The Problem - Portal Security

- Active Interrogation systems. Time to decision demands High Probe Radiation Levels
- Hidden “Small” Radiation Levels but Large Threat (SNM)

<table>
<thead>
<tr>
<th>Large Medical or Industrial Radiation Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNM</td>
</tr>
</tbody>
</table>
SNM Detection in Cargo-Associated Particle
Neutron Generator

<table>
<thead>
<tr>
<th>U-235 Target</th>
<th>Avg. Count or Intensity</th>
<th>Avg. Energy (MeV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prompt Gamma-Rays</td>
<td>~7</td>
<td>~ 1</td>
</tr>
<tr>
<td>Prompt Neutrons</td>
<td>~ 4.4</td>
<td>~ 2</td>
</tr>
<tr>
<td>Delayed Gamma-Rays</td>
<td>~ 0.127</td>
<td>&gt; 3</td>
</tr>
<tr>
<td>Delayed Neutrons</td>
<td>~ 0.017</td>
<td>~0.5</td>
</tr>
</tbody>
</table>
Small Object Scanner

Purdue Proprietary

Applied Physics Laboratory

HPGe Detector

Data Acquisition System

Electro-Mechanical Detector Cooler

Neutron Generator

Scanned Object

HPGe Detector

Backup Power Supply

Dynamic Neutron Guide Element

Neutron Generator Electronics

Purdue Proprietary
The Problem - Safeguards

- Fuel Cell Assembly
- $^{137}$Cs - $10^8$ times more than $\gamma$-rays of interest
- Blinds the detector
- Tracking U235, Pu239, Pu241
The Problem- Emergency Management

• Fukushima
• $^{137}$ Cs Everywhere!
Blinds normal detection systems
• Can’t Find or Analyze True Source Issues
Portable Liquid Noble Gas detector:

- Radiation hard.
- Operate up to 40-MHz
- Detect gamma rays 150-KeV to 11-MeV
- Excellent energy resolution
- Self contained to be movable or portable.
Pulse Height Spectrum

4 and 3 MeV Alpha Particles

Depleted Uranium
Technology Challenge

Uranium 235 is quite restricted and requires active interrogation.
- Low cost-portable neutron production (API)
- Large area, high rate - fast gamma ray detectors

Sealed containers require active interrogation for explosives-chemical agents-SNM.
- Broad band neutron spectrum, thermal to 12MeV neutrons
- High rate - fast gamma ray detectors

Spent fuel assay requires active interrogation.
- Radiation hard - high rate - fast gamma ray detectors