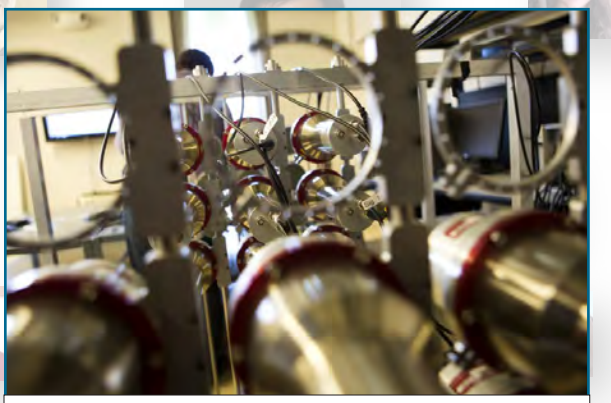
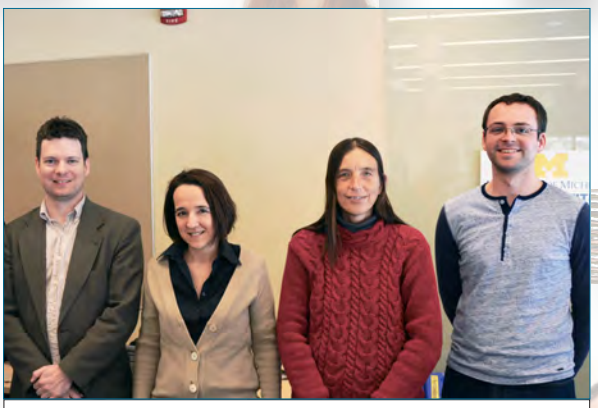


Innovations in Technology
Dual Particle Imaging System

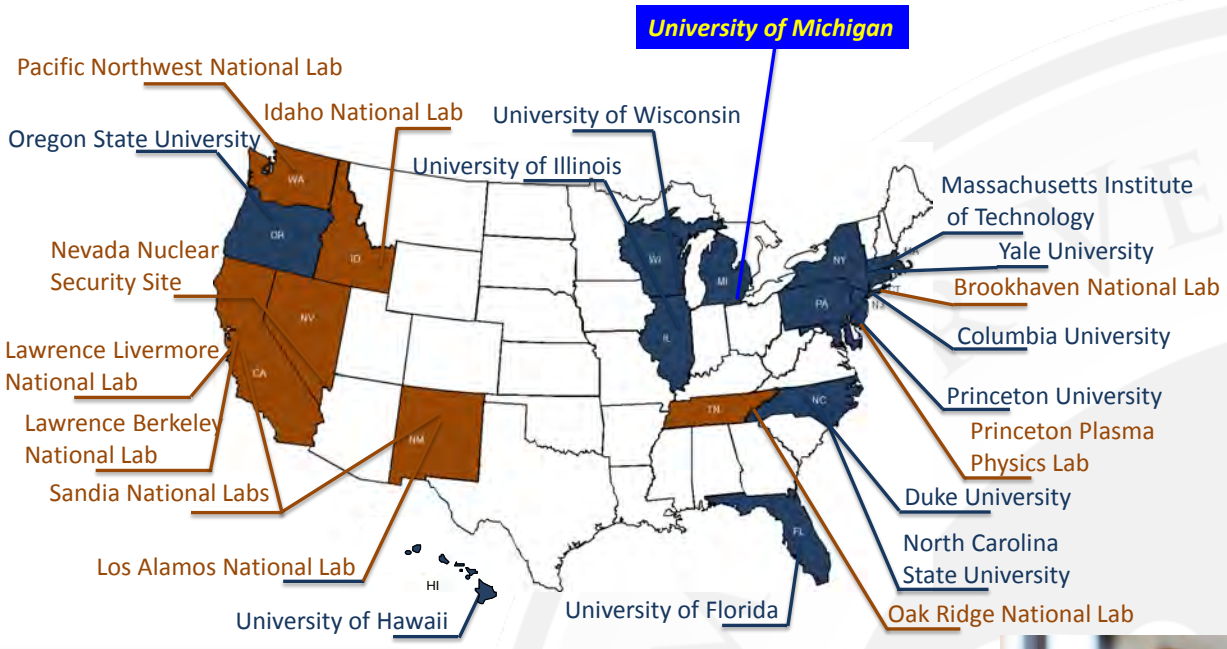


National Laboratory Engagement
Dr. Ramona Vogt
Lawrence Livermore National Laboratory

