

Facility for Rare Isotope Beams

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■ The Facility for Rare Isotope Beams (FRIB) is a user facility for the U.S. Department of Energy Office of Science (DOE-SC), with financial support from and furthering the mission of the DOE-SC Office of Nuclear Physics

- The FRIB user community includes 1,800 scientists, with 1,116 (61%) in the U.S. Members are from 133 colleges and universities, 13 U.S. national laboratories, and 51 countries (fribusers.org).
- Since the start of user operation in May 2022, FRIB has delivered more than 370 rare isotope beams to experiments and supported 840 participants – 661 from the United States (79%) – including 221 students, across 155 experiments, 22 countries, and 149 institutions.
- Published results are available at frib.msu.edu/publications.

■ FRIB is oversubscribed by a factor of 3: high demand for high-merit science

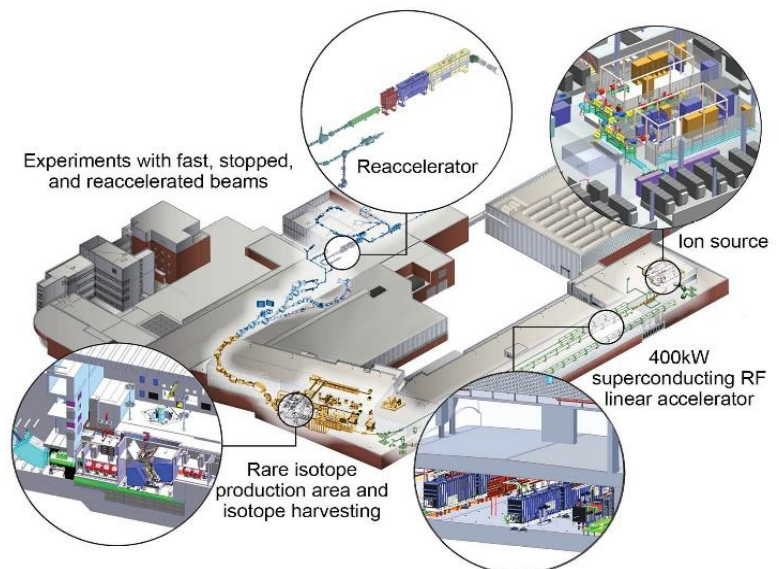
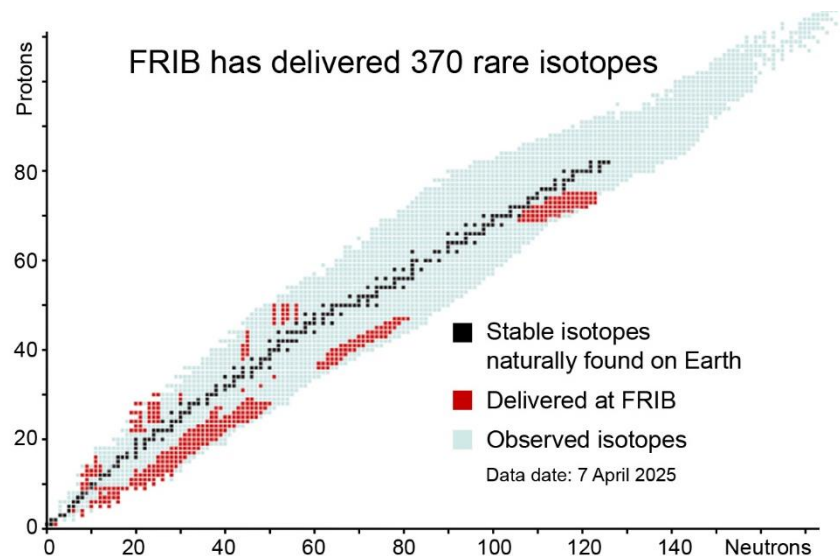
- FRIB's science program is forged with input from the FRIB Program Advisory Committee (PAC), a group of world-leading scientists and experts who review non-proprietary beam-time requests submitted to FRIB for merit, consistent with DOE-SC policy and U.S. law, and make recommendations to the FRIB Laboratory director.
- FRIB continues to be oversubscribed and can only accommodate around 30 percent of all requested beam-time due to the large interest.
- The FRIB beam-time scientists requested from the second to third PAC increased from 11,859 to 14,283 hours.
- At the third PAC in January 2025, beam time was awarded to 45 U.S. institutions across 24 U.S. states, counting among them seven U.S. national laboratories and 35 colleges and universities.

