

INL and the Consortium for Verification Technology

INL Support in FY2015 and Capabilities and Resources for Future Support

October 2015

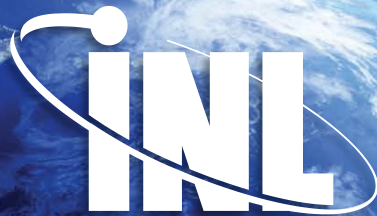
David Chichester, Distinguished Staff Scientist
Nuclear Nonproliferation Division
National & Homeland Security Science and Technology Directorate





Our Mission

Discover, demonstrate and secure innovative nuclear energy solutions, other clean energy options, and critical infrastructure.



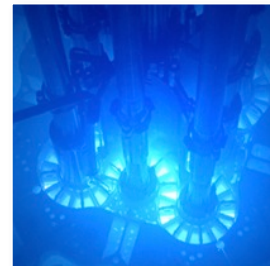
Idaho National
Laboratory

Our Vision

INL will change the world's energy future and secure our critical infrastructure.

Idaho National Laboratory

- ~3800 employees
- 890 square miles
- 111 miles of electrical distribution lines
- 579 buildings
- 177 miles of paved roads
- 14 miles of railroad lines
- 4 reactors
- Mass transit system
- Protective security force
- Multiple irradiated-fuel storage pools
- Dry-cask fuel storage research testbed



CVT Activities at INL – Infrasound

- In May INL hosted Dr. Milton Garcés and Mr. Anthony Christie of the University of Hawaii, Manoa, for a week-long scoping study exploring the infrasound signatures present at nuclear facilities.
- Acoustic observations were taken across the INL site including:
 - Advanced Test Reactor (research reactor)
 - Hot Fuel Examination Facility (hot cell)
 - Analytical Laboratory (a radiochemistry laboratory with hot cells and glove boxes)
- Work is underway examining the potential use of this type of data for verification; further observations are planned



Colling fan duct and the exhaust stack at ATR



GUEST SPEAKER

Milton Garcés, Ph.D.

Executive and Director
Infrasound Laboratory
University of Hawaii, Manoa
Kaliua-Kona, Hawaii



Infrasound: Past, Present, and Future

Infrasound was an integral part of nuclear monitoring during the Cold War. After the cessation of atmospheric tests, infrasound research and technology declined and lay dormant until the 1996 signing of the Comprehensive Nuclear-Test-Ban Treaty (CTBT). The new International Monitoring System (IMS) infrasound network far outperformed any preceding infrasound systems and triggered a renaissance of discovery and technology development. In this seminar, Dr. Garcés will discuss the use of infrasound systems for nuclear monitoring, the ongoing challenges and technical development priorities outlined by the CTBT Infrasound Technology Roadmap, and anticipated increases in scale and sophistication of data mining as infrasound enters the Big Data stage.

Dr. Garcés specializes in the study of global infrasound from man-made and geophysical sources in the atmosphere, ocean, and solid Earth. He founded the Infrasound Laboratory of the University of Hawaii, and operates CTBT International Monitoring System stations in Hawaii and Palau, as well as regional stations in Hawaii. Recent projects include the preparation of the CTBT Infrasound Technology Roadmap and the study of signatures from high-yield explosions (including those from volcanoes and meteors). New projects under the NNSA Consortium for Verification Technology aim to advance the state-of-the-art of infrasound technology related to the monitoring and verification of nuclear treaty compliance.

Thursday, May 28

10:00 – 11:00 a.m.

