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Title:	Science, Technology and Engineering at LANL
Author(s):	Janet A. Mercer-Smith and Terry C. Wallace
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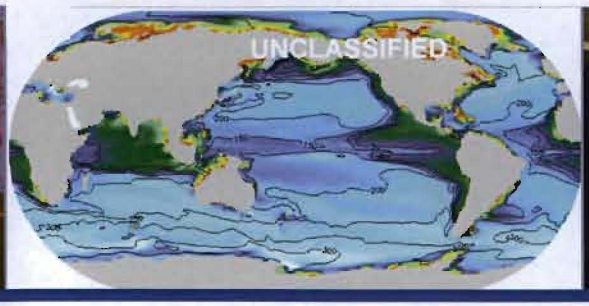
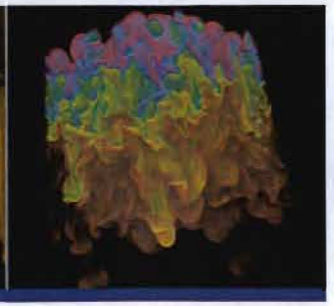
Form 836 (7/06)

Science, Technology and Engineering at LANL

Janet A. Mercer-Smith and Terry C. Wallace

The Laboratory provides science solution to the mission areas of nuclear deterrence, global security, and energy security. The capabilities support the Laboratory's vision as the premier national security science laboratory. The strength of LANL's science is at the core of the Laboratory. The Laboratory addresses important science questions for stockpile stewardship, emerging threats, and energy. The underpinning science vitality to support mission areas is supported through the Post Doc program, the fundamental science program in LDRD, collaborations fostered through the Institutes, and the LANL user facilities. LANL fosters the strategy of Science that Matters through investments, people, and facilities.



Capabilities of the Lab serve program.

Science, Technology and Engineering at LANL

Terry C. Wallace
Principal Associate Director for
Science, Technology and Engineering

January 13, 2011

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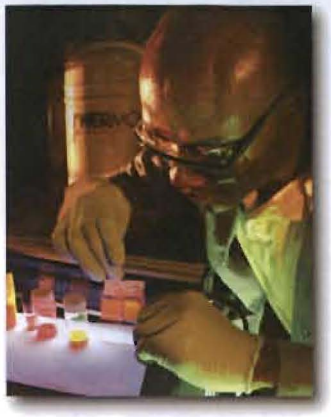
LANL identified core capabilities to support its mission.

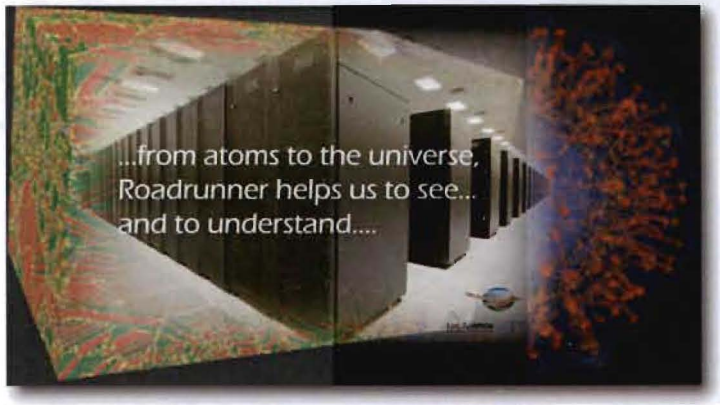
- Capabilities are strategic areas where LANL needs to excel.
- Capabilities are chosen to be cross-cutting.
- Capabilities are led by an Associate Director.
- Capabilities do not reside in one organization.
- Strategies and plans are being developed for each capability.



CINT: nanomaterials

LANSCE: proton radiography

Trident laser facility



Roadrunner supercomputer

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Capabilities

LANL identified core capabilities to support its mission.

- Accelerators and Electrodynamics
- Advanced Manufacturing
- Biosciences
- Chemical Science
- Computational Physics and Applied Mathematics
- Computer and Computational Sciences
- Earth and Space Sciences
- High-Energy Density Plasmas and Fluids
- Information and Knowledge Sciences
- Materials
- Nuclear Engineering and Technology
- Nuclear and Particle Physics, Astrophysics, and Cosmology
- Sensors, Remote Sensing, and Sensor Systems
- Weapons Science and Engineering

Peer review: 24 capability reviews over the last four years assessed status of capabilities and made recommendations.

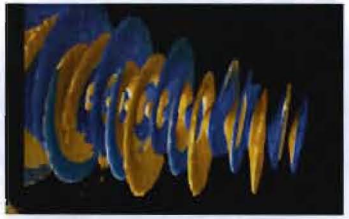
The capabilities of the Laboratory serve program.

Weapons Science & Engineering

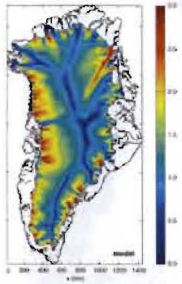
Accelerators & Electrodynamics

Biosciences

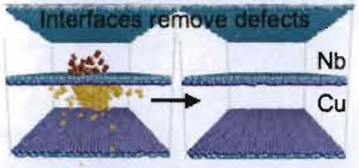
Chemical Science



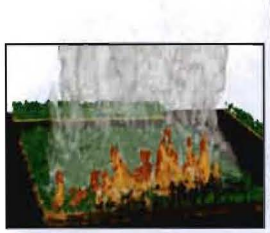
Computational Physics & Applied Mathematics



Information & Knowledge Science



Materials



Earth & Space Sciences

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Capabilities

LANL's capabilities map to SC Core Capabilities.

- Particle Physics
- Nuclear Physics
- Accelerator Science & Technology
- Plasma and Fusion Energy Sciences
- Condensed Matter Physics & Materials Science
- Chemical & Molecular Science
- Climate Change Science
- Biological Systems Science
- Environmental Subsurface Science
- Applied Mathematics
- Advanced Computer Science, Visualization, & Data
- Computational Science
- Applied Nuclear Science & Technology
- Applied Materials Science & Engineering
- Chemical Engineering
- Systems Engineering & Integration
- Large-Scale User Facilities/Advanced Instrumentation

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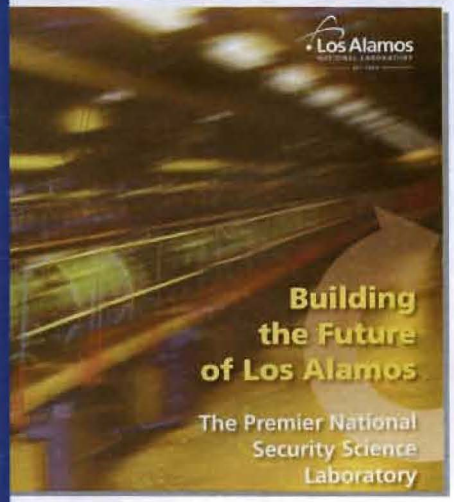
LANL's Major S&T Initiatives



- Experimental science focused on materials for the future
- Information science and technology enabling integrative and predictive science
- Science of Signatures for enduring national needs

Materials for the Future

Information Science and Technology for Integrative and Predictive Science

Science of Signatures

Controlled Functionality
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Strategy to Maintain Science Excellence

