THE GREENSHEET

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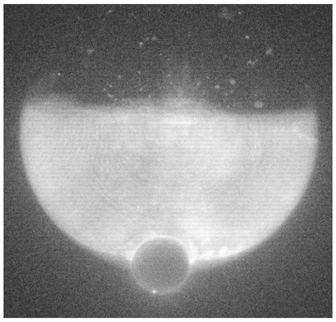
RADIOCHEMISTRY AT MSU

Contributed by Greg Severin

The new radiochemistry laboratory in MSU's chemistry department is now fully operational; complete with detectors, lead-lined hoods, and an auto-radiographer. Most importantly, the laboratory is approved for wet chemistry with open sources of select radioisotopes like zirconium-88 that was collected as part of an NSCL experiment headed by Lawrence Livermore National Lab's Nick Scielzo. At the radiochemistry lab, graduate students Hannah Clause and Paige Abel were able to investigate what happens chemically to radioisotopes like zirconium-88 when they are implanted in water at high energy from the NSCL fragment separator. Interestingly, so-called "hard" metals like zirconium are so unstable in water that they stick to almost any surface that they come in contact with. This feature was easily identified in a radiograph of the back-wall of the container that the zirconium-88 was collected in. The image below shows immediately that the radioactive zirconium was indeed "sticky", with the water-line still imprinted on the container even after it was drained.

Nevertheless, thanks to the new radiochemistry laboratory, it was possible to recover a large fraction of the stuck zirconium-88 just by washing with dilute acid. This is a great beginning to the isotope harvesting project, which will add radiochemistry into the NSCL's capabilities to provide rare isotopes for science.



Left: A radiograph of the back-wall of the zirconium-88 collection container. The brighter areas indicate places where zirconium stuck to the material. The water-line is clearly visible across the top, and the drain-port is visible as the small circle in the bottom. Right: Hannah and Paige working in the newly finished radiochemistry laboratory.

VIEWING COSMIC SHOWERS WITH VIRTUAL REALITY

Contributed by Jonathan Barney and Jacob Crosby

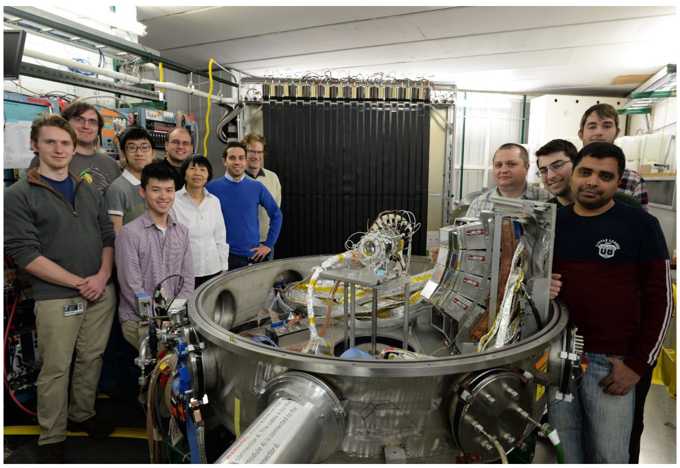
A Time Projection Chamber (TPC) is a gas detector that has an amplification region that collect the electrons ionized by charged particles traversing the detector. These electrons induce signals on an X, Z pad plane (like pixels in a TV) and the drift time of the electrons from the ionization point to the pad plane provides the third, Y, dimension. By convention, Z is the beam direction. The HiRA group at NSCL constructed the SπRIT (SAMURAI pion Reconstruction Ion Tracker) TPC which has been used successfully to study heavy ion collisions at RIKEN, Japan.

To visualize the three-dimensional data from nuclear reactions collected by the TPC, a Virtual Reality (VR) application using commercial and open source software is under development by Jacob Crosby, an undergraduate student working in the HiRA group. The application uses the momentum to charge ratio for particles detected within the TPC to model their motion, ionization of electrons, and the detection of ionized electrons on the pad plane.

The cosmic data that was taken with the TPC during the RIKEN campaign is used to produce an immersive simulation of a cosmic shower inside the detector, allowing a user to experience firsthand the particles moving through the TPC. The VR application is being developed with the Unity game engine, which can potentially be extended to multi-platform usage. Instead of an expensive commercial headset, the VR application uses a Google Cardboard headset (~$10 each). Currently, a demo application is available to run on Android phones. To experience a VR simulation of a cosmic event within the SπRIT TPC, contact Jacob Crosby or Jon Barney.

