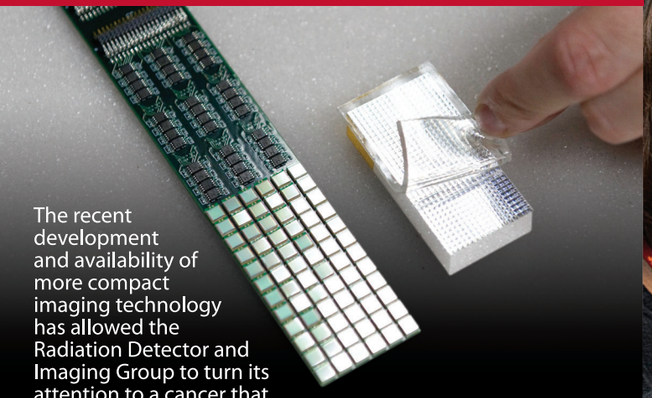
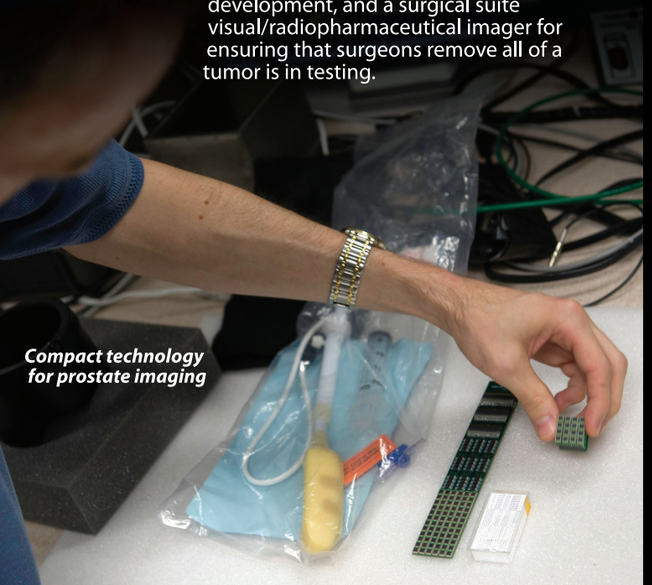
PROSTATE CANCER IMAGING



The recent development and availability of more compact imaging technology has allowed the Radiation Detector and Imaging Group to turn its attention to a cancer that strikes one in every six men – prostate cancer.

The group initially obtained a new technology, silicon photomultipliers, for use in a planned upgrade of Jefferson Lab's scientific facilities. But the group soon realized that the small size and insensitivity to magnetic fields also makes the silicon photomultipliers an excellent choice for building a prostate cancer probe. Such a probe could be placed near the prostate for early detection of small tumors. It could also be used in concert with ultrasound and MRI without fear of generating false images. The technology is currently in development.

The group also is exploring dedicated human cancer imaging technologies for cancers of the head, neck and heart. In addition, a small probe for detecting cancer in lymph nodes just under the skin is in development, and a surgical suite visual/radiopharmaceutical imager for ensuring that surgeons remove all of a tumor is in testing.



Compact technology for prostate imaging

Cancer tissue imager

BREAST CANCER IMAGING

Doctors typically rely on X-ray mammography for early detection of breast cancer. But mammography sometimes provides inadequate diagnostic information and has a limited ability to distinguish between benign and malignant tumors.

