Who We Are

The nuclear physics group at the University of Tennessee, Knoxville, is a research team devoted to understanding the properties of the atomic nucleus and strongly interacting matter.

Disciplines

Fundamental Neutron Physics
Nuclear Structure
(Theory & Experiment)
Relativistic Heavy Ion Physics

Faculty Members & Partners

Carrol Bingham
Geoff Greene
Robert Grzywacz
Kate Jones
Witold Nazarewicz
Thomas Papenbrock
Ken Read
Lee Riedinger
Soren Sorensen

Center of Excellence for Ion Beam Studies for Stewardship Science
Holifield Radioactive Ion Beam Facility
Joint Institute for Heavy Ion Research
ORNL Physics Division

Contributors/Sponsors

U.S. Department of Energy
National Nuclear Security Administration

Results and Distinctions

▪Opening of the Fundamental Neutron Physics Beamline (FNPB) at the Spallation Neutron Source.

▪2008 UT-Battelle Award for scientific research to honor computing properties of medium-mass nuclei.

▪Development of sophisticated digital electronics and associated software to analyze data from nuclear decay experiments.

▪Development of components for the LeRIBSS, a newly-developed experimental end station at HRIBF.

▪First observation of α-decay from the proton emitting nucleus ^{109}I. Occurring just 3 times in 20,000, the measurement of this decay branch has enabled limits to be placed on the production of astrophysically significant nuclei. The group's publication in *Phys. Rev. Lett.* was selected by the editors as a suggestion for reading across all fields.

▪Direct and unambiguous proof of ground-state 2-proton radioactivity, a new form of radioactive decay proven using a novel imaging technique of nuclear decays. The work was featured in the Nuclear Science Advisory Committee's long-range plan and was also an editors' suggestion paper in *Phys. Rev. Lett.*

Nuclear Physics Group

What We Do

The nucleus is the center of all matter. It's the engine of fusion, which fuels stars, and fission, the science behind nuclear energy. The NP Group uses theory and experiment to discover the properties of the nucleus: how can we understand the macroscopic properties of the nucleus from the interactions between the individual protons and neutrons (nucleons), and how can we understand the internal quark-gluon structure of the nucleons?

Research

Scientists at UT are involved in a number of different nuclear physics research projects. Theorists are leading a national endeavor (the Universal Nuclear Energy Density Functional) funded by DOE and the NNSA to develop a comprehensive description of all nuclei based on the fundamental interaction of their protons and neutrons. Experimentalists test nuclear many body theories at extreme conditions measuring the properties of nuclei and nucleonic matter with accelerated stable and radioactive ion beams at national facilities. The Relativistic Heavy Ion Physics (RHIP) group is part of the PHENIX collaboration at Brookhaven National Laboratory and ALICE at CERN, where heavy nuclei collide at extremely high energies to create matter. Experiments in nuclear astrophysics give insight into the nuclear reactions in stars, essential for understanding the conditions whereby chemical elements are synthesized by nuclear processes. A newly-opened beamline at the Spallation Neutron Source will allow scientists to use neutrons for the study of beta decay and parity violation, and to search for the electric dipole moment. The NP group has developed new technologies to analyze the decay of radioactive nuclei and to support a new Low Energy Radioactive Ion Beam Spectroscopy Station at Oak Ridge National Laboratory's Holifield Radioactive Ion Beam Facility. UT's nuclear physicists are also active partners in high spin gamma ray spectroscopy experiments and several international collaborations, including the Japan-U.S. Institute for Physics with Exotic Nuclei.

Education

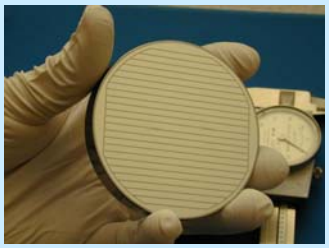
The UT group's collaborations with both Oak Ridge National Laboratory and other teams around the world provide students with opportunities to work in world-class facilities (e.g., SNS, CERN, HRIBF and Gammasphere) and to contribute to pioneering research in nuclear physics.

Outreach/Economic Development

The nuclear physics group has supported the state's technical industry by drawing on the considerable scientific talent and resources in East Tennessee's Technology Corridor. For example, an instrument company in Oak Ridge, the PHDs Co., made the germanium strip detector used in decay spectroscopy experiments. Group members also work with the university to support outreach efforts such as the Science Olympiad and the Speakers Bureau to engage students of all levels in the possibilities science offers.

Facilities

The NP group uses several top research facilities, including supercomputing facilities (National Center for Computational Sciences, National Energy Research Scientific Computing Center, and the National Institute for Computational Sciences); the Holifield Radioactive Ion Beam Facility, the Spallation Neutron Source, Gammasphere and the Fragment Mass Analyzer at Argonne National Laboratory, PHENIX at the Relativistic Heavy Ion Collider, CERN (ISOLDE, ALICE), the National Superconducting Cyclotron Laboratory, JYFL (Jyväskylä, Finland), and GSI (Germany).



A double sided germanium strip detector made by PHDs Co. in Oak Ridge, used for decay spectroscopy studies in UT's nuclear physics group.

Students at work at the ORNL Holifield Radioactive Ion Beam Facility, which produces high quality beams of short-lived, radioactive nuclei for studies of exotic nuclei and astrophysics research.

Contact Information

Soren Sorensen
Professor and Head
Department of Physics and Astronomy
865/974-3342
sorensen@utk.edu

www.phys.utk.edu

www.phys.utk.edu/expnuclear/

www.phys.utk.edu/rhip/