Applications of Nuclear Science & Technology (ANS&T) Meeting

(held in Rockville, Maryland, August 22-23, 2011)

Lee S. Schroeder*

Presentation to the NPWG Meeting, November 17, 2011
At Brookhaven National Laboratory

*LBNL (retired) and TechSource Inc.

Application of Nuclear Science and Technology:

ANS&T Exchange Meeting
August 22-23, 2011
Rockville, MD

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Advanced Technology Research and Development
DOE Office of Science
Office of Nuclear Physics

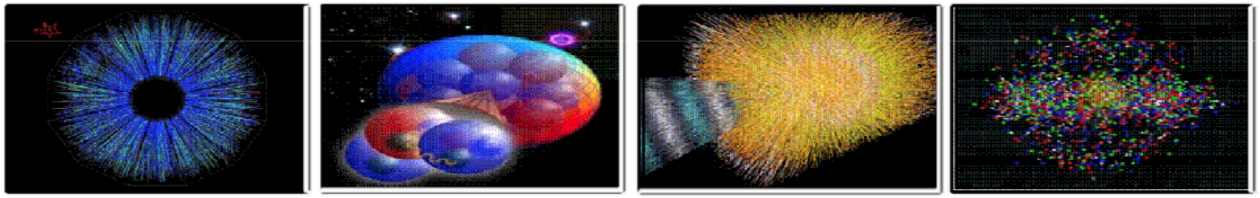
http://science.energy.gov/np/benefits-of-np/applications-of-nuclear-science -and-technology/

Nuclear Physics Program Mission

Mission: To discover, explore and understand all forms of nuclear matter; to understand how the fundamental particles, quarks and gluons, fit together and interact to create different types of matter in the universe, including those no longer found naturally

Priorities:

- To understand how quarks and gluons assemble into the various forms of matter and to search for yet undiscovered forms of matter
- To understand how protons and neutrons combine to form atomic nuclei and how these nuclei have emerged during the 13.7 billion years since the origin of the cosmos
- To understand the fundamental properties of the neutron and develop a better understanding of the neutrino
- To conceive, plan, design, construct, and operate national scientific user facilities; to develop new detector and accelerator technologies
- To provide stewardship of isotope production and related technologies to advance important applications, research and tools for the nation
- To foster integration of the research with the work of other organizations in DOE



NP Isotope Program Mission

In 2009 the Isotope Production Program from DOE Office of Nuclear Energy was transferred to the Office of Science's Office of Nuclear Physics.

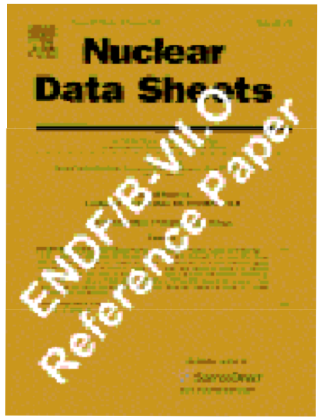
The **mission** of the DOE Isotope Program is three fold:

- Produce and/or distribute radioactive and stable isotopes that are in short supply, associated byproducts, surplus materials and related isotope services.
- Maintain the infrastructure required to produce and supply isotope products and related services.
- Conduct R&D on new and improved isotope production and processing techniques which can make available new isotopes for research and applications.

Isotope Production Facility (LANL)

Brookhaven Linac Isotope Producer

National Nuclear Data Center (NNDC) At BNL



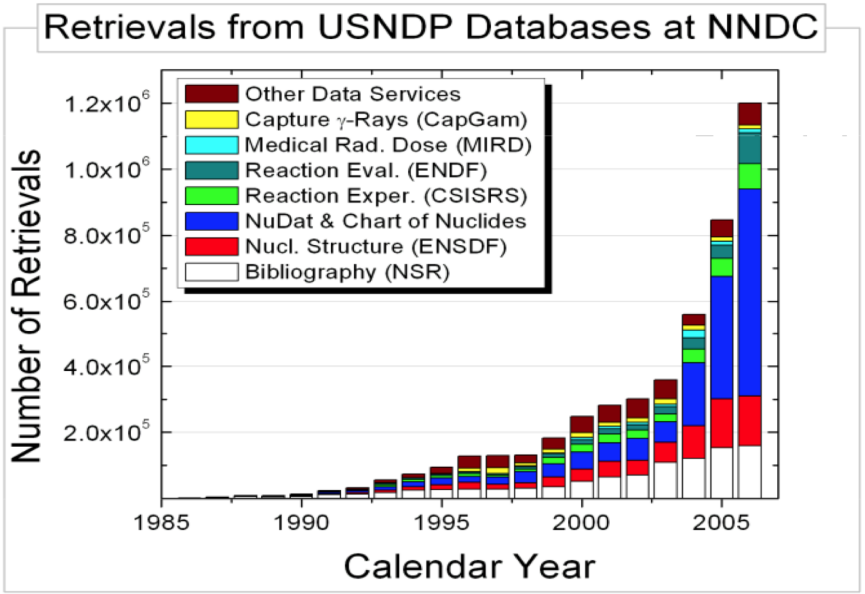
Evaluated Nuclear Data

USNDP:

- U. S. Nuclear Data Program (USNDP) evaluates, archives and disseminates information
- Information (nuclear properties/reaction cross sections) from nuclear physics research worldwide
- U.S. activities coordinated by the National Nuclear Data Center (NNDC) at BNL

Applications:

- Basic Nuclear Physics Research
- Accelerator Design
- Nuclear Medicine & Imaging
- Energy Generation
  - New reactors
  - Transmutation of waste
- National Security
  - Stockpile stewardship
  - Safeguards & nuclear management
  - Nuclear interrogation



Nuclear Data
Link Between Basic Science and Applications

Nuclear Science Community

✦ microscopic experiments

✦ (microscopic) theories

✦ publications

Nuclear Data Community

✦ compiles results of microscopic measurements

✦ evaluates them and provides complete files of recommended values using nuclear theory modeling

✦ archives and disseminates, bibliography, experimental data and recommended data files in readable format (ENDF, ENSDF)

✦ preservation of information worth billions

✦ development of nuclear reaction theory

Application Community

✦ For R&D needs data:

- complete
- consolidated
- organized
- traceable
- readable

✦ Validates data against integral measurements

ANS&T Exchange Meeting

This is a two-day presentation meeting between the Principal Investigators (PIs) with 2009 and 2010 awards in Applications of Nuclear Science and Technology (ANS&T) supported by NP and American Recovery and Reinvestment Act ARRA funds, interested members of the NP community, NP Federal Program Managers, and Program Managers from other federal agencies with programmatic interests in ANS&T. The meeting today is designed to achieve the following goals:

- To provide a platform for the PI to present the status of their NP-supported grant work in ANS&T to the NP Program Managers, to interested people from the NP community, and to Federal Program Managers from other agencies.

- To provide an opportunity for NP to assess the progress made on each grant.

- To offer an opportunity to exchange information with the community and other federal agencies regarding each group's application work and capabilities.

- To provide the interested agencies with an opportunity to expand their awareness of potentially new capabilities in the field.

Basis of ANS&T Initiative

The primary goal of ANS&T initiative is to pursue forefront nuclear science research and development needed to achieve Nuclear Physics mission goals and that are also relevant to applications important to the Nation. Proposals that are solely based on pure research or pure application will not be considered for funding.

Areas of interest include but are not limited to:

a. Identification and development of approaches to the measurement of **nuclear data** needed for the nuclear energy industry and other applications;

b. Measurement of neutron cross sections and other relevant nuclear data such as decay properties, delayed neutrons, fission yields, photon production, etc., required for advanced reactor fuel cycles and other applications.

c. Development and **use of covariances and covariance matrices to support reactor and fuel cycle design** and other applications, and to identify priorities for cross section measurements and improved modeling of nuclear reactions.

d. Existing or **new instrumentation and accelerator design and development**, and analytical and computational methods that can be applied to nuclear forensics, handling of nuclear wastes, nuclear energy, national defense, medicine, environmental, space exploration, finance, commerce, radiation health physics, etc;

Proposal Evaluation

- **A Panel Review process is used for selection of proposals for award**

- **Criteria for Proposal Evaluation**
  - **Scientific and/or technical** merit of the proposed project – both the nuclear physics research and the application of that research;
  - The **Appropriateness of the proposed method** or approach;
  - The **Competency of the applicant's** personnel;
  - The adequacy of the **proposed resources**, and the reasonableness and appropriateness of the proposed **budget;** and
  - Any other factors relevant to the proposed project.

- **Program Policy Factors**

  a. The particular outstanding scientific opportunity in nuclear physics research afforded by the proposed research and its relevance to the **NSAC Performance Measures** and/or opportunities identified in the NSAC 2007 Long Range Plan;

  b. The **relevance** and impact of this opportunity on **applications and applied sciences**; and

  c. The opportunity for **training personnel** in key disciplines of nuclear science that are in short supply, such as nuclear chemistry and closely related disciplines, nuclear forensics, nuclear engineering, and radiation health science.

ANS&T Applications and Awards

FY 2009

- NP received over **200 applications** in FY 2009 in response to ANS&T FOA 09-13.
- Total funding available: **$22M** (~19M ARRA funding and ~3M from NP base)
- Following a panel review of the proposals a total of 22 proposals were selected for funding.

FY 2010

- Four additional proposals ranked highest from the remaining proposals were funded in FY10.
- Total funding available: **$3.7M**

The PI presentations in this meeting cover FY 2009 and 2010 awards

FY 2011

- NP received about **49 applications** in FY 2011 in response to ANS&T FOA 11-450
- Total funding available: **$3.2M**
- Following a panel review of the proposals , a total of 9 proposals were selected for funding.