Consortium *for* Verification Technology

Student Internships
Cameron Miller, CVT Fellow
Lawrence Berkeley National Laboratory
Mentor: Dr. Cameron Geddes

Outreach
Oglala Lakota College delegation
Host: University of Michigan



CVT Team: 12 Universities & 9 National Labs
Total funding $25M over 5 Years

The Consortium for Verification Technology (CVT), consists of twelve leading universities and nine national laboratories, working together to provide the research and development and human capital needed to address technology and policy issues in treaty-compliance monitoring. The underlying issues include nuclear nonproliferation and safeguards in support of the mission of the NNSA's Defense Nuclear Nonproliferation Research and Development office.

CVT Director
Professor Sara Pozzi
University of Michigan

The CVT universities and national laboratories form a diverse, geographically distributed team, with faculty and scientists who have demonstrated outstanding research capabilities and well-established collaborations, and who are committed to educating the next generation of nuclear-nonproliferation specialists. The team addresses the major gaps and emerging challenges in treaty verification through six thrust areas: (i) treaty verification: characterizing existing gaps and emerging challenges, (ii) fundamental data and techniques, (iii) advanced safeguards tools for accessible facilities, (iv) detection of undeclared activities and inaccessible facilities, (v) disarmament verification, and (vi) education and outreach. In each of these areas, graduate students play a central role in interdisciplinary research projects led by faculty and laboratory experts in the consortium.

Over the course of the project, the CVT will deliver new instruments and methods for nuclear nonproliferation, safeguards, and arms control treaty verification. We will educate Bachelors, Masters, and Ph. D. students with the talent, training, and commitment to meet the current and emerging challenges in this field. These graduates will have strong ties to the national laboratory system thanks to the collaborative research projects in which they will be engaged.

The CVT team at the 2015 fall workshop. October 16, 2015, Ann Arbor, Michigan

HIGHLIGHTS

Anne Harrington visits the University of Michigan, Nuclear Engineering and Radiological Sciences department as a guest lecturer for the Third Annual Michigan Memorial Phoenix Project Lecture. During her visit on March 27th, 2016, she presented her talk titled, "Policy and Technology: Can They Work Together to Minimize Future Security Risks?".

above. Lab tour at University of Michigan, 03/27/2015
left to right: Shaun Clarke (CVT Assistant Director, Associate Research Scientist), Anne Harrington (Deputy Administrator for Defense Nuclear Nonproliferation for NNSA), Kyle Polack (CVT Fellow, PhD Candidate), and Mike Hamel (CVT Associate, PhD Candidate)

Professor Areg Danagoulian, MIT, wins 2015 IEEE/ NPSS Radiation Instrumentation Early Career Award.

Ruaridh Macdonald, CVT Student Associate is featured in MIT news, September 2015, in an article titled, "Upholding disarmament agreements with engineering."

CVT students are part of the first place team for the 2015 American Nuclear Society Student Design Competition for their Graduate Category submission titled "Zero Knowledge Active Interrogation of Nuclear Warheads".

left to right: Brianne Heisinger, Crystal Green (CVT Associate), Jennifer Arthur (CVT Fellow) , Kyle Kondrat, Matthew Krupcale (CVT Fellow), and Prof. Ron Gilgenbach (University of Michigan, Nuclear Engineering and Radiological Sciences).

HIGHLIGHTS

Professor R. Scott Kemp, MIT faculty, receives prestigious Sloan Research Fellowship!

Professor Sara A. Pozzi, University of Michigan, is featured in "Celebrating Women in Physics" in an Elsevier Special Issue.

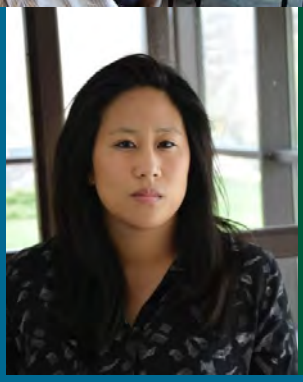
Prof. Pozzi is being featured for her publication titled "MCNP-PoliMi: a Monte-Carlo code for correlation measurements".

Nuclear Verification at Low Numbers, A Scoping Workshop

Princeton University, December 10-11, 2015

The CVT hosts an annual workshop to educate new users of the MCNPX-PoliMi code.

