FRIB LABORATORY UPDATE for USERS July 2017

FRIB Project civil construction reaches beneficial occupancy

Civil construction on the FRIB Project reached beneficial occupancy on 24 March. The top image above shows the conceptual rendering, while the bottom image is a photo of the building after the construction reached beneficial occupancy.

Civil construction on the FRIB Project reached beneficial occupancy on 24 March.

Beneficial occupancy is the stage of construction in which the facility can be used for its intended purpose before final completion. Although beneficial occupancy has been achieved, various trade contractors will still be on site finishing punch-list items, and commissioning will continue through the summer.

The installation of cryomodules continues within the linear accelerator tunnel, and the cryogenic transfer line assembly is ongoing.

Any construction work that will be completed past the beneficial occupancy date will not affect installation of technical equipment. Such work includes

- storm sewer work,
- site grading and restoration,
- installation of site fencing and stainless steel

FRIB's Conventional Facilities and Infrastructure Division completed areas of the building ahead of schedule and collaborated with technical groups, which facilitated the early installation of scientific equipment.

benches,
• and generator testing.

2017 FRIB Visiting Scholars Program for Experimental Science names award winners

Andrew Klose

Adam Fritsch

Last year, FRIB and NSCL initiated the FRIB Visiting Scholar Program for Experimental Science. The goal of the program is to encourage and help junior researchers to establish a research program at FRIB/NSCL.

The award supports short term stays at FRIB/NSCL for junior/non-tenured faculty or staff members. The award consists of a stipend of $5,000 intended for travel and local expenses.

The first scholar in 2016 was Andrew Rogers, from the University of Massachusetts Lowell. Andrew spent last summer at MSU to work on the preparations for an experiment to explore isomers in the neutron-rich hafnium region.

This year, two visiting scholarships were awarded: Andrew Klose from Augustana University in South Dakota and Adam Fritsch from Gonzaga University in Washington. Andrew will work on the development of laser spectroscopic experiments with the BEam COoler and LAser spectroscopy (BECOLA) facility, and Adam will work on detector developments within the Active Target Time Projection Chamber (AT-TPC) collaboration.

Annual Nuclear Physics DC Day held 22 May

In the past few years, it has become a tradition for members of the nuclear physics community to participate in a "Nuclear Physics DC Day," where they get the chance to visit with members of their congressional delegations and discuss the importance of nuclear science. This year, the Nuclear Physics DC Day took place on 22 May. Almost 90

nuclear physicists from 28 different states participated with about 25 from the low-energy nuclear physics community. They met with staffers of 57 representatives and 54 senators.

The main “ask” this year was to oppose cuts to the U.S. Department of Energy Office of Science budget and to support funding for the DOE Nuclear Physics program consistent with the recommendations of the 2015 DOE/NSF Nuclear Science Advisory Committee Long Range Plan.

The feedback from the meetings was very positive, and the staffers were in general very supportive of basic science research. Such meetings are essential as they show the Congress the direct impact that funding for basic science has on researchers and students from their states and districts.

Please consider participating next year. Also encourage your graduate students and postdocs as it is a valuable experience for them.

DOE-SC Office of Project Assessment review held 27-29 June

The DOE-SC Office of Project Assessment’s (OPA) review of FRIB was held 27-29 June. The main focus of the review was to assess overall FRIB Project progress since the last review in December 2016, with a focus on our technical progress.

The review committee was organized into five subcommittees and FRIB staff gave 53 presentations.

The OPA assessed all aspects of the FRIB Project – technical, cost, schedule, management, and environmental safety and health – and found that FRIB is making appropriate progress toward completion and is well-managed. The review committee answered all charge questions affirmatively.

DOE has scheduled the next FRIB Project progress review for 5-7 December 2017.

Technical installation progress advances

Technical installation progress continues to advance at FRIB, with the project meeting new milestones on a regular basis. This article highlights significant progress since what was featured in our last issue in January.

