

Exceptional service in the national interest



Physics and life at the US DOE National Labs

Clark S. Snow



Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Some great advice

- Never trust a dog to watch your food. - Patrick, age 10
- When your dad is mad and asks you, "Do I look stupid?" don't answer him. - Michael, 14
- Never tell your mom her diet's not working. - Michael, 14
- When your mom is mad at your dad, don't let her brush your hair.- Taylia, 11
- Don't sneeze in front of mom when you're eating crackers.- Mitchell, 12
- Don't squat with your spurs on. – Jason, 9
- Don't pick on your sister when she's holding a baseball bat.- Joel, 10
- When you get a bad grade in school, show it to your mom when she's on the phone. - Alyesha, 13
- Never try to baptize a cat. – Elaine, 11

Personal Background

- Southern California native, go **Dodgers!**
- BS, MS Brigham Young University, go **Cougars!**
- Accepted twice to UIUC
- PhD with Lance Cooper in 2003

Starting UIUC

Graduation Day



My Research at UIUC



- Strongly correlated electron systems
- High-pressure Raman scattering at low-T and B-Field

Pressure-Tuned Collapse of the Mott-Like State in $\text{Ca}_{n+1}\text{Ru}_n\text{O}_{3n+1}$ (n=1,2): Raman Spectroscopic Studies

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⁴Department of Physics, Kyoto University, Kyoto 606-8502, Japan,
 and CREST, Japan Science and Technology Corporation, Japan

(Dated: September 26, 2002)

We report a Raman scattering study of the pressure-induced collapse of the Mott-like phases of $\text{Ca}_3\text{Ru}_2\text{O}_7$ ($T_N=56$ K) and Ca_2RuO_4 ($T_N=110$ K). The pressure-dependence of the phonon and two-magnon excitations in these materials indicate: (i) a $T \sim 0$ pressure-induced collapse of the antiferromagnetic (AF) insulating phase above $P^* \sim 55$ kbar in $\text{Ca}_3\text{Ru}_2\text{O}_7$ and $P^* \sim 5-10$ kbar in Ca_2RuO_4 ; (ii) a surprising insensitivity of the exchange interaction to pressure in both systems; and (iii) evidence for persistent AF correlations above the critical pressure of Ca_2RuO_4 , suggestive of phase separation involving AF insulator and ferromagnetic metal phases.

PACS numbers: 71.30.+h 75.30.Kz 75.50.Ei 78.30.-j

Quantum Melting of the Charge Density Wave State in 1T-TiSe₂

C. S. Snow, J. F. Karpus, S. L. Cooper*, T. E. Kidd⁺, and T.-C. Chiang

Department of Physics and Frederick Seitz Materials Research Laboratory,
 University of Illinois at Urbana-Champaign, Urbana, Illinois 61801
 (Dated: June 19, 2003)

We report a Raman scattering study of low-temperature, pressure-induced melting of the CDW phase of 1T-TiSe₂. Our Raman scattering measurements reveal that the collapse of the CDW state occurs in three stages: (i) For $P < 5$ kbar, the pressure dependence of the CDW amplitude mode energies and intensities are indicative of a "crystalline" CDW regime; (ii) for $5 < P < 25$ kbar, there is a decrease in the CDW amplitude mode energies and intensities with increasing pressure that suggests a regime in which the CDW softens, and may decouple from the lattice; and (iii) for $P > 25$ kbar, the absence of amplitude modes reveals a melted CDW regime.

PACS numbers: 71.30.+h; 71.45.Lr; 78.30.-j

My Job Search

On-Line Applications

- ~50 Applications
- 2 phone interviews
- 1 invitation for interview

China Lake NWC
Ridgecrest, CA

Direct Contact

- 2 Discussions
- 2 invitations for interview

Post-Doc at LANL
Staff at Sandia

Referrals

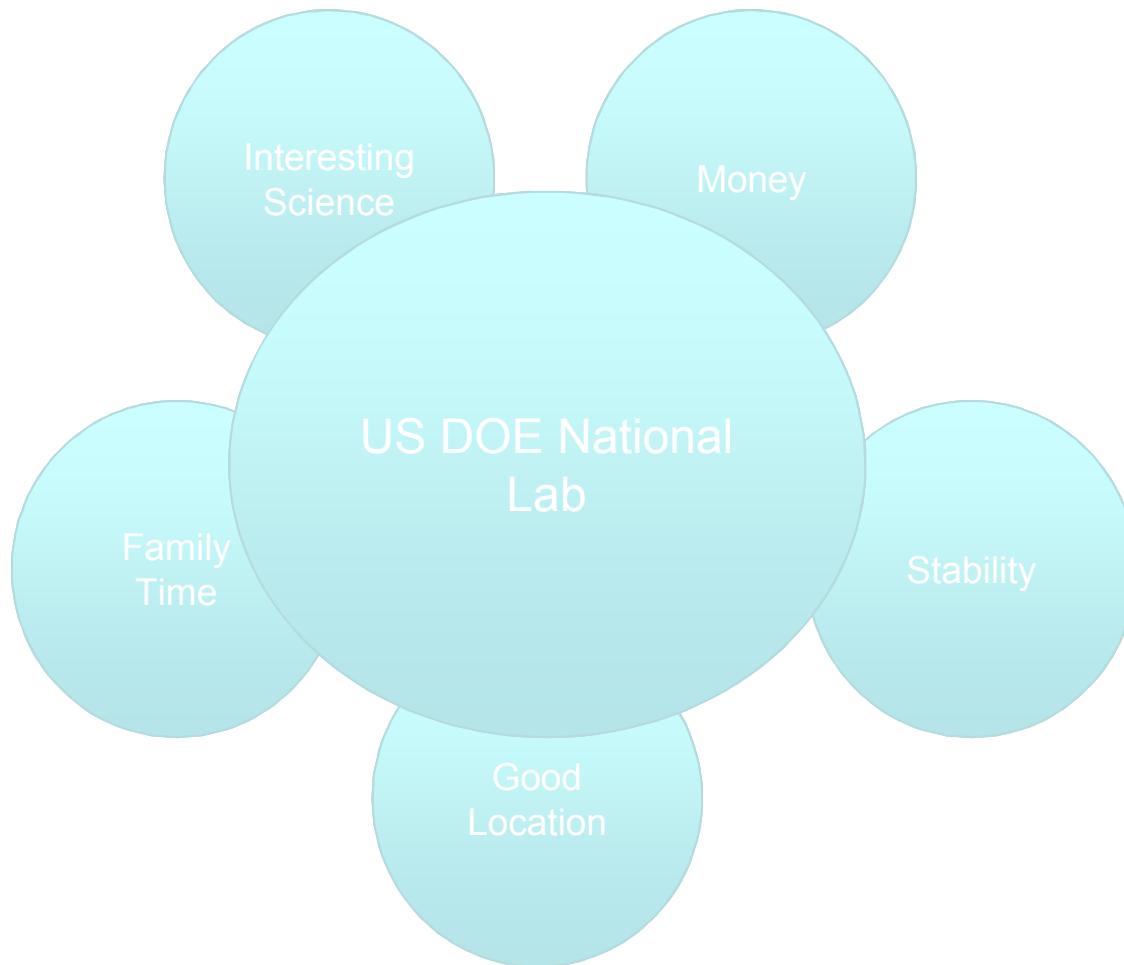
- 2 Referrals
- 2 phone interviews
- 2 invitations for interview