EROB Conference Room 249

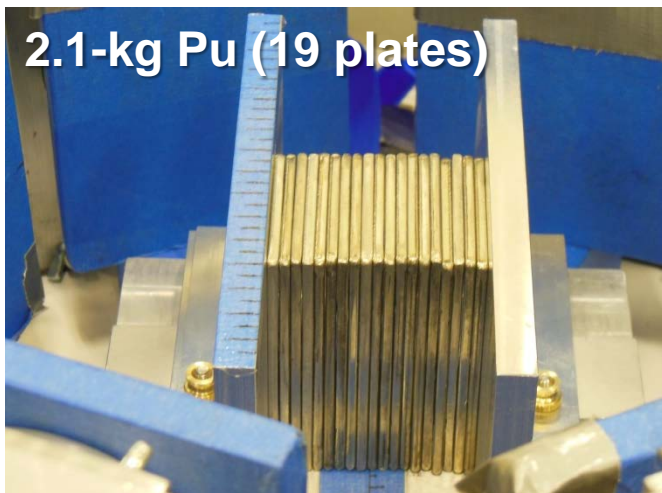
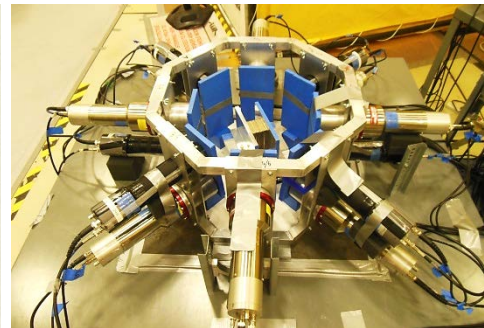
For more information contact Stacie Harmon (6-8381) or David Chichester (6-8620)

National & Homeland Security

**INL Nonproliferation
Seminar, May 22**

CVT Activities at INL – Fast-Neutron Multiplicity Analysis

- In August INL hosted Dr. Angela Di Fulvio of the University of Michigan for a week-long experiment campaign at INL's ZPPR facility
- Two types of clad plutonium plates
 - 110.7-g Pu, 72.0% ^{239}Pu
 - 105.3-g Pu, 93.9% ^{239}Pu
- 16-channels of data



CVT Summer Interns at INL

Daniel Shy

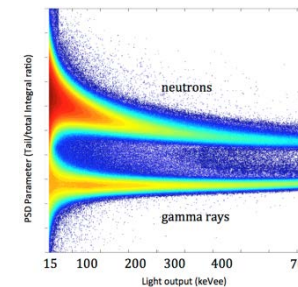
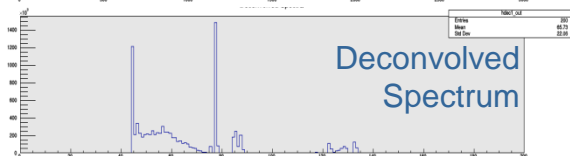
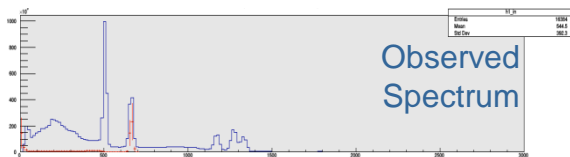
- U. Michigan
- Optimization of inorganic scintillator detectors to improve gamma-ray spectroscopic performance
- Development of spectral deconvolution methods interpreting gamma-ray spectra



Charles Sosa

- U. Michigan
- Optimization of organic scintillator detectors to improve neutron/gamma-ray pulse shape discrimination (PSD)
- Evaluation of optimal waveform digitization parameters to maximize PSD performance of organic scintillators

White-water rafting on the Snake River, August, 2015



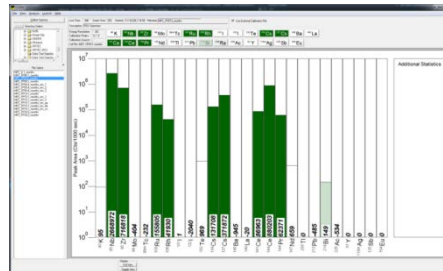
PSD-focused optimization aimed at further separating neutron and gamma-ray signals

