



# FRIB Overview and Proposal Evaluation Process

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U.S. DEPARTMENT OF  
**ENERGY**

Office of  
Science

# FRIB is 93% Complete:

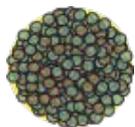
## Planning for User Operation in Early 2022

- FRIB Project constructs a \$730 million user facility funded by the Department of Energy Office of Science (DOE-SC), Michigan State University, and the State of Michigan
- CD-4 date is June 2022, managing to early completion in 2021
- FRIB will be a DOE-SC user facility for world-class rare isotope research supporting the mission of the Office of Nuclear Physics in DOE-SC, FRIB established, owned and operated by MSU
- FRIB will enable scientists to make discoveries about the properties of these rare isotopes in order to better understand the physics of nuclei, nuclear astrophysics, fundamental interactions, and applications for society



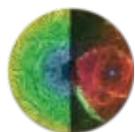
**Facility for Rare Isotope Beams**  
U.S. Department of Energy Office of Science  
Michigan State University

# FRIB Enables Scientists to Make Discoveries Remains Aligned with National Priorities



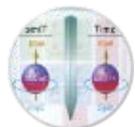
## Properties of atomic nuclei

- Develop a predictive model of nuclei and their interactions
- Many-body quantum problem: intellectual overlap to mesoscopic science, quantum dots, atomic clusters, etc.



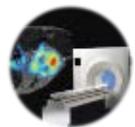
## Astrophysics: What happens inside stars?

- Origin of the elements in the cosmos
- Explosive environments: novae, supernovae, X-ray bursts ...
- Properties of neutron stars



## Tests of laws of nature

- Effects of symmetry violations are amplified in certain nuclei



## Societal applications and benefits

- Medicine, energy, material sciences, national security

Science is aligned with national priorities articulated by

- Nuclear Science Advisory Committee to DOE and NSF *Long Range Plan for Nuclear Science* (2015)
- National Research Council *Decadal Survey of Nuclear Physics* (2012)
- National Research Council *Rare Isotope Science Assessment* report (2006)

