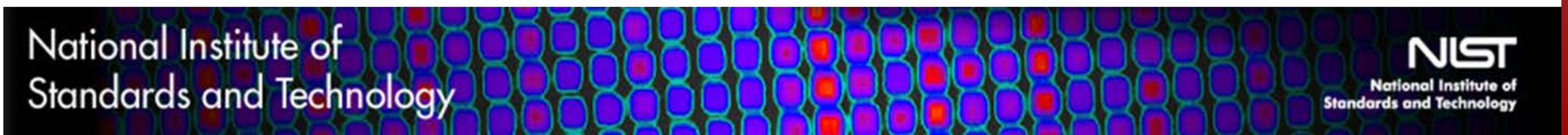
NIST Update and Agenda Review

VCAT: October 6, 2015

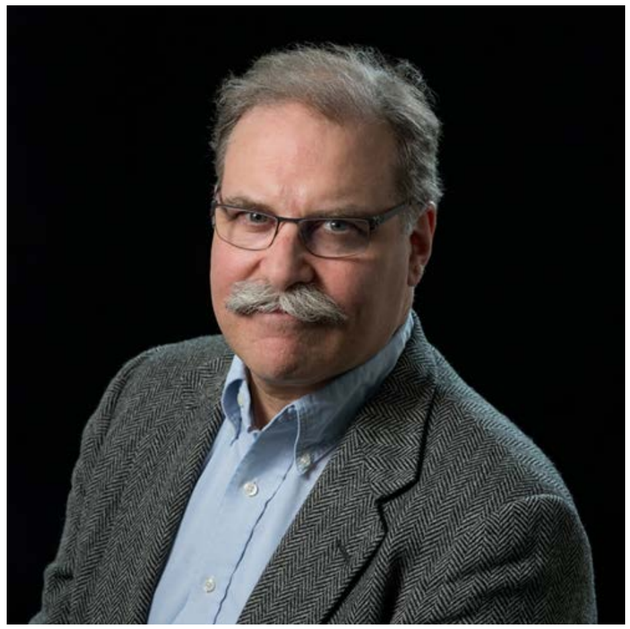
Willie E. May, NIST Director and
Under Secretary of Commerce for Standards and Technology



Welcome to New VCAT Member

Tod Sizer

- *Vice President of the Wireless Research Program in Bell Labs, Alcatel-Lucent.*

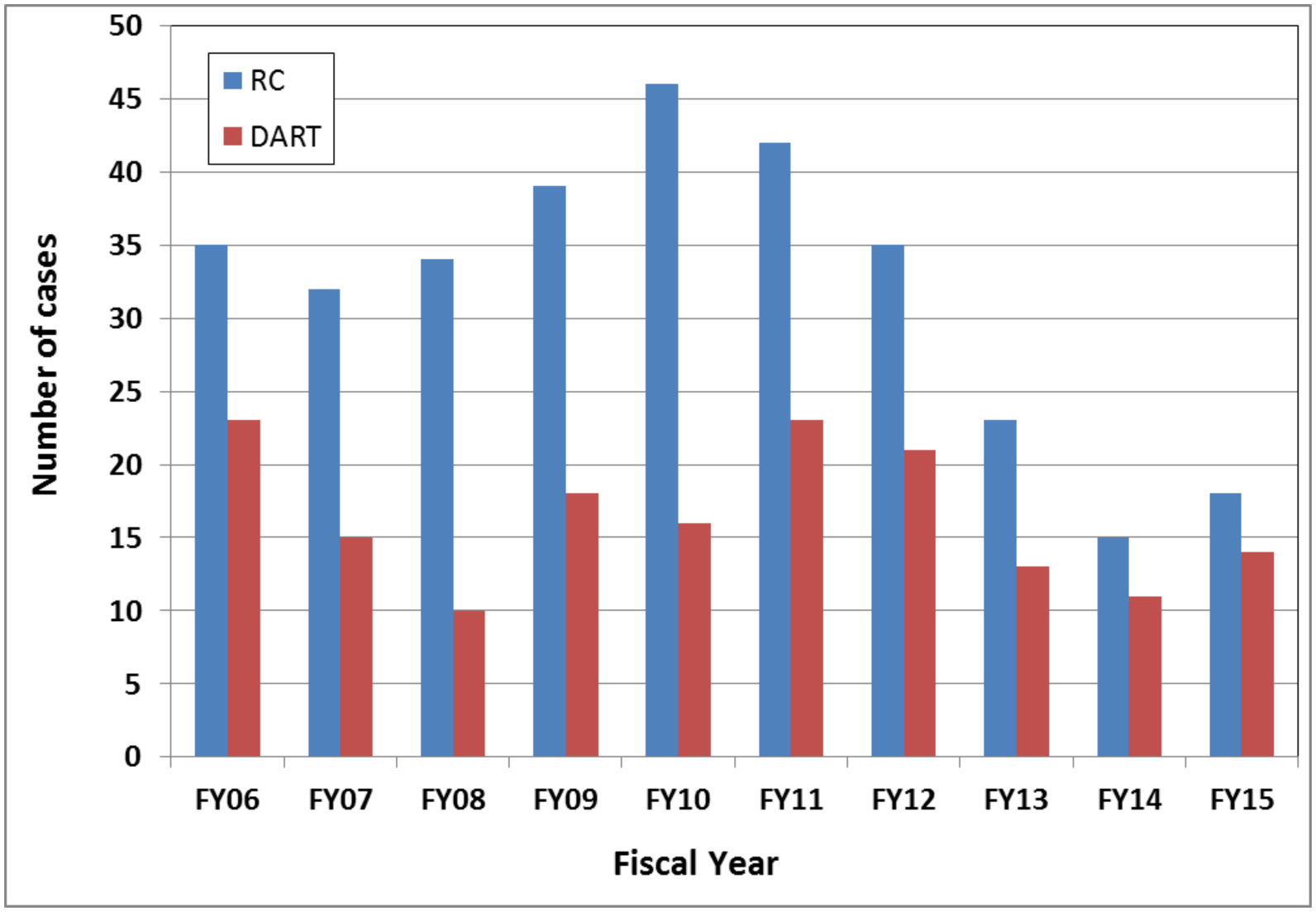


- Leads teams in six worldwide locations that are providing innovations in all aspects of wireless systems, technology and software
- Provides significant impact as a key proponent and inventor of the lightRadio™ and small cell technology and systems leading to Alcatel-Lucent's product line solution to address the current Wireless Data explosion.
- Named a Bell Labs Fellow "*For sustained creative contributions to wireless systems, particularly in the convergence of packet and wireless technologies*"

Topics: NIST Update

- **Safety and Site Security Update**
- **Update on Director's Priorities**
- **NIST Budget Status**
- **Selected Staff Awards/Achievements**
- **Strategic Research and Programmatic Updates**
- **Agenda Review**

Safety Update



Goal = Zero

Recordable case (RC)

To a first approximation, an injury that required medical treatment beyond first aid

DART case

An OSHA recordable that resulted in employee Days Away, Restricted duty, or job Transfer

Building 236 Incident

United States Department of Justice

THE UNITED STATES ATTORNEY'S OFFICE
DISTRICT of MARYLAND

FOR IMMEDIATE RELEASE — Friday, August 21, 2015

Former NIST Police Officer Admits That He Attempted to Manufacture Methamphetamine, Causing an Explosion

"Methamphetamine is Unsafe to Produce and Unsafe to Use"

