

Two Training Events for NIST Staff

Thurs, Nov 14 – A Short Course on NIST Essentials

and

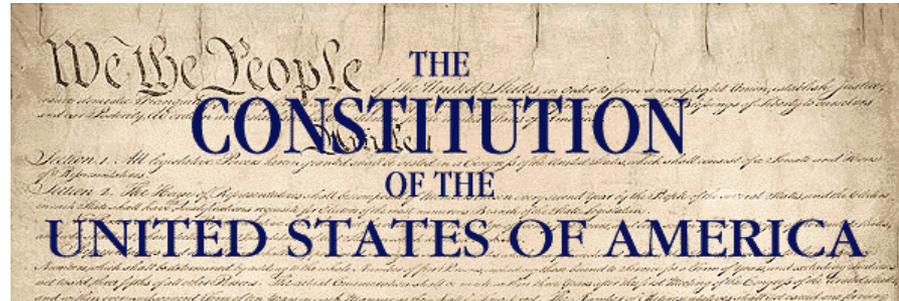
**Fri, Nov 15 – Setting Standards: A Simulation Exercise in Strategy and
Cooperation in Standardization Processes**

Heritage Room, Bldg. 101

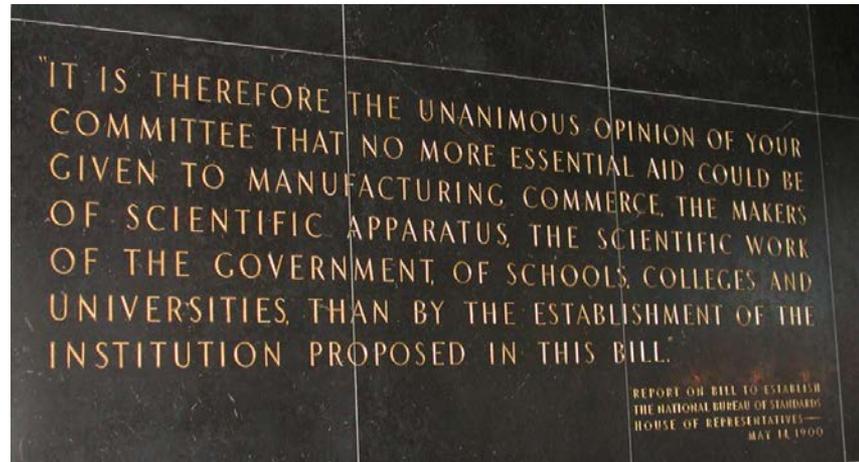
National Institute of Standards and Technology (NIST)

- Non-regulatory agency within U.S. Department of Commerce

- Founded in 1901 as National Bureau of Standards



Article I, Section 8: The Congress shall have the power to ...*coin money, regulate the value thereof, and of foreign coin, and fix the standard of weights and measures*



Unique Mission within the Federal Government ...

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: A Premier Scientific Institution

A world-leading measurement science and standards program

- Work resulting in 4 + 1 Nobel Prizes since 1997
- Kyoto Prize winner in 2011
- MacArthur Fellowship winner in 2003
- National Medal of Science winners in 1998 and 2007
- ~ 10 National Academy Members
- ~120 National Society Fellows
- ~60 National/International Awards/yr



Debbie Jin
2003 MacArthur
Genius Grant
2013 L'Oreal/UNESCO
"For Women in
Science" award



Dan Shechtman
2011 Nobel Prize
in Chemistry based on work
while Visiting Scientist at
NIST



Bill Phillips
1997 Nobel Prize
in Physics



Eric Cornell
2001 Nobel Prize
in Physics



John Hall
2005 Nobel Prize
in Physics

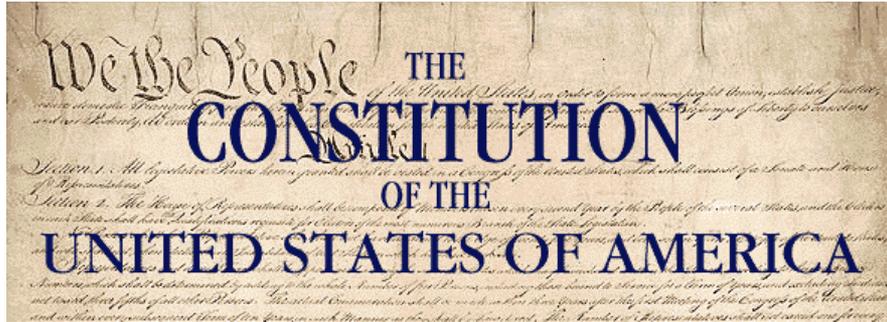


David Wineland
2007 National Medal of Science
2010 Nobel Prize



John Cahn
1997 National Medal of Science
and 2011 Kyoto Prize
in Materials Science