Applications and Awards

FY 2009 ($22 M)	National Labs	University	Industry	Total
# of Applications	94	90	34+1	219
# of Awards	19	2	1	22

FY 2010 ($3.7 M)	National Labs	University	Industry	Total
# of Applications	-	-	-	-
# of Awards	4	1	0	5

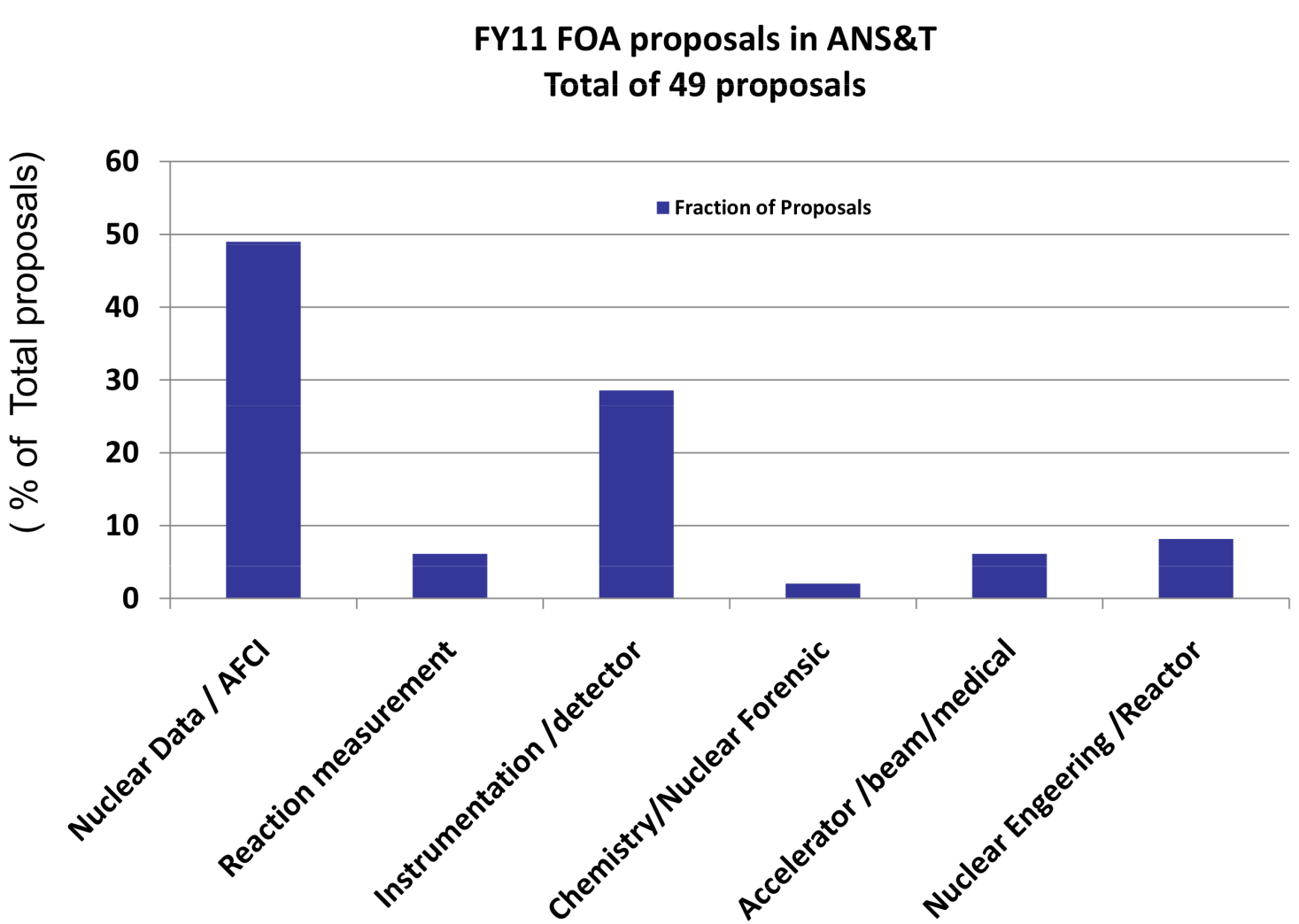
FY 2011 ($3.2 M)	National Labs	University	Industry	Total
# of Applications	32	10	7	49
# of Awards	7	2	0	9