UC Santa Barbara
ATK Thiokol (Utah)

Job offers:

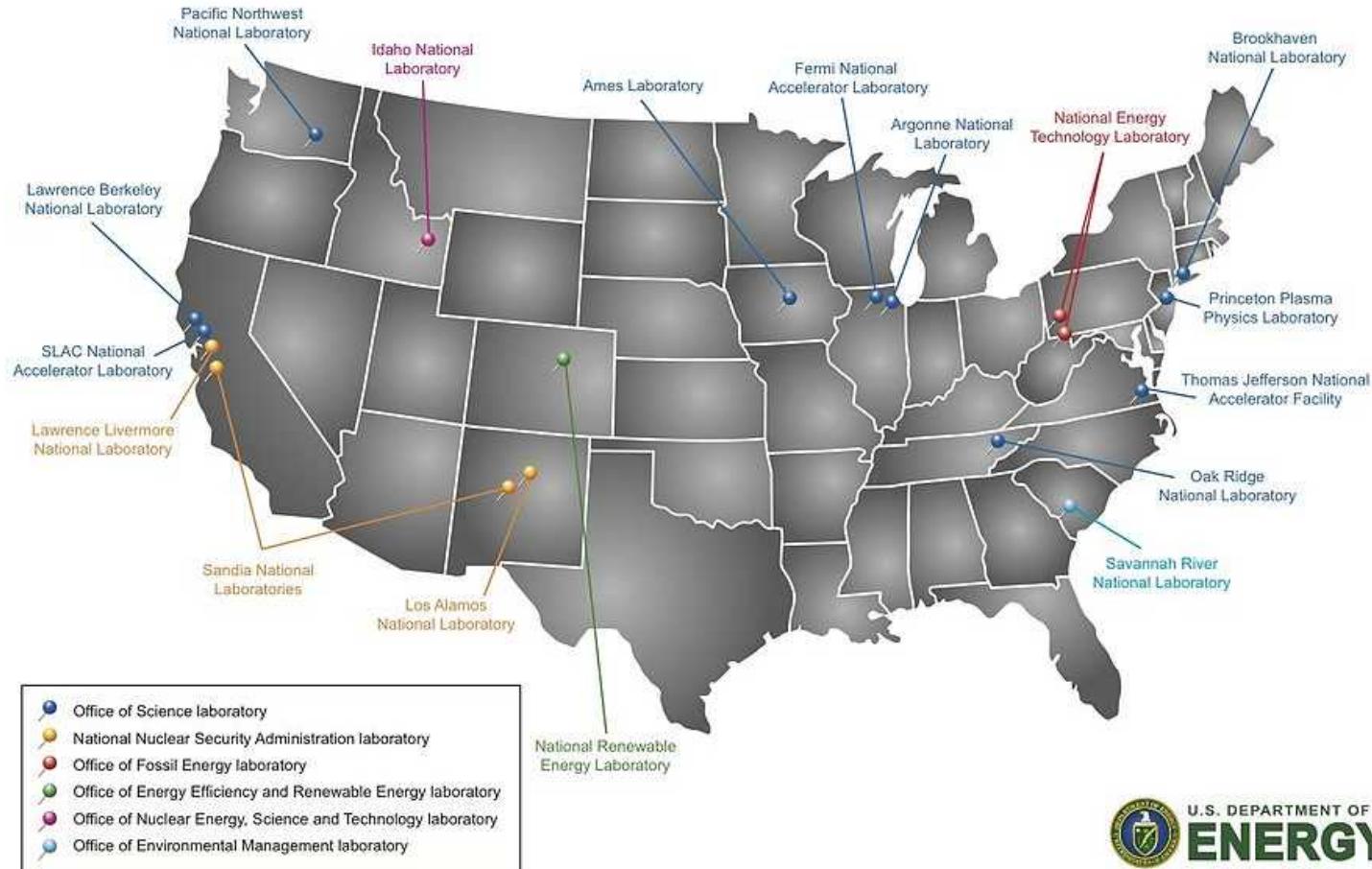
1. Post-Doc at LANL
2. Staff at Sandia
3. Staff at ATK Thiokol

What I wanted in Life



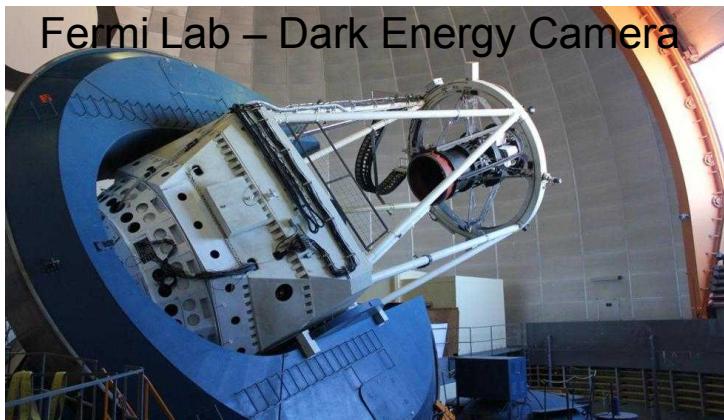
Overview of the US DOE system

Department of Energy National Laboratories



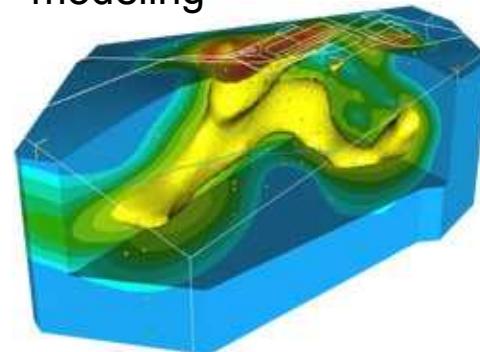
What do the DOE labs do?