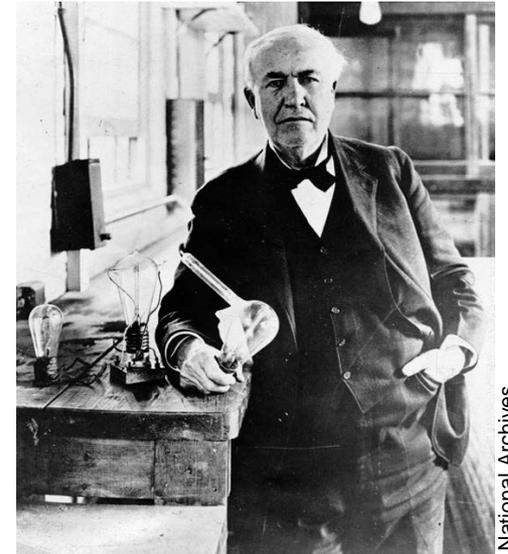
The Importance of Measurements and Standards



Article I, Section 8: The Congress shall have the power to...*fix the standard of weights and measures*

National Bureau of Standards established by Congress in 1901

- Eight different “authoritative” values for the gallon
- Electrical industry needed standards
- American instruments sent abroad for calibration
- Consumer products and construction materials uneven in quality and unreliable



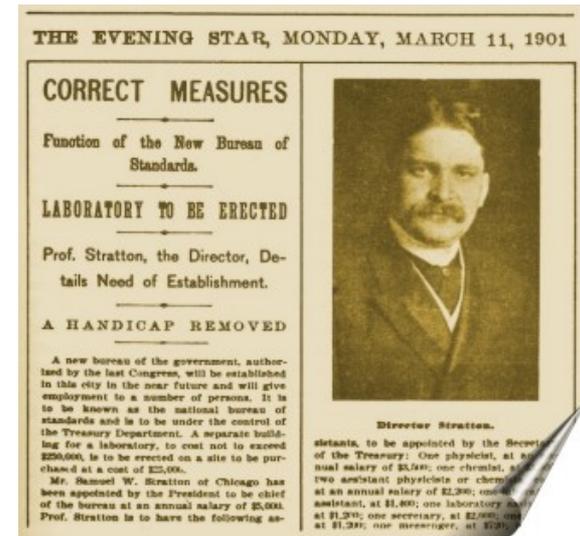
Estimated that 80% of global merchandise trade is influenced by testing and other measurement-related requirements of regulations and standards

NIST (NBS) established in 1901

“It is therefore the unanimous opinion of your committee that no more essential aid could be given to

- manufacturing
- commerce
- the makers of scientific apparatus
- the scientific work of Government
- schools, colleges, and universities

than by the establishment of the institution proposed in this bill.”



House Committee on Coinage, Weights and Measures ... on the establishment of the National Bureau of Standards (now NIST) May 3, 1900

Organic Act of 1901; Updated in 2008

Functions and activities of the Institute include:

- **custody and dissemination of national standards.**
 - comparison of US national standards with those of other nations
- determination of physical constants and the properties of materials
- solutions to measurement and standards problems of other government agencies
- providing (Innovation) assistance to industry

Early Driver for Standards in the U.S.

1904

Out-of-town fire companies arriving at a Baltimore fire cannot couple their hoses to the hydrants. 1526 buildings razed.