FY 2009 Proposal Awards

	FY 2009 funding of FOA 09-13, "Application of Nuclear Science and Technology"				
	Proposal Title	***Institutions***	***Principal Inv.***	***Duration (Years)***	***Funding ($k)***
1	Development of an Atom-Trap Detector to Analyze Rare Isotopes of Noble Gas	ANL	Zheng-Tian Lu	3	1300
2	Measurement and Evaluation of Actinide Neutron Cross Sections Relevant to Advanced Fuel	INL (Lead) /ANL	Youinou /Kondev and Pardo	3	1060 / 960
3	Transfer Reactions on Unstable Nuclei Science Applications	ORNL	Bardayan	3	1900
4	Neutron Cross Section Covariances for the ENDF/B-VII Library	BNL (Lead) /LANL	Oblozinsky /Talou	3	1400 / 1000
5	Construction, Optimization And First Experiments: Oak Ridge Isomer Spectrometer And Separator (Oriss)	Oak Ridge Associated U. (OAU)	Carter	3	1780
6	Total Absorption Spectrometer	ORNL	Grzywacz/ Rykaczewski	3	1580
7	Nuclear Reaction Modeling for Actinides	LANL (Lead) /LANL	Kawano /Younes	3	1005 / 695
8	New Approach for 2D Readout of GEM Detectors	MIT	Hasell	1	160
9	Single Crystal Large Volume Position Sensitive HPGe Detectors	ORNL	Radford	3	900
10	Use of Covariances in a Consistent Data Assimilation for Improvement of Basic Nuclear Parameters in Nuclear Reactor Applications: From Meters to Femtometers	INL (Lead) /BNL	Palmiotti /Herman	3	682 / 408
11	Beta-Decay Studies of Neutron-Rich Fission Products for Advanced Fuel Cycle Applications	ANL	Lister	3	2000
12	Improved Prompt and delayed Decay Specra for Advanced Fuels	LANL (lead) /LLNL	Hayes /Ching-Yen Wu	3	1098 / 592
13	Fiber Optic Based Thermometry System for Superconducting RF Cavities	MicroXact Incorporated	Kochergin	3	584
14	SRF Q0 Improvement Program	TJNAF	Myneni	2	684
15	Development Of A Suite Of Engineered Multi-Spoke Superconducting Cavities For Nuclear Physics, Light Sources, And Driven Systems Applications	ODU /TJNAF	Delayen /Mammosser	3	1448 / 1150

FY 2010 Proposal Awards

	FY 2010 funding of FOA 09-13, "Application of Nuclear Science and Technology"				
	Proposal Title	***Institutions***	***Principal Inv.***	***Duration (Years)***	***Funding ($k)***
1	Development of fast 3D gamma-ray imaging technologies for radiation treatment, nuclear physics and nuclear security	LBNL	Mihailescu	3	1026
2	Development of Field-Shaping Electrode Configurations for High-Resolution Semiconductor Radiation Detectors for Nuclear Sciences, Forensics, and Safeguards	LBNL	Vetter	3	1350
3	Application of Two Phase (Liquid/Gas) Xenon Gamma-Camera to the Detection of Special Nuclear Material and PET Medical Im	Yale /U Conn	McKinsey /Gai	1	342
4	Cross Section Measurement and Evaluation for Nuclear Applications	LBNL	Firestone	1	380
5	Micropattern Optical Sensors in Scintillian Counters	ORNL	Varner	3	650


FY11 FOA proposals in ANS&T
Total of 49 proposals
(% of Total proposals)
60
50
40
30
20
10
0
Fraction of Proposals
Nuclear Data / AFCI
Reaction measurement
Instrumentation /detector
Chemistry/Nuclear Forensic
Accelerator /beam/medical
Nuclear Engeering /Reactor

Agenda page 1

DOE-NP ANS&T Exchange Meeting

AGENDA		Plaza I		1439.26
Day - 1: Monday, August 22, 2011		NUCLEAR DATA		
Time	**Dur.**	**Presentation Title**	**Speaker**	**Organization**
8:30 AM	10	Welcome and Introductory Remarks	Hallman/Gillo	DOE, NP
8:40 AM	30	ANS&T Program	Manouchehr Farkhondeh	DOE, NP
9:10 AM	40	Neutron Cross Section Covariances for the ENDF/B-VII Library [Collaboration]	Herman/Talou	BNL/LANL
9:50 AM	40	Use of Covariances in a Consistent Data Assimilation for Improvement of Basic Nuclear Parameters in Nuclear Reactor Applications: From Meters to Femtometers [*Collaboration*]	Palmiotti/Herman	INL/BNL
10:30 AM	**30**	**Coffee Break**		
11:00 AM	40	Nuclear Reaction Modeling for Actinides [Collaboration]	Kawano/Younes	LANL/LLNL
11:40 AM	45	**Keynote speaker - 1**	Giuseppe Palmiotti	INL
12:25 PM	**65**	**Lunch Break**		
1:30 PM	30	Transfer Reactions on Unstable Nuclei for Nuclear Science Applications	Bardayan	ORNL
2:00 PM	30	Beta-Decay Studies of Neutron-Rich Fission Products for Advanced Fuel Cycle Applications	Lister	ANL
2:30 PM	30	Decay studies of fission products with a new Modular Total Absorption Spectrometer (MTAS)	Rycaczewski	ORNL
3:00 PM	**30**	**Coffee Break**		
3:30 PM	30	Cross Section Measurement and Evaluation for Nuclear Applications	Firestone	LBNL
4:00 PM	40	Measurement and Evaluation of Actinide Neutron Cross Sections Relevant to Advanced Fuel Cycles via Accelerator Mass Spectroscopy [*Collaboration*]	Youinou/Pardo	INL/ANL
4:40 PM	40	Improved Prompt and Delayed Decay Spectra for Advanced Fuels [*Collaboration*]	Hayes-Sterbenz/Wu	LANL/LLNL
5:20 PM	**Adjourn**			

