

ABSTRACT

Simulation and Optimization of the HINS Ion Source Extraction System

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The heart of the High Intensity Neutrino Source (HINS) Linac is a magnetron-type, circular aperture H- source, which is currently being tested at Fermilab. Although this prototype already delivers the beam current and emittance required by the HINS project, an exploration of whether or not the performance of the source could be improved was undertaken. To this end, the extraction geometry of the source was simulated with SIMION 8.0 and Finite Element Method Magnetics. The effects of changing the angle of the extraction cone (cone angle), the size of the gap between the extraction cone and the source plate (extraction gap), and the aperture of the extraction cone (extraction aperture) were studied. These parameters were chosen because we thought that they would have the greatest impact on space charge effects, which is a major source of emittance growth in this ion source. Based on the results of these simulations, four different configurations were ultimately tested in the ion source. The simulations indicated that the final emittance of the source should be significantly decreased by utilizing geometry with a 45 degree cone angle, a 4 mm extraction gap, and a 3 mm extraction aperture. Subsequent emittance measurements on the ion source have confirmed this result. This new geometry also allows the source to output a higher current beam with the same duty factor.