Nuclear Science Division Newsletter

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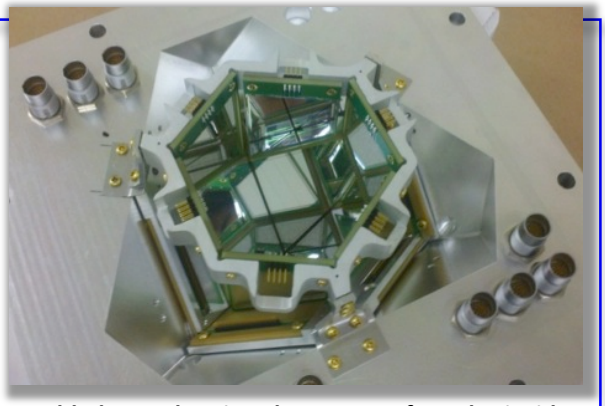
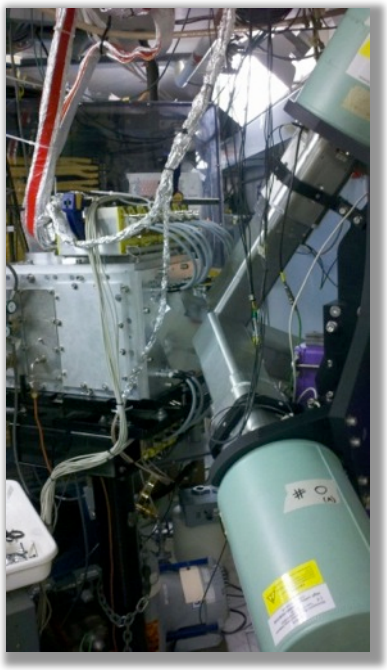
Corner Cube Clover sees more superheavies



Uncabled CCC showing the corner of a cube inside a pyramidal vacuum window with hexagonal upstream detectors.

Recent experiments at the LBNL 88-Inch Cyclotron's Berkeley Gas-filled Separator (BGS) have focused on the production of superheavy elements (SHE, elements with ≥104 protons in their nuclei) in ^{48}Ca irradiations of actinide targets and studying the nuclear structure of nuclides near ^{254}No by observing the decay of K-Isomers. The investigation of SHE is of great interest due to the 'island of stability' where elements with ~114 protons in their nuclei are theorized to be nearly stable. This compares to uranium, the heaviest naturally occurring element, with 92 protons. K-isomers occur in deformed (non-spherical) nuclei. Their observation tells us more about the way the neutrons and protons are arranged in the nucleus.

Recently, a new BGS focal plane detector has been built to increase detection efficiency in these experiments. It consists of silicon detectors arranged in the shape of a corner of a cube, while another set of tetrahedral shaped silicon detectors forms a hexagonal tunnel directly upstream. The corner of the cube fits on the inside of a pyramid-shaped vacuum window, which protrudes out the back side of the detector chamber, allowing placement of three germanium clover γ-ray detectors directly behind. The new detector system has been named CCC, representing some permutation of clover-cube-corner.

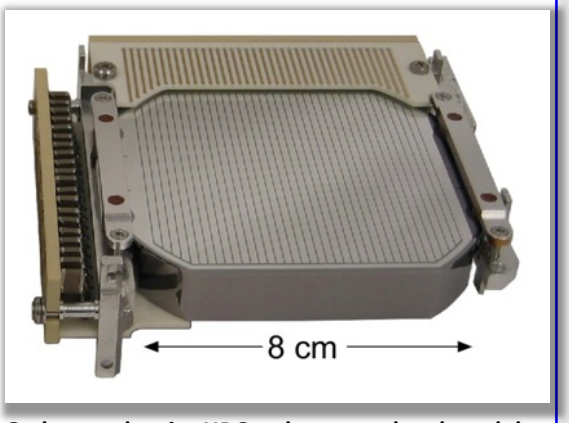


Pyramidal vacuum window surrounded by three clover Ge γ-ray detectors. In normal operations, the clover detectors are situated 0.5 mm from each face of the pyramid.

