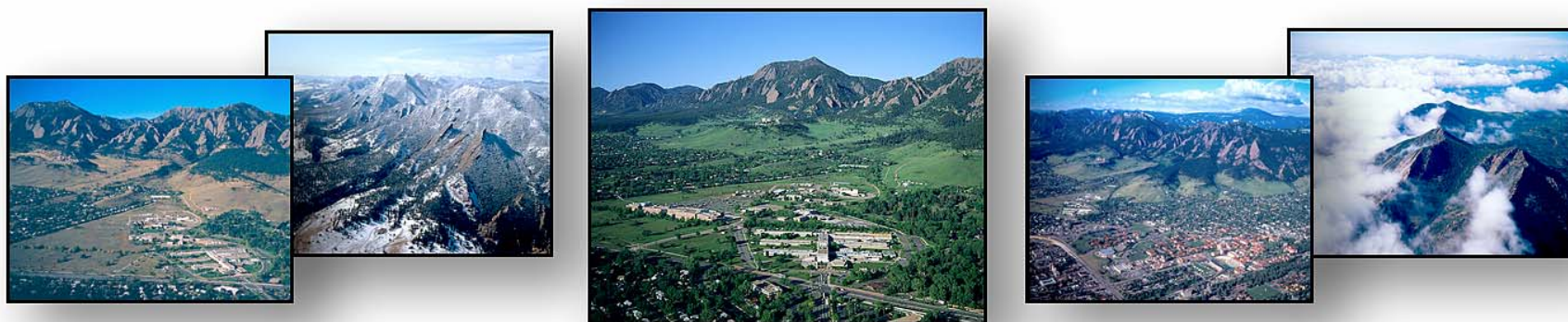


*U.S. Department of Commerce*  
**National Institute of Standards and Technology:  
Overview and Opportunities**

**Dennis Friday**  
**NIST-Boulder Laboratories**



**NIST**  
**National Institute of  
Standards and Technology**  
Technology Administration  
U.S. Department of Commerce

**Strengthening Math and Science Education  
American Competitiveness Initiative Workshop  
Las Vegas, NV                      November 28-29, 2006**

# Outline:

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## NIST Overview:

### Mission

How we are organized?

Extramural Programs

Laboratory Programs

## The American Competitiveness Initiative

Impact on NIST and the Nation

## Opportunities for Involvement with NIST

Educational Baldrige Quality Program

Grants

Specific Research Areas

SURF

PREP

(NIST)<sup>2</sup>

Direct collaboration



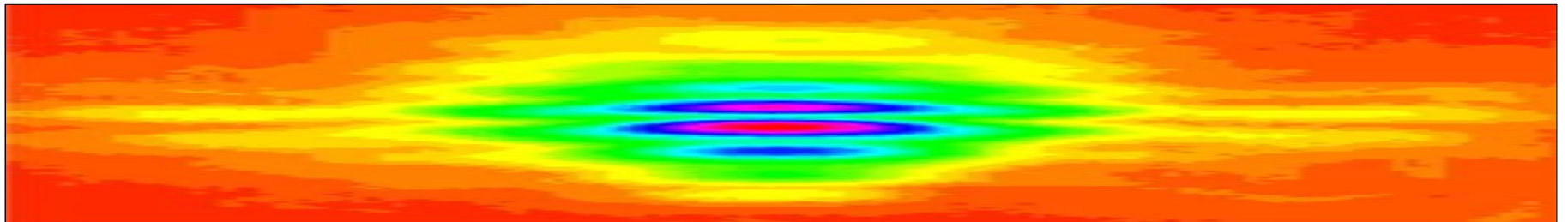
# NIST Mission

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To promote U.S. innovation and industrial competitiveness by advancing

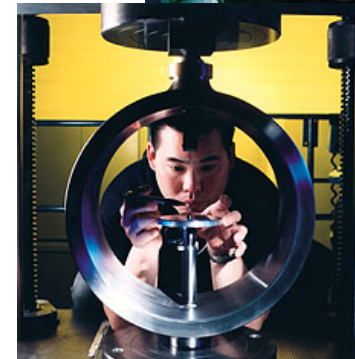
measurement science,  
standards, and  
technology

in ways that enhance economic security and improve our quality of life



# NIST At A Glance

- Director: Dr. William Jeffrey
- 2,900 employees (2450 FTP, 450 FTE)
  - 1400 technical professional
  - 1050 admin/clerical/wage-grade/technicians
- Two primary sites:
  - Gaithersburg, MD (2550), Boulder, CO (350)
- 1,800 guest researchers
- 1,500 field agents
- 850 users of facilities
- Appropriations for FY 2006: \$745.1M
- Professional staff profile: PhD (50%), MS (23%), BS (23%)
- Four main programs areas:
  - Hollings Manufacturing Extension Partnership Program
  - Baldrige National Quality Program
  - Advanced Technology Program
  - NIST Laboratories