- **Everything!**
- Nuclear Weapons
- Homeland Security
- Basic Science
- Energy Science
- Environmental Science

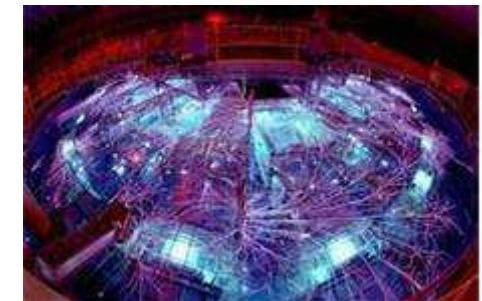


Fermi Lab – Dark Energy Camera

SRNL – ground water modeling



Sandia – z-machine



DOE Lab Culture

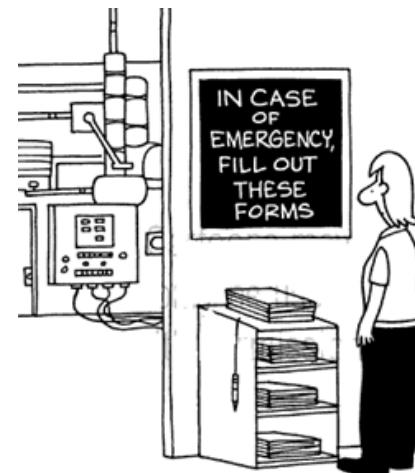
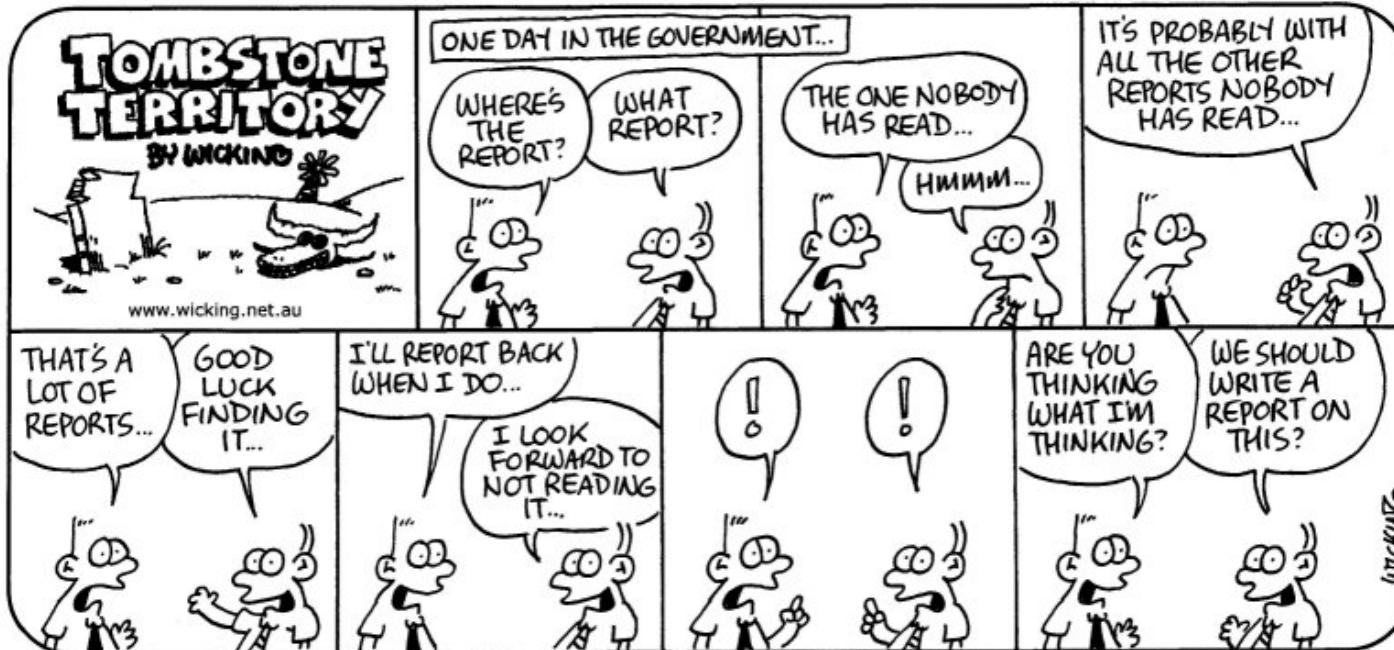
- Safety – ES&H (Environment, Safety and Health)
- Paperwork – goes with Safety
- Team work
- Meetings – goes with Team work
- Reports
- Funding
- Security



Safety is Everywhere



Paperwork is Everywhere



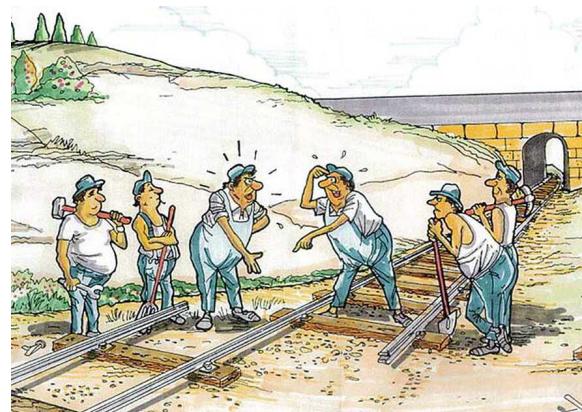
Meetings are Everywhere



Team work

“No man is an island, entire of itself...” – John Donne

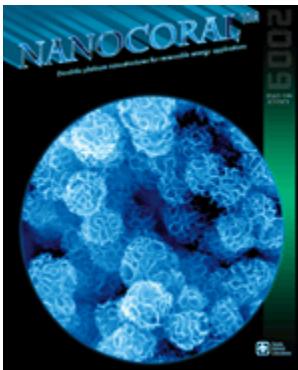
- Labs typically tackle larger problems
- Work with technologists, financial and budget analysts, other scientists



What do you work on (money)?

