Research Facility Development Division
Research Instruments Group
SAMURAI Team

1. Abstract

In collaboration with research groups in and outside RIKEN, the team designs, develops and constructs the SAMURAI spectrometer and relevant equipment that are and will be used for reaction experiments using RI beams at RI Beam Factory. The SAMURAI spectrometer consists of a large superconducting dipole magnet and a variety of detectors to measure charged particles and neutrons. After the commissioning experiment in March 2012, the team prepared and conducted, in collaboration with researchers in individual experimental groups, the first series of experiments with SAMURAI in May 2012. Then, amount numbers of experiments were well performed until now utilizing the property of SAMURAI. The team also provides a basis for research activities by, for example, organizing collaboration workshops by researchers who are interested in studies or plan to perform experiments with the SAMURAI spectrometer.

2. Major Research Subjects

Design, operation, maintenance and improvement of the SAMURAI spectrometer and its related research instruments. Support and management for SAMURAI-based research programs. Generate future plans for next generation instruments for nuclear reaction studies.

3. Summary of Research Activity

The current research subjects are summarized as follows:

(1) Operation, maintenance and improvement of a large superconducting dipole magnet, the main component of the SAMURAI spectrometer
(2) Design, development and construction of various detectors that are used for nuclear reaction experiments using the SAMURAI spectrometer
(3) Preparation for planning experiments using SAMURAI spectrometer
(4) Maintenance and improvement of the SAMURAI beam line
(5) Formation of a collaboration platform called "SAMURAI collaboration"
(6) Preparation for next generation spectrometer for nuclear reaction studies

Members

Team Leader

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Visiting Researcher

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List of Publications & Presentations

Publications

[Original Papers]

B. Monteagudo *et al*., "Mass, spectroscopy and two-neutron decay of ^{16}Be," Phys. Rev. Lett. **132**, 082501 (2024).

P. J. Li *et al*., "Validation of the ^{10}Be ground-state molecular structure using ^{10}Be $(p, p\alpha)$ ^{6}He triple differential reaction cross-section measurements," Phys. Rev. Lett. **131**, 212501 (2023).

Y. Kondo *et al*., "First observation of ^{28}O," Nature (London) **620**, 965 (2023).

H. Wang *et al*., "Intruder configurations in ^{29}Ne at the transition into the island of inversion: Detailed structure study of ^{28}Ne," Phys. Lett. B **843**,138038 (2023).

S. Chen *et al*., "Level structures of ^{56,58}Ca cast doubt on a doubly magic of ^{60}Ca," Phys. Lett. B **843**,138025 (2023).

T. Phol *et al*., "Multiple mechanisms in proton-induced nucleon removal at 100 MeV/nucleon," Phys. Rev. Lett. **130**, 172501 (2023).

Z. Elekes *et al*., "Shape coexistence in ^{66}Se," Phys. Lett. B **844**, 138072 (2023).

A. Corsi *et al*., "Searching for universality of dineutron correlation at the surface of Borromean nuclei," Phys. Lett. B **840**, 137875 (2023).

S. Kim *et al*., "Unbound states in ^{17}C and *p-sd* shell-model interactions," Phys. Lett. B **836**, 137629 (2023).

Presentations

[International Conferences/Workshops]

SAMURAI International Collaboration Workshop 2023, LPC–CAEN, Caen, France, August 29–31, 2023.
`https://indico.in2p3.fr/event/30290/`.

T. Nakamura (invited), "Weakly bound and unbound nuclei near and beyond the neutron drip line," International Symposium on Physics of Unstable Nuclei 2023, Phu Quoc Island, Vietnam, May 4–8, 2023.

T. Nakamura (invited), "Exploring neutron-rich extremes of the nuclear landscape," UK Nuclear Physics Conference (IOP), York, UK, April 4–6, 2023.

Y. Kondo (invited), "Four- neutron unbound nucleus ^{28}O studied by the invariant mass method," Advances in Radioactive Isotope Science (ARIS) 2023, Avignon, France, June 4–9, 2023.

L. Stuhl, "Study of Gamow-Teller giant resonance in ^{11}Li drip-line nucleus," The 7th International Conference on Collective Motion in Nuclei under Extreme Conditions (COMEX7), Catania, Italy, June 11–16, 2023.

Y. Togano, "Electric dipole strength of ^{52}Ca," The 7th International Conference on Collective Motion in Nuclei under Extreme Conditions (COMEX7), Catania, Italy, June 11–16, 2023.

H. Otsu (invited), "Overview SAMURAI," Direct Reactions and Spectroscopy with Hydrogen Targets: Past 10 years at the RIBF and future prospects, York, UK, July 31–August 4, 2023.

