LABORATORY
UPDATE for ALUMNI
NSCL FRIB
January 2017

Civil construction progress allows FRIB to advance several technical installation milestones

On 27 October, the 4.5 Kelvin lower cryogenic cold box was delivered to FRIB from Oklahoma. Weighing in at 100,000 pounds, the 39-foot-wide cold box was placed horizontally in FRIB's cold box room.

As civil construction advances ahead of schedule and approaches beneficial occupancy in March, FRIB Project team members managing technical work are preserving this schedule float and delivering their scope to ensure the baseline is delivered with a high likelihood of success.

- FRIB's Conventional Facilities and Infrastructure Division assisted in the placement of the radio frequency quadrupole (RFQ) in the linac tunnel, which weighed approximately 30 tons. The RFQ will prepare the beam for acceleration in FRIB's linac.
- The 85,000 pound wedge vessel was delivered on

There are several significant technical achievements to report:

- On 27 October, the 4.5 Kelvin (K) lower cryogenic cold box was delivered to FRIB from the supplier in Oklahoma. Weighing in at 100,000 pounds, the 39-foot-wide cold box was placed by the construction manager horizontally in FRIB's cold box room. It joins the vertical upper cryogenic cold box, also weighing 100,000 pounds, that was delivered to FRIB in August. The two cold boxes will be connected to cool helium to an extremely low temperature, which will make the cavities within the cryomodules superconducting in FRIB's linear accelerator (linac) tunnel. The upper cold box lowers the temperature of the helium from 300 degrees K to 60 K. The lower cold box serves as the second step in the helium-cooling process, dropping the temperature from 60 K to 4.5 K. When the cavities are superconducting, there is no resistance, which means there will be virtually no heat loss with an electrical current, making FRIB more energy-efficient as it accelerates rare isotope beams. The FRIB baseline schedule calls for both cold boxes to be installed in October 2017; it now looks possible to have the installation done earlier and to make liquid helium in 2017.

The 85,000-pound wedge vessel was delivered in October and is currently being tested. After testing, the wedge vessel will be installed in the target area.

28 October and is currently being tested. After testing, the wedge vessel, which houses focusing magnets and a wedge assembly for beam momentum compression, will be installed in the target area in mid-December.

- The air-handling units for the front end and the tunnel have been turned on.
- Magnets have been delivered and are being stored in the linac tunnel, with several installed along the beamline.

Additionally, civil construction work is ongoing. Raised-access flooring in the surface building is now complete, and electrical panels are being mounted on the south equipment racks. Piping is being installed to storage tanks in the chemical treatment room. In the compressor room and the cold box room, warm-side piping installation is ongoing. Ductwork is being installed for the lower second floor mechanical room, and roofing continues on the west side of the building.

FRIB's Conventional Facilities and Infrastructure Division assisted in the placement of the radio frequency quadrupole (RFQ), which weighed approximately 30 tons. The RFQ will prepare the beam for acceleration in FRIB's superconducting linear accelerator.

DOE Office of Project Assessment review held 6-8 December

The DOE-SC Office of Project Assessment's (OPA) review of FRIB was held 6-8 December. The main focus of the review was to assess overall FRIB Project progress since the last review in June 2016, with a focus on our technical progress toward delivering the baseline.

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 overall making appropriate progress toward completion. The review committee answered all charge questions affirmatively.

DOE has tentatively scheduled the next review for 27-29 June.

NSF awards MSU funding to operate NSCL until 2021

A cooperative agreement between Michigan State University and the National Science Foundation (NSF) awarded in November will fund continued operation of NSCL for the user community. The agreement will allow forefront research in nuclear and accelerator science and maintain NSCL as one of the world's flagship nuclear science research facilities. It provides much needed funds to allow ReA3 to be operated as a user facility.

"We are extremely happy and grateful. This cooperative agreement from the NSF allows researchers to continue enabling cutting-edge scientific research into the nature and origin of atomic nuclei," said Brad Sherrill, University Distinguished Professor of physics and NSCL director. "We are excited about what this means for our users." It is anticipated that the funding will run about 3,000 hours of approved experiments each year.

As one of the nation's major user facility providing beams of rare isotopes for nuclear science, NSCL provides unique, hands-on learning opportunities for the next generation of nuclear scientists. It offers the opportunity for forefront science and for users to develop programs that will continue when FRIB is completed.

The Physics Division of the National Science Foundation has supported NSCL operation at MSU since the mid-1980s. The new funding will cover continued operation until 2021. "It is incredibly important to both the nation's leadership in nuclear science and to our scientific user community that rare isotope research continue in a strong way at NSCL until FRIB," said Thomas Glasmacher, University Distinguished Professor of physics and FRIB Laboratory director.

