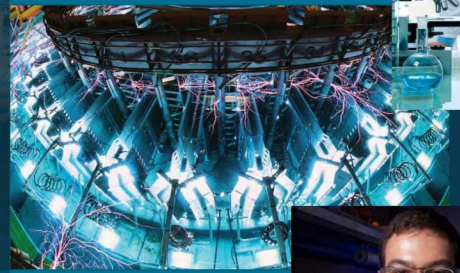
Sandia National Laboratories

Information Session (ME/MSE focused)

Scott Grutzik, PhD (sjgrutz@sandia.gov)

SAND2019-10652PE



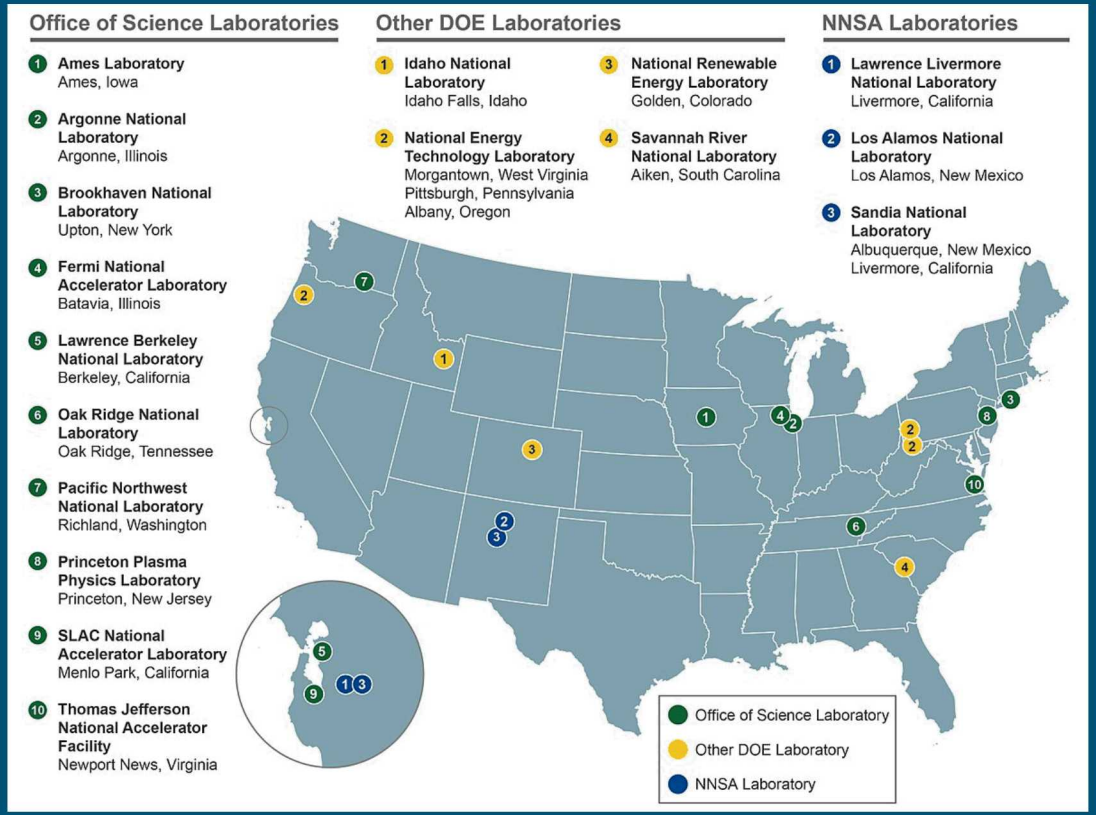
World-changing technologies.

Life-changing careers.

Yello recruiting campaign:

Text “SWE19” to (505) 605-6276

U.S. National Laboratories (DOE)



Credit:
en.wikipedia.org/wiki/United_States_Department_of_Energy_national_laboratories

Nuclear Security Enterprise (NSE)

NNSA Management & Operating (M&O) Partners work together to maintain and enhance nuclear security.

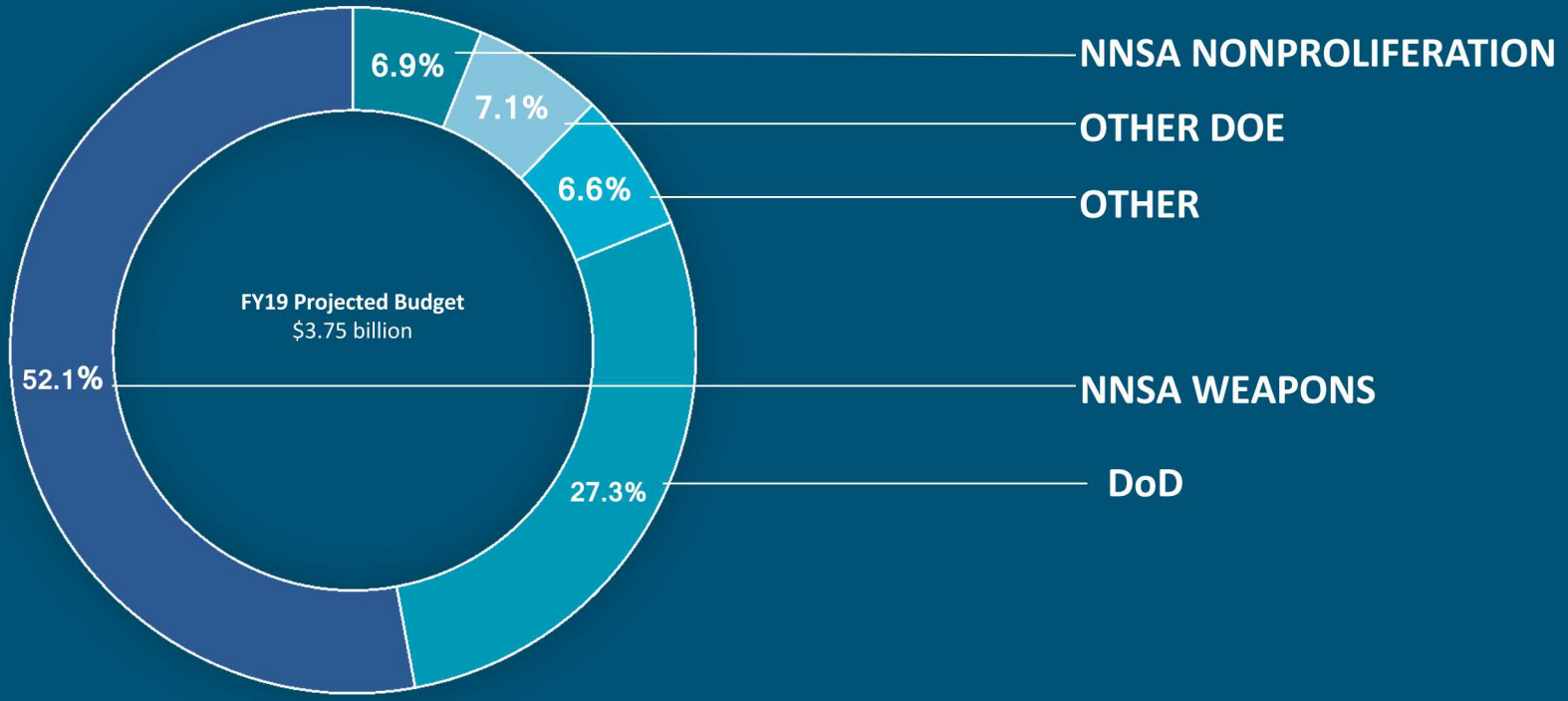
NNSA M&O's offers opportunities for BA, MS and PHD in:

- Electrical • Mechanical • Nuclear • Computer • Engineering
- Cyber Security • Computer Science • Data Science • Physics
- Chemical • Mathematics • Science • Business • Project • Management/Project Control and more!

NNSA has locations in:

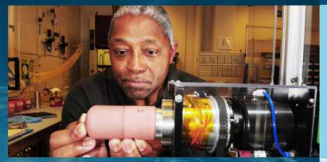
- Aiken, SC
- Amarillo, TX
- Kansas City, MO
- Livermore, CA
- Oak Ridge, TN
- Albuquerque, NM
- Germantown, MD
- Las Vegas, NV
- Los Alamos, NM
- Washington, DC

Sandia's Funding ~ $3.75 Billion



FY19 Projected Funding

Fulfilling Our National Security Mission



Nuclear Deterrence

Sandia provides the science needed to enable the U.S. nuclear stockpile, and does fundamental scientific, biomedical, and environmental research to enhance national security, economic competitiveness, and improved quality of life.

Defense Nuclear Nonproliferation

Sandia's primary mission is ensuring the U.S. nuclear arsenal is safe, secure, and reliable and can fully support our nations deterrence policy.

National Security Programs

Sandia provides systems, science, and technology to meet national security objectives in such areas as cybersecurity, science and technology products, and integrated military systems.

Energy & Homeland Security

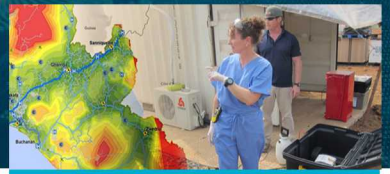
We protect the United States from threats at home and abroad by developing the technical expertise to monitor and assess emerging dangers, guard materials and critical assets, and respond to crises.

