Office of Defense Nuclear Nonproliferation Research and Development

University Program Review (UPR) 2021 Meeting

Time-Encoded Dual Particle Imager (IanTErn)

Consortium for Monitoring, Technology, and Verification (MTV)

September 8, 2021

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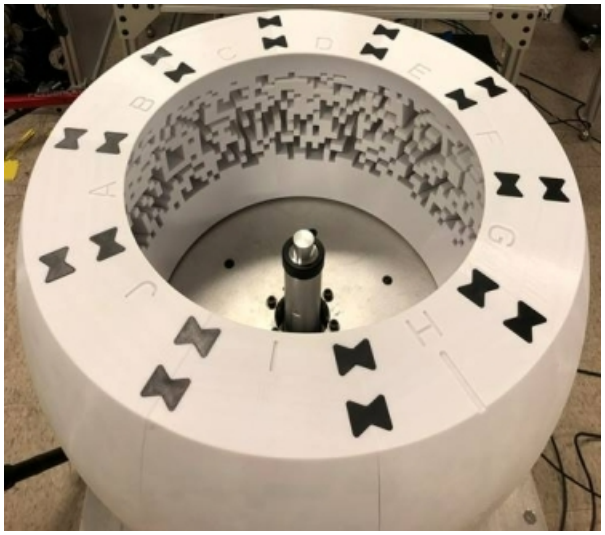
Peter Marleau[2]
1) University of Michigan, 2) Sandia National Laboratories

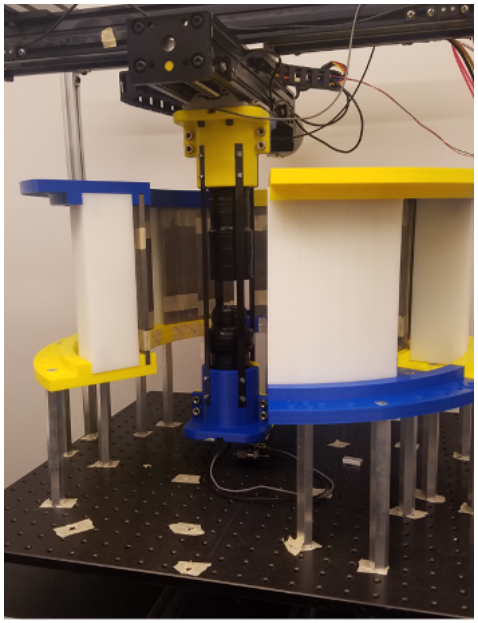
System Comparisons

CONFIDANTE (Sandia)



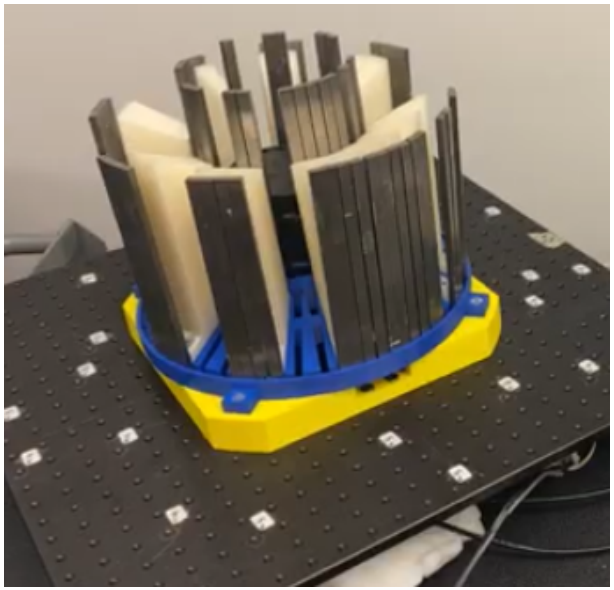
Outer Diameter: 66.6 cm
Inner Diameter: 56.6 cm

MATADOR (Michigan)



