

New accelerator is helping scientists understand the working of the universe

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University of Notre Dame physics professor Michael Wiescher is interested in the origin of the elements in the chemical evolution of the universe and a new particle accelerator in Nieuwland Hall of Science is helping advance that research.

"We try to simulate the reactions that take place in stars," Wiescher said.

He points out that our bodies are 70 percent [hydrogen](#) — 50 percent of which was formed 12 billion to 13 billion years ago in the Big Bang and the rest in subsequent generations of stars.

"You have a direct personal connection," he said. "Half of the atoms in your body have been part of supernova explosions of stars.

The new National Science Foundation (NSF)-funded 5 MV [accelerator](#) represents a major equipment upgrade for the University and is the first accelerator NSF has funded in nuclear physics in nearly a quarter century.

It is housed inside a new forty-foot-tall tower located above the existing Nuclear Science Laboratory (NSL) in the center of Nieuwland. The University's nuclear astrophysics program, started in the mid-1980s, is one of the leading global centers, attracting visitors from 20 to 30 countries.

The new accelerator at Notre Dame is helping to recreate stellar nuclear

processes in the laboratory to complement the observational studies of new earth- and space-based telescopes that trace past and present nucleosynthesis processes in the Cosmos.

The accelerator replaced the KN accelerator and provides high intensity heavy ion beams for experiments at Notre Dame's St. George recoil separator and also increases the intensities for protons and alpha beams. The accelerator is being used primarily to expand the research program of Notre Dame's Institute for Structure and Nuclear Astrophysics (ISNAP) and the Joint Institute for Nuclear Astrophysics (JINA), a Physics Frontier Center of NSF.

ISNAP is a university research center that operates the NSL at Notre Dame. The laboratory is built around three Van de Graff accelerators operating in different energy regimes and has a broad program in low energy physics. These three accelerators offer ideal conditions for experiments exploring basic nuclear physics questions about the quantum structure of nuclei or the origin of the elements in nuclear reaction processes in stars.

The NSL accelerators have the capability of producing intense particle beams of both stable and unstable nuclei of various types for research interests including nuclear reactions with radioactive ion beams (RIBS) and nuclear astrophysics associated with stellar explosions.

In addition to its basic science interests, ISNAP researchers have developed a number of interdisciplinary applications of nuclear physics techniques primarily in materials analysis and radiation chemistry. In collaboration with faculty from Notre Dame's Department of Anthropology, PIXE (Particle Induced X-ray Emission) is used to test the provenance and age of archaeological samples. Environmental studies are being pursued through accelerator mass spectrometry and radioactive counting techniques. The laboratory also pursues research

with the medical industry such as the testing of new detectors as well as performing studies of artificial joint components to measure durability.

The laboratory's radiation chemistry program revolves around studies of the effect of ionizing radiation on the molecular decomposition of water and various organic materials, including polymers. The practical aspect to this type of work has direct applications to the management of nuclear reactors and the treatment of storage of radioactive waste. The effect of low energy radiation on biological cell and DNA material is also of great interest for radiation treatment applications. This work is carried out by the Notre Dame Radiation Laboratory which is funded by the Department of Energy.

Provided by University of Notre Dame

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