In addition to continuing to fund the operations of NSCL cyclotrons, the agreement also will provide funding to operate the newly built ReA3 program that will allow researchers to perform experiments with re-accelerated rare isotopes at 3 to 5 MeV/u. A separate proposal will be submitted to the NSF to enable research at higher energy from 6 to 12 MeV/u by, so called ReA6. If funded, this will expand NSCL operation to include rare-isotope beams reaccelerated to energies above Coulomb barrier. This capability should be available sometime in 2019.

NSCL users discover bubble nucleus

Research conducted at the National Superconducting Cyclotron Laboratory (NSCL), headed by a French research group from IPN Orsay, has shed new light on the structure of the nucleus.

The work, detailed in Nature Physics, found that the distribution of the protons in silicon-34 has a bubble-like center, something scientists had suspected for some time, but hadn't been able to prove so far. Interestingly, the distribution of neutrons does not exhibit a bubble. Usually, the protons and neutrons that make up a nucleus are distributed fairly

uniformly throughout. So the scientists, as well as the scientific world, took notice when this central depletion of protons was discovered.

Reactions to the Nature Physics article included online articles published on PhysOrg, Science Newsline, Science Bulletin, and ChemEurope, and several others. In addition, several aggregator websites posted links to the online articles.

'Science of Team Science' Part 2: The potential of wearable sensors for capturing social networks

by John Hollenbeck, University Distinguished Professor, Eli Broad Professor of Management

Figure 1: The gentleman above has a wearable sensor on that contains Bluetooth sensors and infrared detectors to capture co-location, microphones to assess incoming and outgoing verbal behavior, and accelerometers for detecting movement.

(This is the second part of a series that describes the results from the National Science Foundation Science of Team Science Project conducted at FRIB by researchers from the Eli Broad College of Business. Part 1 ran in the last issue of the Laboratory Update for Alumni.)

The substantive thrust of the Science of Team Science (STS) Project is to assess various components of the formal and informal social network at FRIB and to demonstrate how these affect the performance of individuals and teams. However, this research was also comprised of a methodological element associated with how to best capture social networks. Specifically, one purpose of this study was to address whether data collected from wearable

The research team examined the ability of these sensors to (a) accurately report known signals in a series of laboratory studies, (b) produce relational data that converges and agrees with traditional subjective reports of relationships, and (c) enhances the prediction of future job performance using relational data. The results of this research demonstrated several limitations associated with most of the sensors that were deployed on the WS studied. For example, the microphones were poor detectors of verbal activity due to the fact that the microphones varied widely in their sensitivity to sound. In addition, the loose coupling of the device to the wearer (worn around the neck on a long chain) created difficulties for both the assessment of movement via the accelerometer and co-location via the infrared system.

In contrast, the Bluetooth system was very accurate for detecting known networks in laboratory studies, and FRIB members' reports of relationships with one another converged with Bluetooth reports of the same relationships. Finally, when it came to predicting job performance, as shown in Figure 2, self-reports of having a large number of friends were only predictive of performance when those reports were corroborated by Bluetooth (solid line). Indeed, there was a negative relationship between the self-reported number of friends and performance when those self-reports were contradicted by Bluetooth (dotted line) — all of which points to the importance of accurate self-awareness.

sensors (WS) could be used to augment traditional subjective surveys.

The limitations with traditional subjective surveys for assessing the strength and reciprocity of relationships are well-known. These include biases attributable to lack of self-awareness, lack of memory, lack of frankness, and socially based stereotypes of other individuals. However, alternatives to this method have not been readily available until very recently. Specifically, scientific developments in the area of WS technology have opened up the possibility for the continuous passive collection of data over long periods of time. For example, the actual WS that was studied at FRIB (see Figure 1) contained Bluetooth sensors and infrared detectors to capture co-location, microphones to assess incoming and outgoing verbal behavior, and accelerometers for detecting movement. Each of these sensors "fire" every few seconds to assess the world around the wearer as this relates to other wearers or base stations located in physical areas where one would expect social activity.

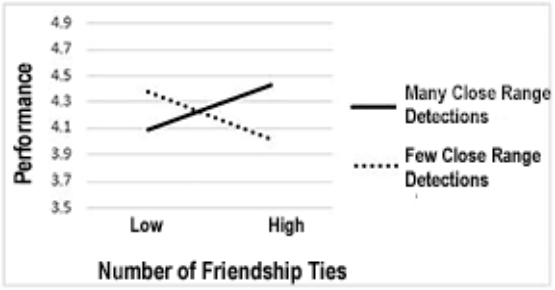

Figure 2: Self-reports of having a large number of friends were only predictive of performance when those reports were corroborated by Bluetooth (solid line). There was a negative relationship between the self-reported number of friends and performance when those self-reports were contradicted by Bluetooth (dotted line).

'Dance' project explains isotope research through movement

Several MSU units came together through Science and Society at State to conceptualize a performance that will help explain nuclear physics – and FRIB, in particular – through dance.

