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## Studies of space-charge compensation of positive ions by creating time-dependent secondary electrons in low-energy beam transport line

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The space-charge neutralization of an ion beam by created electrons when the beam ionizes the gas is investigated using a three-dimensional electrostatic particle-in-cell code. Different kinds of injected gases are considered, and their space-charge compensation transient times are compared. The created secondary electrons by the beam collision with neutral gas along the beam trajectories are loaded in the simulation by a Monte Carlo generator, and their space charge contribution is added to the primary beam space charge densities. The injection and accumulation of secondaries are time-dependent and this process is continued until total space charge densities reach a steady state. In this study, a 2.4-meter LEBT line with two solenoid magnets is considered. Usually, the proton beam energy is 25 keV and the current level is around 10-15 mA. Additionally, beam extraction studies are conducted, and the extracted beam is used in both IBSIMU and Tracewin codes for LEBT lines to validate the results.

### Footnotes

### Funding Agency

### Paper preparation format

LaTeX

### Region represented

Asia

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