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SIMULATION VS. PERFORMAMCE OF THE TRIUMF CANREB RFQ COOLER-BUNCHER

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The CANadian Rare-isotope laboratory with Electron Beam ion source (CANREB) project at TRIUMF [1] produces a large variety of rare radioactive and stable isotope beams for fundamental research. Essential to CANREB is a new radiofrequency quadrupole (RFQ) cooler-buncher [2] operating in grade 5.0 helium gas at 3 MHz, 1.2 kV_{pp} (q $\sim$ 0.2) with 60-70 W input RF power. The RFQ is designed to (A) accept beams with <100 pA currents at <60 keV energies, and (B) deliver cooled and bunched beams <10^6 ions/bunch at 100 Hz with >90% efficiency, <10 eV energy spread, and short <1 us time-spread. Commissioning tests with picoamp beams of 30 keV $^{133}Cs^{+1}$ (r $\sim$ 5 mm, angular spread $\sim$ 10 mrad) in $\sim$ 5 mtorr helium yield >90% transmission through the RFQ with >80% bunching efficiency. Simulations agree with $^{133}Cs^{+1}$ performance characteristics. Here we discuss simulation of beam properties in the RFQ obtained with SIMION to actual performance for $^{133}Cs^{+1}$, $^{85}Rb^{+1}$ and other isotopes of interest, over a range of energies. Preliminary results indicate q-values for RFQ operation with >90% transmission occur for 60 keV: $^{133}Cs^{+1}$ = 0.10-0.25, $^{85}Rb^{+1}$ = 0.09, and $^{133}Cs^{+1}$ (18.5 keV) = 0.14-0.30, $^{85}Rb^{+1}$ (29 keV) = 0.12-0.16.

References:

[1] The CANREB project for charge state breeding at TRIUMF. F. Ames, R. Baartman, B. Barquest, C. Barquest, M. Blessenohl, J. R. Crespo López-Urrutia, J. Dilling, S. Dobrodey, L. Graham, R. Kanungo, M. Marchetto, M. R. Pearson, and S. Saminathan. Proceedings of the "17th International Conference on Ion Sources", Oct. 15-20, 2017, Geneva Switzerland, AIP Conf. Proc. 2011, 070010-1–070010-3; (2018).

[2] B.R. Barquest, J.C. Bale, J. Dilling, G. Gwinner, R. Kanungo, R. Krucken, M.R. Pearson. Development of a new RFQ beam cooler and buncher for the CANREB project at TRIUMF. NIMB 376 (2016), 207-210.

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