Time Encoded Imaging

Time encoded imaging (TEI) is a new approach for standoff detection of special nuclear materials (SNM) which relies on encoding directional information in the time dependent modulation of fast neutron detection rates. Other imaging methods require either multiple interactions (e.g. neutron scatter camera or Compton imagers), leading to intrinsically low efficiencies, or spatial modulation of the signal, which requires complicated, high channel count, and expensive position sensitive detectors.

Sandia's rotational self-modulation design concept for time-encoding the direction information relies on simple compact construction with large detection volumes that minimizes complexity and simplifies calibration while maintaining high efficiency. Utilization of directional information enables on-the-fly background estimation which enhances sensitivity while eliminating the need for a separate reference background measurement. The scalability of Sandia's TEI systems makes them a very promising detector class for weak source and large stand-off distance detection.

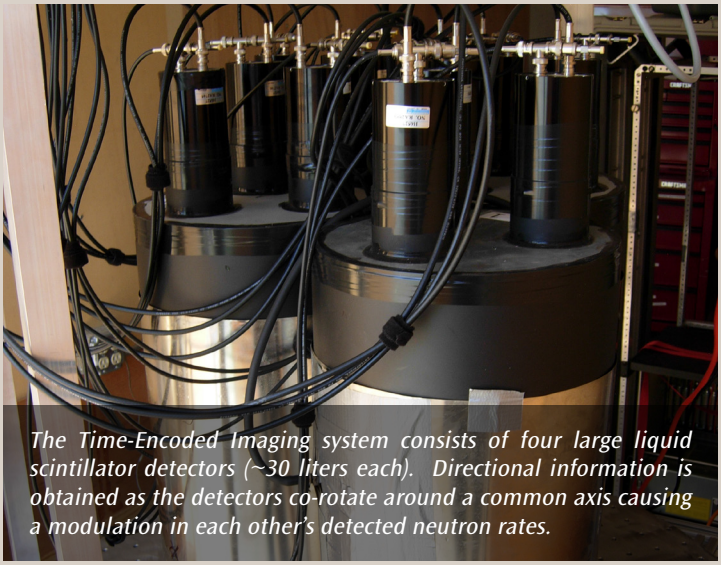
Potential Applications

- Nuclear Security and Non-Proliferation
- Timely detection of SNM at large stand-off (demonstrated to 100 meters)
- Timely detection of shielded SNM in buildings and cargo
- Area and perimeter monitoring and sweeping

Technological Benefits

- Reduced detector complexity
- Simple construction and low-costs
- High detection efficiency in compact and portable package
- Good signal to background discrimination through directionality
- Source localization
- Scalability

The Time-Encoded Imaging system installed in a 20 ft. trailer for field tests, including the detection of a special nuclear material equivalent source at 100 meters via its fission neutron signature.



The Time-Encoded Imaging system consists of four large liquid scintillator detectors (~30 liters each). Directional information is obtained as the detectors co-rotate around a common axis causing a modulation in each other's detected neutron rates.

US Patent: 8,866,100

TRL Level: 6

System/subsystem model or prototype demonstration in a relevant environment. Representative of the deliverable demonstrated in relevant environment.

U.S. DEPARTMENT OF ENERGY | NNSA National Nuclear Security Administration

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