Outer Diameter: 51.4 cm
Inner Diameter: ~25 cm

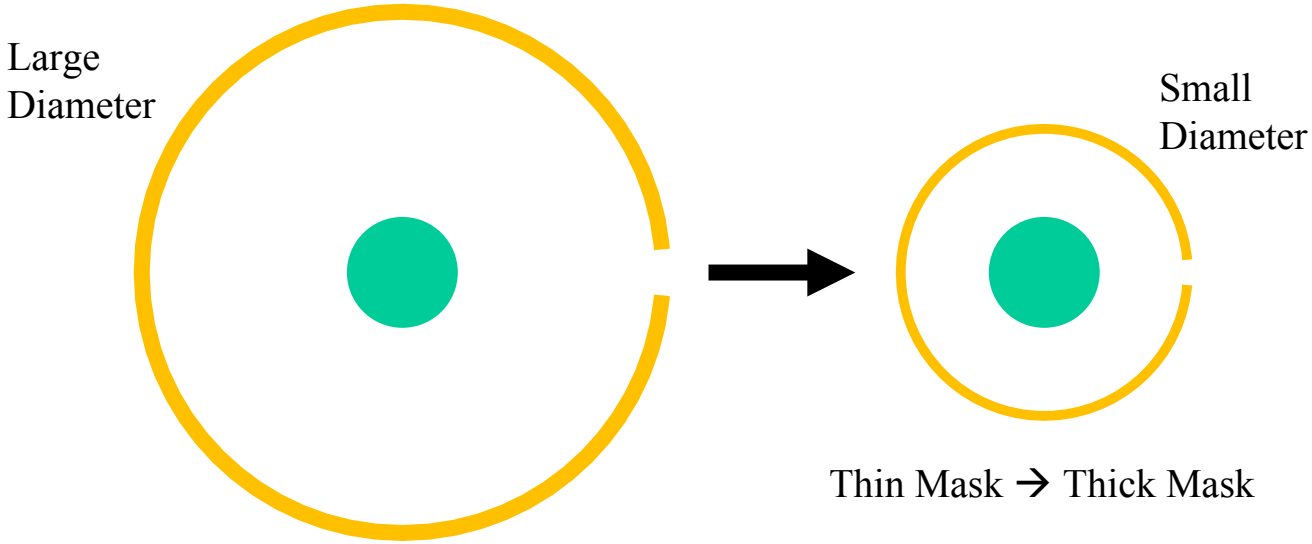
lanTErn (Michigan)



Outer Diameter: 30.635 cm
Inner Diameter: ~12 cm

Motivation

- **1D, man-portable, dual particle cTEI imaging system is desirable for nuclear nonproliferation**
- **Overall Goal: Retain image quality when transitioning from a large to small diameter coded mask.**



Mission Relevance

Nonproliferation
NNSA works to prevent nuclear weapon proliferation and reduce the threat of nuclear and radiological terrorism around the world. The agency endeavors to prevent the development of nuclear weapons and the spread of materials or knowledge needed to create them.

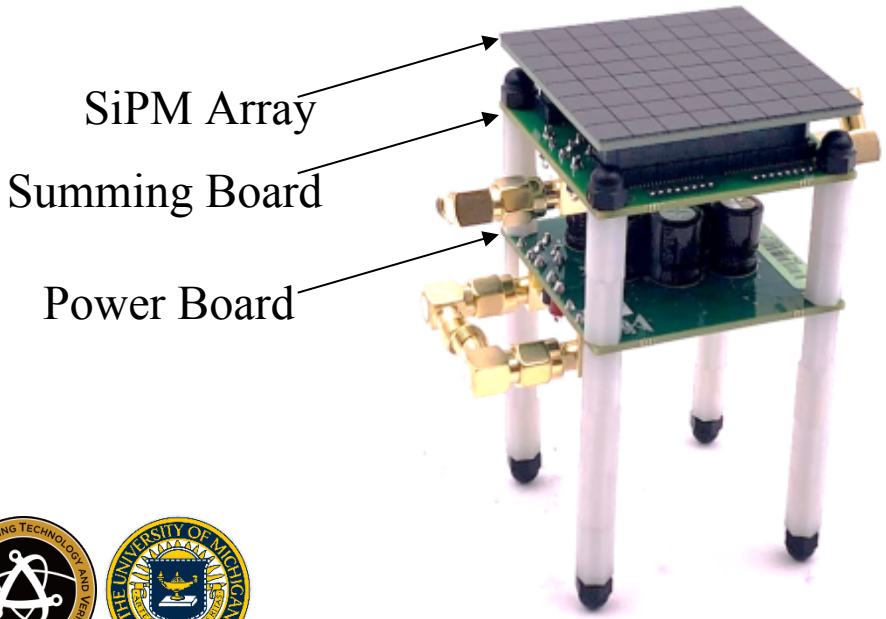
- **Nonproliferation applications: source verification and search operations**
- **Need for a compact, cost-effective fast neutron imager**

