Contribution ID: **37** Type: **not specified**

Mass evolution at the extreme neutron deficient-side of the N=82 shell in the Lu, Yb and Tm isotopic chains

Abstract:
Since the beginning of this decade, investigation near the proton dripline has regained interest thanks to the recent advancements in terms of neutron deficient radioactive ion beam production and continuous development of low energy apparatus dedicated to high-precision measurements. Among them, Penning-trap mass spectrometers offer a way to experimentally determine the exact localization of the proton dripline by extracting proton separation energies. Such measurements are crucial for testing predictive capabilities of nuclear theories. They have also proven to be useful in studying changes in the nuclear structure shell closure towards driplines, where shells can weaken or disappear giving rise to new magic numbers [1,2].
Recently, significant efforts have been put at TRIUMF using TITAN's multi-reflection time-of-flight mass spectrometer to perform high-precision mass measurements in the N = 82 vicinity in the ytterbium [2] and thulium [3] isotopic chains. However, this region of the nuclear chart is known to be the host of several low-lying isomeric states. The presence of such isomers can somewhat limit the precision of mass measurements due to contamination issues, preventing a complete interpretation of the experimental results.
We propose here to investigate the mass evolution in the neutron deficient lutetium, ytterbium and thulium isotopic chains combining the strengths of the S3LEB and PIPERADE/MLLTRAP apparatus, located in the S3 and DESIR experimental areas, respectively. The isotopes of interest can be produced at S3 using, for instance, a nickel primary beam on various targets, like Mo or Ru. The future mass measurements discussed here will require the use of the PI-ICR technique [4] at the DESIR Penning-trap installations which will allow enough resolving power to separate ground-states from the low-lying isomeric states. Additionally, the laser spectroscopy capabilities of S3LEB, when coupled with the PI-ICR technique, will enable unambiguous identification of ground and isomeric states, ensuring robust and interpretable results.

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