Materials for the Future: building toward MaRIE

LDRD DR Investments

- **Meso-scale Modeling of the Evolution of Interfaces under Extreme Strains**
- **Kinetic and Spatial Effects on Dynamic Damage**
- **Spatial-temporal Frontiers of Atomistic Simulations in the Petaflop World**
- **Robust Nuclear Waste Form Design and Novel Materials Discovery**

MaRIE

Centers and Consortia

BES: Fundamental Science

CMIME
Center for Materials at Irradiation and Mechanical Extremes

CMSNF
Center for Materials Science of Nuclear Fuel

Center for Defect Physics

NE:Applied Modeling & Simulation

CASL
Consortium for Advanced Simulation

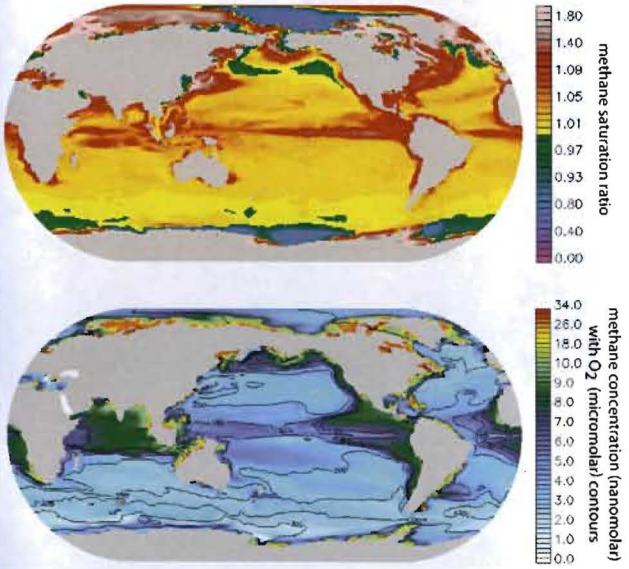
Advanced Scientific Computing Research

Exascale Codesign Center for Materials in Extremes

Strategy to Maintain Science Excellence

Science of Signatures

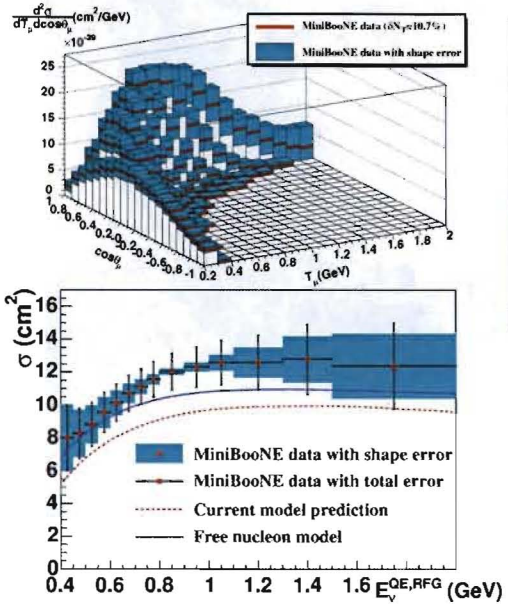
Methane in Ocean



- Model methane release from clathrates as climate warms
- Increased methane concentration would cause areas of hypoxia in the ocean

Journal of Geophysical Research (in press 2010)

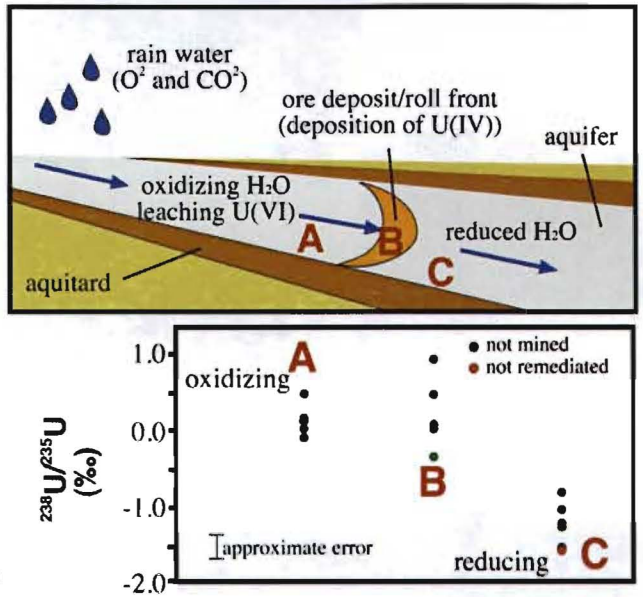
MiniBoone



- Neutrino charged-current quasi-elastic scattering on carbon
- Higher cross section than model gives insight into nuclear physics

Physical Review D (2010)

Actinide Measurements



- Unprecedented precision in measuring uranium isotopes
- Applications in environmental remediation, nuclear forensics

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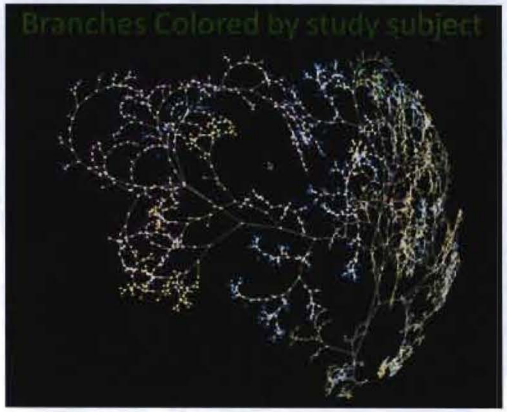
Strategy to Maintain Science Excellence

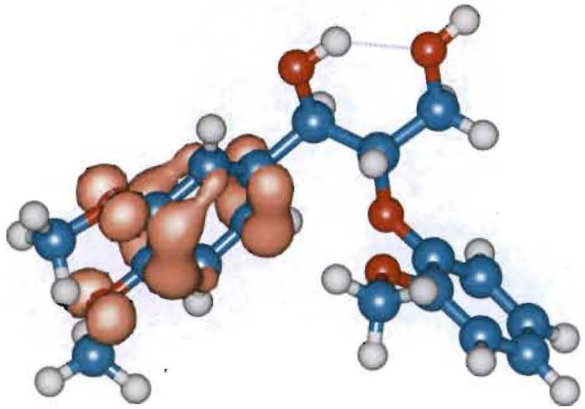
Information Science and Technology

Health: HIV



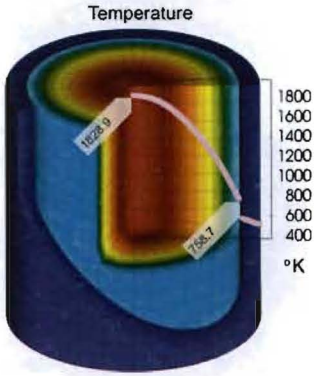
- HIV evolution and design of "mosiac vaccines"
- *Nature Medicine* 2010 (2 papers)
- Center for HIV/AIDS Vaccine Immunology consortium plans human trials of mosiac vaccines

Biofuel

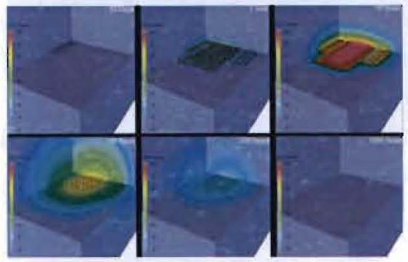


- Simulate lignin decomposition
- Application for conversion of biomass to biofuel
- *Journal of Organic Chemistry* 2010

