Full-particle simulation on beam ion plasma in linear confinement system

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A linear confinement system offers several useful applications because of its simple structure. Axially injected beam ions can be trapped electrostatically in the system which functions as neutron generator when the beam is deuteron. Since it is considered, however, that many instabilities like two-stream instability are induced in the plasma, it is necessary to investigate the electromagnetic behavior of the plasma. Therefore, a 3-dimensional full-particle simulation is carried out in the present study.

Here, the Cartesian coordinate system is employed in order to avoid unfavorable numerical noise near the geometric axis. Temporal evolution of electromagnetic fields is calculated by solving the Maxwell's equations considering displacement current.

In this calculation, we set two groups of ions as initial condition. Here, one group is assumed to have a beam velocity, and the other group is assumed to be at rest. Ions are arranged so as to have a Gaussian distribution within the beam radius while electrons are arranged so as to be uniformly distributed inside the confinement chamber radius. Therefore, we consider the situation where the outward radial electric field is initially formed. Periodic boundary conditions are applied in the axial direction in order to avoid end loss of ions.

As a result of the calculation, radial density fluctuation is observed, and it is found that the oscillation frequency is almost the same as the electron plasma frequency.