FRIB Status, NSCL, and the Path Forward

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Joint DNP Town Meetings on Nuclear Structure & Nuclear Astrophysics
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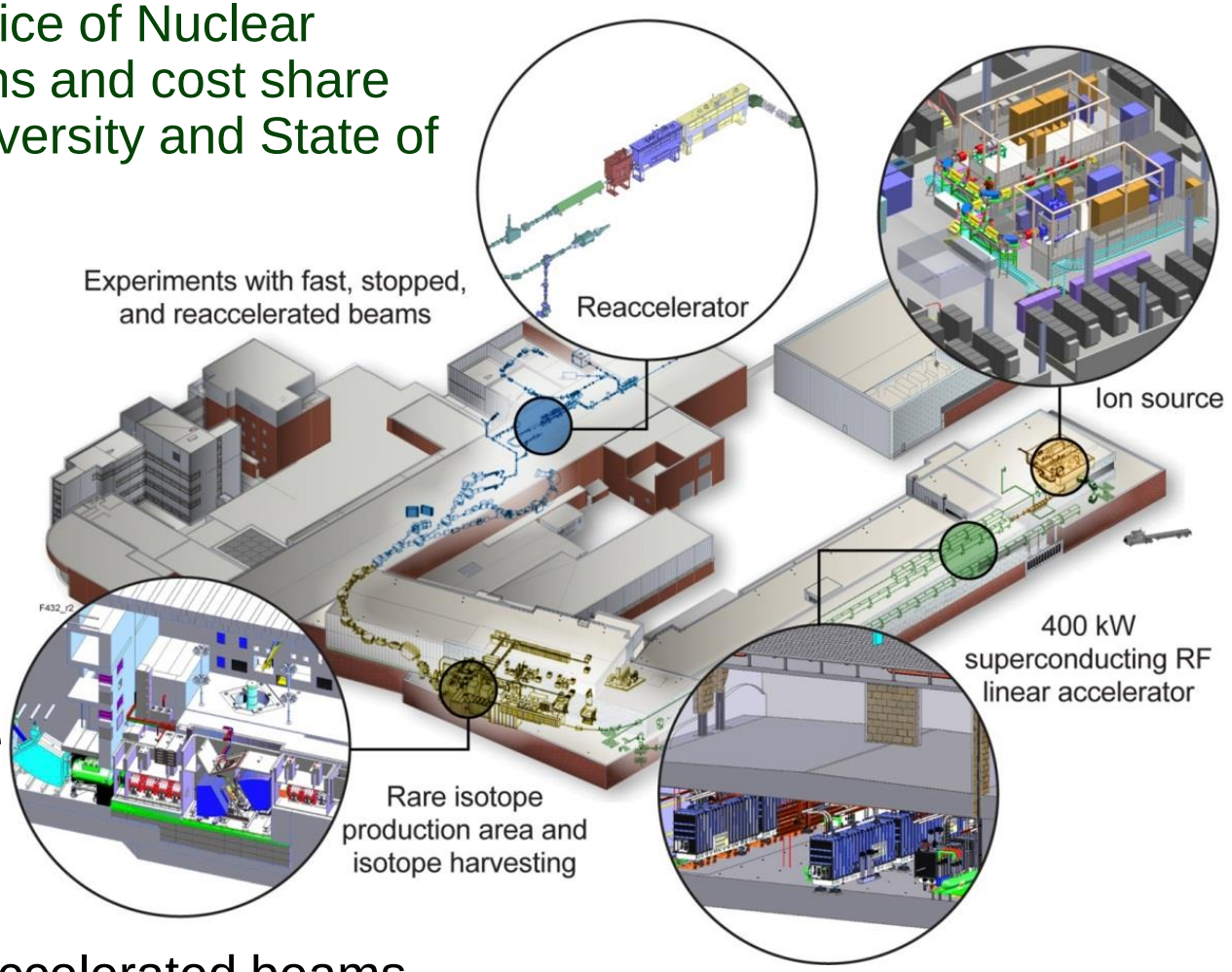
Mitchell Institute, Texas A&M University