Advanced Science & Technology

We support the resilience and security of the nation's energy system, protect digital and physical critical infrastructure, and reduce U.S. vulnerability to chemical, biological, radiological and nuclear terrorism.

Sandia's Impact

Sandia is often called upon to respond to high-profile events, including 9/11 and the Ebola outbreak.



Ebola Outbreak

Sandia contributes to global response of Ebola outbreak by developing a sample delivery system cutting the wait time and potentially fatal exposure.

Cleanroom invented 1963

$50 billion worth of cleanrooms built worldwide. They're used in hospitals, laboratories and manufacturing plants today.

9/11

Sandia sets contingency plans for release of materials and aircraft attacks on critical facilities immediately after 9/11. Search dogs are equipped with cameras for search and rescue K-9 handlers. The capability allowed search efforts to be carried out in spaces inaccessible to humans.

Detecting IEDs

Combat personnel now have a new tool for uncovering improvised explosive devices: Sandia's highly modified miniature synthetic aperture radar system, which is being transferred to the U.S. Army.

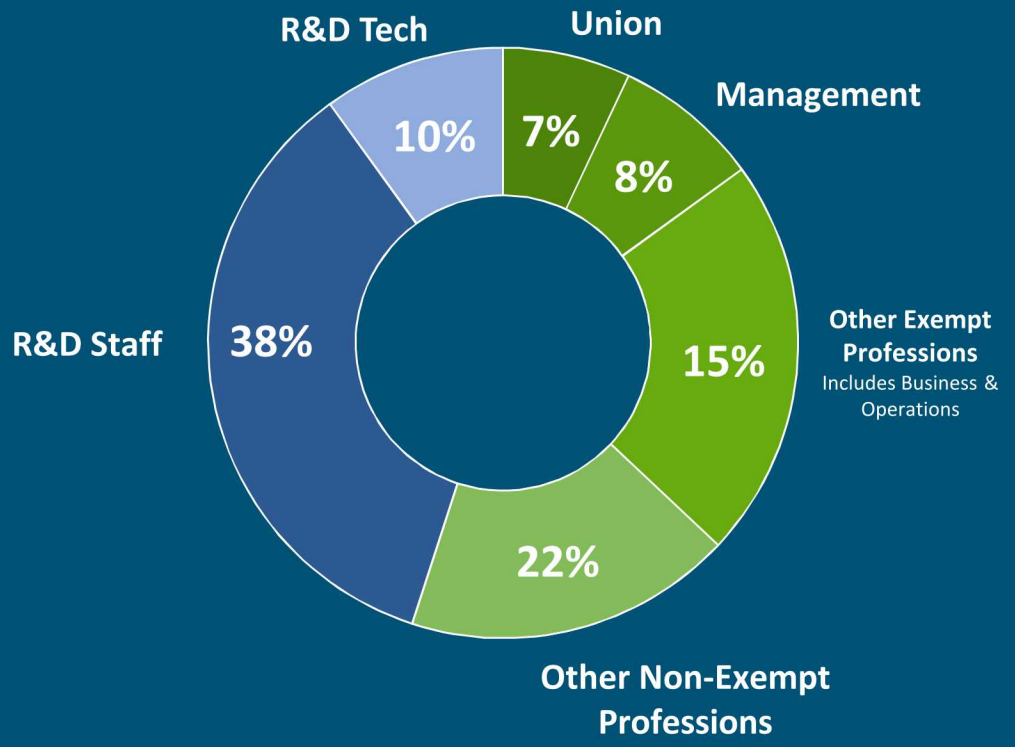
Our Workforce & Culture

Our Workforce ~14,100 employees

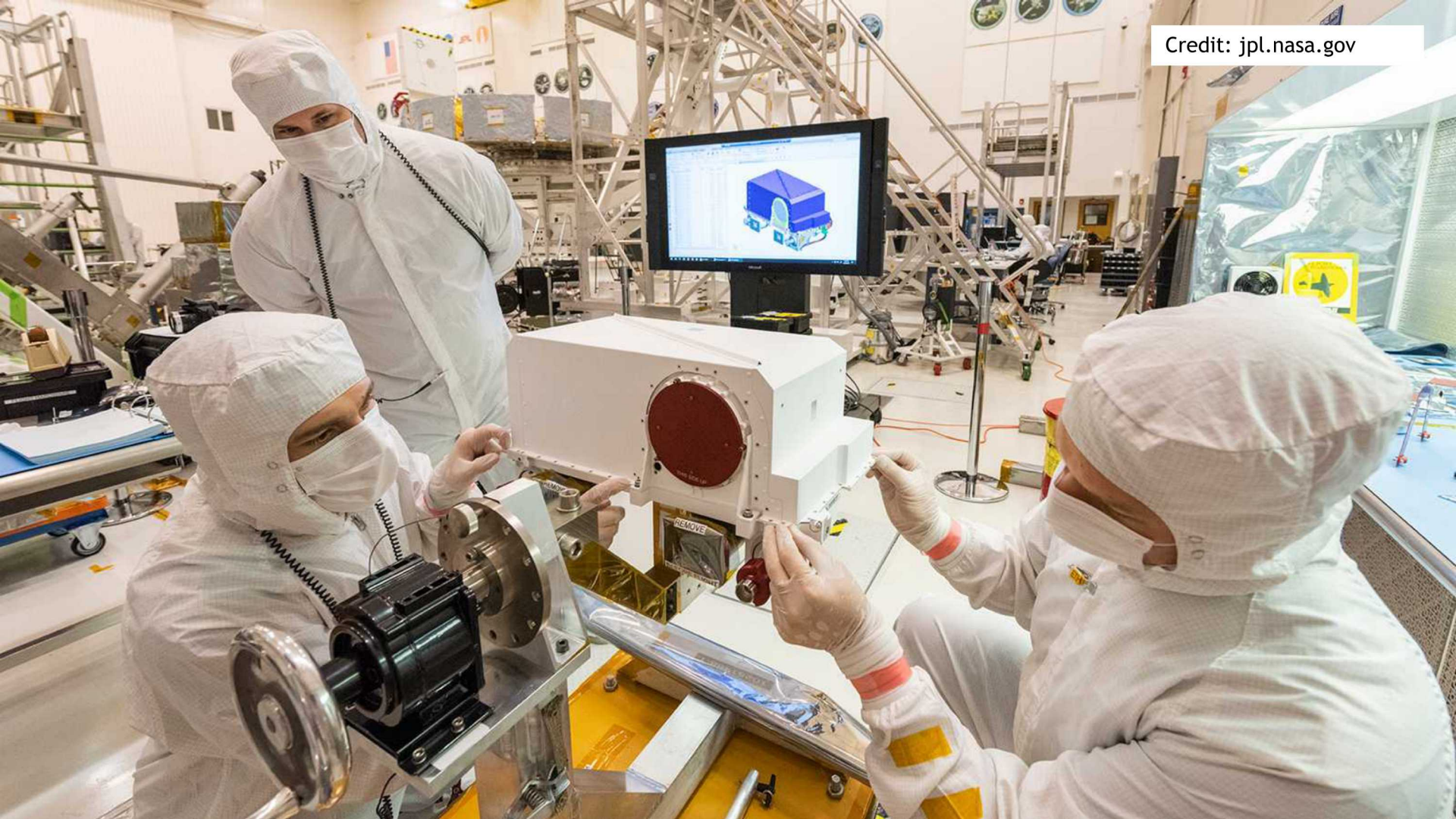
~12,300 Regular employees
~1,800 Temporary employees, students & postdoctoral appointees

New Mexico Site: *(see breakout)*
Workforce: ~12,500
R&D employees: ~4,200
(R&D Staff & Technologists)

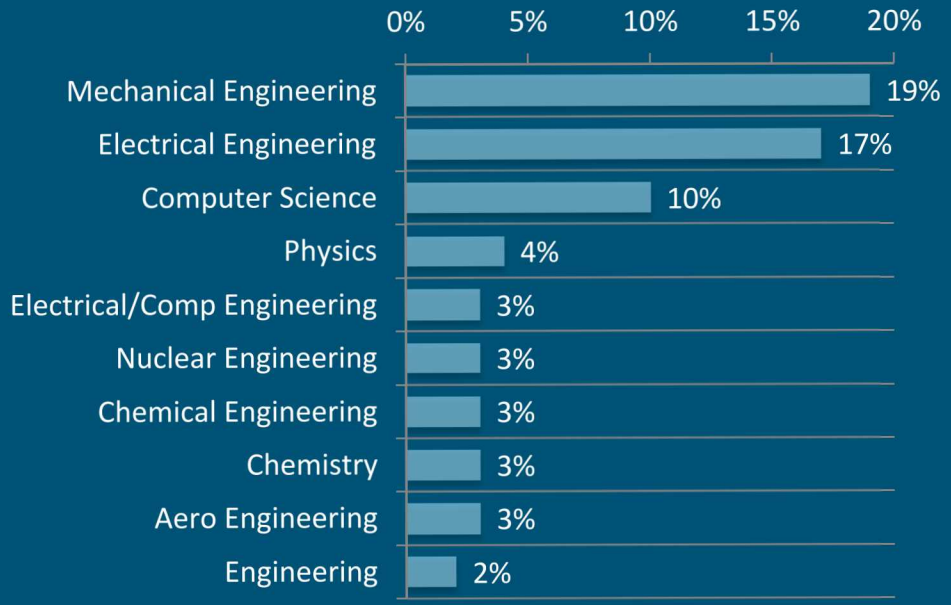
California Site: *(see breakout)*
Workforce : ~1,600
R&D employees: ~650
(R&D Staff & Technologists)