Nuclear Energy



- Model across scales for predictive, physics-based fuel performance



- 3D thermal analysis of high level waste in a generic salt repository

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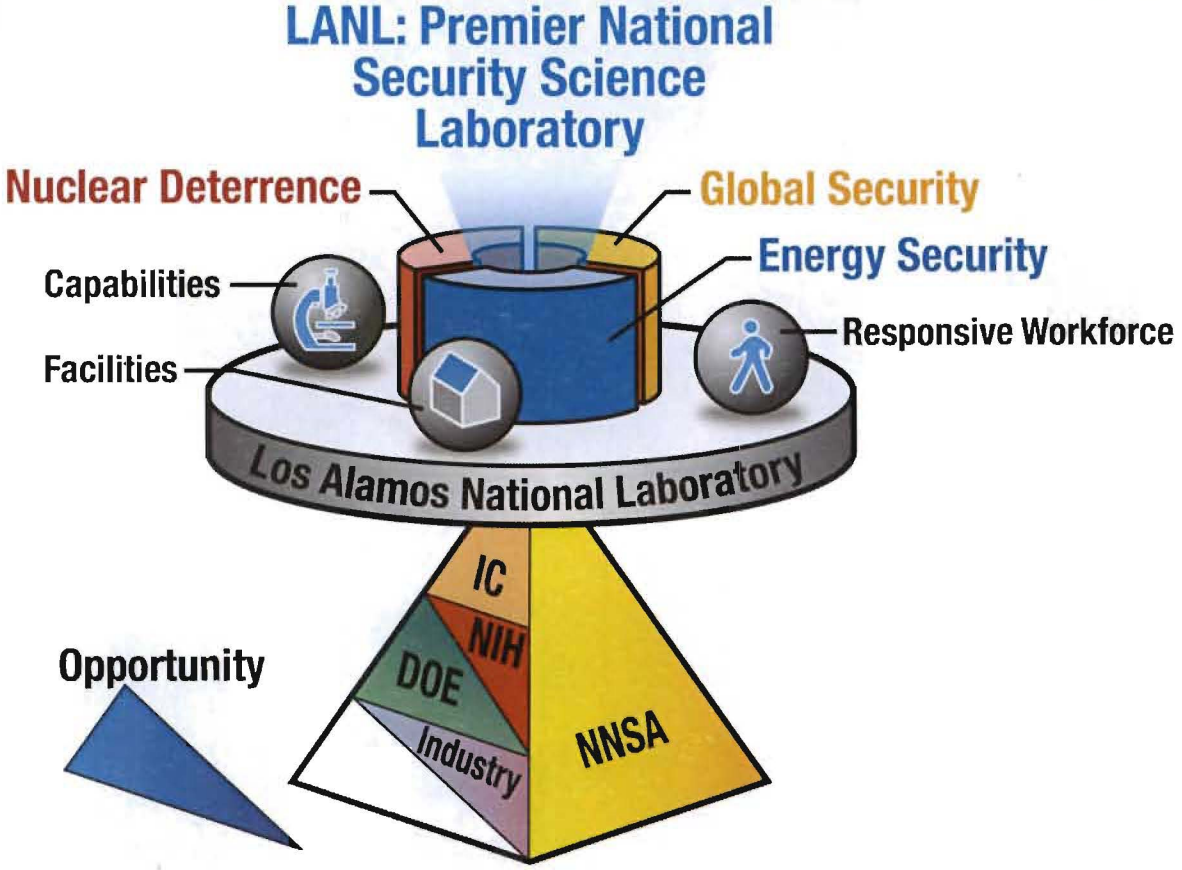
LANL's WFO Strategy

- Advances national security missions
- Drives excellence in our core capabilities
- Leverages LANL's strengths
- Ensures that WFO does not detract from NNSA mission



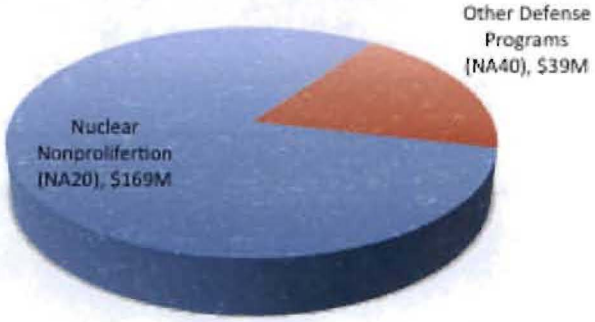
Supports fundamental capabilities needed for a national security science Lab.

Components of WFO

NNSA work other than NA-10

FY09 NA-20 & -40 BA shown

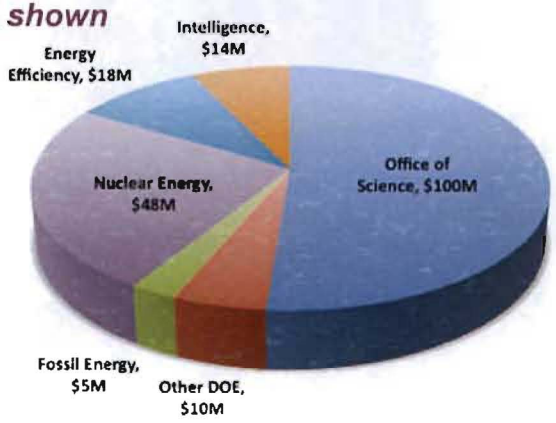
$208M



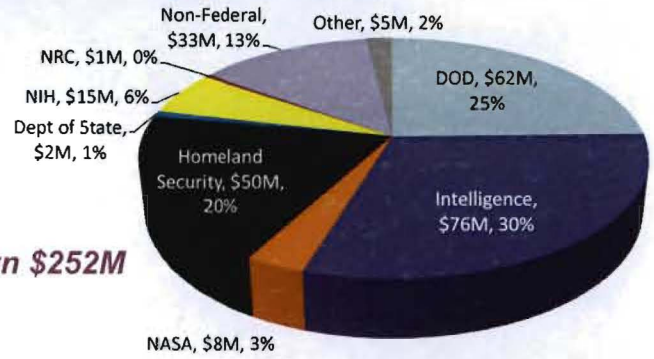
DOE work other than NNSA

FY09 BA shown

$195M



National Security work Other than DOE ("WFO")

