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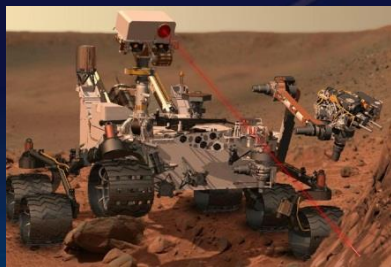
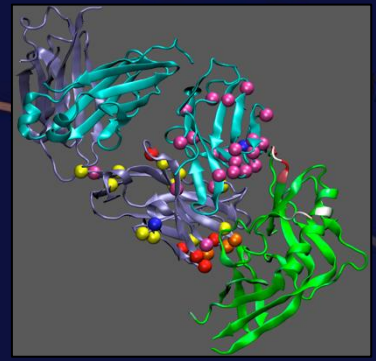
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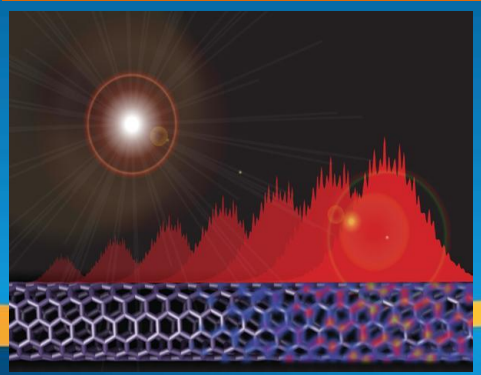
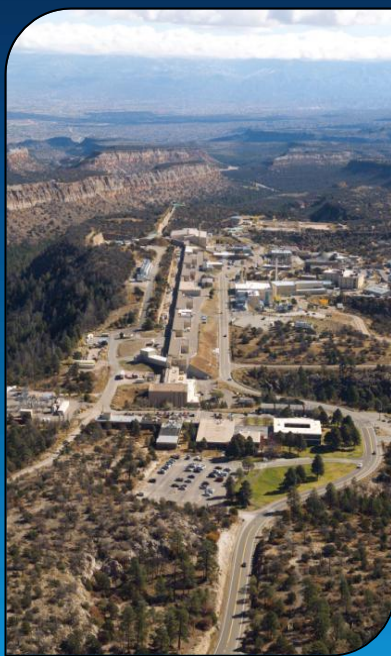
Los Alamos National Laboratory

# Science Excellence for Mission Impact

**Alan Bishop**  
Principal Associate Director  
Los Alamos National Laboratory

March 19, 2014

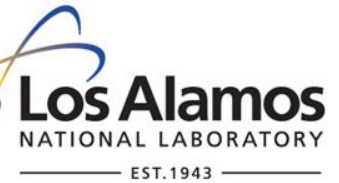
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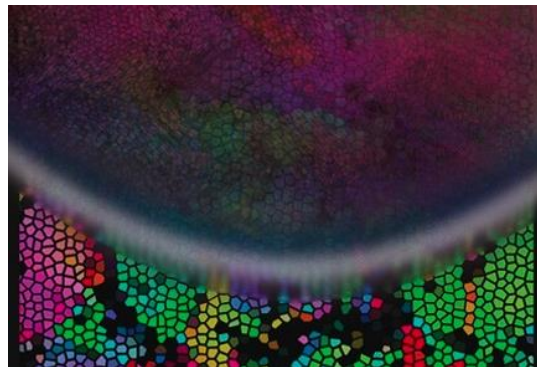
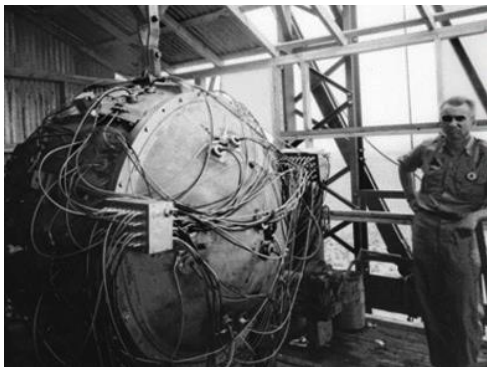


# Los Alamos: National Security Science Laboratory

solving this nation's most crucial challenges



- We anticipate, innovate, and deliver solutions.
- We span the spectrum from Discovery through Applied Science to Prototypes.
- We use the outstanding science, engineering, and technology from our core stockpile stewardship mission for other national needs.