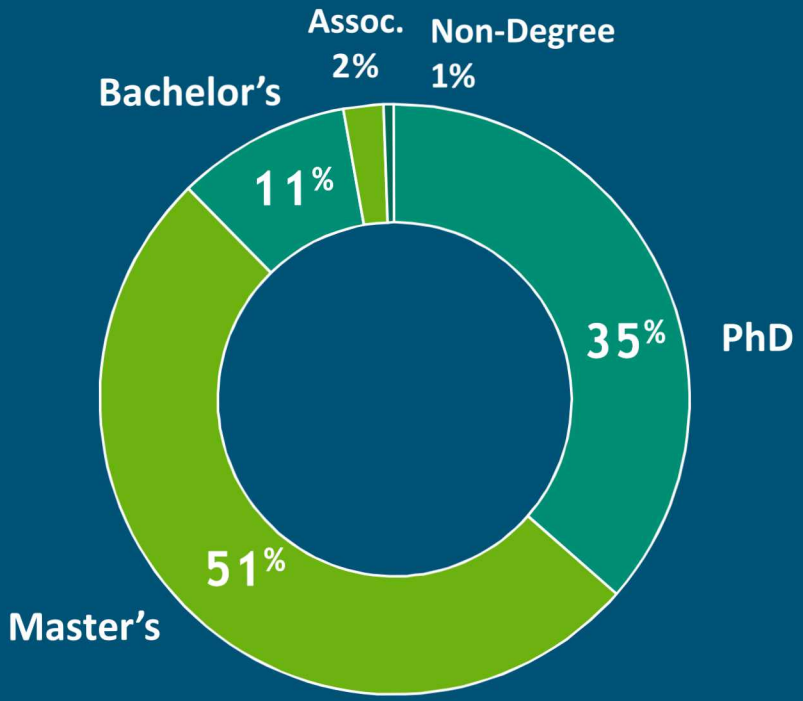
Data as of July 2019


Credit: jpl.nasa.gov
REMOVE

R&D by Discipline & Degree

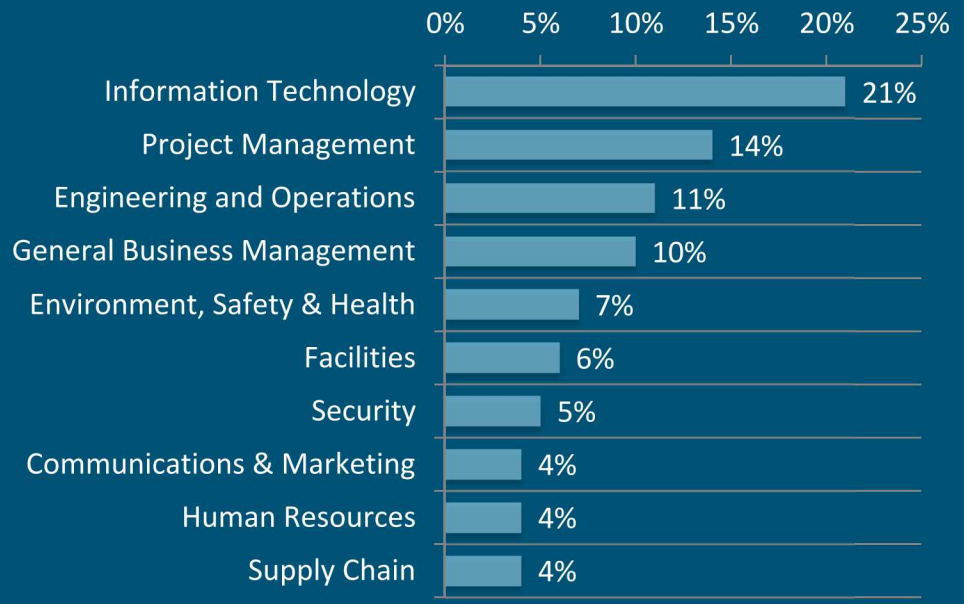


Top 10 job descriptions shown, Regular exempt non-management employees only

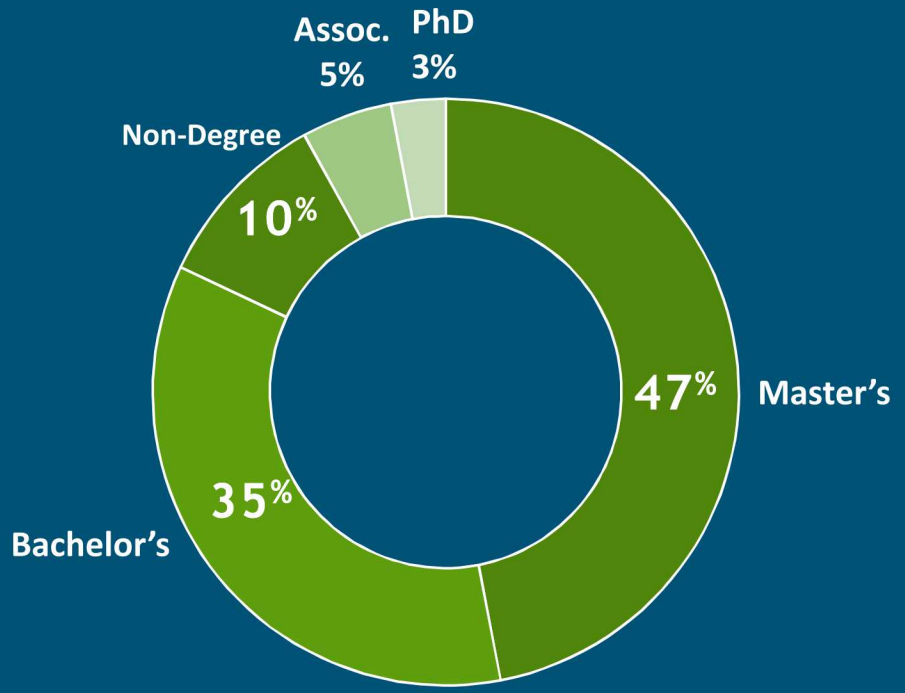


Data as of July 2019

Business & Operations Staff



Top 10 job families shown , Regular exempt non-management employees only



Degree levels for all our
non-management professions including those not represented

Data as of July 2019

Working at Sandia

Living in Albuquerque

Watch:
Sandia New Mexico Video

Life in Albuquerque

- Albuquerque is the largest city in New Mexico with a population of over 500,000
- Affordable housing, reasonable cost of living
- Minimal traffic congestion compared to larger cities

Albuquerque Environment

- High desert climate with 278 annual days of sunshine
- Average temperatures between 78˚ and 40˚
- Wide-open spaces

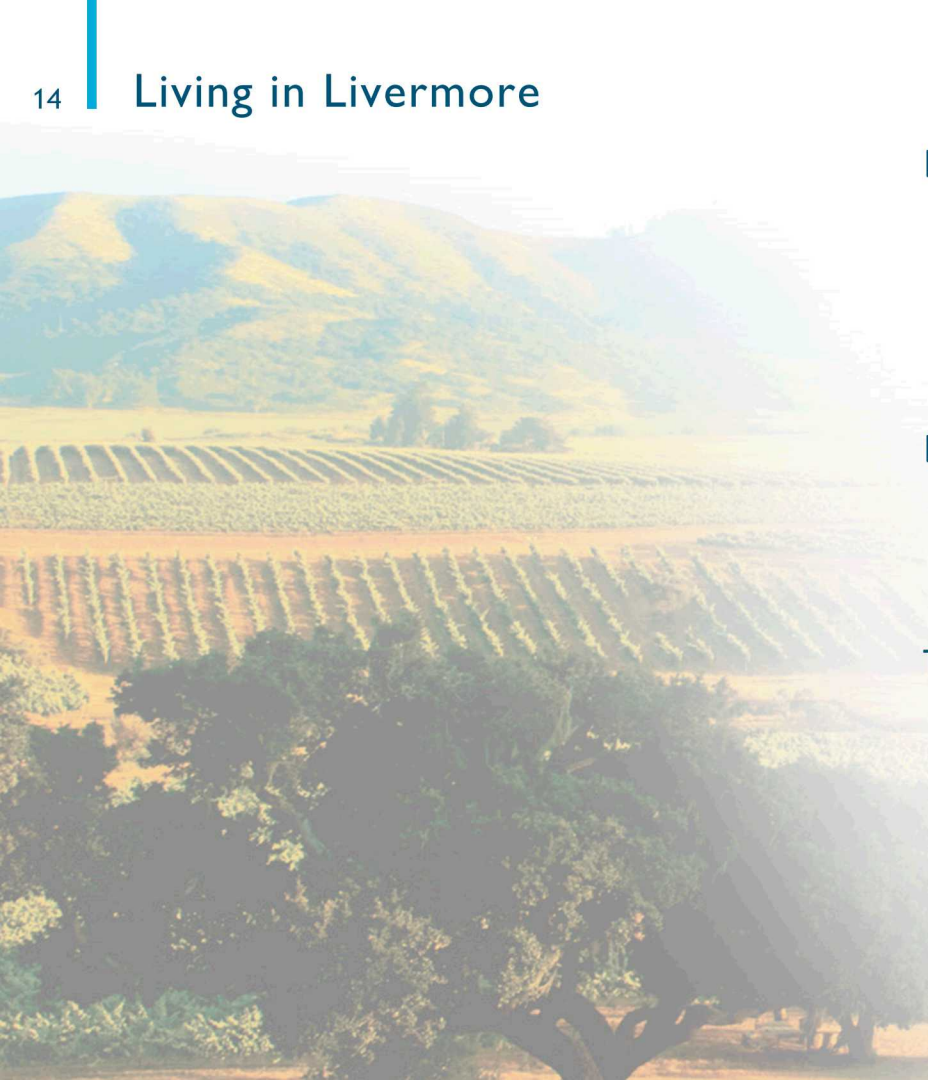
Things to Do

- Outdoor recreation - Ski, snowboard, hike, etc.
- Santa Fe – rich culture
- International Balloon Fiesta
- Explore Indian pueblos and our Hispanic heritage
- Green chile – NM Cuisine
- Museums, Parks, Sports

