Study of plasma jets formation in a transverse magnetic field on the laser-plasma facility KI-1

A. A. Chibranov, A. G. Berezutskiy, Yu. P Zakharov, I. B. Miroshnichenko, V. G. Posukh, M. A. Rumenskikh, I. F. Shaikhislamov, A. E. Ivanov, M. V. Loginov

ILP SB RAS, Novosibirsk, Russia, chibranov2013@yandex.ru

A series of experiments on the formation of collimated plasma jets into a transverse magnetic field, including in a counter configuration, were conducted on the KI-1 setup [1, 2]. For this purpose, flat polyethylene targets located at a distance of L ≈ 1 m from each other were irradiated with CO_2 laser pulses with an energy of E = 100 J and a duration of τ = 100 ns, generating laser plasma flows with an initial energy of $E_0 \approx 32$ J, a velocity of $V_0 = 250$ km/s and a total number of particles of $N \approx 1.3 \cdot 10^{18}$, expanding into a transverse magnetic field of $B_0 = 340$ G. The measurements were carried out using a system of combined magnetic and electric probes, as well as using photo recording systems. The obtained data demonstrated that when a plasma flow expands from a target into a transverse magnetic field, the plasma forms a collimated "sheet" structure with plasma spreading along the field and collimation across the field, which was also detected from the ultra-high-speed photography data. The flow extends over a distance of more than 1 meter, which is much greater than the ion gyroradius $R_L \approx 18$ cm in this experiment. When two plasma flows expand in a magnetic field, an interaction of two jets is observed in plasma glow photographs and probe measurements. The formation of a sharp compression front of the magnetic field with a high concentration and high-frequency oscillations (ν ≈ 1 MHz) of the main component of the magnetic field were also detected. Thus, the experiments made it possible to determine the features of the dynamics of directed plasma flows in a transverse magnetic field, including in the case of a counter configuration.

The work was supported by the Russian Science Foundation grant № 24-62-00032, https://rscf.ru/project/24-62-00032/.

1. Y.P. Zakharov et al //*AIP Conference Proceedings. – American Institute of Physics*, **369**, № 1, p. 357-362, (1996).
2. I. F. Shaikhislamov et al //*Plasma Physics and Controlled Fusion*, **56**, № 12, p. 125007, (2014).