無衝突衝撃波の実験的研究に向けたプラズマ計測法の検討

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Examination of plasma diagnostics for experimental study on collisionless shocks

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Collisionless shocks are ubiquitus in a variety of space and astrophysical phenomena. Recently, high power laser facilities have successfully reproduced collisionless shocks. A laser experiment is now expected to be a new research tool for collisionless shock physics. In collaboration with the Institute of Laser Engineering at Osaka University we plan to investigate multi-scale phenomena in a collisionless shock reproduced by Gekko XII laser. A single foil target in a gas is ablated by the laser irradiation. The ablated plasma expands in a surrounding plasma of the gas origin, which leads to the formation of a shock. In the experiment local plasma quantities in the shock transition region are measured by using collective Thomson scattering measurement. The collective Thomson scattering is the interaction between a sufficiently low frequency incident electromagnetic wave and collective oscillations of a plasma. The interaction produces scattered waves which include information of collective plasma phenomena. The Thomson scattering measurement has been widely used so far to measure experimental as well as space plasma. However, the scattering theory has not been well established in the case that the plasma is highly non-equilibrium as in a shock transition region. In this study we discuss the scattering processes in highly non-equilibrium plasmas typical in a shock transition region and suggest that the so-called electron features of the Thomson scattering, which are usually weak signals in an equilibrium plasma, may be a good measure of a microinstability in a shock transition region.