Study of the pygmy-dipole resonances of $^{132}$Sn and $^{128}$Sn in inelastic $\alpha$-scattering

J. Tschentscher, $^{1,2}$ T. Aumann, $^{1}$ D. S. Ahn, $^{1,2}$ R. Avigo, $^{3,4}$ H. Baba, $^{2,5}$ K. Boretzky, $^{2,5}$ A. Bracco, $^{3,4}$ C. Caesar, $^{5}$ A. Camera, $^{3,4}$ S. Chen, $^{2,6}$ V. Derya, $^{7}$ P. Doornenbal, $^{2,5}$ J. Endres, $^{7}$ N. Fukuda, $^{2,5}$ U. Garg, $^{8}$ A. Giaz, $^{3,4}$ M. N. Harakeh, $^{6}$ M. Heil, $^{3,5}$ A. Horvat, $^{1}$ K. Ieki, $^{10}$ N. Imai, $^{11}$ N. Inabe, $^{2}$ N. Kalantar-Nayestanaki, $^{9}$ N. Kobayashi, $^{11}$ Y. Kondo, $^{12}$ S. Koyama, $^{11}$ T. Kubo, $^{2,5}$ I. Martel, $^{13}$ M. Matsushita, $^{14}$ B. Million, $^{15}$ T. Motobayashi, $^{2}$ T. Nakamura, $^{12}$ N. Nakatsuka, $^{2,16}$ M. Nishimura, $^{2}$ S. Nishimura, $^{2}$ S. Ota, $^{14}$ H. Otsu, $^{7}$ T. Ozaki, $^{12}$ M. Potri, $^{1}$ R. Reifarth, $^{17}$ D. Rossi, $^{18}$ A. Saito, $^{12}$ H. Sakurai, $^{2,11}$ D. Savran, $^{5}$ H. Scheit, $^{1}$ F. Schindler, $^{1,2}$ P. Schrock, $^{1,2}$ D. Semmler, $^{1,2}$ Y. Shiga, $^{2,10}$ M. Shikata, $^{15}$ Y. Shimizu, $^{9}$ H. Simon, $^{5}$ D. Steffenbeck, $^{2}$ H. Suzuki, $^{5}$ T. Sumikama, $^{10}$ D. Symochko, $^{1}$ I. Syndikus, $^{1}$ H. Takesha, $^{6}$ S. Takeuchi, $^{2}$ R. Taniuchi, $^{11}$ Y. Togano, $^{1,2}$ J. Tsubota, $^{12}$ H. Wang, $^{2}$ O. Wieland, $^{4,5}$ K. Yoneda, $^{2,2}$ Z. Zenihiro, $^{2}$ and A. Zilges $^{7}$

Pygmy-dipole resonance is commonly considered as a dipole mode of the nucleus related to a vibration of excess neutrons against a core. As such, it should be related to the neutron richness of the nucleus as well as its neutron-skin thickness. So far, the experimental information on this low-lying dipole mode is astonishingly scarce, even for stable nuclei $^{11}$. One interesting open question is the isospin character of the low-lying dipole strength. In an experiment with the stable $^{124}$Sn isotope $^{21}$, it has been concluded that a large fraction of the pygmy strength is of isoscalar character, however significant differences in the strength distribution compared with photoexcitation have been observed.

In November 2014, the isoscalar mode of the pygmy-dipole resonances in $^{128}$Sn and $^{132}$Sn isotopes were measured in inelastic $\alpha$-scattering at RIKEN. The isotopes of interest were produced with a high-intensity primary $^{238}$U beam of 345 MeV/u impinging on a beryllium target. The resulting secondary beam with an energy of approximately 200 MeV/u was directed towards the liquid helium target with a thickness of approximately 300 mg/cm$^2$. The $\gamma$-rays, which are ejected at the target position, have been measured by 8 large-volume 3.5×8.5 Labr$_3$Ce crystals from Hector INFN Milano $^{5}$ and 95 large-volume NaI(Tl) DALLI$^{2}$ crystals. These crystals surrounded the target chann---

\begin{itemize}
  \item $^{1}$ Institut für Kernphysik, TU Darmstadt
  \item $^{2}$ RIKEN Nishina Center
  \item $^{3}$ INFN sezione di Milano
  \item $^{4}$ Dipartimento di Fisica, Universita degli studi di Milano
  \item $^{5}$ GSI Helmholtzentrum Darmstadt
  \item $^{6}$ School of Physics, Peking University
  \item $^{7}$ Institut für Kernphysik, Universität zu Köln
  \item $^{8}$ Department of Physics, University of Notre Dame
  \item $^{9}$ KVI-CART Groningen
  \item $^{10}$ Department of Physics, Rikkyo University
  \item $^{11}$ Department of Physics, University of Tokyo
  \item $^{12}$ Department of Physics, Tokyo Institute of Technology
  \item $^{13}$ Departamento de Física Aplicada, Universidad de Huelva
  \item $^{14}$ Center for Nuclear Research, University of Tokyo
  \item $^{15}$ VECC India
  \item $^{16}$ Department of Physics, Kyoto University
  \item $^{17}$ Institut für Kernphysik, Goethe Universität Frankfurt
  \item $^{18}$ National Superconducting Cyclotron Laboratory, Michigan State University
  \item $^{19}$ Department of Physics, Tohoku University
\end{itemize}

Fig. 1. Particle identification plot of the secondary beam after the liquid Helium target, gated on incoming $^{132}$Sn ions determined using the ZeroDegree spectrometer.

References