



国立研究開発法人理化学研究所 仁科加速器研究センター
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Online application of multi-reflection time-of-flight mass spectrometry
-- nuclear masses and beyond

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Due to the complexity of nuclear systems, theoretical models are not yet achieving the required precision to answer today's questions about their structure far from stability. Among the accessible pool of observables in nuclei, ground-state masses are of fundamental meaning to obtain information about the summed strength of nuclear interactions, most importantly due to the exact access to nucleon separation energies. However, nuclear precision mass measurements continuously face new challenges as the majority of demands for nuclear data is directed to species with the lowest production cross sections and short half-lives. Multi-reflection time-of-flight (MRTOF) mass spectrometry as invented in the 1990's by H. Wollnik [1] has opened new opportunities for measuring the masses of nuclides with half-lives down to a few milliseconds with high precision. First on-line application of this technique was achieved at CERN/ISOLDE in 2012 [2,3], where an MRTOF device was at first used as a high-resolution mass separator. Later the use as a spectrometer of its own right led to the discovery of a strong neutron-shell effect at $N=32$ in Ca isotopes and provided missing benchmarks for new advances in chiral effective field theory [4] and ab initio Green function theory of medium-mass nuclei [5]. Recently at the MRTOF mass spectrograph set up at RIKEN, new on-line mass measurements of heavy and super-heavy nuclei have been performed [6,7], where the capability of simultaneously measuring the masses of several ion species with production cross sections down to 100 nb was demonstrated. Among these results are the first mass measurements on super-heavy elements performed at RIKEN. However, enabling also new measurements of isotope shifts in hyperfine structure and the search for medical isotopes, the application of MRTOF devices goes far beyond the purpose of a bare mass measurement. An overview of achievements and possibilities will be provided in this seminar.

[1] Wollnik and M. Przewloka, Int. J. Mass Spectrom. Ion Proc. 96, 267 (1990) [2] R. N. Wolf et al., Nucl. Instrum. Meth. A 686, 82 (2012) [3] R. N. Wolf et al., Phys. Rev. Lett. 110, 041101 (2013) [4] F. Wienholtz et al., Nature 498, 346 (2013) [5] M. Rosenbusch et al., Phys. Rev. Lett. 114, 202501 (2015) [6] P. Schury et al., Phys. Rev. C 95, 011305(R) (2017) [7] Y. Ito et al., RIKEN APR, submitted (2017)

* The talk will be given in English language..

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