Differences in Research Among Academia, Government Laboratories, and Industry

Presented to

Rice University Graduate Student Association

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OAK RIDGE NATIONAL LABORATORY
U. S. DEPARTMENT OF ENERGY

Welcome to ORNL

ORNL Video

http://www.ornl.gov/ornlhome/video/video.shtml

Government Laboratory Culture

- **Safety**
- **Security (if national security related)**
- **Great Science**

Freedom to Pursue Own Ideas

Drivers

- Large profit
- Profit
- Support national technical initiatives driven by sponsoring agencies in turn driven by administration policies
- Education driven

Research Activities

- Market driven; little choice regarding work assignment, focused research
- Mission oriented
- Small development funding
- Whatever one can find funding to do
- Core/base funding is provided (theoretically)
- National labs have consulting contracts with academia: joint appointments
- Student internships
- User facilities

Publish or Perish?

- Publication not important at all: Sometimes discouraged (trade secrets)
- Emphasis is on patents or new products

- Encouraged to document work in open literature
- Published where customers are likely to see it
- Papers are a marketing tool

- Pathway to promotion
- National and international recognition

Impact on Science and Technology

- Small business innovative research (SBIR) grants

- DOE, DoD advisory committees
- Large-scale experiments
- Experiments that academia or industry can not do because of:
  - Commercialization
  - Cost
  - National security
  - Unique expertise required

- Membership in national academies provides leadership in science and technology direction
- e.g., National Academy of Science

Scale of Research

- Virtually no research
- Bench- scale
- Bench-scale prototype
- Large-scale
- More regulated R&D
- Bench-scale to pilot plant

Government/ industry partnerships

e.g., advanced nuclear reactors

Multi-nation collaborative research address problems common to both countries

Teaming (egos)

- Difficult

- Easy
- Can form a team in a heart beat
- Internationally known experts available at finger tips
- Government/ industry partnerships
- International collaboration

