

## GRETINA RETURNS TO NSCL

Contributed by: Alexandra Gade & Dirk Weisshaar

After a one year stint of running experiments at the ATLAS facility at Argonne National Laboratory, the Gamma-ray tracking array GRETINA returned to NSCL for its second fast-beam science campaign. Just like its first very successful stay at NSCL in 2012-13, GRETINA is presently being set up at the target position of the S800 spectrograph in anticipation of an in-beam gamma-ray spectroscopy campaign scheduled to start in October.

The trucks with most equipment arrived from Chicago during the last week of July. With fantastic support from all involved departments, the S3 vault was perfectly prepared, including the construction of an area that houses the digital readout electronics and the setup of the complex frame structure of the array, so that not even a month after the arrival, all seven GRETINA modules were mounted in the vault and connected to the liquid nitrogen filling system. Each of the GRETINA modules consists of four 36-fold segmented high-purity germanium crystals and provides 148 electronics signals that are digitized in the readout electronics and subsequently processed in GRETINA's dedicated computer farm (GRETINA does not travel light!).

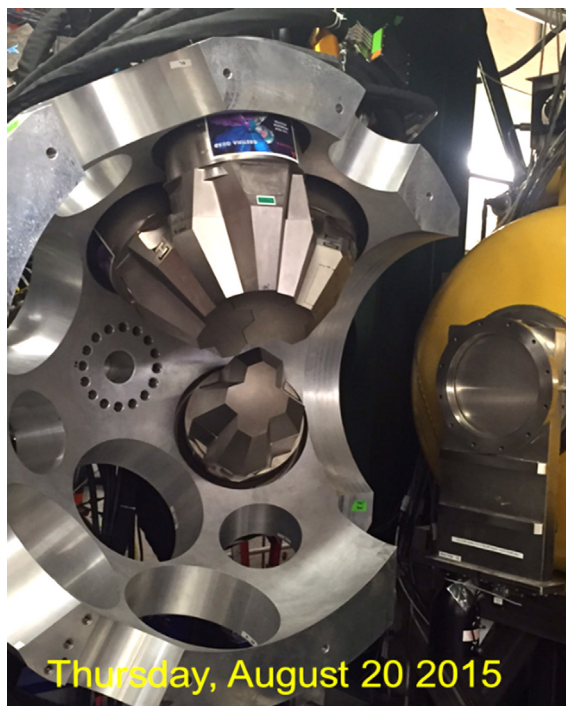


Figure 1: Four GRETINA modules are mounted in one of the massive hemispheres of the holding frame.

The upgraded computer farm is housed in the NSCL/FRIB computer room and now provides some 900 cores that are used to determine real-time signal shapes and gamma-ray interaction points inside the detectors to a few millimeter accuracy. This position information is needed for in-beam gamma-ray spectroscopy to correct for large angle and velocity-dependent energy shifts originating from the so-called Doppler effect that occurs when the gamma rays are emitted in flight by nuclei that move with more than 30% of the speed of light.

At present, the data acquisition system is being finished in close collaboration with colleagues from Lawrence Berkeley National Laboratory, the mother institution of GRETINA. The eighth and possibly ninth detector module will arrive before the science campaign starts in October, bringing GRETINA closer to GRETA, which is aspired to cover the complete solid angle with 30 detector modules in the era of FRIB. GRETINA was funded by the U.S. DOE Office of Science.

## STUDYING THE NEUTRON TO PROTON RATIOS IN NUCLEI

Contributed by: Pawel Danielewicz

Nuclei consist of two types of nucleons, neutrons and protons. Most nuclei found in nature have slightly more neutrons than protons. With the availability of exotic nuclear beams, such as at NSCL or at the future FRIB facility, it becomes possible to study nuclear systems with quite different neutron-proton compositions than those found in nature. There is a strong interest in how nuclear systems responds to large imbalances between the number of neutrons and protons. In particular, researchers aim to uncover how the imbalance distributes itself across a nucleus. The most naive expectation is that the neutrons and protons distribute themselves uniformly across the nucleus. Based on the fact that the strong nuclear force are quite oblivious to interchanging a neutron for a proton, Pawel Danielewicz and Jenny Lee (formerly NSCL student, now professor at U of Hong-Kong) were able to show that the excess should distribute itself over a somewhat larger volume than that occupied on the average by nucleons. With this, the nuclear periphery, or surface, is dominated by the species which are in excess, either the neutrons or protons. The theory was able to demonstrate that the layer where one species dominates over the other should be independent of the overall size of the nucleus. This is comparable to a