1905

National Fire Protection Association adopted NBS-developed national hose **coupling standard**



Birth of the U.S. “Standard Samples” Program

1905

Standard samples program begins with “standardized irons” in collaboration with **the American Foundrymans Association**

1906

At the request of the **Association of American Steel Manufacturers**, the Bureau [*now NIST*] began work on certification of 17 types of steel

- By 1951, there were 502 Standard Samples, 98 of these were steels
- Today there are more than 1400 different NIST SRMs with annual sales of ~32,000 units



With additional needs came expansion

Train Derailments ... Poor Quality Control

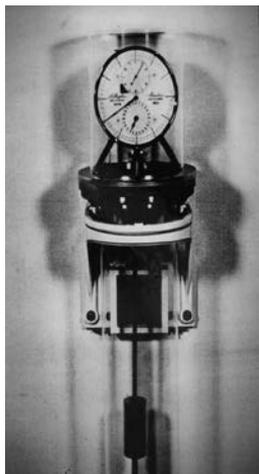


1912

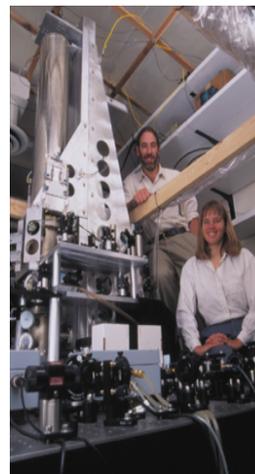
- A report by the [Interstate Commerce Commission](#) revealed alarming statistics for railroad accidents; almost 42,000 occurred in the U.S. in the previous decade.
 - NBS began a program to examine cracked rails and other failed parts through **chemical, microscopic, and mechanical tests.**

NIST still leads the World on the Realization of the SI

pendulum clock
1 s in 3 years
(1904)

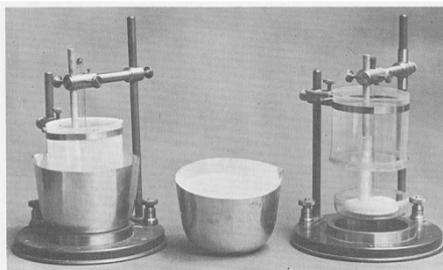


second

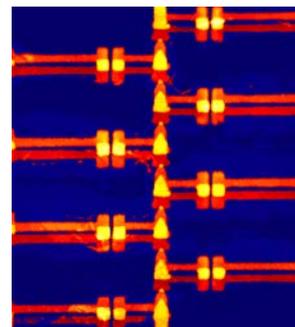


NIST F1
atomic clock
1 s in 30 million
years
(1999)

silver voltameter
current standard
(1910)



ampere



single
electron
counter
(20xx)

physical artifact
(1889)



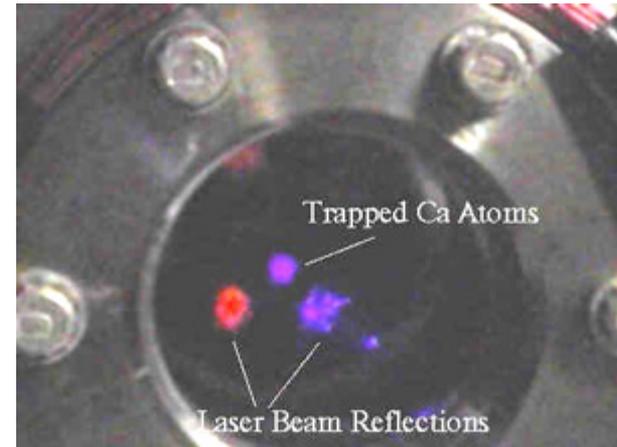
kilogram



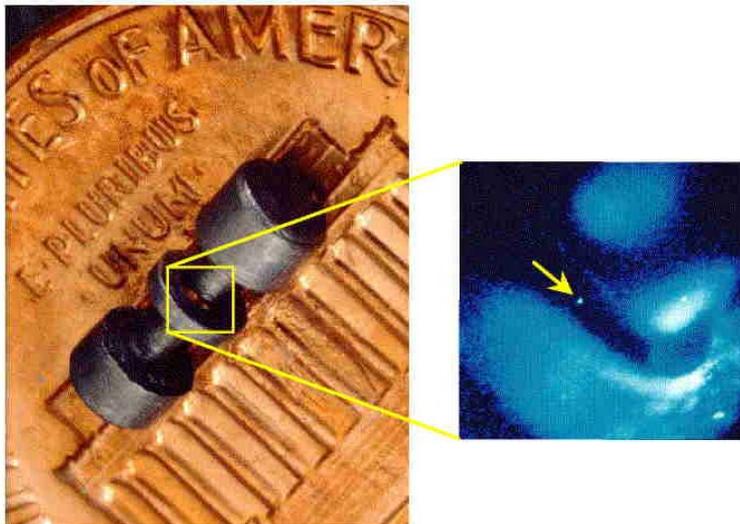
electronic
kilogram
(20xx)

