FACILITY FOR
RARE ISOTOPE BEAMS

April 2024

Addressing National Priorities

FRIB Is an Important Research Tool for America

Michigan State University (MSU) operates the Facility for Rare Isotope Beams (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. FRIB provides intense beams of rare isotopes (that is, 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.

FRIB is the only accelerator-based user facility on a university campus. User facility operation is supported by the DOE-SC Office of Nuclear Physics as one of 28 DOE-SC user facilities. FRIB spent and obligated more than $1 billion in procurements and labor, with over 94 percent invested in the United States.

Science

FRIB is a core piece of U.S. research infrastructure with broad benefits to other sciences, medicine, materials science, national security, and industry. Discoveries at FRIB will transform our understanding of nature. FRIB addresses science's most important questions related to the stability, composition, reactions, and applications of atomic nuclei.

FRIB provides researchers with more than 1,000 new rare isotopes never before produced on Earth. This enables researchers to answer key scientific questions, ranging from the origins of stars and the universe to how to diagnose and cure diseases, optimize nuclear reactors, and destroy nuclear waste.

FRIB has the potential to enable major discoveries. The goal of research at FRIB is a comprehensive theory of atomic nuclei, leading to major benefits and new opportunities.

Workforce Development

FRIB is uniquely positioned to provide opportunities for the next generation of U.S. science and technical talent.

FRIB is a magnet for top students in nuclear physics. MSU is home to a top-ranked nuclear physics graduate program, according to U.S. News and World Report.

FRIB is the only accelerator-based user facility on a university campus 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, the MSU Department of Physics in the MSU College of Natural Science, and the MSU College of Engineering offer graduate education programs in accelerator science and engineering to contribute to the workforce in areas of national need.

Learn more at frib.msu.edu

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FRIB Adds Value to Nation

Isotope Harvesting Benefits Society

An area of discovery opportunity for researchers is rare isotope harvesting. During routine operation for its nuclear physics mission—without interfering with FRIB's primary users—extra, unused isotopes can be "harvested."

FRIB isotope harvesting offers a fast development path for any rare isotope, leading to innovations. Rare isotopes have a role in multiple fields of study, such as medicine, biochemistry, materials science, horticulture, and astrophysics. Isotope harvesting at FRIB is recommended by the Nuclear Science Advisory Committee Isotopes Subcommittee, a federally chartered advisory committee to DOE. The DOE Isotope Program is providing $13.2M over five years, covering base operations and core research, for FRIB's isotope harvesting project.

Leveraging FRIB for Chip Testing

The FRIB Single Event Effects (FSEE) Facility (frib.msu.edu/fsee) 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. SEEs are caused when a single particle deposits enough energy to cause an effect in a device. Such effects could lead to device failure or other errors in systems on Earth, in airplanes, or in spacecraft. The high-ion energy allows testing to be done in air, rather than in vacuum, simplifying issues such as part cooling and access. MSU obtained a $14M federal contract to refurbish FRIB's K500 cyclotron (frib.msu.edu/k500) into a dedicated facility to test electronics for space flight.

Innovation and Economic Engine

FRIB supports multi-disciplinary collaboration, affords opportunities to generate new intellectual property, and stimulate external investment. FRIB enables scientists to perform research and further development in industry and in the national interest. Past discoveries in nuclear science have enabled important advances in medical technology, like MRI and PET machines; smoke detection in homes to keep families safe; and cell phone technology.

FRIB provides leadership in applying accelerator technology to the sciences and developing technology required to operate the most powerful superconducting, heavy-ion accelerator.

Strategic Capabilities

Particle accelerators are used in discovery science, medicine, and high-tech industry. Accelerators are the workhorses of nuclear physics research—the ones with the muscle to smash atoms so the aftermath can be studied. FRIB is an emerging leader in accelerator science based on expertise acquired building FRIB. Strategic capabilities include superconducting radio frequency, helium liquefaction, superconducting large-gap magnets, and machine learning.

Enhancements to Optimize FRIB Potential

The High Rigidity Spectrometer (HRS) project (hrs.lbl.gov) 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.

The FRIB400 energy upgrade (frib.msu.edu/frib400) 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 (frib.msu.edu/frib400paper), recommended in "A New Era of Discovery: The 2023 Long Range Plan for Nuclear Science."

For More Information

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