Mathematics and Statistics at Sandia National Laboratories: A Perspective from an Engineering Scientist

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Sandia National Laboratories
Albuquerque, NM

Raleigh, NC
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North Carolina State University

U.S. DOE National Laboratories

Science Labs

Nuclear Energy Lab

Fossil Energy Lab

Energy Efficiency and
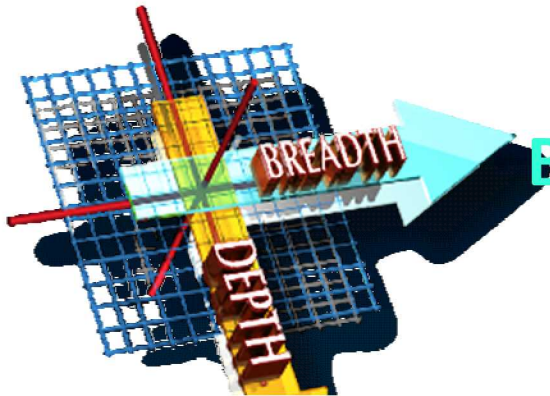Renewable Energy Lab

Sandia National Laboratories

- **Core Purpose**: help secure a peaceful and free world through technology.

- Provide objective, multidisciplina[ry] assessments for complex problem[s].

- Focus on solutions with large science and technology content.

- Create prototypes for production and operation by industry.
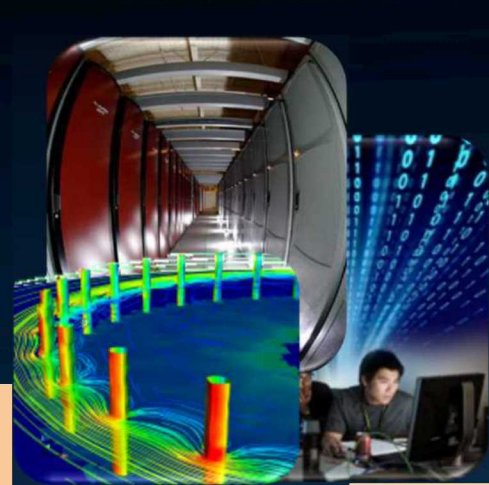
Scope & Complexity of National Security

SNL Applies both
BREADTH & **DEPTH**
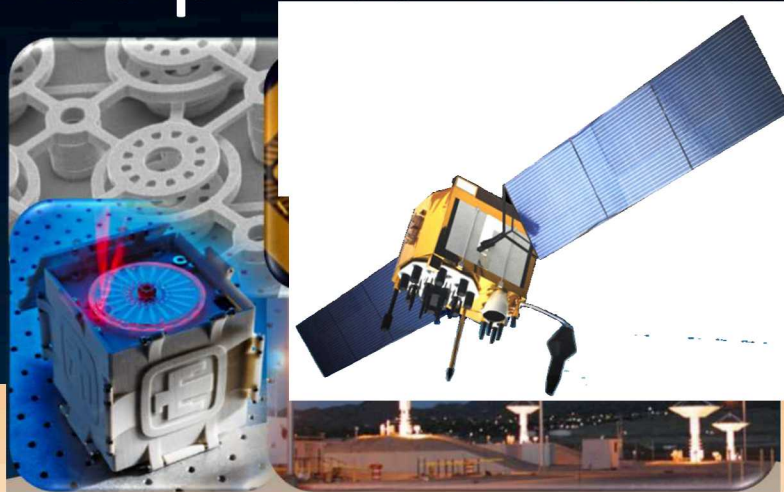solving the nation's most
challenging
problems.

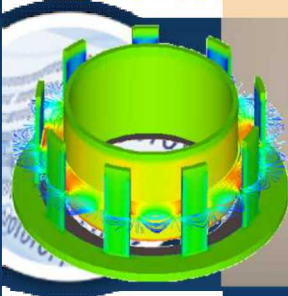# Research Disciplines Drive Capabilities

High Performance Computing

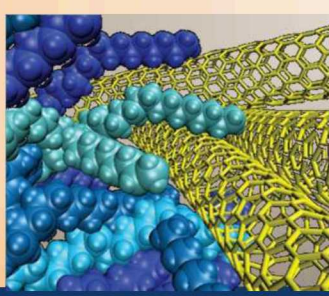**Science & Technology Products**
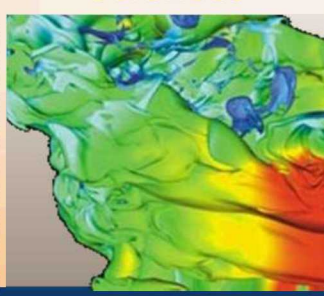
Renewable Systems & Energy Infrastructure
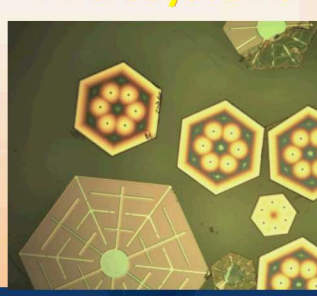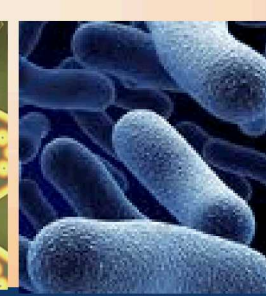
Computer Sciences
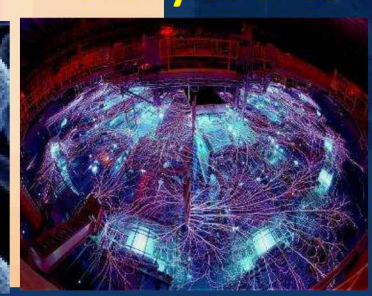
Materials

