# $\gamma$-decaying isomers and isomeric ratios in the $^{100}$Sn region[†]

J. Park,[*1,*2] R. Krücken,[*1,*2] D. Lubos,[*3,*4,*5] R. Gernhäuser,[*3] M. Lewitowicz,[*6] and S. Nishimura,[*4]
for the EURICA Collaboration

The structure of the heaviest $N = Z$ doubly magic nucleus $^{100}$Sn and the nuclei in its vicinity has been investigated in depth both experimentally and theoretically.[1)] Isomeric states in these exotic isotopes contain valuable experimental information on some of the research topics in this region of nuclides, such as the robustness of the $N = Z = 50$ shells and the role of the proton-neutron interaction in $N \sim Z$ nuclei.

This report contains a summary of results from the EURICA Xe campaign in 2013 on the $\gamma$-decaying isomers in the $^{100}$Sn region. Proton-rich isotopes in $^{100}$Sn region were produced from fragmentation reactions of $^{124}$Xe on a $^{9}$Be target, and were separated and identified through BigRIPS and the ZeroDegree spectrometer at the RIBF. They were implanted in WAS3ABi,[2)] and time-delayed $\gamma$ rays emitted from the isomers of the implanted nuclei were detected with EURICA[3)] for half-life ($T_{1/2}$) measurements.

Several new results were found: the discovery of a $(4^+)$ isomer in $^{92}$Rh; the excitation energy of the $(15^+)$ isomer in $^{96}$Ag, and the $T_{1/2}$ of the $(6^+)$ isomer in $^{98}$Cd. Figure 1 shows the electromagnetic transition strengths derived from half-life measurements of $\gamma$-decaying isomers observed in this experiment, as well as the theoretical values from different shell model (SM) calculations. The SLGM interaction[4)] uses a model space of proton and neutron $(2p_{1/2}, 1g_{9/2})$ orbitals above the $^{76}$Sr core. The other SM approaches are described in the original article. Two sets of proton and neutron effective charges (a) and (b) were employed to gauge and account for core polarization effects. A good agreement between experimental and theoretical transition strengths was found in general. However, the transition strengths were significantly lower than predicted in $^{92,93}$Ru. On the other hand, experimental transition strengths of the core-excited $(12^+)$ isomer in $^{98}$Cd exceeding SM predictions may be related to the increased proton core polarization in light, even-mass Sn isotopes.[5)] Further theoretical efforts are needed to address these discrepancies.

In addition, experimental isomeric ratios of both $\gamma$-decaying and $\beta$-decaying isomers were determined and compared with the abrasion-ablation model[6,7)] coupled to the sharp cutoff model. A good agreement between experimental and theoretical values was obtained for positive-parity isomers with $J > 4$.

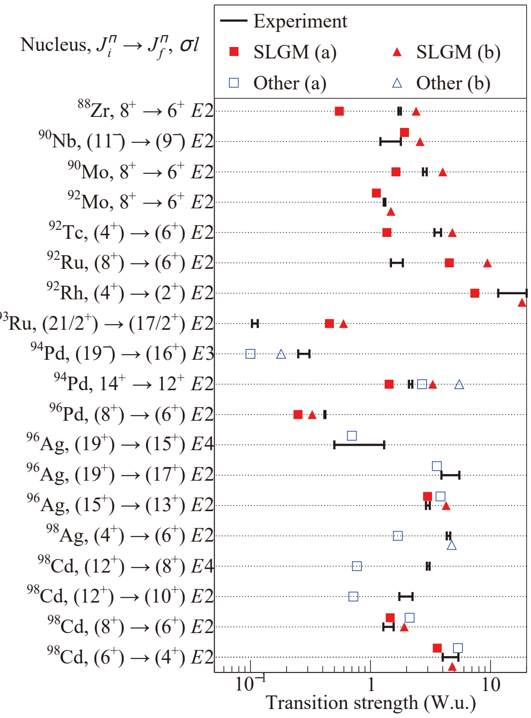


Fig. 1. Experimental electromagnetic transition strengths of isomers measured in this work and shell model calculations. See the text for details on the different models.

No experimental signature of an isomer in $^{100}$Sn was found, which was hypothesized from SM.[8,9)] With assumptions from SM calculations and the theoretical isomeric ratio, limits on the $\gamma$-ray energy and $T_{1/2}$ were proposed on the isomer in $^{100}$Sn.

† Condensed from the article in Phys. Rev. C. **96**, 044311 (2017)

*1 Department of Physics and Astronomy, University of British Columbia
*2 TRIUMF
*3 Physik Department, Technische Universität München
*4 RIKEN Nishina Center
*5 Excellence Cluster Universe, Technische Universität München
*6 Grand Accélérateur National d'Ions Lourds (GANIL)

References

1) T. Faestermann, M. Górska, H. Grawe, Prog. Part. Nucl. Phys. **69**, 85 (2013).
2) S. Nishimura, Prog. Theor. Exp. Phys. **2012**, 03C006 (2012).
3) P.-A. Söderström *et al.*, Nucl. Instrum. Methods B **317**, 649 (2013).
4) F. J. D. Serduke, R. D. Lawson, D. H. Gloeckner, Nucl. Phys. **256**, 45 (1976).
5) P. Doornenbal *et al.*, Phys. Rev. C **90**, 061302 (2014).
6) J.-J. Gaimard, K.-H. Schmidt, Nucl. Phys. **531**, 709 (1991).
7) M. de Jong, A. V. Ignatuyk, K.-H. Schmidt, Nucl. Phys. **613**, 435 (1997).
8) F. Nowacki, Nucl. Phys. **704**, 223 (2002).
9) V. I. Isakov, K. I. Erokhina, Phys. At. Nucl. **65**, 143 (2002).