- Forced focus teams
- Little teaming across companies
- Industry institutes

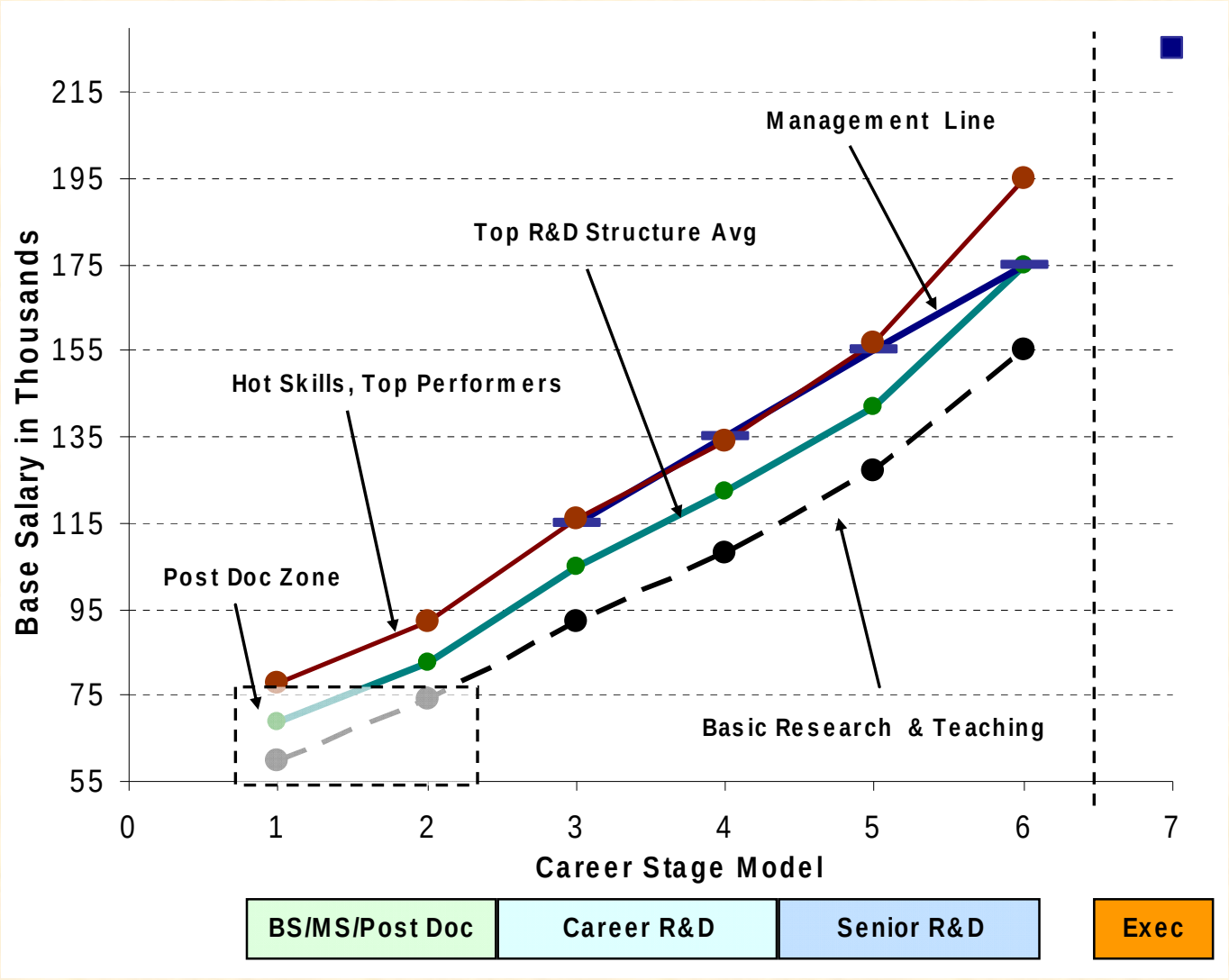
Job Security

- ~95% fail within first three years
- Beltway bandits
- Job shop piecework
- Obtaining tenure is questionable now
- Must be flexible: career will change direction 2 or 3 times
- e.g. Exxon

