Collisional effects on beam transport in dense plasma

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The transport of high currents in dense plasma is an important issue relevant with the fast ignition scheme of laser fusion. Collisional effects on the transport of relativistic electron beams through cold dense plasma have been studied theoretically and numerically. Dispersion relation for kinetic beam-plasma instabilities in full k-space is solved by the Padé approximation of the plasma dispersion function and by rotating the coordinate system. It is shown that the electrostatic components of the general oblique mode are suppressed by the collisional effect while the electromagnetic components are enhanced by it. As a special case of the electromagnetic instabilities, the current-filamentation instability has the largest growth rate, which becomes dominant in the nonlinear stage as shown in our two-dimensional particle-in-cell simulations. It is also shown that, even though a beam appears divergent during the transport in dense plasma in the collisionless case, it becomes collimated in the collisional case due to stabilization of the electrostatic instabilities and magnetic collimation. This is favorable for the fast ignition scheme of laser fusion.

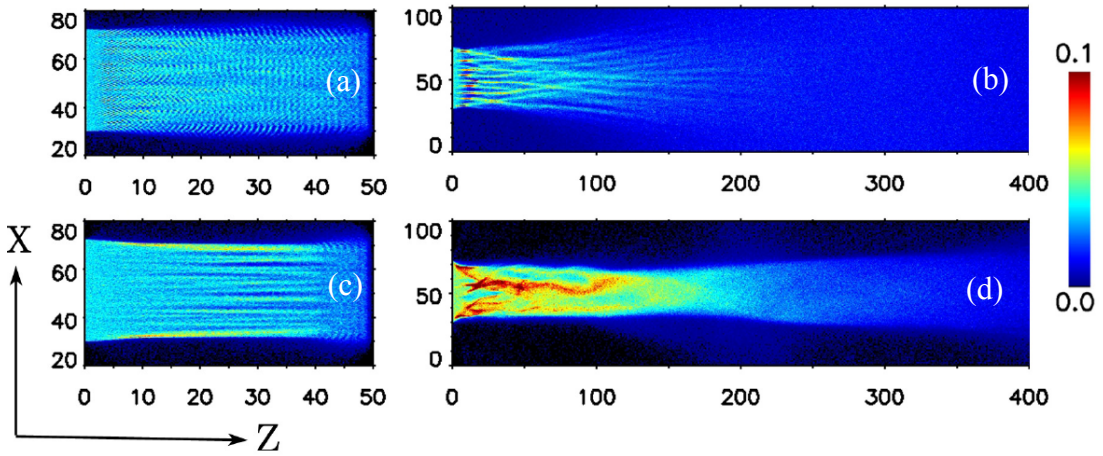

Figure 1: Snapshots of the beam electron density obtained by PIC simulation. Plots (a) and (b) show the results for collisionless plasma at different time, while plots (c) and (d) show the corresponding results for collisional plasma.