Engineering Sciences

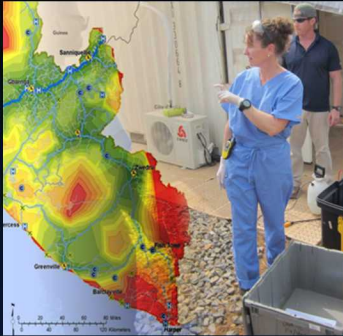**Nanodevices & Microsystems**

Bioscience

High Energy Density Science

Research Disciplines

Examples of Sandia's Impact

Ebola Outbreak

Developed a sample delivery system cutting the wait time and potentially fatal exposure.

Detecting IEDs

Highly modified miniature synthetic aperture radar system helps uncover improvised explosive devices.

Invented Cleanroom 1963

Used in hospitals, laboratories and manufacturing plants today.
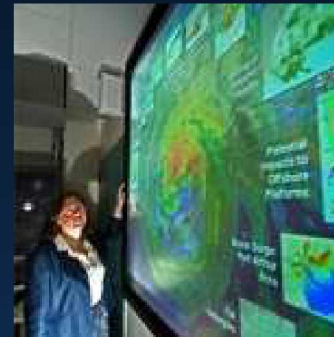
Hurricane Katrina

Assess flooding and infrastructure failures.

Fukushima Quake

Helped clean up radioactive wastewater.
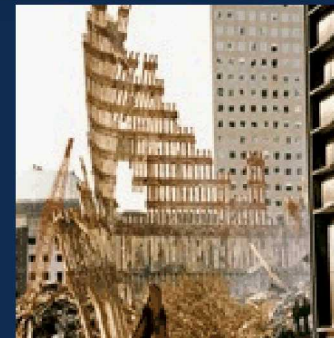
9/11

Planned for subsequent attacks on facilities. Enabled search & rescue K-9s with cameras to allow search of inaccessible spaces.

Sandia Albuquerque (NM)

On-site workforce: ~10,000

R&D staff: ~3,800

Distinguishing capabilities:
- Renewable Energy
- Microelectronics
- Cyber/Homeland Security…

Degree Level
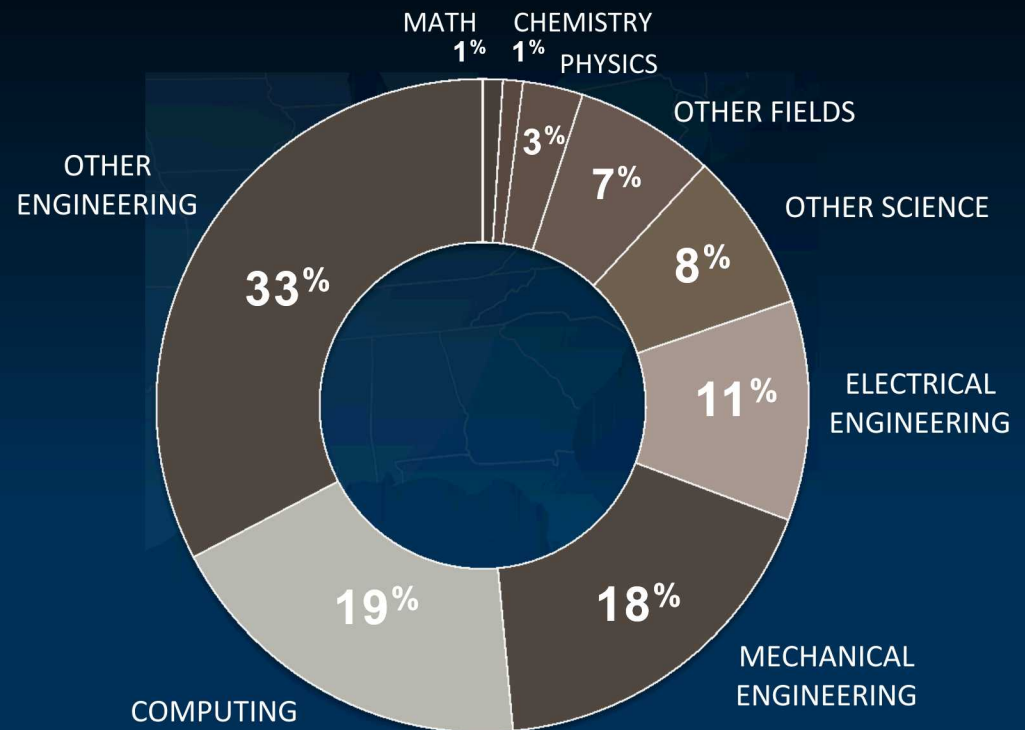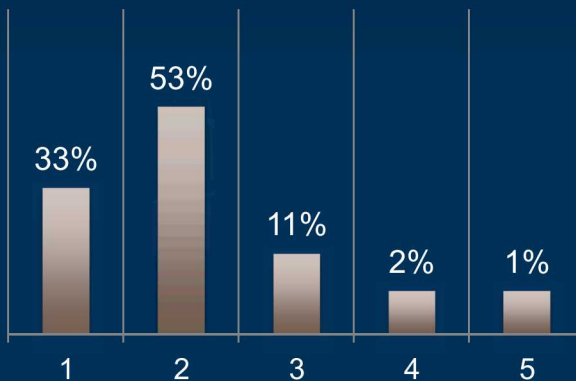
Data as of June 29 end of Q3 of the FY18