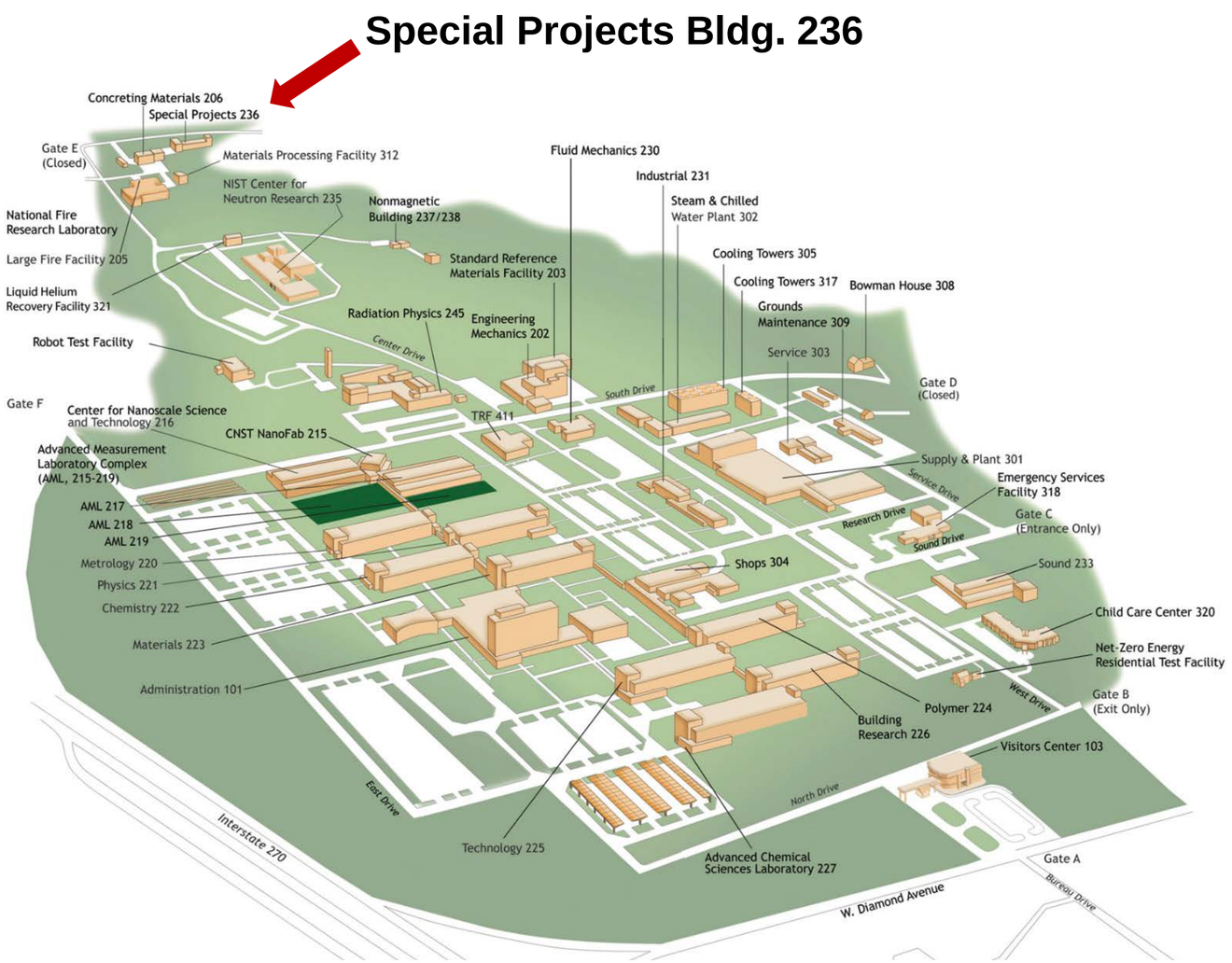
Greenbelt, Maryland – Former National Institute of Standards and Technology (NIST) police officer Christopher Bartley, age 41, of Gaithersburg, Maryland, pleaded guilty today to attempting to manufacture methamphetamine in a laboratory room on the NIST campus on Saturday, July 18, 2015, which resulted in an explosion.

The guilty plea was announced by United States Attorney for the District of Maryland Rod J. Rosenstein; Acting Special Agent in Charge Scott Hinckley of the Federal Bureau of Investigation; Special Agent in Charge Karl C. Colder of the Drug Enforcement Administration - Washington Field Division; and Chief J. Thomas Manger of the Montgomery County Police Department.

"Methamphetamine is unsafe to produce and unsafe to use," said U.S. Attorney Rod J. Rosenstein. "Mr. Bartley damaged government property and jeopardized the health and safety of NIST employees by mixing dangerous chemicals."

Building 236 Incident

- ~7:00 pm Saturday, July 18, an explosion occurred in a laboratory room in Bldg. 236.
  - A member of the NIST security force assigned to the Gaithersburg campus suffered non-life threatening injuries, was treated at a local trauma center, and was subsequently released.
  - The NIST Police and Fire Departments responded to the incident and due to the presence of what appeared to be meth manufacturing evidence requested the assistance of the Montgomery County Police and Fire Departments.
  - The officer resigned from Federal Service, effective July 19.
  - Former Officer pleaded guilty on Aug. 21, 2015 to attempting to manufacture amphetamine in a NIST laboratory
  - Sentencing scheduled for November 19, 2015.



United States Attorney Rod J. Rosenstein commended the FBI, DEA and Montgomery County Police Department for their work in the investigation, and praised NIST for their assistance in the investigation.

Building 236 Incident: NIST Actions in Response

- **Immediately following the incident, open NIST Staff access to Building 236 was restricted until further notice.**
  - No critical research activities were taking place in the building.
  - It was largely unoccupied and is located in a remote area of the campus.
- **We are reviewing NIST security patrol procedures, including required check-in times, and strengthening our internal controls related to afterhours access and patrols of the NIST Gaithersburg and Boulder campuses.**
- **We are investigating the installation of individual electronic locks on doors for individual labs to improve access control and accountability.**
  - Access then could be limited on an individual basis, as approved by laboratory management.
- **We have extended invitations to 4 external security experts with specific experience in protecting a research campus to conduct independent reviews of NIST's current security posture (both campuses).**

NIST Response – *cont'd*: Security Committee of Experts

To conduct independent reviews of NIST's current security posture (both campuses), including staffing, processes, policies and procedures.

- **Committee of Experts (CoE)**
  - Boeing Senior VP for Security
  - NIH Associate Director for Security & Emergency Response
  - Oak Ridge National Laboratory (ORNL) Security Specialist
  - Department of Commerce Assistant Director for Security and Emergency Management

- **Each external security expert, depending upon his/her expertise, will be asked to provide an independent review, assessment and evaluation to determine whether current**
  - security/law enforcement measures and protocols
  - physical security systems and safeguards
  - risk management principles
  - security, law enforcement and contract security staffing, and
  - the security/law enforcement management structure

at NIST are consistent with government or industry best practices, and appropriate to ensure the continued security and safety of NIST personnel, program activities and resources.

Additional Allegation Last Week:

Officer Who Cooked Meth In Gov't Lab Also Had Sex While On Duty and Was Engaged In Attendance Fraud

On Wednesday, Rep. Lamar Smith, chairman of the [House committee that oversees] NIST, sent a letter to NIST Director Willie May demanding more information about the incident.

The Libertarian Republic

We were recently informed that the DHS Federal Protective Service is planning to conduct a delegation oversight audit of our Gaithersburg site in the next 30 – 75 days.

