Los Alamos National Laboratory:

Innovation serving National Security missions

Precision Strike Annual Review (PSAR-15)

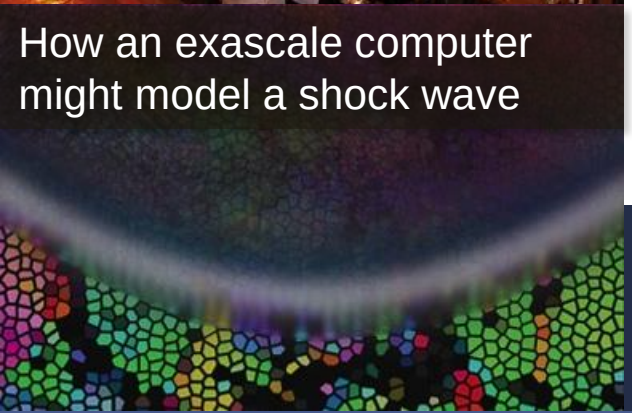
David Pesiri
Director, The Richard P. Feynman Center for Innovation

Los Alamos NATIONAL LABORATORY EST.1943
NNSA National Nuclear Security Administration
Operated by Los Alamos National Security, LLC
for the U.S. Department of Energy's NNSA

The Los Alamos mission is to solve national security challenges through scientific excellence

Trinity device before testing

Dual Axis Hydrodynamic Radiography Test Facility



How an exascale computer might model a shock wave

DISCOVERY ⟷ APPLIED SCIENCE ⟷ PROTOTYPES

Our results

- 126 R&D 100 Awards
- 32 E. O. Lawrence Awards
- The Seaborg Medal
- The Edward Teller Medal
- The Nobel Prize in Physics

A proud history, leaning forward to shape the future

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Strategic Deterrence:
Los Alamos focuses on a triad of responses to nuclear threats

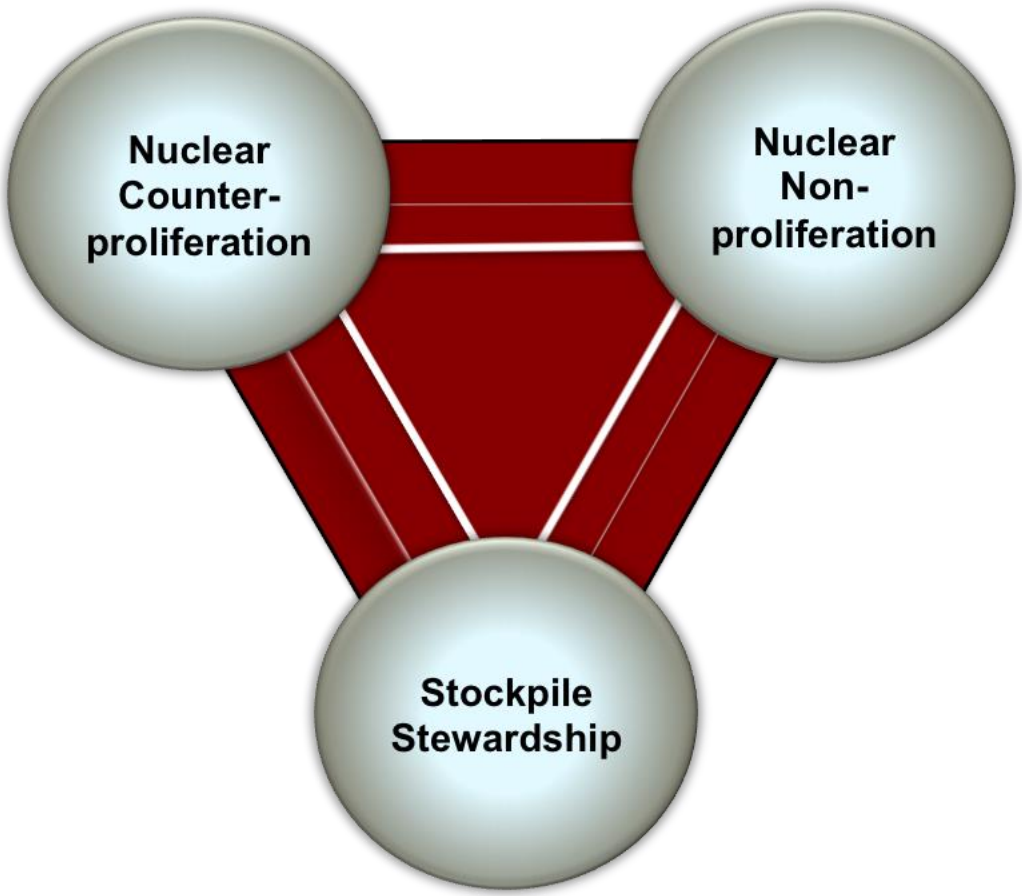
"I state clearly and with conviction America's commitment to seek the peace and security of a world without nuclear weapons…"

