

The NIST logo is displayed in the top left corner of the slide, consisting of the letters "NIST" in a bold, blue, sans-serif font.

NIST Role – Radiological/Nuclear Detection Instruments

**Connecting Metrology, Standards, and Conformity Assessment at NIST and Beyond
Meeting 28 November 2012**

Leticia Pibida, Ph.D.

leticia.pibida@nist.gov

Presented by: Michael Unterweger

Team members:

Fred Bateman, Paul Bergstrom, Heather Chen-Mayer, Scott Dewey, David Gilliam, Jack Glover, Craig Heimbach, Larry Hudson, Ronnie Minniti, Bruce Norman, Alan Thompson, Ron Tosh, Michael Unterweger, Peter Volkovitsky



UNCLASSIFIED

The NIST logo is located in the bottom right corner of the slide, consisting of the letters "NIST" in a bold, blue, sans-serif font.

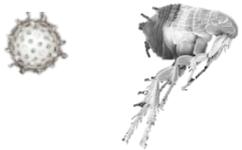
Radiation – You, Me and NIST

Uses of Radiation:

- Medical applications – diagnostics, therapy, imaging, blood irradiation
- Food and material irradiation
- Dosimetry for radiation workers
- Nuclear power plants
- Scanning at airports – X-ray imaging
- **Border crossing screening**
- **Cargo container screen in ports**
- **Security applications – detection of illicit trafficking of Rad/Nuc materials**

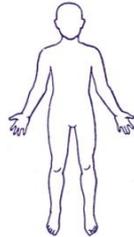


Diagnostics
0.1-100 mGy

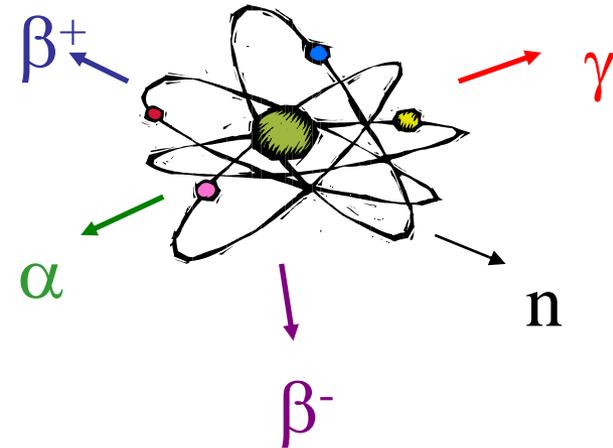
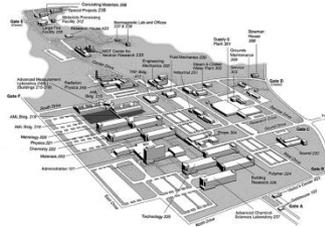


10 Gy ~ 1 m

Therapy
20-80 Gy



Sanitation
15-35 kGy



How Do We Measure Radiation?

Measure gamma-rays

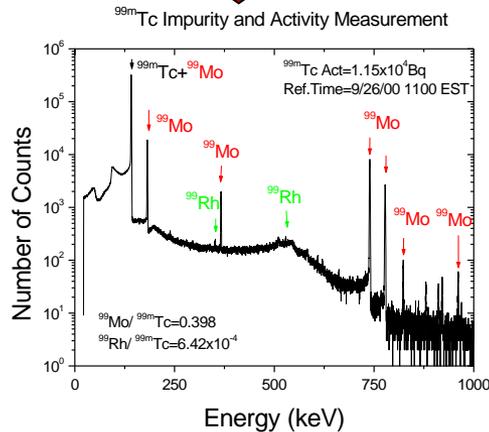
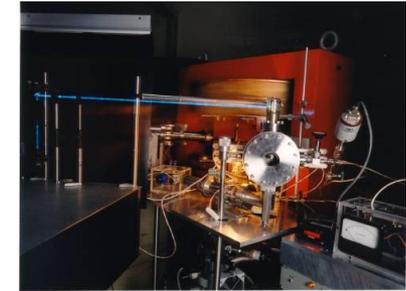
Spectrometry