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DOE-NP ANS&T Exchange Meeting

AGENDA		Plaza I		
Day - 2: Tuesday, August 23, 2010		INSTRUMENTATION		
Time	**Dur.**	**Presentation Title**	**Speaker**	**Organization**
8:30 AM	30	Development of an Atom-Trap Detector to Analyze Rare Isotopes of Noble Gas	Lu	ANL
9:00 AM	30	Construction, Optimization And First Experiments: Oak Ridge Isomer Spectrometer And Separator (ORISS)	Carter	ORAU
9:30 AM	40	Development of a Suite of Engineered Multi-Spoke Superconducting Cavities for Nuclear Physics, Light Sources, and Driven Systems Applications *[Collaboration]*	Delayen/Mammosser	ODU/TJNAF
10:10 AM	**30**	**Coffee Break**		
10:40 AM	30	SRF Q0 Improvement Program	Myneni	TJNAF
11:10 AM	30	Fiber Optic Based Thermometry System for Superconducting RF Cavities	Kochergin	MicroXact
11:40 AM	45	**Keynote speaker - 2**	**Lee Schroeder**	**TechSource-Inc./LBNL**
12:25 PM	**65**	**Lunch Break**		
1:30 PM	30	Fast 3D gamma-ray imaging technologies for radiation treatment, nuclear physics and nuclear security	Mihailescu	LBNL
2:00 PM	30	Single Crystal Large Volume Position Sensitive HPGe Detectors	Radford	ORNL
2:30 PM	30	Application of Two Phase (Liquid/Gas) Xenon Gamma-Camera to the Detection of Special Nuclear Material and PET Medical Imaging	Destefano/McKinsey	YALE
3:00 PM	**30**	**Coffee Break**		
3:30 PM	30	Development and applications of micropattern optical sensors to scintillation counters	Varner	ORNL
4:00 PM	30	Field-Shaping Electrode Configurations for High-Resolution Semiconductor Radiation Detectors for Nuclear Sciences, Forensics, and Safeguards	Vetter	LBNL
4:30 PM	30	New Approach for 2D Readout of GEM Detectors	Redwine/Hasell	MIT
5:00 PM	**15**	**Closing Remarks**		
5:15 PM	**Adjourn**			

Nuclear Data Needs for Advanced Reactors and Fuel Cycles

Giuseppe Palmiotti

DOE-NP ANS&T Exchange Meeting
August 22-23, 2011
Hilton Hotel & Executive Meeting Center, Rockville, MD

NUCLEAR PHYSICS APPLICATIONS WITH EMPHASIS ON:

Instrumentation

Early Prospecting Gear

Accelerators

First Cyclotron, Berkeley Rad Lab

Lee S. Schroeder*

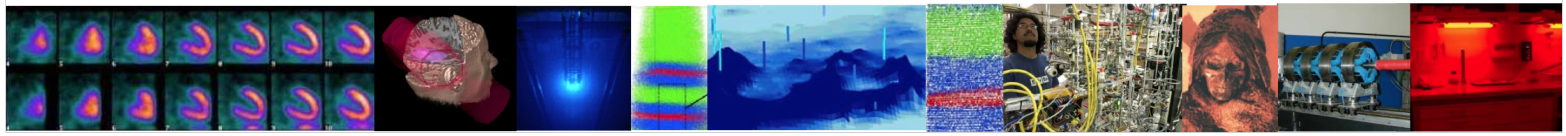
Presented to the Applications of Nuclear Science & Technology (ANS&T)