Topics: NIST Update

- Safety and Site Security Update
- Update on Director's Priorities
- NIST Budget Status
- Selected Staff Achievements
- Strategic Research and Programmatic Updates
- Agenda Review

My Priorities

- **Fill key leadership vacancies** (e.g., Directors of PML, EL, MEP, SCO and my replacement as ADLP)

- **Work with the Senior Leadership Team in:**
  - Continuing to strengthen the NIST Safety Culture
  - Completing the successful implementation of programs that NIST has initiated in response to pressing national needs
  - Enhancing current and developing new capabilities needed to enhance mission delivery
  - Addressing long-term sustainability of the Baldrige Program
  - Strengthening the MEP Program
  - Supporting the Secretary in the execution of the Department's Strategic Plan
  - **Improving the efficiency and effectiveness of our internal operations**
    - becoming an organization known and looked up to for our "Operational Excellence"
  - **Increasing staff engagement in the direction and implementation of NIST programs and priorities**

Priorities: Filling key leadership vacancies

- Previously filled: PML Director, James Olthoff;
  EL Director, Howard Harary;
  MEP Director, Carroll Thomas
  Standards Coordination Office Director, Gordon Gillerman
  Advanced Manufacturing National Program Office Director, Mike Molnar

- **Pending: Associate Director for Laboratory Programs**
  - 86 people applied for vacancy that closed on June 26th.
    - 46 from government
    - 13 from academia
    - 27 from industry

  - **Selection Imminent**

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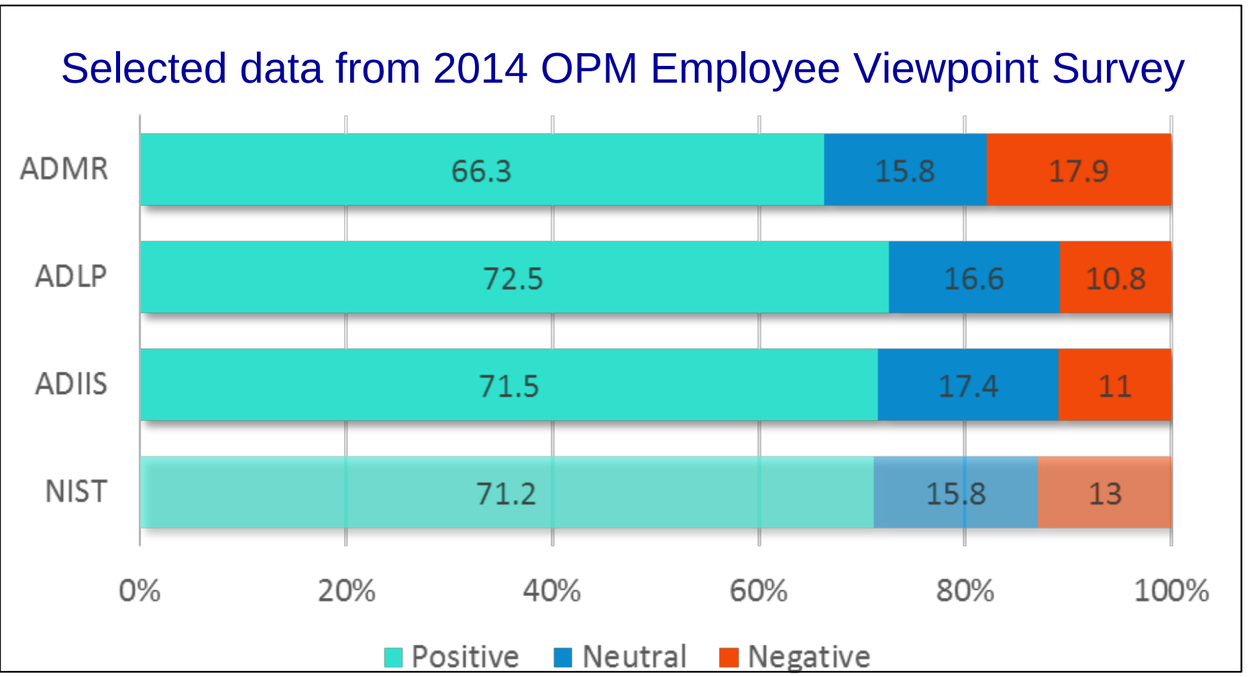
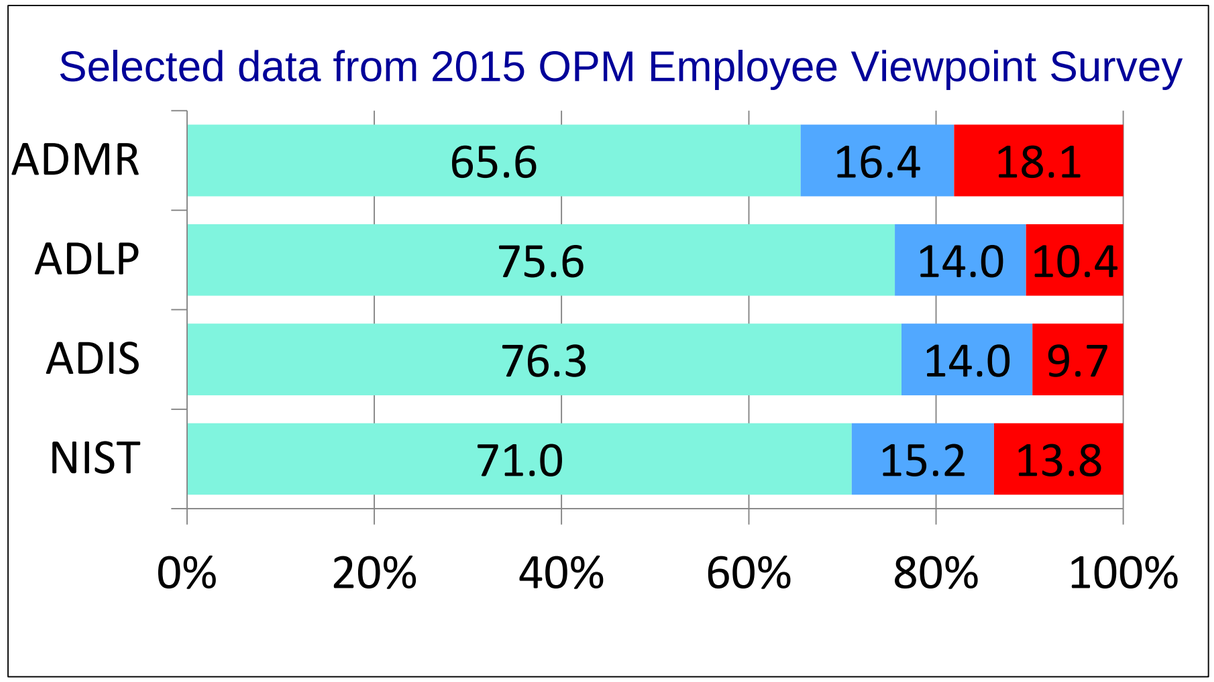
Priority: Employee Engagement and Satisfaction

NIST Administrative Support Staff





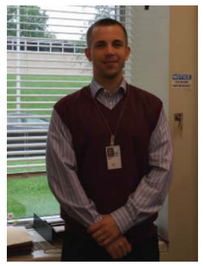
HR selected 11 questions from the survey related to employment engagement and job satisfaction.

Director’s Recognition for Excellence in Mission Support

Established to recognize staff within the Management Resources Directorate whose commitment to and excellence in service delivery has stood out among their customers

- Nominations from the Lab and IIS Directorates
- Three Selections made since program was initiated in May 2015
- For each winner, the Contribution and its Impact is publicized to NIST Staff via an email from the NIST Director

Those recognized so far:

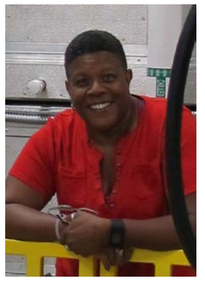


Keith Bubar
Acquis. Mgmt. Div.

“for his work as the Contract Specialist whose work helped establish the FFRDC to support NIST’s NCCoE”

Lynda Roark
Acquis. Mgmt. Div.

“for her exceptional customer service in negotiations and procurements of critical components for “Re-Inventing the Realization and Dissemination of Pressure, Temperature, and Length.”



Cynthia Hudson
Design and Constr. Div.