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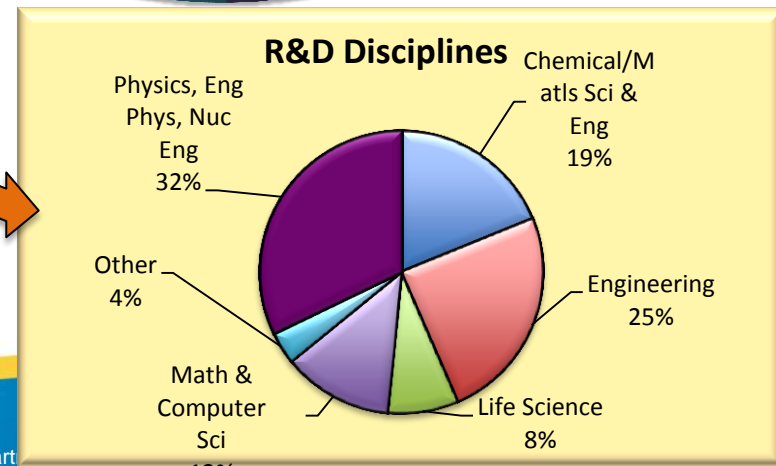
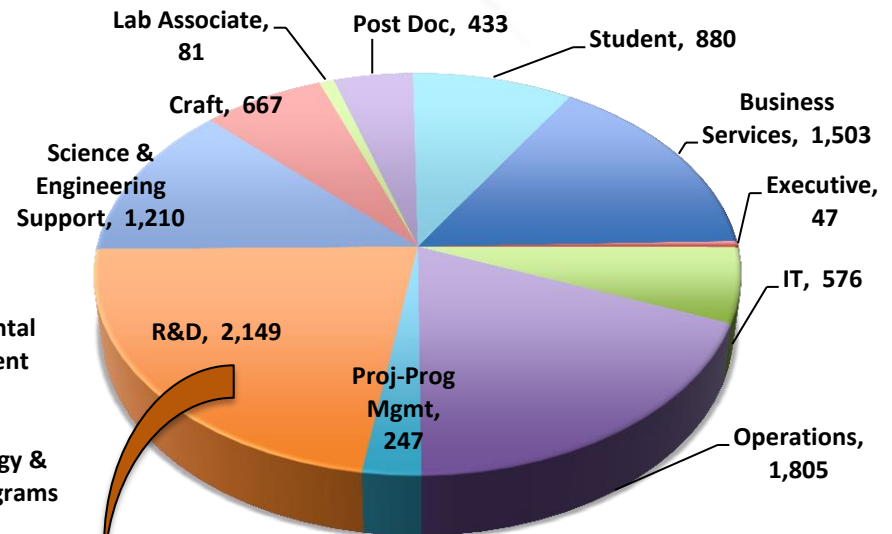
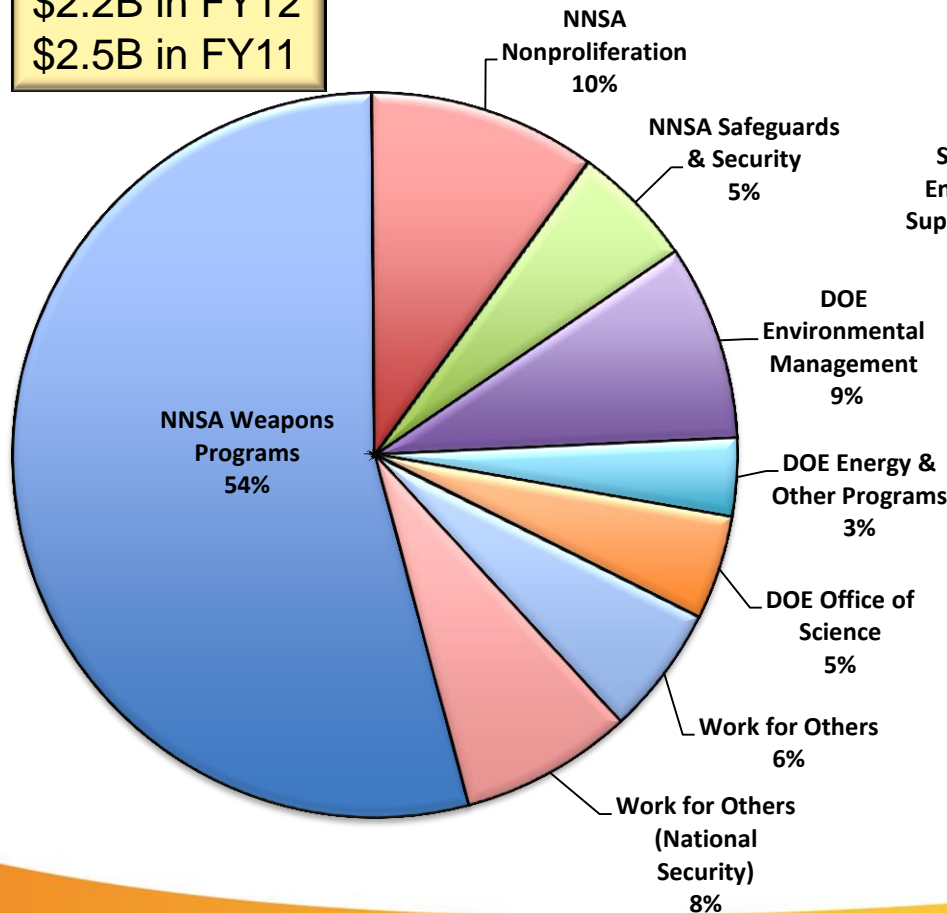
# Applying multidisciplinary capability:

Inherent in our broad funding and workforce base

**\$2.1–2.2B in FY2013/2014**

**\$2.2B in FY12  
\$2.5B in FY11**

9,600 National Security specialists collaborate in a wide variety of technical disciplines



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# ST&E Capability Pillars:

Build cross-disciplinary teaming expertise  
for current and future missions

## SCIENTIFIC EXCELLENCE FOR NATIONAL SECURITY

LANL  
MISSIONS

Nuclear  
Deterrence

Global  
Security

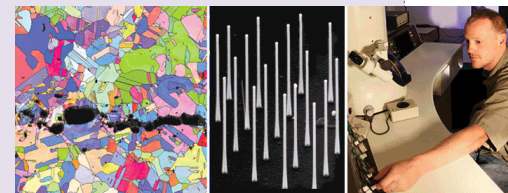
Energy &  
Emerging  
Threats

Integrating Assets for  
Program Execution

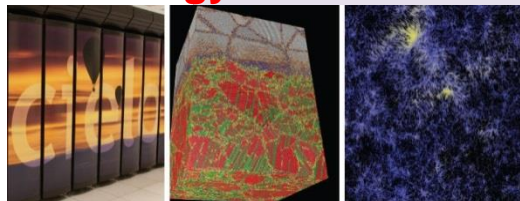
### Science of Signatures



### Materials for the Future



### Information, Science, and Technology for Prediction



## CAPABILITY PILLARS

### Nuclear and Particle Futures



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# Scientific vitality underpins LANL missions:

Investments in reciprocal pipelines of people, ideas, partnerships

## International User Facilities

**Excellent Reviews in FY13**



National High Magnetic Field Laboratory



Center for Integrated Nano Technologies



LANSCe

## Scientific Vitality

## Fundamental Science Investment



**Innovation for our Nation**

## Institutes



**Universities & Industry**

**National Security Education Center**

## Student and Postdoc Programs

**Excellent Review in FY13**



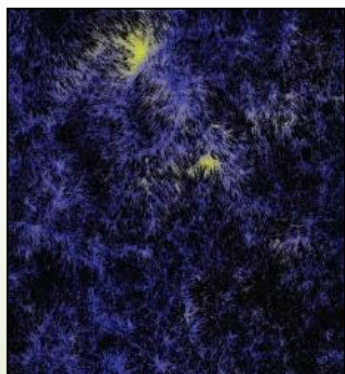
**Students: ~1,250 in FY13**

**Postdocs: ~420 in FY13**

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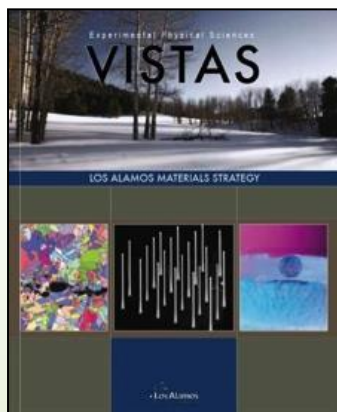
# FY15 **DR** Focus Areas support all missions