dance hall full of couples, where the excess of male dance partners are gathered within a distance of one yard from the wall or the dance hall, no matter how large the excess of male dance partners is or how large the hall.

Subsequently, Pawel Danielewicz and Pardeep Singh, a postdoctoral associate from India who stayed for one year at NSCL, set up to test the theory by analyzing data from two types of nucleon-induced reactions, elastic scattering and quasielastic charge-exchange. In an elastic reaction, a proton or neutron scatters off a nucleon without transferring energy. In a quasielastic charge-exchange reaction, a proton projectile changes its identity into a neutron, with a minimal change in energy. While the elastic scattering data provides a measure of the average distribution of nucleons in a target, the charge-exchange processes provides a measure of the distribution of the neutron-proton imbalance. Danielewicz and Singh were able to determine that the imbalance spreads out over a larger volume than nucleons on the average, with an outer layer of 0.5-0.7 fm dominated by neutrons prevailing in the considered targets, as expected from the earlier work by Pawel and Jenny. The precise size of the layer helps in extrapolating properties of nuclear matter from nuclei we can study in the Laboratory to astrophysical phenomena, such as neutron stars. The latter are very dense objects, with a radius of about 7 miles, that can have a mass of about twice that of the Sun, and which have a strong imbalance in favor of neutron.

## CCF UPDATE

Last week, the cyclotrons ran O-18 beam for a MoNA experiment that ended early Monday. The beam was switched to Ne-22, and an implantation experiment in the S2 vault began on Tuesday morning.

## NSCL & FRIB GIFT SHOP

The [NSCL/FRIB Gift Shop](#) will soon be raising prices in response to increased costs. If you'd like to buy some items at current rates, shop online today (and choose in-store pickup to save on shipping).

## HEALTH4U CHAIR MASSAGES

Health4U's Chair Massage Samplers are offered free of charge to our eligible campus population as a way to receive a "touch of relaxation" during the work day. FRIB/NSCL is hosting this event on Tuesday, **October 13, 2015** from 11:30am-1:30pm. Please contact [Janell Kebler](#) to make your appointment.

## SEMINARS

- **TUESDAY, SEP 08 AT 11:00 AM**  
Theory Trailer Conference Room  
Kevin Fosse, NSCL  
'Existence of Rotational States in the Continuum'
- **WEDNESDAY, SEP 09 AT 4:10 PM**  
NSCL Lecture Hall  
Kevin Dusling, APS/PRL  
'Physical Review Letters: The Inside Story'
- **THURSDAY, SEP 10 AT 11:00 AM**  
NSCL Lecture Hall  
Balraj Singh, McMaster University  
'One Stop Shopping for Nuclear Data'
- **THURSDAY, SEP 10 AT 1:30 PM**  
1221A Conference Room  
Brett Deaton, North Carolina State University  
JINA-CEE Postdoc Fellow, Title to be Announced

## PEOPLE AT THE LAB

- Karl Fischer joined the Lab as a student employee, his line manager is Stephen Stanley.
- Joe Belarge joined the Lab as a Research Associate, his line manager is Alexandra Gade.
- Hideki Tatsumoto joined the Lab as a group leader, his line manager is Fabio Casagrande.
- Abhimanyu Singh joined the Lab as a student employee, his line manager is Ben Arend.
- Jonas Hallstein and Kristen Parzuchowski joined the Lab as student employees, their line manager is Jaideep Singh.

[THE ARCHIVE FOR PREVIOUS GREENSHEETS IS AVAILABLE HERE](#)

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