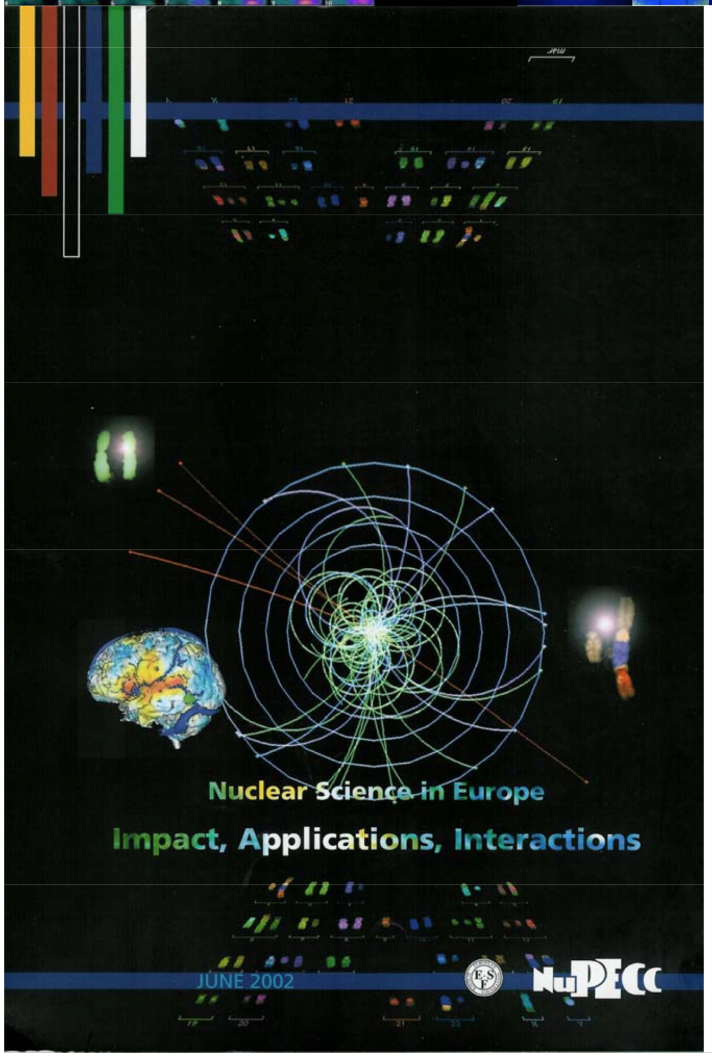
Rockville Maryland, August 22-23, 2011

Nuclear Physics Applications

in industry, medicine, and liberal arts

- Energy Sources
- Nuclear Forensics
- Homeland Security
- Imaging and Diagnostics
- Radiation Treatment
- Material Science
- Art and Archaeology





Physics Applications

Energy

- ADS & Transmutation
- Fusion confinement
- Nuclear Waste
- Energy Storage

Nuclear Forensics

- Homeland Security
- Risk Assessments
- Nuclear Trafficking
- Proliferation

Life Science

- Medical Diagnostics
- Medical Therapy
- Radiobiology
- Biomedical tracers

Material Analysis

- Nanotechnology
- Ion Implantation
- Material Structure
- Geology & Climate
- Environment
- Art & Archaeology