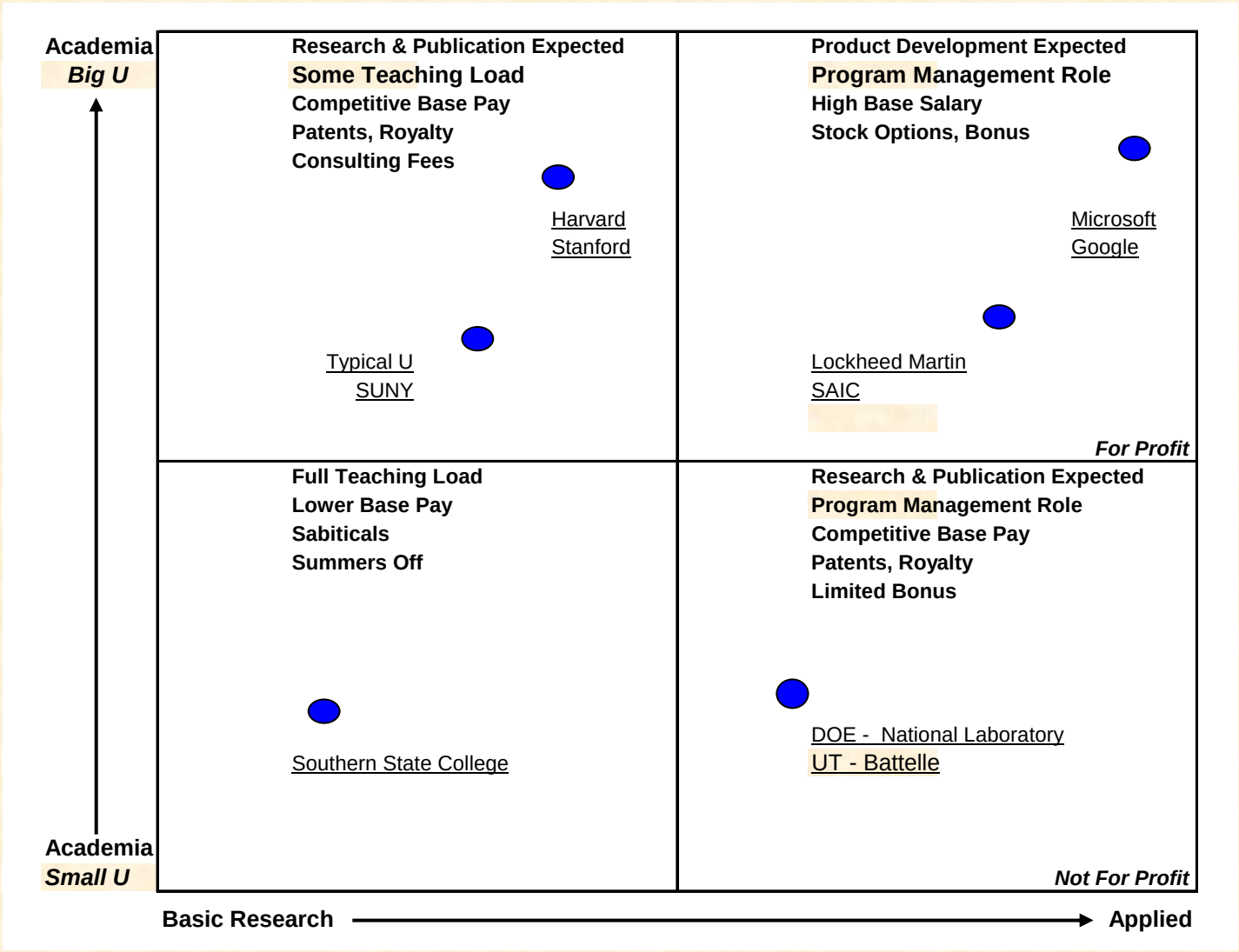
Different Types of Government Labs

- ***Single purpose*** **– National Renewable Energy Lab (NREL)**
- ***Multi-purpose*** **– Oak Ridge (ORNL), Argonne (ANL), Brookhaven (BNL)**
- ***DOE-defense labs*** **– Los Alamos (LANL), Sandia (SNL), Lawrence Livermore (LLNL)**
- ***Dept. of Defense labs*** **– Wright Patterson Air Force Base, Navy Research Lab**
- ***NASA labs/centers*** **– Johnson Space Center**