"Make no mistake: As long as these weapons exist, the United States will maintain a safe, secure and effective arsenal to deter any adversary."

President Obama
April 2009

"The greatest threat to US and global security is no longer a nuclear exchange between nations, but nuclear terrorism by violent extremists and nuclear proliferation to an increasing number of states."

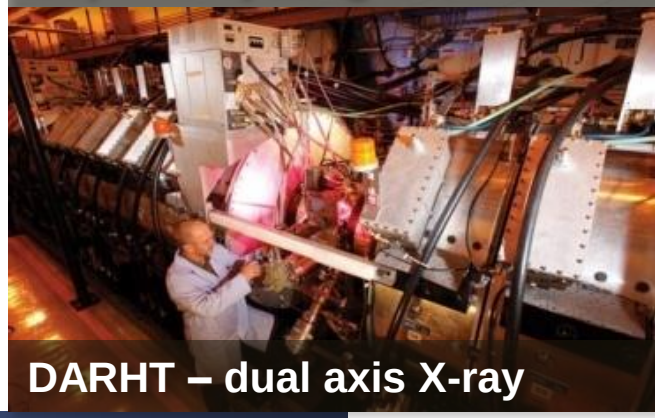
President Obama
April 2010



Our core mission is to ensure the US nuclear deterrent

- Ensure safety, reliability, and performance of stockpile
- Design agency for four out of seven warhead systems constituting nation's deterrent

- Modeling, simulation, radiography, and non-nuclear testing provide assurance



Confidence without nuclear testing requires a fundamental understanding of science and engineering

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How could you ensure this worked, *without* starting the engine?

Our stockpile is as unique in manufacturing as the engine of this sports car

- » High-performance race cars comprise 80,000 components
- » If they were assembled 99.9% correctly, **they would still start the race with 80 things wrong**

The United States faces a much more complex challenge in maintaining its nuclear stockpile

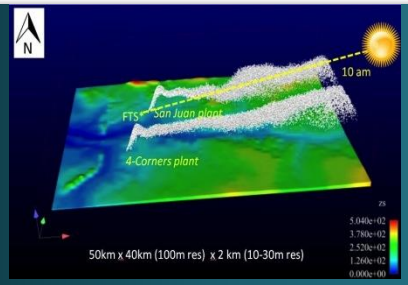
Four pillars define key science investments

