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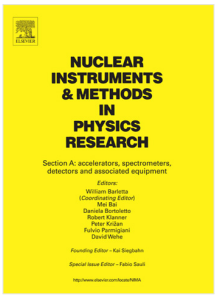

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A Versatile Triple Radiofrequency Quadrupole System for Cooling, Mass Separation and Bunching of Exotic Nuclei

Emma Haettner[a,b], Wolfgang R. Plaß[a,b,*], Ulrich Czok[a,b,1], Timo Dickel[a,b], Hans Geissel[a,b], Wadim Kinsel[a,b], Martin Petrick[a], Thorsten Schäfer[a], Christoph Scheidenberger[a,b]

[a] *II. Physikalisches Institut, Justus-Liebig-Universität Gießen, 35392 Gießen, Germany*
[b] *GSI Helmholtzzentrum für Schwerionenforschung GmbH, 64291 Darmstadt, Germany*

Abstract

The combination of in-flight separation with a gas-filled stopping cell has opened a new field for experiments with exotic nuclei. For instance, at the SHIP/SHIPTRAP facility at GSI in Darmstadt high-precision mass measurements of rare nuclei have been successfully performed. In order to extend the reach of SHIPTRAP to exotic nuclei that are produced together with high rates of unwanted reaction products, a novel compact radio frequency quadrupole (RFQ) system has been developed. It implements ion cooling, identification and separation according to mass numbers and bunching capabilities. The system has a total length of one meter only and consists of an RFQ cooler, an RFQ mass filter and an RFQ buncher. A mass resolving power (FWHM) of 240 at a transmission efficiency of 90% has been achieved. The suppression of contaminants from neighboring masses by more than four orders of magnitude has been demonstrated at rates exceeding 10^6 ions/s. A longitudinal emittance of 0.45 eVμs has been achieved with the RFQ buncher, which will enable improved time-of-flight mass spectrometry downstream of the device. With this triple RFQ system the measurement of e.g. N=Z nuclides in the region up to tin will become possible at SHIPTRAP. The technology is also well suited for other rare-isotope facilities

*Corresponding author
Email address: Wolfgang.R.Plass@exp2.physik.uni-giessen.de (Wolfgang R. Plaß)
[1] Deceased.