



Low Energy Community Meeting held 12-13 August



More than 230 people participated in the annual Low Energy Community Meeting, held 12-13 August, at the University of Notre Dame. (Photo courtesy of Notre Dame College of Science)

More than 230 people participated in the annual Low Energy Community Meeting, held 12-13 August, at the University of Notre Dame. The annual meeting serves as a time for nuclear scientists in the low-energy nuclear physics community to interact and discuss future plans, initiatives, and facilities.

The program of the main meeting consisted of plenary sessions and eleven working groups where among other things the early anticipated physics experiments at FRIB were discussed. The presentations are posted on the [meetings website](#).

At the end of the meeting, [summaries of the working groups](#) were presented, and the following resolutions were adopted by the participants:

- FRIB remains the community's top priority. The community eagerly anticipates the completion of FRIB and the forefront science this facility will enable.
- The broader science program requires continued effective operations at the Association for Research at University Nuclear Accelerators (ARUNA), the Argonne Tandem Linac Accelerator System (ATLAS), and the National Superconducting Cyclotron Laboratory (NSCL) facilities. The community strongly supports the continued operation of these facilities

Seven satellite workshops were held prior to the main meeting. A day-and-a-half-long workshop on Nuclear Data Needs and Capabilities for Basic Science discussed the needs of the nuclear physics research community for data sets and capabilities. These presentations are also available [online](#).

Three workshops were directly related to FRIB: Tracking Detectors for Fast Beams, Data Acquisition, and a SECAR collaboration meeting. In addition, there were two ARUNA workshops and one workshop on the Argonne Gas-Filled Fragment Analyzer (AGFA) and the Argonne In-flight Radioactive Ion Separator (AIRIS), two detector systems at Argonne National Laboratory (ANL).



Tim Hallman, DOE-SC Associate Director for Nuclear Physics, addresses the attendees at the Low Energy Community Meeting. (Photo courtesy of Notre Dame College of Science)

and targeted investments to upgrade their capabilities.

- Strong research support is essential for capitalizing on the discovery potential of present and future facilities.
- The user community strongly endorses the energy upgrade of ReA3 to ReA6 prior to FRIB as it offers tremendous opportunities for forefront science already at NSCL.



The annual meeting serves as a time for nuclear scientists in the low energy nuclear physics community to interact and discuss future plans, initiatives, and facilities. (Photo courtesy of Notre Dame College of Science)



Civil construction continues ten weeks ahead of schedule;
cryogenic cold box delivered in August





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FRIB civil construction continues to progress ten weeks ahead of schedule, with an increasing number of technical installations. Most notably was the installation of the 100,000-pound vertical cryogenic cold box on 10 August. The cold box was built in Oklahoma and took ten days to travel the roughly 900 miles to Michigan, as it could only travel during daylight due to Department of Transportation rules. In order to avoid transportation challenges around Chicago, the cold box ultimately arrived in Michigan by way of the Lake Michigan car ferry, SS Badger.

The cold box will be used to cool helium to an extremely low temperature. The helium will then be used to cool cryomodules in the linac tunnel. Cryomodules must be cold to make the cavities inside them superconducting. When the cavities are superconducting, there is no resistance, meaning there is virtually no heat loss with an electrical current. This will make FRIB more energy-efficient as it accelerates rare isotope beams.

Another notable technical installation was that of three vertical cryogenic transfer lines in the cold-box room. Using cranes, the transfer lines were lowered into the room through a roof hatch.



The 100,000-pound vertical cryogenic cold box arrived at FRIB on 10 August. The cold box was built in Oklahoma and arrived to Michigan by way of the Lake Michigan car ferry, SS Badger.

Each of the three transfer lines is dedicated to a segment of the linear accelerator. The vertical lines are used to transfer liquid helium from the cold box down into the linac tunnel.

Two 800 kilowatt generators were installed on the north side of the building, which can be switched on in under ten seconds, should a power outage ever occur at FRIB. As for the rest of the building, overhead mechanical and electrical piping is continuing in the cold-box room. Heat exchanger piping is ongoing in the cryopant mechanical room, and condenser water piping is being installed in the lower second floor chiller room. Warm helium side piping is ongoing in the compressor room. In the hot cell, painting continues, and the hot cell robotic crane rail is being installed. Concrete placement is on the verge of completion, with 40,558 yards representing 94 percent of the concrete required for the project. Installation of non-conventional utilities (NCU) piping progresses in both the upper second floor as well as the target facility, and overall NCU piping is 74-percent complete.



Using cranes, vertical cryogenic transfer lines were lowered into the cold box room through a roof hatch. Each of the three transfer lines is dedicated to a segment of the linear accelerator.



News from the executive committee: FRIB communications resources available

by Heather Crawford, FRIB Users Organization Chair, Lawrence Berkeley National Laboratory

The FRIB Users Organization Executive Committee would like to bring new resources to the attention of the FRIB user community. With the help of the FRIB Project, and in particular the FRIB Communications team (thanks, team!), a set of resources is now available to all users who, for example, may be attending regional society meetings and want to publicize FRIB and its science, or perhaps are giving seminars and want to include the latest from FRIB.