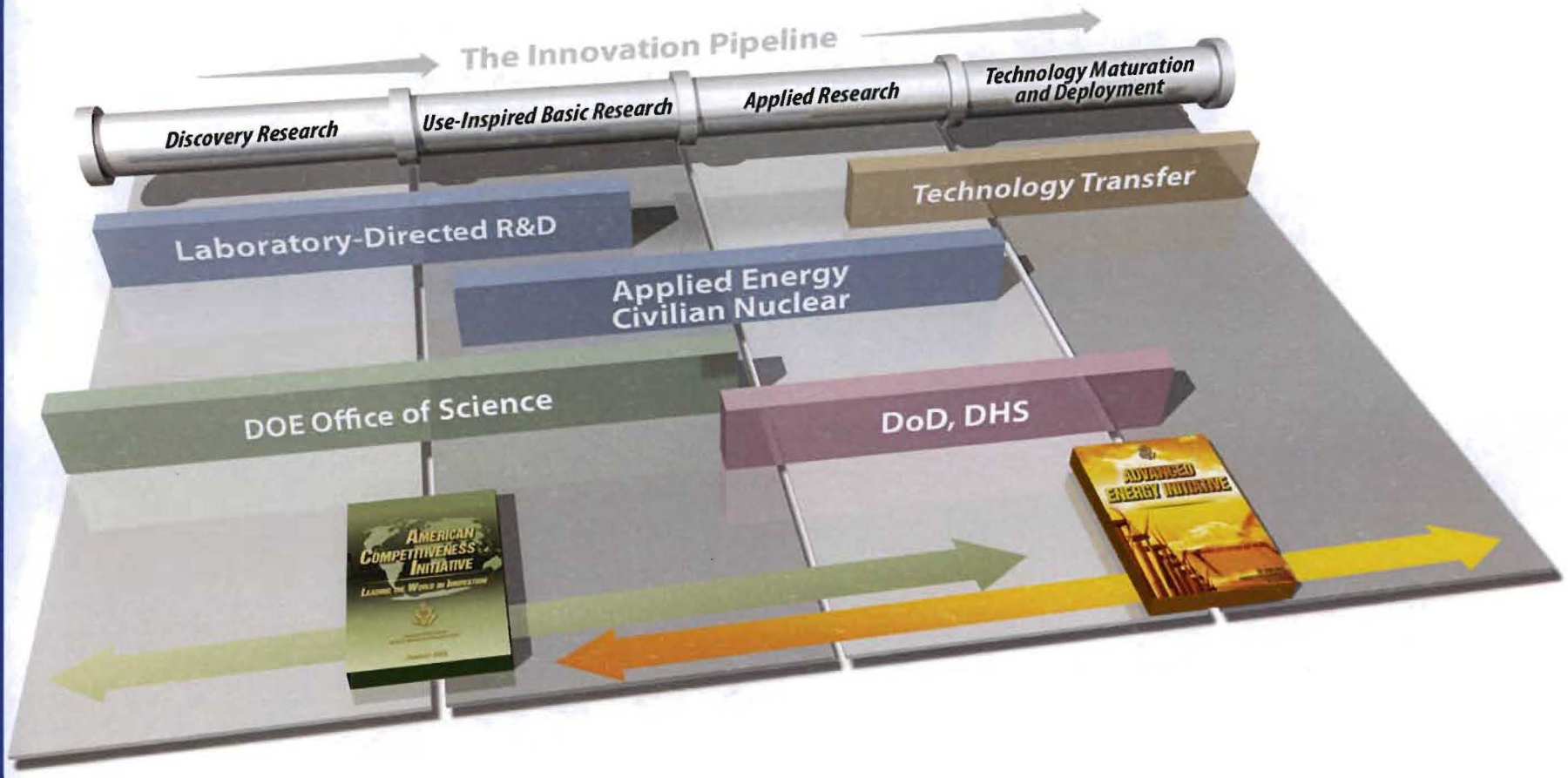


FY09 BA shown $252M

WFO-related fee component (based on WFO est. costs)

FY07	$7,393K
FY08	$7,304K
FY09	$6,886K
FY10	$6,592K (est.)

The innovation pipeline supports the Lab's science and capabilities.



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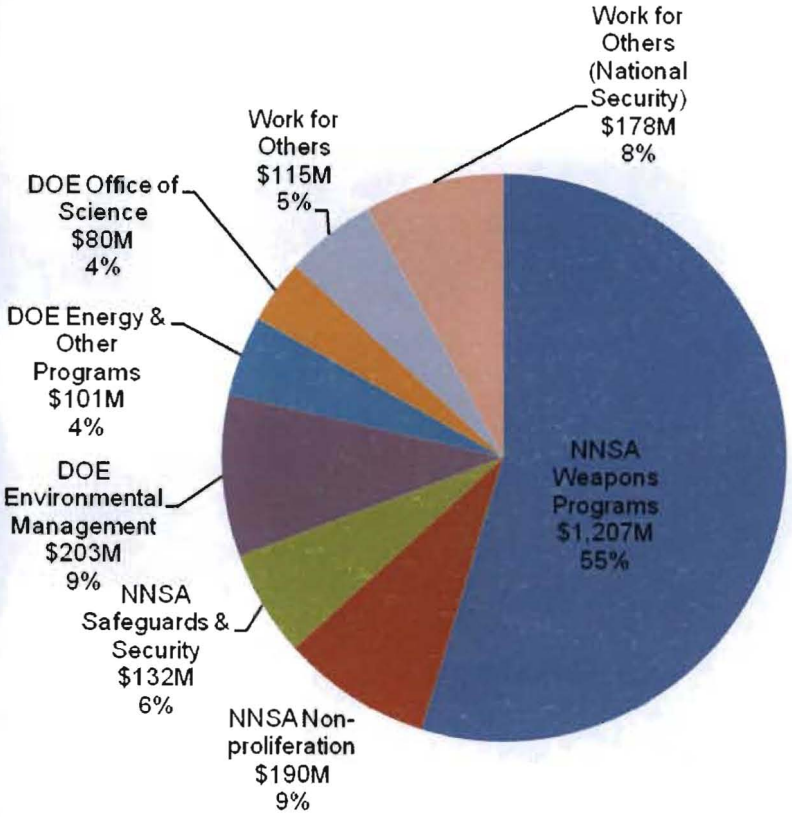
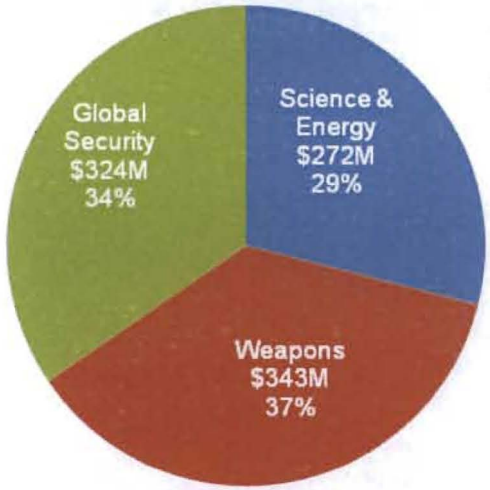
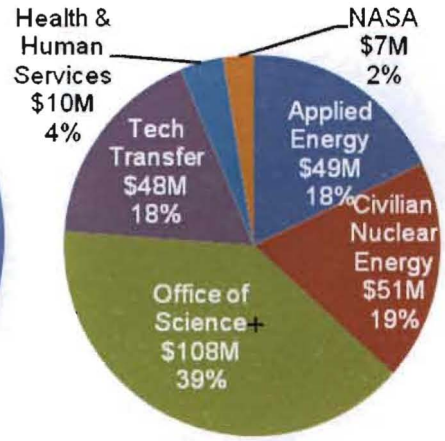
FY10 Laboratory Budget

The Lab's FY10 annual budget was approximately $2.2 Billion*



Science & Energy Funding: $273M**





Laboratory's R&D Funding: $939M**

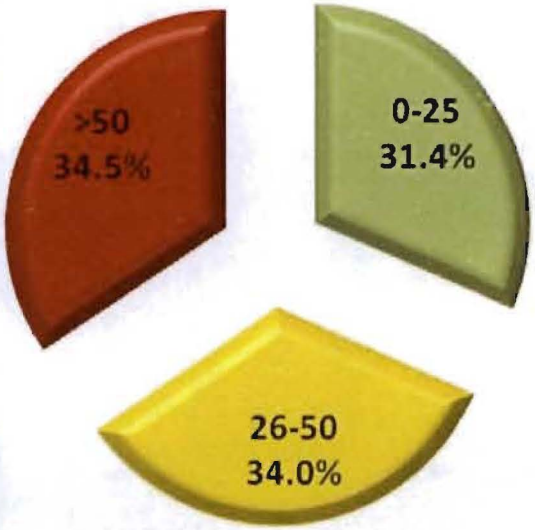
+ Includes Genome, Tropical Western Pacific, and Stimulus

