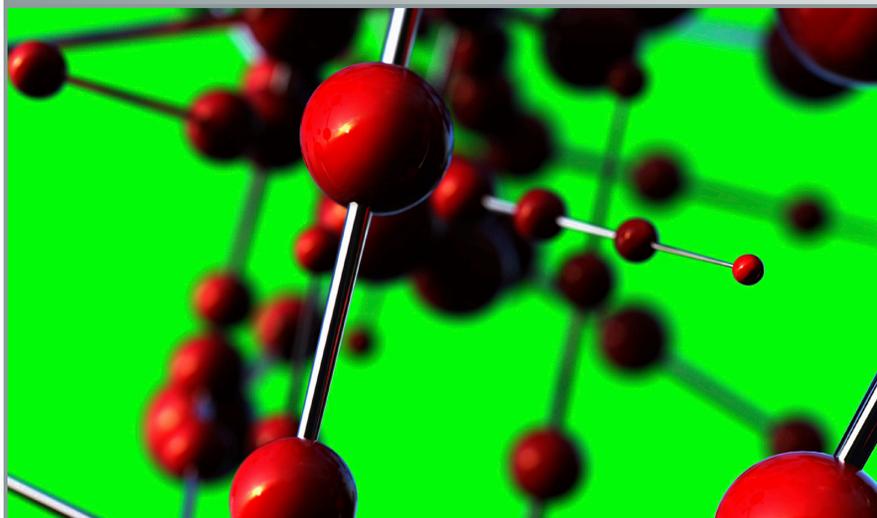


Neutron-Sensitive Anger Camera

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Technology Summary

The Anger camera, invented more than 50 years ago, has long been a staple of medical imaging and other biological/biomedical applications. However, it was originally designed to detect gamma rays, with later modifications to detect neutrons. This invention offers an improved Anger camera design for neutron detection.

Because neutrons are essentially neutral, they can penetrate materials more deeply than charged particles, providing in-depth structural information. Moreover, they provide greater sensitivity to hydrogen atoms than x-rays—important in cellular and energy studies. However, because they don't carry a charge, indirect techniques must be used to detect them. Many neutron detectors rely on helium-3 gas in a chamber for detection. With the worldwide shortage of helium-3, people have been working to find safe, effective, inexpensive alternatives. This ORNL invention retains many of the desirable performance characteristics of helium-3 detectors while offering, in many cases, lower parallax errors, more uniformity, and lower cost.

On the hardware side, this invention consists of (1) an optical package with a 1.5 to 2 mm thick transparent scintillator optically coupled to a photomultiplier tube (PMT) array with an optical gel “cookie” for quick changeout of individual PMTs; (2) a precision mounting system that uses custom-machined, pin-tipped set screws to locate the PMTs with greater than ± 0.1 mm precision; (3) custom-designed summer boards; and (4) a custom-designed power distribution system that distributes 12-volt power to the system. All of the components are housed in a light-tight enclosure to shield the system from outside light, which can negatively impact results. Of equal importance, the system incorporates unique ORNL signal processing and position location techniques. The resulting improved Anger camera not only meets the requirements for neutron detection but does so with very high efficiency, high resolution, and low background noise.

Advantages

- Very high efficiency
- High timing and position resolution
- Extremely accurate neutron time-of-flight measurement
- Lower parallax errors and better uniformity than standard helium-3 detectors
- Low background noise
- Low cost

Potential Applications

- Study of small crystals (≤ 1 millimeter) and molecules such as proteins and enzymes
- Drug development
- Genetics
- Nondestructive testing
- Hydrogen studies
- Materials science
- Various neutron scattering applications

Patents

Richard A. Riedel; Theodore Visscher; Lloyd G. Clonts; Yacouba Diawara; Cornelius Donahue, Jr.; and Christopher A. Montcalm. *Neutron-Sensitive Anger Camera*, U.S. Provisional Patent Application 61/592,785, filed January 31, 2012.

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