OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY
FACT SHEET

ORNL has developed a Large Area, High-Speed Neutron Imaging Detector

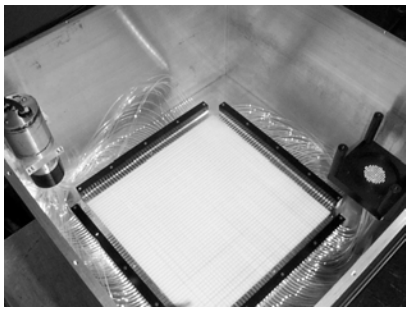
Wavelength-Shifting Optical Fibers Enable Large Area Neutron Imaging Detectors

Imaging Neutron Detector developed under ORNL LDRD Program

The Spallation Neutron Source (SNS) under construction at the Oak Ridge National Laboratory (ORNL) will be the most important new neutron scattering facility in the United States. Neutron scattering instruments for the SNS will require large area detectors with fast response (< 1 microsecond), high efficiency over a wide range of neutron energies (0.1 to 10 eV), and low gamma ray sensitivity. We are currently developing area neutron detectors based on a combination of a ^{6}LiF/ZnS(Ag) scintillator screen coupled to a wavelength-shifting fiber optic readout array. A 25 x 25 cm prototype detector has been developed and tested at the Intense Pulsed Neutron Source at the Argonne National Laboratory and the High Flux Isotope Reactor at Oak Ridge. The detector has demonstrated good imaging properties coupled with very low gamma ray sensitivity. The response time of this detector is approximately 1 microsecond. The neutron scintillator screen, fiber optics readout and photomultiplier tubes are mounted in an aluminum light-tight enclosure. Neutrons enter the detector through a 0.125-inch thick cover plate. An array of wavelength-shifting fibers is clamped on the screen opposite the cover plate in a 2-dimensional array with 48 fibers in each direction. One end of every fiber is mapped onto an individual cathode of a Philips XP1704 multi-anode photomultiplier tube. This tube contains 96 individual anodes in a single vacuum envelope. The other ends of the fibers are attached to a single anode Hamamatsu R1924 tube, which provides a coincidence pulse for each detection event.

Detector Characteristics

- Light collection is accomplished by a 2-D array of wavelength shifting fibers
- A multi-element photomultiplier and electronics system converts the light pulses to an image using charge division
- Coincidence detection essentially removes all phototube noise and gamma response



Imaging Neutron Prototype.

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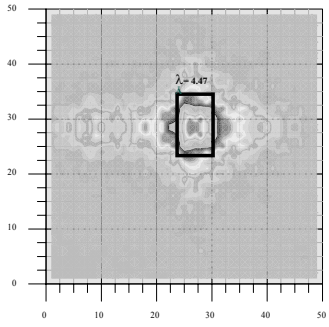

Neutron Image from Carbon Target