Sandia Livermore (CA)

On-site workforce: ~1,200

R&D staff: ~600

Distinguishing capabilities:
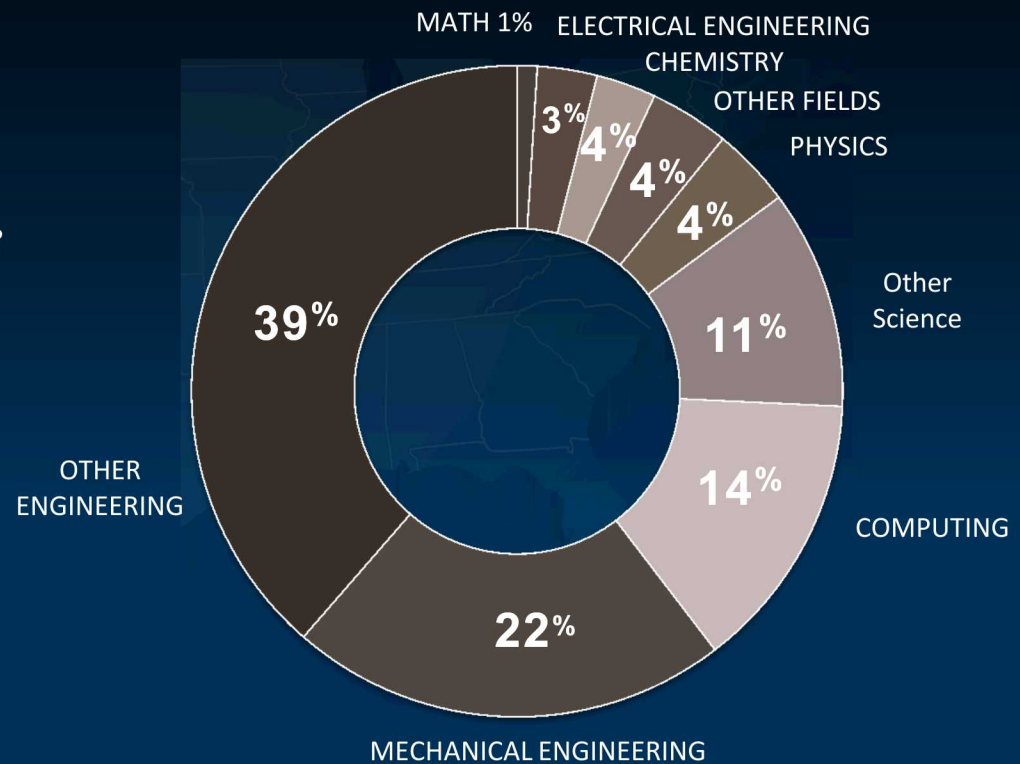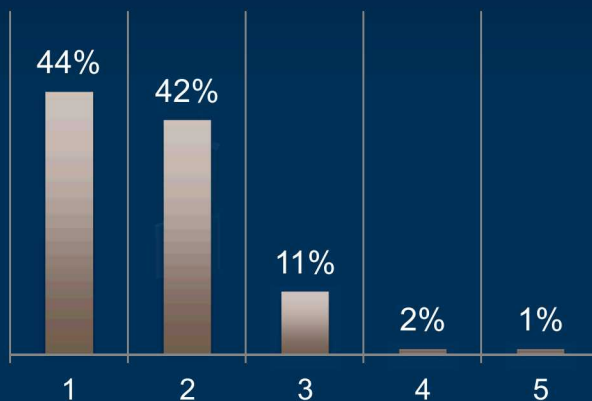
- Applied Biosciences
- Combustion Research
- Information Systems and *more*

Degree Level

Data as of June 29 end of Q3 of the FY18

Sandia Mathema/Statis-ticians

**Mathematicians and Statisticians work
in almost every area across SNL in 80+ organizations.**

Center for Computing Research

Discrete Mathematics, Optimization, &
Uncertainty Quantification

Scalable System Algorithms, Software,
Analysis, & Visualization

Multiscale/Cognitive Science, Data-driven &
Neural Computing

Mission Engineering & Information Systems Analysis

Sensor, Data, Imaging Analysis

Data Science, Cyber Security,
Cryptography, Analytics

Digital & Quantum Information
Sciences & Systems

Engineering Sciences

Diagnostic, Shock, Structural, Climatic, Fluid & Reactive Processes, Fire S&T

Computational Solid/Structural/Thermal/Fluid Mechanics & Dynamics

Verification & Validation, Uncertainty Quantification, Credibility Processes

- Statisticians work mostly in areas of Risk/Reliability Analysis, Quality
  Engineering, Quantification of Margins and Uncertainty (QMU).