Radio frequency quadrupole assembled and tuned in FRIB’s linear accelerator tunnel

The RFQ is a microwave cavity resonator that uses a high-frequency oscillating electromagnetic field to focus and accelerate a low-energy beam of ions.

The FRIB RFQ is a brazed copper structure with a total length of approximately 16 feet, approximately 3 feet wide. To simplify the manufacturing, the structure

The radio frequency quadrupole (RFQ) was assembled and tuned in FRIB's linear accelerator tunnel. The RFQ prepares the beam for further acceleration in FRIB's superconducting linear accelerator.

In December 2016, the radio frequency quadrupole (RFQ) was assembled and tuned in the FRIB linear accelerator tunnel. The RFQ is a critical system of the FRIB linear accelerator, required to run the beam.

The energy of the beam produced by FRIB ion sources is too low for the injection into superconducting radio frequency cavities, so the RFQ increases the beam energy from 12 keV/u to 500 keV/u and prepares the beam for the injection into the superconducting linac.

was split into five segments. Each segment weighs approximately 3 metric tons, together adding up to 15 tons for the whole RFQ. A pair of water skids constantly pumps 300 gallons per minute (GPM) of precisely temperature-controlled water through the RFQ to remove excessive heat deposited on the walls of the RFQ. Prior to running the beam through the structure, FRIB staff will conduct an accelerator readiness review (ARR) focusing on safety and machine readiness.

The demonstration of the beam acceleration in the RFQ is an important milestone for the project, enabling further beam commissioning of the superconducting linac.

First half-wave resonator successfully tested

The first half-wave resonator cryomodule was successfully tested in February, enabling mass production of HWR cryomodules.

In February, the first half-wave resonator cryomodule was successfully tested. Since half-wave-resonators (HWRs) make up two-thirds of the FRIB linear accelerator, the performance of the HWR cryomodules is critical for the project.

The cryomodules contain superconducting radio frequency (SRF) resonators to accelerate the beam and superconducting solenoids to focus it. The resonators and solenoids operate at cryogenic temperatures, hundreds of degrees below room temperature.

The successful completion of the tests on the first HWR cryomodule allowed for the start of mass production of HWR cryomodules for the FRIB linear accelerator, which is the heart of FRIB. The second HWR cryomodule is finished and is now in testing, and work has started on the third and fourth HWR cryomodules.

First β=0.041 cryomodule installed on beamline

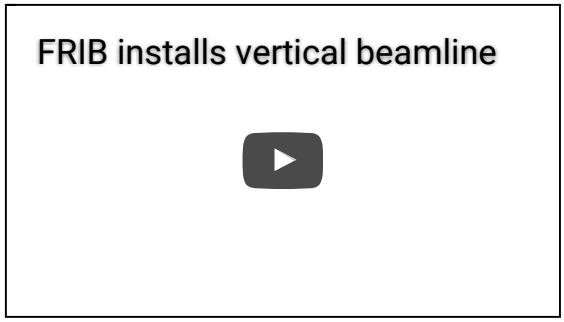
The first FRIB superconducting cryomodule was installed on FRIB's linear accelerator tunnel's beamline in March.

The first FRIB superconducting β=0.041 cryomodule was installed on the beamline in FRIB's linear accelerator tunnel in March. While this is the third cryomodule to be moved to the tunnel, it is the first to be placed on the beamline.

After being lowered through the access shaft, and moved through the tunnel, the cryomodule was inserted into its near-final position and placed on adjustable stands. The assembly and installation of all components and diagnostics for the upper Low Energy Beam Transport (LEBT) line was completed on 6 March. It was then connected to the Advanced Room-TEMperature Ion Source (ARTEMIS).

ARTEMIS was FRIB's first accelerator component to be installed, which took place last year. It is one of two electron cyclotron resonance (ECR) ion sources that FRIB will use to produce ions from elements.