# Hollings Manufacturing Extension Partnership (MEP) Program

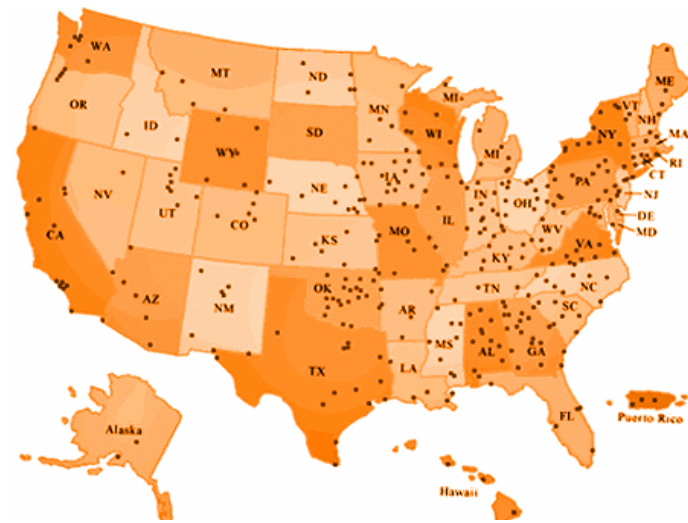
The Hollings MEP is a nationwide network that provides hands-on help to smaller manufacturers.

Business assistance includes:

- Quality management
- Human resource development
- Financial planning

Technical assistance includes:

- E-commerce
- Process improvement
- Plant layout
- Product development
- Energy audits



# Baldrige National Quality Award



- Premier U.S. award for performance excellence and quality achievement
- Awards in Manufacturing, Service, Small Business, Education, Health Care
- More than 2 million copies of Criteria for Performance Excellence distributed (not including downloads from Web)

- Quality programs modeled on Baldrige: 49 state and local (up from fewer than 10 in 1990); 60 international



# The NIST Laboratories

**Manufacturing  
Engineering**



**Building and  
Fire Research**



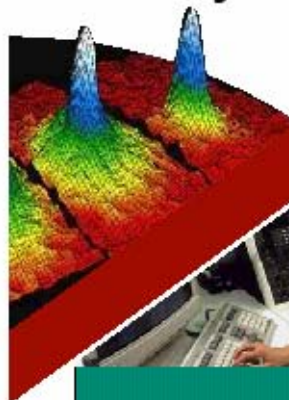
**Chemical  
Science and  
Technology**



**Materials Science  
and Engineering**



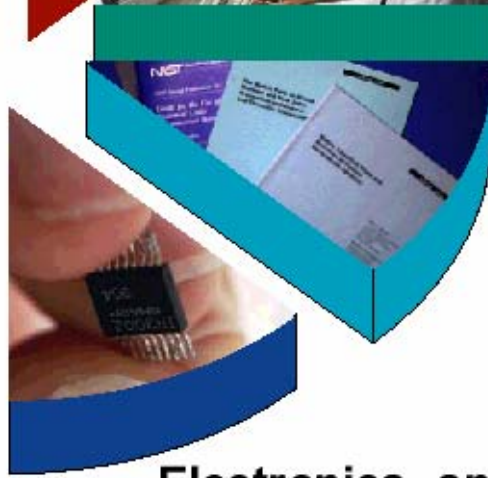
**Physics**



**Information  
Technology**



**Technology  
Services**



**Electronics and  
Electrical Engineering**

# NIST serves a broad customer base...



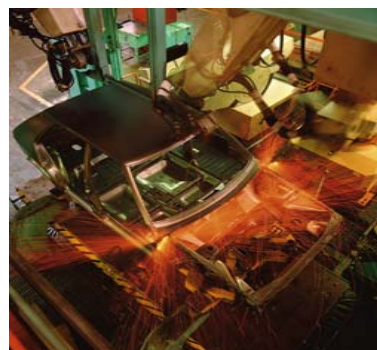
Environmental  
Technologies



Manufacturing



Food and  
nutrition



Transportation



Pharmaceuticals



Law  
enforcement



Biotechnology



Computer software  
and equipment



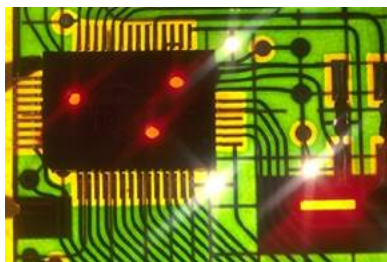
Construction



Microelectronics



# NIST provides innovation infrastructure to... ...advance manufacturing and services



semiconductor  
electronics



“lean manufacturing” of  
plastics



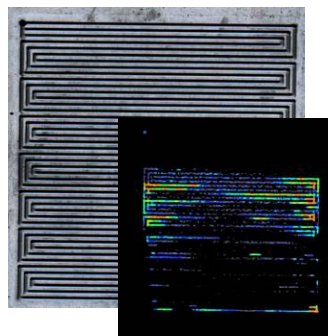
automobile  
manufacturing  
interoperability



pharmaceuticals



chemicals



fuel cell  
technology



healthcare

# NIST provides innovation infrastructure to... ...facilitate trade



secure automated  
banking



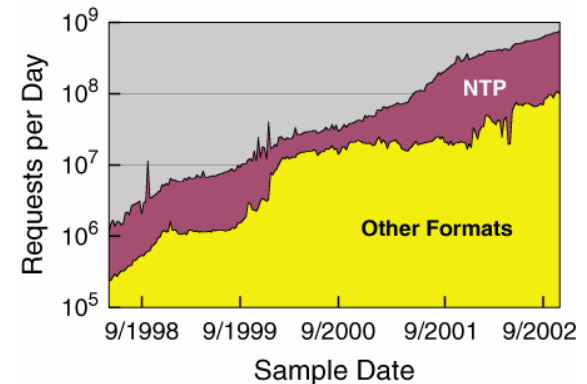
International standards to  
counteract technical barriers to  
trade (TBT)



