# A Field Deployable Imaging Neutron Detector (FIND) for SNM

**Jason S. Legere[1], Peter F. Bloser[1], Amanda C. Madden[2], Christopher M. Bancroft[1], James M. Ryan[1], Mark L. McConnell[1], Colin Frost[1], Sonya S. Smith[1], Richard Kroeger[3], Nathan Paradis[3], Ken Collins[3]**

[1]Space Science Center, University of New Hampshire, Durham, NH 03824 USA

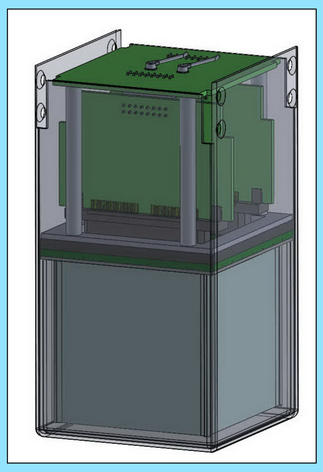
[2]Los Alamos National Laboratory, Los Alamos, NM 87545 USA

[3]Space and Naval Warfare Systems Command, SSC Pacific, San Diego, CA 92110 USA

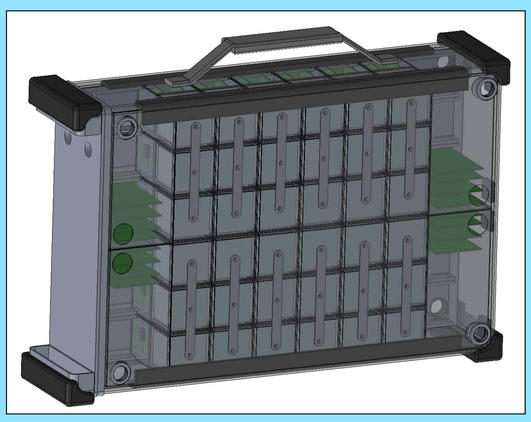
## Abstract

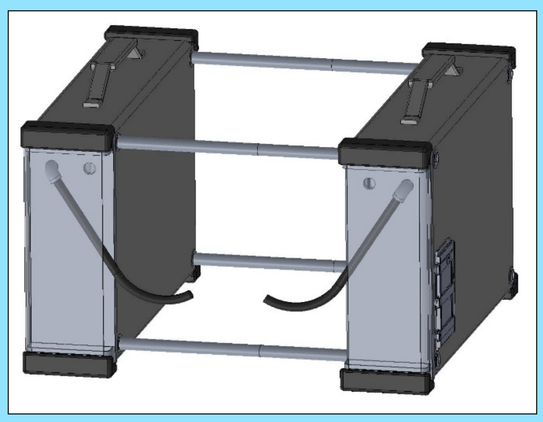
Neutron detection is of particular interest for nuclear or radiological material identification for security and proliferation deterrence, as well as for nuclear waste detection and monitoring. We present a concept for a Field-Deployable Imaging Neutron Detector (FIND) based on modern, commercially available detector technology that is compact, low-power, low-mass, and rugged. Individual detector cells are composed of plastic scintillator with pulse-shape discrimination (PSD) ability read out by arrays of silicon photomultipliers (SiPMs). A double-scatter neutron camera is formed by two layers of such detector cells. The compactness, ruggedness, and low weight of this technology allows these layers to be easily transported in standard portable containers for rapid deployment and assembly in the field. We describe the FIND instrument concept and initial tests of detector cell performance.

## FIND Design



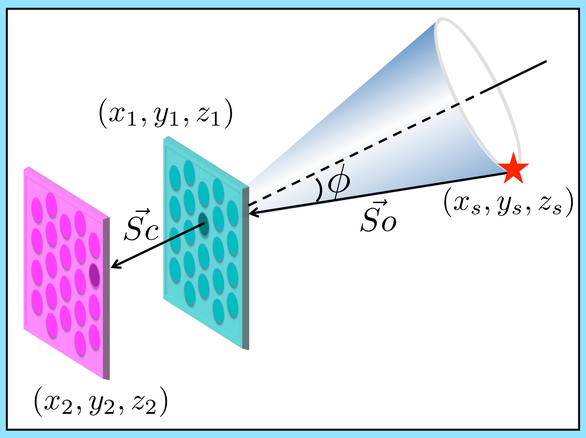
- Field Transportable System with Real Time Feedback
- Operates from on-board battery, external 12 VDC, external 120 VAC
- Operates a minimum of 8 hrs off on-board battery
- Modular design allows for the two layers to be contained in telescoping cases for compact transport

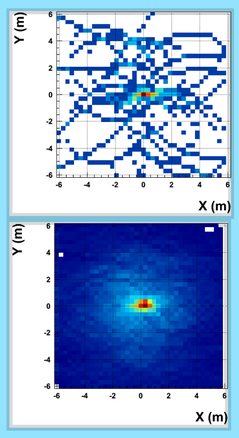




## Technique

- Detect multiple n-p scattering in position-sensitive detector layers made up of individual scintillator cells
- Measure: positions, energy deposits, time-of flight, pulse shape
- Apply n-p scatter kinematics to compute incident neutron energy and direction