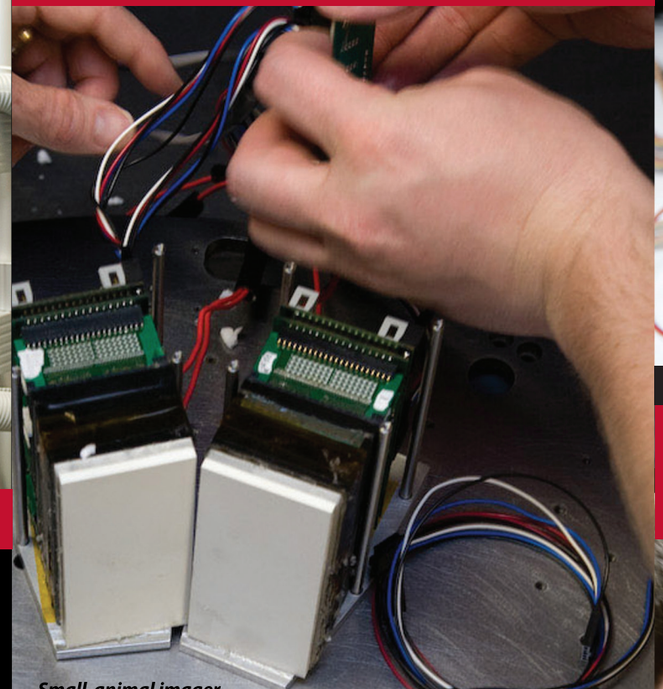
Jefferson Lab's Radiation Detector and Imaging Group, in collaboration with university and industry partners, has developed compact imagers for the improved detection of breast cancer. These instruments provide superior diagnostic results for situations where mammography is inconclusive and further evaluation is needed.

The instruments developed at Jefferson Lab are small, dedicated imagers. The devices provide images of the breast that can be compared directly to mammograms, allowing doctors to use both imaging technologies together for the very best opportunities to accurately diagnose and locate breast tumors.

In addition, several new technologies for breast cancer screening, diagnosis and treatment are being developed or explored. These include more sensitive systems that can locate ever-smaller cancer tumors more accurately and aid in biopsy; imagers for monitoring radiation therapy to ensure cancer tumors receive the full dose of treatment, while minimizing excess radiation to healthy tissues; and imagers that combine other methods of cancer tumor imaging, such as X-ray, in one device.

Some of the technologies developed at Jefferson Lab are already in use in cancer clinics and are saving the lives of women worldwide. Others are in clinical trials, undergoing rigorous testing with patients. Yet others are in the design stage, as the group actively works with doctors and cancer researchers to improve the technologies for eventual use in the clinic.

WANT TO KNOW MORE?



Small-animal imager

Learn more about Jefferson Lab
by visiting www.jlab.org,
by sending an e-mail to jlabinfo@jlab.org
or by calling (757) 269-7100.

Jefferson Lab

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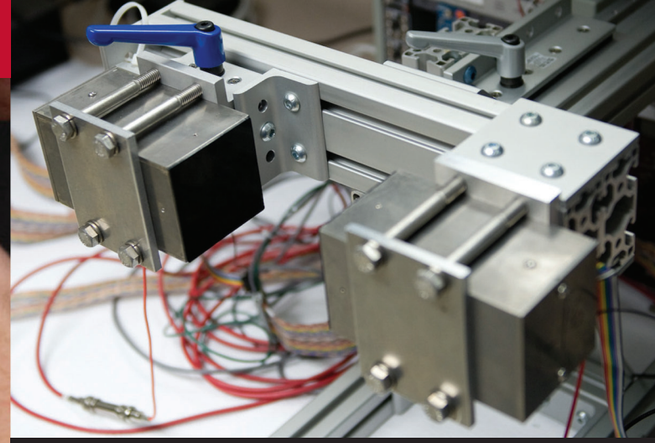
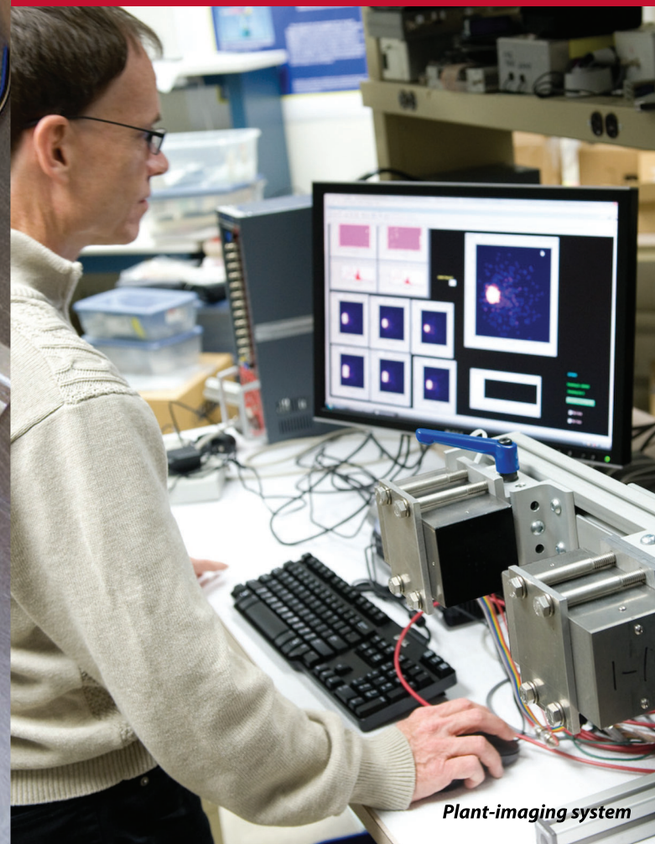