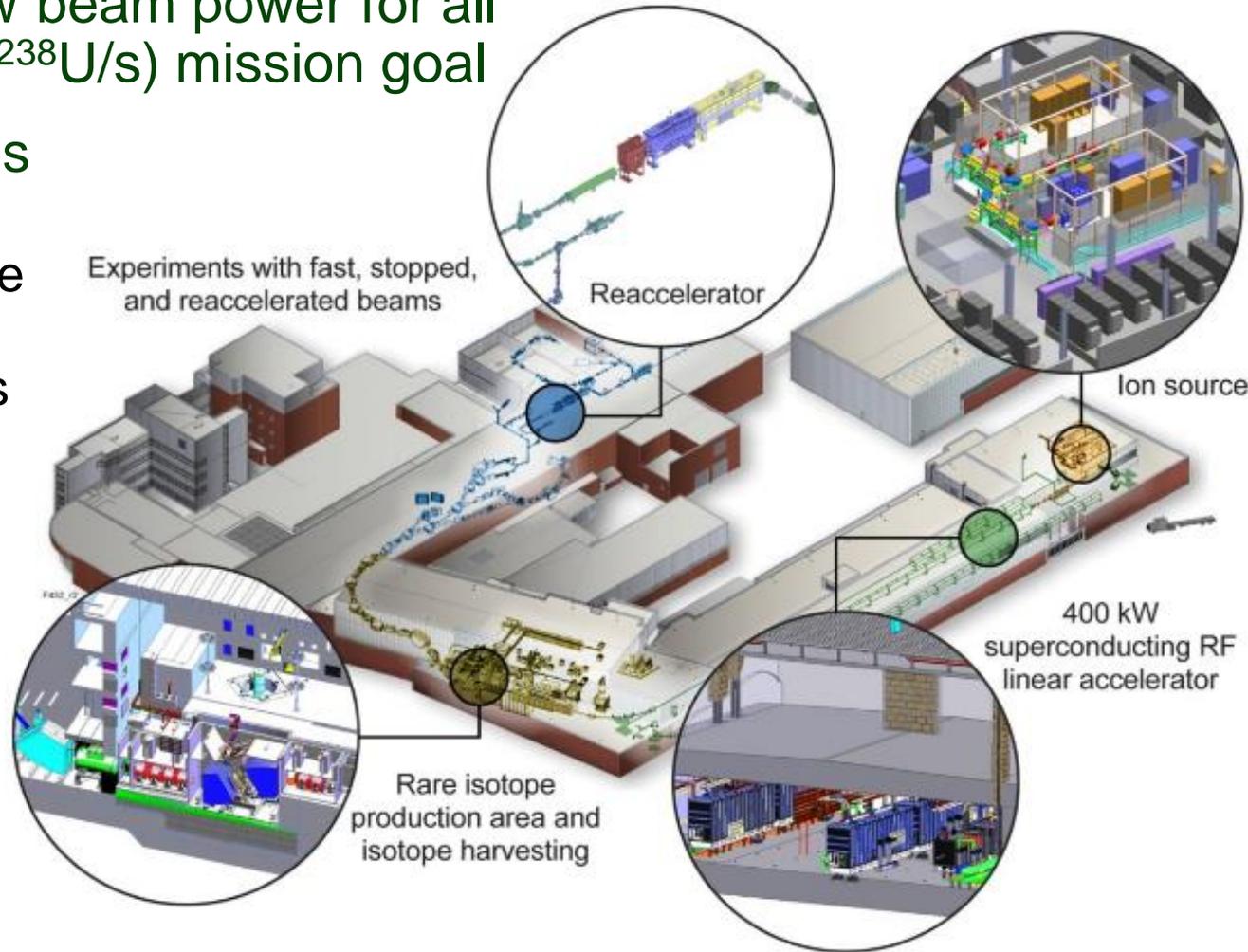
Opportunities articulated in

- Nuclear Science Advisory Committee Isotopes SC *2015 Long Range Plan for the DOE-NP Isotope Program*

# FRIB Optimized for Science

## with Fast, Stopped and Reaccelerated Rare Isotope Beams

- Key feature is 400 kW beam power for all ions ( $8\text{p}\mu\text{A}$  or  $5 \times 10^{13} \text{ }^{238}\text{U/s}$ ) mission goal
- Separation of isotopes in-flight provides
  - Fast development time for any isotope
  - Beams of all elements and short half-lives
  - Fast, stopped, and reaccelerated beams
  - High selectivity
- Isotope harvesting capability from beam dump water



# Proposals to Seek Beam Time for Non-Proprietary Research

- FRIB publishes its capabilities in the Call for Proposals for non-proprietary research and invites scientists to seek beam time, free of charge, with a promise to publish the results furthering the public good
- Proposals are written by a group of scientists, represented by the spokesperson, who work together to advance science
- Proposals articulate
  - most importantly, the scientific case for the experiment
  - the capability of the group to execute the experiment and publish the results, with key roles and evidence of past performance
  - technical capabilities or resources sought from FRIB beyond those represented in the Call for Proposals
    - » For example: new primary beam, new gas handling system, ...
  - technical capabilities or resources brought to FRIB for the experiment and when these will be available and who provides them
    - » For example: new detector being built, postdoc who will analyze data and is paid by a grant which is being reviewed by funding agency now



# Evaluation of Proposals

- FRIB professional staff evaluates
  - submitted proposal against FRIB's published capabilities
  - a likely cost of technical capabilities and resources sought from FRIB beyond those represented in the call for proposal
- These evaluations will be shared with the spokesperson, FRIB management, and the Program Advisory Committee
- The Program Advisory Committee evaluates
  - The full scientific value of the results
  - The technical feasibility of the proposal
  - The ability of the collaboration to successfully conduct the proposed experiment
  - The ability of the collaboration to publish the results in a timely manner
- PAC advises the Laboratory Director on beam time allocation
  - Allocation based on overall value
  - Value = Worth/Cost



# Enhancing the Likely Value of Your Proposal

- Enhance value = worth/cost: increase worth, reduce cost
- Increasing worth of proposals
  - Work on important problems, conceive an impactful experiment to advance knowledge, to deliver the best science
  - Form the strongest team, both in science and technical execution, to deliver successful experiment and publish them with the largest likelihood of success
    - » Nature not being the way we assumed it to be is new knowledge
    - » Experiments failing for technical reasons is not success
  - Measure, analyze, and publish multiple exit channels
    - » More theses, more papers, not all of them of highest import, provide added worth
  - Plan and prepare to deliver flawless execution of experiment
  - Plan and prepare for timely analysis of data
  - Plan and prepare for publication in high-impact journals
- Cost is dominated by FRIB operations cost
  - Marginal cost for additional capabilities and resources sought



# Enhancing FRIB's Capability and Capacity While Delivering World-Class Science

- Need to operate at a minimum level of overall system availability to assure user satisfaction (85%-90%)
- Need to balance between machine and secondary beam development time (not available to deliver nuclear science) to enhance FRIB capability and running more hours at present capability to increase capacity to deliver nuclear science
  - Need to do both, some science programs need more capability, some need more capacity
  - Good example RHIC: peak luminosity for A-A collisions increased factor of 500 over 15 years
- Need to reduce machine tuning and secondary beam tuning times, as they support neither capability nor capacity (an FRIB action)