Monzano Alarm and Nuclear Material Consolidation Project

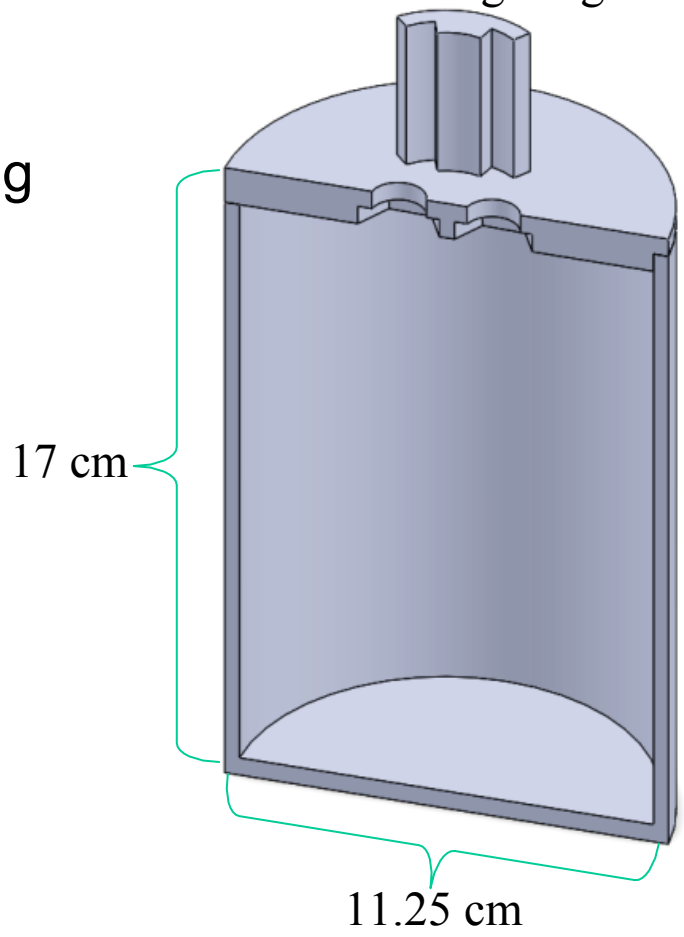

https://en.wikipedia.org/wiki/Multiple_independently_targetable_reentry_vehicle

Detector Setup

- 16x16 array of 4mm x 4mm SensL J-Series SiPMs
- Summing board and power board from Sandia National Laboratories
- Goal: Allow for ease of crystal swapping

