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Simple 3D PIC Analysis for Beam Phase Space Oscillation in RF Driven Negative Hydrogen Ion Source

Temporal oscillation of the negative hydrogen ion (H^-) beam phase space in Radio Frequency (RF) ion source is a serious problem which causes increase in the beam divergence angle in the fusion application or unexpected beam loss due to Twiss mismatch in the accelerator application. Physical mechanism of the oscillation is investigated by a simple 3D Particle-In-Cell (PIC) model. The model takes into account the transport processes of electron, proton and H^- in the extraction region. The calculation domain is in vicinity of the single beam aperture in J-PARC ion source configuration. In order to understand relation between the plasma density oscillation and the extracted H^- beam characteristics, the input electron and proton fluxes from the driver region are varied parametrically with the fundamental and the second harmonics of the J-PARC RF frequency (2 and 4 MHz). The numerical results give an idea to the main physical processes between the oscillations of the plasma parameters and the extracted H^- ion trajectories in the different RF phases.

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