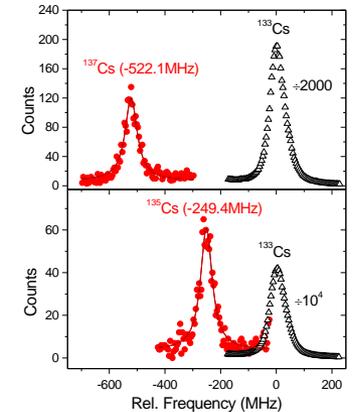
Gross Count



Measure atoms (ions)



Count rate
Exposure rate
Absorbed Dose



Not all Radiation is Bad

Naturally occurring radioactive materials

^{40}K , ^{238}U - ^{226}Ra , ^{232}Th

Where do you find it

Cat litter

Roofing tiles – clay

Fertilizer

Ceramics

Hay

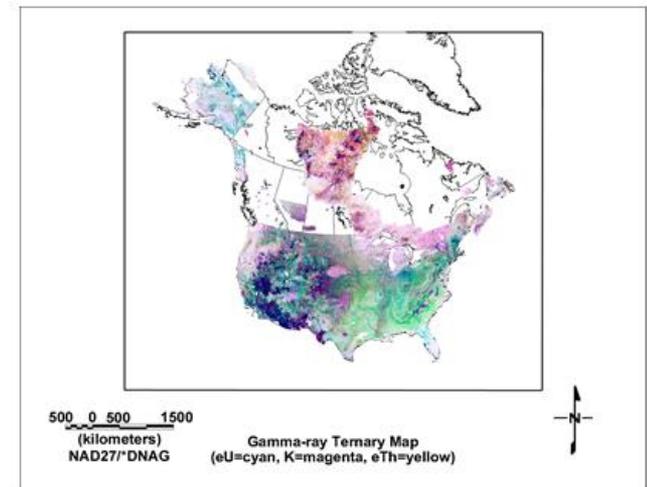
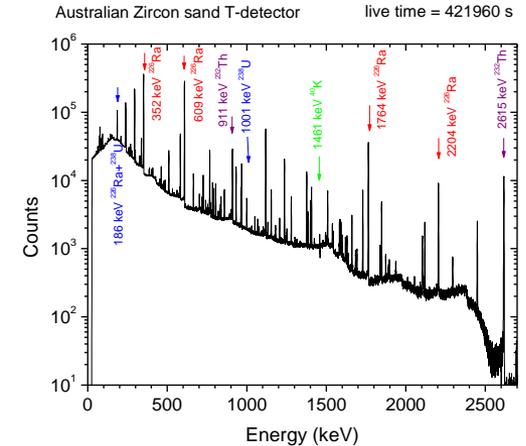
Soil

Coal

Ice melt

Welding rods

Sand



Radiation Detectors for Security Applications



Range of Use of Radiation Detectors - End User

- **Personal radiation detectors (PRDs) – First responders, CBP, Coast Guards**
- **Hand-held Radionuclide identification devices (RIDs) – CBP, Coast Guards**
- **Backpack based radiation detection systems (BRDs) – First responders, Coast Guards, DOE**
- **Vehicle mounted systems – First responders, DoD, DOE, CBP**
- **Aerial based systems – First responders, DOE**
- **Maritime based systems – Coast Guards**
- **Dosimeters (Passive, Active) – Radiation workers, DoD**
- **Package and cargo screening – Postal Service, CBP, Scrap metal sites**



NIST Leadership in Rad/Nuc Detector Standards Development

10 standards developed for testing of Rad/Nuc Instruments

- **ANSI N42.32 (IEC 62401) under revision**
 - American National Standard Performance Criteria for Alarming Personal Radiation Detectors for Homeland Security
- **ANSI N42.33 (IEC 62533)**
 - American National Standard for Portable Radiation Detection Instrumentation for Homeland Security
- **ANSI N42.34 (IEC 62327) under revision**
 - American National Standard Performance Criteria for Hand-held Instruments for the Detection and Identification of Radionuclides



NIST Leadership in Rad/Nuc Detector Standards Development

- **ANSI N42.35 (IEC 62244) under revision**
 - American National Standard for Evaluation and Performance of Radiation Detection Portal Monitors for Use in Homeland Security