Materials for the Future

Defects and Interfaces

Extreme Environments

Emergent Phenomena

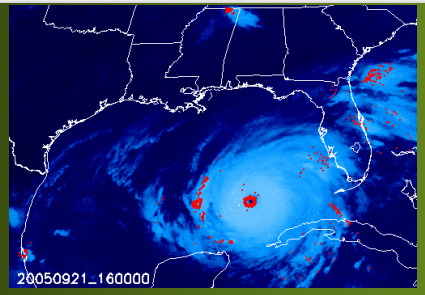


Science of Signatures

Discover Signatures

Revolutionize Measurements

Forward Deployment

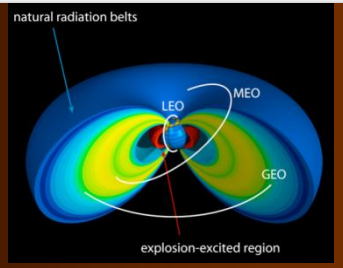


Integrating Information, Science, and Technology for Prediction

Complex Networks

Computational Co-Design

Data Science at Scale



Nuclear and Particle Futures

High Energy Density Physics & Fluid Dynamics

Nuclear & Particle Physics, Astrophysics & Cosmology

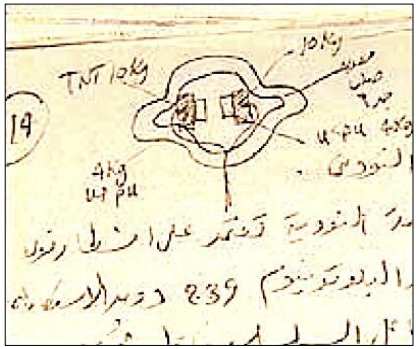
Applied Nuclear Science & Engineering

Accelerators & Electrodynamics

Intelligence, Defense & Counterterrorism—Kinetic, Quick Response

Time frame: Ultra-short, hours to days

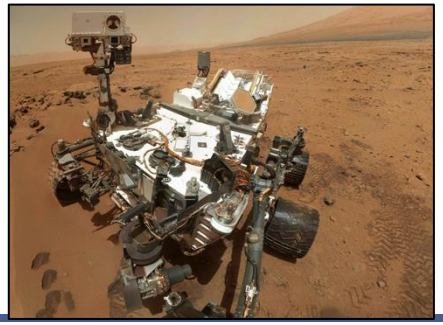
Focus Areas: Intelligence Community, nuclear counterproliferation, rapid prototypes, Special Operations/ warfighter/command support, nuclear counterterrorism



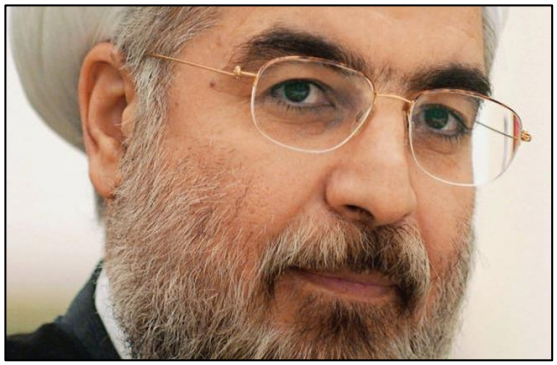
Emerging Threats—
Transformation & Innovation

Time frame: Months to years

Focus Areas: Foreign nuclear weapons assessments, new technologies, bio-threat and defense, nuclear forensics, responsive space, sensors



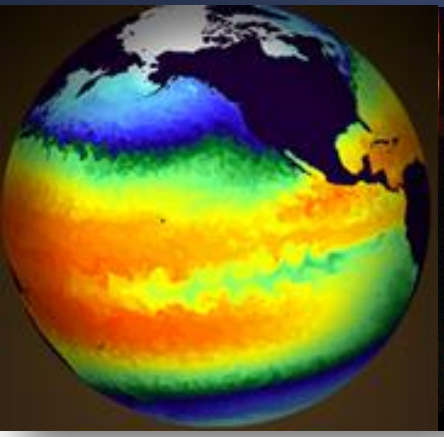
Nuclear Nonproliferation and Security— Cooperation & Diplomacy