“for her exceptional, dedicated customer service in overseeing the construction of a new Intelligent Building Agents Laboratory (IBAL) facility”

Priorities: Increasing Technical Staff Engagement

in the direction and implementation of NIST programs and priorities

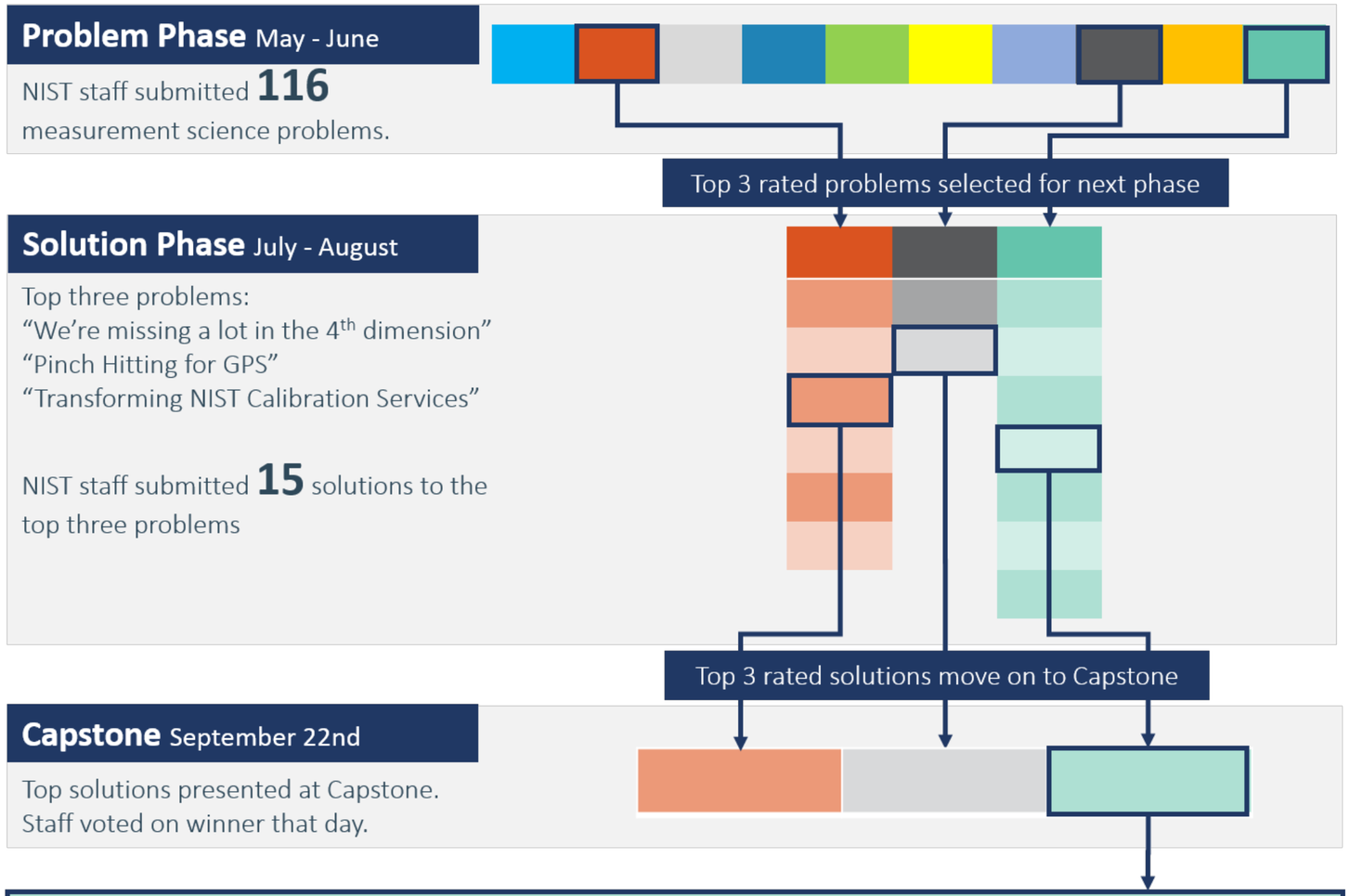
- **"NIST Innovations in Measurement Science (IMS) Program" Started in 1979**
  - to fund high risk and potentially high payoff fundamental research that would provide new competences to help NIST in carrying out its mission and address future measurement and standards needs.
  - Projects selected via a management-filtered "bottoms-up" process
  - Since its inception the IMS Program has funded over 100 research projects that have formed the cutting edge of research programs and/or evolved into core competences/capabilities within the NIST Laboratory Program
  - led to development of a cold-neutron small-angle scattering facility that led to the NIST Center for Neutron Research (NCNR)
  - supported growth of our NIST program in biology
  - addressed fundamental problems in metrology, such as the links between electrical and mechanical SI units

- **New "Colleague's Choice Innovations in Measurement Science (C2IMS) Program" Initiated in 2015**
  - Topic to be funded is Peer-Selected; Peer-Selected Solution Team provided with IMS-level funding for 3 years (up to $1 M/yr)
  - First Competition was launched in May and Winner announced in September 2015

C2IMS – First Winner

“Transforming Calibration Services Across the Spectrum with New Technologies, Automation and eAccess”