Facility overview slides, construction progress slides and fact sheets updated quarterly (see frib.msu.edu/users/user-resources.html for more details) are available upon request to either communications@frib.msu.edu or fribusercontact@fribusers.org.

We hope this will prove to be a valuable resource for all of the FRIB users!



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Additionally, scientists were on-hand to talk about their work on the frontiers of rare-isotope research, and

presentations, and tours that allowed attendees to learn more about a world-leading science facility in operation (NSCL) and one in the making (FRIB).

The four-hour open house, made possible by 130 volunteers, offered an array of experiences for all ages. Tours were held in the currently operational experimental areas in NSCL that will be used in FRIB experiments, and visitors could tour the FRIB facility under construction.

Several hands-on activities and demonstrations showed the fields of FRIB and NSCL research, including playing the Isotopolis video game, operating an electromagnetic accelerator, smashing model "nuclei" made of magnetic marbles, and operating a control system like a cyclotron operator.



The open house provided several hands-on activities and demonstrations that showed the fields of FRIB and NSCL research.

several educational videos were shown in the "FRIB Theater."

In the presentation hall, speakers gave presentations on the NSCL/FRIB Laboratory, the science being explored, and career opportunities for young people.

This was the first public open house to show the public both NSCL and FRIB.

To see highlights of the day, check out the [photo gallery](#) and the [time-lapse video](#).



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DOE Office of Project Assessment review held 28-30 June



The review committee was organized into five subcommittees and FRIB staff gave 51 presentations.

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

DOE has scheduled the next review for 6-8 December.

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Professor Greg Severin joins FRIB to develop isotope-harvesting research program



Professor Greg Severin

An important potential scientific benefit of FRIB is the ability to harvest unused isotopes to serve more than one user at a time.

Like NSCL, the FRIB facility is designed to produce only one specific isotope for a single user at any one time. It turns out that very few nuclei accelerated by FRIB will be converted into the specific isotope desired by a given user. In fact, only a small fraction of the nuclei in the beam are even fragmented at all.

Typically, more than ninety percent of the beam passes straight through the target without undergoing a nuclear collision. These high energy beam particles will be collected in a large, circulating volume of water where they have an additional chance to react, sometimes producing other sought-after isotopes.

The laboratory has undertaken a few experiments to study how to collect the unused isotopes, and Dr. Gregory Severin has just taken a joint faculty position with FRIB and the MSU Chemistry Department to begin a full-fledged research program in this area.

Greg comes to MSU from the Technical University of Denmark, where he worked on developing unconventional radionuclides as therapeutic and diagnostic agents in medicine. He is preparing a brand new radiochemistry laboratory in the Chemistry Building next door to the FRIB Laboratory for work here.

He plans to study the production and chemical separation of unused isotopes with intermediate half-lives and useful decay properties that will be copiously produced in the beam dumps. For example, the high-yield rare isotopes ^{47}Ca and ^{76}Kr produced during ^{48}Ca and ^{78}Kr runs, respectively, at NSCL and later FRIB will be used as generators for the important medical nuclides ^{47}Sc (for therapy) and ^{76}Br (for PET imaging). Future possibilities include harvesting ^{44}Ti for astrophysics studies and ^{225}Ra for EDM measurements, both of which will be by-products of normal operations at FRIB.



ReA energy upgrade whitepaper now available online



The ReA energy upgrade whitepaper was released in July 2016 and is available [online](#).

The ReA energy upgrade whitepaper was released in July 2016 and made available [online](#). This whitepaper was compiled based on input from the low-energy community, including presentations and discussions initiated by a one-day workshop on science opportunities with the ReA3 energy upgrade. The workshop was held in August 2015 at Michigan State University and was very well attended, with over seventy registered participants.



LINAC conference at MSU 25-30 September



The whitepaper presents the exciting scientific opportunities afforded by the ReA energy upgrade, encompassing a broad range of nuclear science: nuclear structure, nuclear astrophysics, fundamental symmetries, and societal applications. As articulated in the whitepaper, the ReA energy upgrade will provide unique beams to facilitate reaction studies with well-established probes, mapping out the evolution of structural phenomena throughout the nuclear chart.

The whitepaper also describes a pre-conceptual layout of the ReA6-12 facility that could host state-of-the-art equipment such as GRETINA/GRETA, a solenoidal spectrometer, and the ISLA recoil separator as well as general-purpose end stations for user-developed equipment with strong complementary capabilities.

To facilitate communication and discussion with users, the [ReA energy upgrade working group](#) was formed, and recent updates on the ReA3 experiments and detector development were discussed during the working group session in the 2016 Low-Energy Community Meeting. As a conclusion, the energy upgrade of ReA3 to ReA6 prior to FRIB was strongly endorsed by the user community to take immediate advantage of the unique science capabilities with reaccelerated beams at NSCL.