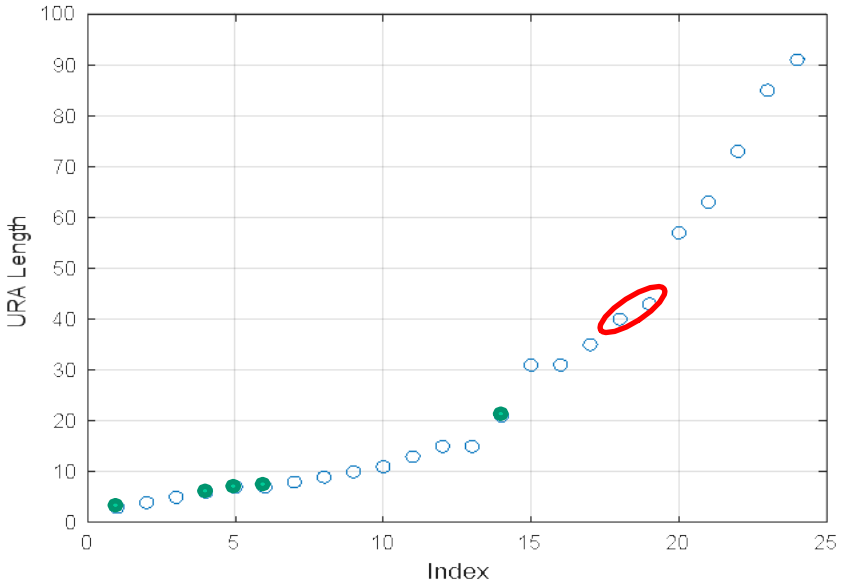


Cross section of light tight box

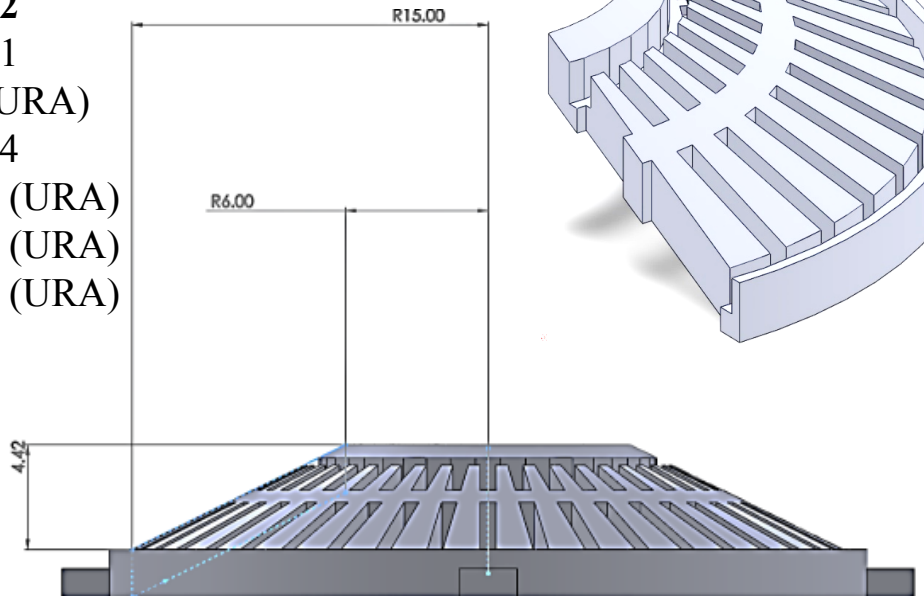


Mask Test Bed

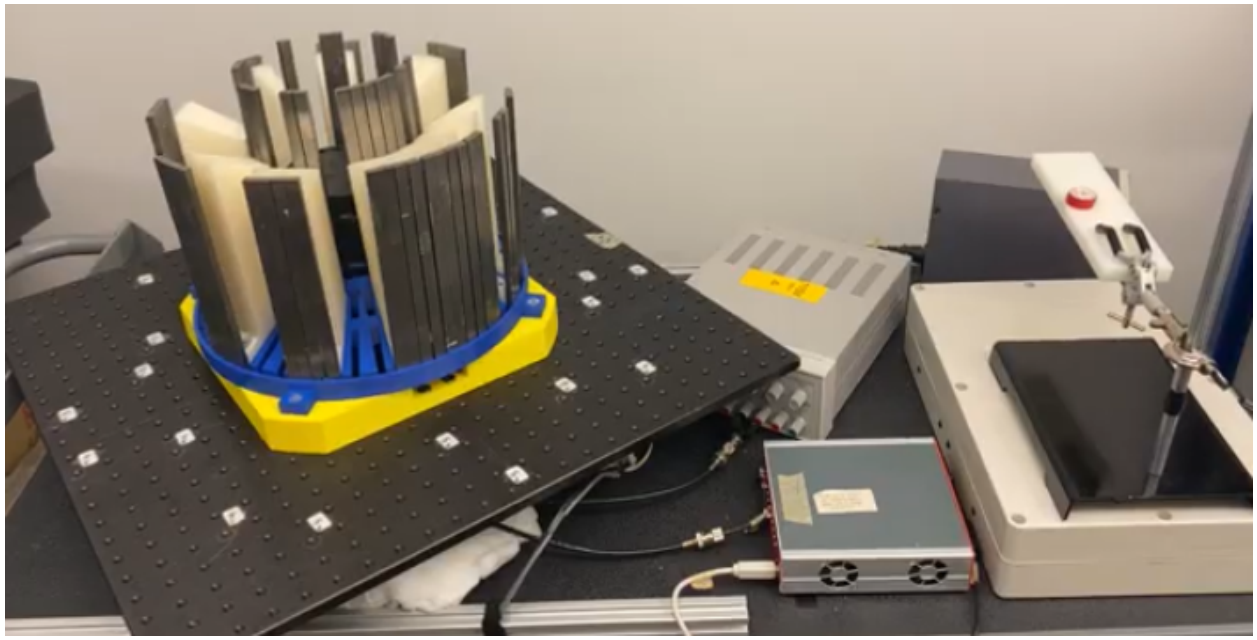
- Design of a mask bed for testing of several unconventional cTEI masks
- Goal: Allow for even and odd numbered mask patterns (can have URAs as well as mask-antimask patterns)



42
21
(URA)
14
7 (URA)
6 (URA)
3 (URA)