volume and flow  
standards



electric power  
metering



[www.time.gov](http://www.time.gov)  
billions of hits daily

# NIST provides innovation infrastructure to... ...improve public safety and security



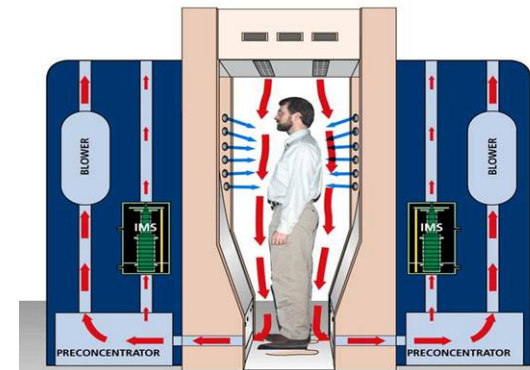
metal detectors



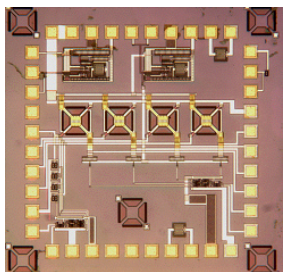
wireless interoperability among first responders



smoke detectors



Trace explosives detection portal



novel sensors to detect gases

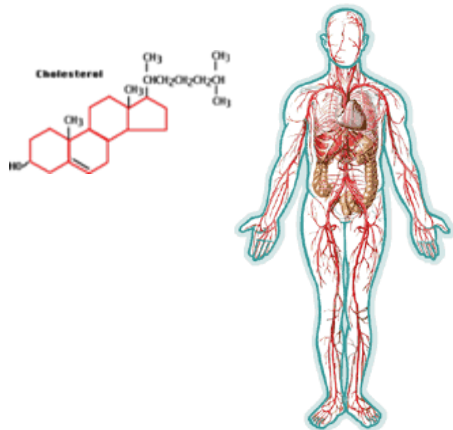


altimeter calibration

standards for body armor



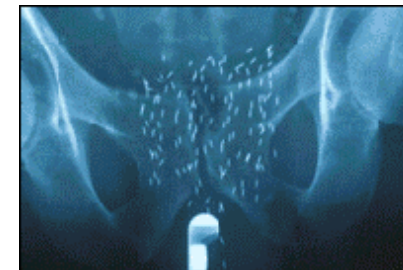
# NIST provides innovation infrastructure to... ... improve quality of life



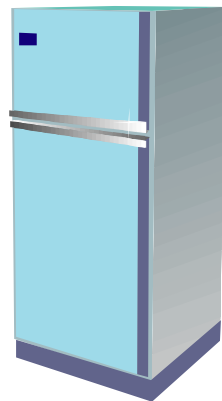
cholesterol standard  
reference material



drinking water quality



prostate and breast-cancer  
treatment

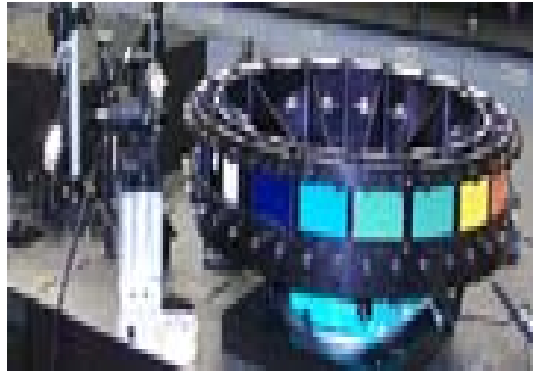


database and  
measurements  
for alternative refrigerants



standards for sulfur  
in fossil fuels

# ...with many services and products



Calibration Services



Laboratory Accreditation



Assistance for small manufacturers



Standard reference materials and data



Cybersecurity Best Practices



Quality Guidelines

NIST has...

...strong partnerships



University of Colorado



Hollings  
Marine  
Laboratory



International Technology  
Roadmap for Semiconductors

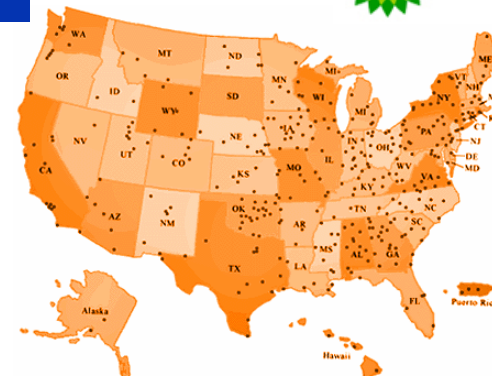


# NIST has...

# ...strong partnerships



Living.  
Improved daily.