*does not include Stimulus

**includes $31M of Stimulus

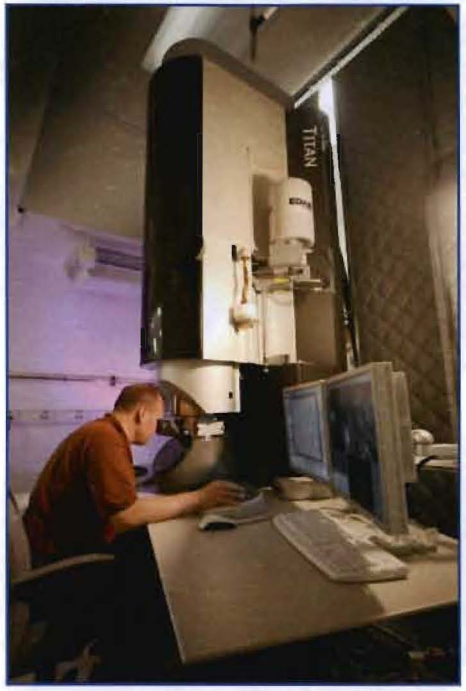
Major LANL Challenges

Facilities



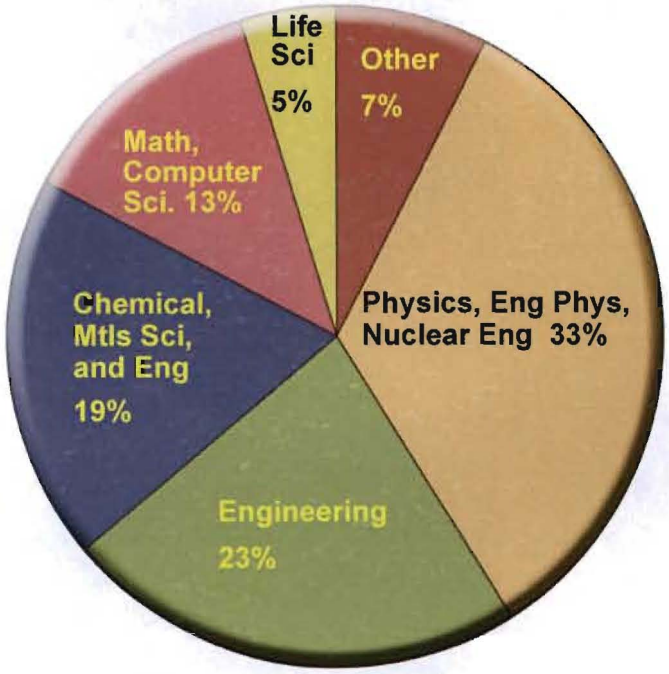
Age of LANL Permanent Buildings

Equipment and Instrumentation



TEM
Electron Microscopy Laboratory

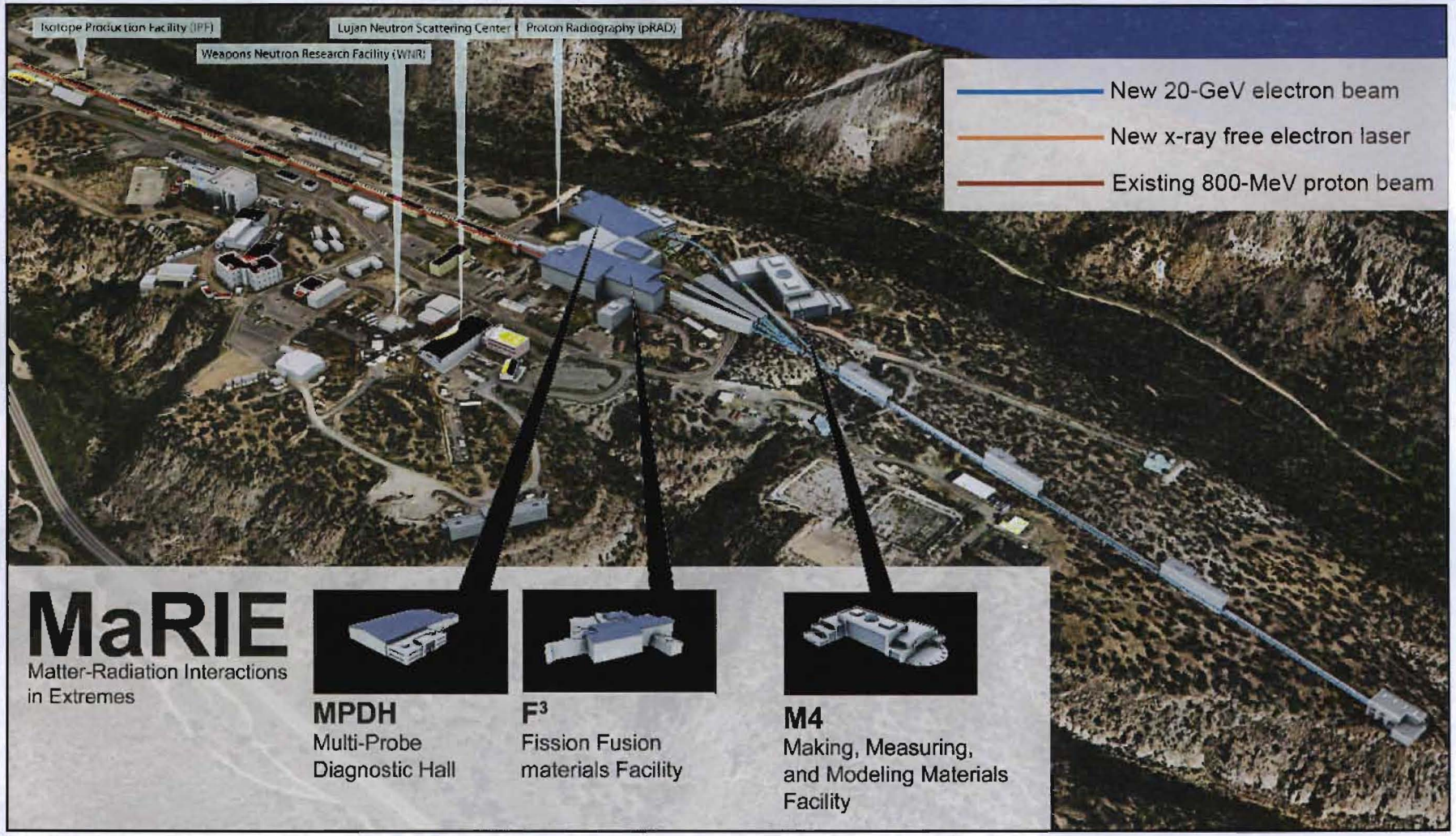
Maintaining a Capabilities Laboratory



R&D Scientist and Engineer Disciplines

Los Alamos is a ***Science Laboratory***, and the success of the Lab depends on the health of the science.