Photo Credit:
MarbleStreetStudio.com

Living in Livermore

Watch:
Sandia California Video



Life in Livermore

- Livermore's relaxed lifestyle populates nearly 90,000
- Close proximity to first-tier universities, Silicon Valley companies, and other top research laboratories and facilities
- Access to California's finest public and private schools

Livermore Environment

- 260 annual days of sunshine
- Average temperatures between 73˚ and 46˚
- Annual average rainfall: 14.8 inches

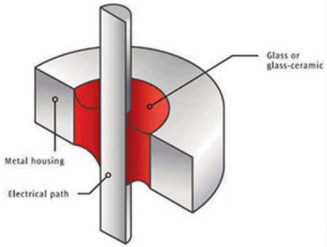
Things to Do

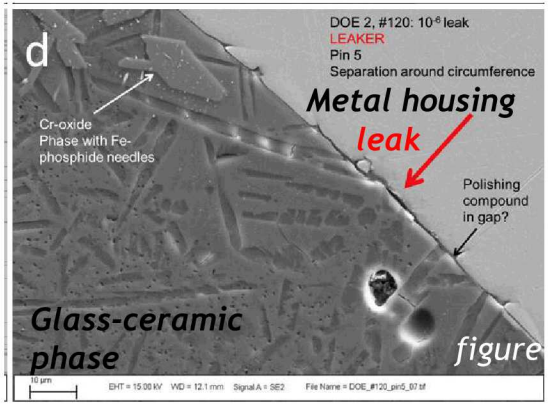
- Vineyards
- Beaches
- State Parks
- Sports – Nearby are six major league franchises
- Art haven
- Proximity to SF Bay Area

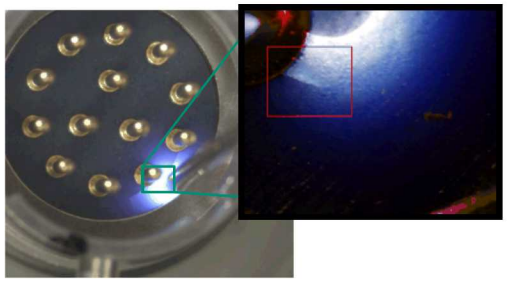
Advanced Science and Technology

https://www.youtube.com/watch?v=o1qAjLSEv0A

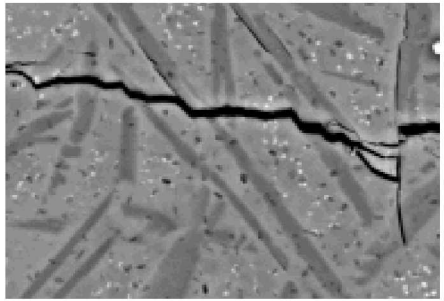
Failure in brittle materials and BritMAPP



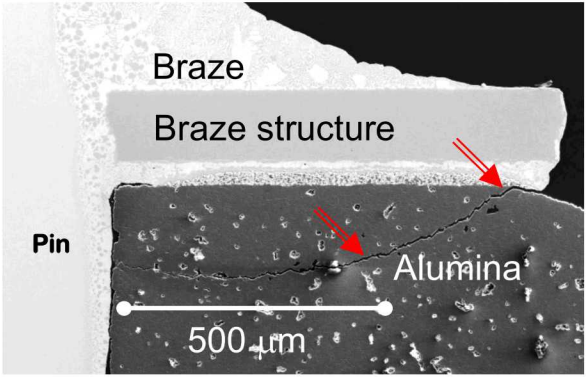




Glass to metal seals

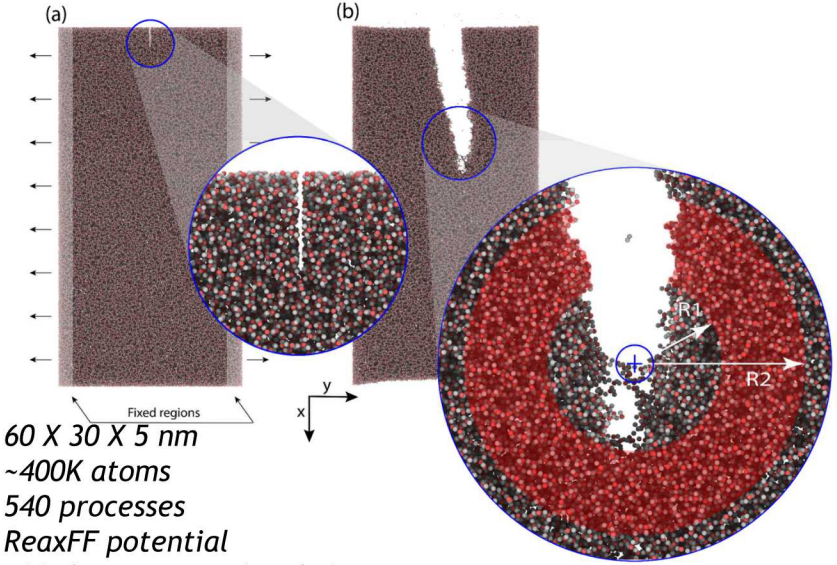


Glass-ceramics



Brazed connections

Atomistic fracture simulations



- *60 X 30 X 5 nm*
- *~400K atoms*
- *540 processes*
- *ReaxFF potential*
- *~30 day computational time*

Property	Simulation	Experimental
Density (gm/cm3)	2.16 +/- 0.01	2.20
Young's modulus (GPa)	77.90+/- 2.02	72.9
Shear modulus (GPa)	25.81 +/- 0.95	31.3
Poisson ratio	0.250+/- 0.005	0.165

Question:

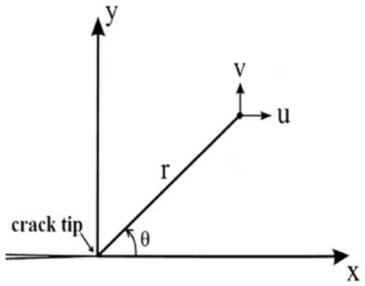
What impact does chemistry have on fracture toughness?

- We use molecular dynamics simulations to investigate fracture in a model system of silica glass
- Critical values of the stress intensity factors (continuum measures) are intrinsic material properties: fracture toughness
- We developed a novel method to determine SIFs while maintaining the discrete material representation
- Our solution method can apply to any full-field displacement solution, e.g. digital image correlation or FEA

Credit: Mark Wilson, Comp Materials & Data Science

Collocation: fit MD displacements to analytical fields

- Asymptotic expansion of the stress/displacement field around a crack tip
- Think of this like a Taylor expansion: more terms means it is accurate to longer distances
- Expansion coefficients for n = 1, 2 terms are particularly of interest
- Any given observed discrete displacement about a crack tip can be described in terms of the Williams expansion
- Fit these expansion terms to observed displacement data



$$u(r,\theta) = \sum_{n=0}^{\infty}\sum_{m=1}^{2} A_m^n f_m^n(r,\theta)$$

$$= \sum_{n=0}^{\infty} A_1^n \frac{r^{n/2}}{2\mu}\left[\left(\kappa + \frac{n}{2} + (-1)^n\right)\cos\frac{n}{2}\theta - \frac{n}{2}\cos\left(\frac{n}{2}-2\right)\theta\right] +$$

$$\sum_{n=0}^{\infty} A_2^n \frac{r^{n/2}}{2\mu}\left[\left(-\kappa - \frac{n}{2} + (-1)^n\right)\sin\frac{n}{2}\theta + \frac{n}{2}\sin\left(\frac{n}{2}-2\right)\theta\right]$$

$$v(r,\theta) = \sum_{n=0}^{\infty}\sum_{m=1}^{2} A_m^n g_m^n(r,\theta)$$

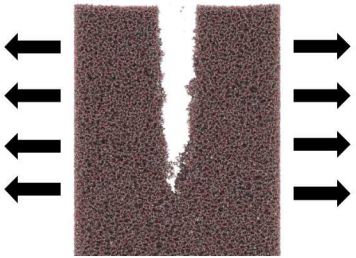
$$= \sum_{n=0}^{\infty} A_1^n \frac{r^{n/2}}{2\mu}\left[\left(\kappa - \frac{n}{2} - (-1)^n\right)\sin\frac{n}{2}\theta + \frac{n}{2}\sin\left(\frac{n}{2}-2\right)\theta\right] +$$

$$\sum_{n=0}^{\infty} A_2^n \frac{r^{n/2}}{2\mu}\left[\left(\kappa - \frac{n}{2} + (-1)^n\right)\cos\frac{n}{2}\theta + \frac{n}{2}\cos\left(\frac{n}{2}-2\right)\theta\right]$$

