THE GREENSHEET

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IDENTIFYING VERY HEAVY RARE ISOTOPE BEAMS

Contributed by Bill Lynch & Tom Ginter

The NSCL has developed primary beams of platinum-198, lead-208, bismuth-209, and uranium-238 that can be fragmented to produce very heavy rare isotope beams. However, their use in experiments has proven to be challenging. Chief among the challenges has been the difficulty of identifying and tagging heavy secondary beam isotopes as they emerge from the A1900 separator and travel down the beam line. Without being able to tag and identify these secondary-beam isotopes, one may not know which rare isotope is causing the reaction that is being measured. To address these challenges, the Beam Physics group formed a collaboration with experimentalists from the NSCL and Western Michigan University.

The collaboration used the LISE++ beam production simulation software package to devise a strategy for secondary beam production and identification. Testing this strategy with a lead-208 primary beam involved fragmenting it in the A1900 separator and passing the resulting secondary beams through momentum defining slits that were 2 mm apart, selecting the momentum of secondary beam isotopes to a precision of about 0.02%

Identifying the produced secondary beam isotopes such as lead-196 required achieving four objectives:

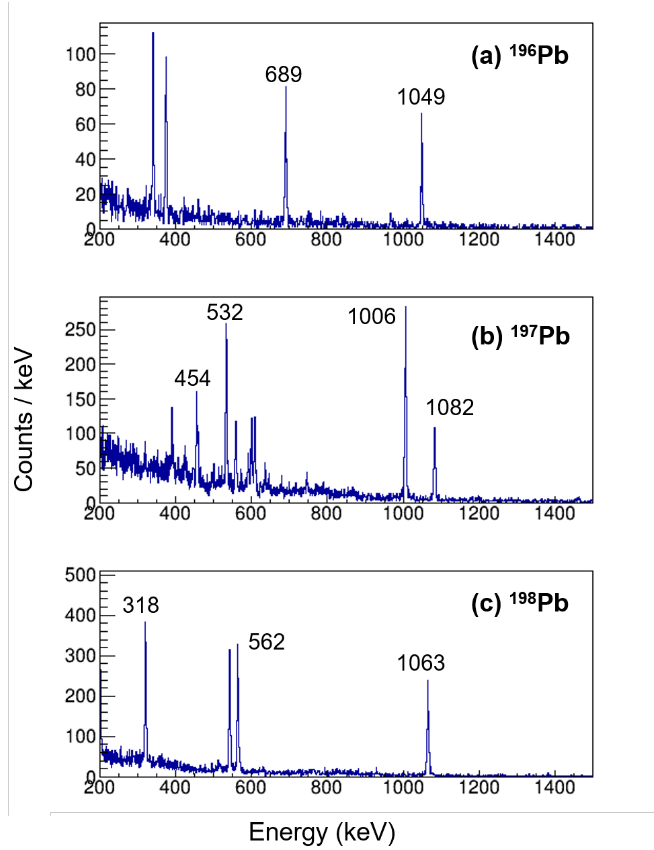
1) measuring the time of flight of such isotopes from the A1900 to the S2 vault with a precision of 500 trillionth of a second,

2) measuring the energy loss of such isotopes in an ion chamber to 1% precision,

3) identifying the lead-196 fragment in the data by measuring photons (γ-rays) from the decay of excited states of lead-196 with typical lifetimes of a millionth of a second, and

4) estimating the background in the lead-196 peak coming from other nuclei that came down the beam line with another number of atomic electrons.

Objectives 1, 3, and 4 were achieved in a recent test run and the results are consistent with the LISE++ calculations. The figure below shows three measured γ-ray spectra obtained by gating both the time of flight and energy loss to select lead-196, 197, and 198 nuclei, respectively. The labeled peaks correspond to the γ –rays emitting when long–lived states in these nuclei decay. They confirm the strategies used in the test run to identify and tag these rare isotope beams. Now the collaboration is investigating how to improve the detectors and the detection method. This study can enable studies of fission of light lead isotopes at the NSCL and provides information relevant to future beam development at FRIB. The project is part of the thesis of Adam Anthony.



This figure shows γ-ray peaks from the decay of isomers in detected lead-196, 197, and 198 nuclei in the secondary beam.

EXPERIMENT OF THE WEEK

Last week, Experiment 19002 used a chlorine-45 rare-isotope beam produced from a calcium-48 primary beam to study a reaction channel that involves the chlorine-45 nuclei picking up a proton in the collision with a carbon target placed at the S800 spectrograph. The gamma-ray detection system GRETINA was used to tag the final state that argon-46 was left in from its gamma-ray decays.

These so-called pickup reactions with fast beams have very interesting characteristics that will allow experimenters to assign angular momentum values to excited states and determine if the emitted gamma-ray radiation is of electric or magnetic character. The nuclear structure of argon-46 has been controversially discussed in the literature and its description has challenged nuclear shell-model calculations for a while. The present data will settle a number of experimental controversies as to the nature and placement of previously claimed excited states in this nucleus.

PORTABLE FAN SAFETY

With the hot weather outside, it is a good time to take a look at fans and fan safety. Fans help move the air around us to help keep us and our equipment cooler. However, there are some important safety items to consider:

Are the guards in place?
Fans that are less than 7 feet off the ground must have guards on them to prevent injury. The openings need to be ½ inch or less. Inspect fans to ensure the guards are in place and secure. Injury can occur if the guards come loose or are not in place.

Is the fan clean?
Fan blades that are clean and free of dust and dirt actually move more air than a dirty blade and will function more efficiently. With the fan unplugged, remove the guards to wipe dust and dirt off the blades and guards.

Is the plug in good condition?
Check the plug and cord to ensure all the electrical prongs are in place and the cord isn't frayed. Ensure the motor cover is securely in place.

If the guards, blades or cord are damaged, take the fan out of service for repair or replacement.

CCF UPDATE

For the past week, the cyclotrons continued running a calcium-48 primary beam. On Tuesday morning, a LEBIT precision mass measurement ended, followed by configuration changes in the A1900 and controls development. In the afternoon, a neon-29 secondary beam was developed for a GRETINA experiment in S3 that began on Wednesday morning.

SEMINARS AND EVENTS

- MONDAY, JUL 15 AT 9:00 AM
  1200 FRIB Laboratory
  Brandon Elman, NSCL Thesis Defense
  'Probing Proton Cross-Shell Excitations for Ni-70 Using Nucleon Knockout Reactions'

PEOPLE AT THE LAB

- Xinyi Wang, Daniel Lay, Karina Martirosova and Tyler Witzel joined the Lab as Graduate Students.

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