## Information Science and Technology



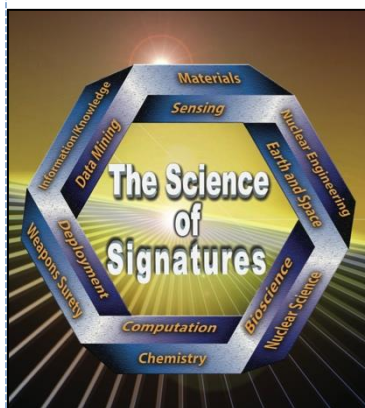
- Data Science at Scale
- Computational Co-design (Novel Computing Devices, Software, Algorithms)

## Materials for the Future



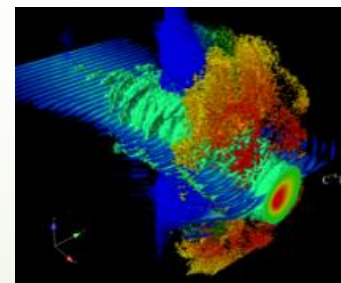
- Defects and Interfaces
- Extreme Environments
- Emergent Phenomena

## Science of Signatures



- Discover Signatures
- Revolutionize Measurement
- Forward Deployment

## Nuclear and Particle Futures



- Nuclear & Particle Physics, Astrophysics & Cosmology
- Applied Nuclear Science & Engineering
- High Energy Density Physics and Fluid Dynamics
- Accelerators and Electrodynamics

## Complex Natural and Engineered Systems



- Multi-scale and Collective Phenomena
- Dynamics and Feedbacks across Boundaries and Interfaces
- Large-scale Integration

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# Perils of Uncertainty:

We *will* be called to address new problems



*the pivot to Asia*



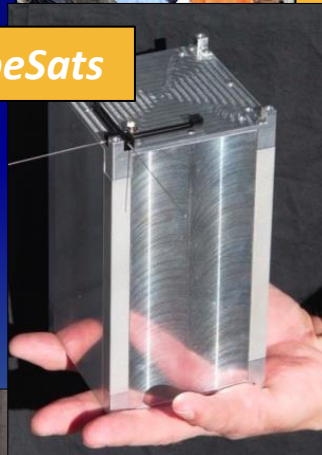
*nuclear proliferation*



*terrorism & the increasing reach of technology*



*CubeSats*



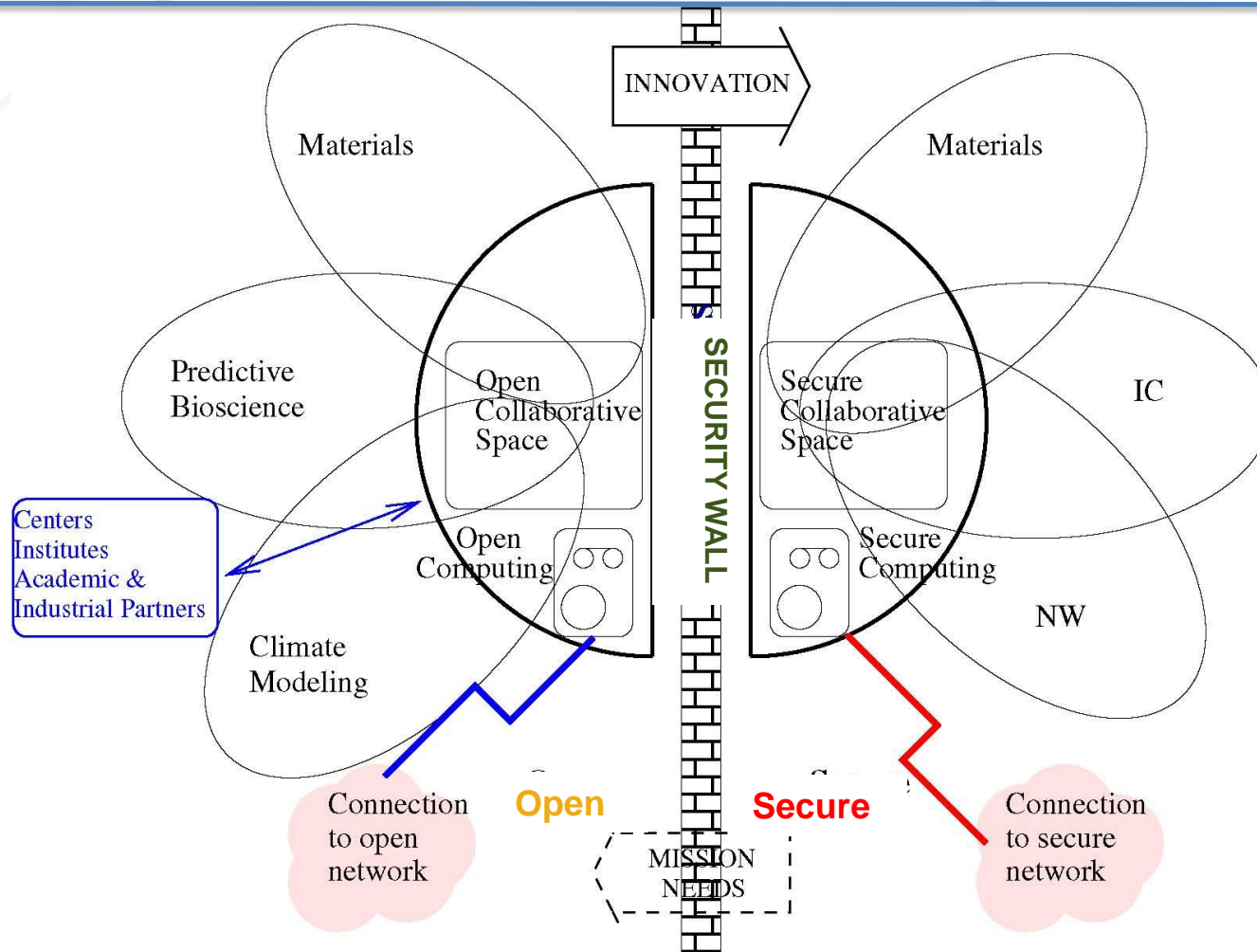
*asymmetry & the rise of the individual*