The National Superconducting Cyclotron Laboratory, the Facility for Rare Isotope Beams, the Center for Community and Economic Development, the Wharton Center, and the Office of the Vice President for Research and Graduate Studies collaborated on "Dance of the Rare Isotope Beams," partnering with the dance company Dance Exchange. The Dance Exchange's expertise is using dance to translate a variety of complex concepts for its audiences.

The planned events involve outreach professionals from the MSU units, and organizers hope it will help teachers explain FRIB science to students using the "language" of creative movement. The goal is to increase awareness about FRIB in general and also to increase students' interest in pursuing careers in science. Teachers from across the region will have the opportunity to attend a workshop to learn more about the project and how it can help them explain the scientific concepts in their classrooms.

The mission of Science and Society at State is to promote interdisciplinary research and education across science, technology, engineering, and mathematics (STEM); health sciences; social sciences; and humanities disciplines.

PBS children's program features NSCL

WKAR featured NSCL Associate Director for Education and Outreach Artemis Spyrou in two recent Curious Crew videos. In a shorter segment, Spyrou is featured in "Curious about Careers: Nuclear Physicist." A longer interview with Spyrou is included in a full Curious Crew episode, called "Resonance." Spyrou's segment in the full episode starts at 20:17.

Both videos show highlights of Spyrou taking a Curious Crew member on a tour of the National Superconducting Cyclotron Laboratory. Spyrou explained the field of physics and the cyclotron during the tour. The full program also included NSCL Graduate Students Rebecca Lewis and Katie Childers and Research Assistant Ben Crider.

Curious Crew is a PBS program for children featuring video stories about hands-on scientific exploration. The young hosts interview experts in scientific fields to learn more about how the world works.

Alumni spotlight: Jac Caggiano

Jac Caggiano

Jac Caggiano received his PhD in experimental nuclear physics in 1999 from Michigan State University under the tutelage of Dr. Bradley Sherrill and collaborating with Dr. Walter Benenson. He spent his time mapping the magnetic fields of the two large S800 dipoles, and then performing indirect nuclear astrophysics experiments and measuring atomic masses using the S800.

Following grad school, Jac was a postdoc at Argonne National Laboratory from 1999 to 2001, working primarily on nuclear astrophysics and ion-trapping experiments.

Proposing and performing experiments at Yale University led him to take a position at the Wright Nuclear Structure Laboratory from 2001-2004. He then took a position in the DRAGON group at TRIUMF in Vancouver, Canada, from 2004-2006, studying nuclear astrophysics reactions directly.

Since 2006, Jac has pursued radiation-detection research in the interest of national security. Jac is currently employed at Lawrence Livermore National Laboratory (LLNL) as a physicist. He joined LLNL in 2009 to lead the neutron time of flight (NTOF) diagnostic group at the National Ignition Facility that designed a new NTOF spectrometer which revolutionized the way NIF neutron spectroscopy is performed.

When Jac is not working or spending time with his wife and three cats, he is discovering new ways to injure himself via his new hobby, powerlifting.

We want to hear from you

Send us your story ideas! Let us know what you are up to!

Contributors this issue

- Brad Bull
- Zach Constan

We want to feature at least one story each issue about you—our FRIB/NSCL alumni, so please email us story tips about you and/or your fellow alumni to alumni@frib.msu.edu. Tell us about discoveries, business ventures, partnerships, awards, and other professional developments, and we may feature them in a future issue. Also let us know if there are other types of laboratory updates you'd like to see in future alumni issues.

- Thomas Glasmacher
- John Hollenbeck
- Jac Caggiano
- Artemis Spyrou

LOOKING AHEAD

24 March	ReA Solenoidal Spectrometer Projects meeting to be held at Argonne National Laboratory (ANL)
12-14 April	NSF Review of NSCL
1-5 May	Experimental Systems Advisory Committee (ESAC) Review of FRIB (tentative)
3-4 May	NSCL Program Advisory Committee (PAC) 41 (proposals due 1 March)
28 May – 2 June	ARIS 2017 - The third international conference on Advances in Radioactive Isotope Science
30 May – 1 June	Accelerator Systems Advisory Committee (ASAC) Review of FRIB
27-29 June	DOE-SC Office of Project Assessment Review of FRIB (tentative)
3-4 August	2017 Low Energy Community Meeting at Argonne National Laboratory (ANL)

The FRIB Laboratory Update for Alumni is published by the FRIB Laboratory and distributed via email. Please e-mail questions, comments, address changes, story tips, contributions, or requests to unsubscribe from this list to alumni@frib.msu.edu. If you are in touch with other NSCL/FRIB alumni, please forward this to them and invite them to contact us to subscribe.

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Michigan State University is establishing FRIB as a national user facility for the Office of Nuclear Physics in the U.S. Department of Energy Office of Science. Operation of NSCL as a national user facility is supported by the Physics Division of the U.S. National Science Foundation.