Crowd-sourced . . . – a true bottoms-up process



Throughout the process

5,300 Ratings and Votes

100 Comments

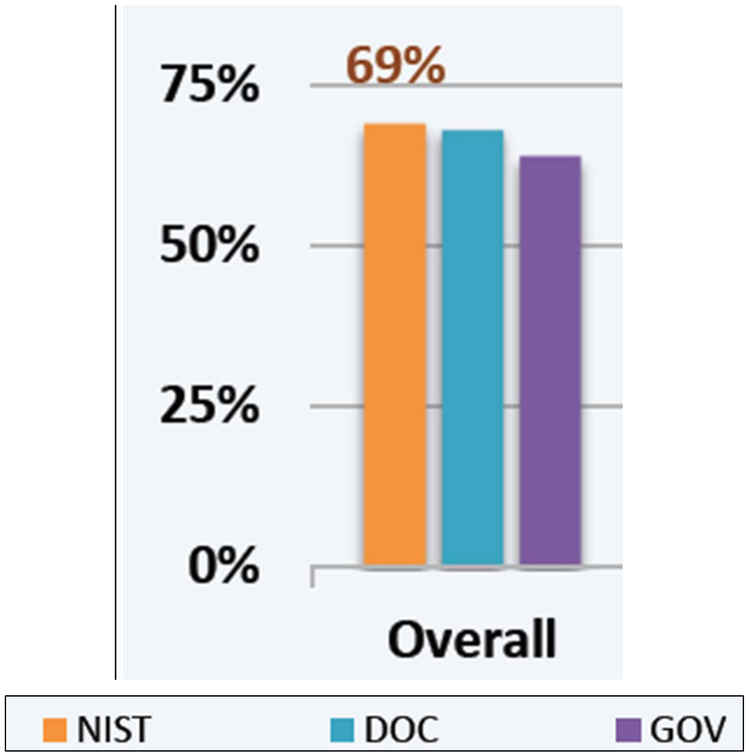
Winning Team

Anita Vanek (OISM) and her team

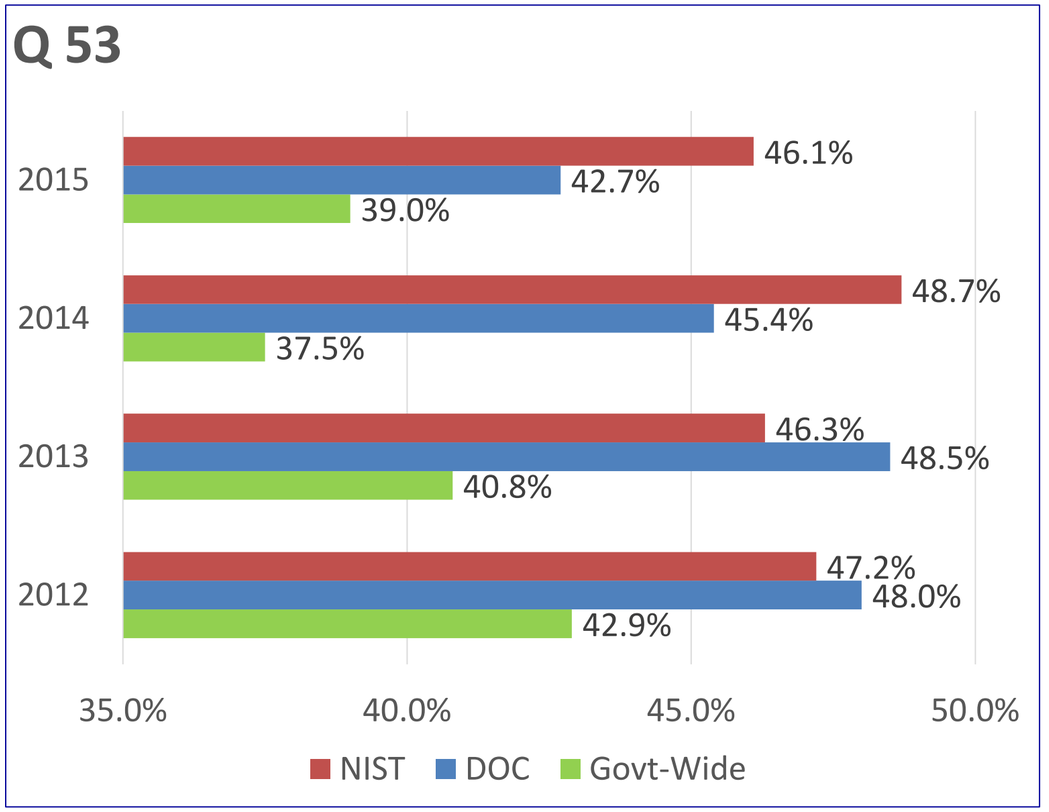
- Greg Strouse (PML)
- Michelle Stephens (PML)
- Dan Sawyer (PML)

2015 OPM Federal Employee Viewpoint Survey

Employment Engagement Index



In my organization,
Leaders generate high levels of motivation and commitment in the workforce.



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Status of NIST FY16 Budget Request (Dollars in millions)

	FY 2015 Enacted	FY 2016 President's Request	FY2016 House CJS Mark	House Mark +/(-) Over FY 16 Request	FY2016 Senate CJS Mark	Senate Mark +/(-) Over FY 16 Request
STRS	**$675.5**	**$754.7**	**$675.0**	**($79.7)**	**$684.7**	**($70.0)**
Laboratory Programs	591.3	661.6	TBD	N/A	TBD	N/A
Corporate Services	17.3	16.9	TBD	N/A	TBD	N/A
Stds Coord & Special Pgms	66.9	76.2	TBD	N/A	TBD	N/A
ITS	**$138.1**	**$306.0**	**$130.0**	**($176.0)**	**$145.0**	**($161.0)**
Advanced Mfg Tech Consortia	8.1	15.0	0.0	(15.0)	15.0	0.0
Hollings Mfg Ext Partnership	130.0	141.0	130.0	(11.0)	130.0	(11.0)
Nat'l Network for Mfg Innovation	0.0	150.0	0.0	(150.0)	0.0	(150.0)
CRF	**$50.3**	**$59.0**	**$50.0**	**($9.0)**	**$63.3**	**$4.3**
Total, NIST Discretionary	**863.9**	**1,119.7**	**855.0**	**(264.7)**	**893.0**	**(226.7)**

1/ National Network for Manufacturing Innovation is a newly proposed program in FY 2016.

Current Status:

- FY2016: Continuing Resolution passed to fund until December 11, 2015 at FY2015 levels
- FY2017: In Progress; difficult since FY17 builds on FY16

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NIST Staff honored at 67th Annual DoC Awards Ceremony,
Sept 29, 2015

Gold Medal

"**for establishing the National Cybersecurity Center of Excellence** (NCCoE) to accelerate adoption of cybersecurity standards and best practices. With industry partnerships, the NCCoE builds practical security reference designs that can be rapidly applied to the real challenges that businesses face today. This achievement includes the Department's first Federally Funded Research and Development Center (FFRDC) and the Nation's first FFRDC devoted wholly to cybersecurity."

Keith Bubar
Office of Acquisition and Agreements Management

Kevin Kimball
Office of the Director

Lauren Didiuk
Office of the General Counsel

Leah Kauffman
Nathan Lesser
Gavin O'Brien
Timothy McBride
N. Lucy Salah
Murugiah Souppaya
Karen Waltermire
Information Technology Laboratory

Gold Medal

"**for designing, constructing, operating, and continually improving the world's most accurate official time and frequency standards** (atomic clock), the NIST-F2 laser-cooled cesium fountain primary frequency standard. NIST-F2 is the U.S. national standard for the second, is one of the most visible and widely used assets of the Department of Commerce, substantially outperforms past atomic clocks, and is demonstrably the most accurate primary standard in the world."

Steven Jefferts
Thomas Heavner
Physical Measurement Laboratory

Silver Medal

“for leadership in the **White House “Green Button”** initiative, **giving consumers the vital information they need to manage their own energy usage**. Working closely with industry and other agencies, the team led the development of technology foundation for Green Button, including standards, testing, and technical support for implementers. With voluntary adoption by many utilities nationwide, more than 59 million U.S. customers now have Green Button data access to help them reduce their costs and promote a more sustainable environment.”

David A. Wollman
Martin J. Burns
John A. Teeter
Engineering Laboratory

Silver Medal

“for conceiving, developing, and bringing to the public domain via a dedicated website, the **SASSIE software and tutorial suite** that has **revolutionized the analysis of neutron and x-ray small-angle-scattering data from complex biological systems.** SASSIE models biomolecules composed of thousands of atoms with such speed that all atoms can be included, thus avoiding the huge information loss of current coarse-grained methods. SASSIE’s impact is such that an internationally funded consortium was created to extend it to the cloud and ensure its continued development.”

Joseph Curtis
NIST Center for Neutron Research

Silver Medal

“for his global leadership in the development, application, and dissemination of **cavity-enhanced laser spectroscopy methods and high-accuracy spectroscopic data** for quantitative analysis of **greenhouse gases** such as carbon dioxide, water vapor, methane, and oxygen. This work played a key role in enabling both space and ground-based remote-sensing measurements of atmospheric carbon and other species that are required for robust, long-term investigations of climate change and air-quality monitoring.”

Joe Hodges
Material Measurement Laboratory

Silver Medal

"for **improving confidence in genome-scale measurements** so that they can be used to **reliably diagnose disease and develop treatments**. Since microarray measurements were initially unreliable, the team formed a 100-member consortium to assist in developing new types of reference materials and software for determining microarray data quality. Due to the team's efforts, genomic data reliability can be assured, leading to the use of genome-scale measurements in disease diagnosis, in assessing the accuracy of gene sequencing and in tracking the origin of Ebola in West Africa."

Marc Salit
Jennifer McDaniel
Sarah Munro
Material Measurement Laboratory

Examples of Additional Recent Staff Recognitions

Arthur S. Flemming Award - **Dean DeLongchamp, MML**
for "outstanding federal service as a chemical engineer in the initiation, growth, and development of a flexible electronics research program" with a "lasting impact on organic electronics and photovoltaics research in the United States and around the world."