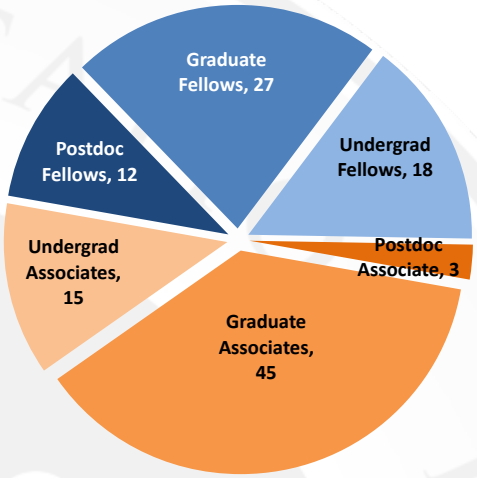
Pin-Yu Chen, CVT Undergraduate Associate, is recognized for Outstanding performance during his 2015 PNNL Internship.



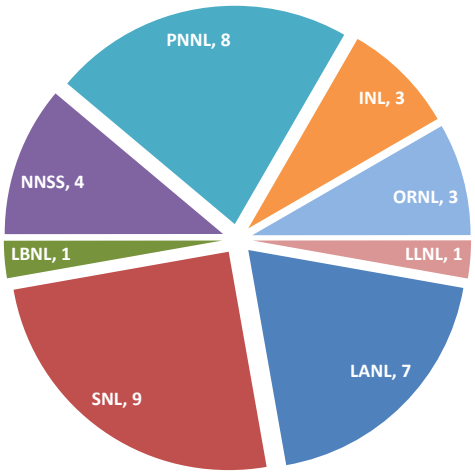
Elizabeth Hou, CVT Fellow, wins 1st place at the Michigan Institute for Computational Discovery and Engineering (MICDE) Poster Competition

STUDENT AND POSTDOC FELLOWS & ASSOCIATES

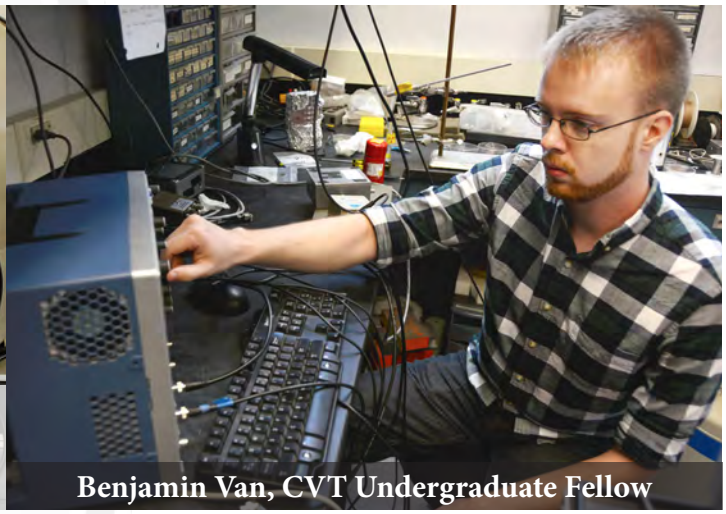
Student and Postdocs, 57 Fellows & 63 Associates