Sandia Wolfpack

- **~90 Alumni**
- **~40 NCSU doctoral degrees**
- **~15 student interns (Summer 2019)**

My Route to SNL Engineering Sciences

- **Worcester Polytechnic Institute (B.S.)**
  - Goal was Nuclear _Engineering_, but ended up…
  - Physics (quantum mechanics), Mathematics (Steklov eigenvalues)
  - COMAP Mathematical Contest in Modeling (MRI image analysis) [_Consortium for Mathematics and its Applications_]
- **Headed** for theoretical particle physics (SUNY Stony Brook), but was **diverted** to the Industrial Applied Mathematics Program (NCSU).
- **North Carolina State University (M.S., Ph.D.)**
  - Industrial Mathematical Modeling Workshop (intro. to smart materials).
  - Degrees: Computational/Industrial Applied Mathematics
  - Dissertation: Shape Memory Alloy (SMA) modeling.
  - **Grad. Internships**: The Boeing Company (sparse optimization), SNL (SMAs).
- Applied only to non-academia positions and chose…
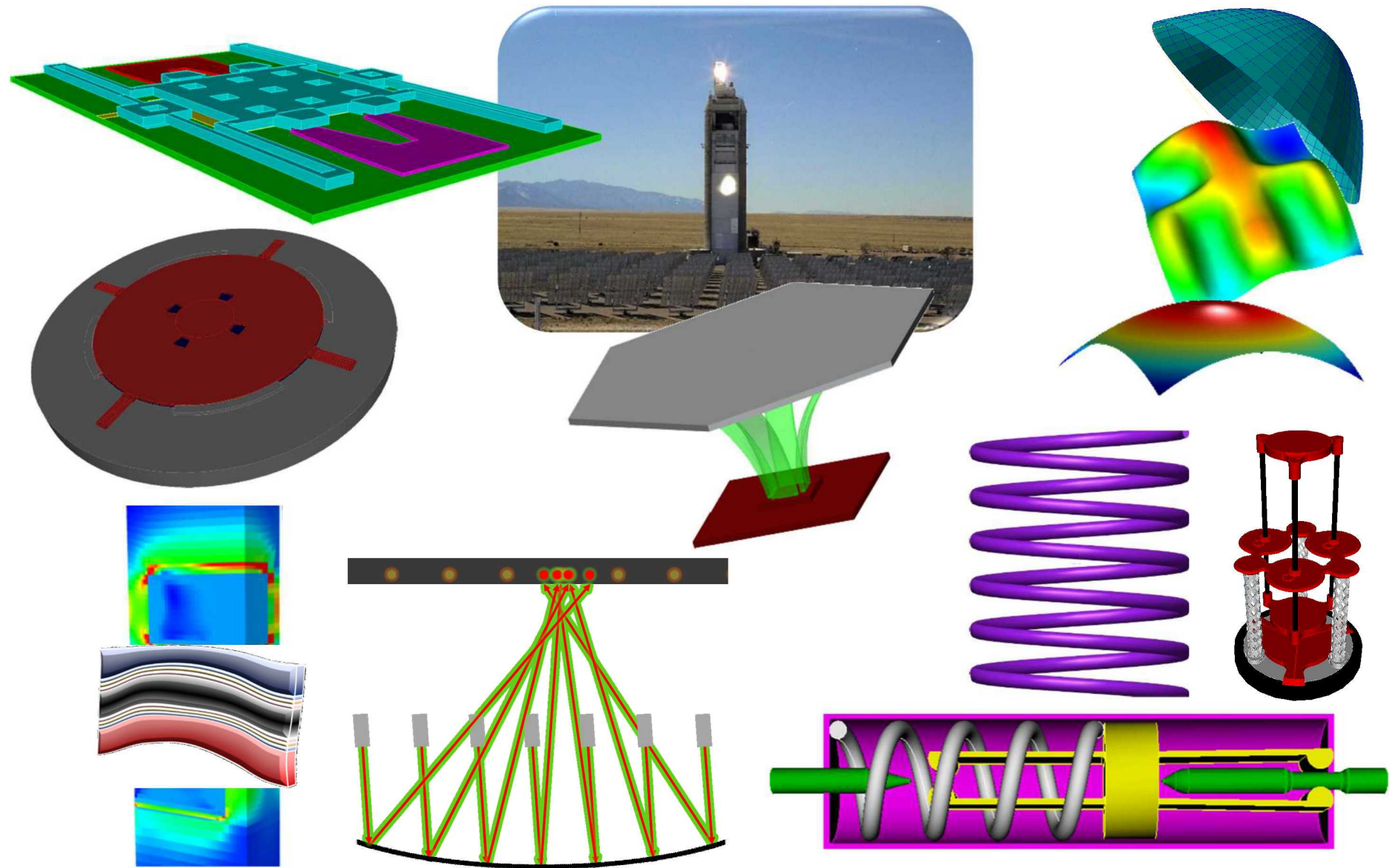- **Sandia National Laboratories, Albuquerque**
  - Adaptive structures, smart materials and metamaterials research.
  - Mechanical design with uncertainty quantification and optimization.
  - Thermal stress analysis, including Finite Element multiphysics.
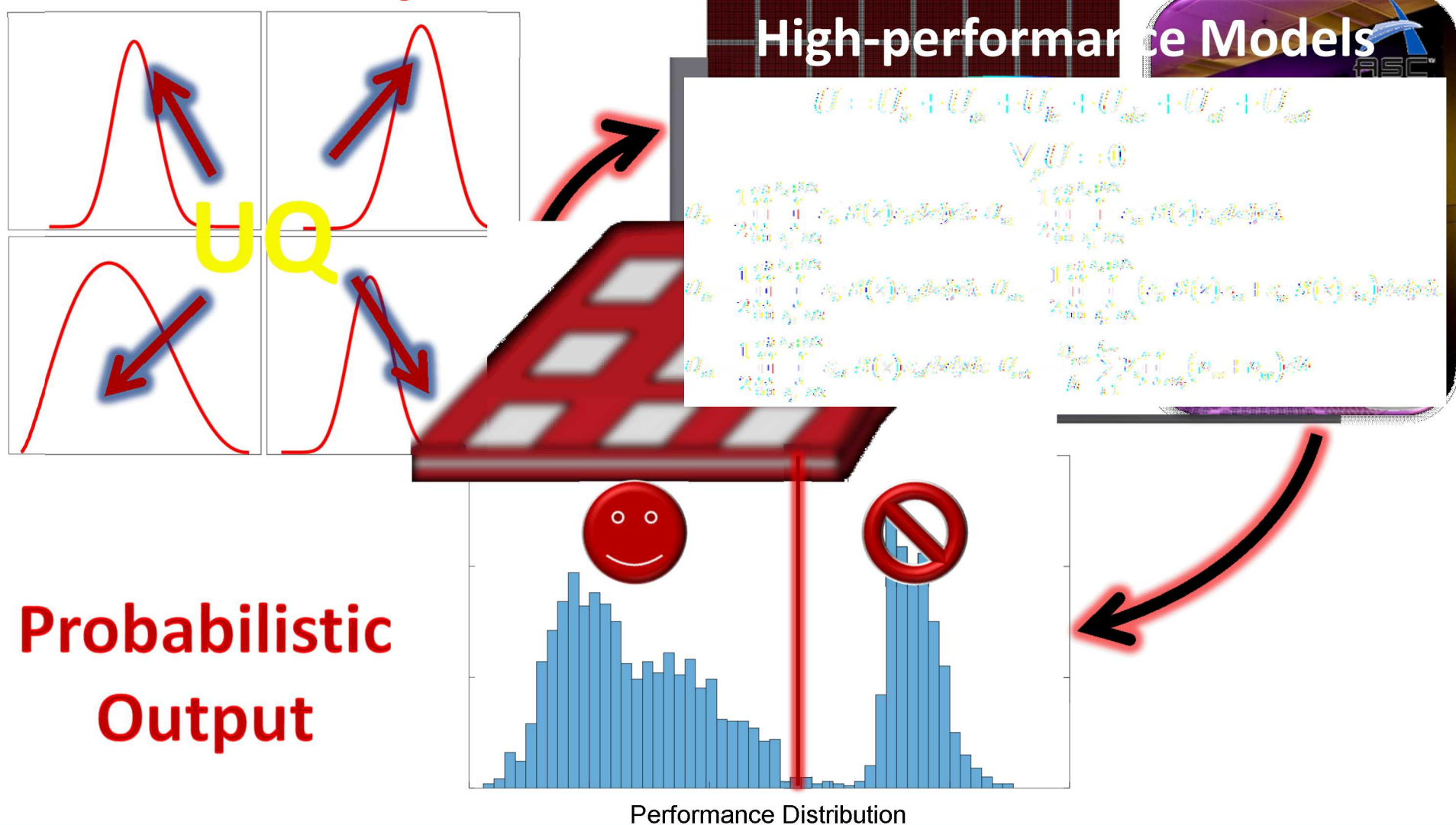 - Thermomechanical modeling of micro- and meso-electronics, MEMS.
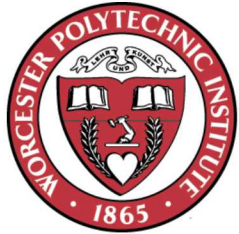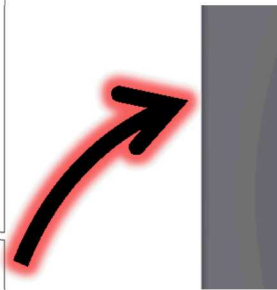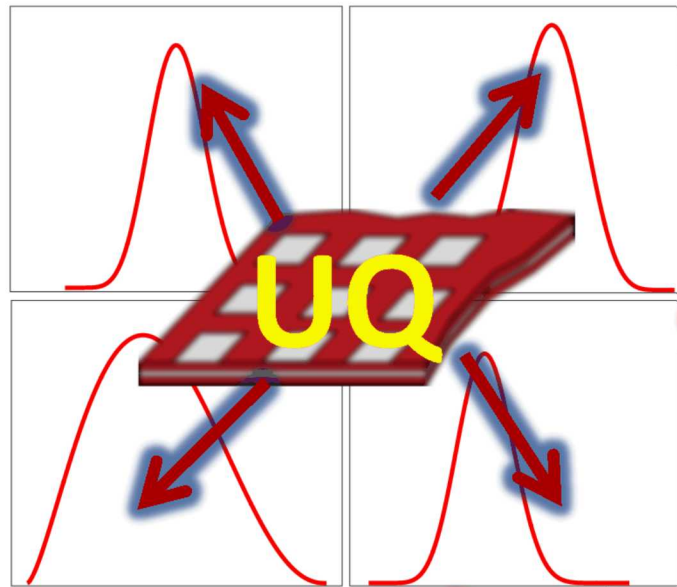
My Interdisciplinary Research (Some!)