Research to Develop Future Clocks

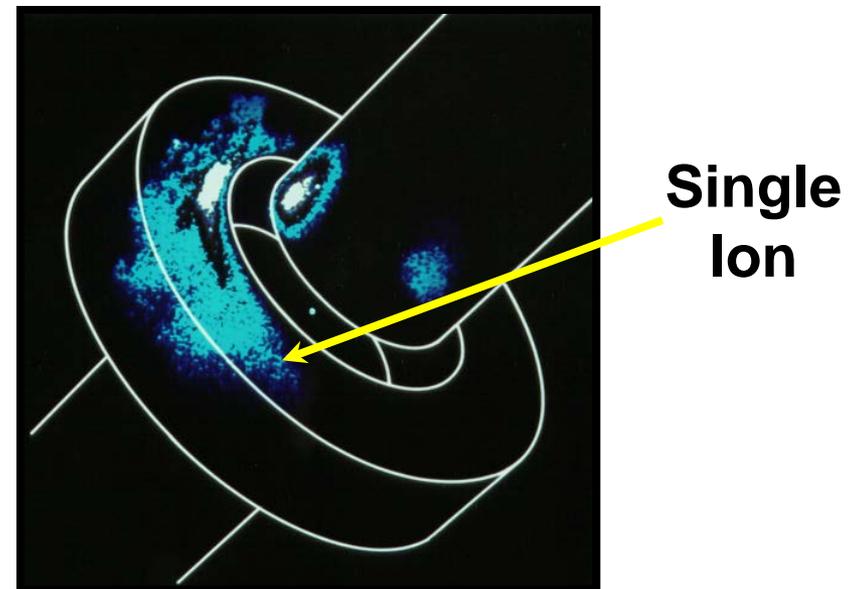
Optical clocks have the potential for accuracy about 1,000 times better than the cesium fountain (atomic) clock that currently serves as the US primary time and frequency standard (10^{-18} , 1 second in 30 billion years).



Laser-cooled calcium trap



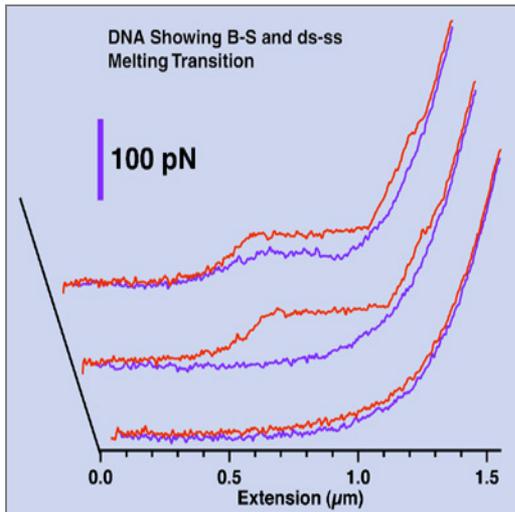
Single mercury ion trap



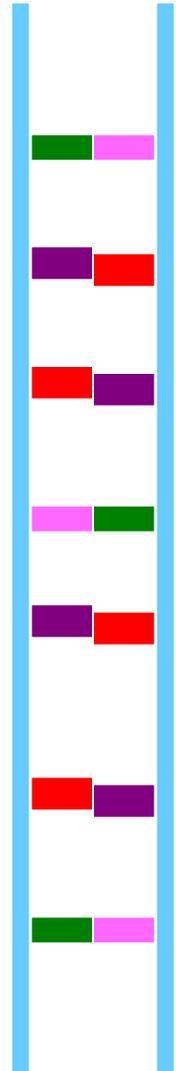
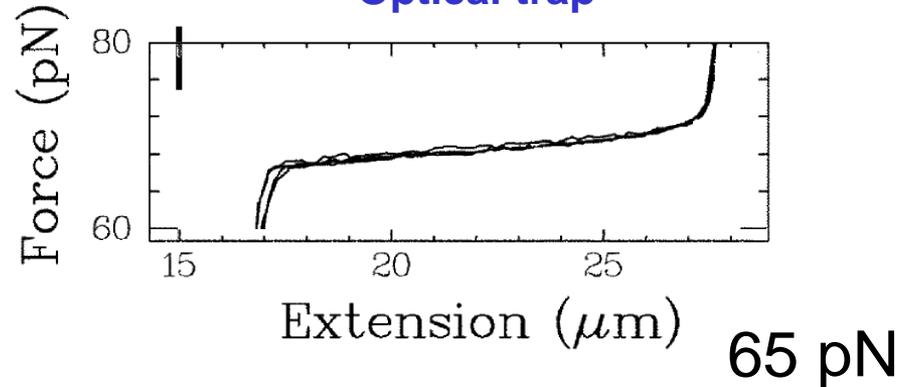
Single Ion

