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Commissioning of a Plasma Ion Source Using Monte Carlo Optimisation Methods

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The controlled collimation of ion beams is of paramount importance in particle accelerators, high energy beamlines, and detector systems, as it determines the sensitivity and resolution of the instruments. This is especially the case when dealing with radioactive ion beams, where high transportation yields are crucial due to the short lifetimes of certain nuclei. For this reason, it is essential to model the beam dynamics in order to optimise properties such as transmission and energy spread before the commissioning of new instruments. A plasma ion source (PIS), comprised of a heated filament followed by an anode, Einzel lens and X-Y correction steerers, was modelled and Monte Carlo simulations were run using SIMION. The simulations also included the integration of this beam into the existing beamline of TRIUMF's Ion Trap for Atomic and Nuclear science (TITAN). Optimising the voltage configurations in these simulations has proved successful in the commissioning of the PIS at the TITAN experiment, which will provide a versatile ion source, capable of delivering stable isotopes from gas and solid samples. The PIS will be able to deliver important calibration beam to TITAN's experiments and will also enable off-line, high precision isotope composition measurements with the Multiple-Reflection Time-Of-Flight Mass Spectrometer (MR-TOF MS).

Author: FLOWERDEW, Jake (University of Calgary)

Co-authors: MUKUL, Ish (TRIUMF); KWIATKOWSKI, Anna (TRIUMF); DILLING, Jens (triumf/UBC); WIESER, Michael (University of Calgary); Prof. THOMPSON, Robert (University of Calgary, Canada)

Presenter: FLOWERDEW, Jake (University of Calgary)

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