$$K_I = \sqrt{2\pi}A_1^1 \qquad K_{II} = -\sqrt{2\pi}A_2^1 \qquad T = 4A_1^2$$

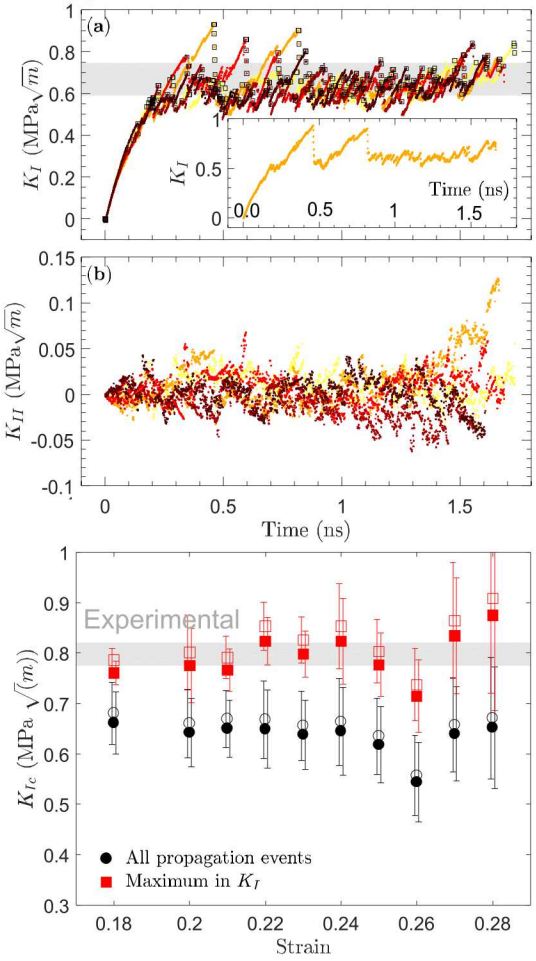
Collocation method applied to MD fracture

- As the system equilibrates K_I builds and ultimately plateaus with propagation events.
- We interpret the plateau region as representative of K_{IC}
- Calculated K_{IC} matches well with experimental values over a range of imposed strains
- Significant strain magnitudes: due to characteristic length scale of fracture these values are not surprising

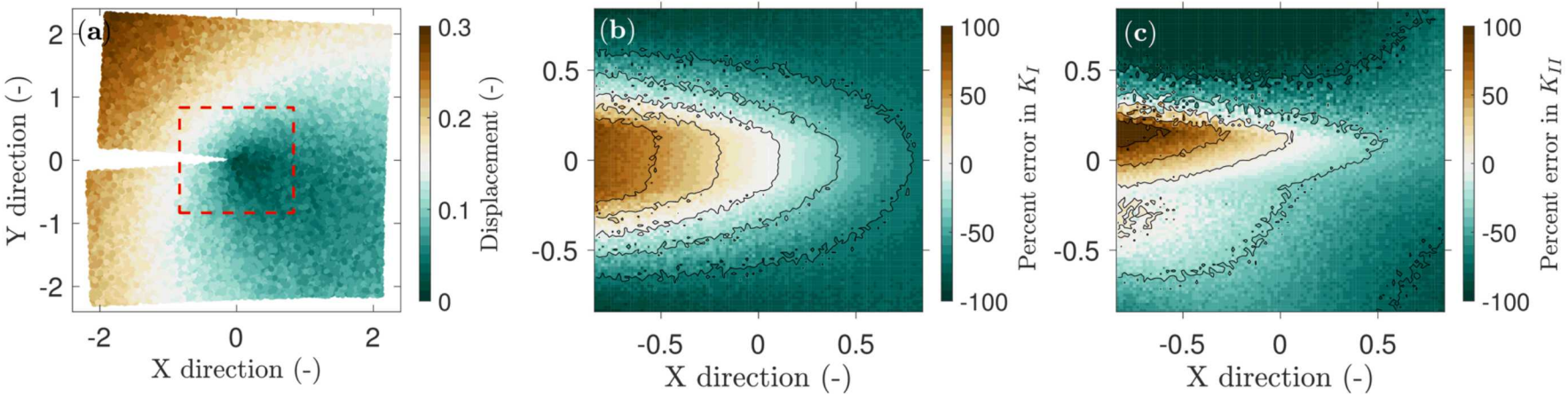


Held in constant strain

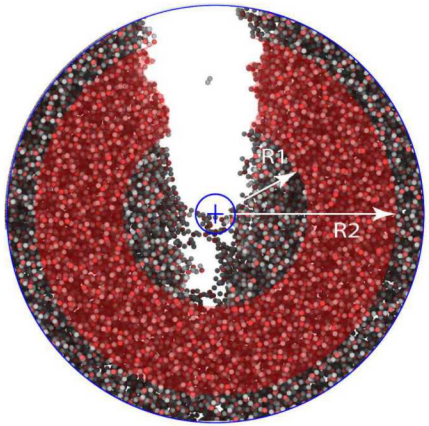
Applied strain 0.22



Misidentification of the crack tip



- Misidentification of the crack tip location can lead to significant error with collocation
- This can be important when applying the method to molecular dynamics, DIC, ductile FEA, etc
- Cause of possible errors in molecular dynamics:
  - Bridging Si-O chains
  - Crack tip blunting



Numerically locating the "true" crack tip

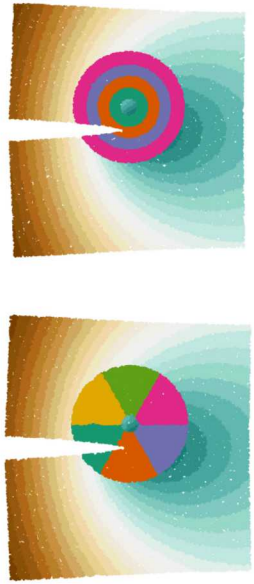
- We exploit the separability of the LEFM fields to identify the crack tip location
- A cost function can then be minimized to find spatial location

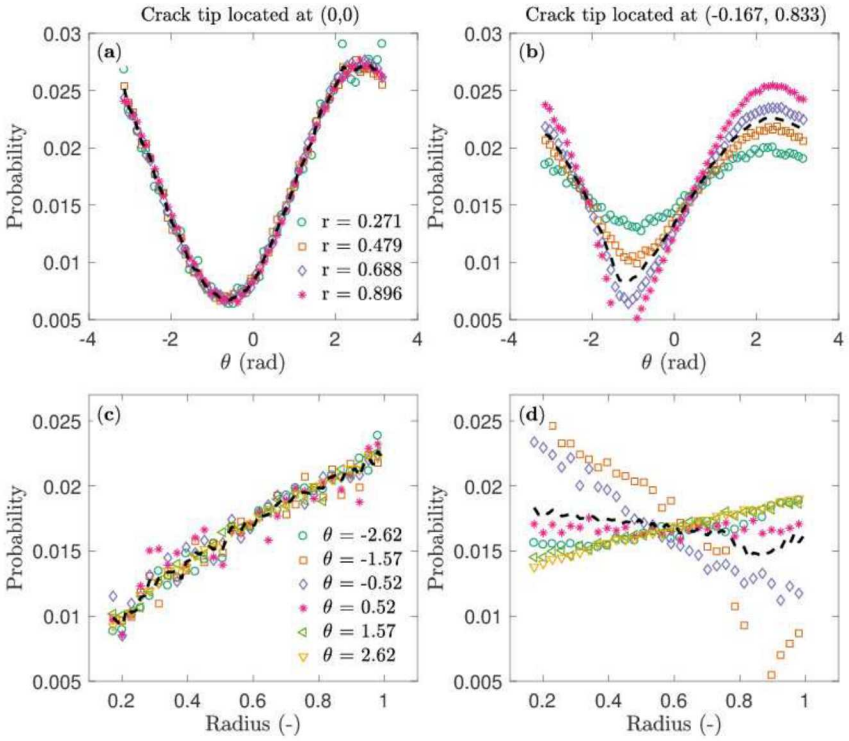
$$u(r,\theta) = \sum_{n=0}^{\infty} A \frac{r^{n/2}}{\mu} f(\theta)$$

$$\Phi^R(x,y) = \frac{1}{N}\sum_{j=1}^{N} \left\| P_j^R(r,\theta) - \bar{P}_j^R(r,\theta) \right\|_2$$

$$\Phi^\theta(x,y) = \frac{1}{N}\sum_{j=1}^{N} \left\| P_j^\theta(r,\theta) - \bar{P}_j^\theta(r,\theta) \right\|_2$$

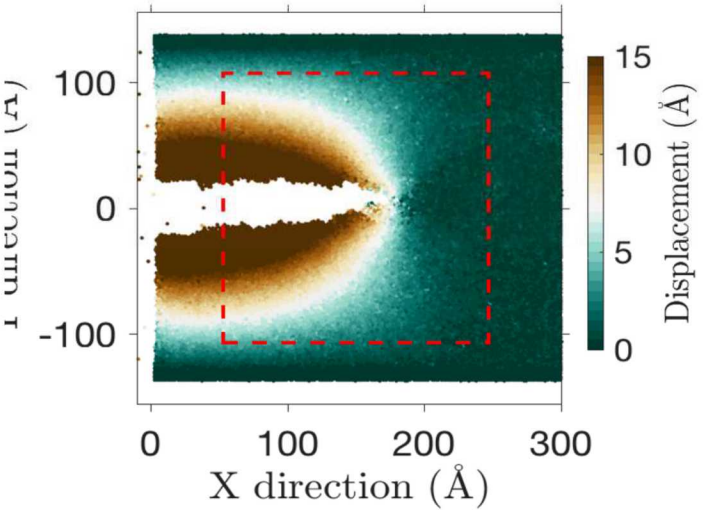
$$\Phi(x,y) = \Phi^R(x,y) \cdot \Phi^\theta(x,y)$$



