Interaction of high Mach-number shocks in laser-produced plasmas

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Abstract

Shock waves are known to be important for particle accelerations and thermalization of plasmas both in the universe and in space plasmas. Therefore, they have been studied theoretically, numerically, and observationally for many years. The interactions of two shocks and of a shock with an interface where density increases are also commonly observed. Shock collisions, for example, occur between forward and reverse shocks at solar winds [1] and between an interplanetary shock and Earth's bow-shock [2]. Shock-interface interactions are observed in molecular clounds when supernova remnant shocks propagate them

[3]. These interactions are also important for paticle acceleration and plasma heating. High Mach-number shocks have been produced with high-power laser systems [4,5] to investigate a single collisionless shock. We observed multiple shock interactions in temporal evolution data of the plasma expansion and shock propagation. Shock collisions were measured with optical probe diagnostics and streaked emission measurements. These results show clear jumps of emission brightness and plasma density at regions where shocks interact. We discuss the possibility of model experiments for strong shock formations and shock interactions as observed in the universe and in space plasmas using a high-power laser.

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