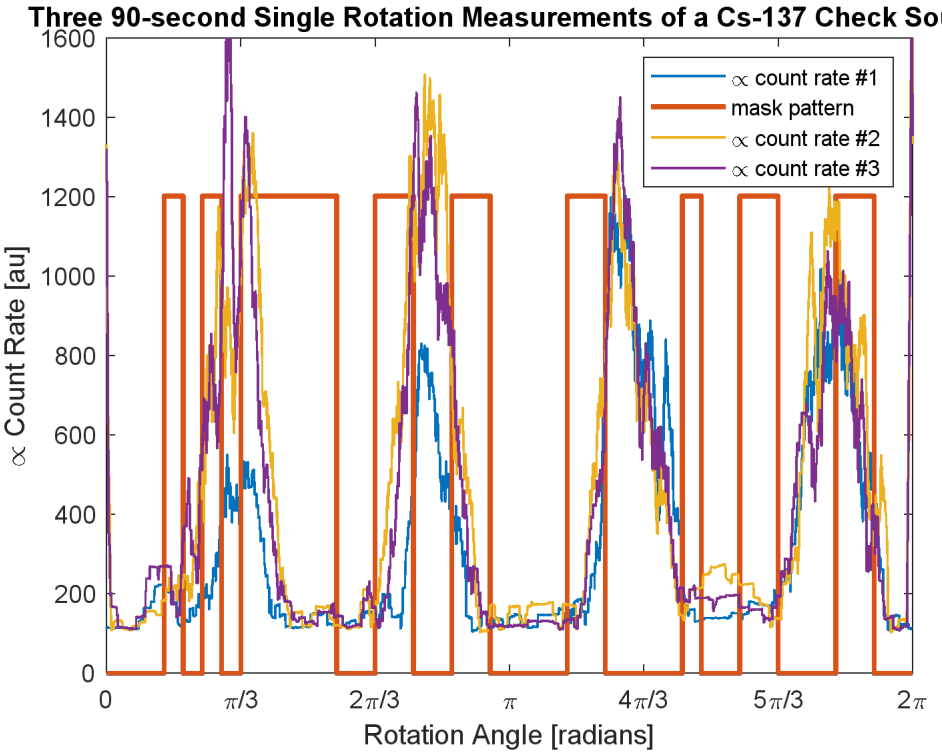


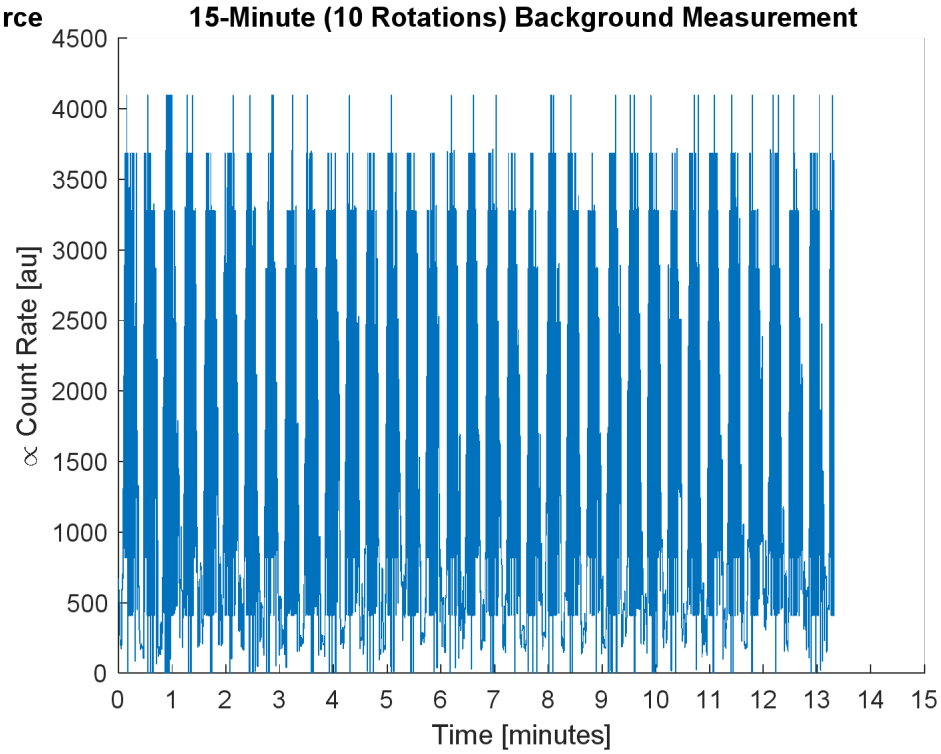
Current Status and Future Work



- **Current Status**
  - System mechanics and electronics have been assembled and preliminary measurements have been completed
- **Future Work**
  - Tests of different mask patterns, pixel pitch, source strength, rotation speed, etc.