One of My Current Interests

Uncertain Input
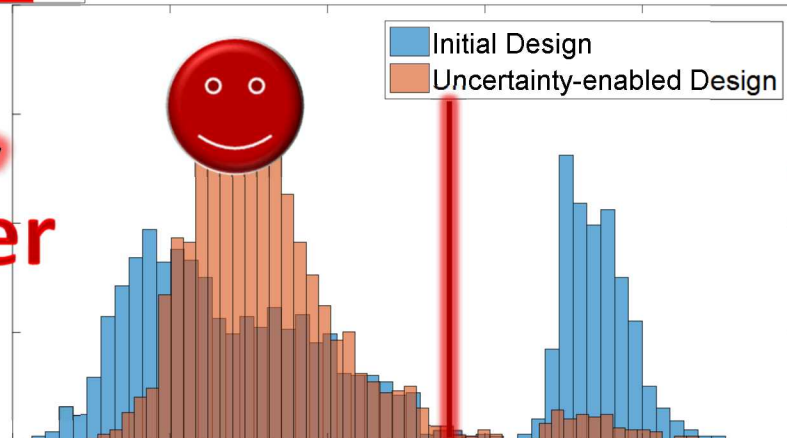
UQ

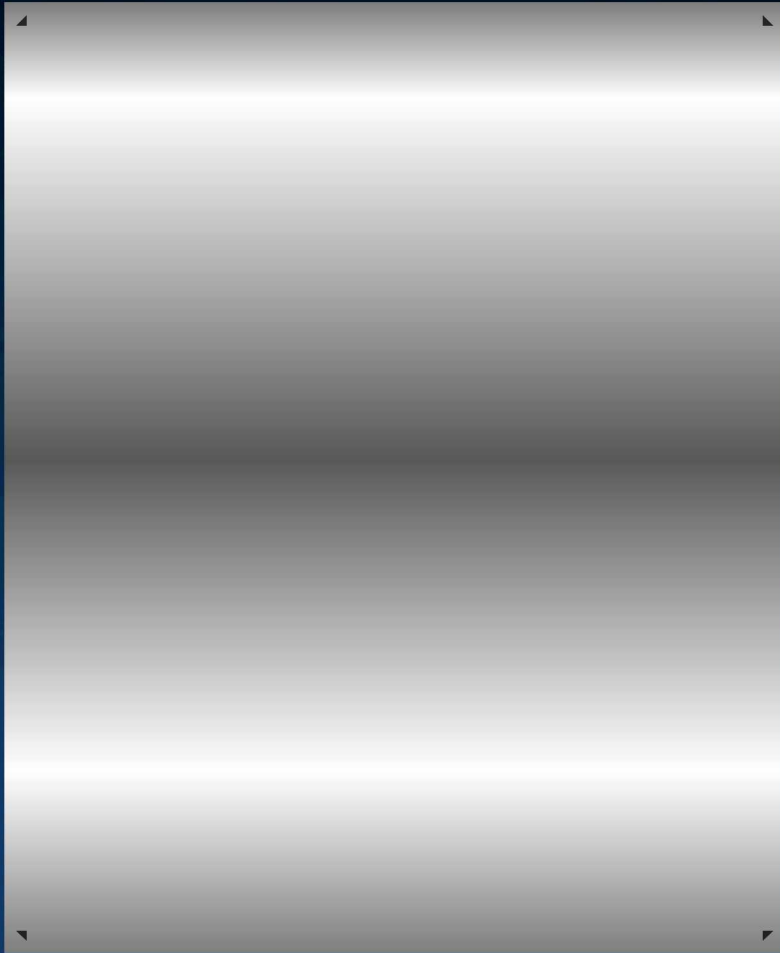**High-performance Models**

Probabilistic Output

Performance Distribution

Uncertainty-enabled Design

The Sandia Work Experience

- Challenging assignments

- State-of-the-art research facilities

- Access to outreach and networking groups

- R&D 100 Awards, patent royalties, and more

- Career mobility

Work with Top Minds

Our unique work requires the collective minds of the nation's top scientists, engineers, and support staff, many of which are recognized for developing a range of breakthrough technologies.
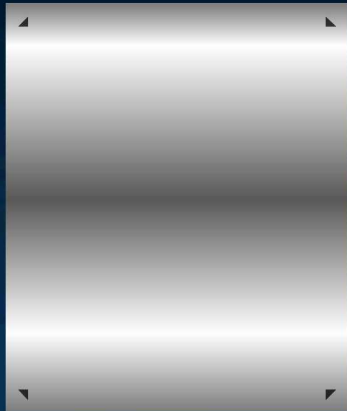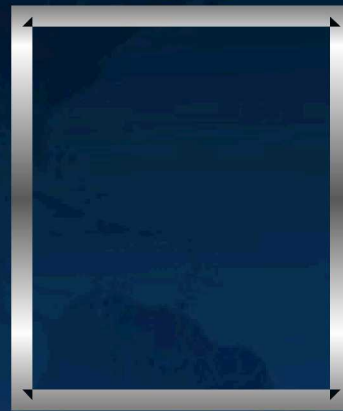

Tamara Kolda
Fellow of the Society for Industrial and Applied Mathematics

Somuri Prasad
Asian American Engineer of the Year Award

Jon Madison
Black Engineer of the Year Award

Cliff Ho
Fellow of the American Society of Mechanical Engineers

Apply Online! *sandia.gov/careers*

Sign up for Automatic Job Notifications!
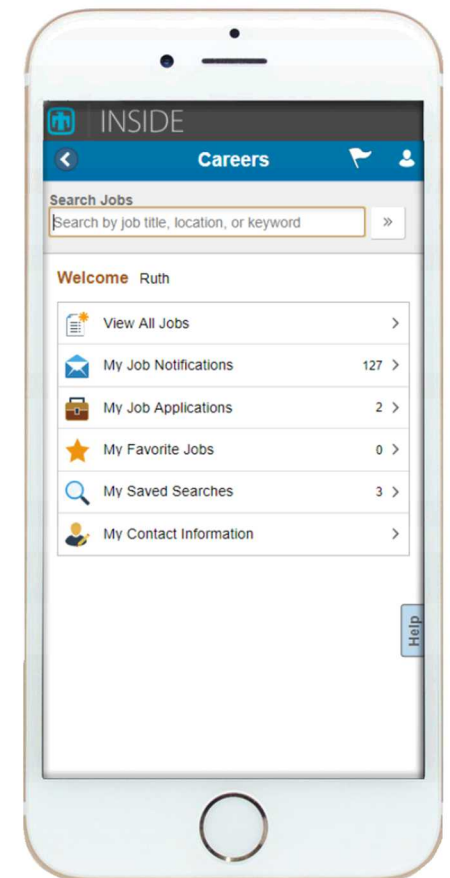