Vertical beamline sections installed



This video shows the installation of the vertical beamline sections.

On 1 May, the first of two vertical beamline sections was installed and aligned in the vertical shaft connecting the front end with the linear accelerator tunnel. The following day, the second section was installed. Each section of the beamline was lifted by a 30-ton capacity crane and moved with precision into the shaft, guided by several FRIB staff.

Assembly of the vertical beamline began in January. This section of the accelerator consists of the beamline itself housed by two spaceframes.

Assembly of the vertical beamline began in January. This section of the accelerator consists of the beamline itself housed by two spaceframes. The top section measures approximately 13 feet in height, and the bottom measures approximately 14 feet. The frames were assembled first and then the beamline components were installed from the top.

The vertical beamline connects the upper Low Energy Beam Transport (LEBT) to the lower LEBT. The particle beam starts in the upper section of the accelerator, and the vertical beamline transports it to the lower section. This is a critical step in the acceleration of the beamline, as the particle beam must be able to travel from the upper section into the linac tunnel below. Now that both sections have been placed, the vertical beamline will be connected to the upper and lower LEBT.

The installation required coordination and collaboration between the installation groups, vacuum groups, and the alignment team. It marks an important milestone in the construction of the linear accelerator.

News from the Executive Committee



New members of the FRIB Users Organization Executive Committee (from left): Carl Brune, Kelly Chipps, and Catherine Deibel.

The FRIB Users Organization Executive Committee elections wrapped up in early January of this year. We'd like to welcome Carl Brune (Ohio University) and Catherine Deibel (Louisiana State University) as general members, and Kelly Chipps (Oak Ridge National Laboratory) as a member of the Operations subcommittee.

Carl, Catherine, and Kelly join the executive committee with the departure of Robert Grzywacz (University of Tennessee), Mark Riley (Florida State University, operations subcommittee), and Artemis Spyrou (NSCL) — we thank them very much for their service!

U.S. Department of Energy's Office of Advanced Scientific Research holds Exascale Requirements Reviews

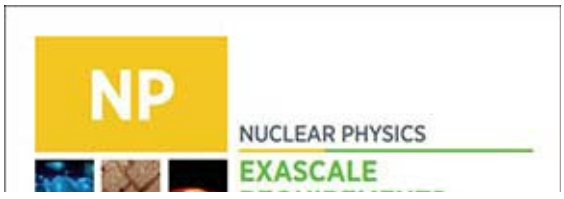
Since 2015, the U.S. Department of Energy's Office of Advanced Scientific Research (ASCR) has partnered with each of the scientific program offices in the DOE Office of Science (SC) to hold six separate Exascale Requirements Reviews to identify mission-critical science objectives that require high-performance computing, storage, and networking for the 2020-2025 timeframe.

The DOE SC Exascale Requirements Review for Nuclear Physics (NP) was held in June 2016 and brought together key computational domain scientists and DOE planners and administrators to determine the requirements for an exascale ecosystem for nuclear physics.

Review participants focused on main areas for which

To realize the full value of the six reviews to SC, the ASCR Facilities held an Exascale Requirements Crosscut Review in March 2017. The deliverable from this meeting will include a report written by the ASCR Centers summarizing requirements, findings, and identifying cross-cutting Office of Science computational ecosystem needs.

As an FRIB user, we encourage you to read the report and consider responding to future calls for community input as the exascale efforts move forward.



exascale resources are required to achieve the goals of the nuclear physics community: nuclear astrophysics, experiment and data (including FRIB), nuclear structure and reactions, as well as cold and hot quantum chromodynamics. The NP Exascale requirements relayed in the document include computation, data analysis, libraries/tools, software, workflows, high-performance computing services, and the full range of computer requirements (small cluster to exascale) to support forefront scientific research in nuclear physics through 2025.

