

Workshop “Low-energy heavy-ion reactions and science of superheavy elements”

Y. Watanabe,^{*1} H. Miyatake,^{*1} H. Haba,^{*2} N. Imai,^{*3} K. Ogata,^{*4} and S. Sakaguchi^{*4}

A workshop titled “Low-energy Heavy-Ion Reactions and Science of Superheavy Elements” was held on March 3, 2024, at Room 202 of Gakushikaikan, Tokyo. This workshop was held to review the scientific achievements of Prof. Toru Nomura of the High Energy Accelerator Research Organization (KEK), who passed away on September 16, 2022, at the age of 82 and to discuss the prospects for the science of low-energy heavy-ion reactions and superheavy elements (SHEs). The workshop was jointly organized by Wako Nuclear Science Center (WNSC), Institute of Particle and Nuclear Studies, KEK, the RIKEN Nishina Center (RNC), the Center for Nuclear Study (CNS), the University of Tokyo, and the Research Center for Superheavy Elements (RCSHE), Kyushu University. Seventy participants attended the workshop and engaged in discussion. The workshop was opened with an opening address by Y. Watanabe of KEK. As listed in Table 1, 14 invited talks were delivered to cover the historical transition of SHE research, theoretical and experimental studies of nuclear properties such as α -decay, fission, and mass, and reaction mechanisms to synthesize SHE nuclei *via* fusion and multi-nucleon-transfer reactions. Nuclear chemistry techniques for the discovery of new elements and the investigation of their chemical properties were also presented. All speakers included in their talks Prof. Nomura’s scien-



Fig. 1. Photo of the workshop “Low-energy Heavy Ion Reactions and Science of Superheavy Elements” held on March 3, 2024, at Room 202 of Gakushikaikan, Tokyo.

tific achievements and their precious memories of him. After each talk, exciting discussions transpired regarding the future of the research on low-energy heavy-ion reactions and the science of SHEs (Fig. 1). The workshop was closed with remarks by N. Imai of CNS. After the workshop, a memorial service for Prof. Nomura was separately held in Room 201 of Gakushikaikan.

Table 1. List of presentations.

Sessions	Title of presentation [*]	Speakers
1	Analysis of fusion–fission dynamics using dynamics models and future prospects	Y. Aritomo (Kindai Univ.)
	Effects of nuclear deformation in the competition between fusion and quasi-fission processes	K. Nishio (JAEA)
	α -particle emission process in fusion reaction – Nomura mechanism revisited –	S. Sakaguchi (Kyushu Univ.)
2	Study on neutron-rich nuclei pioneered by multi-nucleon transfer reactions	Y. Watanabe (KEK)
	Progress in experimental studies on low-energy heavy-ion nuclear reaction mechanisms	T. Tanaka (GANIL)
	Present and future of time-dependent mean field theory: Beyond TDHF	K. Sekizawa (Inst. Sci. Tokyo)
3	Search for superheavy elements by GARIS	K. Morimoto (RIKEN)
	Discovery and chemistry of superheavy elements	H. Kudo (Niigata Univ.)
	From superheavy element to island of stability – By precision mass measurement	M. Wada (KEK)
4	Fission study of proton-rich unstable nuclei using RIBF and SAMURAI – From the viewpoint of the existence limit of nuclei –	M. Sasano (RIKEN)
	Theory of fusion probability for SHEs – Dynamical origin of enhanced fusion hindrance –	Y. Abe (Osaka Univ.)
	New research developments using low-energy heavy-ion nuclear reactions	N. Imai (Univ. Tokyo)
	Heavy-ion physics with Toru Nomura	M. Ishihara (Univ. Tokyo/RIKEN)
	Future prospects for low-energy heavy-ion reaction theory	K. Hagino (Kyoto Univ.)

^{*} The titles are English translations of the original Japanese titles by the authors.

^{*1} Wako Nuclear Science Center (WNSC), IPNS, KEK

^{*2} RIKEN Nishina Center

^{*3} Center for Nuclear Study, University of Tokyo

^{*4} Research Center for Superheavy Elements, Kyushu University