

Nuclear Science and Transmutation Research Division
 Superheavy Element Research Group
 Superheavy Element Device Development Team

1. Abstract

A gas-filled recoil ion separator has been used as a main experimental device for the study of superheavy elements. This team is in charge of maintaining, improving, developing, and operating the separators and related devices. In the RIBF facility, three gas-filled recoil ion separators are installed at RILAC and RRC facility. One is GARIS that is designed for a symmetric reaction such as coldfusion reaction, and the other two are developed for an asymmetric reaction such as hot-fusion reaction, GARIS-II and GARIS-III. New elements $^{278}113$ were produced by $^{70}\text{Zn} + ^{209}\text{Bi}$ reaction using GARIS. Further the new element search is currently in progress by using GARIS-II and GARIS-III.

2. Major Research Subjects

- (1) Maintenance of GARIS, GARIS-II and development of new separator GARIS-III
- (2) Maintenance and development of detector and DAQ system for superheavy element research
- (3) Maintenance and development of target system for GARIS, GARIS-II and GARIS-III

3. Summary of Research Activity

The GARIS-II and III are newly developed which has an acceptance twice as large as existing GARIS, in order to realize higher transmission. A new element search program aiming to element 119 was started using GARIS-II. And new separator GARIS-III was developed and installed into the RILAC experimental hall. After the some commissioning works of GARIS-III, new 119th element search has been started. We will also offer user-support if a researcher wishes to use the devices for his/her own research program.

Members

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List of Publications & Presentations

Publications

[Original Papers]

- T. Niwase, M. Wada, P. Schury, P. Brionnet, S. D. Chen, T. Hashimoto, H. Haba, Y. Hirayama, D. S. Hou, S. Iimura, H. Ishiyama, S. Ishizawa, Y. Ito, D. Kaji, S. Kimura, J. Liu, H. Miyatake, J. Y. Moon, K. Morimoto, K. Morita, D. Nagae, M. Rosenbusch, A. Takamine, T. Tanaka, Y. X. Watanabe, H. Wollnik, W. Xian, and S. X. Yan, “ α -decay-correlated mass measurement of $^{206,207}\text{g.mRa}$ using an α -TOF detector equipped multireflection time-of-flight mass spectrograph system,” *Phys. Rev. C* **104**, 044617 (2021).
- P. Schury, T. Niwase, M. Wada, P. Brionnet, S. Chen, T. Hashimoto, H. Haba, Y. Hirayama, D. S. Hou, S. Iimura, H. Ishiyama, S. Ishizawa, Y. Ito, D. Kaji, S. Kimura, H. Koura, J. J. Liu, H. Miyatake, J. -Y. Moon, K. Morimoto, K. Morita, D. Nagae, M. Rosenbusch, A. Takamine, Y. X. Watanabe, H. Wollnik, W. Xian, and S. X. Yan, “First high-precision direct determination of the atomic mass of a superheavy nuclide,” *Phys. Rev. C* **104**, L021304 (2021).

Presentations

[International Conference/Workshop]

- T. Niwase (invited), “Recent results of GARIS-II + MRTOF experiment,” TASCA21 workshop, Online, June 21, 2021.

[Domestic Conferences/Workshops]

庭瀬暁隆 (口頭発表), 「MRTOF+ α -TOF による $^{257,258}\text{Db}$ の精密質量測定」, 日本物理学会第 77 回年次大会, オンライン, 2022 年 3 月 15–19 日.

庭瀬暁隆 (口頭発表), 「MRTOF と α -TOF 検出器による, α 崩壊に相関した精密質量測定法の開拓」, 日本放射化学会第 65 回討論会 (2021), オンライン, 2021 年 9 月 22–24 日.

庭瀬暁隆 (口頭発表), 「超重核 ^{257}Db の直接質量測定」, 日本物理学会 2021 年度秋季大会, オンライン, 2021 年 9 月 14 日–17 日.

[Seminars]

T. Niwase, “Direct mass measurement of superheavy nuclides via MRTOF mass spectrograph equipped with an α -TOF detector,” RIBF Nuclear Physics Seminar, Online, February 22, 2022.

庭瀬暁隆, 「超重元素の質量測定」, 2021 年度核化学夏の学校, オンライン, 2021 年 8 月 26–27 日.