THOMAS JEFFERSON NATIONAL ACCELERATOR FACILITY

NUCLEAR IMAGING

NUCLEAR PHYSICS ADVANCING MEDICINE



Plant-imaging system

Prototype brain imager

PHYSICS IN MEDICINE

The link between medicine and nuclear physics research may be one of the best-kept secrets in science. For more than a century, the medical field has looked to nuclear physics for new discoveries and practical applications for finding the source of illness and improving treatment.

At the U.S. Department of Energy's Thomas Jefferson National Accelerator Facility, scientists, engineers and technicians in the Radiation Detector and Imaging Group are continuing the tradition of adapting cutting-edge physics research technology to developing application-specific, imaging systems for a variety of medical uses and for medical-oriented research.

The new technology the group develops provides unique opportunities for imaging some areas of the human body that are either difficult to access with current technologies or for which improvements can be made. These advancements provide many benefits, including the saving of lives.

BIOMEDICAL RESEARCH

The Radiation Detector and Imaging Group, in collaboration with university partners, is developing a high-resolution imager for small animals. The ability to image gene expression in live, un-anesthetized animals will provide a valuable tool for molecular biology and human disease research. For example, it could reveal how effective new drugs are at treating, and possibly, reversing genetic disease. Or it could give researchers the ability to, for the first time, watch how a drug is distributed throughout the body in real time. This knowledge could help researchers develop more effective regimes for common drugs.

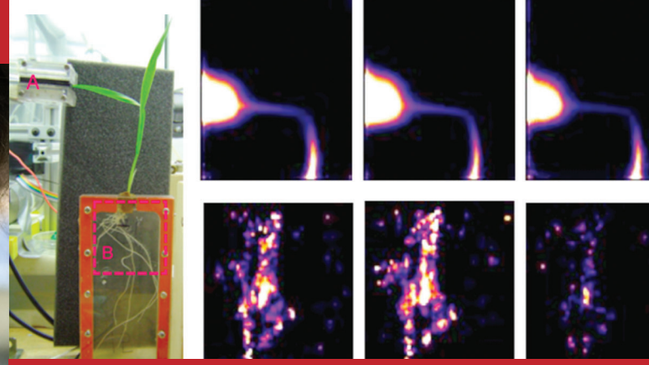
Other examples of applications of small animal imagers include studies of human cancers, such as cancers of the breast, prostate and skin, in animal models.

