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Publication Date
2002-05-26

Theory and Simulations in Support of the High Current Transport Experiment for Heavy-Ion Fusion.

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Abstract

The Virtual National Laboratory (VNL) is leading the US effort to develop a multi-beam induction linac driver for Heavy-Ion Fusion (HIF). A central project in this effort is an ongoing High Current Transport Experiment (HCX) at LBNL designed to economically test transport issues using a single, driver-scale beam characteristic of those envisioned at the low-energy end of a driver. The primary mission of the HCX is to investigate aperture fill factors acceptable for the transport of low-energy heavy-ion beams (coasting K+, 1-2 MeV) at high space-charge intensity (line-charge ~ 0.2 micro-Coulombs/meter) over long pulse durations (2-10 micro-sec) with particular focus on issues that could not be addressed by previous generations of scaled experiments. It is anticipated that results from the HCX will allow confident construction of next generation experiments leading to a multi-beam Integrated Research Experiment (IRE). Transport issues impacting the aperture fill factor that are explored include: applied field nonlinearities, beam nonuniformities and collective modes, envelope mismatch, misalignment induced centroid excursions, imperfect vacuum, halo, desorbed gas and electron effects resulting from lost ions. Here, we present theory and simulations carried out to better understand these processes in support of the design and operation of the HCX.

Supported by the Office of Energy Research, US DOE, atLBNL and LLNL under contract numbers DE-AC03-76SF00098 and W-7405