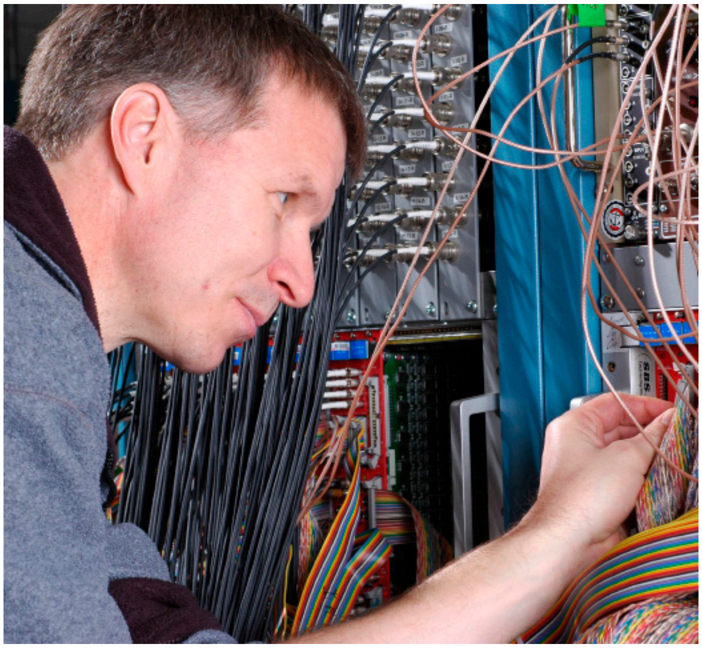

Michael Thoennessen

Professor

Experimental Nuclear Physics

Selected Publications

Current status and future potential of nuclide discoveries, M. Thoennessen, Rep. Prog. Phys. **76***, 056301 (2013)*

Study of Two-Neutron Radioactivity in the Deacy of ^{26}O, Z. Kohley et al., Phys. Rev. Lett. **110***, 152501 (2013)*

Novel techniques to search for one- and two-neutron radioactivity, M. Thoennessen et al., Nucl. Instrum. Meth. A **729***, 207 (2013)*

First observation of ^{15}Be, J. Snyder et al., Phys. Rev. C **88***, 031303(R) (2013)*

Nuclear Structure at and beyond the neutron dripline, T. Baumann, A. Spyrou, M. Thoennessen, Rep. Prog. Phys. **75***, 036301 (2012)*

M.S., Physics,
University of Cologne,
1985

PhD, Physics,
SUNY Stony Brook,
1988

Joined NSCL in
November 1990

thoennessen@nscl.msu.edu

My research begins where the nuclear chart ends. While normal neutron-rich nuclei decay by converting a neutron into a proton (β decay) on a time scale of milliseconds or longer, nuclei beyond the end of the nuclear chart, or neutron-unbound nuclei, contain so many neutrons that they decay by emitting one or two of the excess neutrons on a time scale of 10-21s. I am part of the MoNA/Sweeper collaboration which specializes in the study of these neutron-unbound nuclei. The masses and lifetimes of these extremely short-lived nuclei cannot be measured with standard techniques. The availability of fast radioactive ion beams at NSCL gives us the opportunity to create neutron-unbound nuclei and study them by detecting their decay products. For example ^{25}O, the first neutron-unbound oxygen nucleus, was first observed by our group. A primary beam of ^{48}Ca was accelerated to about 50% of the speed of light with the Coupled Cyclotron Facility and a secondary beam of ^{26}F was selected by the A1900 fragment separator. The ^{26}F interacted with a target where we were specifically interested in the one-proton stripping reaction which leads to ^{25}O. Instantaneously, ^{25}O then decays inside the target into ^{24}O and a neutron. Due to the large incoming velocity ^{24}O and the neutron will leave the target at very forward angles so that are possible to detect with high efficiency. The detection is done with two devices which were specifically designed for these studies. The 4 Tesla superconducting "Sweeper" magnet deflects the charged decay fragment into a set of particle detectors that identify the ^{24}O fragments and measure their energies and angles. The Sweeper magnet was built at the National High Magnetic Field Laboratory at Florida State University in collaboration with NSCL.

The second device is the MoNA-LISA array which is a highly efficient large area neutron detector designed to measure the energy and angle of the emitted neutrons. MoNA and LISA were constructed by a collaboration of primarily undergraduate institutions, and undergraduates continue to participate in the experiments and data analyses. From the energies and angles of the fragments and neutrons, it is possible to reconstruct the mass of the neutron-unbound nuclei. ^{25}O is only one example of the many neutron-unbound nuclei at the limit of nuclear existence, and we have recently expanded our experiments to study even more exotic nuclei which decay by the emission of two neutrons. The combination of MoNA-LISA and the Sweeper with the fast radioactive beams is one of the few facilities in the world where these nuclei can be explored. In addition to discovering more new unbound nuclides, we continuously develop new experimental capabilities, for example we are currently installing a liquid deuterium target for (d,p) reactions and are designing an active target to improve the overall resolution of the setup.

MoNA-LISA: The MOdular Neutron Array and the Large multi-Institutional Scintillator Array.