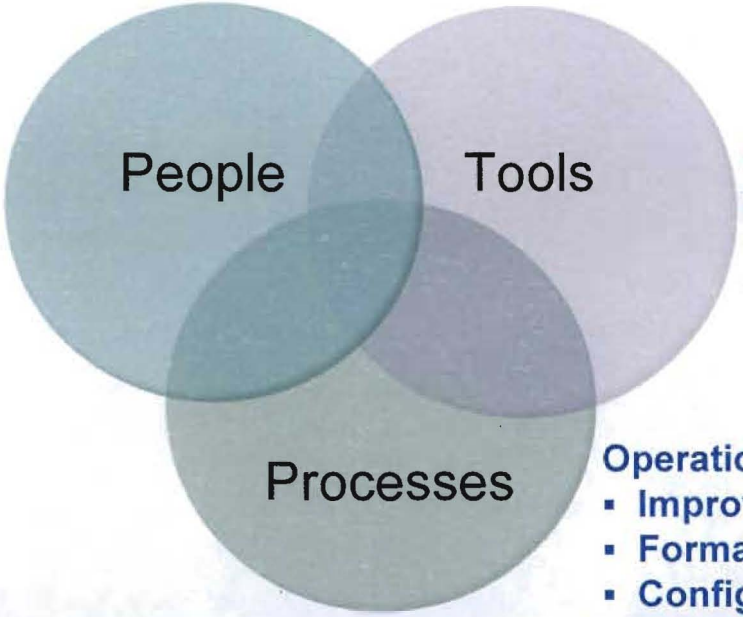
LANL has defined an acquisition strategy for MaRIE.



Fiscal Challenges

- **Pension costs – large obligations in defined benefit.**
- **Processes for infrastructure improvement remain cumbersome.**
  - Investment for most STE facilities that are not dominated by weapons program deliverables relies on scarce G&A resources and is constrained by other limits (e.g. IGPP).
- **Redoing the IT infrastructure.**
  - Goals: support LANL programs, improve productivity, competitiveness, and service delivery, and lower cost.

- Governance
- Re-engineering
- "Ruthless Standardization"



Accelerated IT Roadmap
- Common Business Apps
- Network Transformation
- Desktop Standardization

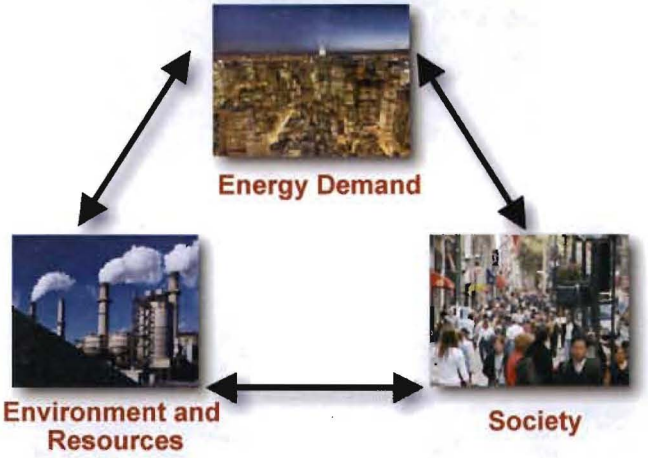
Operational Efficiency (OE)
- Improved Customer Service
- Formality of Operations
- Configuration Control
- Risk Management Framework

Challenges

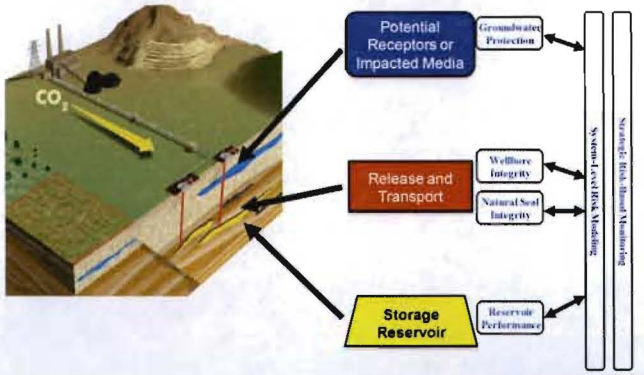
Managing a Science Laboratory in the National Interest

- Vital Science Enterprise

- Anticipate National Need



- Deliver System Solutions



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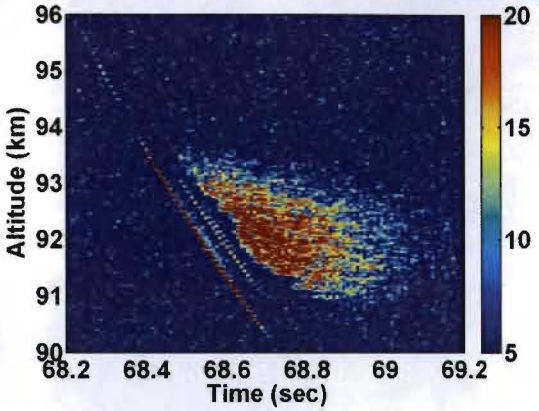
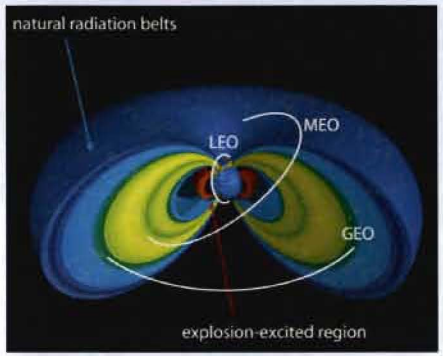
Backup Slides

