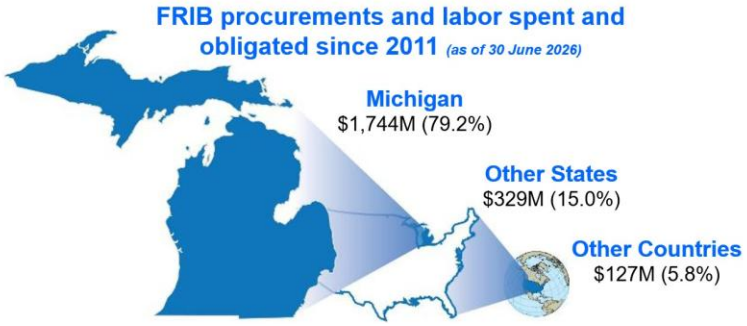
# Addressing State, National Priorities

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), with financial support from and furthering the mission of the DOE-SC Office of Nuclear Physics. User facility operation is supported by the DOE-SC Office of Nuclear Physics as one of 28 DOE-SC user facilities.

FRIB provides state-of-the-art capabilities to advance nuclear science, with additional benefits to medicine, materials science, and industry, strengthening U.S. competitiveness and national security, and accelerating translation of discovery into real-world impact.

## Economic Impact in Michigan

FRIB is a DOE-SC user facility for nuclear science with benefits to medicine, materials science, national security, and industry. FRIB has spent and obligated over $2 billion in procurements and labor since January 2011, with $1.7 billion (79%) in Michigan, and 94 percent in the United States. FRIB uses a best-value procurement approach as required by federal regulations. Michigan has proven to be a great resource, and a strong regional skilled workforce supported civil construction.




## FRIB Adds Value to Nation

**Artificial intelligence (AI) as an Enabling Capability, Aligned with U.S. Genesis Mission**

As a DOE Office of Science user facility based at a university, FRIB advances the goals of the U.S. Genesis Mission (genesis.energy.gov) by harnessing artificial intelligence to accelerate discovery in nuclear science and develop the workforce.

Integrating advanced AI systems into the research infrastructure, FRIB strengthens U.S. leadership in nuclear science while transforming how science is done: applying machine learning (ML) approaches to shorten discovery timelines and driving new advances across experimental nuclear science, theoretical nuclear science, and accelerator science.

**Learn more at frib.msu.edu**

## Enabling World-Leading Discoveries

FRIB designed, built, and now operates the most powerful heavy-ion accelerator, providing researchers intense beams of rare isotopes (short-lived nuclei not normally found on Earth).

FRIB enables scientists to make discoveries about rare isotopes, nuclear astrophysics, fundamental interactions, and applications for society, including in medicine, homeland security, and industry.

FRIB's scientific program is forged with input from the FRIB Program Advisory Committee (PAC), a group of international world-leading scientists who review non-proprietary beam-time requests submitted to FRIB for merit and make recommendations to the FRIB Laboratory director. FRIB is open to all interested researchers, subject to applicable laws and regulations.

FRIB is oversubscribed by a factor of 3 and can only accommodate around 30% of requested beam-time. Published results are available at frib.msu.edu/publications.

Approximately 1,800 scientific users are engaged in FRIB science and instrumentation. They organized themselves in an independent FRIB Users Organization (fribusers.org).

## Nuclear Science Leadership

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.

**Experimental nuclear science:** AI-enabled particle identification and real-time event selection allow researchers to process complex experimental data more rapidly.

**Theoretical nuclear science:** ML algorithms and intelligent systems to simulate nuclear structure, reactions, and dynamics, expanding computational capabilities to solve the hardest scientific challenges in many-body physics.

**Accelerator science:** AI-guided beam tuning and diagnostics improve operational performance and efficiency

### Forward-Looking Integration with Quantum Science

Quantum information science and technology (QIST) combines quantum mechanics, information theory, and computer science to advance emerging technologies in communication, security, energy, and medicine. At FRIB, this intersection provides a vital testing ground for future quantum computing and sensing. Through a cohesive, laboratory-wide approach aligned with DOE-SC mission priorities and the Quantum Innovation Executive Order, FRIB coordinates its scientific, technical, and workforce strengths to advance quantum innovation. Researchers use rare isotopes to reveal how quantum behavior shapes atomic nuclei, with experimentalists enhancing quantum measurements and entanglement studies, and theorists developing quantum algorithms for nuclear many-body systems.

### Chip Testing Capability Addresses Critical National Need

Leveraging FRIB's accelerator expertise, its heavy-ion chip-testing facilities—the FRIB Single Event Effects Facility (FSEE) and 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 (frib.msu.edu/see). Enabled by DOE-SC investment as a self-supporting program, these facilities provide high-energy heavy-ion beams that simulate decades of cosmic ray exposure on electronic components, estimating failure likelihood within minutes. Complementing this, the MSU Space Electronics Initiative (space-electronics.msu.edu) positions MSU as a national leader in chip design and testing by developing the nation's workforce in these fields.

### Isotope Harvesting Benefits Society

FRIB's isotope harvesting infrastructure enables the production of high-purity radionuclides for research applications, including nuclear physics, astrophysics, materials science, biology, and nuclear medicine. During routine operation—without interfering with FRIB's primary users—extra, unused isotopes can be "harvested." DOE Isotope Program provided funding to establish the capability and now supports operations and research.

## Innovation and Economic Engine

FRIB supports multidisciplinary collaboration, generates intellectual property, and stimulates private-sector development. Building on nuclear science discoveries like MRIs, PET scans, smoke detectors, and cell phones, FRIB drives medical and industrial applications. FRIB operates the most powerful superconducting heavy-ion accelerator, including low-beta superconducting radiofrequency particle acceleration and large-scale, high-efficiency helium liquefaction. As a research facility, it partners with local economic developers to support regional growth and national priorities.

## Attracting and Training Next Generation

FRIB, located on the campus of a research-intensive university, attracts the best students to study nuclear science, accelerator science, cryogenic engineering, and radiochemistry, areas in which workforce development is in short supply and critical to U.S. economic competitiveness, energy security, nuclear security, and nonproliferation efforts. The university setting enables hands-on training in a world-class facility.

Between 2018–2024, MSU awarded 17% of U.S. nuclear physics PhDs. Median time to degree is 5.33 years (U.S. median is 6 years) and 81% PhD completion rate (U.S. average is 60%).

FRIB employs 132 graduate students and 79 undergraduate students.

## Research and Student Training Supports National Security

FRIB offers students hands-on experience, engaging in cutting-edge research supported by the DOE-SC and the National Nuclear Security Administration.

Students explore pathways in nuclear science that directly contribute to national security and prepare them for future success in the Nuclear Security Enterprise.

## For More Information

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