In-flight γ-ray spectroscopy and $T_{1/2}$ measurements of ^{129}In and ^{128}Cd

M. Mikołajczuk[1,2], M. Górska[2], A. Korgul[1], M. Armstrong[2,3,4], K. Wimmer[2,5,6,7], A. Jungclaus[6], and Zs. Podolyák[8], for the RIBF 189 experiment collaboration
[1]*Faculty of Physics University of Warsaw, Warsaw, Poland*
[2]*Gesellschaft für Schwerionenforschung, Darmstadt, Germany*
[3]*Insitut für Kernphysik, Köln, Germany*
[4]*Lawrence Berkeley National Laboratory, Berkeley, United States*
[5]*RIKEN Nishina Center, Wako-shi, Japan*
[6]*Department of Physics University of Tokyo, Tokyo, Japan*
[7]*Instituto de Estructura de la Materia CSIC, Madrid, Spain and*
[8]*Department of Physics, University of Surrey, Surrey, United Kingdom*

The studies of nuclear structure near doubly magic ^{132}Sn continues to attract major experimental and theoretical efforts. Studies of nuclear interaction in near vicinity of proton ($Z = 50$) and neutron ($N = 82$) shell closures provides opportunity to challenge predictions of theoretical models in this exotic region of nuclei chart. However, experimental data in the region, especially considering half-lives of low lying excited states, is scarce. Shell quenching, role of intruder states and cross shell excitations is a question posed by the theoretical investigations. Moreover, comparison of excited states properties between ^{132}Sn and ^{100}Sn regions allow to probe nuclear interaction over wide span of isospin. Those questions will be addressed based on the study of excited states in ^{129}In and ^{128}Cd

Nuclei of interest were produced in Radioactive Isotope Beam Factory at RIKEN during the HiCARI campaign [1]. Excited states were populated in the $^{9}Be(^{130}In,^{129}In)$ and $^{9}Be(^{130}In,^{128}Cd)$ nucleon knock-out reactions following in-flight fission of a ^{238}U primary beam. In close geometry relative to the ^{9}Be target an array of segmented HPGe detectors [1] was installed for γ-ray detection. Based on the reconstructed velocity of ions and position of γ-ray emission during their de-excitation event-by-event, γ-ray spectra were obtained for each reaction channel. Line shape of identified transitions carries information regarding their energy (E) and half-life ($T_{1/2}$). Taking into account precisely measured HiCARI geometry, response function of every HPGe crystal to the γ-ray of given E and $T_{1/2}$ was simulated using Geant4 package [2]. Finally, E and $T_{1/2}$ were extracted by minimizing χ^2 of response functions fitted to the experimental data (fig.1). This method allows to accesses very short half-lives ranging from single ps up to few hundreds of ps, making it perfect tool to study low lying excited states of the nuclei in close vicinity of ^{132}Sn. Results will be interpreted employing state-of-the-art shell model calculations.

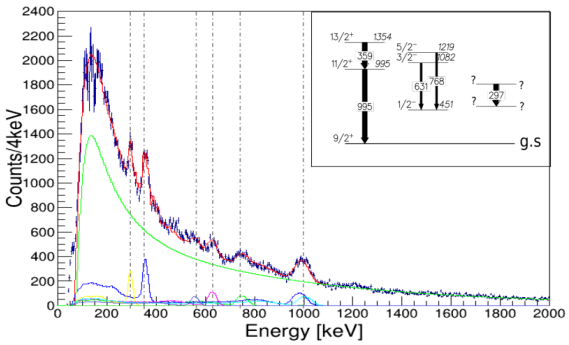

FIG. 1: γ-ray spectrum obtained for $^{9}Be(^{130}In,^{129}In)$ channel. Experimental spectrum is marked with "+" while response function fitted to each transition as well as sum of fitted functions are marked with solid lines. Inset shows relevant part of level scheme for ^{129}In. Transition at 297 keV could not be identified based on available literature [3].

[1] K. Wimmer *et al.*, RIKEN Accelerator Progress Report 54 (2020) S27.
[2] L. A. Riley*et al.*, NIM A 1003, 165305 (2021).
[3] Y. Saito *et al.*, PRC 102, 024337 (2020).