# NIST Center for Neutron Research



Preservation of pharmaceuticals

- National resource for neutron-based measurements
- “See” structure at the nanoscale
  - Uniquely sensitive to hydrogen
  - Probe magnetic structure
  - Non-destructive probe



Magnetic data storage



Chemistry of cement



Petrochemicals



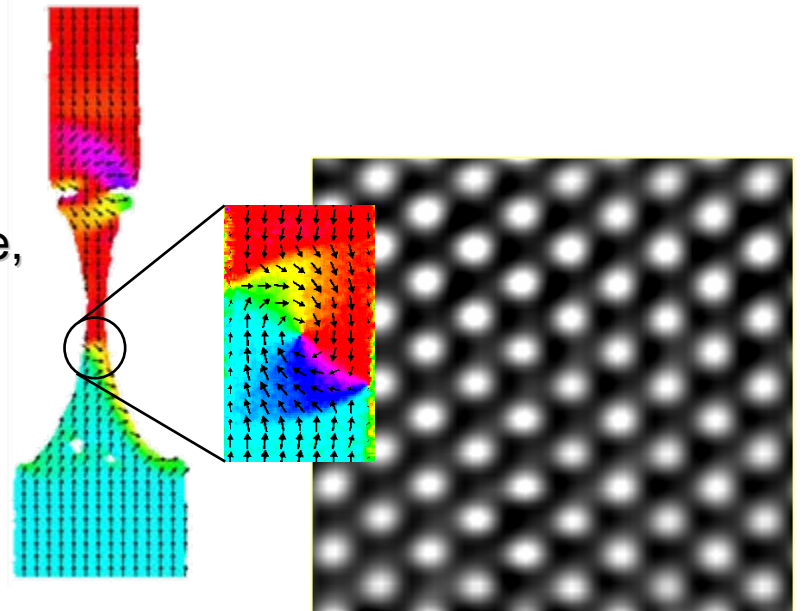
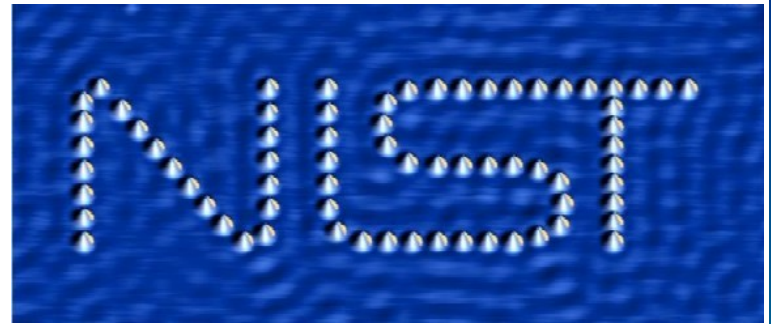
Fuel cells  
H<sub>2</sub> storage materials

POC: Dr. Pat Gallagher, (301)-975-6210 [patrick.gallagher@nist.gov](mailto:patrick.gallagher@nist.gov)



# Center for Nanoscale Science and Technology (CNST)

- New multidisciplinary center aimed at converting nanotechnology discoveries to products
- Mission: develop the necessary measurement science and instrumentation to meet emerging needs
- Establish the materials and process characterization to enable scaled-up, reliable, cost effective manufacturing of nanoscale materials, structures, devices, and systems
- Partner with industry, academia, and government to turn the potential of nanotechnology into reality



POC: Dr. Robert Celotta, (301)-975-3710 [robert.celotta@nist.gov](mailto:robert.celotta@nist.gov)

**NIST has...**

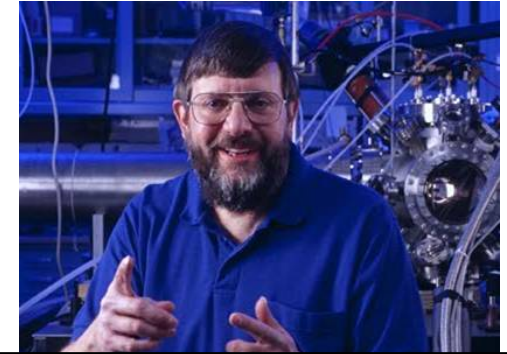
**...world-class staff**



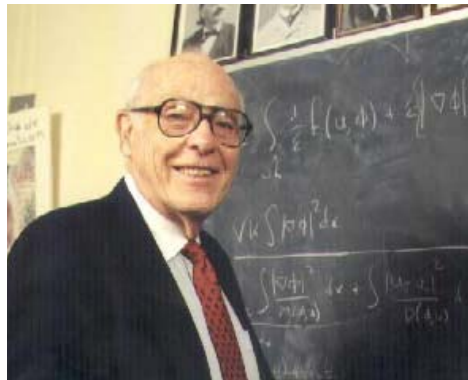
Jan Hall  
2005 Nobel Prize  
in Physics



