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## Elucidating the transition in shell structure and deformation from the doubly-magic $100\text{Sn}$ to the Isospin-Symmetric Island of Inversion around $80\text{Zr}$ with laser spectroscopy of neutron-deficient Pd

The neutron-deficient region below the heaviest doubly-magic  $N=Z$  nucleus  $100\text{Sn}$  provides a rich and important testing ground for nuclear structure effects, from shell closures and the evolution of deformation and single-particle behaviour moving away from them, to neutron-proton pairing around the  $N=Z$  line. It has thus attracted significant interest in recent years, with measurements of several ground- and isomeric-state properties performed at various facilities worldwide [1-3,5]. Mass measurements have crossed the  $N=50$  shell closure in some chains in the region [2], certain up to the  $N=Z$  line. Laser spectroscopy studies beyond  $N=50$  in this region are however currently limited to the silver chain, where a surprisingly large kink in the charge radii was observed when crossing the shell closure [3]. This is in contrast to the behaviour across  $N=50$  in lighter nuclei such as Mo, located closer to the so-called “Isospin-Symmetric Island of Inversion” around  $80\text{Zr}$  [4]. The palladium chain is located right in the middle between the two  $N=Z$  nuclei  $100\text{Sn}$  and  $80\text{Zr}$ .

As the S3 spectrometer will be well suited for the production of RIBs in this region, several LOIs have already been proposed for laser spectroscopy measurements in the gas jet environment of the S3-Low Energy Branch. The Pd chain poses a particular challenge, as no resonant laser ionisation scheme with sensitivity to the nuclear parameters has been found so far. Due to the electronic structure, any transition from the atomic ground state will display none or barely any isotope shifts, making charge radii measurements in the gas jet (near) impossible.

In a collinear beamline, however, such as the LASAGN setup foreseen in the DESIR facility, this limitation can be overcome by populating metastable states in a charge-exchange cell and performing spectroscopy from these states. This strategy has enabled isotope shift and hyperfine structure measurements in the Pd chain at the IGISOL facility over the past years, down to  $98\text{Pd}$  [5]. Taking advantage of the higher production rates at S3, we propose to extend these measurements across the  $N=50$  shell closure, possibly down to the  $N=Z$   $92\text{Pd}$  nucleus. This would permit studying the evolution of the kink in the charge radii across  $N=50$  when moving away from  $Z=50$ , and add clarity on the transition from the region around the doubly magic  $100\text{Sn}$  nucleus towards the “Isospin-Symmetric Island of Inversion” around  $80\text{Zr}$ .

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[2] G. Kripkó-Koncz et al., *Phys. Rev. Res.* 7, L042022 (2025)

[3] M. Reponen et al., *Nat. Comm.* 12:4596 (2021)

[4] J. Ha et al., *Nat. Comm.* 16:10631 (2025)

[5] S. Geldhof et al., *Phys. Rev. Lett.* 128, 152501 (2022)

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