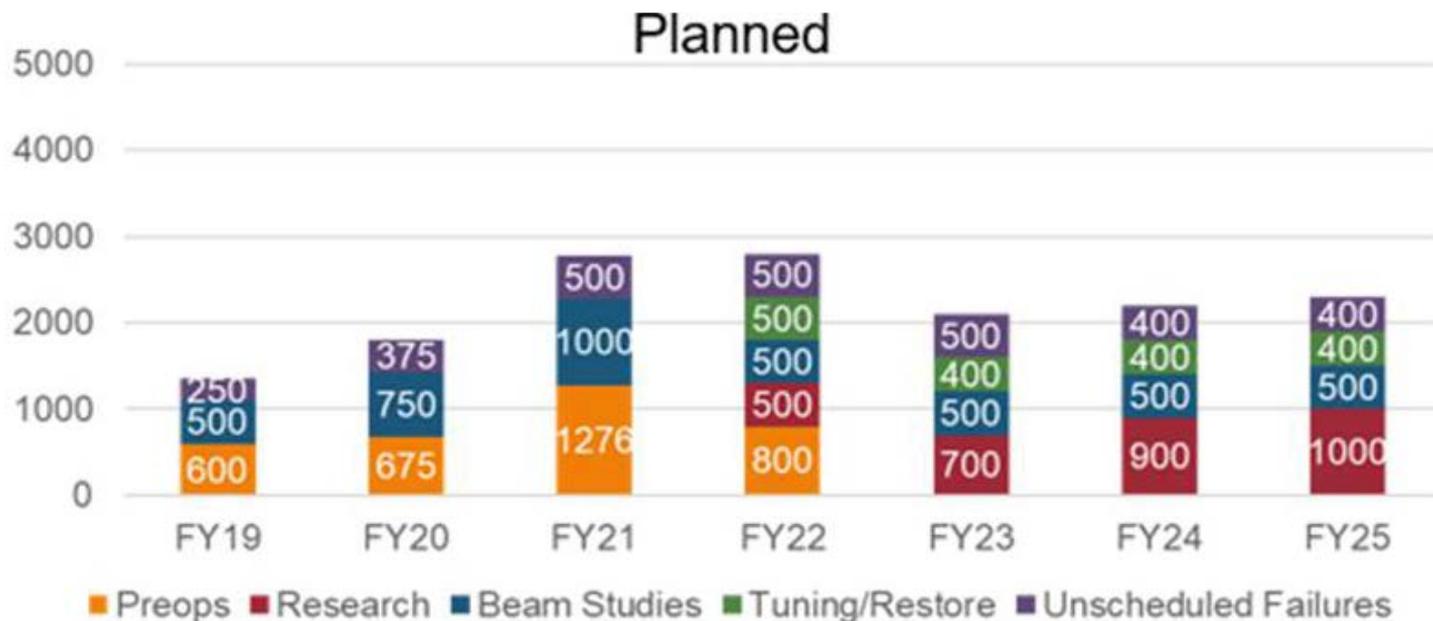
# Enhancing FRIB's Capability to Increase Rare Isotope Rate

- Primary beam power
  - Have a notional plan to get to mission beam power of 400 kW in five years. Requires significant machine development; many unknowns, no heavy-ion accelerator has reached this power.
- Additional primary beams
  - Depending on the element, may require not much machine development, some elements are difficult to develop in ion source. Not many unknowns.
- Primary beam time structure, beam energy optimization
  - Easy in a linear accelerator, relative to cyclotrons
- Please tell us what capability increases can benefit your experiments. We will do the low-cost ones right away, and consult with PAC and ONP on expensive ones.



# Enhancing FRIB's Capability and Capacity While Delivering World-Class Science

- The sum of development time, science time, and breakdown time is limited by operations cost and operations funding, which is part of the DOE-SC nuclear physics budget, which is subject to annual congressional appropriation
- Our community needs to articulate its value proposition for the nation each year, and preserve the public trust



# Code of Conduct, Preserving the Public Trust, and Explaining our Value Proposition

- We share an interest in scientific discovery. That is best accomplished when all can participate in a welcoming environment
  - Adherence to FRIB Code of Conduct, see [frib.msu.edu/code-of-conduct.html](http://frib.msu.edu/code-of-conduct.html)
- We receive public funds to further the public good
  - Comportment consistent with the public trust we enjoy
- Our science is funded by Congress with discretionary public funds.
  - We need to explain the value we add to society to members of the public and the elected officials who represent us



# Summary

- FRIB is 93% complete and on track to commence user operation in early 2022
- Proposals evaluated against science, technical feasibility, ability of collaboration to deliver experiment and publish results
- FRIB's capabilities and capacity will increase over time to optimize value = worth / cost.
  - Please tell us what capability increases are most important to you
- We need to continue to articulate the value our science provide to the nation and comport ourselves consistent with the public trust we enjoy
- I hope this workshop facilitates exchange of ideas, making connections, forming collaborations to propose the best FRIB experiments possible. FRIB is here to enable your discoveries within the resources we have.

