Research Facility Development Division
Accelerator Group
Cyclotron Team

1. Abstract

The mission of the RIKEN Radioactive Isotope Beam Facility (RIBF)[1] is to improve our understanding of the mechanism of element synthesis in the universe through experiments using intense heavy-ion beams. According to the medium-term targets of the RNC, our team's mission is to maintain and improve the highly reliable operation of the RIBF accelerator complex, in collaboration with other teams of the RNC. The stable operation of the RF system is crucial for handling very high-power beams. Our goal is to develop a highly reliable/stable radio-frequency (RF) system for RIBF cyclotrons and linacs, enabling high-power beam operations. A highly stabilized system makes it possible to achieve single-turn extraction for each cyclotron over a long-term beam service. Single turn-turn extraction is crucial to to minimize the loss of high-power beam at extraction. Furthermore, RIBF is a unique facility where the deuteron spin orientation can be freely controled at the target position owing to the single-turn extraction operation.[2]

Recently, we successfully achieved energy and intensity upgrades for the injector RILAC, which are required for super-heavy element synthesis experiments, by introducing the superconducting linac SRILAC. After three years of hardware improvements on the linac, we achieved a beam intensity of 4.2 particle μA with a duty factor of 86%.[3] Since FY2021, this team has been assigned to take over the duties under an outsourcing contract for the operation staff.

References

1) H. Okuno *et al*., Prog. Theor. Exp. Phys. **2012**, 03C002.
2) N. Sakamoto *et al*., TUB04, Proc. CYCLOTRONS2016.
3) K. Yamada *et al*., MOIXA04, Proc. SRF2023.

2. Major Research Subjects

(1) Room-temperature and superconducting RF technology for heavy-ion accelerators
(2) Development of superconducting linac
(3) Operation of RIBF accelerator complex

3. Summary of Research Activity

- Room-temperature and superconducting RF technology for heavy-ion accelerators. We have successfully constructed a superconducting linac for the SHE experiment. Thanks to the newly developed digital feedback circuit, the amplitude and phase of the accelerating electric field are highly stabilized. The existing analog feedback circuits for the room-temperature RF system will be replaced by the newly developed digital feedback circuit.
- After commissioning the hardware of the superconducting linac, the next target is to achieve long-term operation with high reliability. One of the most significant issues with superconducting cavities is the increase in field emission due to prolonged operation. We are currently working on finding a solution to restore the original performance of the superconducting cavity by utilizing high-power pulsed conditioning.
- User beam services are performed by the operation staff. To ensure effective operation and software and hardware maintenance, a weekly operation meeting is held. During these meetings, problems and difficulties are discussed among members of the hardware groups and the safety management group.

Members

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Research/Technical Scientists

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Kenji SUDA (Technical Scientist)

List of Publications & Presentations

Publications

[Proceedings]

M. Nishida, K. Suda, S. Fukuzawa, M. Hamanaka, S. Ishikawa, K. Kobayashi, R. Koyama, R. Moteki, T. Nakamura, M. Nishimura, J. Shibata, N. Tsukiori, K. Yadomi, T. Adachi, T. Dantsuka, M. Fujimaki, T. Fujinawa, N. Fukunishi, H. Hasebe, Y. Higurashi, E. Ikezawa, H. Imao, O. Kamigaito, M. Kidera, M. Komiyama, K. Kumagai, T. Maie, Y. Miyake, T. Nagatomo, T. Nakagawa, M. Nakamura, J. Ohnishi, H. Okuno, K. Ozeki, N. Sakamoto, A. Uchiyama, S. Watanabe, T. Watanabe, Y. Watanabe, and K. Yamada, "Status report of the operation of RIBF ring cyclotrons," Proceedings of the 21st Annual Meeting of Particle Accelerator Society of Japan, Yamagata (YAMAGATA TERRSA), Japan, July 31–August 3, 2024, WTSP09, (2024), pp. 1135–1140, https://www.pasj.jp/web_publish/pasj2024/proceedings/PDF/WTSP/WTSP09.pdf.

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K. Kaneko, H. Yamauchi, K. Oyamada, M. Tamura, A. Yusa, J. Suzuki, Y. Higurashi, N. Sakamoto, M. Fujimaki, H. Imao, M. Kidera, T. Nagatomo, T. Nakagawa, T. Nishi, K. Ozeki, K. Suda, A. Uchiyama, T. Watanabe, Y. Watanabe, K. Yamada, and O. Kamigaito, "Present status of RILAC," Proceedings of the 21st Annual Meeting of Particle Accelerator Society of Japan, Yamagata (YAMAGATA TERRSA), Japan, July 31–August 3, 2024, WTSP07, (2024), pp. 1129–1132, https://www.pasj.jp/web_publish/pasj2024/proceedings/PDF/WTSP/WTSP07.pdf.

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Presentations

[International Conference/Workshop]

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[Domestic Conferences/Workshops]

M. Nishida (poster), K. Suda, S. Fukuzawa, M. Hamanaka, S. Ishikawa, K. Kobayashi, R. Koyama, R. Moteki, T. Nakamura, M. Nishimura, J. Shibata, N. Tsukiori, K. Yadomi, T. Adachi, T. Dantsuka, M. Fujimaki, T. Fujinawa, N. Fukunishi, H. Hasebe, Y. Higurashi, E. Ikezawa, H. Imao, O. Kamigaito, M. Kidera, M. Komiyama, K. Kumagai, T. Maie, Y. Miyake, T. Nagatomo, T. Nakagawa, M. Nakamura, J. Ohnishi, H. Okuno, K. Ozeki, N. Sakamoto, A. Uchiyama, S. Watanabe, T. Watanabe, Y. Watanabe, and K. Yamada, "Status report of the operation of RIBF ring cyclotrons," 21st Annual Meeting of Particle Accelerator Society of Japan, Yamagata (YAMAGATA TERRSA), Japan, July 31–August 3, 2024.

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K. Kaneko (poster), H. Yamauchi, K. Oyamada, M. Tamura, A. Yusa, J. Suzuki, Y. Higurashi, N. Sakamoto, M. Fujimaki, H. Imao, M. Kidera, T. Nagatomo, T. Nakagawa, T. Nishi, K. Ozeki, K. Suda, A. Uchiyama, T. Watanabe, Y. Watanabe, K. Yamada, and O. Kamigaito, "Present status of RILAC," 21st Annual Meeting of Particle Accelerator Society of Japan, Yamagata (YAMAGATA TERRSA), Japan, July 31–August 3, 2024.

N. Sakamoto (poster), O. Kamigaito, K. Ozeki, K. Suda, K. Yamada, A. Uchiyama, T. Nagatomo, Y. Higurashi, and T. Nishi, "Present performance and perspectives of the RIKEN Heavy-Ion Superconducting LINAC (SRILAC)," 21st Annual Meeting of Particle Accelerator Society of Japan, Yamagata (YAMAGATA TERRSA), Japan, July 31–August 3, 2024.