LDRD

LDRD projects must be in the forefront areas of science and technology relevant to DOE/NNSA missions. Normally LDRD projects will be relatively small and will also include one or more of the following characteristics—
 (1) advanced study of hypotheses, concepts, or innovative approaches to scientific or technical problems;
 (2) experiments and analyses directed towards “proof of principle” or early determination of the utility of new scientific ideas, technical concepts, or devices; and
 (3) conception and preliminary technical analyses of experimental facilities or devices.
 b. Normally LDRD projects will be limited to a maximum period of performance of 36 months. Exceptions may be granted by the (CSO)/Deputy Administrator, NNSA, or his/her authorized designee.
 c. The maximum funding level established for LDRD must not exceed 8 percent of a laboratory's total operating and capital equipment budgets, including non-DOE funded work, for the year. The system for accrual of these funds, to a reasonable extent, must provide for equitable pro rata contributions by all sources of operating and capital equipment funding.



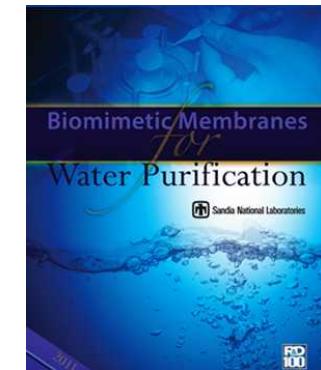
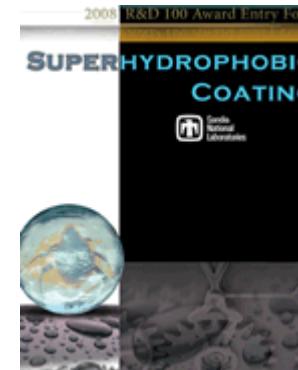
WFO

Industrial partners
 Other Gov't agencies
 NSF
 DHS
 DTRA
 DARPA
 ARPA-E
 etc.

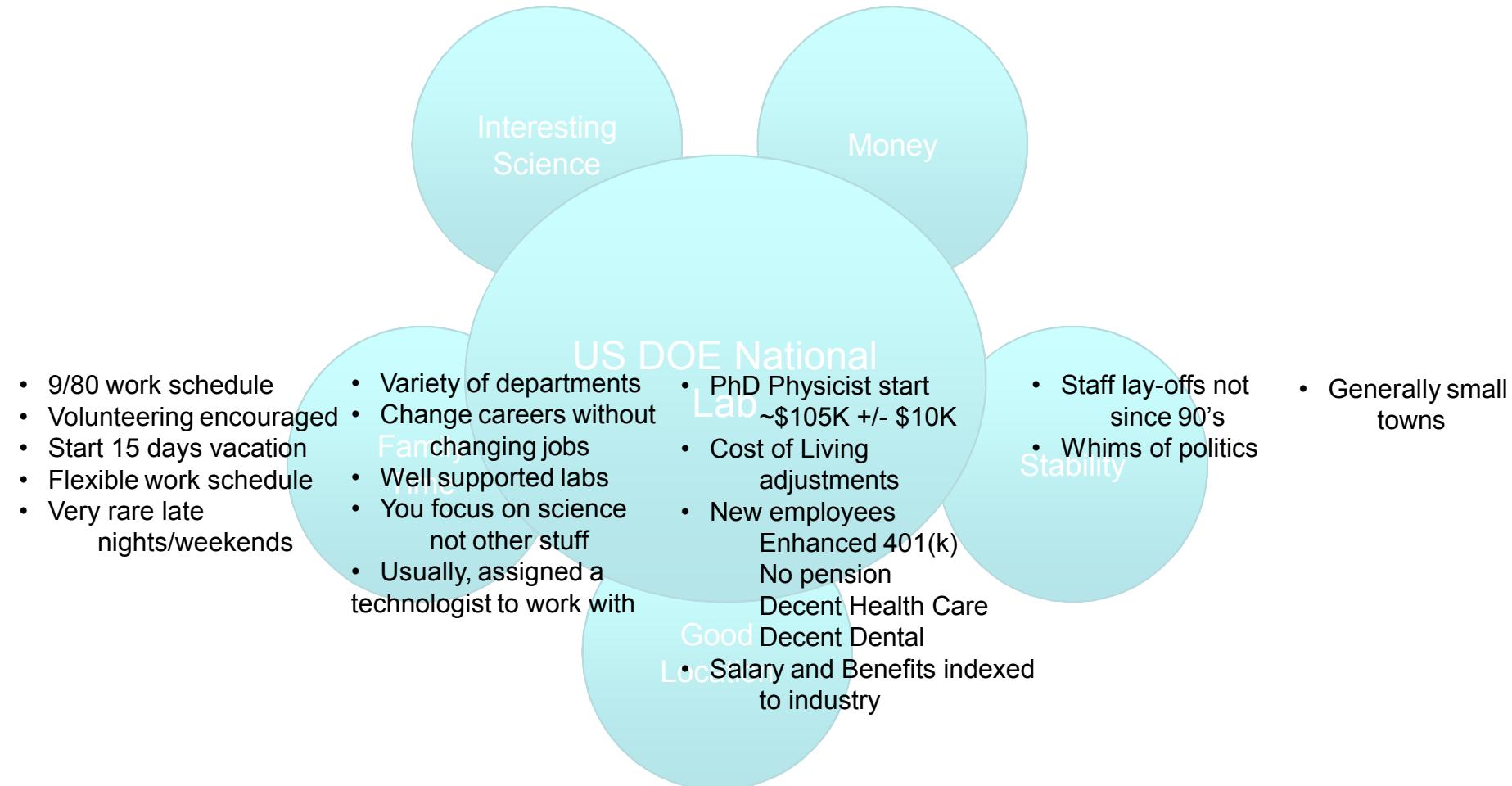


Programmatic

Existing programs funded by someone already or mandated by Congress.



