FRIB LABORATORY UPDATE for USERS June 2023

FRIB science program is progressing

Multi-institutional teams of scientific users are conducting experiments and publishing results.

One year ago, in May 2022, FRIB began operation as the 28th U.S. Department of Energy Office of Science user facility. As it now begins its second year of operation, FRIB is working to support a broad scientific program, continue its technological developments, and further enhance user discovery opportunities.

FRIB science program underway

Since the start of user operation, FRIB has delivered more than 200 rare isotope beams to experiments and supported 413 participants, including 78 students, across 37 experiments, 104 institutions, and 31 countries.

The approved science program covers the spectrum of FRIB science themes—properties of rare isotopes; nuclear astrophysics; fundamental interactions; and applications for society, including in homeland security. Program Advisory Committee (PAC)-recommended experiments also utilize the full range of FRIB's capabilities—fast, stopped, and reaccelerated rare-isotope beams—and use all FRIB experimental areas and major FRIB instruments.

In the first year of operation, FRIB has successfully run PAC-recommended experiments with rare isotope yields increasing beam power safely from 1 kW to 3 kW to 5 kW, and further primary beam current increases are planned for

the fall.

The experiments have used a wide range of primary beams. Currently, the primary beam list includes ^{18}O, ^{36}Ar, ^{40}Ar, ^{64}Ni, ^{64}Zn, ^{70}Zn, ^{70}Ge, ^{82}Se, ^{86}Kr, and ^{198}Pt, with corresponding beam energies and beam currents, and a list of new beams requested by users. This list is updated as we develop new primary beams, increase primary beam currents, and receive user requests.

Science results being published
Multi-institutional teams of scientific users are conducting experiments and publishing results. One week after the ribbon cutting, the first experiment was completed. Science results from that experiment have been published in two publications:

- "Crossing N=28 Toward the Neutron Drip Line: First Measurement of Half-Lives at FRIB" in *Physical Review Letters* (November 2022) – the first FRIB scientific publication
- "Microsecond Isomer at the N=20 Island of Shape Inversion Observed at FRIB" in *Physical Review Letters* (June 2023)

Additional publications from this experiment and the other completed experiments will be submitted soon.

Enhancements to realize the full FRIB potential

High Rigidity Spectrometer project
The High Rigidity Spectrometer (HRS) project will have a significant benefit for FRIB's scientific program, in particular with regard to extending the scientific reach to neutron-rich isotopes by a combined production-rate and luminosity increase of up to a factor of more than 100.

The project is underway, and a user community of over 500 scientists supports HRS.

FRIB400 energy upgrade
The FRIB400 energy upgrade will double FRIB's beam energy to 400 MeV/nucleon and expand the scientific impact by increasing the yield of many rare isotopes tenfold.

The science community laid out the enormous opportunities in the FRIB400 whitepaper, which was endorsed by the community in preparation for the 2023 Long Range Plan.

Isotope harvesting
FRIB isotope harvesting offers a fast development path for any rare isotope, leading to innovations and funding opportunities. A 2019 article in the *Journal of Physics G: Nuclear and Particle Physics* has additional information about isotope harvesting at FRIB.

Space radiation effects
The FRIB Single Event Effects (FSEE) Facility uses energetic and penetrating

heavy-ion beams to measure the response of electronic components to such ions. This simulates in a few minutes the effect of cosmic rays on electronics over decades.

Long range plan update

The Nuclear Science Advisory Committee (NSAC) Long Range Planning (LRP) process in response to a charge issued by the U.S. Department of Energy and the National Science Foundation is ongoing. Whitepapers from town hall meetings initiated by the Division of Nuclear Physics of the American Physical Society, including the ones on Nuclear Structure, Reactions, and Astrophysics and Fundamental Symmetries, Neutrons, and Neutrinos – both addressing the science opportunities enabled by FRIB – were submitted to the LRP Writing Group and serve as the nuclear science community's input to the process. The community whitepapers, as well as information on the LRP Writing Group and its subcommittees, can be found on the NSAC Long Range Plan website. The Resolution Meeting, where the final recommendations for the field's priorities will be finalized, is scheduled for the week of 10 July with completion of the LRP and the subsequent rollout anticipated for the fall.

Low Energy Community Meeting 2023 9-11 August at FRIB Laboratory

FRIB will host the 2023 Low Energy Community Meeting (LECM) 9-11 August. The annual LECM meeting is an opportunity for the user communities of FRIB, ATLAS, and the ARUNA laboratories to collaborate on developments and define priorities. Past meetings have noted the importance of facility operation, equipment and capability upgrades, and the FRIB energy upgrade FRIB400. Over the course of the three days, members of the low-energy nuclear physics community will participate in plenary sessions, working group sessions, and workshops at the meeting.

News

Below are some recent FRIB website articles. For more, visit the FRIB website.

- Global superconducting radio frequency community attends FRIB-hosted conference in Grand Rapids
- Rebecca Surman named 2022 American Association for the Advancement of Science Fellow
- 2023 FRIB Visiting Scholar Program for Experimental Science names award winners
- FRIB Theory Alliance topical program 16-26 May at FRIB
- INSIGHT workshop brings together faculty and students representing national research traineeship programs

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In the News

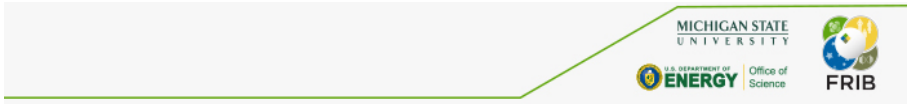
Below are some recent FRIB-focused articles from selected outlets. For more, visit the FRIB website.

- World-leading rare isotope facility is online in Michigan (Physics Today)
- Element creation in the lab deepens understanding of surface explosions on neutron stars (Phys.org)
- Excited sodium-32 with a spherical wave function (APS Physics)
- Storied accelerator to test chips (Science)

Upcoming Events

Below is a list of upcoming events. For more, visit the FRIB website.

- 9-15 July: 20th Exotic Beam Summer School
- 10 July: IReNA Workshop: Weak Interactions in Nuclear Astrophysics
- 16-29 July: Physicists Inspiring the Next Generation (PING) 2023
- 9-11 August: Low Energy Community Meeting 2023



Michigan State University operates FRIB as a user facility for the U.S. Department of Energy Office of Science (DOE-SC), supporting the mission of the DOE-SC Office of Nuclear Physics.

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