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**Electron effects in intense, ion beam linacs – theory and
experimental planning for HCX***

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Abstract

Heavy-ion accelerators for HIF will operate at high aperture-fill factors with high beam current and long durations. This will lead to beam ions impacting walls: liberating gas molecules and secondary electrons. Without special preparation a large fractional electron population is predicted in the High-Current Experiment (HCX), but wall conditioning and other mitigation techniques should result in substantial reduction. Theory and particle-in-cell simulations suggest that electrons, from ionization of residual and desorbed gas and secondary electrons from vacuum walls, will be radially trapped in the ~4 kV ion beam potential. Trapped electrons can modify the beam space charge, vacuum pressure, ion transport dynamics, and halo generation, and can potentially cause ion-electron instabilities. Within quadrupole (and dipole) magnets, the longitudinal electron flow is limited to drift velocities ($E \times B$ and grad-B) and the electron density can vary azimuthally, radially, and longitudinally. These variations can cause centroid misalignment, emittance growth and halo growth. Diagnostics are being developed to measure the energy and flux of electrons and gas evolved from walls, and the net charge and gas density within magnetic quadrupoles. We will also measure the depth of trapping of electrons, their axial and radial transport, and the effects of electrons on the ion beam. *Work performed for the USDOE by UC-LLNL under Contract W-7405-ENG-48, and by UC-LBNL under Contract DE-AC03-76F00098.