What I wanted in Life

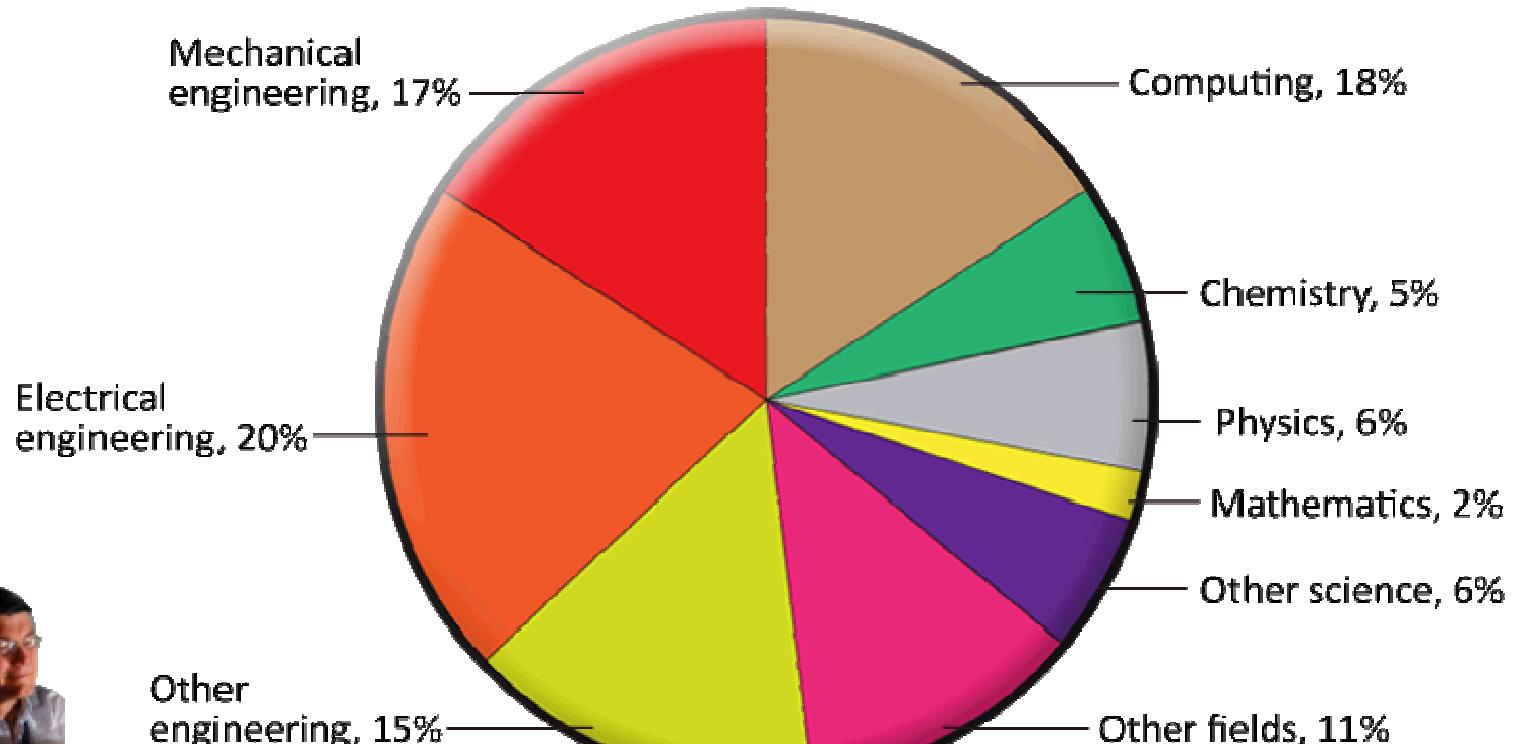


The Sandia Workforce

- Onsite workforce: 11,554
- Regular employees: 8,949
- Gross payroll: ~\$515M

Data for FY12 through the end of March

Technical staff (4,419) by discipline



Sandia's Sites



Albuquerque, New Mexico



Carlsbad, New Mexico



Tonopah, Nevada



Livermore, California



Amarillo, Texas



Kauai, Hawaii



Sandia in the Community

- United Way in 2011
 - New Mexico: >\$4.6M
 - California: >\$265,000
 - Participation
 - 2011 – 71.8%
 - 2010 – 70.3%
- Lockheed Martin donations to nonprofit organizations – \$1.4M
- Volunteer hours in 2011 – 108,000
- K-12 education partnerships
- Began work on our 12th Habitat house in April 2012



National Security Challenges

1950s

Nuclear weapons



1960s

Development engineering



1970s

Multiprogram laboratory



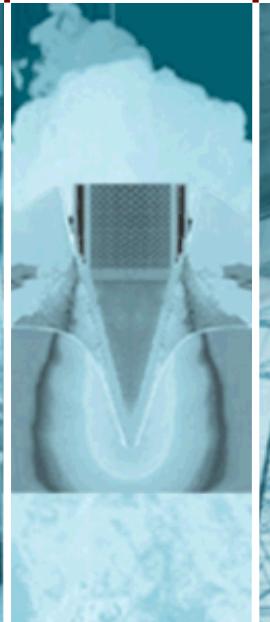
1980s

Missile defense work



1990s

Post-Cold War transition



2000s

Post 9/11



2010s

Life Extension Programs
START



Nuclear Weapons

Pulsed power and radiation effects sciences



Warhead systems engineering and integration

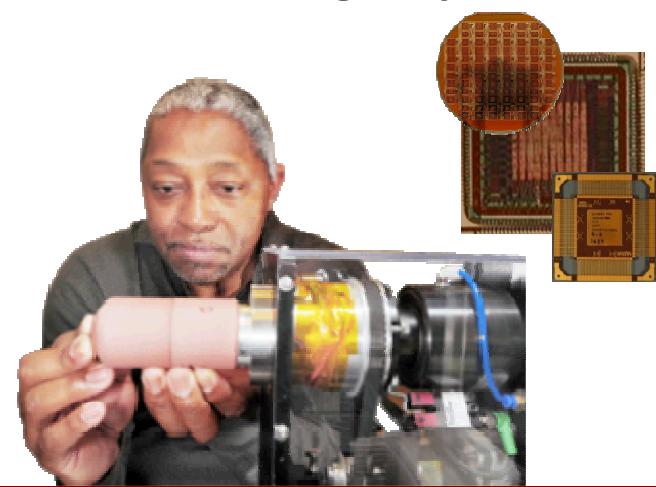


Design agency for nonnuclear components

- Neutron generators
- Arming, fuzing and firing systems
- Safety systems
- Gas transfer systems

