

# NUCLEAR PHYSICS

Touching the Lives of Everyday Americans



Many modern medical diagnostic and treatment techniques – from MRI to PET scans to proton therapy for cancer – originated from nuclear physics technologies.

The nuclear sciences provide highly trained individuals and tools that are vital to medicine, industry, energy and national security.

In the century since its inception, basic nuclear physics research has had far-reaching impacts on the lives of everyday Americans. The field has spurred the development of unique technologies, techniques and expertise that have benefited such diverse applications as medical diagnostics and treatments, food safety, nuclear monitoring and deterrence.

This kind of innovative technology continues to yield ever more societal and economic benefits.

## MEDICINE

Nuclear physics technologies lie at the root of many of today's most

advanced medical diagnostic procedures and treatments. Daily, more than 40,000 patients receive procedures made possible by nuclear physics advancements.

Particle accelerators and particle detection technologies, first developed to study atomic matter, are now used to benefit the human heart and other vital organs. More than 50 medical isotopes, most of which were first characterized by researchers, have been artificially produced by particle accelerators and used in internal imaging of the human body. Other particle accelerators have taken a more active role, generating particle beams that eradicate cancers.

Still others ensure that medical equipment is safe, efficiently sterilizing bandages, syringes and surgical tools.

In the imaging suite, particle detection technologies developed for research are now used to reveal disease and injury in the human body. Many diagnostic techniques, from MRI to PET to CT scans, owe their existence to nuclear physics.

The lab's Biomedical Research & Innovation Center (BRIC) partners with industry, academia and healthcare organizations to develop more of these state-of-the-art technologies.

## INDUSTRY AND ENERGY

From smoke detectors to oil and natural gas wells, technologies developed for nuclear science are applied in industrial settings to improve consumer products, ensure efficient energy production and exploration, and improve building and manufacturing practices.

Isotopes discovered by nuclear physicists and produced with particle

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accelerators are used in a wide range of industrial applications, including smoke detector improvements, oil exploration, manufacturing integrity scans and sterilization of components. Particle accelerators enable "well logging" by oil and natural gas companies, which is a quick test of the production potential of drill sites. They also enable efficient electron-beam



Particle accelerators enable tests of potential oil and natural gas drilling sites.

welding of materials and eliminate pathogens in and extend the shelf-life of certain foods.

Nuclear power currently provides nearly 20% of U.S. electric power. The highly skilled workforce needed to keep nuclear power generation plants operating efficiently and safely often come from the nuclear science community.

## NATIONAL SECURITY

Sensitive detectors and particle accelerator techniques and tools also enable the U.S. to safeguard its borders, monitor nuclear weapon activity and protect our citizens traveling by air.

Cargo-scanning technologies deployed at borders and throughout the country screen containers for unauthorized materials, sensitive detectors sniff for components produced by materials used to make bombs, and passengers and luggage are quickly scanned and cleared at airports with techniques originating in nuclear science.



Nuclear sciences train next-generation experts in a variety of STEM fields.

## STEM WORKFORCE

Workers in a multitude of related disciplines support the nuclear science mission, including nuclear physicists, accelerator scientists, computer scientists and engineers. Many science, technology, engineering and math (STEM) students who begin their advanced studies and training in nuclear physics eventually go on to contribute in other fields enabled by nuclear science.

This highly trained nuclear science workforce provides qualified individuals who are vital to medicine, industry, energy and national security.

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