- FRIB is becoming real
- Scientists engaged and getting ready for science
- Early science opportunities at NSCL with fast, stopped, reaccelerated beams
- Essential to realizing FRIB's promise of discovery are
  1. Delivering baselined FRIB Project on schedule and budget
  2. Building of key instruments
  3. Vibrant theory community
  4. Realization of early science opportunities
  5. Science-driven upgrades

Facility for Rare Isotope Beams
A Future DOE-SC National User Facility for Nuclear Physics

- Funded by DOE–SC Office of Nuclear Physics with contributions and cost share from Michigan State University and State of Michigan
- Managing to early completion in Dec 2020
- Key feature is 400 kW beam power for all ions ($5x10^{13}$ $^{238}U/s$)
- Separation of isotopes in-flight
  - Fast development time for any isotope
  - Suited for all elements and short half-lives
  - Fast, stopped, and reaccelerated beams



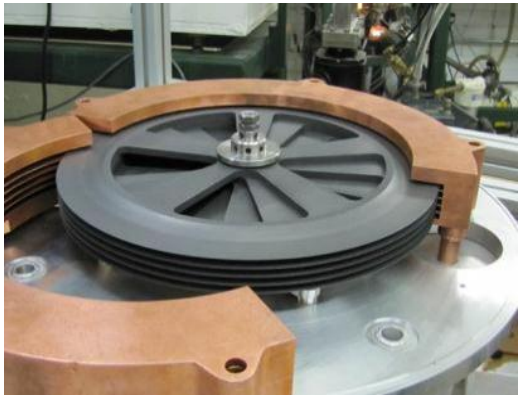
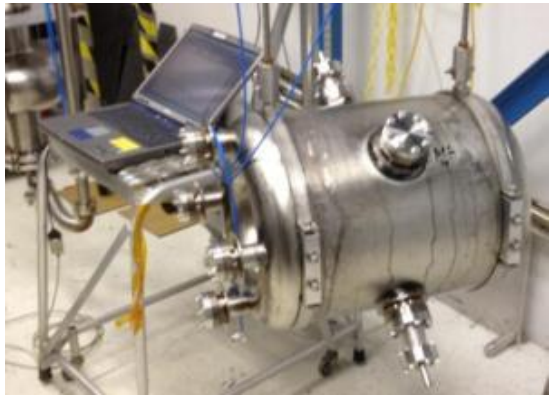
FRIB is Becoming Real: Civil Construction Eight Weeks Ahead of Baseline Schedule

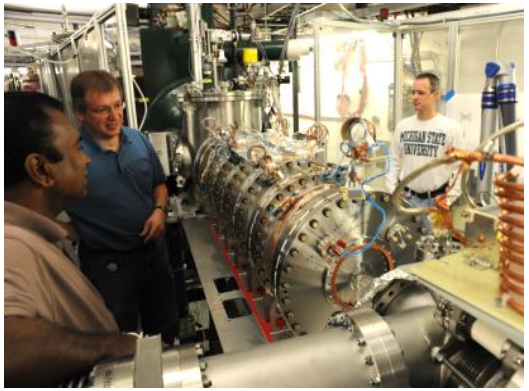
FRIB construction site on 13 August 2014 - web camera at www.frib.msu.edu

FRIB is Becoming Real: Ready for Technical Construction

- Affirmed by June DOE-SC Office of Project Assessment Review
- Start of technical construction October 2014
- Project well-managed, good relationship with DOE-SC, NP, MSU





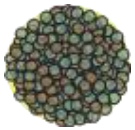
FRIB is Becoming Real: Working with the Best in the Nation and World

- Argonne National Laboratory
  - Liquid lithium charge stripper; Stopping of ions in gas; Fragment separator design; Beam dynamics; SRF
- Brookhaven National Laboratory
  - Radiation resistant magnets; Plasma charge stripper*
- Fermilab
  - Diagnostics
- Jefferson Laboratory
  - Cryogenics; SRF
- Lawrence Berkeley National Laboratory
  - ECR ion source; Beam dynamics*
- Oak Ridge National Laboratory
  - Target facility; Beam Dump R&D; Cryogenic Controls
- Stanford National Accelerator Lab
  - Cryogenics*
- Sandia
  - Production target*
- Budker Inst. of Nuclear Physics (Russia)
  - Production target*
- GANIL (France)
  - Production target
- GSI (Germany)
  - Production target
- INFN Legnaro (Italy)
  - SRF
- KEK (Japan)
  - SRF technology, SC solenoid magnets
- RIKEN (Japan)
  - Charge strippers
- Soreq (Israel)
  - Production target*
- Tsinghua University & CAS (China)
  - RFQ
- TRIUMF (Canada)
  - SRF, beam dynamics

