



Contribution ID: 144

Type: Oral

## The first $\beta$ delayed $\gamma$ -ray spectroscopy of $^{109}\text{Mo}$ and the interpretation of its low-lying states

The neutron and proton mid-shell region, around  $N = 60$  and  $Z = 40$ , is renowned for a sudden drop of first  $2^+$  state energy in even-even isotopes indicating shape deformation at  $N = 60$  [1-5]. Type II shell evolution is suggested to explain the origin of this shape deformation [6, 7] but more experimental data is required to understand this region. In order to figure out the structural properties of corresponding nuclei, there have been studies on molybdenum nuclei ( $Z = 42$ ) with  $N \geq 60$  [5, 8-11]. However, the detailed quasiparticle configuration remains undetermined and recent experimental study on  $^{106,108,110}\text{Mo}$  also showed some discrepancies from theoretic calculation in side bands especially on  $^{110}\text{Mo}$  [5]. In studying the strongly deformed region, the even-odd nuclei play an important role to understand the neutron quasi-particle states near the Fermi surface.

In the present study, the low-lying states in  $^{109}\text{Mo}$  were investigated by measuring the delayed  $\gamma$ -rays after the  $\beta$  decay of  $^{109}\text{Nb}$  for the first time under the EURICA project in RIKEN. Two new isomeric  $\gamma$ -rays were measured together with the 69-keV  $\gamma$ -ray from the known isomer [11, 12]. The internal conversion coefficients of the isomeric  $\gamma$ -rays were quantitatively studied for the first time. The most like quasi-particle configuration for the ground and isomeric states were assigned considering measured mean lifetime, decay branches, and coincidence counts. One more quasi-particle state was newly assigned to a new excited state strongly populated by the  $\beta$  decay of  $^{109}\text{Nb}$ . Our results will give useful restrictions for theoretical models in this region. We will present the experimental results and discuss the quasi-particle configurations of the low-lying states in  $^{109}\text{Mo}$ .

- [1] H. Wollnik et al., Nucl. Phys. A 291, 2, p. 355, 1977.
- [2] R. E. Azuma et al., Phys. Lett. B 86, 1, p. 5, 1979.
- [3] M. A. C. Hotchkis et al., Nucl. Phys. A 530, 1, p. 111, 1991.
- [4] T. Sumikama et al., Phys. Rev. Lett. 106, 202501, 2011.
- [5] J. Ha et al., Phys. Rev. C 101, 044311, 2020.
- [6] T. Togashi et al., Phys. Rev. Lett. 117, 172502, 2016.
- [7] T. Otsuka and Y. Tsunoda 2016 J. Phys. G: Nucl. Part. Phys. 43 024009.
- [8] W. Urban et al., Phys. Rev. C 73, 037302, 2006.
- [9] C. Goodin et al., Phys. Rev. C 80, 014318, 2009.
- [10] J. Marcellino et al., Phys. Rev. C 96, 034319, 2017.
- [11] W. Urban et al., Phys. Rev. C 102, 024318, 2020.
- [12] D. Kameda et al., Phys. Rev. C 86, 054319, 2012.

**Primary authors:** Dr BAE, Sunghan (Center for Exotic Nuclear Studies, Institute of Basic Science, RIKEN Nishina Center, Japan); SUMIKAMA, Toshiyuki (RIKEN Nishina Center, Japan, Department of Physics, Tohoku University, Japan)

**Co-authors:** BROWNE, Frank (RIKEN Nishina Center, Japan, School of Computing, Engineering, and Mathematics, University of Brighton, United Kingdom); BRUCE, Alison (School of Computing, Engineering, and Mathematics, University of Brighton, United Kingdom); CHOI, Seonho (Department of Physics and Astronomy, Seoul National University, Republic of Korea); NISHIZUKA, Ipppei (Department of Physics, Tohoku University, Japan); NISHIMURA, Shunji (RIKEN Nishina Center, Japan); DOORNENBAL, Pieter (RIKEN Nishina Center, Japan); LORUSSO, Giuseppe (RIKEN Nishina Center, Japan, Department of Physics, University of Surrey, United Kingdom, National Physical