DNA as an Intrinsic Force Standard

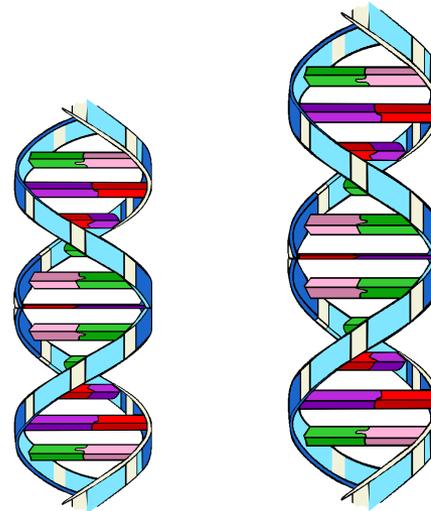
AFM



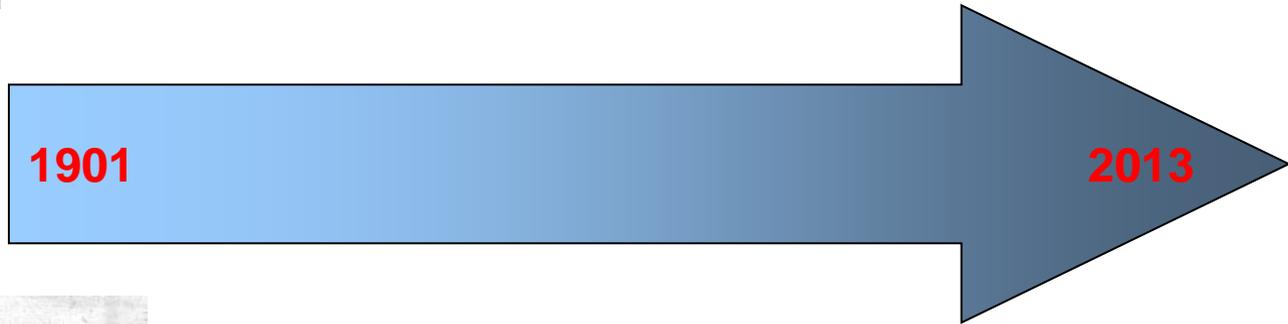
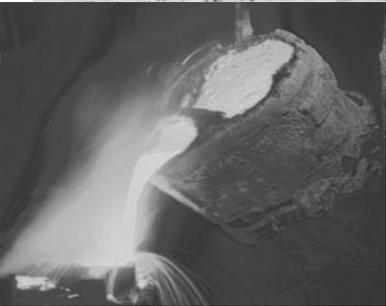
Optical trap



- DNA can be manufactured to atomic precision anywhere in the world.
- The force required to induce DNA transition is used as a biophysics “standard” – but firm metrological basis does not exist
- NIST is working to measure the DNA transition force with traceable metrology using approaches based on both optical and AFM techniques.



Since our inception, in addition to maintaining the more traditional National physical standards, **we have also focused a significant portion of our research and measurement services activities on addressing contemporary societal needs.**



U.S. Innovation Agenda – NIST has an increasing role

Advanced Manufacturing

- Precision Measurements
- Bio and Nanomanufacturing
- Additive Manufacturing
- Smart Manufacturing
- Advanced Materials

Cybersecurity

- Executive Order – Framework for Critical Infrastructure
- National Cybersecurity Center of Excellence



