domain have been also considered. This is called magnetized target fusion (MTF). Magnetic field has effects on relativistic electrons energy deposition rate in fuel. In this work, fast ignition method in cylindrical fuel chambers is investigated and transportation of the relativistic electrons and protons is calculated using MCNPX and FLUKA codes with 0. 25 and 0. 5 tesla magnetic field in single and dual hot spot. Furthermore, the transfer rate of relativistic electrons and high energy protons to the fuel and fusion gain are calculated. The results show that the presence of external magnetic field guarantees higher fusion gain, and relativistic electrons are much more appropriate objects for ignition. MTF in dual hot spot can be considered as an appropriate substitution for the current ICF techniques.

Keywords: fusion, pellet, inertial method, fast ignition, fusion gain

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