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High-Precision Mass Measurements near the N = 50 shell closure

The vicinity of ^{100}Sn is a rich landscape for studying nuclear isomers and exotic decay modes, including superallowed α, βp, β2p, βα, and βpα emissions. This region is further characterized by enhanced neutron-proton pairing arising from its proximity to shell closure, making it an ideal testing ground for the nuclear shell model. In nuclear astrophysics, the rapid proton capture process (rp-process) follows a path close to the proton-drip line passing through the neighbourhood of 100Sn. Despite considerable interest and significant recent experimental progress [1-4], data on ground and isomeric states of nuclei near the proton-drip line remains missing or partially known. For example, in the silver isotopic chain, the mass of 95Ag was recently measured at the IGISOL facility but the predicted two long-lived isomers were somehow not observed [3]. Additionally, nuclei such as ^{94}Ag, ^{96}Cd, and ^{98}In exhibit N=Z spin-gap isomers, with ^{94}Ag standing out due to its multiple decay channels and two long-lived isomeric states—one of which features a uniquely high spin (21+) for a β-decaying isomer. Precise mass measurements of these isotopes are therefore essential to clarify and constrain theoretical predictions of nuclear structure in this region.
Penning trap spectroscopy, combined with the Phase-Imaging Ion-Cyclotron-Resonance (PI-ICR) technique, offers unparalleled resolving power and sensitivity allowing to distinguish states with very low energy differences and measure mass with high precision [5]. In this Letter of Intent, we propose to take advantage of the strengths of the S3LEB and the forthcoming PIPERADE double Penning traps at the DESIR facility to perform high-precision mass measurements of neutron-deficient nuclei near the proton-drip line. In parallel, the production of these nuclei could be carried out using SPIRAL1 via fusion-evaporation reactions in an optimized Target Ion Source System (TISS) coupled to a FEBIAD ion source, within the framework of the TULIP project [6]. The use of the PI-ICR technique in combination with PIPERADE should enable the resolution of states with minimal energy differences and mass measurements at a precision level of up to $\delta M/M \sim 10^{-10}$. Additionally, isomers in the vicinity of ^{100}Sn could be further investigated through post-trap decay spectroscopy. Together, these measurements will not only benchmark theoretical nuclear structure models but also provide critical constraints for rp-process network calculations, thereby advancing our understanding of nucleosynthesis and refining predictions for the N=Z=50 region and beyond.

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