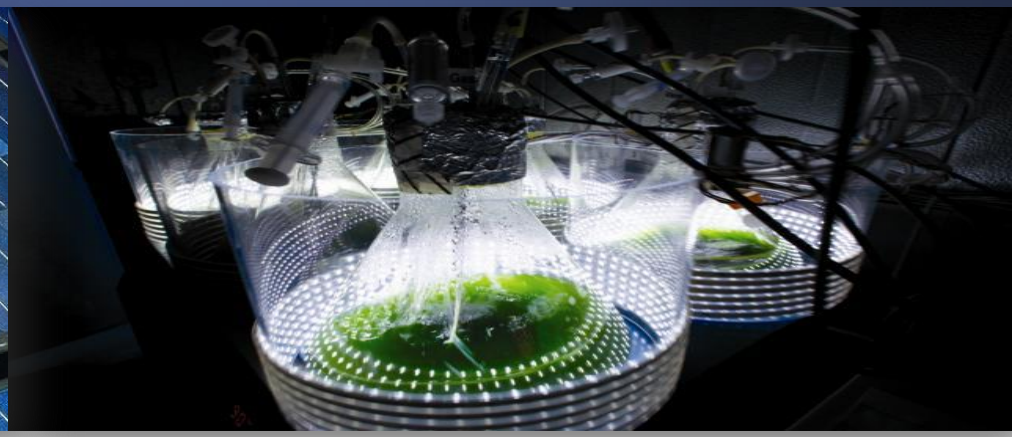


Time frame: Months, years, to decades

Focus Areas: Deter and detect, secure materials, treaty verification, second line of defense

Pursuing energy security breakthroughs and global impacts





- **Hydrogen fuel cells**
- **Algal biofuels**
- **Quantum Dots**
- **Safer nuclear reactors**
- **Impacts of growth in energy demand**
- **Energy infrastructure analysis**

In a world with limited resources,
energy security is national security

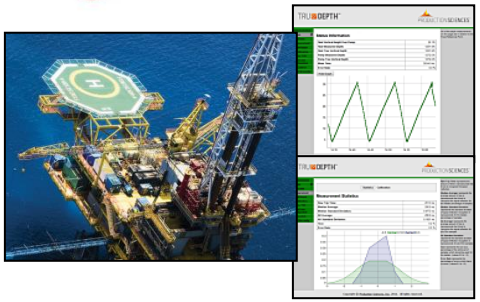
Our Innovation Doctrine

Principles that define our approach to technology innovation:

- The US technology advantage in national security is tied to our ability to innovate. Los Alamos must understand and participate in diverse sources of innovation, across all sectors of the increasingly global economy.
- Innovation requires the transition of ideas through deployment for an end use. One of the key paths to achieve this is through strategic partnerships with industry leveraging our core mission.
- Los Alamos has a special responsibility as an FFRDC. Our role is to be a trusted adviser on technology and policy implementation. This responsibility must also be realized appropriately with partnerships with the private sector
- We must relentlessly improve and continually demonstrate value to our extended stakeholders.
- Competence in creating valuable Intellectual Property is essential for innovation. The broader class of Innovation Assets illustrates the vitality of the institution and inspires those who work here.
- The ability to move at the speed of business (fast, fair, valuable transactions driven by an innovation strategy) is required to succeed as a modern R&D enterprise.
- Success in innovation requires engagement from -- and delivers equities to -- programs, inventors, and line organizations.
- Our sponsors and partners tell the most powerful stories about success in innovation, driving public awareness of the Laboratory, its people. and programs.

Our model for growing long-term partnerships based on Strategic Alliances

Chevron Oil & Gas



Moving energy technologies to the marketplace

- 10 years, 26 active projects
- >500 patents
- 6 technologies in commercialization stage
- 2014 R&D100 Award: Safire meter with GE

GE Oil & Gas · Schlumberger · Baker Hughes · Superior Energy Services · Halliburton · Apache

P&G Mod & Sim

connect + develop

25 Years of Open Innovation

P&G Impact

- > $5 MMM in savings annually
- 4 % gross margin increase
- 145 plants, 35+ product categories globally

LANL Impact

- validation of reliability codes for weapons program
- in-sourced for NNSA Pu facility

EY Building a better working world

EMC² HPC

From Procurement to Partnership

- ABBA (Advanced Burst Buffer Appliance)
- I/O Performance
- Hardware-Software Design
- Next-Gen Storage
- Cyber Security
- Cloud Applications

RSA SECURITY · Seagate · intel

Emergent

Lockheed Martin · EY · Seagate · ATK · Allied Minds · Toshiba · Cray · GE · Cedars-Sinai

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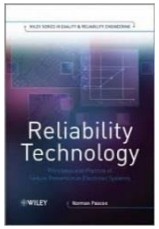
Accelerated market impact via new business models

Recent

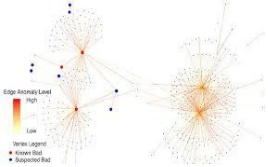
- Low Cost Portable Cytometry
- Statistical Modeling of Reliability
- Plant growth and Yield
- Acoustic Imaging for Fluid Flow
- Muon Tomography