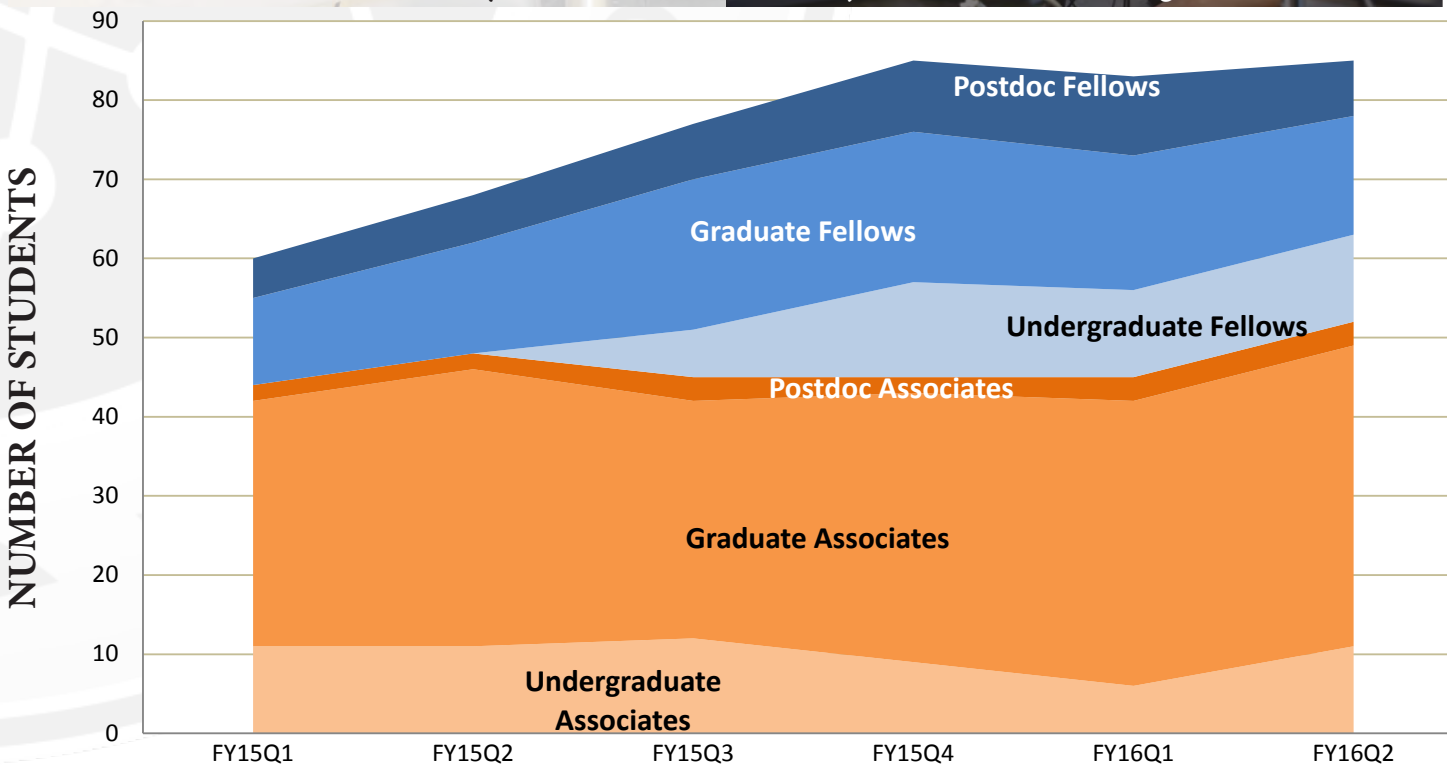
CVT Internships per laboratory, 36 total



Ciara Sivles, 2016 Internship
Pacific Northwest National Laboratory
Mentor: Justin McIntyre



