Experimental Study of relativistic femtosecond laser plasma interaction with dense plasma

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We reviewed experimental studies of interaction of femtosecond laser radiation with intensity up to 5·1018 W/cm2 with dense plasma, conducted recently using terawatt femtosecond laser facility of ILC MSU. The main stress was on the control of plasma parameters (luminosity in X-ray and gamma ranges, generation of bunches of relativistic electrons and fast multicharged ions) and their optimization by choosing interaction regime and preplasma parameters. The latter is unavoidable due to action of prepulses with different intensity and duration always pertaining in the temporal structure of a powerful femtosecond pulse. That is why we are paying a lot attention to the contrast of the laser pulse at nano- and picosecond scales. The current intensity contrast of our system reaches 1010, that is enough to avoid surface breakdown before the mail pulse action.

There are four main activities described in the paper:

- study of impact of prepulses of different types onto plasma parameters (ASE, short prepulses within nano- and picosecond timescales) under interaction with solid targets [1–4];

- study of high-contrast laser pulse interaction with long controlled preplasma, created by an additional nanosecond laser pulse [4, 5];

- study of short prepulse impact advancing the main pulse by 5–15 ns under interaction with melted metal targets [6–8];

- study of interaction with targets having micro- or nano-relief on their surfaces and some applications of laser-plasma sources [9–10].

These researches are underway in the tight collaboration with scientific groups from different RAS institutes and are supported by RFBR.

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