Emerging Threats

Science and technology for Global Security



Large interstellar dust

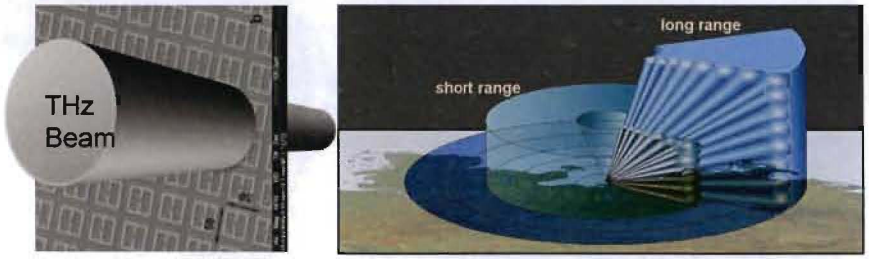


DREAM: Dynamic Radiation Environment Assimilation Model

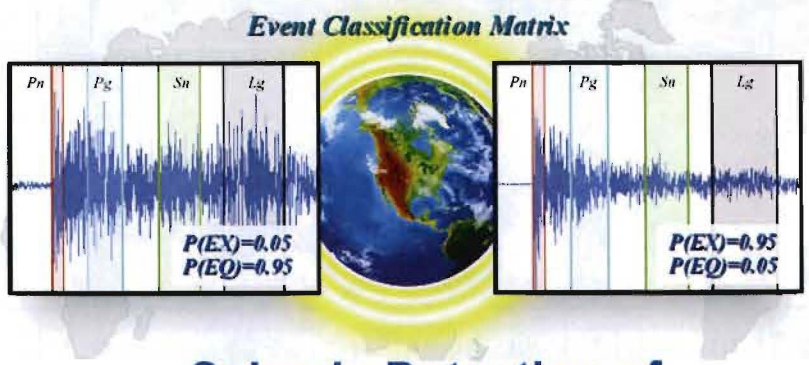
Actinide particle in soil

Space Situational Awareness: Threats from space

Nuclear Forensics: Identification & attribution



Terahertz metamaterials that modulate



Electrical and Optical Control of Materials

Seismic Detection of Nuclear Explosions

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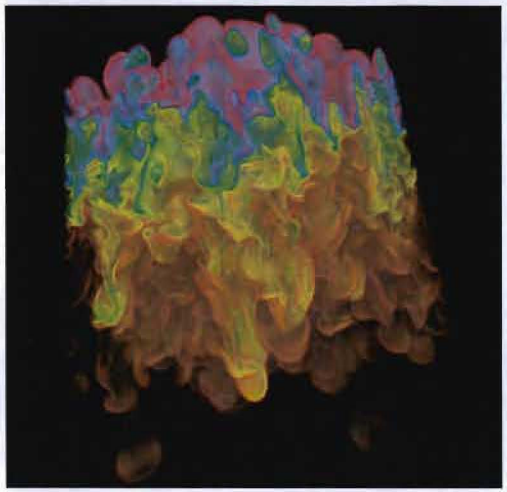
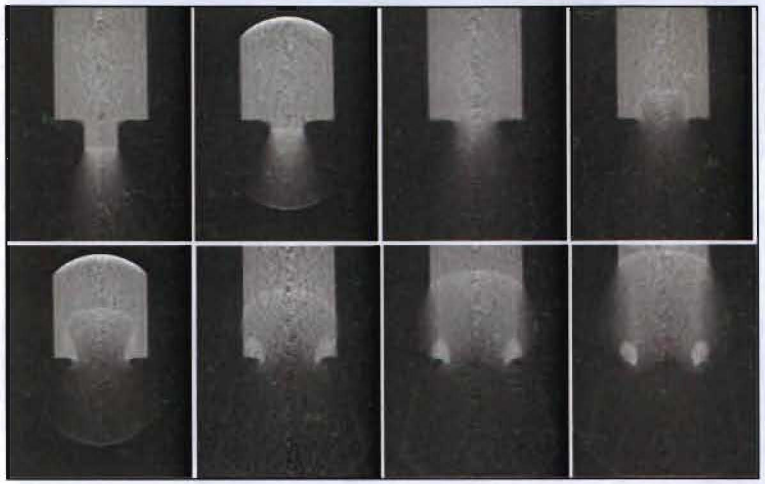
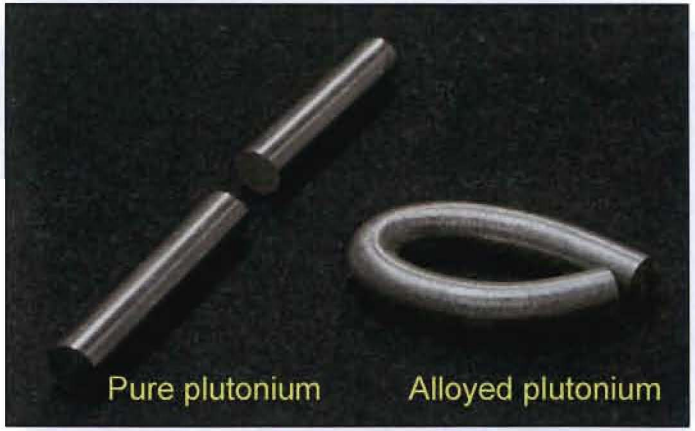
Science Questions for Stockpile Stewardship



