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Innovative Concept of the Compression and Heating of the Plasma Targets in the Scheme for Magneto-Inertial Fusion

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This paper presents a concept of dynamic plasma compression which unites a technique of megagauss magnetic field generation and methods of plasma confinement in a specially formed magnetic configuration. This concept is a determining one for the magneto-inertial (hybrid) approach to the controlled thermonuclear fusion. Comparing to the inertial confinement the main magneto-inertial fusion advantages are smaller values of plasma density and temperature, which are nevertheless sufficient for heating the target and thermonuclear reaction ignition. In this case magnetized plasma is initially created inside an axisymmetric magnetic trap and exposed to direct compression by means of laser beams (laser driver) and/or plasma jets (plasma liner).

Prospective high energy density systems such as different sources of neutrons and protons will be used in the near future to perform cutting-edge materials research, non-destructive analysis, medical isotope production, chemical waste disposal, personnel training, etc. The goal of the investigation is complex numerical research and optimization of the pulsed high-temperature processes in a dense magnetized plasma (target). Distinctive feature of this problem is the presence of initial seed fields (the imposed external pulse magnetic field) and compression of a magnetic flux by laser beams (laser driver) or plasma jets (plasma liner). An embedded magnetic field is compressed along with the target plasma to achieve magnetic insulation. The presence of the megagauss magnetic field strongly inhibits electron thermal conduction losses by several orders of magnitude. Modeling of magnetized plasma compressed by the laser beams and plasma jets is described. Theoretical estimation of MIF prospects as the target compressed by a pusher (laser Driver or plasma liner) for the achievement of fusion temperatures is done.

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