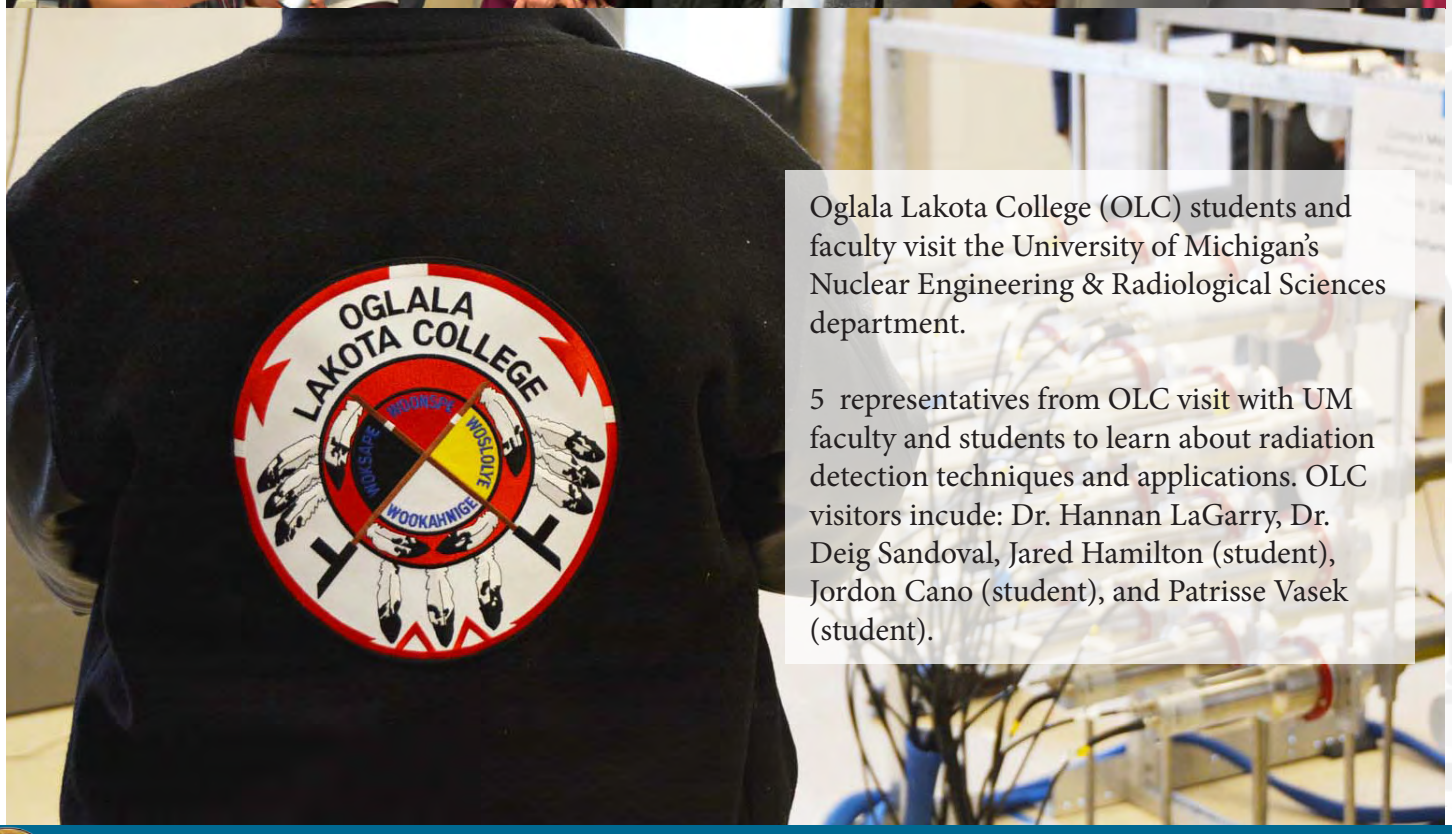
Benjamin Van, CVT Undergraduate Fellow



OUTREACH

right. A middle school student testing his hand-made cloud chamber during the "Are You Radioactive?" Workshop

below. Tony Shin, CVT Fellow, discusses how our equipment is used for research to students from University High School Academy.



Oglala Lakota College (OLC) students and faculty visit the University of Michigan's Nuclear Engineering & Radiological Sciences department.

5 representatives from OLC visit with UM faculty and students to learn about radiation detection techniques and applications. OLC visitors incude: Dr. Hannan LaGarry, Dr. Deig Sandoval, Jared Hamilton (student), Jordon Cano (student), and Patrisse Vasek (student).

TECHNICAL ACHIEVEMENTS

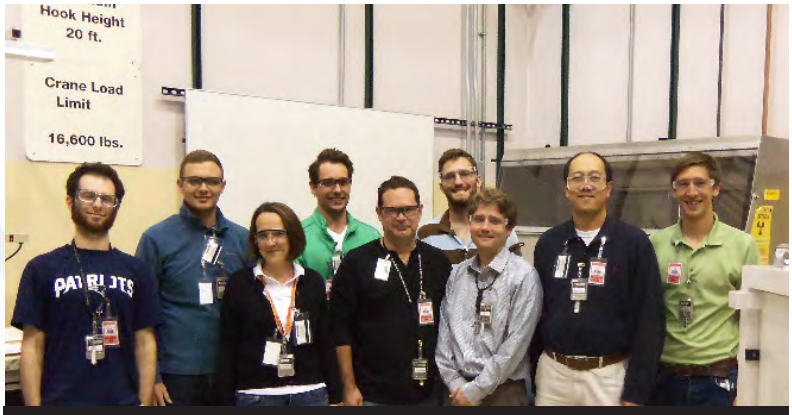
2015 Experiments at the Device Assembly Facility

Conducted successful university-led experiments with Cat-I special nuclear material at the Device Assembly Facility (July 6 – 9, 2015)

