Compact high resolution isobar separator for study of exotic decays

A. Piechaczek[1], V. Shchepunov[1], H. K. Carter[1] J. C. Batchelder[1], E. F. Zganjar[2]

[1]*UNIRIB, Oak Ridge Associated Universities, Oak Ridge, TN 37830*
[2]*Department of Physics & Astronomy, Louisiana State University, Baton Rouge, LA 70803*

A compact isobar separator, based on the Multi-Pass-Time-of-Flight (MTOF) principle, is developed [1]. A mass resolving power (MRP) as spectrometer of 110,000 (FWHM) is achieved in Time-of-Flight spectra of N_2 molecules (no physical ion separation) after 300 laps or ToF = 9.7 ms. Operated as a separator [2], molecules of N_2 and CO with $\Delta M/M = 1/2500$ or 10.433 MeV are separated with a Bradbury Nielsen electrostatic ion gate, and the MRP (FWHM) is about 40,000 after 120 laps. In the separator as well as in the spectrometer mode, the transmission amounts to 50 - 80%, and the transverse beam acceptance and energy acceptance are 42 π mm mrad and $\pm$ 2.5%, respectively. For injection of radioactive ion beams into the MTOF device, and to further improve its MRP, cooler and buncher RF quadrupoles were designed and built [3]. Stand-alone tests of the RF quadrupoles have yielded a bunch width of 30 ns at 1% of the peak height (FWHM = 9 ns) and a transmission in DC mode of 75 – 80 %. With such bunch parameters, MRPs of the MTOF separator of ~ 400,000 (FWHM) or about 200,000 (baseline) are expected. Studies of isomers and isomeric decays (with energies of typically > 500 keV for a mass A = 100 nucleus) become possible: in spectrometer mode, isomers can be identified simply by recording ToF spectra and in the separator mode, isomeric decay properties can be studied by enhancing or depleting the fraction of the isomer in the decaying sample. At the HRIBF, the MTOF separator will be initially used around ^{100}Sn, and in the regions of neutron deficient rare-earth nuclei and of neutron-rich nuclei. Incidental measurements of mass differences will be performed, determining Q_b values with accuracies of ~ 1%.

[1] A. Piechaczek *et al.*, Nucl. Instr. Meth. **B 266** (2008) 4510-4514

[2] A. Piechaczek *et al.*, submitted to Eur. Phys. J. **A**

[2] V. Shchepunov *et al.* and V. Kozlovskiy *et al.*, to be published

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