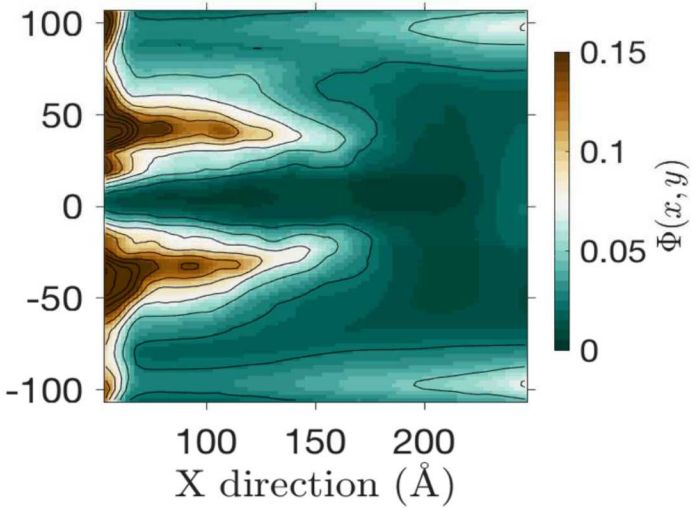


Locating crack tip in molecular dynamics

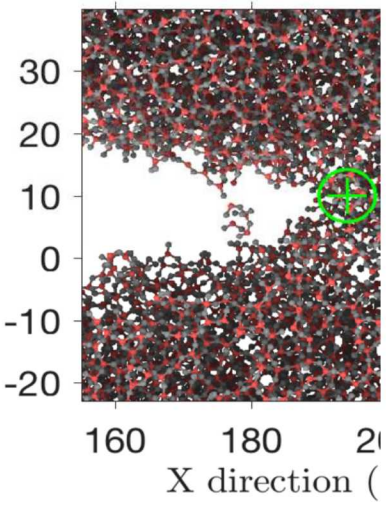
Displacement

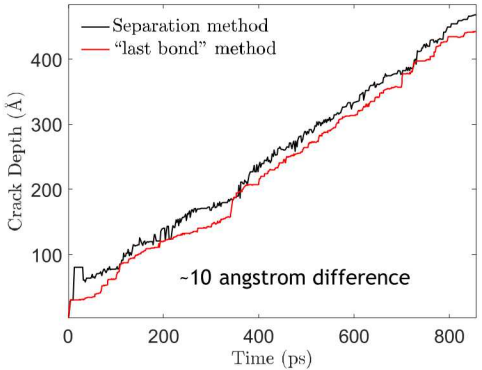


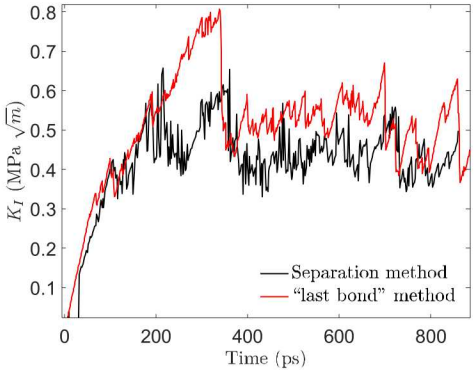
Cost function



Atomic







Employment Opportunities

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. Available for Summer, Year Round and Co-op.

Eligibility Criteria

- Full-time enrollment status at an accredited school during the academic school year
- Undergraduate equivalent of 12 hours per semester
- Graduate equivalent of 9 hours per semester
- Must have a minimum cumulative GPA of 3.0 on a 4.0 scale for Technical, R&D, and Business interns; 2.5 on a 4.0 scale for Clerical and Labor interns
- Have U.S. citizenship for positions that require a security clearance or as stated in the job posting
- At least 16 years of age

Institute Internships

Institute Programs Website

- AutonomyNM
- Computer Science Research Institute (CSRI)
- Energy Surety Incubator (ESI)
- Interdisciplinary Design, Engineering, and Assurance Students (IDEAS)
- Interns for Security, Arms Control, and Force Protection Engineering (iSAFE)
- Mission Services Talent Acquisition Team (MSTAT)
- Monitoring Systems and Technology Intern Center (MSTIC)
- Nonlinear Mechanics and Dynamics (NOMAD)
- Nuclear Weapons Summer Product Realization Institute (NWSPRINT)
- Research and Applications of Mechanics of Structures (RAMS)
- Science of Extreme Environments Research Institute (SEERI)
- TITANS: Cyber Security
- TITANS: Math and Analytics
- TITANS: Software Engineering

Post-doc Opportunities

Key areas for post-docs at Sandia:

- Computer science/Computer Engineering
- Electrical Engineering
- Mechanical Engineering
- High-performance computing
- Microelectronics and microfluidics
- Nanotechnology
- Physics
- Chemistry/ Electro Chem
- Biosciences and biotechnology
- Radiation & electrical sciences
- Engineering sciences
- Pulsed power sciences
- Materials science & engineering

Eligibility Criteria

- A recent PhD (conferred 5 years prior to employment) or the ability to complete all PhD requirements before hire date.

Fellowship Opportunities

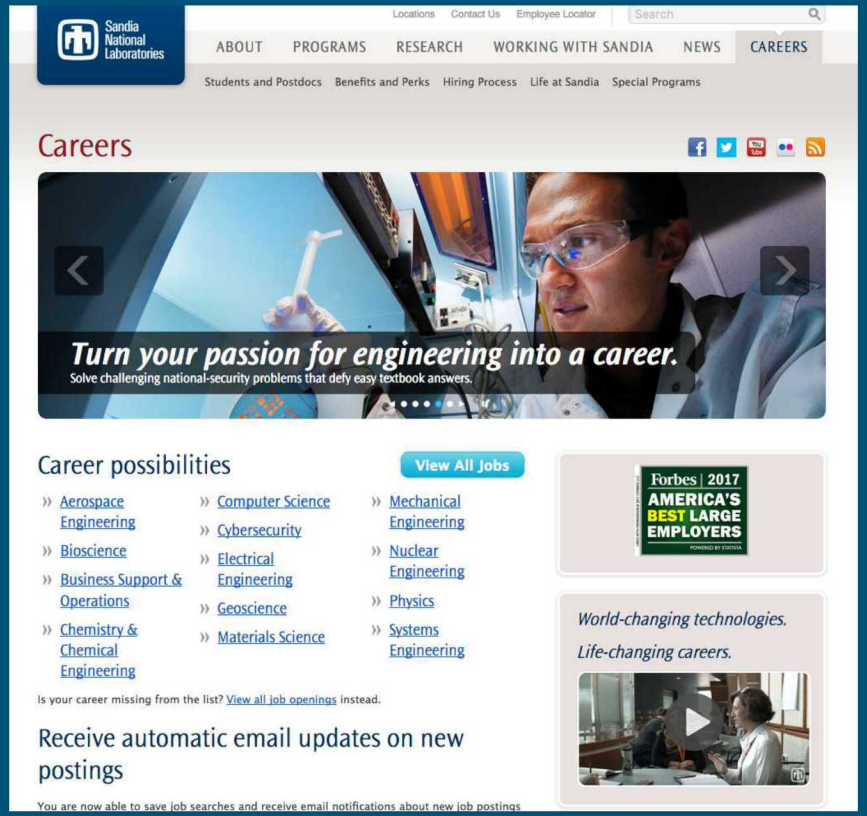
Sandia provides postdoctoral fellows with professional development opportunities and prepares fellows to conduct independent, groundbreaking research.

Postdoctoral Fellowships

- Harry S. Truman Fellowship
- Jill Hruby Fellowship
- John Von Neumann

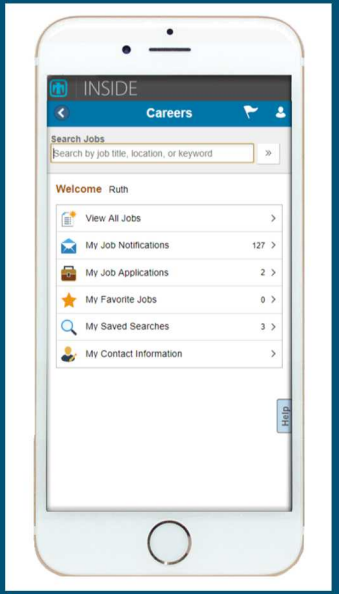
**Sign up for Automated Job Notifications!*

Apply Online! sandia.gov/careers



Sign up for Automated Job Notifications!

Mobile Job Applications



Yello recruiting campaign:

Text “SWE19” to (505) 605-6276

Or sign up for career discussions through Handshake


Thank You!

