Nuclear Science Division Newsletter

In this issue: **October, 2012**

Parylene coatings fight alpha backgrounds in CUORE

The upcoming CUORE experiment will search for neutrinoless double beta decay of ^{130}Te using an array of 988 TeO_2 crystal bolometers inside a copper container. Decay alphas from contaminants on the copper surfaces are the largest source of background in the energy region of interest (2528 keV), so the collaboration has invested significant effort in addressing this issue. Most recently, NSD postdoc Ke Han proposed and led an initiative to investigate whether coating the detector's copper parts with a thin layer of Parylene could significantly reduce the number of emitted alphas reaching the crystal detectors. Parylene is a trade name for a variety of chemically deposited polymers. It is conformally coated to objects via aroom-temperature molecular-level vacuum-deposition process. It is a not-unfamiliar material in the NSD, as the Majorana group has already used Parylene coatings in several applications—e.g., to make radioactively clean ribbon cables. The proposal offered speed, simplicity, and low cost in comparison to other alpha mitigation techniques. For these reasons, the collaboration approved a dedicated, high-sensitivity validation run involving standard detector modules.

A miniature CUORE -like tower containing 12 TeO_2 crystal detectors. All of the copper parts were coated with a 50-micron-thick Parylene film prior to assembly.

This summer, the NSD CUORE group retrofitted a newly purchased Parylene coater to meet the radio-purity requirements. The coater was then shipped to Gran Sasso National Laboratory (LNGS), Italy, where NSD CUORE group members Tom Banks, Brian Fujikawa, Ke Han, and Thomas O'Donnell built a miniature CUORE-like detector tower *(see photo)* whose copper parts had been coated with a 50-micron-thick Parylene film. Both the coating and assembly were carried out in one of CUORE's underground clean room at LNGS. Data taking began in October and is expected to continue to the end of 2012. The NSD CUORE group is leading the data analysis effort and will soon verify whether this simple yet powerful technique indeed eliminates alpha backgrounds without introducing unwanted side effects.

NSD throws open its doors

About 7,000 members of the community visited LBNL during its annual Open House on Saturday, October 13th. This year's theme was "Adventures in Science with Berkeley Lab's Science Explorers". Exhibit highlights included a science maze, robots playing basketball, a model house for optimizing energy efficient building, popping balloons with lasers as part of a demonstration about plasma wakefield acceleration, a LEGO scale model of the ATLAS detector, and a photo opportunity with recent Nobel Laureate Saul Perlmutter's photo.

The Nuclear Science Division was well represented. We shared a 20" x 40" tent with the Physics Division and Cosmology Group with the theme "Exploring the Universe at the Smallest and Largest Scales". NSD personnel staffed booths on GRETINA, radioactivity and cosmic rays and IceCube.

Tours of the 88-Inch Cyclotron were especially popular: tickets ran out within a few hours. Volunteers worked to take the eager visitors on tours of the facility in groups of 15, taking a total of 350 people during the Open House.

Many volunteers contributed to make this a successful Open House. Special thanks go to Shamsuzzoha Basunia who coordinated the NSD efforts.

A group touring the 88-Inch Cyclotron facility (photos by S. Basunia)

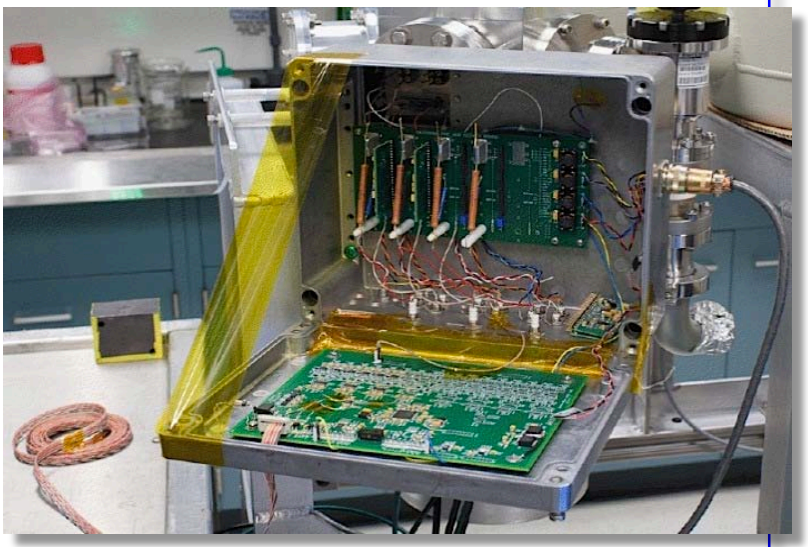
Majorana Moves Forward

Over the past several months, members of the MAJORANA group have made tremendous progress on many fronts. The group has begun delivering the detector signal readout system to the MAJORANA laboratory at the Davis campus of the Sanford Underground Research Facility (SURF) in Lead, SD.

