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LASER PLASMA EVOLUTION IN EXTERNAL 10T MAGNETIC FIELD

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Abstract. A Magnetized Laser Plasma Facility was built at USTC, which is composed of a nanosecond heating laser beam (6J/527nm/7ns), a femtosecond detecting laser beam (2mJ/800nm/50fs), and a 7-30T pulsed magnetic field generator. A series of laser plasma evolution experiments were performed at USTC. (1) When a high-speed plasma stream, produced by laser ablated solid target, expanding in a external transverse magnetic field, we found that the laser plasma forms an asymmetric hollow plasma bubble which caused by the plasma accumulation at the plasma-magnetic field interface. The asymmetry of the plasma bubble can be reversed by turning the direction of the magnetic field. The plasma, streaming along the surface of the plasma bubble, converges at the head of the bubble and generates a plasma jet moving freely across the magnetic field. Hall MHD simulation shows that the asymmetry of the bubble is induced by the Hall effect. It indicates that the jet's movement is supported by the E×B drift that E is contributed by the self-polarization electric field -V×B. (2) Plasma optical images and the ablation holes on the target show that the laser ablation is enhanced by using the external 7T magnetic field. The laser plasma is confined by the magnetic field and forms a plasma bubble surrounding the laser focus spot. The target surface, which contacts the plasma bubble, is heated by the energy transport along the surface of the plasma bubble. Thus the debris and the target surface surrounding the laser focus spot are ablated and increases the plasma generation. (3) When an external magnetic field is added along the laser channel in underdense plasma, we found that the electron thermal transport was suppressed by the magnetic field, which enhances the plasma temperature. It can be used to restrain the stimulated scattering process in laser fusion. We found that 20-30T external magnetic field is needed to mitigate the stimulated scattering process on Shenguang-III primary laser facility of China.