2015 American Society for Heating, Refrigeration and Air Conditioning Engineers) ASHRAE Exceptional Service Award - **Steve Emmerich, EL**
in recognition of service with distinction on committees and of time and talent freely given on behalf of the Society. This award is bestowed on a select few who have a large number of contributions to the society over many years and through multiple avenues.

2015 AACC Conference Awardee, **Ashley Beasley-Green, MML**
for her Urine Abumin Standardization presentations, received both the 'Distinguished Abstract Award' presented by the National Academy of Clinical Biochemistry and the 'Mass Spectrometry and Separation Sciences Poster Recognition Award'.

NPSTC Leadership Award, **Dereck Orr, CTL**

For his work to advance the cause of public safety communications as PSCR Program Manager

IEEE Joseph F. Keithley Award in Instrumentation and Measurement, **Sam Benz, PL**
Given for outstanding contributions in electrical measurements. Full citation: "For creating and disseminating quantum-based superconducting voltage standards that form the basis for worldwide precision voltage measurements."

Washington Academy of Science Award, **Marc Cicerone, MML**
In recognition of "groundbreaking and high-impact optical measurement methods for quantifying biological systems, and exemplifying the type of innovation in the physical sciences needed to make breakthrough advances in biology."

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NIST – Who We Are and What We Do

NIST is a world class scientific and technical agency uniquely focused on driving innovation and economic competitiveness through:

- **a world-leading scientific research program --** measurement, technology, and standards solutions to our stakeholders
- **a nation-wide network of centers --** focused on strengthening our nation's small and medium manufacturers
- **a program in performance excellence --** used to assess the nation's companies and organizations which is recognized, utilized, and emulated around the world
- **an Advanced Manufacturing National Program Office** -- facilitating expansion of a nation-wide network of Institutes for innovation in Manufacturing

We have a great and unique Mission and are:

- a key player on the Administration's Innovation Team
- the nation's go-to agency for measurements, standards, and technology
- receiving bipartisan and bicameral support

NIST At-a-Glance

Major Assets, Partnerships, People, Budget

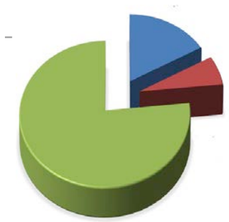
2 Large Research Campuses

Gaithersburg, MD– **62** bldgs. **578** acres
Boulder, CO—**26** bldgs., **208** acres

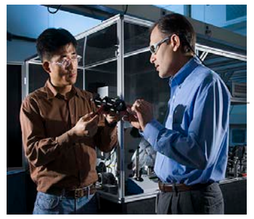
Partnerships In Every State

~**400** Manufacturing Extension Locations
10 joint institutes/Centers of Excellence

FY 2015 Appropriations. $864 Million



NIST labs, $**675.5 M**
Industrial Technology Services, $**138.1 M**
Construction of Research Facilities, **$50.3 M**



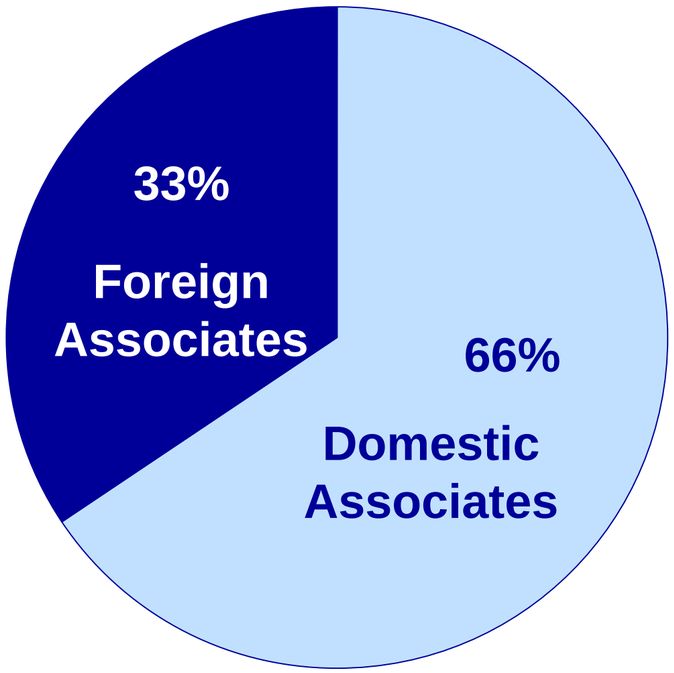
People: Employees & Associates

~**3,000** Employees
~3,500 Guest Researchers & other NIST Associates
~400 NIST Staff on **~ 1,000** standards committees

Additional Resources
~ $120 M from other government agencies
~ $50 M from reimbursable services

Augmenting our Staff via Associates

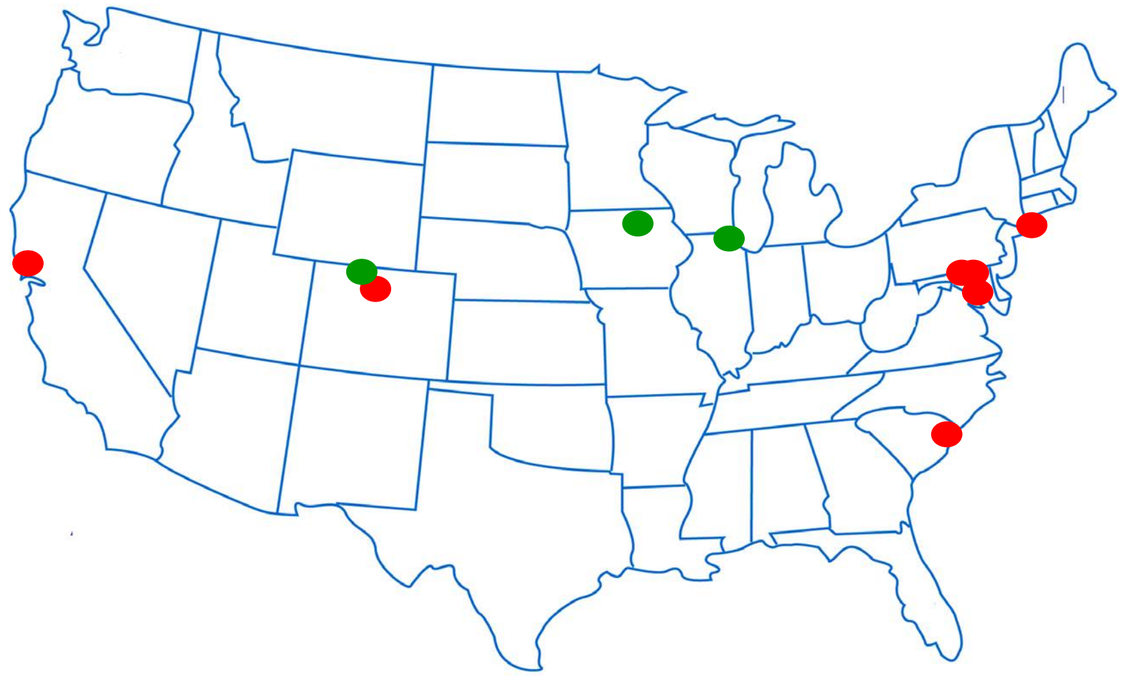
More than doubling our research talent through on-campus research collaborations



DOMESTIC		**2300**
Academia	**1649**	
Industry Total	**712**	
Small Businesses	*558*	
Large Businesses	*154*	
Other Agency	**367**	
FOREIGN		**1206**
Academia	**364**	
Industry	**17**	
Government (including NMIs)	**80**	
Total for FY2014		**3506**

Leveraging the nation's best experts in a range of S&T fields

Joint Institutes and Centers of Excellence



Joint Institutes/Centers (red)