The CCC is now being commissioned in an experiment designed to investigate K-Isomers in ^{257}Rf (Z=104) and ^{265}Rf. It will result in a 6-fold increase in efficiency compared to the detection system used in previous experiments. An experiment beginning in September 2012 will make the first identification of the number of protons in a SHE nucleus by detecting characteristic K *x*-rays that occur immediately following the α-decay of a SHE. The new CCC detector will result in 3-fold efficiency increase for these studies.

Laboratory develops new detectors

New technology is a critical enabler for advances in nuclear science. The NSD Semiconductor Detector Laboratory (SDL) and its staff have a long history of accomplishments in the development and production of radiation detectors and the support of NSD's scientific mission. In the early 1960's, lithium-drifted Si detectors were one of the main focuses of the SDL, and such detectors were produced extensively for NSD experiments. Lithium-drifted Ge detectors were also produced. This was followed by the development of high-purity Ge (HPGe) crystal growth in the early 1970's and the eventual development of new detector technologies based on the material. Position sensitive Si and HPGe detectors were developed, and the first Si and HPGe drift detectors were made in the SDL. The shaped-field point-contact HPGe, which has become the core technology for the MAJORANA Demonstrator project, was also invented in the SDL. In the mid-1990's the detector work was expanded to CdZnTe, which led to the highly successful coplanar-grid technology.



Orthogonal-strip HPGe detector developed by the SDL for gamma-ray tracking, imaging, and high-resolution spectroscopy.

Today the SDL is part of NSD's Applied Nuclear Physics program. The facility and its staff have all the equipment and expertise necessary to develop and manufacture unique detectors and detection systems based on Si, HPGe, and CdZnTe. The lab derives its support from programs funded by DHS, NASA, DOE NNSA as well as DOE Office of Science. One of the current focus areas of these programs are gamma-ray tracking, imaging, and high-resolution spectroscopy for applications in the areas of nuclear physics, astrophysics, nuclear nonproliferation, and homeland security. An example SDL technology is the large-area orthogonal-strip HPGe detector based on the SDL-developed amorphous semiconductor electrical contacts. Arrays of such detectors have been used in prototype instruments for DHS and NASA. Another example is the High Efficiency Multimode Imager, which is based on arrays of CdZnTe coplanar-grid detectors representing a modular, very compact and light-weight, and low-power gamma-ray spectroscopy and imaging instrument for energies ranging from below 50 keV to several MeV.

NSD Fragments

The MAJORANA and KATRIN group welcomed five new members in July: (left to right) **Stefan Groh**, **Anton Huber**, **Susanne Mertens**, **Alex Hegai**, and **Nicolas Abgrall**. Abgrall and Mertens joined the group as postdoctoral fellows, and are starting off by working on detector assembly for MAJORANA. Abgall received his PhD from the University of Geneva in Switzerland. His doctoral research involved studying neutrino production in the NA61/SHINE experiment at CERN. Mertens received her PhD from the Karlsruhe Institute of Technology (KIT) in Germany where she carried out a proof-of-principle experiment to reduce backgrounds from trapped electrons resonance in the KATRIN spectrometers by stochastically heating them. She is supported by a Karlsruhe House of Young Scientists (KHYS) fellowship. The same program is also supporting a 3-month visit by KIT doctoral student Stefan Groh. In addition, Anton Huber and and Alex Hegai (Tuebingen) are also visiting, supported by from Germany's Deutscher Akademischer Austausch Dienst (DAAD). Groh and Huber are working on KATRIN, while Hegai is working on high purity germanium detector development.

Everyone enjoyed themselves at the annual NSD BBQ held on August 3 at the 88" Cyclotron High-Bay. Many people pitched in to ensure a good time was had by all. Can you spot the RNC program head pulling double-duty as part of the clean-up crew?

Newsletter Notes

Please send any comments, including story suggestions to Spencer Klein at srklein@lbl.gov.

Previous issues of the newsletter are available at:
https://commons.lbl.gov/display/nsd/NSD+Newsletter