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Relation between plasma instabilities and frequency ratio of the plasma oscillation to the gyration in the shock transition region

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Both of Mach number and plasma beta are widely known as important parameters control for shock dissipation mechanisms. We show here the ratio of plasma oscillation frequency to plasma gyration frequency is another important parameter for shocked plasma energization process. We carried out one-dimensional periodic particle-in-cell simulation which mimics shock transition region. The interaction among three component of the flow; inflow ions, inflow electrons, and reflected ions, is investigated. We report plasma energy variation (especially focus on the electron component) under every value of the frequency ratio of the plasma oscillation to the gyration. Under large ratio of this value (similar to our heliosphere), electrostatic Buneman instability works effectively on the electron heating as shown in the previous studies. When the frequency ratio of the electron plasma oscillation to the electron gyration is larger than 20, non-thermal electrons are observed in addition to the strong thermalization. As a result of the strong electron heating, ion holes are generated and be stable. The ion holes result in the gradual heating of the electron. This is the same phenomenon with that observed at just downstream region from the shock front in the shock simulation. On the other hand, when the frequency ration is smaller (below 5), magnetic force is dominant and we can not find nonlinear evolution of the Buneman instability like electron hole dynamics. In this case resulted electron heating is small but non-thermal electrons are generated effectively. We carried these simulation under the following conditions; Mach number = 16, plasma beta for the electron and ions = 0.01, mass ratio = 1836.