T. Pohl, "Multiple mechanisms in proton-induced one nucleon removal from ^{14}O at ∼100 MeV/nucleon," Direct Reactions and Spectroscopy with Hydrogen Targets: Past 10 Years at the RIBF and Future Prospects, York, UK, July 31–August 4, 2023.

N. Orr, "NEBULA—Plus: The upgrade of the NEBULA fast neutron array," Direct Reactions and Spectroscopy with Hydrogen Targets: Past 10 Years at the RIBF and Future Prospects, York, UK, July 31–August 4, 2023.

Y. Kondo, "Four-neutron unbound nucleus ^{28}O studied by the invariant mass method," Direct Reactions and Spectroscopy with Hydrogen Targets: Past 10 Years at the RIBF and Future Prospects, York, UK, July 31–August 4, 2023.

Y. Togano, "CsI(Na) array CATANA to measure protons and gamma-rays," Direct Reactions and Spectroscopy with Hydrogen Targets: Past 10 Years at the RIBF and Future Prospects, York, UK, July 31–August 4, 2023.

M. K. Nishimura, "Directed and elliptic flow using neutron rich Sn + Sn collisions with 270 MeV/nucleon," 6th Joint Meeting of the APS Division of Nuclear Physics and the Physical Society of Japan, Hawaii, USA, November 26–December 1, 2023.

L. Stuhl, "Gamow-Teller giant resonance in ^{11}Li neutron drip line nucleus," 6th Joint Meeting of the APS Division of Nuclear Physics and the Physical Society of Japan, Hawaii, USA, November 26–December 1, 2023.

T. Isobe, "Experimental study of asymmetric nuclear matter EoS from heavy-ion reactions," 6th Joint Meeting of the APS Division of Nuclear Physics and the Physical Society of Japan, Hawaii, USA, November 26–December 1, 2023.

T. Nakamura, "Coulomb and nuclear breakup reactions of a halo nucleus ^{31}Ne," 6th Joint Meeting of the APS Division of Nuclear Physics and the Physical Society of Japan, Hawaii, US, November 26–December 1, 2023.

A. Tsuchida, "New detector system for a (p, pN) reaction in inverse kinematics," 6th Joint Meeting of the APS Division of Nuclear Physics and the Physical Society of Japan, Hawaii, US, November 26–December 1, 2023.

Y. Kondo, "SAMURAI activities including ^{28}O" 2023 Annual Meeting of JSPS/NRF/NSFC A3 Foresight Program "Nuclear Physcis in the 21st Century," Xi'an, China, November 30–December 4, 2023.

Y. Kondo (invited), "Study of ^{28}O by multi- neutron detection at RIBF-SAMURAI," Magic Numbers and Shell Evolution Studied with Novel Devices and Theoretical Perspectives, JPS meeting, Online, March 21, 2024.

H. Liu, "Status of the STRASSE project for quasi-free scattering measurements," Magic Numbers and Shell Evolution Studied with Novel Devices and Theoretical Perspectives, JPS meeting, Online, March 21, 2024.

[Domestic Conferences/Workshops]

阿久津良介, 「ニュートリノ原子核反応予測の精度向上に向けた酸素ビーム実験の概要」, 日本物理学会 2024 年春季大会, オンライン, 2024 年 3 月.

水野裕介, 「ニュートリノ原子核反応予測の精度向上に向けた酸素ビーム実験の検出器シミュレーション」, 日本物理学会 2024 年春季大会, オンライン, 2024 年 3 月.

松井智輝, 「6 中性子クラスター探索実験のための飛跡検出器 PFAD の開発」, 日本物理学会 2024 年春季大会, オンライン, 2024 年 3 月.

石黒宗一郎, 「中性子過剰核における短距離相関対探索のための前方散乱粒子検出器の開発」, 日本物理学会 2024 年春季大会, オンライン, 2024 年 3 月.

大澤悠真, 「^{14}Be のクーロン分解反応」, 日本物理学会 2024 年春季大会, オンライン, 2024 年 3 月.

近藤洋介, 「$N = 20$ 逆転の島の陽子欠損領域における不安定核研究」, 九州大学 理論核物理研究会 「現代核物理の拡がりと展望」, 2023 年 7 月 19–21 日.

Press Release

「原子核の分子構造を発見—不安定ベリリウム 10 原子核は窒素分子とそっくり—」, 2023 年 12 月 6 日, `https://www.riken.jp/press/2023/20231206_1/index.html`.

Master Theses

磯部駆, 「中性子過剰核における短距離相関探索のための後方散乱重陽子検出器の開発」, 東京工業大学, 2024 年 2 月.

H. Lee, "Coulomb dissociation of ^{17}B," 東京工業大学, 2024 年 2 月.