Internships

Encourages qualified students to develop interests in critical skills areas related to our mission, with the ultimate objective of developing our pipeline for our future.

Types: Summer, Year Round and Co-op.
Eligibility Criteria

- Min. cumulative GPA: 3.0 Undergrad/Grad.

- U.S. citizenship for positions that require clearance or as stated in the job posting.

- Full-time enrollment status at an accredited college, university, or local high school.

- At least 16 years of age.

Technical Institute Internships

- Center for Computing Research (CCR)

- Interdisciplinary Design, Engineering, and Assurance Students (IDEAS)

- Nonlinear Mechanics and Dynamics (NOMAD)

- Research and Applications of Mechanics of Structure (RAMS)

- SENTINL: Energy Surety Incubator (ESI), Interns for Security, Arms Control, and Force Protection Engineering (iSAFE).

- TITANS: Center for Analysis Systems and Applications (CASA), Center for Cyber Defenders (CCD), Monitoring Systems and Technology Intern Center (MSTIC).
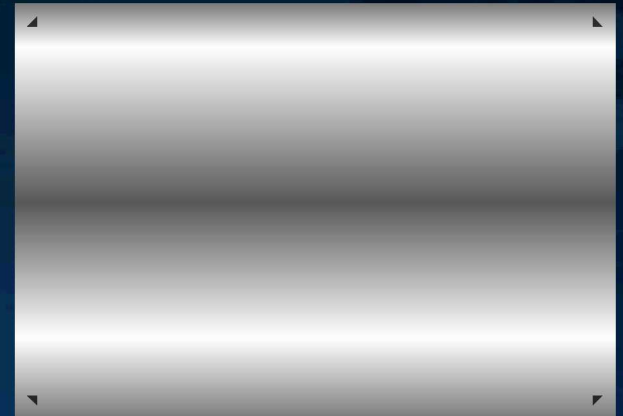
See careers.sandia.gov for more!