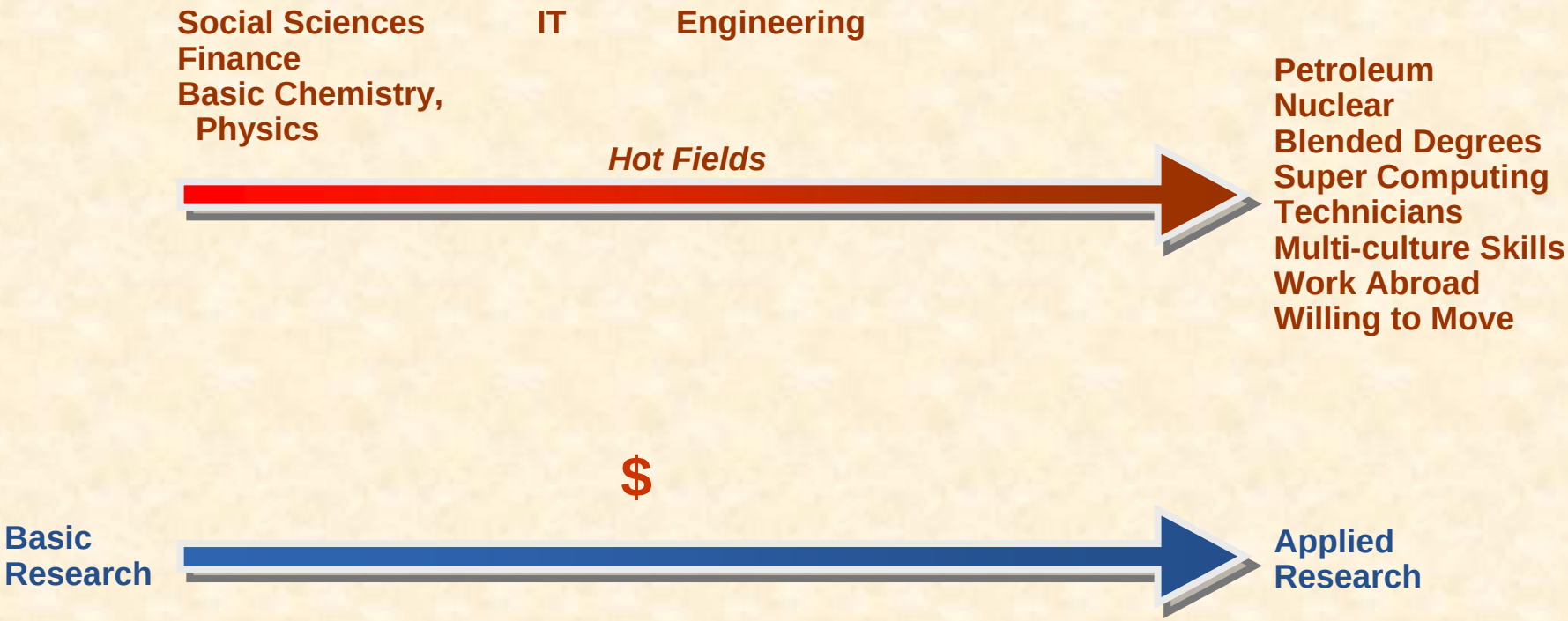
Total Rewards



Salary


Academia
Big U
Research & Publication Expected
Some Teaching Load
Competitive Base Pay
Patents, Royalty
Consulting Fees
Harvard
Stanford
Typical U
SUNY
Product Development Expected
Program Management Role
High Base Salary
Stock Options, Bonus
Microsoft
Google
Lockheed Martin
SAIC
For Profit
Full Teaching Load
Lower Base Pay
Sabiticals
Summers Off
Southern State College
Research & Publication Expected
Program Management Role
Competitive Base Pay
Patents, Royalty
Limited Bonus
DOE - National Laboratory
UT - Battelle
Not For Profit
Academia
Small U
Basic Research
Applied

Total Rewards



Student Internship Programs

http://www.ornl.gov/sci/nuclear_science_technology/nstip/nesls.htm

ORNL Job Page

http://jobs.ornl.gov

BACK UP SLIDES

Today, ORNL is DOE's Largest Multipurpose Science Laboratory

- **$1 billion budget**
- **4,000 employees**
- **3,000 research guests annually**
- **Nation's largest unclassified scientific computing facility**
- **Nation's largest science facility: the $1.4 billion Spallation Neutron Source**
- **Nation's largest concentration of open source materials research**
- **Nation's largest energy laboratory**
- **$300 million modernization in progress**

ORNL is Managed and Operated by UT-Battelle

UT-BATTELLE
Limited Liability Company

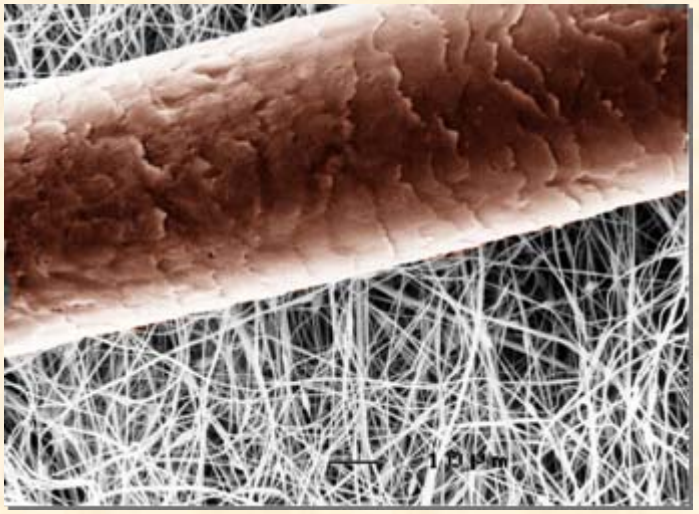
The University of Tennessee
Knoxville, Tennessee

Battelle
Columbus, Ohio

The Next Scientific Frontier at ORNL is the Nanoscale

Research and technology development at the level of individual atoms and molecules

