Iranian Journal of Physics Research, Vol. 12, No. 4, 2013

Fast-shock ignition: a new approach to inertial confinement fusion

A H Farahbod and S A Ghasemi

Research School of Laser and Optics, Research Institute of Nuclear Science and Technology, Tehran
E-mail: afarahbod@aeoi.org.ir

(Received 4 March 2012 ; in final form 31 October 2012)

Abstract

A new concept for inertial confinement fusion called fast-shock ignition (FSI) is introduced as a credible scheme in order to obtain high target gain. In the proposed model, the separation of fuel ignition into two successive steps, under the suitable conditions, reduces required ignitor energy for the fuel ignition. The main procedure in FSI concept is compressing the fuel up to stagnation. Then, two high intensity short pulse laser spikes with energy and power lower than those required for shock ignition (SI) and fast ignition (FI) with a proper delay time are launched at the fuel which increases the central hot-spot temperature and completes the ignition of the precompressed fuel. The introduced semi-analytical model indicates that with fast-shock ignition, the total required energy for compressing and igniting the fuel can be slightly reduced in comparison to pure shock ignition. Furthermore, for fuel mass greater than $\sim 2\,\text{mg}$, the target energy gain increases up to 15 percent and the contribution of fast ignitor under the proper conditions could be decreased about 20 percent compared with pure fast ignition. The FSI scheme is beneficial from technological considerations for the construction of short pulse high power laser drivers. The general advantages of fast-shock ignition over pure shock ignition in terms of figure of merit can be more than 1.3.

Keywords: fast ignition, shock ignition, fast-shock ignition, inertial confinement fusion, non-isobaric model

For full article, refer to the Persian section