Current

- Quantum Encryption
- Cyberdefense/Insider Threat (PathScan)
- Video Analytics & machine Learning (VAST) License
- Agile Space In Process (RFI Stage)




Future

- Unmanned Aerial Systems
- Multi-Int: science, autonomy, persistence
- ATHENA Desktop Human Body

RICHARD P. FEYNMAN CENTER FOR INNOVATION

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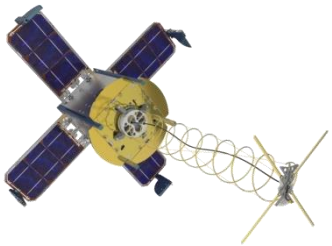
Los Alamos/SOCOM Prometheus Program: CubeSat mission for agile communications

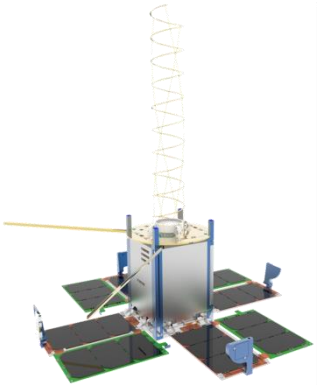
Current Design and Development Plan



ASP 1 Design, Development & First Unit Production

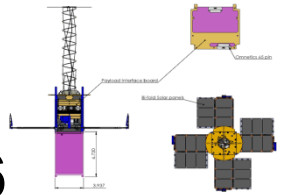
ADCS: ~5 deg Pointing Accuracy
Comms: 140 kb/sec to Ground Station

8 Units On Orbit



ASP 2:

ADCS: ~5 deg Pointing Accuracy (Robust)
Comms: Spread Spectrum
Hosted Payload Interface
Onboard Position Determination



In Design, Launch 2016

ASP 3:

ADCS: Better than 1 deg Pointing Accuracy
Comms: 1 Mb/sec to Ground Station
Propulsion added for maneuverability

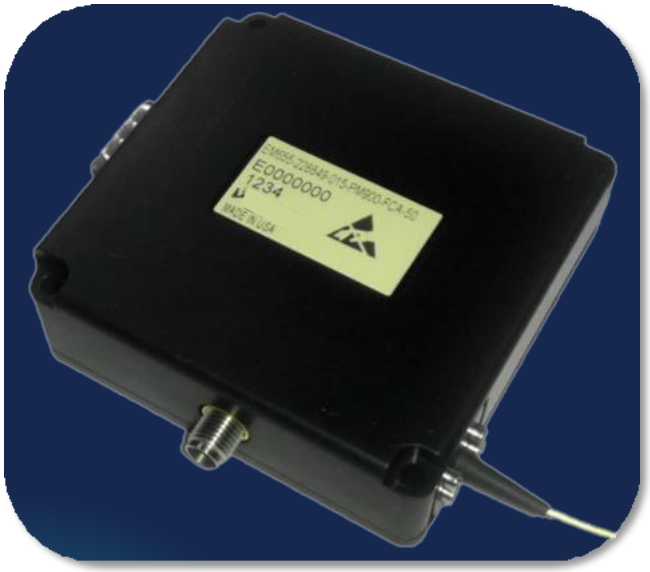
Based on performance of ASP 2, Launch ~2018

Case Study: Whitewood Encryption Systems Inc.

Whitewood's Quantum Random Number Generator (QRNG)

- Based on quantum technologies developed at Los Alamos National Lab with nearly 20 years of R&D
- Generates random numbers with exceptionally high speed and entropy from the quantum properties of light.
- Modular plug-and-play hardware.
- External HD-sized form factor with USB/PCIe interface.
- Cost-effective and easy to deploy.
- Available as a standalone device and offered as a service at select colocation facilities over secured optical fiber.

WHITEWOOD
ENCRYPTION SYSTEMS, INC.
an AMFI Company



Los Alamos QRNG Prototype

nuclear proliferation

the pivot to Asia

contested space

The world remains a dangerous place;
Los Alamos is ready to respond

bioterrorism

the increasing reach of technology

cyber security

asymmetry