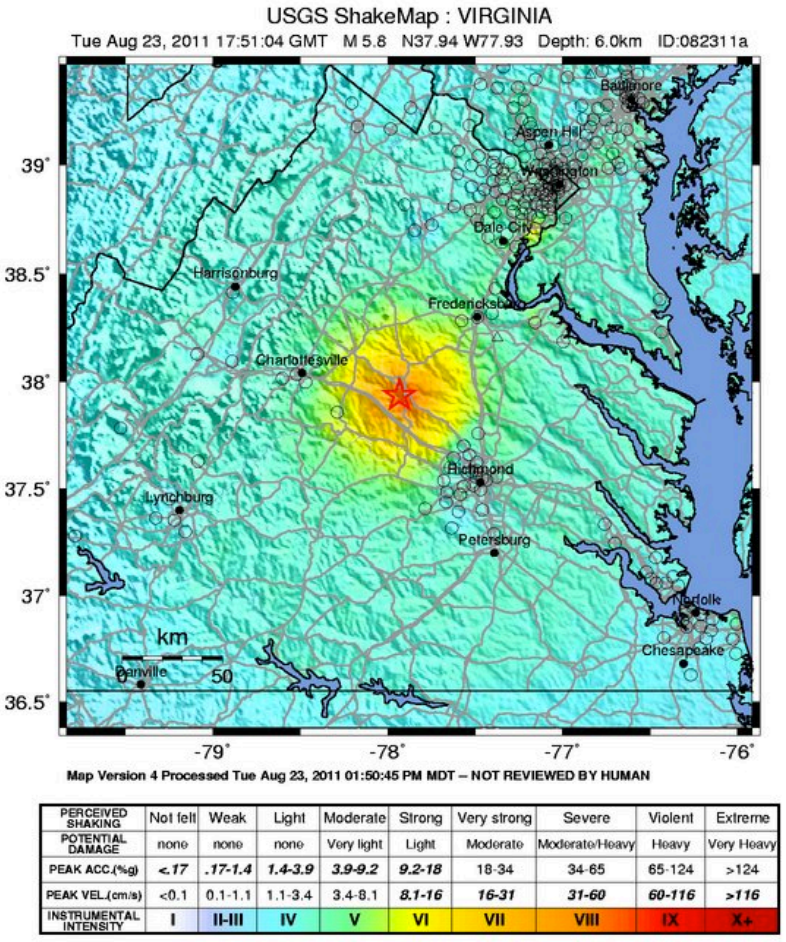
Nuclear Defense

- Weapon Analysis
- Functionality
- Long-Term Storage

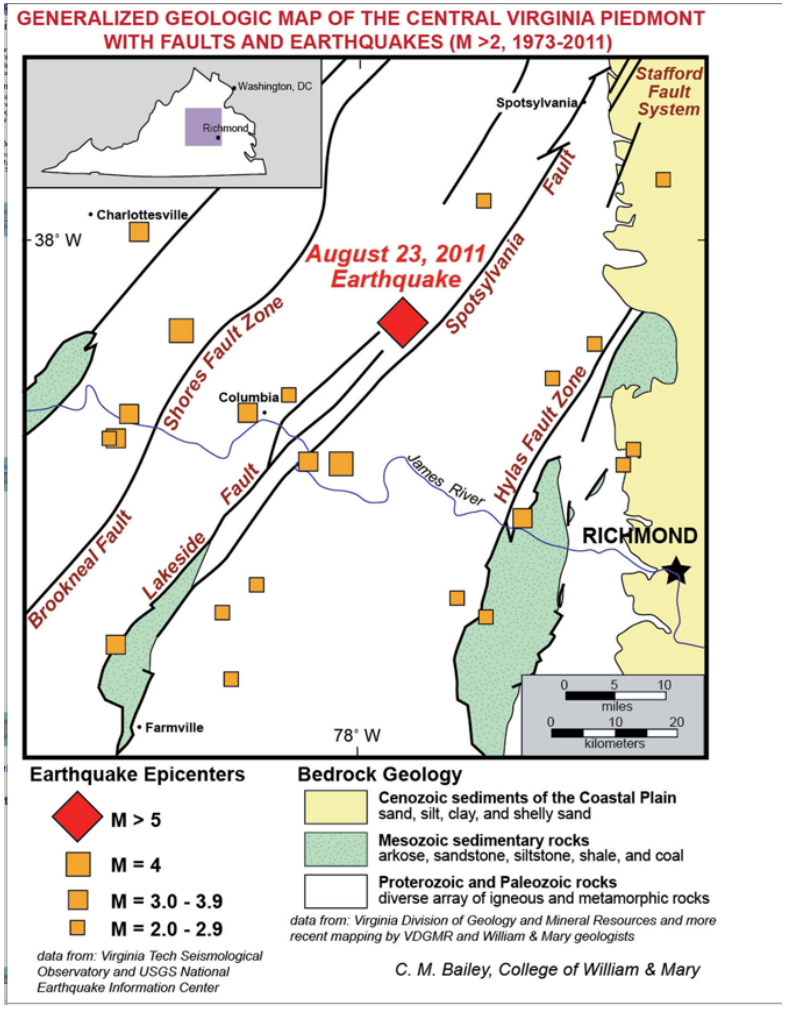
Computation

- Monte Carlo Simulation
- Network Simulation
- Software Development
- Quantum computing

A 5.8 magnitude earthquake hit Virginia region in the U.S. on Tuesday at 1:51 p.m. (EDT), causing moderate tremors and several aftershocks across the U.S. East Coast.



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17-1.4*	*1.4-3.9*	*3.9-9.2*	*9.2-18*	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	*8.1-16*	*16-31*	*31-60*	*60-116*	*>116*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+



BACKUP SLIDES

DOE Isotope Program History

Public Law 101-101 (1990), as modified by Public Law 103-316 (1995) created the Isotope Production and Distribution Program Fund (called a revolving fund) and allow prices charged to be based on costs of production, market value, U.S. research needs and other factors

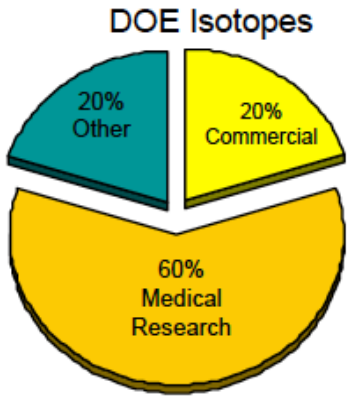
Prices for commercial isotopes are based on full cost. Prices for research isotopes are based on direct cost and may be partially subsidized

The DOE Isotope Program is new to the Office of Science

The Fiscal Year (FY) 2009 President's Request Budget proposed to transfer the Isotope Production Program from the Department of Energy (DOE) Office of Nuclear Energy to the Office of Science's Office of Nuclear Physics