Advanced Communications

Forensic Science

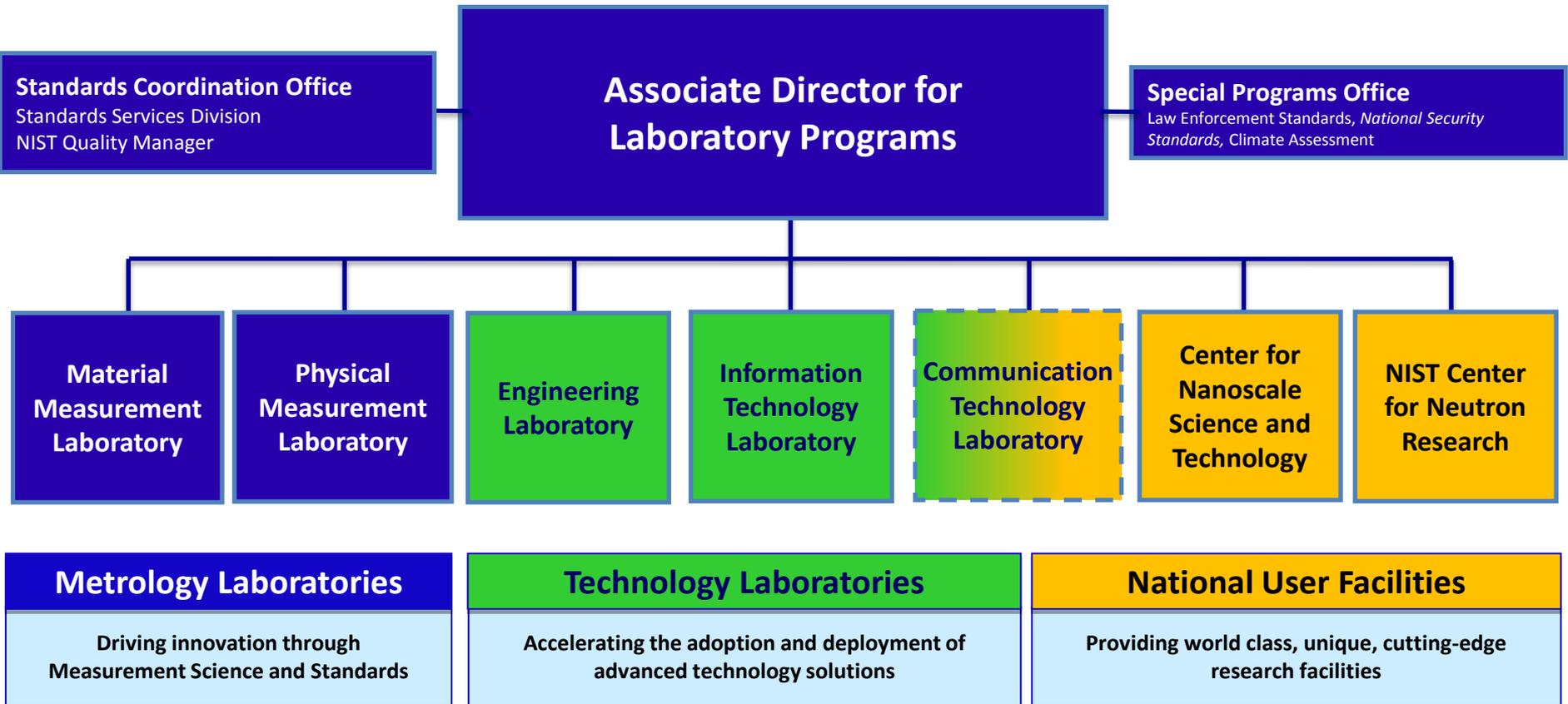
Healthcare

Climate Assessment

Disaster Resilience

NIST Laboratory Program

providing measurement solutions for industry and the nation



NIST Lab Resources for FY13

- ~ \$580 million from Direct Appropriations
- ~ \$120 million from Other Federal and State Agencies
- ~ \$50 million for other reimbursable services

- It is Important for NIST Staff to Understand the Fundamentals of Metrology, Legal Metrology and Documentary Standards
- This workshop – A Short Course on NIST Essentials – is specifically designed for those who have been **working at NIST for roughly 6 years or less** and **those who could otherwise benefit from learning more about the fundamentals of metrology, legal metrology and documentary standards.**
- Today's workshop will look at the big picture of how these topics are interdependent. The collaboration of these efforts can encourage harmonized measurement solutions that stimulate the nation's economic security and enhance our quality of life.

Pat and I support and thank the SCO for providing this training and all of you for participating valuable services.