1300 Scientists Engaged, Ready for Science
www.fribusers.org

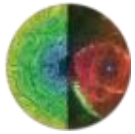
- Scientists have organized themselves in the project-independent FRIB Users Organization (FRIBUO)
  - Chartered organization with an elected executive committee
  - 1386 members (92 U.S. colleges and universities, 10 national laboratories, 51 countries) as of August 2014
  - 19 working groups on instruments
- Annual community meetings
- Science Advisory Committee
  - Review of equipment initiatives (February 2011)
  - Review of FRIB integrated design (March 2012)
  - Review of equipment working group progress (October 2013)

FRIB's Scientific Promise: Scientists Will Make Important Discoveries



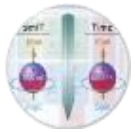
Properties of atomic nuclei

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



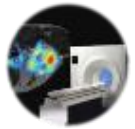
Astrophysics: Nuclear Processes in the Cosmos

- Origin of the elements, chemical history
- Explosive environments: novae, supernovae, X-ray bursts …
- Properties of neutron stars



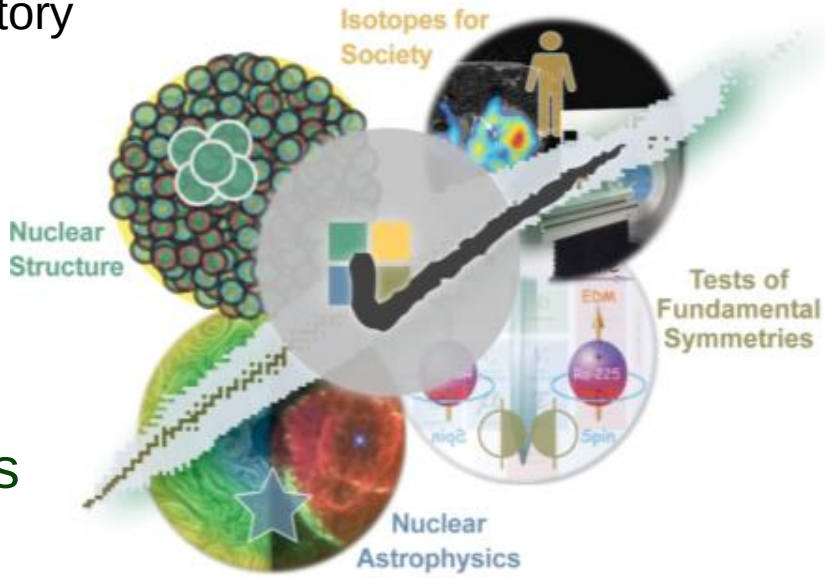
Tests of laws of nature

- Effects of symmetry violations are amplified in certain nuclei



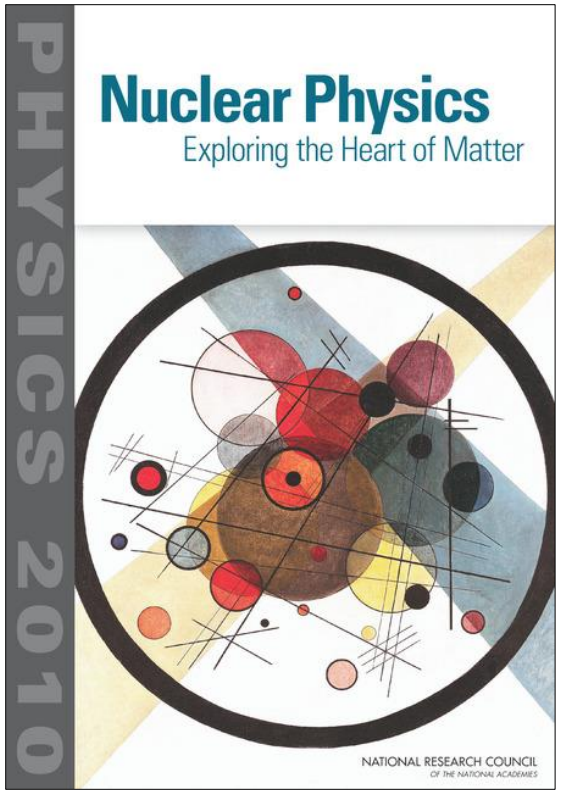
Societal applications and benefits

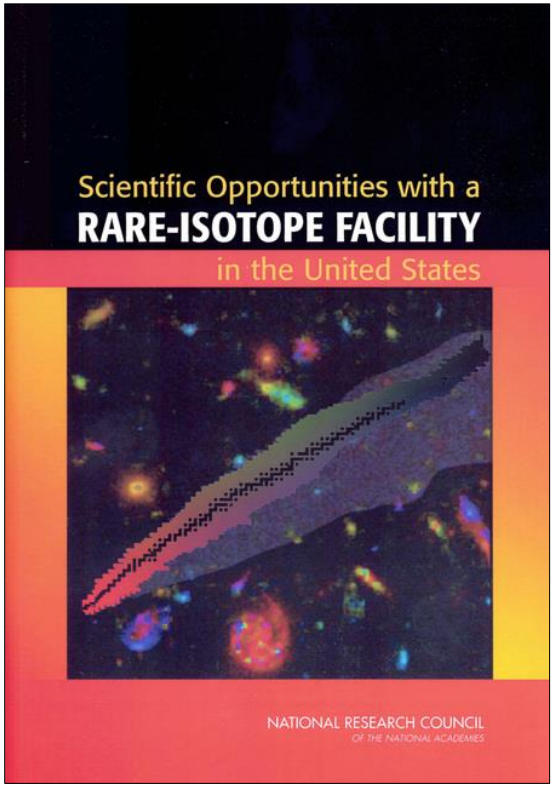
- Medicine, energy, material sciences, national security



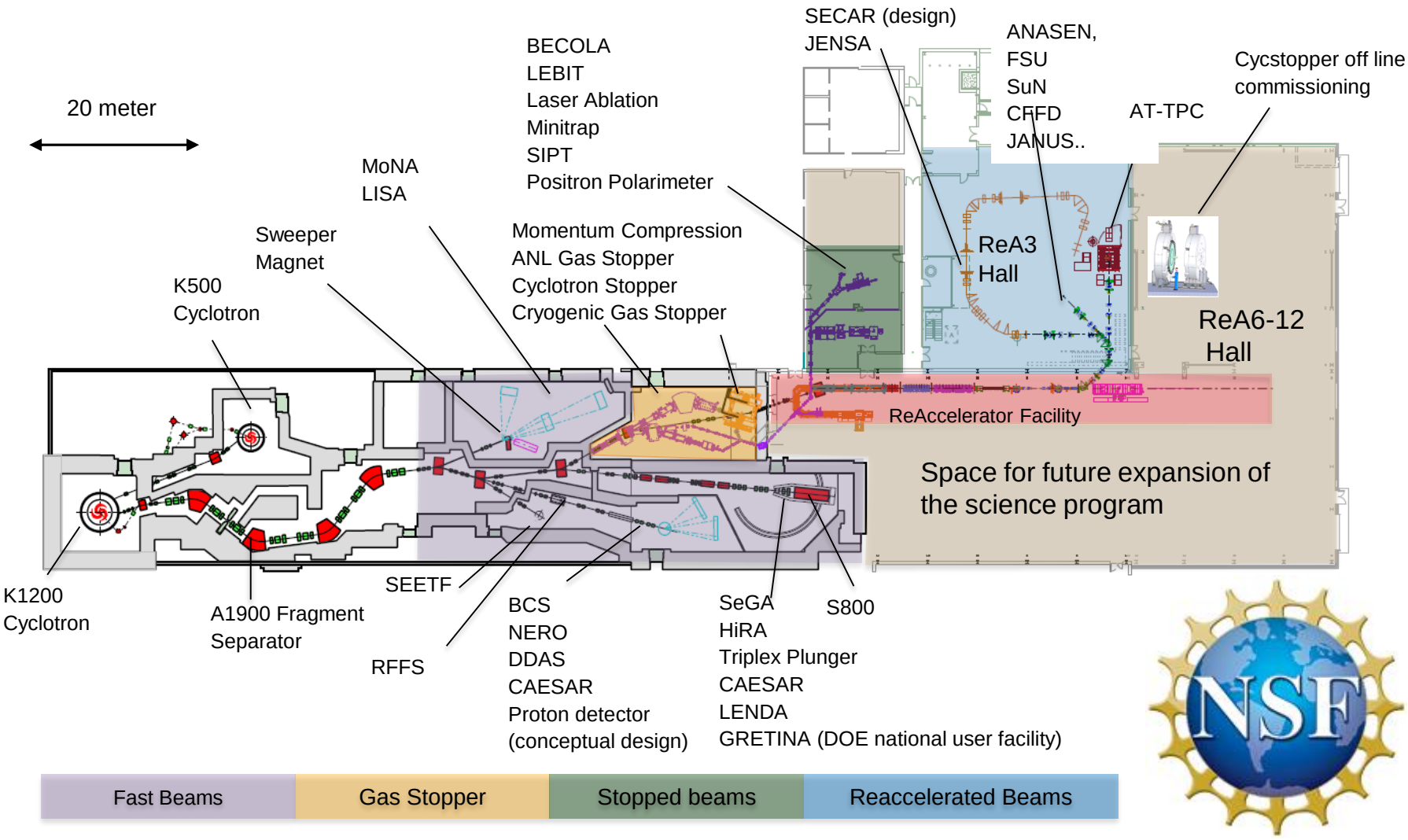
Endorsement of FRIB's Scientific Promise
by National Research Council of the National Academies

