Precision experiments of stored exotic nuclei mass & lifetime measurements at the storage rings

Taka Yamaguchi (Saitama, Japan) For FRS-ESR/ILIMA collaboration, For Rare-RI Ring collaboration

1. Highlights of the ESR experiments

- Time-resolved Schottky mass spectrometry (SMS)
- Isochronous mass spectrometry (IMS)
- 2. Future facilities
 - ILIMA collaboration (FAIR)
 - Upgrade of present activities at ESR
 - Rare-RI Ring collaboration (RIBF)
 - Concept, principle, R&D







Schottky Mass Spectrometry, Isochronous Mass Spectrometry







High-accuracy Mass Measurements Mass Evaluation of Close-lying Frequency Peaks



Mass Surface measured with the SMS





Recent Highlights with the SMS

•Proton-neutron interaction strength around N=126 •L. Chen et al., PRL102(2009)122503.

New isomers

Excitation energies, lifetimes
B. Sun et al., PLB688(2010)294.
M.W. Reed et al., PRL accepted.

•New isotopes discovered at ESR •Mass simultaneously measured •L. Chen et al. PLB691(2010)234.





Nuclear Decays observed in the Ring



Yu.A. Litvinov

2010年9月26日日曜日

Saitama Universi

Lifetime Measurements via SMS Exotic decay modes of highly-charged ions

Bound-state beta decay of ²⁰⁷TI⁸¹⁺





Recent Highlights with the SMS

•Electron capture decays of HCI Enhancement of EC rates of hydrogen-like ions •Y. Litvinov et al., PRL99(2007)262501. •N. Winckler et al., PLB679(2009)36.

•Non-exponential EC decays •Y. Litvinov et al., PLB664(2008)162.





Isochronous Mass Spectrometry







Time-of-Flight Spectrum

Identification by m/q ratio

B. Sun, R. Knoebel, S. Nakajima



Saitama Univer







Mass & Lifetime Measurements at CR/NESR







Rare-RI Ring project at RIBF

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R&D ongoing

Optics calculations

 Injection beam line Injection/ejection scheme Storage Ring **OHigher-order/realistic calculations** Kicker, Septum Improved controller: response time ~450ns Specifications oTest of model kicker TOF counters Test of µm-thick plastic scintillator Test of hybrid photo detector Test of MCP detector High-precision NMR probe

•Precision ~ 10⁻⁷

TARNII-D24TARNII-Q20KEK-PS-Q23



CSR - Cooler Storage Ring at Lanzhou -





Storage Ring Mass Spectrometry at ESR is ongoing.

- Large areas of unknown mass surface
- Exotic decay modes of highly-charged ions
- The future international collaboration ILIMA at FAIR is promising for the continuation and upgrade of the current ESR activities.
- Rare-RI Ring project will work in a complementary style.
- The storage ring in China is a candidate to extend our activities.