- JILA –CO
- Institute for Bioscience and Biotechnology Research—MD
- Hollings Marine Laboratory—SC
- Joint Quantum Institute, Joint Center for Quantum Information and Computer Science—MD
- National Cybersecurity Center of Excellence—MD
- Joint Institute for Metrology in Biology—CA

NIST Centers of Excellence (green)

- Center for Hierachical Materials Design (advanced matls.)—IL
- Center of Excellence in Forensic Science –IA, PA, VA, CA
- Community Resilience Center of Excellence —CO, OK, TX, WA, AL, CA

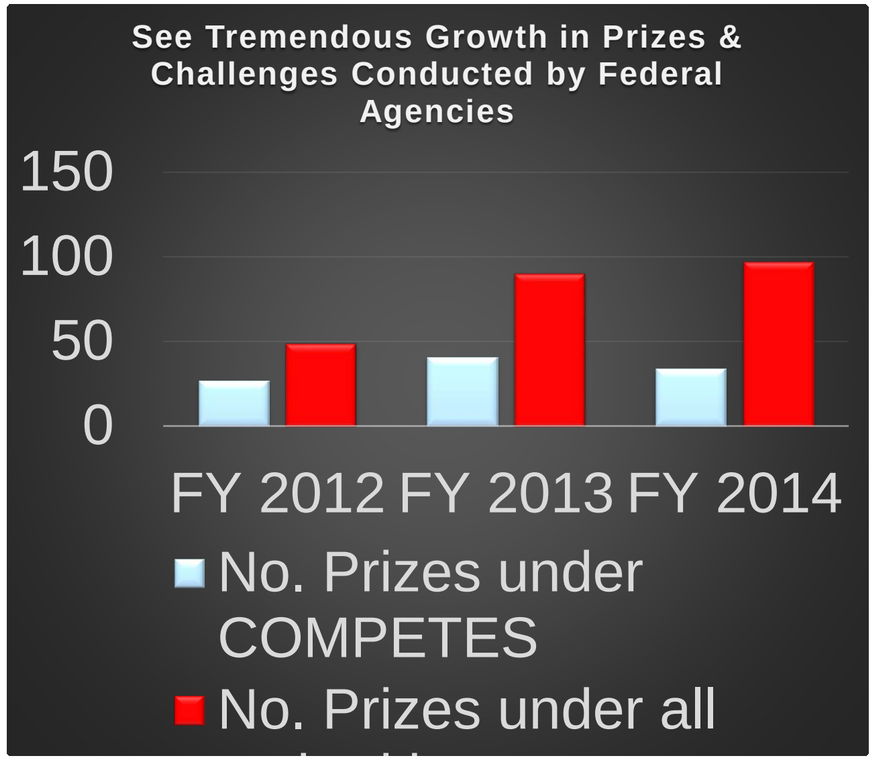
Levering Experts: Federal government use of Prize Competitions

"Each head of an agency, or the heads of multiple agencies in cooperation, may carry out a program to **award prizes competitively to stimulate innovation** that has the potential to advance the mission of the respective agency."

America COMPETES Reauthorization Act (2010)

Benefits

- Shine a spotlight on a problem or opportunity
- Pay only for results
- Target an ambitious goal without predicting which team or approach is most likely to succeed
- Reach beyond usual suspects to tap top talent
- Stimulate private sector investment many times greater than the prize purse
- Bring out-of-discipline perspectives to bear
- Inspire risk-taking by offering a level playing field
- Establish clear target metrics and validation protocols



Update: Head Health Challenge III - Advanced Materials for Impact Mitigation

- A Public-Private Challenge Prize to stimulate the development of advanced materials that exhibit excellent energy absorbing /dissipating properties
- Employs NIST expertise in materials testing and assessment
- Inspired by the National Materials Genome Initiative (MGI)

NIST is leveraging Challenge III to expand MGI-related activities in advanced protection materials

- **January 29, 2015:** NFL SuperBowl Press Conference
- **February 2, 2015:** Challenge III Opens
- **March 2015:** 125 Abstracts Received
- **April 2015:** 75 Winning Abstracts invited to submit full proposal and a material sample
  - Summer 2015: NIST tested the submitted samples; met with judges and selected 5 semifinalists
- **October 2015:** the 5 First Round Awardees receive $250,000 each; begin work to refine materials
- **September 2016:** **Grand Prize Winner awarded $500,000**

Reference Data Challenge

- The NIST Standard Reference Data collection contains some of the world's most accurate and comprehensive datasets of physical, materials science, chemical, and biological data.
- **But is there a better way to share NIST SRD with the researchers who need it?**

We asked people to build an App using at least one of these NIST Datasets:

1. CODATA Fundamental Physical Constants (SRD 121)
2. Ground Levels and Ionization Energies for the Neutral Atoms (SRD 111)
3. Atomic Weights and Isotopic Compositions (SRD 144)
4. Computational Chemistry Comparison and Benchmark Database (SRD 101)
5. NIST-JANAF Thermochemical Tables (SRD 13)
6. ITS-90 Thermocouple Database (SRD 60)

The Judges:

Bibiana Campos-Seijo
Editor, C&E News

Vint Cerf
VP and Chief Internet Evangelist, Google

Stuart Chalk
Assc. Prof. of Chemistry (UNF)

Robert Hanisch
Director, NIST ODI

Ian Kalin
Chief Data Officer, DOC

Diana Ortiz-Montalvo
NIST Research Chemist

Chris Sloop
CTO, Earth Networks

About the Challenge

$45,000
In Prizes

130+
Participants

26
Apps Submitted

Nov. 16th
Winners to be Announced

SHA-3 Competition

- Develop a new cryptographic secure hash algorithm
- Multiple rounds of feedback and crypto community engagement
- Winner announced in Oct. 2012 – ending 5 year competition
- **Aug 2015: NIST Released final version of SHA-3 Standard, FIPS PUB 202**

http://csrc.nist.gov/groups/ST/hash/sha-3/index.html

Global Cities Team Challenge

Challenging teams of cities to work with innovators to develop, deploy, and evaluate standards-based Smart Cities technologies

- **Facilitating partnerships among cities/communities and innovators**
  - Show the impact of replicable and scalable Smart City projects

- **1st Global Cities Team Challenge Expo:**
  - **June 1, 2015 at the National Building Museum in Washington DC**
    - 64 teams exhibited and presented in partnership with 50+ municipal governments around the world
    - 200+ organizations
    - 1200+ attendees, 50+ world-wide media outlets

- **2nd Global Cities Team Challenge being launched**
  - **FY2016 Global City Teams Challenge launch event to be held at NIST on 12-13 November**

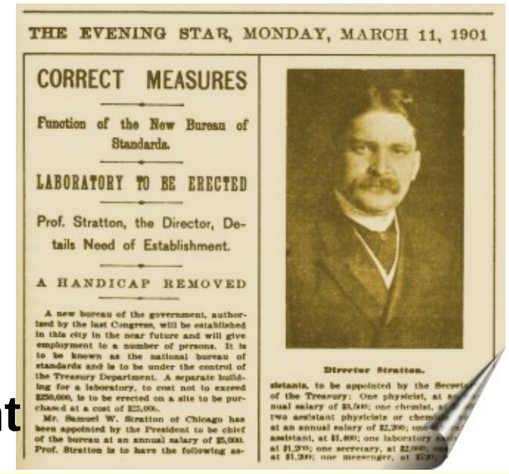
NIST GLOBAL CITY TEAMS CHALLENGE usignite

NIST (NBS) established in 1901

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**



THE EVENING STAR, MONDAY, MARCH 11, 1901

CORRECT MEASURES

Function of the New Bureau of Standards.

LABORATORY TO BE ERECTED

Prof. Stratton, the Director, Details Need of Establishment.