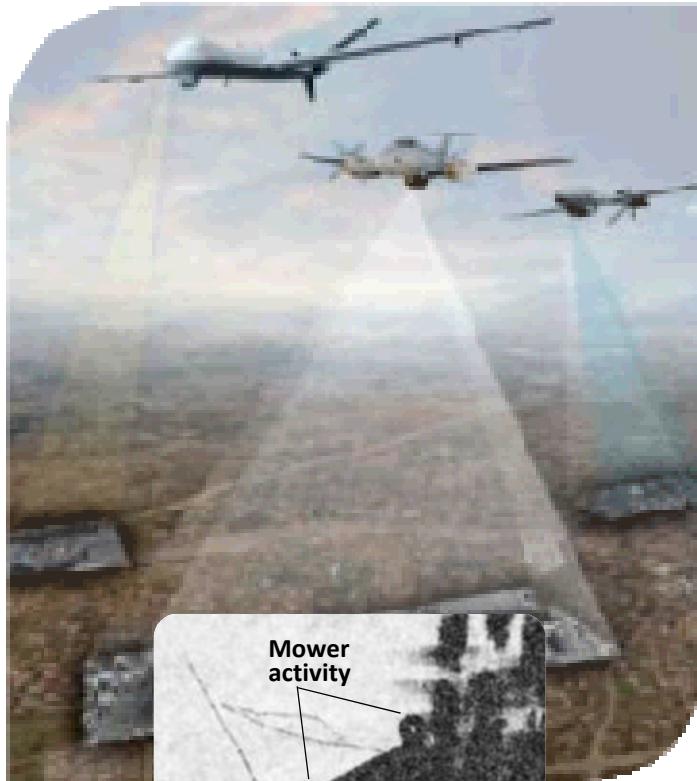


Production agency



Defense Systems and Assessments

Synthetic aperture radar



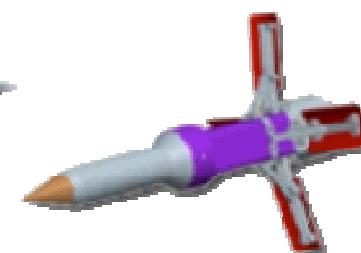
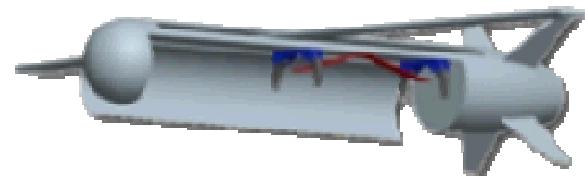
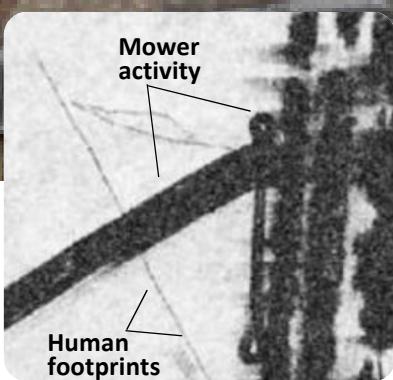
Support for NASA



Support for ballistic missile defense



Ground sensors for future combat systems



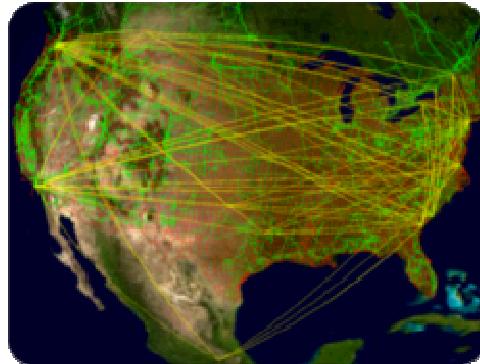
Energy, Climate, and Infrastructure Security



Energy



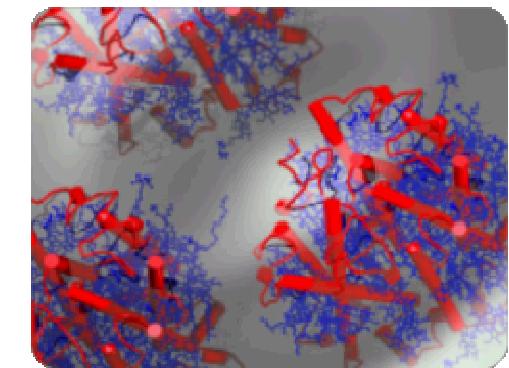
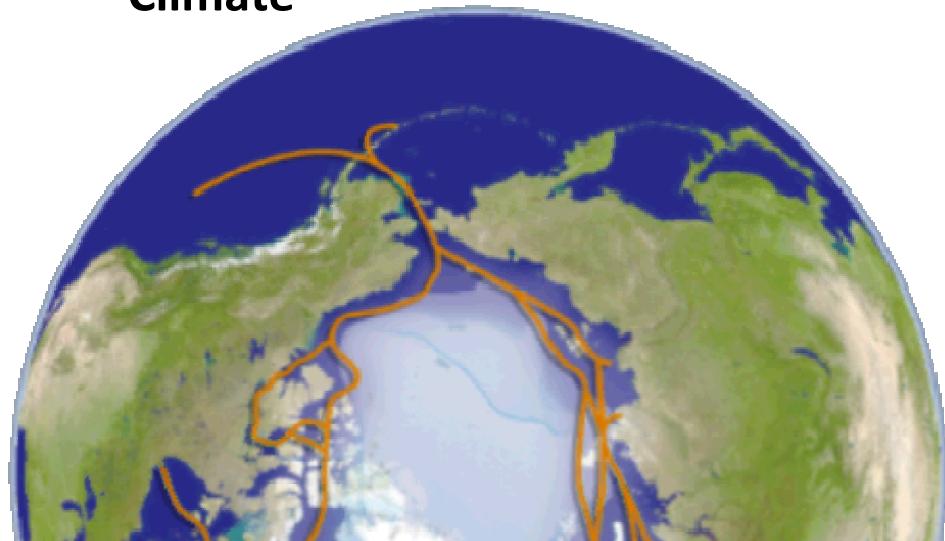
Infrastructure



