

## Electron Injection for Space-Charge Control in HIBF

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One key issue in heavy ion beam fusion (HIBF) is how to effectively focus high-current and high-perveance ion beams onto a small target area, usually with a radius of 2-5mm. Space charge neutralization must be achieved to prevent defocusing as the ion density compresses during focusing. The present study is concerned with the physics of space-charge neutralization by use of various concepts for injection of electrons into the ion beam in addition to plasma neutralization. To date the most widely studied approaches to neutralization use a preformed plasma or ionize a background gas in the beam line. However, these schemes alone face difficulties due to local non-uniformities in charge neutralization due to beam dynamic/focusing effects. Thus, two supplemental techniques are under study and will be discussed here. One involves axially injection of electrons created in a thin foil in the beam path. The other uses a magnetic field to guide the electrons into the direction of the beam path. Both techniques would be used in combination with conventional background plasma, providing added control. A preliminary analysis of these schemes will be presented. Both analytical method and computational simulation using particle-in-cell technique are applied to solve simplified three-fluid equations in this paper. The required electron profile and focusability of the ion beam resulting from the calculation will be given. In addition, the design of possible components that could be added onto an existing HIBF experiment such as NTX at LBL to provide a proof-of-principle test of this type of electron injection will be discussed.