Systems

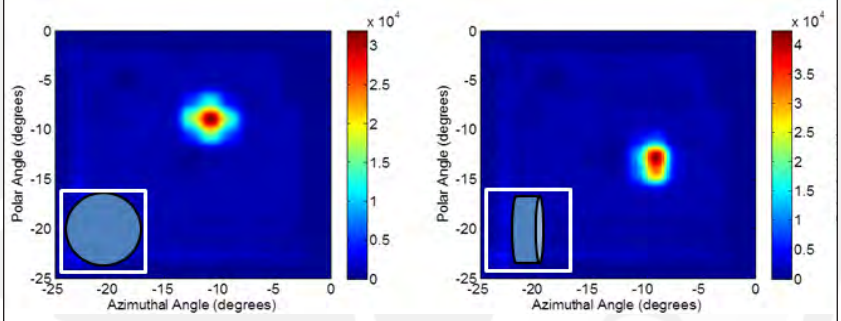
- Neutron coded aperture imager (ORNL, SNL, NCSU)
- Dual particle imager (UM)
- Polaris/Orion Compton scatter gamma imagers (UM)

National lab collaborators: LANL, ORNL, NNSS, SNL

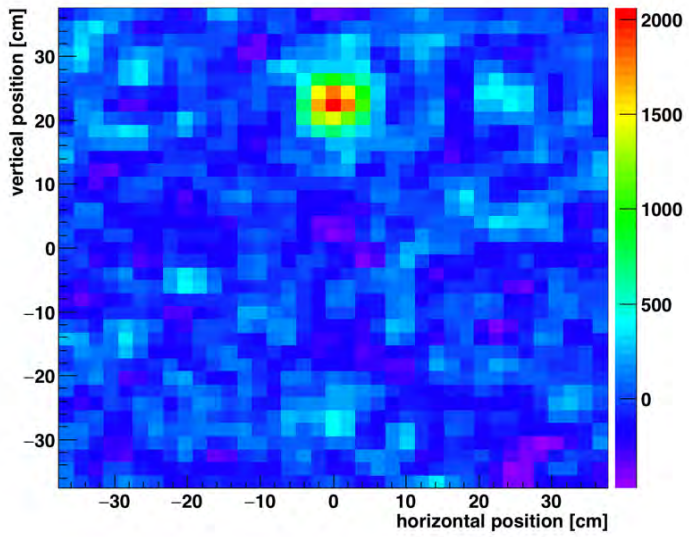


Left to right: Jonathan Mueller (CVT Postdoc Fellow), Michael Hamel (CVT Graduate Associate), Sara Pozzi (CVT Director), Kyle Polack (CVT Graduate Fellow), John Mattingly (Professor NCSU), David Goodman (CVT Graduate Fellow), Jason Newby (ORNL), Zhong He (Professor UM), and Michael Streicher (CVT Graduate Associate)

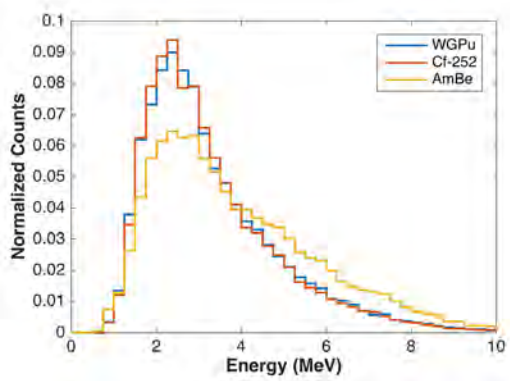
High resolution spatial imaging determines SNM shape