The next conference (LINAC 18) will be hosted by the Institute of High Energy Physics (IHEP) in Beijing, China. FRIB is hosting this year's conference partly because FRIB is under construction at the cutting edge of the linac technology. Accordingly, a tour of FRIB is one of the main events of this conference.

LINAC is unique because all of the oral presentations are plenary and the participants are encouraged to stay in the same hotel in order to further continue technical discussions. Nearly 400 delegates are at the

Above (from left), Carlos Martins (from ESS), Paul Schaefer (from GSI), and Robin Ferdinand (from GANIL) speak at the LINAC 16 conference.

FRIB is hosting the [28th Linear Accelerator Conference](#) (LINAC 16) from 25-30 September at Michigan State University. The conference is held biennially and is the largest international conference dedicated to linear accelerators. The last conference (LINAC 14) was hosted by the European Organization for Nuclear Research (CERN) and took place in Geneva, Switzerland.

conference from eighteen countries. In particular, LINAC 16 is supporting a significant number of students, who will be soon major players in the LINAC community, being stimulated by this exciting forum. The first day was dedicated to the student poster session, and more than thirty students presented their posters for the student poster awards.



Exotic Beam Summer School held 17-24 July at NSCL



This year, forty graduate students attended the Exotic Beam Summer School to learn about challenges in low-energy nuclear physics and interdisciplinary subjects such as medical applications.

The fifteenth Exotic Beam Summer School (EBSS2016) was held at the National Superconducting Cyclotron Laboratory (NSCL) at Michigan State University on 17-24 July.

The aim of this annual school is to introduce students and young researchers to various facets of the science of exotic nuclei, including nuclear structure, nuclear astrophysics, fundamental interactions, and the application of nuclear science and technology. This year, forty graduate students attended the school to learn about challenges in low-energy nuclear physics and interdisciplinary subjects such as medical applications.

As a unique feature of the EBSS series, hands-on activities were organized in the afternoons and, this year, students learned beam optics, particle identification, LISE program, DAQ and electronics, astrophysics simulations, and nuclear theory. These hands-on activities were geared towards preparing students for an actual experiment at NSCL. From Friday through Saturday, students run an in-beam gamma experiment with GRETINA and S800 spectrograph using the 36Ar beam from the NSCL Coupled Cyclotron Facility.

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

More details of EBSS2016 including lecture slides are available [online](#).



ICNT/JINA-CEE Workshop ‘Connecting FRIB with the Cosmos’ held in June at MSU



Yuhri Ishimaru from the International Christian University in Tokyo, Japan, (far right) speaks at the ICNT/JINA-CEE workshop.

FRIB will provide unprecedented access to nuclei that we suspect nature has used as stepping stones during stellar collisions and explosions to create the elements heavier than germanium. This exciting prospect brought together leading scientists from across the world at the ICNT/JINA-CEE workshop “r-Process Nucleosynthesis: Connecting FRIB with the Cosmos”, held in June 2016 at Michigan State University. The goal was to discuss the scientific opportunities created by FRIB in the context of other major developments in computational science and observations. A focus was the development of strategies for first experiments and for establishing the necessary links to theory and astronomy to maximize the impact of the early FRIB scientific program to advance our understanding of the origin of the elements.

The workshop was supported by FRIB within the framework of International Collaborations in Nuclear Theory (ICNT), and the Joint Institute for Nuclear Astrophysics - Center for the Evolution of the Elements (JINA-CEE). It brought together sixty scientists from multiple areas that included experiments with rare isotopes, theoretical predictions of the properties of rare isotopes, astrophysics theory of supernova explosions and colliding neutron stars, and astronomical observations.

The three-week program offered formal presentations, discussions, and collaborative work in a unique interdisciplinary environment. A particularly exciting development discussed at the workshop is the ongoing search for neutron star collisions using the Laser Interferometer Gravitational Wave Observatory (LIGO), following the historic observation of gravitational waves earlier this year. FRIB will create many neutron-rich isotopes that are likely present in the ejecta from explosive stellar events. Together, FRIB and LIGO will offer powerful clues to the answers to the fundamental questions about the origin of heavy elements in nature. The findings of the workshop will appear in a currently prepared review article.



FRIB office tower substantially complete



The FRIB office tower addition has reached substantial completion.

The FRIB office tower addition has reached substantial completion, and people are moving into the new addition.

The parking lot, sidewalk, and new bike loops have been installed around the exterior of the building, and only punch list items remain to reach final completion. Office furniture has been installed on all floors, and the audio visual contractor is working diligently to get the conference rooms functioning.

The seating in the auditorium has been installed, along with the motorized projection screens. Final commissioning is also taking place, and should be complete by mid-September.



Contributors this issue

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LOOKING AHEAD

25-30 September	Linear Accelerator Conference (LINAC) at MSU
31 October-2 November	Experimental Systems Advisory Committee (ESAC) review of FRIB
9-11 November	Accelerator Systems Advisory Committee (ASAC) review of FRIB
6-8 December	DOE Office of Project Assessment Review review of FRIB
8-9 December	Science Advisory Committee (SAC) meeting

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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](#).