Backup Slides

Our Culture – Our Values

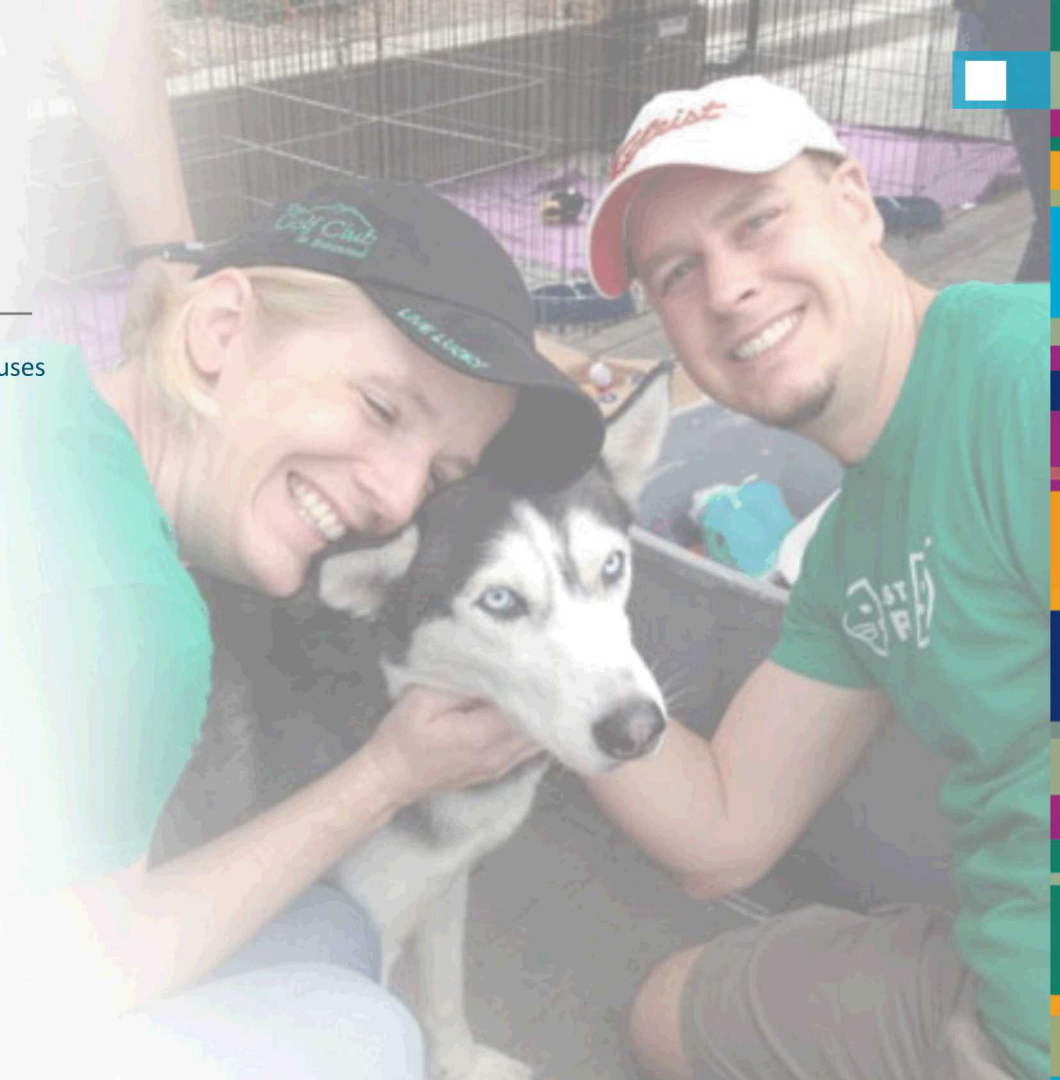
- We serve the nation
- We team to deliver with excellence
- We respect each other
- We act with integrity
- We live safe and healthy lives

Our Culture – Giving Back

~ $5 Million Donated to Nonprofits Annually

Volunteers donate their time to the following causes

- Animal Adopt-a-thons
- Coach sports teams
- Lead scouting troops
- K-12 education outreach
- Help at food banks
- Build homes
- Contributions and drives



Education and Mentoring

In-house Education, Training and Mentoring Programs

- Business
- Communication
- Design and drafting
- Energy
- Health and wellness
- Information technology
- Manufacturing
- Marketing
- Project management
- Sciences

Veterans

Recognizing that veteran capabilities and attributes complement our mission and values, we're intent on attracting the nation's top veteran talent to our company.

At Sandia, you'll find qualities and features that sustain your dedication to being part of something bigger:

- A work ethic and environment driven by a critical mission
- Career possibilities in an array of fields that support national security, such as engineering, biosciences, energy research, cybersecurity, business and operational support, and more
- Opportunities to contribute as an individual or in a leadership position

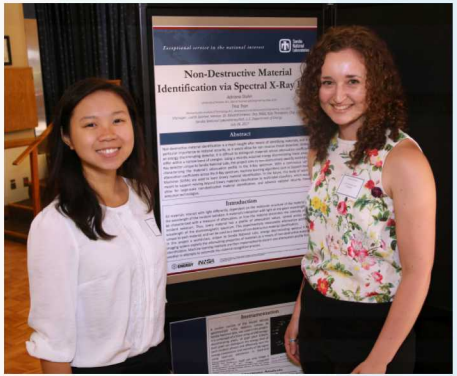
You'll also find encouragement to help you advance your career:

- Colleagues who respect and need your combination of experience and education
- Support, and possibly funding, to further your education
- The Wounded Warrior Career Development Program, which assists veterans with combat related injuries with employment, training, and education for a smooth transition to a civilian career

  Visit: **www.sandia.gov** Keyword search "**Wounded Warrior**"

Internships – Outreach and Networking Events

- Summer Welcome Event
- Intern Career Fair
- Intern Symposium
- Facility Tours
- Speaker Forums
- Professional Development Classes



The Work Experience

- Have meaningful & challenging work assignments
- Work in state-of-the-art research facilities
  Take a Virtual Tour @ tours.sandia.gov
- Work with top minds
- Join outreach and networking groups
- Receive award recognitions,
  like R&D 100 Awards *and more*
- Take a leave to pursue qualifying research and professional opportunities
- Receive patent royalties, if eligible
- Experience a career path in various areas at Sandia

Outreach & Networking Groups

- American Indian Outreach Committee
- Asian Leadership & Outreach Committee
- Black Leadership Committee
- Hispanic Outreach for Leadership Awareness
- Christians in the Workplace Networking Group
- Disability Awareness Committee
- Sandia Parents Group
- Sandia Pride Alliance Network
- Sandia Women's Action Network
- Military Support Committee

And many other employee engagement groups

Quality of Work-Life

Flexible Work Schedules

- 9/80 and 4/10 workweek options
  (with management approval)
- Generous Paid Time Off
- 11 paid holidays – includes a winter shutdown at the end of each calendar year
- Telecommuting arrangements
- Part-time options
- Vacation Buy Plan

Family Life

- Resource and Referral services
- Adoption assistance
- Family recreational activities
- Paid family leave
- Expectant Parent Program

On-site Amenities

- On-site Medical Clinic
- Sandia Laboratory Federal Credit Union
- On-site Café
- On-site Fitness Center
- Access to group exercise classes, clubs and sports activities
- Employee self-formed sports teams

Available at NM & CA sites

Health & Benefits

- Major medical, dental & vision
- Healthcare and dependent care spending accounts
- Health risk assessment screenings
- Exceptional 401(k) Plan
- Employee discounts
- Voluntary benefits like pet, auto, and home insurance as well as identity theft protection
- Tuition assistance