Hydrodynamics: Turbulence



Proton Radiography: HE corner turning

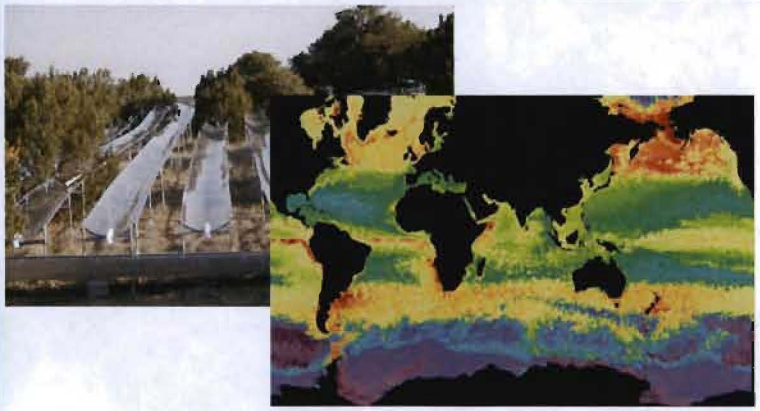


Plutonium Science: Metallurgy

SPaSM on Roadrunner:
Materials dynamics in extreme conditions

Energy

Science for Energy Challenges



Climate / Energy Impacts:
Monitoring, simulation, and prediction

Unconventional Fuels:
Extraction of energy

Materials for energy:
Lighting, energy generation, transmission

Integrated process and systems models:
Carbon management and water resources

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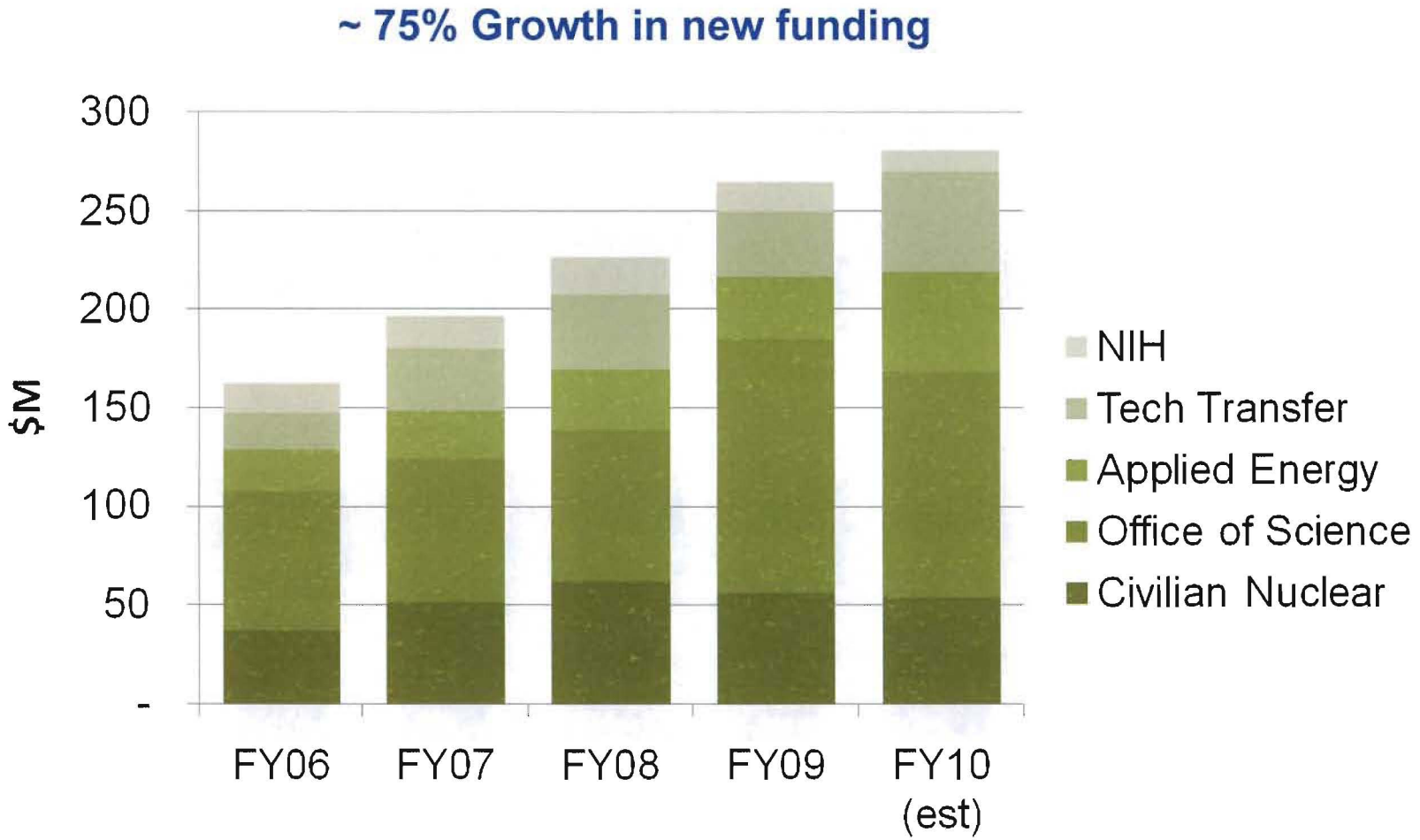
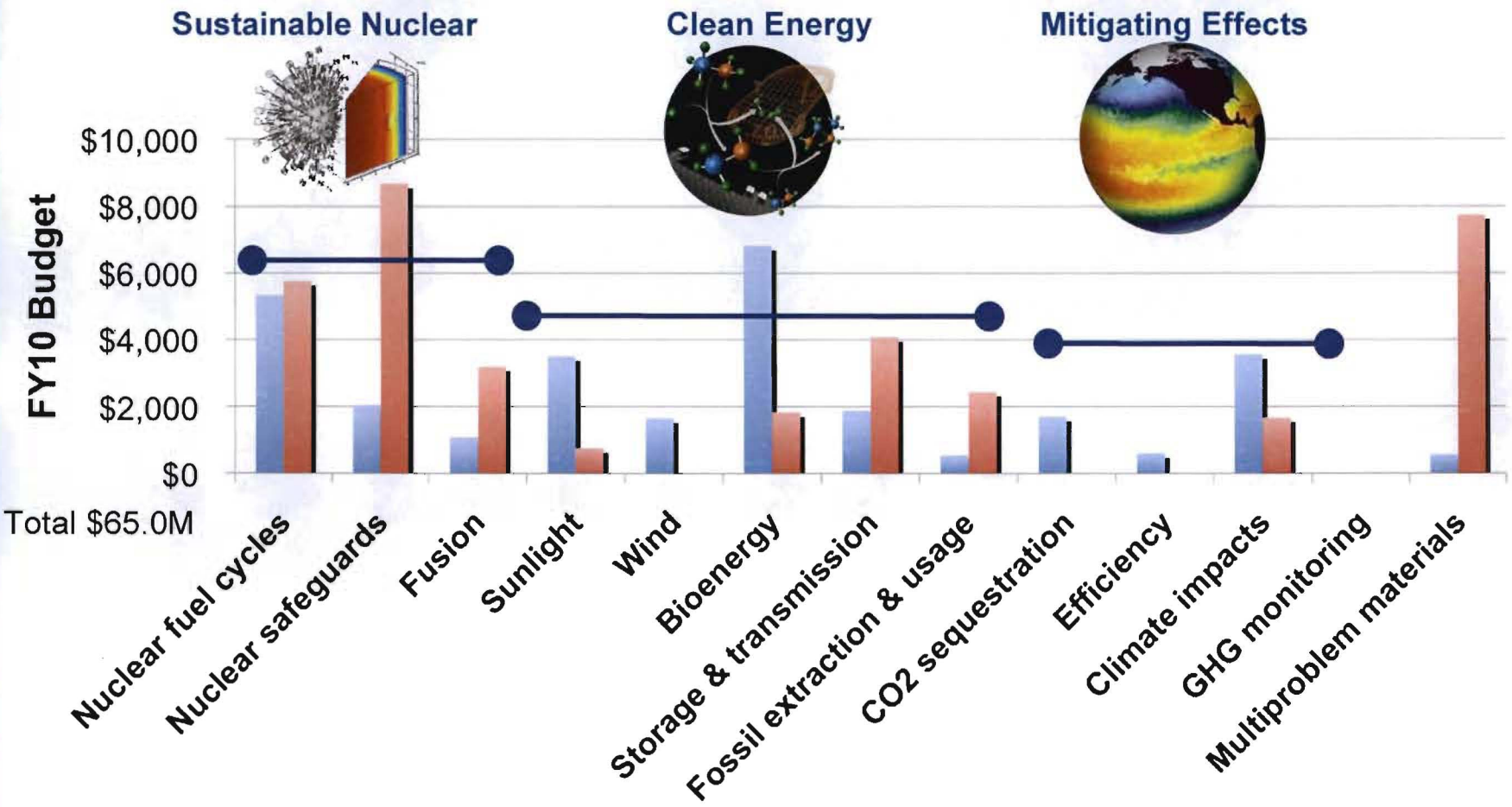
Science and Energy Programs (FY06-FY10)



Meeting program needs draws on diverse capabilities.

Example: Energy solutions draw on a diversity of S&T.



Including first two levels of relevance:
- Addresses identified mission challenge
- Builds underlying science and technology

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Los Alamos is successful in competition for funding to address major science issues.

Biofuels

- National Alliance for Advanced Biofuels and Bioproducts Consortium
- National Advanced Biofuels Consortium
- LANL leads algal strain development, harvesting, extraction, catalyst development, commercialization.

Energy Frontier Research Centers

CMIME
Center for Materials at Irradiation and Mechanical Extremes

- Focus on unique properties of nanomaterials
- CMIME: nanolayered composites provide increased strength and enhanced radiation damage tolerance.
- Center for Advanced Solar Photophysics: nanoscale structures boost solar-energy conversion efficiency.

Green House Gas Information System

- Global climate models
- Monitoring and verification
- Infrastructure analysis

Nuclear Energy

CASL
Consortium for Advanced Simulation of LWRs

- Hub consortium of 10 principal partners
- Modeling and simulation to improve performance of nuclear power plants
- LANL leads material science and models and numerical methods areas.

Science Metrics

Los Alamos is successful in competition for funding to address clean coal, carbon capture, and storage.

US-China Advanced Coal Technology Collaboration

- Goal: ***Develop next generation of clean coal technologies.***
- **LANL leads the Risk Analysis task and supports:**
  - Subsurface Simulation of CO_2 Injection and Coupled Processes
  - Site Characterization and Assessment for Geological Sequestration
  - Novel Capture Technology Development

Carbon Capture and Storage Simulation Initiative

- Goal: ***Accelerate the development of carbon capture and storage technologies.***
- Advanced simulation tools to speed concept to deployment of new methods for capturing CO_2 at industrial facilities.
- Defensible, science-based methodology and advanced simulation tools for quantitative assessment of potential risks associated with long-term CO_2 storage.

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Science vitality underpins the Lab's mission areas.