- **A national research priority for Federal investment**
- **Strongly linked to the missions of the Department of Energy**
- **An exciting new field for cutting-edge science and engineering**
  - **Novel properties and phenomena**
  - **Extraordinary potential for new technologies**



Characteristic dimensions less than 1/1,000th the diameter of a human hair

We are Developing and Deploying World-Class Tools for Nanoscale R&D

Spallation Neutron Source

- High-intensity neutrons for materials research at the nanoscale
- 1.4 MW of beam power on target
- 16 instruments

High Flux Isotope Reactor

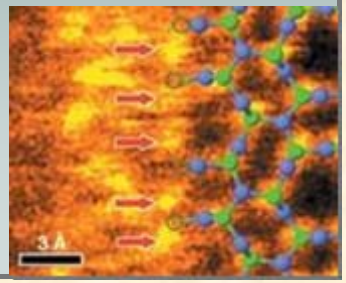
- The nation's leading research reactor
- World-class instruments for neutron scattering R&D

Center for Nanophase Materials Sciences

- $65M facility will begin operating in October 2005
- User program launched with 42 projects

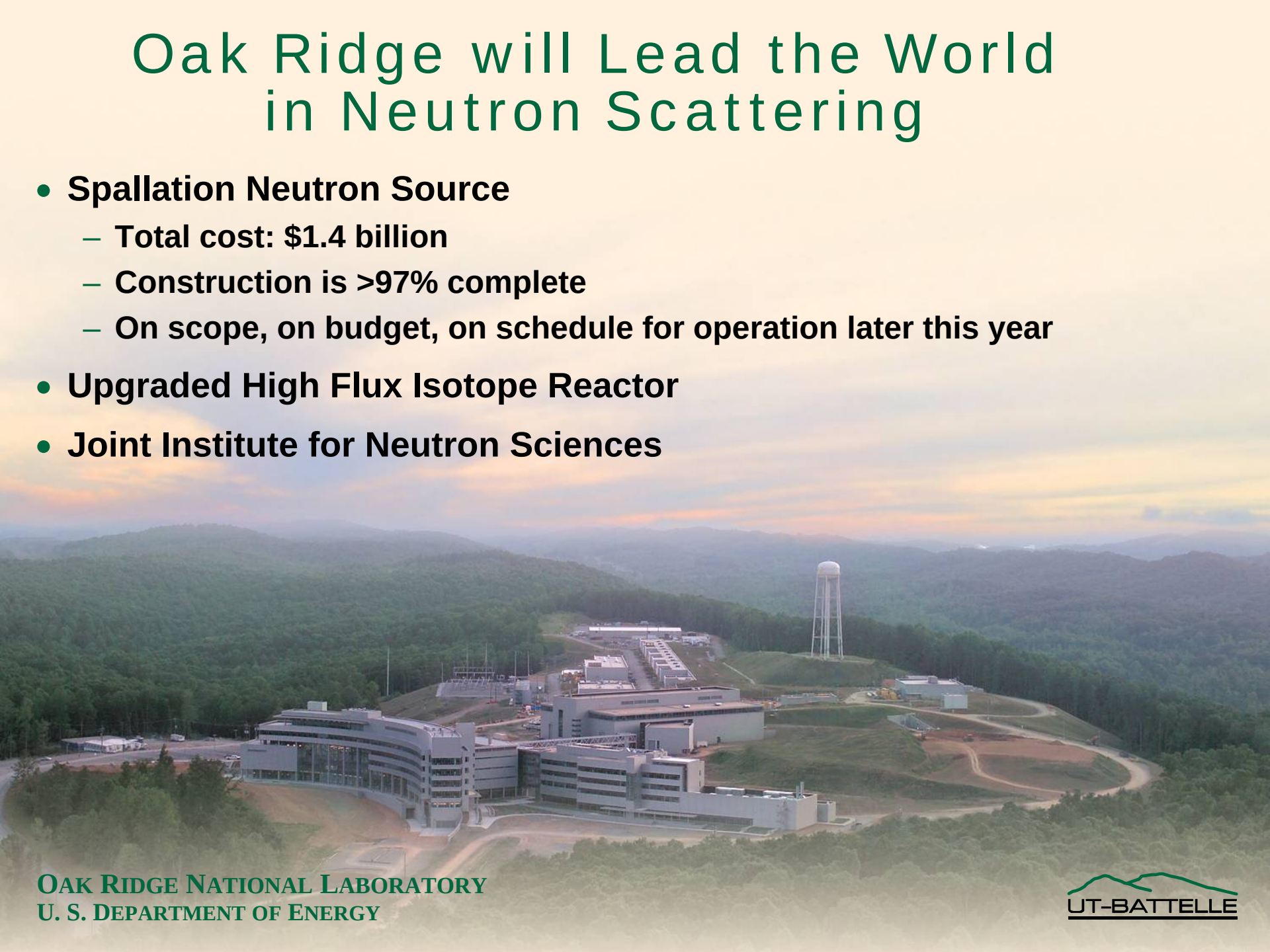
Ultrahigh-resolution microscopy

- Advanced Microscopy Laboratory
- Aberration-corrected electron microscope
- World-record resolution: 0.6 Å



Oak Ridge will Lead the World in Neutron Scattering

- **Spallation Neutron Source**
  - **Total cost: $1.4 billion**
  - **Construction is >97% complete**
  - **On scope, on budget, on schedule for operation later this year**
- **Upgraded High Flux Isotope Reactor**
- **Joint Institute for Neutron Sciences**



We are Unrivaled in Advanced Materials

