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Current status and issues of a study on collisionless shocks by using laser experiment

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Collisionless shocks are ubiquitous in various space and astrophysical environments like a termination shock of a stellar wind, planetary bow shocks, supernova remnant shocks, etc. Recently, collisionless shocks have been able to be experimentally generated by using high power laser facilities. One of the advantages in an experimental study is that both the global and the local structures of the phenomenon are simultaneously accessible in principle, which is inherently difficult in-situ or remote sensing observations in space. However, the shocks produced in the laser experiments and the method for measuring them are quite different from those in space. A majority of the shocks produced in laser experiments are unmagnetized shocks. The methodology for measuring their local quantities in the transition region has not been established.

On the other hand, basic structures and dissipation mechanisms in an unmagnetized shock have not been well understood theoretically. So far high Mach number electrostatic shocks are thought to be generated by the counter streams of two non-identical plasmas. In this study microstructures of such electrostatic shocks are studied by using a full particle-in-cell simulation. In addition, characteristics and issues of currently adopted method of measuring local quantities in shock transition region, known as Thomson scattering measurement, are also discussed.

Keywords: collisionless shock, laser experiment, numerical simulation