*contested space*





# Los Alamos has a unique environment for national security end-to-end integrated capability

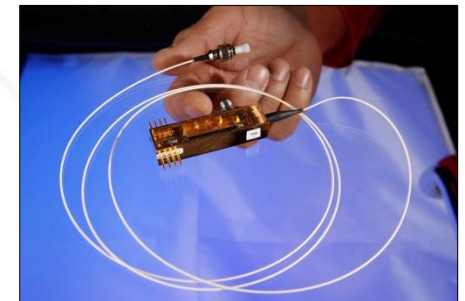


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# Quantum cryptography applied to electric grid security

First-ever demonstration to secure control data for electric grids using quantum cryptography.

- Performed in the electric grid test bed at the Trustworthy Cyber Infrastructure for Power Grid project (University of Illinois)
  - Provides a means to detect and defeat an adversary who tries to intercept or defeat communications.
  - System is based on a miniaturized quantum cryptography invention developed at Los Alamos.



Miniature transmitter communicates with a trusted authority to generate random cryptographic keys to encode and decode information.

Demonstration benefits from partnership with Univ. of Illinois.

Media reports: *Electric Energy Online*, *Nanotechnology Now*, *Electric Energy T&D Magazine*, *Innovations Report Online*, *Smart Grid*, *Penn Energy*.

*Method is compatible with electric-grid control communications, providing strong security based on physics without introducing excessive delays in data delivery.*



# EMC Partnership (2012): Pushing innovation boundaries

# EMC<sup>2</sup>

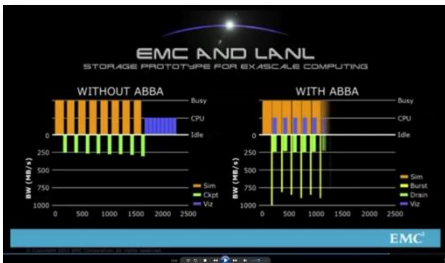
## Reducing checkpoint bottlenecks and data storage costs with software

- ◆ LANL Parallel Log Structured File System (PLFS)



## The Active Burst Buffer Appliance (aBBa)

- ◆ Hardware/software solution jointly developed by LANL & EMC
- ◆ Leverages PLFS
- ◆ Enables real-time analytics on burst data
- ◆ aBBa will be a new EMC product



## Cyber Security

- ◆ EMC is evaluating commercializing LANL's PathScan technology
- ◆ PathScan detects adversaries moving/traversing around networks

**Laying the groundwork to Exascale through partnership**

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