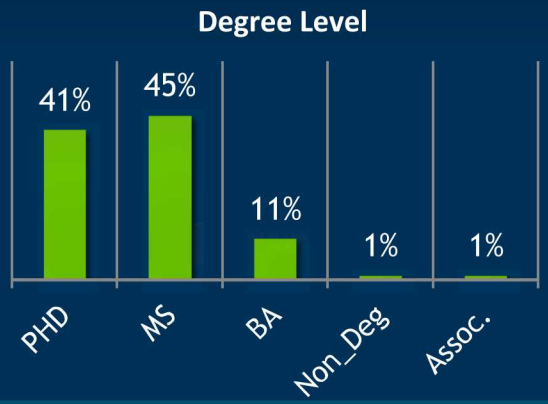
Sandia California - *Livermore*

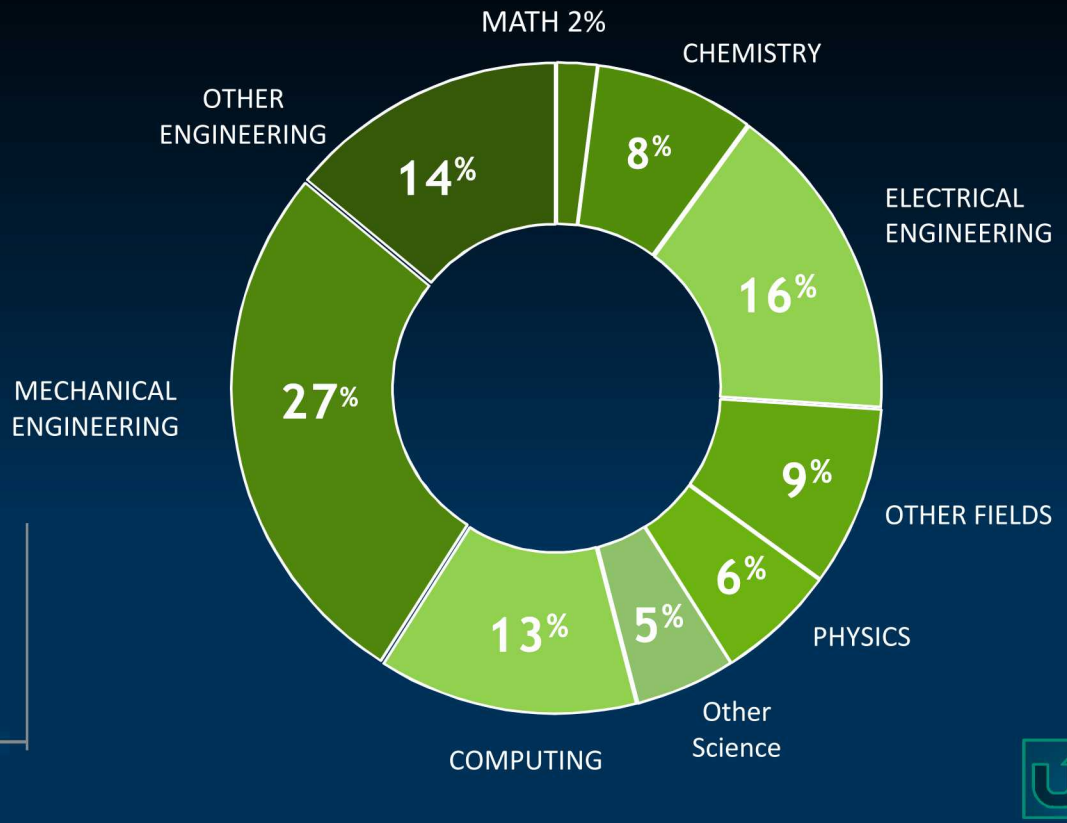
On-site workforce: ~1,600

R&D staff& technologists: ~650

Distinguishing research capabilities:

- Applied Biosciences
- Combustion Research
- Information Systems
- Micro & Nano Technologies and *more*





Data as of July 2019

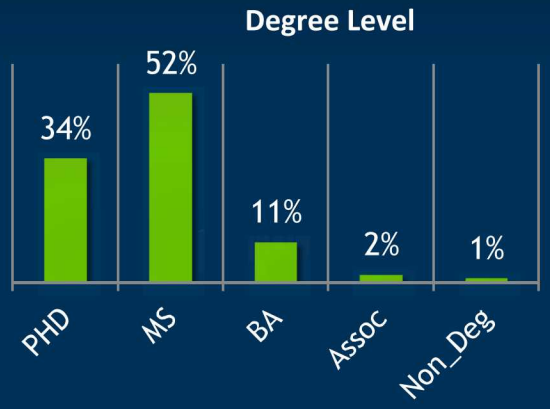
Sandia New Mexico - *Albuquerque*

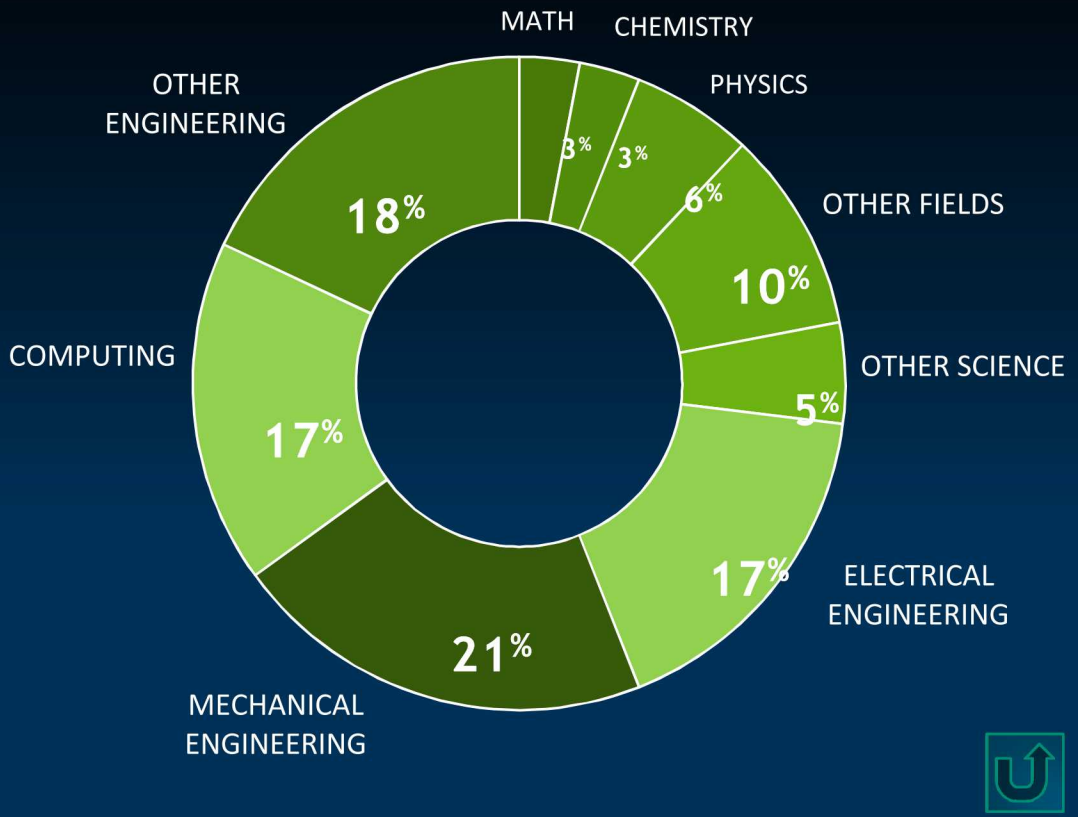
On-site workforce: ~12,500

R&D staff & technologists: ~4,200

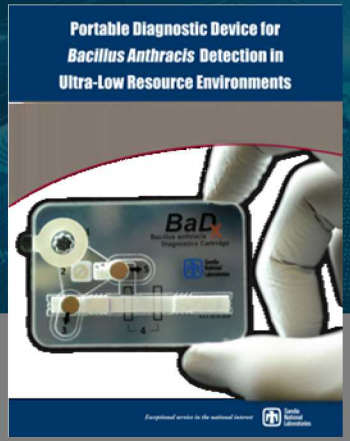
Distinguishing research capabilities:

- Renewable Energy
- Micro-electronics/Semiconductors
- Cybersecurity
- Homeland Security *and more*





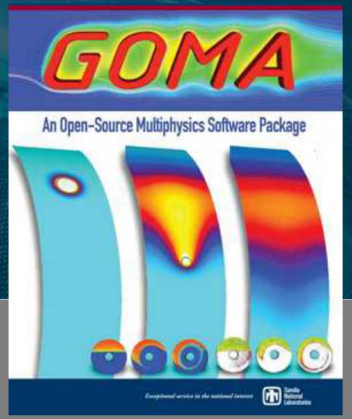
Work with real-world impact



Portable Diagnostic Device for Bacillus Anthracis Detection

Sandia developed a pocket-sized cartridge to sense concentrations of virulent B. anthracis, the bacteria that causes anthrax infection.

>> WATCH VIDEO



GOMA 6.0

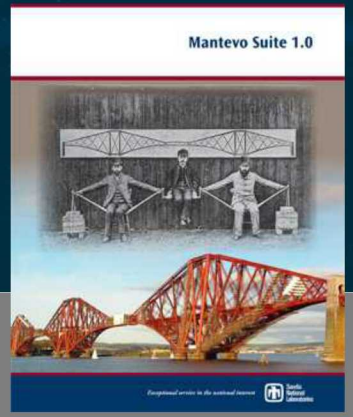
Sandia develops a software package for modeling and simulation, which solves problems in all branches of mechanics, including fluids, solids, and thermal analysis.

>> WATCH VIDEO

Triple Harvesting Plastic Scintillators

A new class of plastic scintillator enables efficient detection of illicit special nuclear materials that may be used to construct a nuclear weapon.

>> WATCH VIDEO



Montevo Suite 1.0

An integrated collection of small software programs (miniapps) models the performance of full-scale applications, yet requires a fraction of the code.

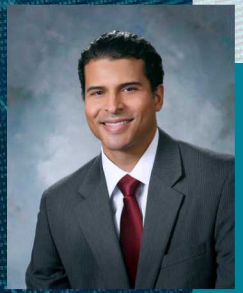
>> WATCH VIDEO

Work with top minds

Our unique work requires the collective minds of the nation's top scientists, engineers, and support staff.

Cliff Ho
Fellow of the American Society of Mechanical Engineers

Ireena Erteza
Asian American Engineer of the Year Award



Conrad James
Black Engineer of the Year Special Recognition Award

Salvatore Campione
Early Career Computer Modeling Award

Sandia's Brand Promise - *Sandia's Employee Value Proposition*

- ***National Security Mission:***
  Your work contributes to the security, peace and freedom of our nation and the world
- ***Uniquely Challenging and Important Work:***
  The work you do will be challenging, and amazing with real-world impact
- ***Work with Great People:***
  You will work with extraordinary people, the top minds in their field
- ***Research Facilities Like None Other:***
  You will have access to some of the best tools, equipment, and research facilities in the world
- ***Healthy Lifestyle, Work-Life Balance:***
  You will experience a balance between your work life and personal life through flexible schedules, competitive benefits, and convenient amenities
- ***Career Mobility:***
  You can have a full-life career at Sandia by working across multiple projects and areas of your interest

Available Videos

Videos require wifi in order to play

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

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