rarefaction shock waves and megaampere Discharges in laser plasma

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When a nanosecond powerful pulse of laser radiation is focusing onto a solid target the plasma steepening and megagauss magnetic field generation near the critical density are observed in laser plasma [1]. Moreover, in a set of experiments the quasi-static currents flowing on targets surface were reveals [2].

By now the many thermal, radiation and dynamo mechanisms of quasi-static magnetic field generation were established and the various models for plasma steepening description were offered [1]. It is usual to discuss these issues associating with the ordinary ITS [1], but here it is of interest to investigate an opportunity to obtain high currents flowing on target surface. For this purpose let us turn the current generation mechanism related with rarefaction shock wave [5].

Here, we are presenting the results of investigation in the laser plasma model with London current [6] where the rarefaction shock wave is a discontinuity on its one side a supercritical plasma takes place and on its other side a subcritical plasma is. A current generating by laser radiation is flowing on the discontinuity surface. The current in its turn creates a magnetic field on the discontinuity sides. In the plasma near the discontinuity the London currents are also induced which are opposite to the current flowing on the discontinuity surface.

It’s shown that under the action of laser radiation on target set in external electric field exceeding the critical value the currents on discontinuity surface in rarefaction shock wave have to be generated in the direction of external electric field. The estimation of discharge current magnitude in the scheme with a target irradiated with laser beam and turned on in the external circuit gives 1MA at the laser pulse energy 10 kJ.

This study was supported by the Russian Foundation for Basic Research (project no. 15–02–05995a).

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