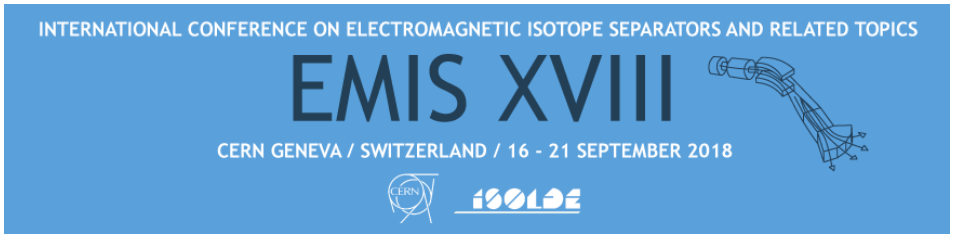

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First application of TITAN's newly installed MR-TOF-MS: Investigating the N = 32 neutron shell closure

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TRIUMF's Ion Trap for Atomic and Nuclear science (TITAN) located at the Isotope Separator and Accelerator (ISAC) facility, TRIUMF, Vancouver, Canada is a multiple ion trap system capable of performing high-precision mass measurements and in-trap decay spectroscopy. In particular TITAN has specialised in fast Penning trap mass spectrometry of singly-charged, short-lived exotic nuclei using its Measurement Penning Trap (MPET). Although ISAC can deliver high yields for some of the most exotic species, many measurements suffer from strong isobaric background. In order to overcome this limitation an isobar separator based on the Multiple-Reflection Time-Of-Flight Mass Spectrometry (MR-TOF-MS) technique has been developed and recently installed at TITAN. Mass selection is achieved using dynamic re-trapping of the ions of interest after a time-of-flight analysis in an electrostatic isochronous reflector system.

After a first commissioning with stable beam from ISAC in mid-2017 the MR-TOF-MS was employed in a measurement campaign aiming to investigate the evolution of the N = 32 neutron shell closure. This shell closure forms several neutrons away from stability and had been established in neutron-rich K, Ca and Sc isotopes, where as in V and Cr, no shell effects can be found. Thus leaving the intermediate Ti isotopes as the ideal test case for state-of-the-art ab-initio shell model calculations. High-precision mass measurements with TITAN's MPET and for the first time with the MR-TOF-MS were able to prove the existence of a weak shell closure in Ti and quenching of the shell in V. These findings challenge modern ab initio theories, which over predicted the strength and extent of this weak N = 32 shell closure.

Being able to resolve all isobars at the same time, the new MR-TOF-MS has become a routine device during TITAN beam times, being used for real-time determination of the radioactive beam composition and optimization of the ISAC mass separator, for precision mass measurements and soon for isobar separation.

We will discuss our recent mass measurements of singly charged ions making use of MPET and the new MR-TOF-MS as well as technical and operational details of the new device and perspectives for future mass measurements of short-lived isotopes at TITAN.

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