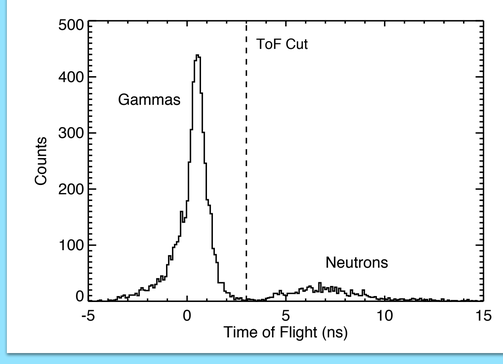


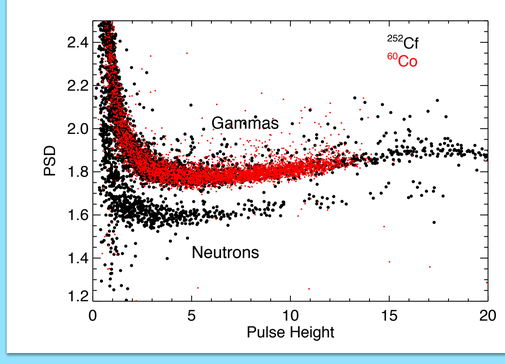

20 events

1000 events

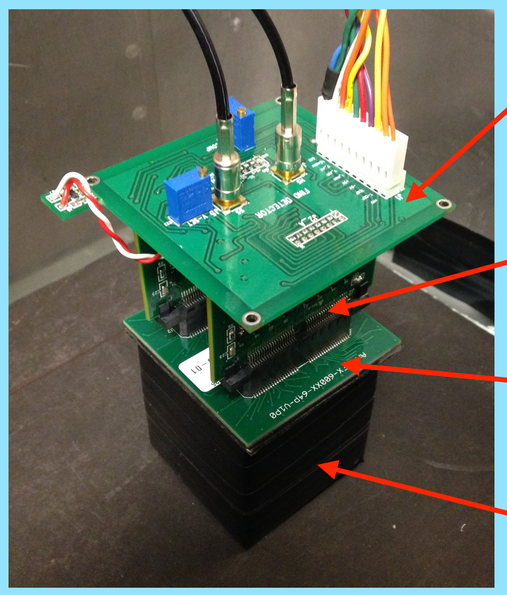
### Time of Flight Performance




### PSD Performance




## Laboratory Results



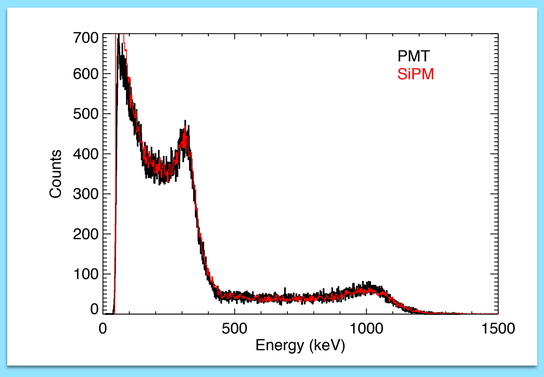
Power Supply and Temperature Compensating Board

Signal Summing Boards

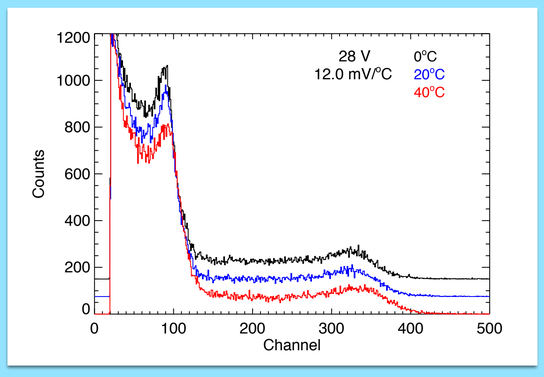
SiPM Array Board ArrayC-60035-64P-PCB

EJ-299-33A PSD Plastic Scintillator

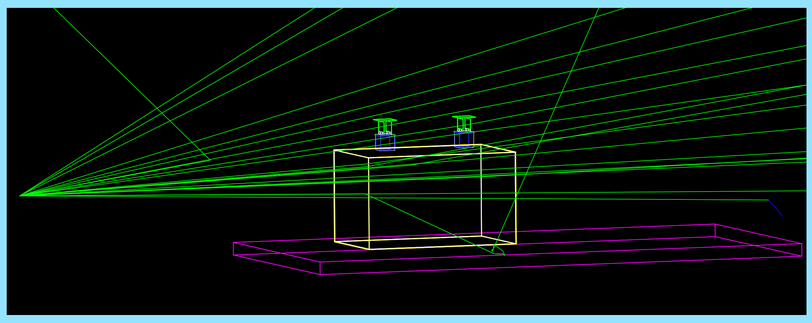
### Spectroscopy Performance



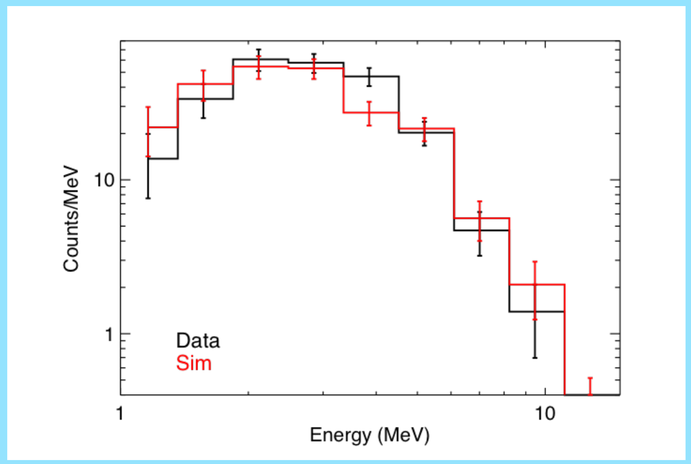

### Gain Control vs. Temperature




## Instrument Modeling



Mass model of the two-cell instrument prototype has been created using the SWORD V5 simulation package.




- Two-Cell prototype has been exposed to $^{252}$Cf source in the lab.
- Recorded neutron energy spectrum is in good agreement with simulations.

SPAWAR Systems Center PACIFIC

University of New Hampshire