- **ANSI N42.38 (IEC 62484) under revision**
 - Performance Criteria for Spectroscopy-Based Portal Monitors used for Homeland Security



- **ANSI N42.42 (IEC 62755) applicable to all instrument standards revision balloted**
 - Data format standard for radiation detectors used for Homeland Security



Information on ANSI N42.42: <http://www.nist.gov/pml/div682/grp04/n42.cfm>
Validation tools: <https://secwww.jhuapl.edu/n42/Account/LogOn>



<http://standards.ieee.org/getN42/>

NIST Leadership in Rad/Nuc Detector Standards Development

- **ANSI N42.43 (no IEC)**

- Standard for Mobile and Transportable Systems Including Cranes used for Homeland Security Applications



- **ANSI N42.48 (IEC 62618)**

- American National Standard Performance Requirements for Spectroscopic Personal Radiation Detectors (SPRDs) for Homeland



- **ANSI N42.49 A & B (no IEC)**

- Performance Criteria for Personal Emergency Radiation Detectors (PERDs) for Exposure Control



- **ANSI N42.53 (IEC 62694) in ballot**

- Performance Criteria for Backpack Based Radiation Detector Systems Used for Homeland Security



Rad/Nuc ANSI N42/IEC Standards Tests

Types

- **General tests:** display, weight, size, data format, alarms, user interface (depend on detector type)
- **Radiological tests:** exposure rate, background, false alarm, gamma and neutron response (strongly depend on detector type)
- **Environmental tests:** temperature, humidity, sealing (similar for all type of detectors)
- **Mechanical tests:** mechanical shocks, vibration, drop test (strongly depend on detector type)
- **Electromagnetic tests:** external magnetic fields, radio frequency, conducted disturbances (burst and radio frequencies), surges and oscillatory waves, electrostatic discharges (similar for all type of detectors)

Standards Validation Testing

Testing is carried out to:

- Determine suitability of requirements based on available technology
- Determine suitability of requirements based on physical constrains
- Determine suitability of test methods
- Determine clarity and necessary details in test methods
- Find deficiencies or errors in document standards
- Find user gaps and future needs