INL Capability Alignment with the CVT Thrust Areas

Thrust Areas	Sub Areas	INL Staff	INL Resources
1: Characterizing Gaps & Emerging Challenges	FMCT Verification Challenges	✓	✓
	Future Disarmament Treaties	✓	✓
2: Fundamental Physical Data, Data Acquisition & Analysis Techniques	Physics of Fission	✓	✗
	Data Analytics	✓	✗
	Data Acquisition for High-Throughput Radiation Detector Systems	✓	✓
3: Advanced Safeguards Tools for Accessible Facilities	Neutron Multiplicity Counting	✓	✓
	Handheld/Portable Room Temp. Semiconductor γ -Ray Imagers	✓	✓
	Stand-off Meas. using LIBS for Limited Access Areas	✓	✓
	Chain-of-Custody Detectors	✓	✓
4: Detection of Undeclared Activities and Inaccessible Facilities	Seismic Signatures	✗	✓
	Infrasound Signatures	?	✓
	Atmospheric Radionuclide Sensing	✓	✓
	Signatures from Undeclared Fuel-Cycle Facilities	✓	✓
5: Disarmament Verification	Rad. Detection Systems for Arms Control & Treaty Verification	✓	✓
	Warhead Dismantlement Facility & Managed-Access Simulator	✓	✓
	Zero-Knowledge Neutron-based Verification System	✓	✓
	Limited Knowledge Transmission NRF	✓	✓
6: Education & Outreach	Multiple	✓	✓

INL Research Staff Interests Aligned with the CVT

- Automated, information-barrier software for assessing gamma-ray spectra for CTBT on-site inspections
PI: Gus Caffrey TA: 1, 5, & 6
- Study of nontraditional signatures and observables associated with reprocessing LWR fuel; evaluation of forensic signatures from LWR fuel
PI: Kevin Carney TA: 1, 4, & 6
- Development of passive and active interrogation methods for characterizing assemblies of SNM for safeguards, arms control, and treaty verification
PI: David Chichester TA: 1, 2, 3, 5, & 6
- Methods and instrumentals for ultra-trace mass and radiochemical analyses and the production of reference materials
PI: Matt Watrous TA: 1, 4, & 6



Screen shot of the OSIRIS user interface, showing results of allowed gamma-ray results



Disassembly of an LWR fuel pin at INL for follow-on radiochemical analyses



Source-assisted multiplicity counting to determine multiplication, M , of an assembly of HEU

Potential INL Resource Support for the CVT

Working with Bulk SNM
(Thrust Areas: 1, 2, 3, 5, & 6)



Active interrogation & multiplicity counting for SNM detection and characterization

U & Pu Processing Facilities
(Thrust Areas: 1, 3, 4, & 6)



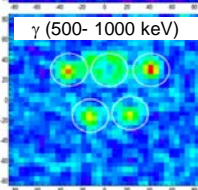
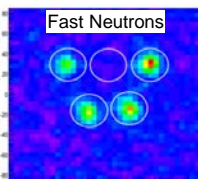
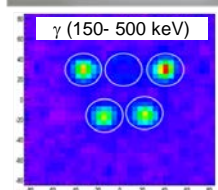
Hot-cell facilities processing irradiated fuel; U and Pu radio-chemistry

Explosives Test Range
(Thrust Areas: 4)



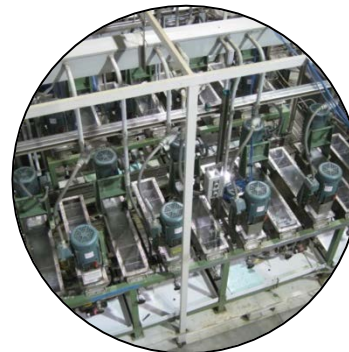
Large explosives test range supporting outdoor RDD detonation events

Radiation Imager Trials
(Thrust Areas: 3 & 5)



Assessing imaging systems for arms control and emergency response (example data from an ORNL system)

PUREX Pilot Plant
(Thrust Areas: 1, 2, 4, & 6)



Engineering-scale solvent extraction pilot plant for non-proliferation R&D



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