First System Results





- **Single Rotation Measurements**
  - Consistent modulation over several measurements
- **Multiple Rotation Measurements**
  - Issues with CAEN Compass and real time data collection

MTV Impact

- **Personnel transitions**
  - John Kuchta is a virtual intern at Sandia National Laboratories where he will continue working on unconventional TEI mask designs and optimizations
- **Technology transitions**
  - This project is being conducted in collaboration with the Radiation and Nuclear Detector Systems group at Sandia National Laboratories

Conclusion

- **The system assembly was finished, and preliminary measurements and data processing are progressing in a timely manner**
- **Preliminary results of repeatable source modulation are promising for nonproliferation applications**

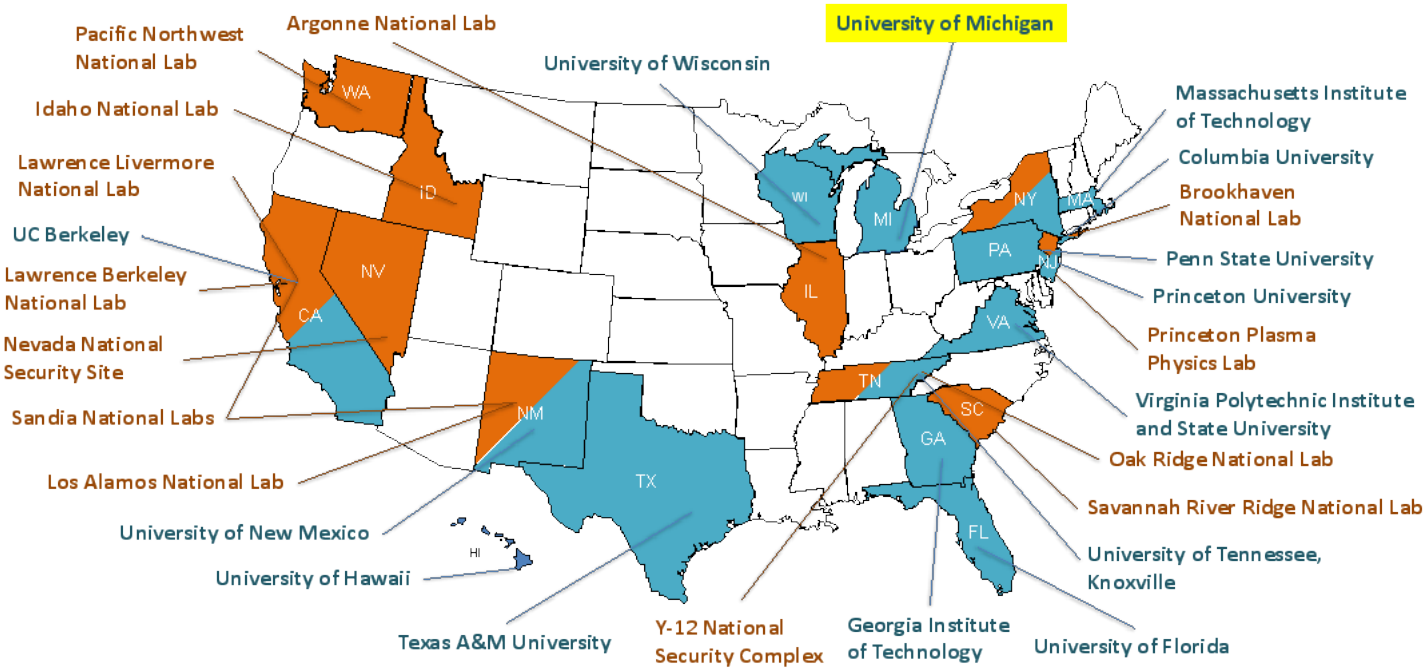
Acknowledgements

The authors would like to acknowledge Melinda Sweany and the rest of the Radiation and Nuclear Detector Systems group from Sandia National Laboratories for their valuable research and technology.

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525. The US DOE National Nuclear Security Administration, Office of Defense Nuclear Nonproliferation Research and Development for co-funding this work.

Acknowledgements

The Consortium for Monitoring, Technology, and Verification would like to thank the NNSA for the continued support of these research activities.



This work was funded by the Consortium for Monitoring, Technology, and Verification under Department of Energy National Nuclear Security Administration award number DE-NA0003920