Crosscuts and enablers



Climate



jbei
Joint BioEnergy Institute

International, Homeland, and Nuclear Security

Critical asset protection



Homeland defense and force protection



Homeland security programs



Global security

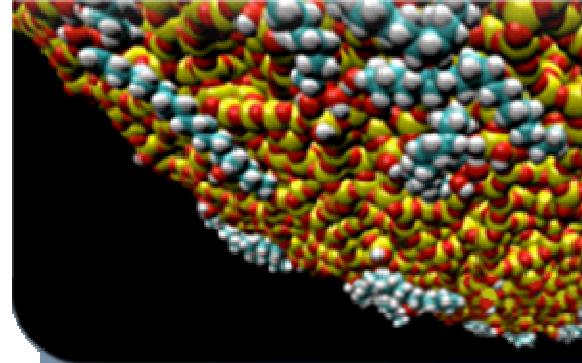


Science and Engineering Foundations

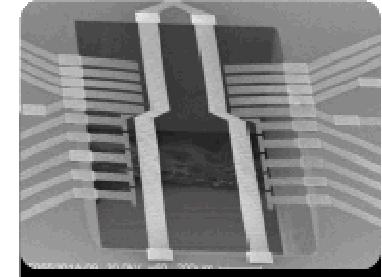
Computing and information science



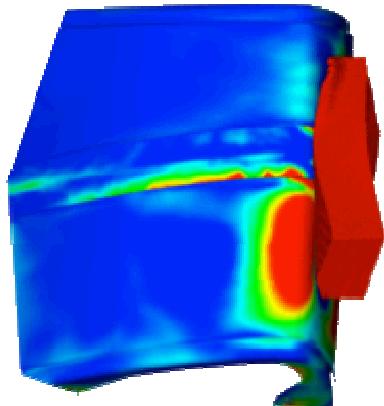
Materials science



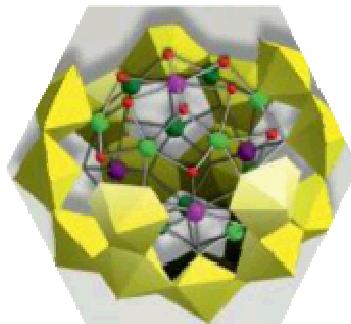
Nanodevices and microsystems



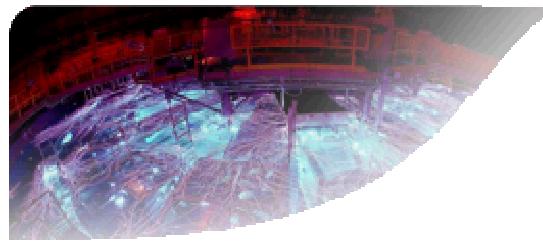
Engineering sciences



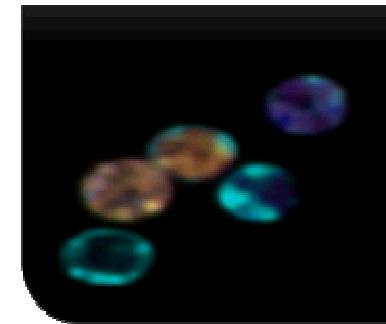
Geoscience



Radiation effects and high-energy density science



Bioscience

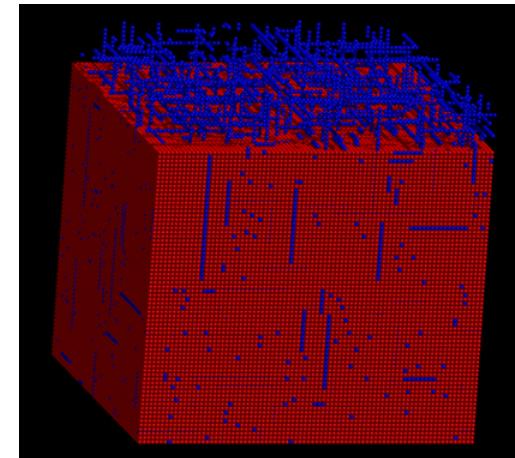
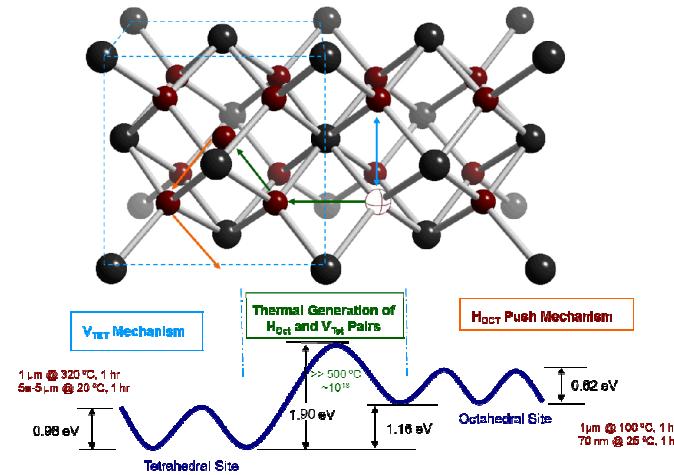


