NSPECT

A PORTABLE IMAGING NEUTRON SPECTROMETER

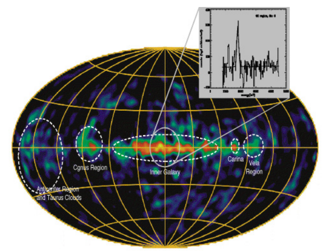
THE HOMELAND SECURITY PROBLEM

Radiation from a terrorist attack is among the most frightening threats we face. This could come in the form of strong but common radioactive sources fashioned into "dirty bombs" to terrorize a city. Worse, however, would be fissile material already in the form of a nuclear bomb—or components that can be assembled into one—similar to those that leveled Hiroshima and Nagasaki.

Detecting these materials is difficult, and efforts to do so must be able to adapt to the particular circumstances presented. For example, when the detector's proximity to the source and time are limited, or when wide areas need to be scanned, the radioactive source must be imaged remotely. In such cases, the radiation signature is "seen" via the radiation it produces and can be used to identify the nature of the material. This *imaging spectroscopy* provides the maximum information without coming into close proximity to the radioactive source.

Common radioactive sources emit gamma rays while nuclear bomb material emits both gamma rays and neutrons. In imaging spectroscopy, being sensitive to both forms of radiation is ideal because while both are difficult to detect, both are difficult to conceal.

The fact that neutrons and gamma rays are electrically neutral means it is difficult to capture the complete properties of any detected neutron or gamma ray. This makes it hard to determine the direction of origin or energy level of the radioactive source. Knowing the direction of origin allows inspectors to pinpoint the location of the illicit material. And the particle's energy is important because it carries information about the nature of the material, e.g., what radioactive isotope is emitting the radiation.



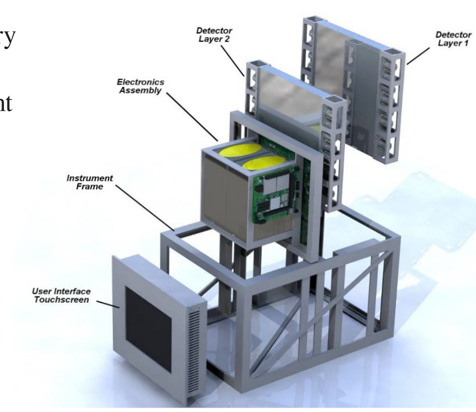
The false color image above was produced by the Univ. of New Hampshire and colleagues on NASA's Compton Gamma Ray Observatory mission. It shows how radioactive aluminum is strewn about in our galaxy.

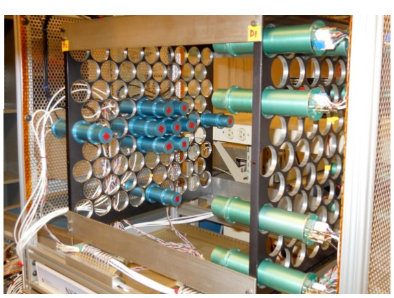
Techniques used in modern astrophysics research regularly perform such difficult measurements in the hazardous radiation environment of space. The methods that allow scientists to image and detect radioactive material in our galaxy and detect neutrons from the Sun can also be used to detect and image radioactive and fissile material in our ports, on our highways, and in our structures.

THE NSPECT INSTRUMENT

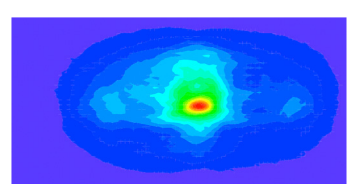
The Portable Neutron Spectroscope, or NSPECT, is the result of a collaboration between Michigan Aerospace Corp. (MAC) and the University of New Hampshire (UNH) with support from the Defense Threat Reduction Agency of the Department of Defense.

NSPECT employs the same techniques as those used on the Compton Gamma Ray Observatory to image fissile material. The instrument is shown schematically at the right, and below in an early stage of construction. The blue and green detecting modules work together using different functions to measure the direction and energy of an incoming gamma ray or neutron. The NSPECT false color image (below right) shows the location (to better than 5 inches) of a neutron-emitting radioactive isotope, similar to plutonium. The clarity of the image improves greatly with a full (77×2) complement of modules, which is part of the work now being done at UNH while Michigan Aerospace prepares the final instrument for a field test in spring 2012.





The completed instrument will fit in the back of an SUV and be self-powered and remotely controlled. The image and spectral signature data will be collected and processed on a laptop located either near the instrument or at a distance.



Contact: Prof. James Ryan, Univ. of New Hampshire
(603)862-3510 • james.ryan@unh.edu

UNIVERSITY of NEW HAMPSHIRE

Michigan Aerospace

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