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SIMULATING ELECTRON CLOUD EFFECTS IN HEAVY-ION ACCELERATORS*

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Heavy-ion fusion (HIF) accelerators, like other positive-charge accelerators, are subject to contamination by stray electrons. HIF economics dictates working with the largest possible beam-pipe fill factor, and stray electrons can be a determinant in setting that limit. For parameters of HIF induction accelerators, the predominant source is ionization of neutral gas released from the beam pipe upon ion bombardment; direct release of secondary electrons can also play a role. Because the beam pipes (and hence electron sources) are localized to the magnet regions, modeling of electron accumulation must take into account ion reflections off the beam pipe. Another consequence is that self-consistent simulation requires bridging timescales ranging from the electron cyclotron period to ion transit times. We present results from several studies: electron clouds formed from direct release of electrons upon ion bombardment of the beam pipe, and from ionization of released neutrals; and effects of various types of model electron cloud distributions on ion beam quality. We also describe a model for averaged electron dynamics which enables bridging electron and ion timescales for both magnetized and unmagnetized electrons, and will present first simulation results using this model.

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