Transfer become complete with Congressional Appropriation

Majority of isotopes produced are for medical community



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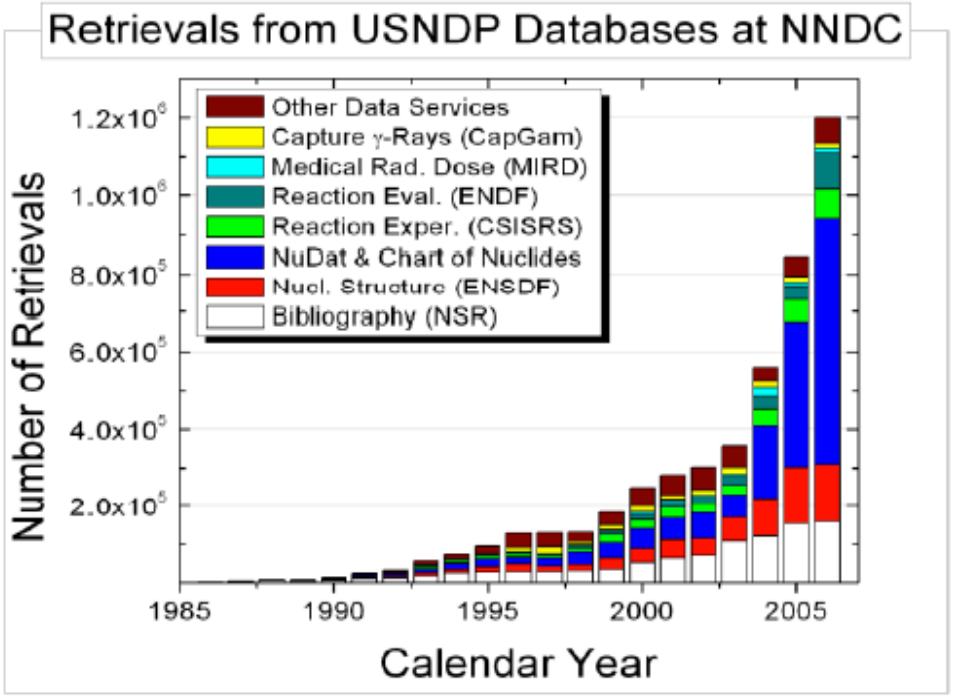
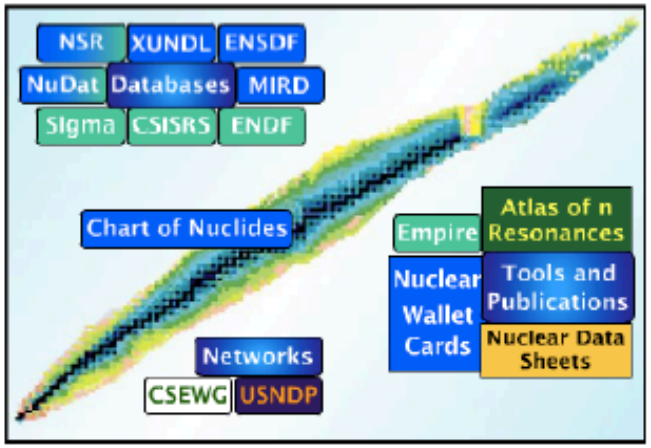


Nuclear data dissemination

NNDC Web site www.nndc.bnl.gov



NNDC **National Nuclear Data Center**
BROOKHAVEN NATIONAL LABORATORY

- Nuclear Structure and Decay Databases
- Nuclear Structure and Decay Tools
- Nuclear Reaction Databases
- Nuclear Reaction Tools
- Bibliography Databases
- Networks and Links
- About the Center
- Publications
- Meetings

2010 ND Week
Santa Fe
November 1-5

ENDF-6 Manual New USNDP/CSEWG GForge Server

Site Index - Search the NNDC: Go

AMDC Atomic Mass Data Center, *Q-value Calculator*

Atlas of Neutron Resonances Parameters & thermal values

CapGam Thermal Neutron Capture γ-rays

Chart of Nuclides Basic properties of atomic nuclei

Covariances of Neutron Reactions

CSEWG Cross Section Evaluation Working Group

CSISRS alias EXFOR Nuclear reaction experimental data

Empire Nuclear reaction model code system, *Reference paper*

ENDF Evaluated Nuclear (reaction) Data File, *Sigma*

ENSDF Evaluated Nuclear Structure Data File

IRDF International Reactor Dosimetry File

MIRD Medical Internal Radiation Dose

NMMSS & DoE NMIRDC Safeguards & inventory decay data standards

NSR Nuclear Science References

Nuclear Data Sheets Nuclear structure & decay data journal, *Special Issues on reaction data*

Nuclear Wallet Cards Ground & isomeric states properties, *Homeland Security version*

NucRates MACS & Astro-physical reaction rates

NuDat Nuclear structure & decay Data

USNDP U.S. Nuclear Data Program

XUNDL Experimental Un-evaluated Nuclear Data List

Sponsored by the Office of Nuclear Physics - Office of Science - U.S. Department of Energy

Acknowledgments - Comments/Questions - Disclaimer