Eric Cornell  
2001 Nobel Prize  
in Physics



Bill Phillips  
1997 Nobel Prize  
in Physics



John Cahn  
1998 National Medal of  
Science



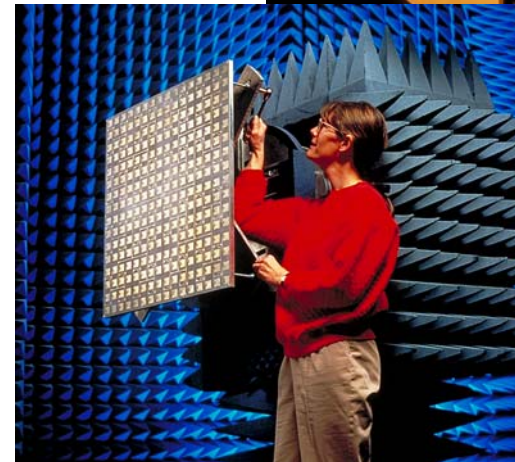
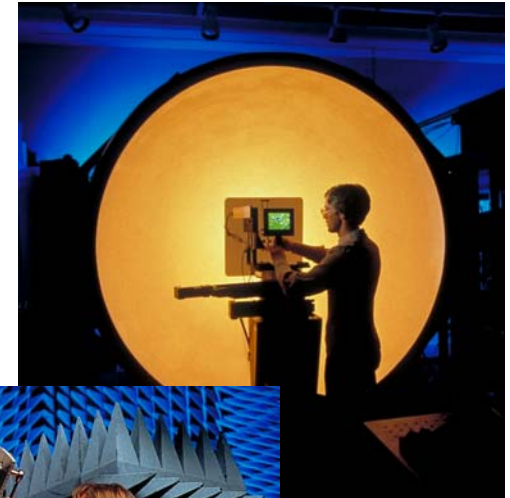
Anneke Sengers  
2003 L'Oréal-UNESCO  
Women in Science Award



Debbie Jin  
2003 MacArthur  
Fellowship

# What NIST Brings to a Partnership

- Unique mission
- World-renowned and highly trained scientists and engineers
- Unique capabilities and facilities
- Strategic focus
- Strong relationships with
  - Industry
  - Academia
  - Government agencies



# President's 10-Year American Competitiveness Initiative (ACI)

- Doubles, over 10 years, investment in:
  - NIST core (laboratory and infrastructure)
  - National Science Foundation
  - DOE Office of Science
- Commits \$50 billion of new funding to these key agencies
- Makes permanent and updates the R&D Tax Credit
- Strengthens math and science education and increases the number of math and science teachers
- Implements worker training and retraining opportunities
- Reforms immigration policies to attract the worlds best scientists

**Total requested FY 2007 increase for NIST programs:**

**\$104M (+24%)**

# NIST Increase in the FY 2007 President's Budget Request

## ***Targeting the most strategic and rapidly developing technologies (+\$45 million)***

- Nano Discovery to Manufacture
- Enabling the Hydrogen Economy
- Quantum Information Science – Infrastructure for 21<sup>st</sup> Century
- Innovations in Measurement Science
- Cybersecurity: Innovative Technologies for National Security

## ***Increasing the capacity and capability of critical national assets (+\$27 million)***

- NIST Center for Neutron Research (NCNR) Capacity and Capability
- Synchrotron Measurement Science and Technology

## ***Meeting the Nation's most immediate needs (+\$12 million)***

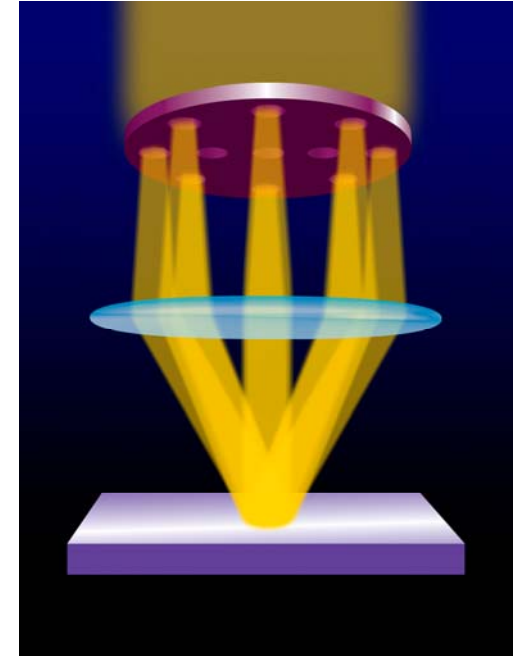
- Manufacturing Innovation through Supply Chain Integration
- Structural Safety in Hurricanes, Fires, and Earthquakes
- International Standards and Innovation: Opening Markets
- Bioimaging: A 21<sup>st</sup> Century Toolbox for Medical Technology
- Biometrics: Identifying Friend or Foe

## ***NIST facilities improvement plan (+\$20.1 million)***

- Design and renovation of 2 buildings in Boulder, CO
- Safety, Capacity, Maintenance and Major Repairs
- NCNR initiative mentioned earlier includes construction funds

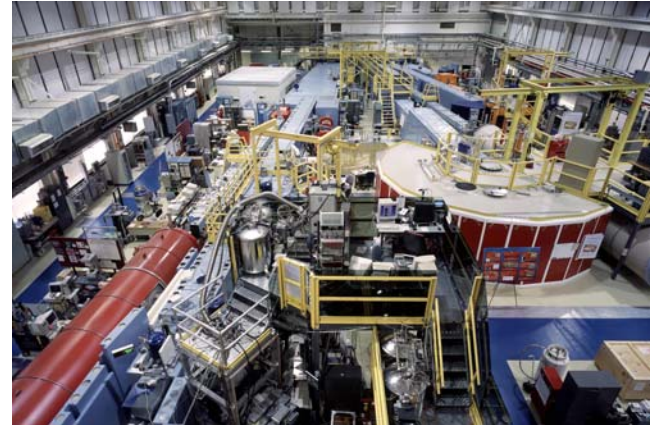
# Enabling Nanotechnology from Discovery to Manufacture