DOE's largest materials and condensed matter programs	Special strengths in advanced alloys and ceramics, correlated electron materials, macromolecular systems, and carbon-based materials
SNS and HFIR offer transforming capabilities	Structure and dynamics, large-scale structures, spins, neutron and neutrino physics
World-class capabilities for nanoscale science	Synthesis, nanoscale characterization, spin-sensitive and other probe spectroscopies
Leadership-class computing	Predictive simulation of materials and molecular interactions
Unmatched characterization capabilities	Electron microscopy, mass spectrometry, local electron probes, physical and chemical properties measurement

DOE's first nanoscience center

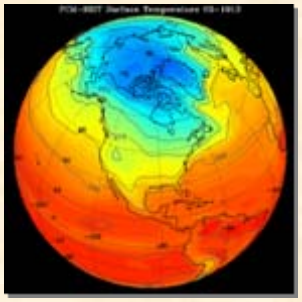
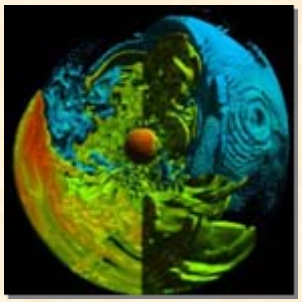
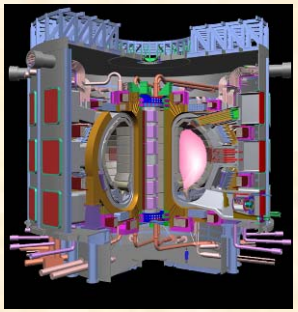
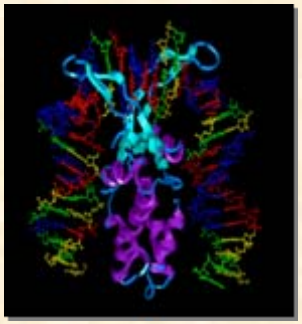
World's foremost capabilities for neutron science

Record-setting electron microscopes

Leadership-class computing

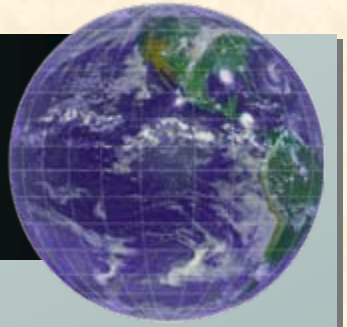
We are at the Forefront in Computing and Simulation

- **Leading the partnership to develop the National Leadership Computing Facility**
  - **Leadership-class scientific computing capability**
  - **100 teraflops by 2006; 250 teraflops by 2007**
- **Attacking key computational challenges**
  - **Climate change**
  - **Nuclear astrophysics**
  - **Fusion**
  - **Materials sciences**
  - **Biology**
- **Providing access to our computational resources through high-speed networking**