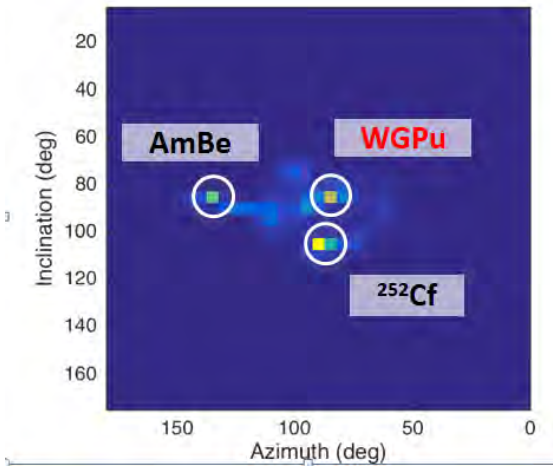


WGPu image filtered based on multiplication



Spatio-spectral discrimination of SNM from non-threat sources





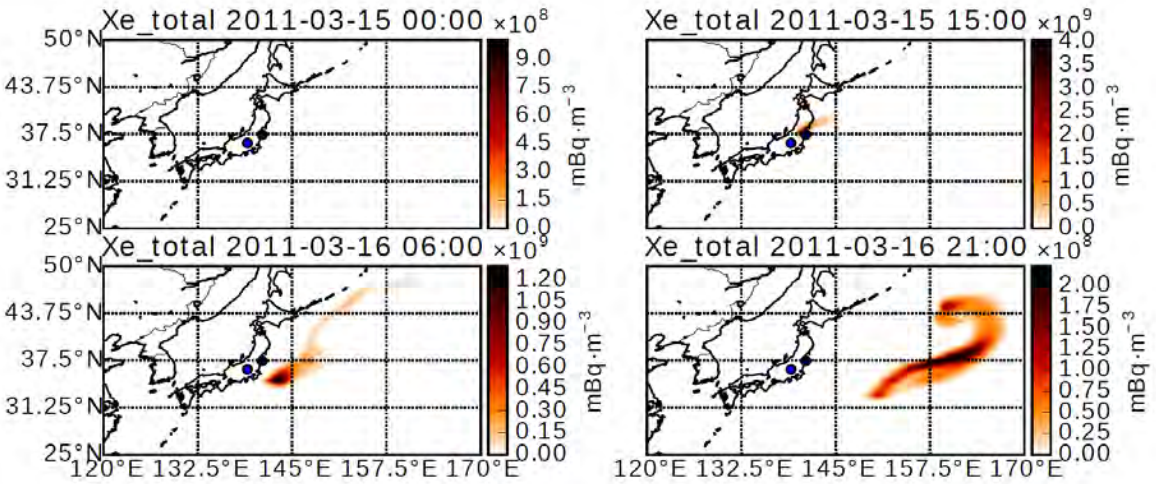
TECHNICAL ACHIEVEMENTS

Analysis of Democratic People's Republic of Korea Test of 6-Jan-2016

- **Analyzed seismic signals from 6-Jan-2016 nuclear event in North Korea**
- **Determined that the event is comparable in magnitude to those from the May 2009 and February 2013 nuclear weapons tests in North Korea**
- **Obtained and performed initial analysis of infrasound and radionuclide data from the International Monitoring System**

National lab collaborators:
LLNL, LANL, SNL, PNNL

Modeling of atmospheric transport



NATIONAL LAB SCIENTIST FELLOWSHIPS

In 2016, the CVT project supported 5 fellowships allowing our national laboratory partners to visit with collaborating CVT universities.

Ramona Vogt
Lawrence Livermore National Lab
Host: Prof. Sara Pozzi
University of Michigan
March 2016

Jorgen Randrup
Lawrence Berkeley National Lab
Host: Prof. Sara Pozzi
University of Michigan
March 2016

David Mascarenas
Los Alamos National Laboratory
Host: Prof. Milton Garces
University of Hawaii
May 2016

Thomas Atwood
Sandia National Laboratories
Host: Prof. Paul Wilson
University of Wisconsin - Madison
February 2016

Kenneth Jarman
Pacific Northwest National Lab
Host: Prof. Scott Kemp
Massachusetts Institute of Technology
June 2016