■ FRIB science is of strategic importance for the United States and the world

- FRIB is a DOE-SC user facility for nuclear science with additional benefits to medicine, materials science, national security, and industry.
- FRIB science is a priority for the nation's science community and is aligned with national science priorities articulated by federal advisory panels.

■ For FRIB, we designed, built, and now operate the most powerful heavy-ion accelerator

- FRIB provides intense beams of rare isotopes (short-lived nuclei not normally found on Earth).
- FRIB enables scientists to make discoveries about the properties of rare isotopes, nuclear astrophysics, fundamental interactions, and applications for society, including in medicine, homeland security, and industry.



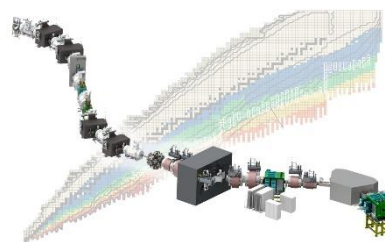
- Discoveries at FRIB transform our understanding of nature. FRIB addresses science's most important questions related to the stability, composition, reactions, and applications of atomic nuclei.
- FRIB user facility operation is supported by the DOE-SC Office of Nuclear Physics as one of 28 DOE-SC user facilities.

■ What is a rare isotope?

- An isotope is one of the forms of a specific element. Only a few isotopes of each element are found naturally on Earth. Rare isotopes are not normally found on Earth but comprise the vast majority of possible isotopes. While they are rare on Earth, they are nevertheless important for understanding the universe and for technical applications like nuclear power.

■ FRIB science opportunities and enhancements underway

- DOE-SC approved start of execution for the High Transmission Beam Line (HTBL), one of the two segments of the High Rigidity Spectrometer (HRS) (hrs.lbl.gov; frib.msu.edu/hrs), a scientific instrument that will serve as the core of FRIB's fast-beam basic research program. The HRS user group includes over 500 scientists. With HRS, the luminosity for experiments with the most neutron-rich and interesting nuclei will increase by a factor of up to 100.
- The FRIB400 upgrade (frib.msu.edu/frib400) will double FRIB's beam energy to 400 MeV/nucleon and expand the laboratory's scientific impact by increasing the yield of many key rare isotopes tenfold. The scientific case for the energy upgrade laid out by the community in the FRIB400 whitepaper (frib.msu.edu/frib400paper).



■ Isotope harvesting benefits society

- Rare isotope harvesting provides additional discovery opportunity. Rare isotopes have a role in fields of study such as medicine, biochemistry, materials science, horticulture, and astrophysics. During routine operation for its nuclear physics mission—without interfering with FRIB's primary users—extra, unused isotopes can be “harvested.”
- The DOE Isotope Program (energy.gov/science/ip) awarded \$13.2M for FRIB's isotope harvesting project to establish the capability and now supports operations and research.

■ Chip testing addresses critical national need by leveraging accelerator expertise

- FRIB's heavy-ion facilities, including the FRIB Single Event Effects Facility (FSEE) and the in-progress K500 Chip Testing Facility (KSEE), address the national shortage of testing capacity for advanced microelectronics used in industries like spaceflight, wireless technology, and autonomous vehicles. Forty-one companies are using FSEE for their product validation.
- Student opportunities through the MSU Space Electronics Initiative—started by FRIB and the MSU College of Engineering—will position MSU as a national leader in chip design and testing and will develop the nation's workforce in these fields.

■ FRIB attracts and trains the next generation of scientists and engineers

- The university environment provides hands-on training and interaction of students with scientists in a world-class facility on a daily basis.
- FRIB currently employs 152 graduate students and 134 undergraduate students (as of 1 April 2025).
- FRIB is a magnet for top students in nuclear science. MSU has a top-ranked nuclear physics graduate program, according to *U.S. News and World Report*.
- FRIB is a top facility for students studying accelerator science, cryogenic engineering, and radiochemistry, all areas identified in federal advisory panel reports as in short supply for the nation and critical to U.S. economic competitiveness, energy security, nuclear security, and nonproliferation efforts.
- FRIB's outreach programs engage Michigan citizens and draw youth to STEM fields at FRIB. FRIB provides programs for schools and the public, with 12,300 personal contacts in 2024.