Our Systems Biology Research Extends from the Molecule to the Ecosystem

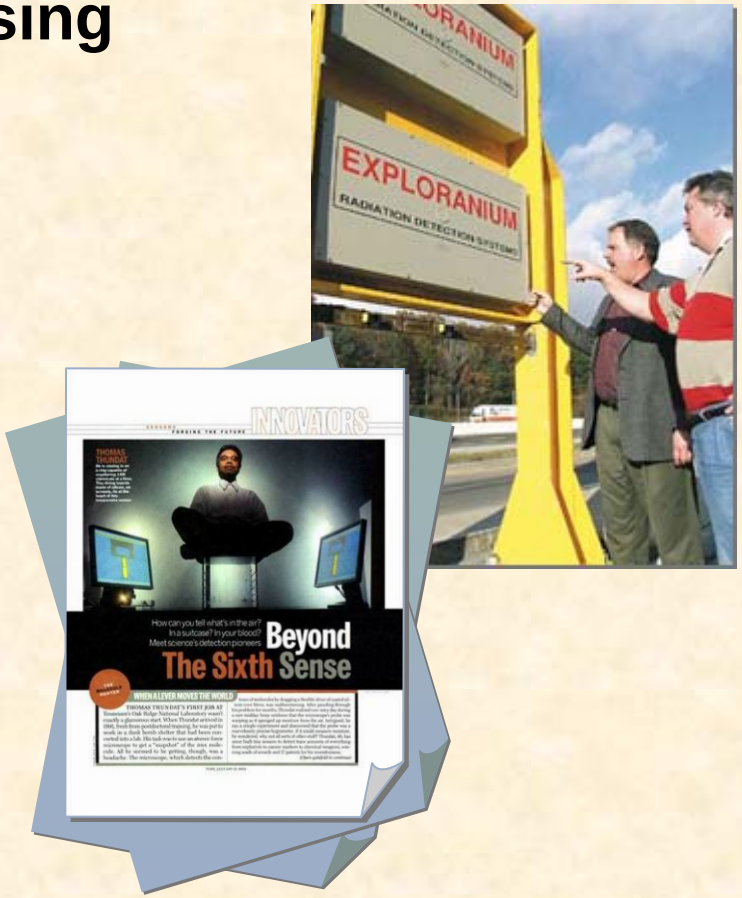
Understand biological systems and apply new knowledge to energy, environmental, and human health challenges



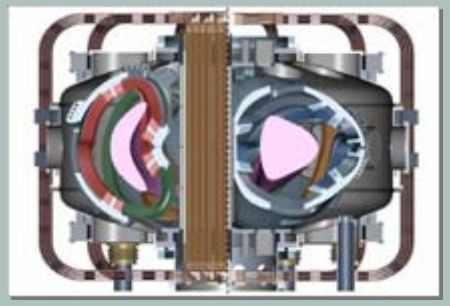
- **Identify the composition and function of "molecular machines"**
- **Use biological processes to**
  - **Produce clean energy**
  - **Sequester carbon**
  - **Help clean up the environment**
- **Understand how living organisms react to their environments**
- **Determine the genetic basis for complex traits**

We Apply our S&T Resources to National and Homeland Security

- **Detecting, preventing, and reversing the proliferation of weapons of mass destruction**
- **Deploying integrated systems for incident awareness, detection, and response**
- **Providing technology for detecting explosives at the part-per-trillion level**
- **Delivering enhanced protection and new capabilities to first responders and warfighters**



We Address the Energy Challenges of the Present . . . and the Future

Generation	Distribution	Consumption
Fossil **Fission** **Renewables** **Fusion**	**Transmission technology** **Hydrogen** **Distributed energy resources**	**Buildings** **Industry** **Transportation**
		

Supporting DOE's strategic goals
for energy security and independence

ORNL has a Large and Diverse Nuclear Science and Technology Program

Comprehensive and diverse capabilities

- **Nuclear Security Technologies**
- **Nuclear Systems Analysis, Design, and Safety**
- **Fuels, Isotopes, and Nuclear Materials**