The NP Exascale Report has recently been finalized; it describes priority research directions, discusses Exascale Computing Ecosystem for NP including computing needs, requirements, and path forward. The NP White Papers prepared by each research area are contained in Appendix C, and individual case studies that formed the bases for the white papers are available in Appendix D of the report and cover many areas of FRIB science and technology.

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Exotic Beam Summer School is 23-29 July

The sixteenth Exotic Beam Summer School (EBSS2017) will be held at Physics Division, Argonne National Laboratory from 23-29 July.

The Exotic Beams Summer School offers students and young researchers the opportunity to explore the science of exotic nuclei.

At the EBSS, students will explore nuclear structure, nuclear astrophysics, the fundamental interactions of particles, and the application of nuclear science and technology. Through the EBSS, researchers will have the ability to more fully take advantage of the potential of next-generation nuclear physics facilities, including FRIB.

The format of the school is unique. In the mornings, students will receive lectures on a wide range of theoretical, experimental, and applied topics from leading nuclear physicists who work with rare isotopes. In the afternoons, students will participate in hands-on activities, learning about the techniques and instrumentation involved in experiments with exotic beams.

At EBSS2017, student activities include performing measurements with the GRETINA gamma-ray tracking array, the Gammasphere array of Ge detectors, the Helical Orbit Spectrometer, the Penning trap, and the Fragment Mass Analyzer, and conducting an experiment with a heavy-ion beam from the ATLAS facility.

The EBSS series is sponsored by the U.S. Department of Energy, the National Science Foundation, and the following laboratories: Argonne National Laboratory, Lawrence Berkeley National Laboratory, Oak Ridge National Laboratory, Lawrence Livermore National Laboratory, the National Superconducting Cyclotron Laboratory at Michigan State University, and the Association for Research and University Nuclear Accelerators (ARUNA).

More details of EBSS2017 are available online.

Annual Low-Energy Community Meeting set for 2-4 August

The seventh annual Low-Energy Community Meeting will be held 2-4 August at Argonne National Laboratory (ANL). The meeting will begin with a workshop on FRIB Day-One Physics. The workshop is being organized jointly by the FRIB User Organization Executive Committee and the FRIB Theory Alliance.

At the start of the meeting, there will be time and space to organize separate collaboration meetings and/or workshops. Parallel working group sessions are scheduled.

The plenary sessions will include updates from Argonne Tandem Linac Accelerator System (ATLAS) at ANL, the National Superconducting Cyclotron Laboratory at Michigan State University, the Association for Research at University Nuclear Accelerators (ARUNA) facilities, FRIB Theory Alliance, as well as science talks of interest to the broader community. The meeting will end with a summary of the working groups. Optional tours of the ATLAS facility will be offered on the last day of the meeting.

In conjunction with the meeting, the FRIB Theory Alliance will hold its annual meeting in order to enhance the interactions between theorists and experimenters of the community.

The Low-Energy Community Meeting is organized by representatives of the community and current members of the organizing committee are Baha Balantekin, Maxime Brodeur, Heather Crawford, Paul Fallon, Alexandra Gade, Benjamin Kay, Krzysztof Rykaczewski, Guy Savard, Hendrik Schatz, Michael Thoennessen, Alan Wuosmaa, and Sherry Yennello. Further information can be found on the meetings website.

Contributors this issue

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LOOKING AHEAD

25-27 July	Accelerator Readiness Review of FRIB Front End
23-29 July	Exotic Beam Summer School (EBSS2017) at Argonne National Laboratory (ANL)
2-4 August	2017 Low Energy Community Meeting at ANL
11-13 August	MoNA Collaboration Meeting at Michigan State University's Kellogg Biological Station
7-9 November	Accelerator Systems Advisory Committee Review of FRIB

The FRIB Laboratory Update for Users is published by the FRIB Laboratory and distributed via email.
Please email questions, comments, and contributions to communications@frib.msu.edu.

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Michigan State University is establishing FRIB as a scientific user facility for the Office of Nuclear Physics in the U.S. Department of Energy Office of Science.