What I do at Sandia

Radiation Damage in Materials Metal-Hydrogen Interactions

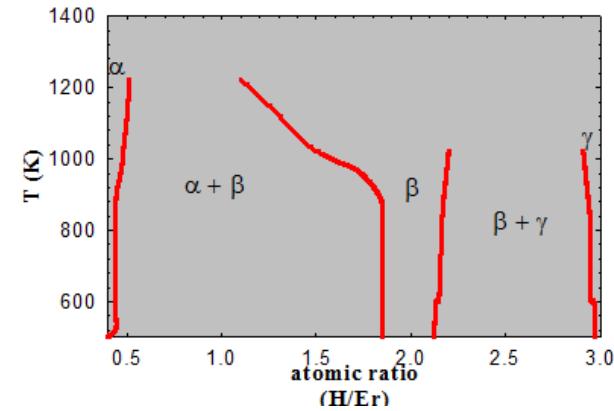
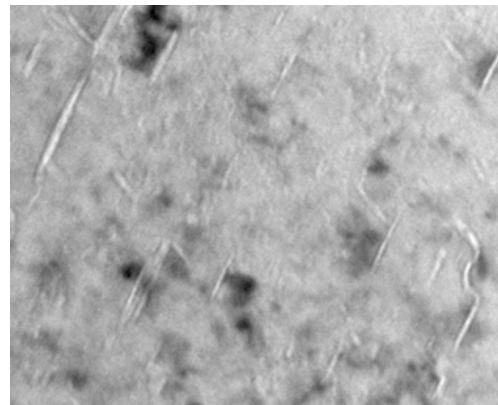
Modeling

- DFT
- KMC

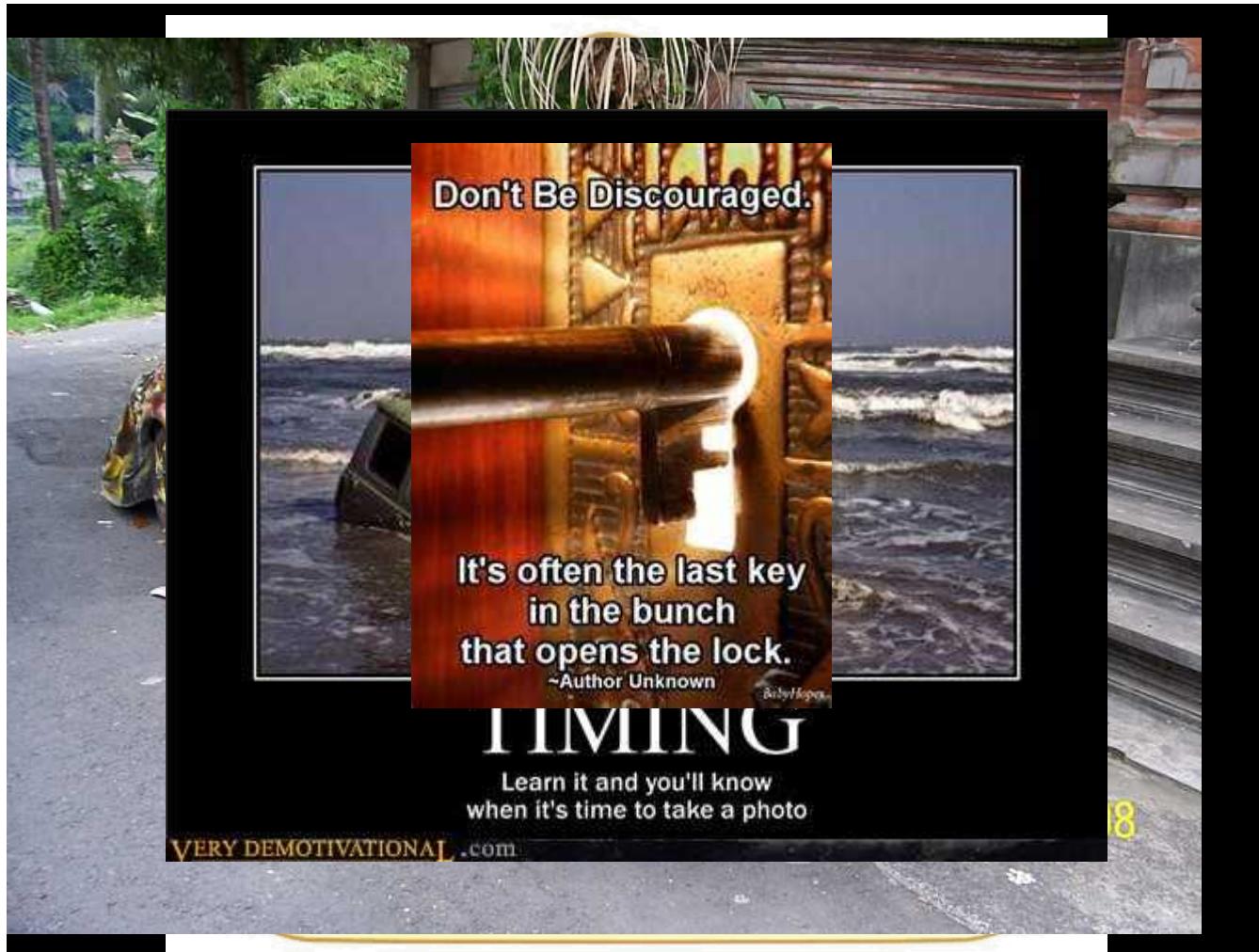


Experiments

- Thermodynamics of M-H systems
- Structure-Property changes with time



How to get hired



Being successful in a DOE Lab

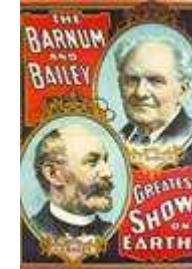
Focus on problem, not technique

- Great opportunity to learn what you need to.
- Focuses effort.

Sell your work and yourself

Every good scientist is half B. F. Skinner and half P. T. Barnum.

-- Principal Skinner, on Bart's science project, "Duffless"



Make yourself invaluable

- Volunteer for programmatic work.
- Tackle the hard problems.

Final words of advice

I always pass on good advice. It's the only thing to do with it. It is never any use to oneself. ~Oscar Wilde, *An Ideal Husband*, 1895

- Enjoy Grad School
- Be confident
- Have Fun
- Join us at a US DOE National Lab