NSCL

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UPGRADES TO THE HIGH RESOLUTION ARRAY AND THE LARGE AREA NEUTRON ARRAY

Contributed by Kyle Brown

The recent observation of the merger of two neutron stars gives us a glimpse of what can happen when two balls of nearly pure neutron matter the size of large city collide and combine. The details are yet to be understood and the final fate of the two neutron stars is still unknown. Whether they collapsed into a black hole, or merged to form a giant neutron star depends on the equation of state (EoS) of nuclear matter. In a neutron star, the EoS is dominated by the symmetry energy, which arises from an imbalance in the number of neutrons and protons. The pressure driven by the symmetry energy counteracts the gravitational force, preventing the neutron star from collapsing into a black hole.

To study the symmetry energy (by comparing the energy spectra of emitted neutrons and protons from heavy ion collisions) the HiRA group has upgraded both the High Resolution Array (HiRA) and the Large Area Neutron Array (LANA). HiRA is an array of modular telescopes made up of a double-sided silicon-strip detector and 4 CsI (Tl) crystals. They can measure the energy and position of charged particles. To increase the range of energies measured in HiRA, the 4-cm-long CsI crystals were replaced by 10-cm-long crystals. This change will roughly double the range of energies for detected protons. LANA is made up of two walls. Each wall is 2x2 m^2 in area, with 25 horizontal bars of liquid scintillator (NE-213). Neutrons and gamma rays can be distinguished by their differing light output in the liquid, but charged particles (like protons) are indistinguishable from neutrons. A large veto wall was constructed in collaboration with Western Michigan University. It consists of 23 vertical bars of plastic scintillator with 3 mm overlap on each bar to completely cover the neutron wall. The 1 cm thick veto wall is thin enough that mainly the charged particles will leave a signal in the bar. Using this information, charged particles can be removed from the neutron walls. Commissioning of the neutron wall with beam is scheduled just before the Christmas holiday.

Zbignew Chajecki of Western Michigan University and Kyle Brown testing the particle veto wall (black vertical scintillation bars) installed in front of the Large Neutron Wall Array (only the Aluminum cover behind the veto bars is visible) in preparation for the commissioning of the veto wall.

LAYING THE GROUNDWORK FOR ISOTOPE HARVESTING

Contributed by Greg Severin

Recently a consortium of nuclear science researchers from across the country issued a "whitepaper" prospectus on isotope harvesting at FRIB. The report outlines the scientific and societal needs for chemically purified isotopes created at FRIB, and is rooted in the immense capacity of FRIB to create short-supply radionuclides. The report draws upon the knowledge generated at a series of biennial workshops sponsored by the Department of Energy Office of Science, and from proof-of-concept experiments performed at NSCL. Many MSU faculty and research staff contributed to the whitepaper- not only from NSCL and FRIB but also from other departments including Chemistry, Toxicology and Microbiology, Plant and Soil Sciences, and Materials Science.

Among the most prominent applications for FRIB isotopes is medicine, particularly because many critical medical isotopes are difficult to create, like the alpha-emitter actinium-225 (225Ac). Just this summer a clinical report appeared in the Journal of Nuclear Medicine describing the dramatic efficacy of 225Ac for halting castrate-resistant metastatic prostate cancer. 225Ac is extremely difficult to produce, and was only available for the clinical study as a generator product from a legacy stockpile of thorium-229. When FRIB begins running full-power uranium-238 beams, by-product 225Ac will accumulate in the water-cooled beam dump at a rate of 44mCi per week. For reference, the clinical study used only 0.3-0.5 mCi per patient dose to achieve "Remarkable antitumor activity." Isotopes like 225Ac highlight the importance

of isotope harvesting from FRIB: the isotopes are being created anyway, and they only need to be collected and purified before they can be put to use in extremely important applications.

Harvested isotopes from both FRIB and NSCL are also very useful in stewardship science applications. This experiment at NSCL that occured a couple weeks ago, headed by Nick Scielzo from Lawrence Livermore National Laboratory (LLNL), is an exploratory harvesting run that will create sample-solutions containing zirconium-88. These solutions will be used by radiochemists like LLNL's Jen Shusterman to fine-tune radioactive target production for neutron activation measurements. Filling-in gaps in neutron reaction matrices will allow stewardship science researchers to garner more information from archived weapons-testing data, and to improve nuclear forensics models. Additionally, the chemical information that results from this week's tests will inform future harvesting projects at NSCL, and at FRIB where the yields are expected to increase by many orders of magnitude.

CCF UPDATE

The cyclotrons are continuing a long run of calcium-48 primary beam. A MoNA experiment in the N2 vault took magnesium-33 secondary beam through the Holiday weekend. On Monday morning, that experiment ended, and a sulfur-39 beam was tuned up in the A1900 for ongoing development work with the Argonne gas cell. On Tuesday morning, a rare-isotope experiment began in the reaccelerator. Sulfur-38 beam was thermalized in the gas cell and sent to ReA for acceleration. Due to the difficulty of tuning the long-lived sulfur-38 isotope in the presence of the stable argon-38 contaminant, the experimenters requested a change to the secondary beam on Wednesday evening. The beam physicists developed argon-46 overnight, and on Thursday morning, ReA began accelerating this beam for delivery to the AT-TPC.

SEMINARS

- MONDAY, DEC 04 AT 11:00 AM
  NSCL Lecture Hall 1200
  Steven Ragnar Stroberg, Reed College
  'Dreams of a Nuclear Theory of Everything'
- TUESDAY, DEC 05 AT 11:00 AM
  Biomedical & Physical Sciences Bldg., Rm. 1400
  Oleg Korobkin, Los Alamos National Laboratory
  'Macronova from the Neutron Star Merger GW170817: Models and Implications'
- WEDNESDAY, DEC 06 AT 11:00 AM
  Biomedical & Physical Sciences Bldg., Rm. 1400
  Francesco Raimondi,
  'Correlations for the Ground and Excited States in the Nuclear Many-body Methods'
- THURSDAY, DEC 07 AT 10:30 AM
  Biomedical & Physical Sciences Bldg., Rm. 1400
  Saori Pastore, Los Alamos National Laboratory
  'Fundamental Physics with Electroweak Probes of Nuclei'
- FRIDAY, DEC 08 AT 11:00 AM
  NSCL Lecture Hall 1200
  Ingo Tews, Institute for Nuclear Theory, University of Washington, Seattle
  'Precision Studies of Nucleonic Matter and Nuclei'

PEOPLE AT THE LAB

- Ana Celis is a new student employee in the Lab.
- Dean Thelen joined the Lab as a Cryomodule Mechanical Technician.
- Floyd Martin is the new Cryogenic Mechanical Design Team Leader.

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