- National Research Council Decadal Study on Nuclear Physics Report
  - Nuclear Physics: Exploring the Heart of Matter (2013)
- National Academies Rare Isotope Science Assessment Committee Report (RISAC)
  - Scientific Opportunities with a Rare-Isotope Facility in the United States (2007)





Early Science Opportunities at NSCL
with Fast, Stopped, Reaccelerated Beams



Delivering FRIB Project on Schedule and on Budget

- Project started in June 2009: Cooperative Agreement between DOE-SC and MSU
  - Project delivery per DOE Order 413.3B: Acquisition Executive SC-2 Dr. Patricia Dehmer, DOE-SC Office of Project Assessment reviews, Federal Project Director from SC-Chicago; MSU shares $94.5M in cost and contributes $212M, D&D is MSU responsibility
- CD-1 approved in September 2010: Conceptual design complete
- CD-2 (Performance Baseline) and CD-3a (Start of Civil Construction) approved in August 2013, pending notice to proceed for civil construction upon FY14 appropriation
- Civil construction began March 3, 2014
- CD-3b DOE-SC Office of Project Assessment review in June 2014 to assess readiness for technical construction (CD-3b)
- Start of technical construction planned for October 2014
- Managing to early completion in December 2020
- CD-4 (project completion) is June 2022
- Funding from DOE-SC - $635.5M
  - Total project cost of $730M includes $94.5M MSU cost share with additional MSU contributions exceeding $212M

Essential to Realizing FRIB's Promise
in the context of the 2015 Long Range Plan for Nuclear Science

- Recommendation to deliver baselined FRIB Project

  With Budget Control Act of 2011 enacted, congressional appropriators for science have less flexibility than in past generation. They need to hear that FRIB remains the priority for the Nuclear Physics community.

Strong endorsement for

- Building of key equipment/instruments

  Instruments are key to discovery. No new instruments in FRIB baseline (also not ReA6/9/12)

- Support to ensure vibrant theory community

  Theorists engaged in FRIB science are key to discovery and offer large ROI

- Realization of early science opportunities

  Sufficient beam time to exploit new, unique capabilities; ensures leadership and return on prior investment now (NSCL, ATLAS, ARUNA). Fully engages community to be poised for world-class FRIB science on day one

- Science-driven upgrades

  Possibilities (higher beam energy, isotope harvesting, multi-user, ISOL, higher-energy reacceleration, storage rings, …). This LRP may well span into the time past FRIB completion, allows planning of upgrades that may take many years.