NUMERICAL ANALYSIS OF APPLIED MAGNETIC FIELD DEPENDENCE IN MALMBERG-PENNING TRAP FOR COMPACT SIMULATAOR OF ENERGY DRIVER IN HEAVY ION FUSION

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An energy driver development is a key issue for inertial fusion energy. In inertial confinement fusion (ICF) driven by heavy ion beams(HIB), high-current HIB are required as the energy driver [1]. Because required parameters of the HIB for ICF are far from that of the conventional beams, the beam behaviors should be researched well for the energy driver development. Instead of the HIB, which is in the condition dominated by the space charge effect, the equivalent beam dynamics can be simulated with a compact experimental apparatus using the electron beams. Therefore, the beam dynamics simulation in the bunch compression of the HIB has been demonstrated using the Malmberg-Penning trap device [2]. In this study, we numerically investigate the beam dynamics for the compact simulator by using Malmberg-Penning trap device [3].

Numerical simulations are performed under the experimental conditions as the HIB simulation by the Malmberg-Penning trap device. In the numerical simulations, the compression ratio of 10 from the initial condition was carried out using the molecular dynamics simulation code [4], which represents a particle-particle method. At the initial condition, 1.6×10^8 electrons with Gaussian distribution as 1 eV are arranged uniformly in cylindrical space with 10 mm in radius and 180 mm in length. The boundary conditions at the both ends are set to be reflection boundary for the particles. The compression time and the applied magnetic field density are 100 ns and 0.01 T or 0.1T respectively.

Figure 1 shows a charge density distribution in longitudinal phase space at the initial condition and at 250 ns. As shown in Fig. 1, the longitudinal velocity spread for both cases increase during the bunch compression. The velocity spread is remarkable in the case of weak magnetic field. As a result, the longitudinal velocity spread during the bunch compression depends the externally applied magnetic field.

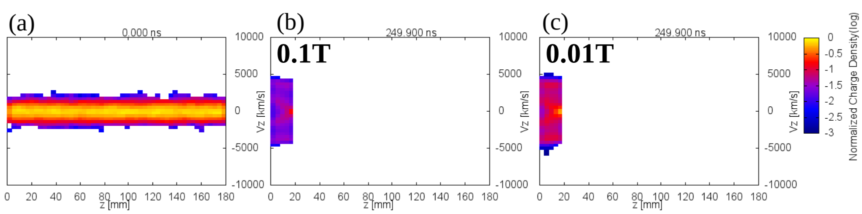

Figure 1 Charge density in longitudinal phase space, (a) at initial condition, (b) after 250 ns with 0.1 T, and (c) after 250 ns with 0.01 T.

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