Laboratory, United Kingdom); SÖDERSTRÖM, Pär-Anderson (RIKEN Nishina Center, Japan); WATANABE, Hiroshi (RIKEN Nishina Center, Japan, IRCNPC, School of Physics and Nuclear Energy Engineering, Beihang University, China); DAIDO, Rie (Department of Physics, Osaka University, Japan); PATEL, Zena (RIKEN Nishina Center, Japan, Department of Physics, University of Surrey, United Kingdom); RICE, Simon (RIKEN Nishina Center, Japan, Department of Physics, University of Surrey, United Kingdom); SINCLAIR, Laura (RIKEN Nishina Center, Japan, Department of Physics, University of York, United Kingdom); WU, Jin (RIKEN Nishina Center, Japan, Department of Physics, Peking University, China); XU, Zhengyu (Department of Physics, University of Tokyo, Japan, Department of Physics, University of Hong Kong, Hong Kong); YAGI, Ayumi (Department of Physics, Osaka University, Japan); BABA, Hidetada (RIKEN Nishina Center, Japan); CHIGA, Nobuyuki (Department of Physics, Tohoku University, Japan, RIKEN Nishina Center, Japan); CARROLL, Robert (Department of Physics, University of Surrey, United Kingdom); DIDIERJEAN, Francois (IPHC, CNRS/IN2P3, Université de Strasbourg, France); FANG, Yifan (Department of Physics, Osaka University, Japan); FUKUDA, Naoki (RIKEN Nishina Center, Japan); GEY, Guillaume (LPSC, Université Grenoble-Alpes, CNRS/IN2P3, France, ILL, France); IDEGUCHI, Eiji (Department of Physics, Osaka University, Japan); INABE, Naohito (RIKEN Nishina Center, Japan); ISOBE, Tadaaki (RIKEN Nishina Center, Japan); KAMEDA, Daisuke (RIKEN Nishina Center, Japan); KOJOUHAROV, Ivan (GSI Helmholtzzentrum für Schwerionenforschung GmbH, Germany); KURZ, Nikolaus (GSI Helmholtzzentrum für Schwerionenforschung GmbH, Germany); KUBO, Toshiyuki (RIKEN Nishina Center, Japan); LALKOVSKI, Stefan (Department of Physics, University of Sofia, Bulgaria); LI, Zhihuan (Department of Physics, Peking University, China); LOZEVA, Radomira (IPHC, CNRS/IN2P3, Université de Strasbourg, France, CSNSM, CNRS/IN2P3, Université Paris-Sud, France); NISHIBATA, Hiroki (Department of Physics, Osaka University, Japan); ODAHARA, Atsuko (Department of Physics, Osaka University, Japan); PODOLYÁK, Zsolt (Department of Physics, University of Surrey, United Kingdom); REGAN, Patrick (Department of Physics, University of Surrey, United Kingdom, National Physical Laboratory, United Kingdom); ROBERTS, Oliver (School of Computing, Engineering, and Mathematics, University of Brighton, United Kingdom); SAKURAI, Hiroyoshi (RIKEN Nishina Center, Japan); SCHAFFNER, Henning (GSI Helmholtzzentrum für Schwerionenforschung GmbH, Germany); SIMPSON, Gary (LPSC, Université Grenoble-Alpes, CNRS/IN2P3, France); SUZUKI, Hiroshi (RIKEN Nishina Center, Japan); TAKEDA, Hiroyuki (RIKEN Nishina Center, Japan); TANAKA, Mana (Department of Physics, Osaka University, Japan, Research Center for Nuclear Physics (RCNP), Osaka University, Japan); TAPROGGE, Jan (RIKEN Nishina Center, Japan, Departamento de Física Teórica, Universidad Autónoma de Madrid, Spain, Instituto de Estructura de la Materia, CSIC, Spain); WERNER, Volker (A. W. Wright Nuclear Structure Laboratory, Yale University, USA, Institut für Kernphysik, Technische Universität Darmstadt, Germany); WIELAND, Oliver (INFN Sezione di Milano, Italy)

**Presenter:** Dr BAE, Sunghan (Center for Exotic Nuclear Studies, Institute of Basic Science, RIKEN Nishina Center, Japan)

**Session Classification:** Poster Session

**Track Classification:** Poster Presentations