NUCLEAR MEDICINE

It's no coincidence that many hospitals have departments of nuclear medicine – a field that sprang from nuclear physics. These departments use technologies that provide medical and biological imaging that rely upon radiopharmaceuticals, specialized drugs that are used to detect certain types of cellular activity in the body.

Unlike X-rays and CT scans, which show structures in the body, nuclear medical imaging reveals the function of cells in the body, allowing doctors to differentiate fast-growing cancer cells from healthy tissue.

In cancer imaging, a radiopharmaceutical can be made to mimic a sugar, but unlike sugar the drug contains a radioactive molecule that gives off particles for a short period of time. Because cancer cells grow more rapidly than most other cells in the body, they need more of the energy provided by sugar. When a cancer cell absorbs a radiopharmaceutical, the drug's particles travel out of the body, where they are collected by a medical imager. The imager shows where the drug has accumulated, revealing the location of cancer cells.

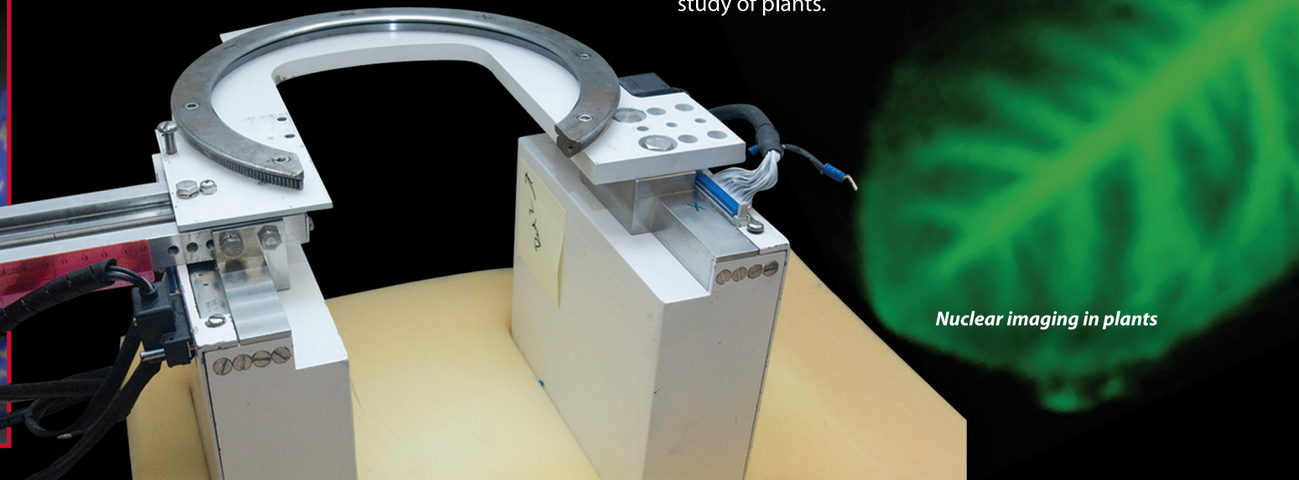


PLANT IMAGING

In response to a growing need, Jefferson Lab's Radiation Detector and Imaging Group is lending its expertise to plant scientists. These plant researchers are attempting to understand how rising amounts of carbon dioxide, or CO_2, in the atmosphere will affect the environment.

Plants have been shown to grow more vigorously when exposed to high levels of CO_2. Eventually, though, a point is reached at which the addition of more CO_2 fails to spur additional plant growth. Scientists want to know what factors limit plants' ability to use additional CO_2, how plants pass on additional CO_2 to bacteria in the soil (carbon sequestration), and in what ways potential biofuel-producing plants can be optimized to take advantage of additional CO_2 in the atmosphere.

The Radiation Detector and Imaging Group is testing variations of the technology used in PET scanners as it seeks a tool for imaging the biological function in growing plants. While PET scans have been used for decades to help doctors diagnose disease in people, they were originally used in the study of plants.



Nuclear imaging in plants