- Nanotech market predicted to exceed \$1 trillion by 2015
- NIST brings:
  - multidisciplinary measurement expertise
  - world-class Advanced Measurement Lab
  - national user facility experience
- Expand the Center for Nanoscale Science and Technology (CNST)
  - work with industry, universities, and other agencies to bridge the gap between science and production
- Expand NIST research efforts to support industry through nanoscale measurement science and standards



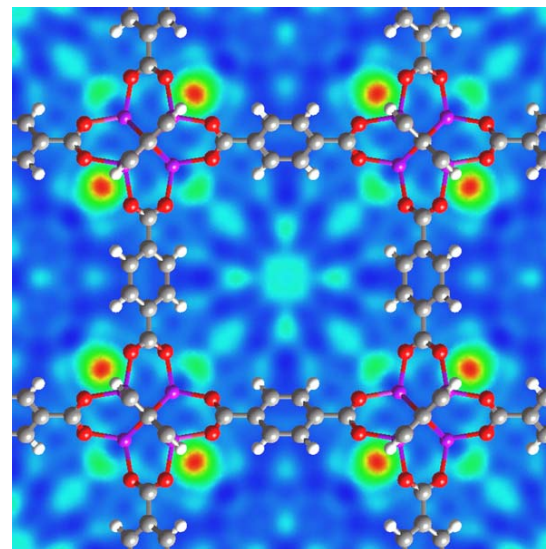
# NIST Center for Neutron Research Expansion and Reliability Improvements

- U.S. neutron facilities can't meet current demand
- Neutrons offer unique benefits
  - protein structure/function
  - trace chemical analysis
- NIST Center for Neutron Research (NCNR)
  - nation's leading neutron facility
  - serves more users than all other U.S. neutron facilities combined
- Upgrade NCNR – 5-year plan
  - Add additional cold source and new guide hall
  - provide new generation of world-class instruments
  - serve 500 more researchers each year



# Enabling the Hydrogen Economy

- Hydrogen fuels benefits
  - reduced dependence on foreign energy sources
  - lower environmental impact
- NIST brings:
  - 50 years of technical expertise
  - Congressional mandates for weights and measures, pipeline safety
- NIST will:
  - improve efficiency, durability, manufacture of hydrogen fuel cells
  - develop standards for pipeline safety and reliability
  - develop standards, calibrations for equitable trade of hydrogen





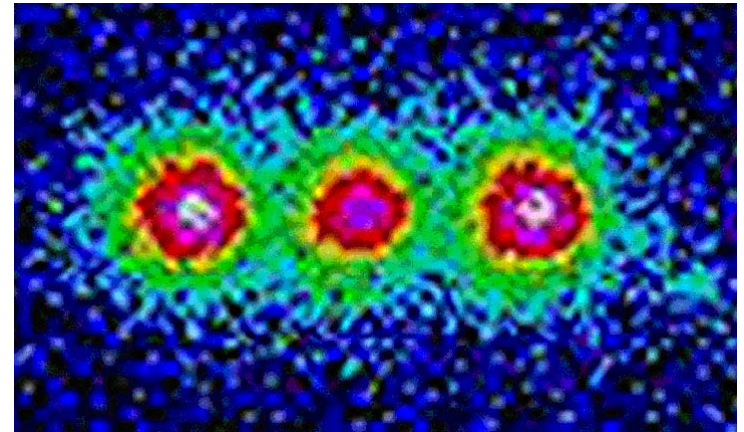
# Manufacturing Innovation Through Supply Chain Integration

- Inefficient exchange of product designs and data
  - costs U.S. economy > \$25 billion/year
- Opportunity mirrors NIST strengths
  - standards, measurements, testing tools, neutral convener
- Will foster seamless global supply chain for the auto, aerospace, and construction industries
  - create “roadmaps” for developing open standards for enterprise integration
  - develop and test standards, ensuring consistency with international standards



# Quantum Information Science – Infrastructure for 21<sup>st</sup>-Century Innovation

- Revolutionary potential, ultrapowerful computers, “unbreakable” code to protect financial transactions
- NIST is a world leader in the field
  - world-renowned scientists, including three Nobel laureates
- NIST will
  - expand research on quantum information
  - develop new measurement tools and methods
  - support a Joint Quantum Institute with a university and the National Security Agency



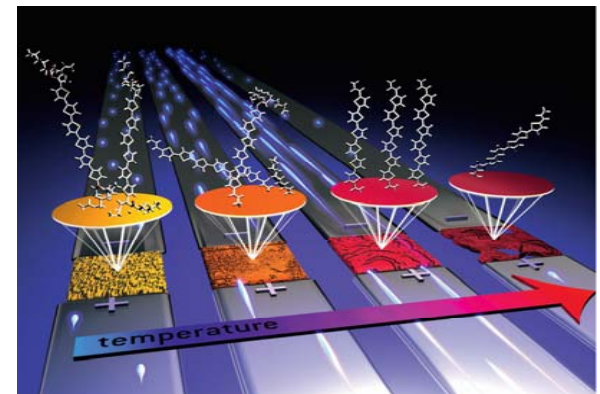
# Structural Safety in Hurricanes, Fires, and Earthquakes