STUDENT ADVANCEMENT MODEL

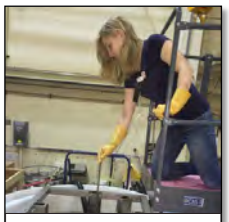
Alexis Trahan

Berkeley UNIVERSITY OF CALIFORNIA

2007 - 2011
UC Berkeley Undergrad
B.S. in Nuclear Engineering

2012, LANL Intern

2014 CVT Associate



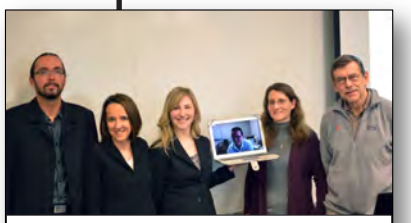
2015, LANL Intern

Los Alamos NATIONAL LABORATORY

2016, LANL Staff

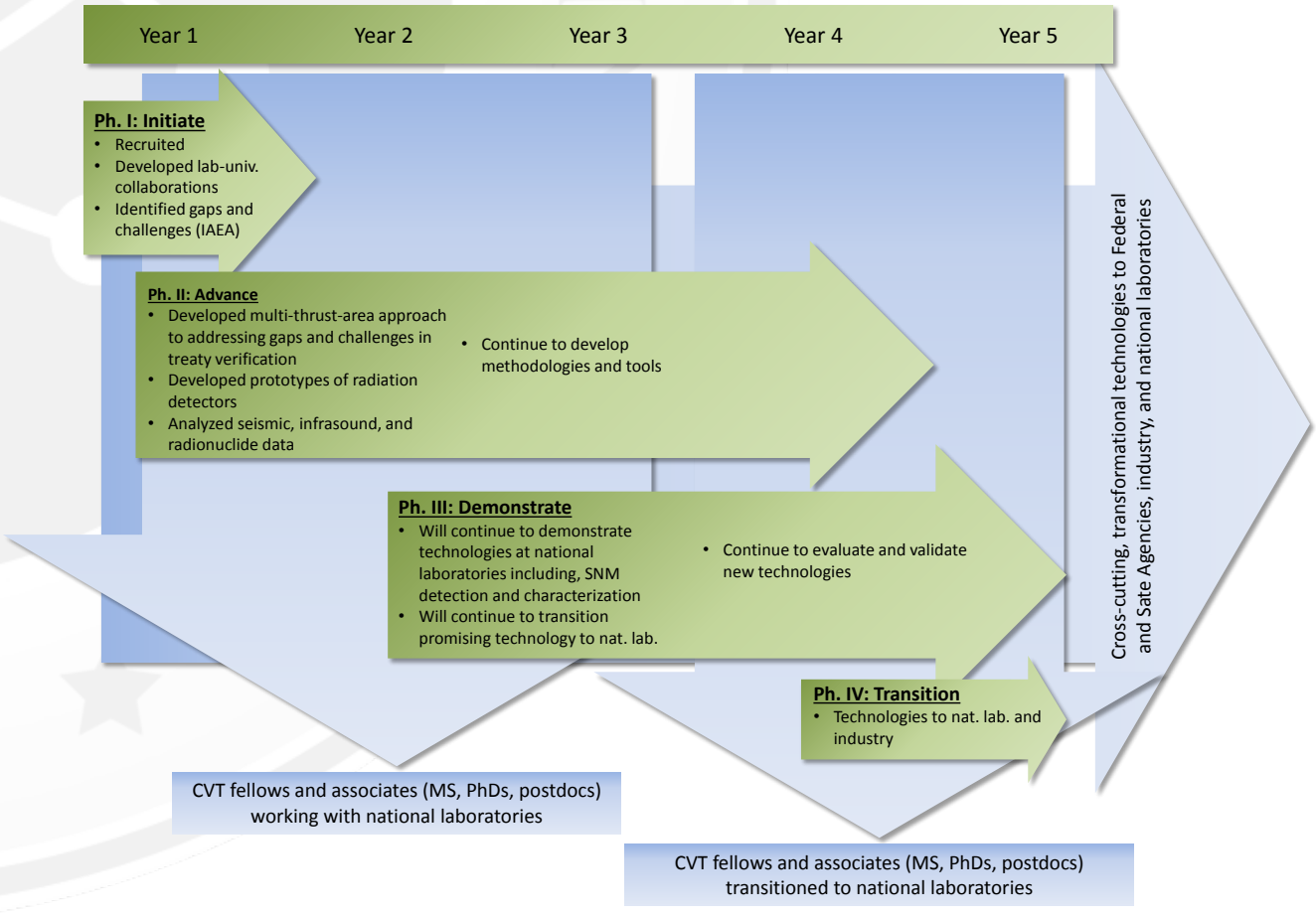
MICHIGAN ENGINEERING UNIVERSITY OF MICHIGAN

2011, Begins UM
Graduate program
For Nuclear Engineering



2016, PhD Defense

ADDRESSING GAPS & CHALLENGES



PUBLICATIONS: 57 JOURNAL ARTICLES

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PUBLICATIONS: 57 JOURNAL ARTICLES

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