



National Nuclear Security Administration



WANDA 2021: Nuclear Data for Defense Nuclear Nonproliferation Applications

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Defense Nuclear Nonproliferation (DNN) Research and Development (R&D)

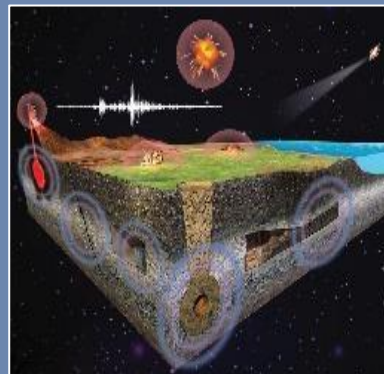
Advance U.S. nuclear security capabilities, in close coordination with mission Partners, using DOE National Laboratories, Universities, & Industry



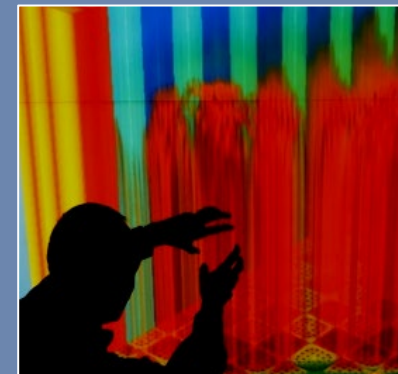
Detect Foreign Weapons Activities



Increase Nuclear Security



Detect Nuclear Explosions



Steward Nonproliferation Capabilities

Develop timely early proliferation detection capabilities

Develop high-confidence verification and monitoring capabilities

Capabilities to detect, locate & characterize foreign nuclear weapons development activities

Capabilities to detect presence, movement & diversion of SNM, including for interdiction, emergency response, safeguards

Capabilities for detecting & monitoring ground-, atmospheric-, & space-based nuclear detonations

Enabling infrastructure, science, and technology, and an expert workforce to meet future nonproliferation challenges

DNN R&D Support to Improve Nuclear Data

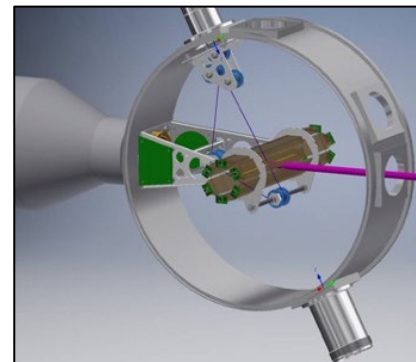
- Between FY09-FY21, experimental and theoretical investments to improve nuclear data capabilities total ~\$75M
- Investments made by:
 - NA-221 - Emergency Response, Safeguards, Arms Control Monitoring & Verification, and Near-field Detection
 - NA-222 – Forensics
- NDREW (2018) provided input for DNN R&D collectively organize nuclear data efforts
- Participation in the Office of Nuclear Physics Interagency FOA in FY18 through FY22 (including current FOA)

Defense Nuclear Nonproliferation
Research & Development
Nuclear Data Strategic Investment Plan
FY2019-2028



Current Nuclear Data Projects in DNN R&D

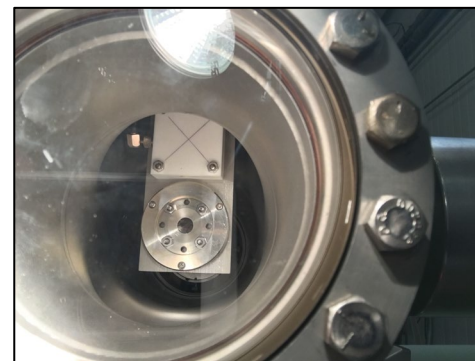
- **2017-2022, ANL:** Improving Antineutrino Spectra Predictions for Nonproliferation Applications
 - Nuclear data for fission products (FP) needed to reliably predict reactor antineutrino spectra
 - FP beams provided by the CARIBU facility, measurements w/Gammasphere
- **2018-2022, LLNL:** Fission Products decay measurements of selected isotopes for nonproliferation applications
 - Improving the Nuclear Data on Fission Product Decays at ANL's CARIBU
- **2019-2023, LANL:** Evaluation of Energy Dependent Fission Product Yields
 - FPY data for ^{235}U , ^{238}U , and ^{239}Pu isotopes using monoenergetic and pulsed neutron beams with energies from 0.5 MeV to 15.0 MeV
- (Honorable Mention): Fission in R-process Elements (FIRE) Topical Collaboration – co-funded with Nuclear Physics



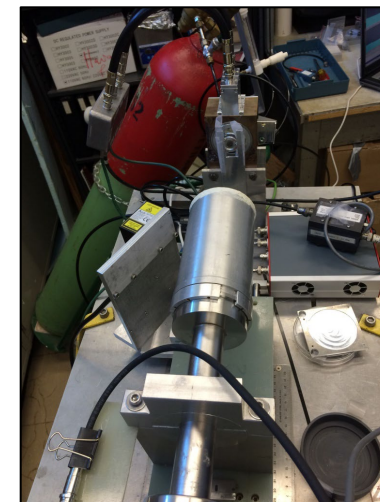
Schematic of beta particle detector array



Target chamber for installation in the Gammasphere detector array



Sample harvested at CARIBU



β - γ coincidence measurement

Focus of Projects for FY22 Interagency FOA

Scoping studies on neutron-induced emission, (α, n) reaction data, secondary γ -ray emission, non-actinide reaction networks, etc. have informed NA-22's FOA input

- Reconcile discrete gamma-ray energies, multipolarities, and branching ratios and primary/secondary gamma-ray spectral data between the ENDF/B-VIII.0 and ENSDF libraries.
- Extend the Generalized Nuclear Database Structure format to include level density information and allow discrete levels in the continuum energy range. This extension enables primary-gamma triggered cascades (i.e., from neutron capture), including complete states up to the neutron separation energy and transitions from other unresolved states.
- Review identified existing gamma production cross-section data for validity, assess any unvalidated existing cross-section data for acceptability to correct existing cross-section data, or fill in missing cross-section data.
- **Perform new gamma production cross-section measurements for incident neutron energies spanning from thermal to 14 MeV for identified, specific instances of incorrect or missing cross-sections.**

Benchmarks

Benchmark Data Needs

NA-22 has needs for improved benchmark data on a variety of elements that comprise structural and shielding materials, controlled or dangerous substances, and detector materials

- Active neutron interrogation techniques are employed in a variety of nonproliferation applications
- Modeling of secondary γ -ray emission from active neutron interrogation would benefit greatly from quality assurance checks with benchmark datasets
- Improved γ -production cross sections are needed on priority elements
- Benchmark data are primarily required from radiative capture (n,γ) and inelastic scattering ($n,n'\gamma$), depending on which cross sections dominate γ -ray production

First Priority	Follow-up	Remaining	
H	He	F	Gd
C	Li	Mg	Bi
N	Be	P	Np
O	B	S	Am
Na	Cl	Ar	
Al	Cr	K	
Si	Mn	Ca	
Fe	Ni	Ti	
Cu	Ge	As	
Pb	Br	Kr	
W	Cd	Mo	
U	I	Sn	
Pu	Cs	Sb	
	La	Xe	