- \$52 billion annually in property damage, disruption of commerce, lost lives
- Goal is to save lives, reduce damage to structures
- Proposed program will advance:
  - extreme wind database and other tools
  - fire and smoke wildland prediction methods
  - earthquake-resistant design and construction methods
  - better prediction of structural capacity



# Synchrotron Measurement Science and Technology

- Synchrotrons complement neutron sources
  - imaging & analysis of chemical, electronic & structural properties used in developing new, innovative materials
- National Synchrotron Light Source at Brookhaven National Lab
  - will upgrade three beamlines and establish two new beamlines
- Will be used by 200 researchers a year
  - any material, made of any elements, subnanometer resolution



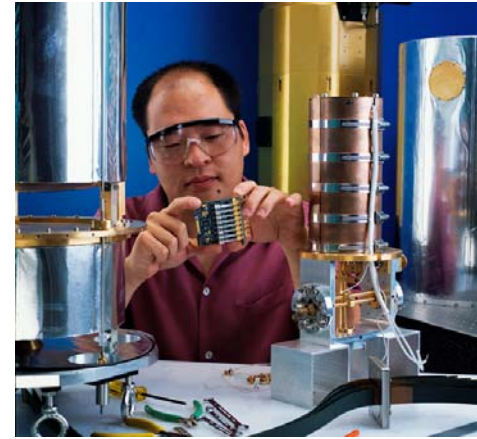
# International Standards and Innovations

- Standards-related barriers to trade constrain innovation, entrench inferior technologies, raise transaction costs, and hinder interoperability
- NIST works to open markets for American workers and exporters
- NIST will
  - provide technical leadership to ensure standards are not a barrier to U.S. exports
  - provide information and effective U.S. coordination with international standards organizations



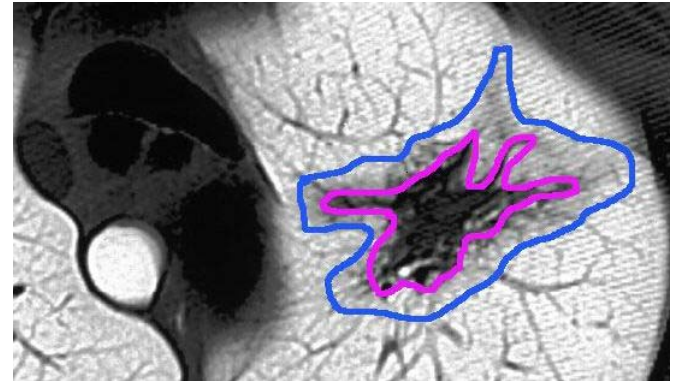
# Innovation in Measurement Science

- Innovation incubator
- Supports high-risk, leading-edge NIST research that anticipates industry's needs
- Launched NIST expertise in quantum information science, fuel cell science, three-dimensional chemical imaging, for example
  - All three NIST Nobel laureates had research funded by this program
- Competitive program to fund multidisciplinary work with greatest potential for fostering innovation



# Bio-Imaging: A 21st Century Toolbox for Medical Technology

- Vision—to convert pictures into reliable data for diagnosis and analysis
- Measurements foundation is lacking—assessments must be accurate, reliable, repeatable
- NIST will partner with NIH, bioimaging industry to improve
  - molecular imaging for understanding bio processes
  - assessment of advanced biomaterials' behavior *in the body*
  - methods and technologies for bioinformatics



# Cyber Security: Innovative Technologies for National Security

- Critical to nation's productivity and infrastructure (transportation, financial systems, power grids, etc.)
- NIST has recognized technical expertise and statutory assignments
  - encryption standards work estimated to have saved industry \$1 billion
- Will develop measurement science and technologies
  - identify and address vulnerabilities in real time
  - assess effectiveness of cyber security controls
  - mitigate attacks





# Biometrics: Identifying Friend or Foe

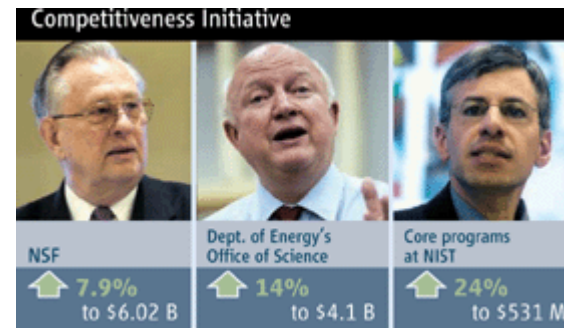
- Automated tools needed to identify people
  - protect borders while allowing efficient travel
- NIST has decades of experience
  - now managing Face Recognition Grand Challenge Program
- Funding allows
  - testing of multimodal systems (2 or more biometrics)
  - image quality standards and tests
  - guidelines for system interoperability



# Growing Support for ACI and NIST...

Science

February 17, 2006



*“Despite an overall budget for 2007 that would reduce domestic discretionary spending, Wolf, who chairs the spending panel with jurisdiction over NSF and NIST, flat-out promises that both agencies “will get their number.” (NSF is pegged for a 7.9 percent boost, and NIST's core programs would rise by 24 percent...”*