Post-doc Opportunities
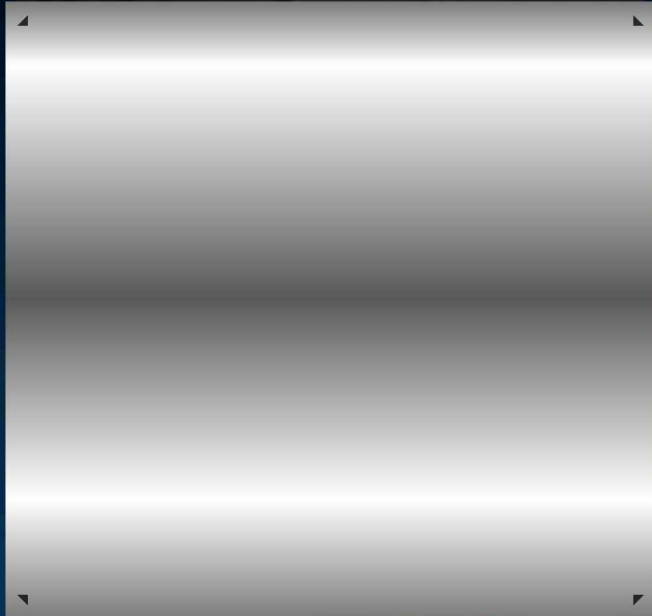
Key areas for post-docs at Sandia:

- Biosciences and biotechnology
- Chemistry and materials science
- Combustion
- Computational mechanics
- Computer science
- Hydrogen
- Microelectronics and microfluidics
- Nanotechnology
- Physics

Eligibility Criteria

- Recent PhD (awarded within past 5 years) or ability to complete all PhD requirements before beginning.

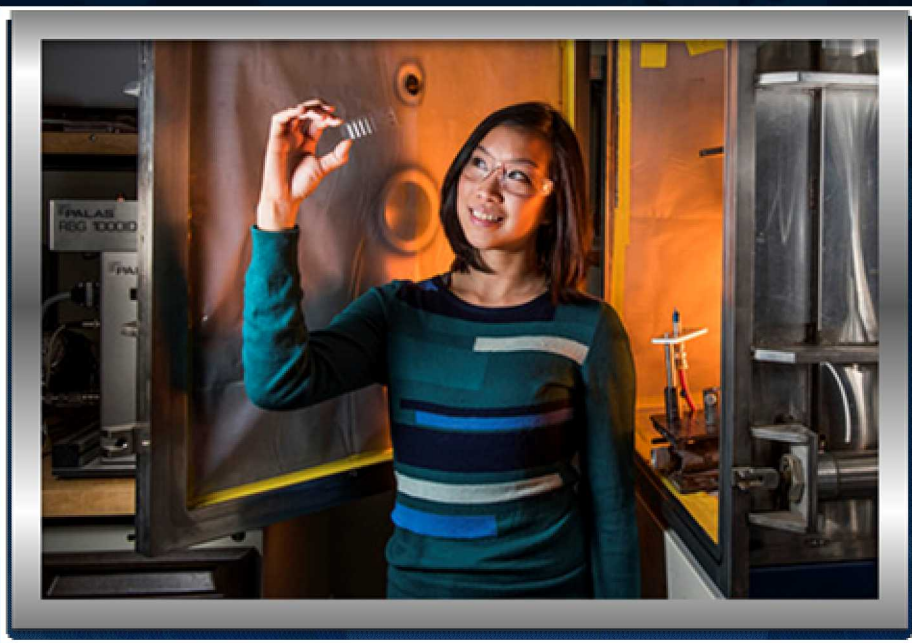- No previous post-doc appointments at a national laboratory.

Fellowship Opportunities

Sandia provides postdoctoral fellows with professional-development opportunities and prepares fellows to conduct independent, groundbreaking research.

Ph.D. Level Fellowships

- Harry S. Truman Fellowship

- Jill Hruby Fellowship

- John Von Neumann

Special Programs, Education & Mentoring

University-based Education
- Tuition Assistance Program
- University Part-Time Program
- Special Master's Program
- Doctoral Study Program

In-house Education, Training and Mentoring Programs
- Business
- Communication
- Design and drafting
- Information technology
- Manufacturing
- Marketing
- Project management Sciences

So Why Sandia?

National Security Mission: Work contributes to the security, peace and freedom of our nation and the world.

Uniquely Challenging and Important Work: Work is challenging, and amazing with real-world impact.

Work with Great People: Work with extraordinary people, the top minds in their field.

Research Facilities Like None Other: Access to some of the best tools, equipment, and research facilities in the world.

Healthy Lifestyle, Work-Life Balance: Balance between work life and personal life through flexible schedules, competitive benefits, and convenient amenities.

Videos

Sandia Mission Video (4:36)
Sandia Our Roots (3:05)

Location Videos
Sandia New Mexico Location (3:23)
Sandia California Location (3:41)

Diversity & Inclusion Videos
Black Leadership Outreach
Asian Leadership Outreach
American Indian Outreach
Hispanic Leadership Outreach

*For more Sandia Videos refer to Sandia's YouTube Channel