EXPERIMENT OF THE WEEK

The four-week experimental campaign aimed to measure the spectral ratios of neutrons and protons emitted in different reactions finished at 6AM this past Sunday. The experiments are a collaboration between MSU and Western Michigan University to study the density dependence of the symmetry energy, an important question about the properties of neutron-rich nuclear matter. Understanding the symmetry energy is essential for understanding the properties of neutron stars and their mergers. In total, 20 TB of data were recorded from beams of calcium-40 and calcium-48.



The HiRA group (left side) and WMU group (right side) standing by the experimental setup in S2. From left to right Jacob Crosby, Sean Sweany, Tommy Tsang, Kuan Zhu, Kyle Brown , Betty Tsang, Daniele Dell'Aquila, Bill Lynch, Zbigniew Chajecki, Jacob Boza, Justin Swaim and Om Bhadra Khanal.

These experiments were the first to use the upgraded HiRA, nicknamed HiRA10 (the 3x4 telescope array located on the right side of the chamber in the photo). Like its previous iteration, HiRA10 is a set of modular detector telescopes consisting of 1-2 layers of silicon strip detectors and 4, 10-cm-long CsI (Tl) scintillator crystals. The combination of energy loss measured in the silicon and the energy deposited in the CsI (Tl) crystals allows us to determine the identity of the charged particle as well as its total energy emitted in a nuclear collision. The silicon layer is segmented into 32 x 32 orthogonal strips to determine the angle of the charged-particle emission to within 0.3 degrees. The Microball situated in the center of the chamber, is an array of 61 CsI (Tl) scintillators that covers nearly 4π in solid angle. It measured the multiplicity of emitted light charged-particles to determine the impact parameter of the reaction. Using the veto wall (25 vertical bars wrapped in black at the back of the picture), we can reject charged particles from neutrons detected in the neutron walls located behind the veto wall. A forward array consisting of 18 small plastic scintillators on a 3D printed radial mount provided the start time for the veto/neutron wall. Energy of the neutrons is determined from the time of flight between the forward array and the walls. A new digital data acquisition designed by our Korean collaborators, was used to readout 100 channels from the nuetron walls in parallel with conventional electronics.

CCF UPDATE

The cyclotrons are running calcium-48 for the fourth week. The HiRA/Neutron Wall campaign ended Sunday morning at 6AM and the CCF entered a short maintenance period to replace stripper foils in the K1200. On Monday, the beam was running again and used to validate the data acquisition system of the Argonne gas cell in N4. On Tuesday morning, a gamma-spectroscopy experiment with the SeGA germanium array began in the general-purpose end station of the reaccelerator. A potassium-45 secondary beam was created in the A1900, thermalized in the gas cell, and accelerated in ReA3 to 4.66 MeV/nucleon.

SEMINARS

- TUESDAY, APR 03 AT 11:00 AM
  1200 (Lecture Hall) FRIB Laboratory
  Jiangming Yao, NSCL/FRIB at MSU
  'Generator Coordinate Method for Nuclear Low-Lying States: from MR-EDF to MR-IMSRG Calculations'
- WEDNESDAY, APR 04 AT 12:00 PM
  1200 (Lecture Hall) FRIB Laboratory
  Oleg Tarasov, NSCL
  'How to Make Rare Isotope Beams at Home'
- WEDNESDAY, APR 04 AT 4:10 PM
  1200 (Lecture Hall) FRIB Laboratory
  Umesh Garg, University of Notre Dame
  'Nuclear Incompressibility: Does it Depend on Nuclear Structure?'
- THURSDAY, APR 05 AT 11:00 AM
  1200 (Lecture Hall) FRIB Laboratory
  Alex Brown and Vladimir Zelevinsky, FRIB
  'Highlights In Progress'

PEOPLE AT THE LAB

- Cal Martin joined FRIB as a Maintenance Technician.
- Michael Liebengood is a new Cryomodule Assembly Group Welder.
- Robert Schartzer joined the Lab as a Cryomodule Installation Assembler.

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THE ARCHIVE OF PREVIOUS GREENSHEETS IS AVAILABLE HERE

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