LBNL engineers designed and fabricated the signal readout electronics. The first batch of the electronics, to be used for the "prototype cryostat" of the MAJORANA DEMONSTRATOR (MJD) project, has been delivered to SURF. The cryostat will allow MJD to run two strings of natural germanium detectors prior to assembling and running the precious ^{76}Ge-enriched detectors in the two subsequent ultraclean cryostats.

The LBNL MAJORANA group is also responsible for the purchasing and acceptance of the ^{76}Ge HPGe detectors. The contract for fabricating these enriched detectors was awarded to AMETEK/ORTEC in Oak Ridge, TN. Over this past summer, the LBNL group collaborated with the company in fabricating two test natural germanium detectors. The detectors met their specifications, and production of the enriched detectors will begin by the end of 2012.

The design of the "point-contact type" germanium detector proposed by AMETEK/ORTEC for the enriched detector run differs from the natural germanium detectors that have been acquired by Los Alamos National Laboratory from CANBERRA. The LBNL team is studying the two test detectors mentioned above intensely, and they will be installed in the prototype cryostat at SURF later this year. The performance of both detectors exceeds the specifications for the enriched detector order.

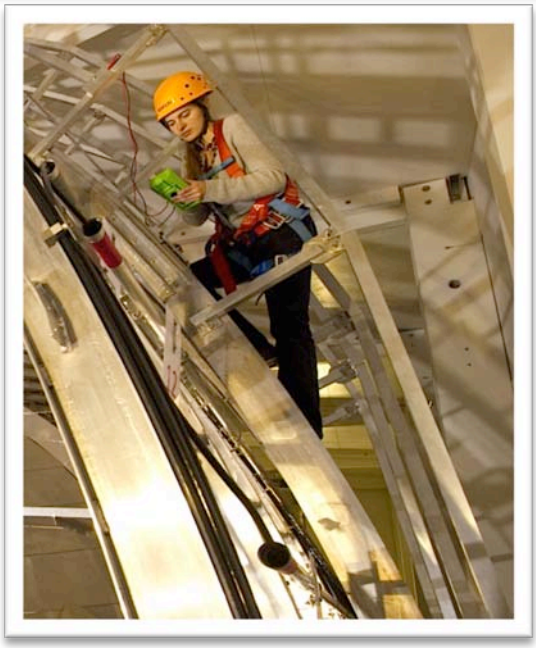


Prototype signal readout electronics developed at LBNL.

In order to reach the stringent MAJORANA DEMONSTRATOR radioactive background, the group has radioassayed some of the most critical components that will be installed inside the clean cryostats. Working with the LBNL Low Background Counting Facility and the Earth Science Division's ICP-MS laboratory, the Majorana team has established the radiopurity of the "low-mass front-end" (LMFE) boards that will be installed in close proximity to each of the germanium detectors. The LMFEs are projected to give a background rate from the ^{232}Th chain of < 0.1 count per tonne of detector per year in the 4-keV energy window centered at the Q-value of ^{76}Ge decay of 2039 keV. A similar limit was obtained for radioactivity from the ^{238}U chain.

NSD Fragments

Visiting NSD postdoc **Susanne Mertens** has won the prestigious Feodor Lynen Research Fellowship from the Alexander von Humboldt Foundation in Germany. Mertens received her PhD from the Karlsruhe Institute of Technology earlier this year. Since arriving in Berkeley in July, she has been working on the high-purity detector systems for use in the MAJORANA Demonstrator. Photo courtesy Karlsruhe Institute of Technology.



NSD postdoc **James Loach** has received a research award from the competitive "1000-talents Plan sponsored by the Chinese government, and is moving to Shanghai Jiao Tong University, where he will be an associate professor.

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