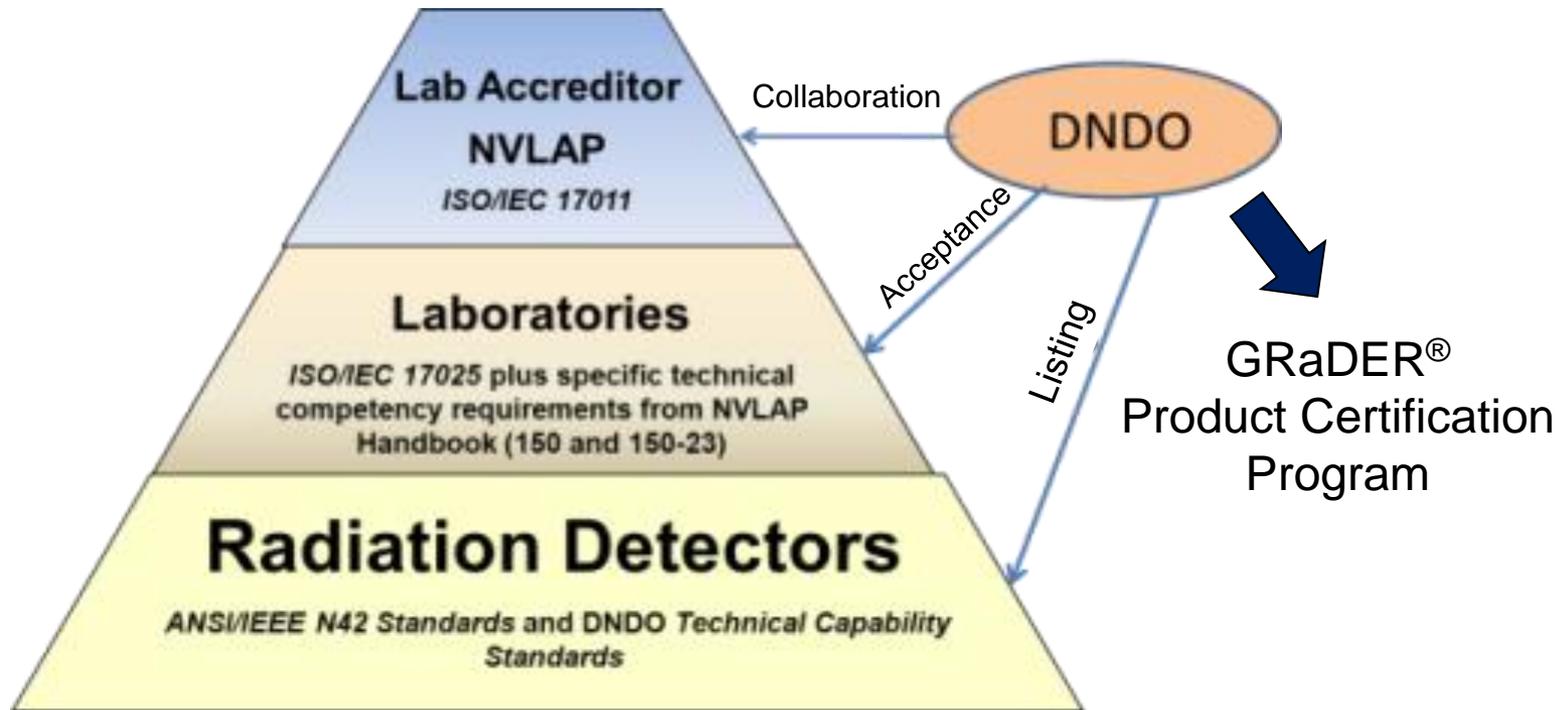


Radioactive Sources Used for Testing

- Testing laboratories need to have traceable sources to warranty reproducible test results
- Design, calibration and development of new sources to meet standard requirements as needed
- New sources were developed for testing against the ANSI/IEEE N42.35, N42.38 and N42.43 standards



Conformity Assessment Program



- 3rd party type testing to evaluate compliance to requirements of IEEE/ANSI Standard

Laboratory Accreditation - Testing Against Standards

Testing against ANSI standards:

- PRDs – ANSI/IEEE N42.32
- Hand held detectors – ANSI/IEE N42.33
- RIDs – ANSI/IEEE N42.34
- Portal monitors – ANSI/IEEE N42.35
- Spectroscopic portal monitors – ANSI/IEEE N42.38
- Mobile systems – ANSI/IEEE N42.43
- Backpacks – ANSI/IEEE N42.53

Laboratory accreditation program:

- NVLAP 150 Handbook
- NVLAP 150-23 Handbook
- Proficiency Test

http://www.nist.gov/manuscript-publication-search.cfm?pub_id=905638

DoD TTOPs: <http://gsi.nist.gov/global/index.cfm/L1-4/L2-19/A-664>

NIST HANDBOOK 150-23
2007 Edition (DRAFT)

National
Voluntary
Laboratory
Accreditation
Program

HOMELAND SECURITY
APPLICATIONS:
RADIATION DETECTION
INSTRUMENTS

Betty Ann Torres
Charlie Brannon
Leticia Pineda
Gordon Gilerman
Michael Unterwieser

National Voluntary Laboratory Accreditation Program
Division of Standards Services
Technology Services

February 2007



U.S. Department of Commerce
Carlos M. Gutierrez, Secretary

Technology Administration
Michelle O'Neill, Acting Under Secretary for Technology

National Institute of Standards and Technology
William A. Jeffrey, Director

Goals of the Rad/Nuc COTS Testing

Standardization of Government Commercial Off The Shelf Testing Program:

- **Testing of COTS based on standard test methods**
 - **Make use of existing data – including different government testing**
 - **Evaluate data based on mission needs**
 - **Make use of existing testing programs – e.g., GRaDER®**
 - **Require accredited laboratories for testing of instruments**
 - **Make use of existing accreditation program – e.g., NVLAP**
- **Instrument performance assessment based on test results**
- **Instrument characterization based on test results – assess Technology Readiness Levels (TRL: 1-9)**
- **Categorization of instrument performance based on mission**
- **Provide a national resource to support agencies currently buying instruments**

GRaDER® - <https://www.dhs.gov/grader-guidance-manufacturers>

Thank you for your attention

Questions?