- The President’s budget for NIST is unprecedented
- Indicates the importance of NIST’s work to the nation
- Funding still needs to be appropriated by Congress
- Many opportunities for cooperation and participation

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Grants

Specific Research Areas

SURF

PREP

(NIST)<sup>2</sup>

Direct collaboration



# Baldrige National Quality Award

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- Premier U.S. award for performance excellence and quality achievement
- Awards in Manufacturing, Service, Small Business, Education, Health Care

Educational institutions are eligible

Examples of MBNQA winners:

Richland College, TX

Pearl River School District, NY

Jenks Public Schools, OK

- Independent expert evaluation based upon seven Baldrige criteria
- Benefits: Prestige and visibility, Insights, Organizational effectiveness
- Cost: No funding supplied, costs you to implement – net gain to you
- Potential synergy with Executive Order 13270 on TCUs 2006 – 2008

## **NIST Grants Programs Relevant for TCUs**

### **Support Relevant to TCU-initiated Small Business Startups**

**Manufacturing Extension Partnership:** Co-funded locally-based extension centers provide small manufacturers with technology and business assistance

**Small Business Innovation Research Program:** Funds proposals by small businesses for research and development efforts that fall within areas recommended yearly by DOC

### **Support Relevant to TCU College/University Research Efforts**

**Precision Measurement Grants** -- Supports researchers in U.S. colleges and universities for experimental and theoretical studies of fundamental physical phenomena

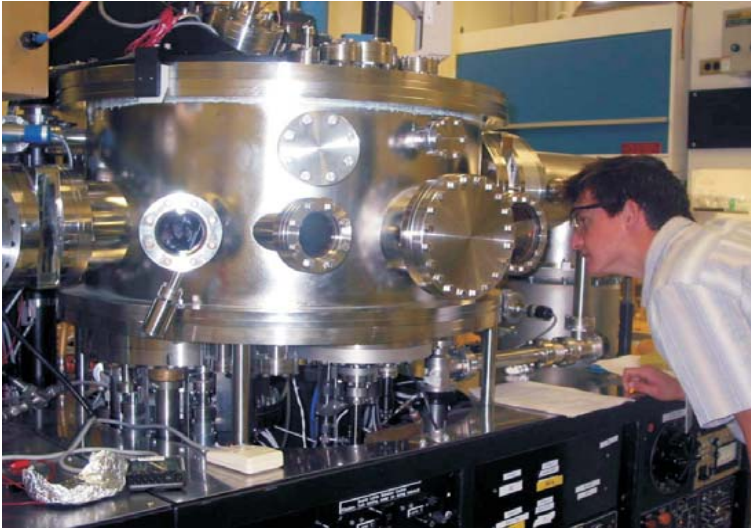
**Fire Research Grants:** Sponsors research by academic institutions, non-federal government agencies, and independent and industrial laboratories that supports NIST's fire research laboratory programs

**Standard Reference Data Grants:** Supports research at academic, industrial, and other non-federal institutions to critically evaluate data in chemistry, physics, and materials properties.

**Materials Science and Engineering Grants:** Supports work in polymers, ceramics, metallurgy, and neutron scattering and spectroscopy research at academic, industrial, and other non-federal institutions.

# Summer Undergraduate Research Fellowship (SURF NIST Boulder)

- 12 week program, May 21 to August 10, 2007
- Complete application information available after December 15 at <http://surf.boulder.nist.gov/>. Application deadline February 15, 2007
- Open to U.S. citizens and permanent residents
- Competitive selection process
- Stipend \$4000, plus travel and housing
- Sister program to the SURF program at NIST in Gaithersburg, Maryland
- For undergraduates at a U.S. university or college with a scientific major, a recommended GPA of 3.0 or better, who intend to pursue a Ph.D.



# Professional Research Experience Program (PREP - NIST Boulder)

- Colleges and Universities apply for PREP status (5 yr cycle – 2009)
- Students at those institutions are then eligible to participate
- Flexible: Part-time/full time, Summers/Year round, Undergraduate, Graduate, Post-Doctoral (Work/Study)
- Open to U.S. citizens and permanent residents
  - Undergraduates at a U.S. university or college with a scientific major, a recommended GPA of 3.0 or better
  - Salary + Tuition during school year
  - Presently:



**University of Colorado**

**Colorado School of Mines**

**Colorado State University**

**University of Denver**

## Other forms of NIST Support for TCUs

**Direct Collaborations:** Individual NIST outreach efforts or direct TCU initiated collaboration with any NIST technical program (subject to availability of funds) is possible and encouraged!

**Examples of trial outreach programs:**

- 1) A sponsored visit to NIST Boulder by students and faculty from Haskell Indian Nations University**
- 2) (NIST)<sup>2</sup> NIST – Navajo Internships in Science and Technology with Dine' College**

**We are open to any suggestions**



# NIST Main Campus Gaithersburg, MD

**Dedicated 1966**



**1954** Department of Commerce Boulder Laboratories – 50 Years **2006**



**1954** Department of Commerce Boulder Laboratories – 50 Years **2006**



Please explore: [www.nist.gov](http://www.nist.gov)

*If questions, email me at:  
friday@boulder.nist.gov*

Thank you