A HANDICAP REMOVED

A new bureau of the government, authorized by the last Congress, will be established in this city in the near future and will give employment to a number of persons. It is to be known as the national bureau of standards and is to be under the control of the Treasury Department. A separate building for a laboratory, to cost not to exceed $250,000, is to be erected on a site to be purchased at a cost of $25,000.

Mr. Samuel W. Stratton of Chicago has been appointed by the President to be chief of the bureau at an annual salary of $5,000. Prof. Stratton is to have the following assistants, to be appointed by the Secretary of the Treasury: One physicist, at an annual salary of $3,500; one chemist, at ... two assistant physicists or chemists, at an annual salary of $2,200; one assistant, at $1,800; one laboratory ... at $1,200; one secretary, at $2,000; one ... at $1,200; one messenger, at $720.

Director Stratton.

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

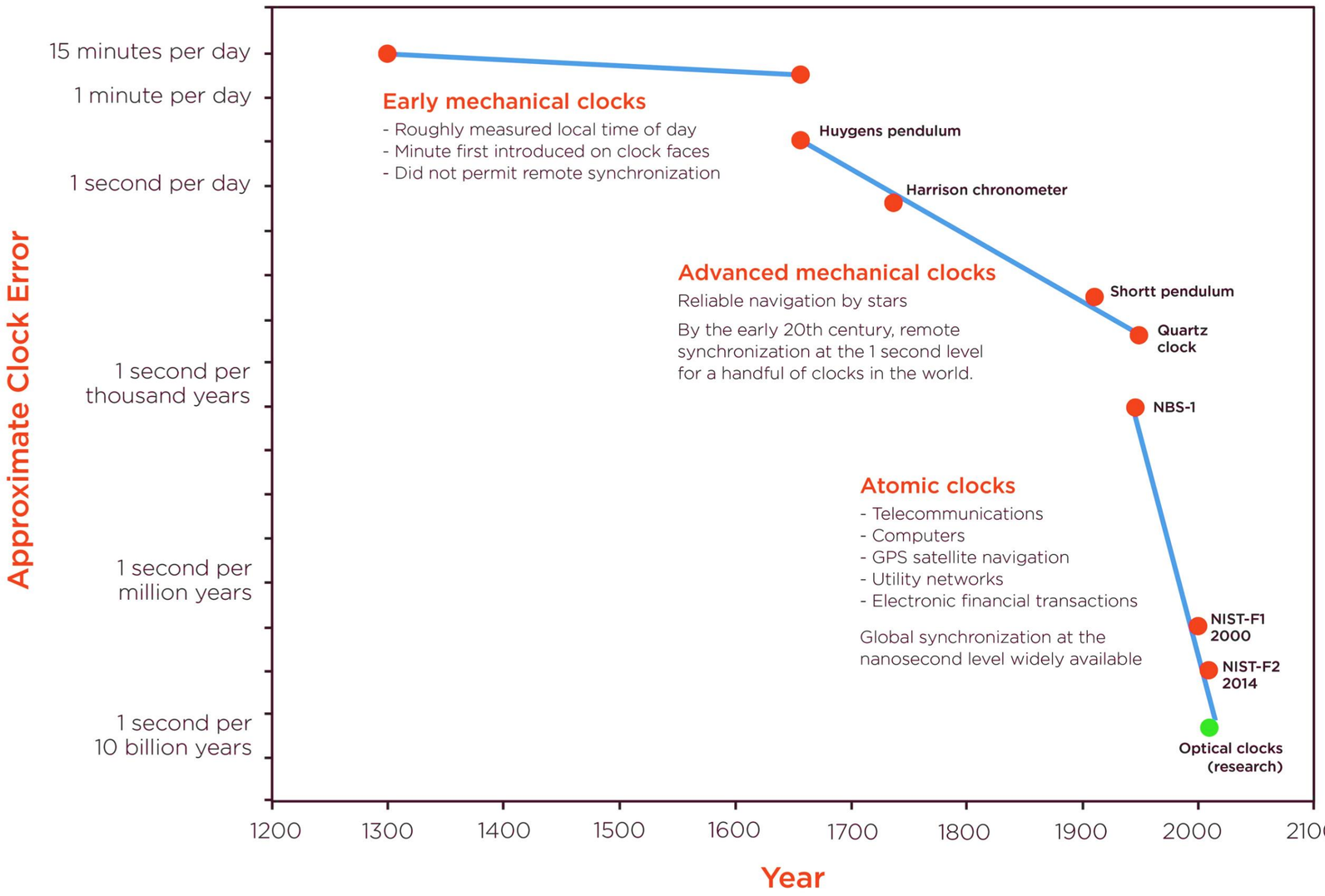
NMI's Around the World *are Working together*

to link our global measurement system to the fundamental constants of nature

Unit		*Reference value used to define the unit in current SI*	*in the new SI*	
second,	s	$\Delta\nu(^{133}\mathrm{Cs})_{\mathrm{hfs}}$	$\Delta\nu(^{133}\mathrm{Cs})_{\mathrm{hfs}}$	Cs hyperfine splitting
metre, m	*c*	*c*		speed of light in vacuum
kilogram,	kg	$m(\mathcal{K})$	*h*	Planck constant
ampere,	A	μ_0	*e*	elementary charge
kelvin,	K	T_{TPW}	*k*	Boltzmann constant
mole,	mol	$M(^{12}\mathrm{C})$	N_{A}	Avogadro constant
candela,	cd	K_{cd}	K_{cd}	luminous efficacy of a 540 THz source

Rigorous realization of these units has provided undeniable impact on trade, commerce, and quality of life

Leading the world in defining the international system of units



TIME

Record-setting Atomic Clock

NIST/JILA's strontium lattice atomic clock, accurate to:
1 second in 15 billion years

Why this level of Precision Matters:

Electric power grid requires:

synchronization to about 1 millionth of a second per day

Modern telecommunications and computer network systems require:

synchronization to about 1 millionth of a second per day

GPS system requires:

synchronization to about 1 billionth of a second per day.

NIST official time is used to time-stamp hundreds of billions of dollars in U.S. financial transactions each working day.

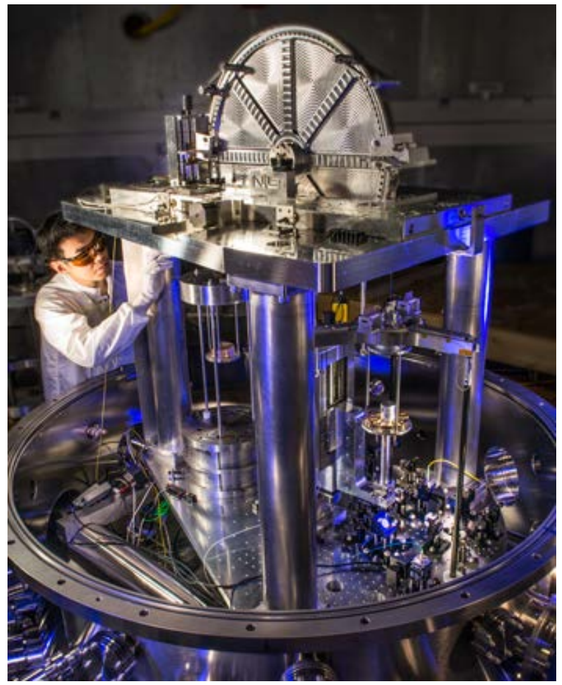
Leading the world in redefining the international system of units

Physical kilogram artifact (1889)

MASS

Redefining mass from a physical artifact to a constant of nature by 2018.

Working with other national metrology institutes around the world, NIST researchers are carefully measuring **Planck's constant** so that it can be the cornerstone of a new, improved International System of Units.



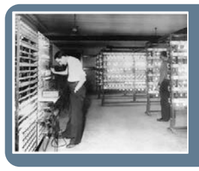
Int. Avogadro Project

Since our inception as NBS, in addition to maintaining the more traditional National Physical Measurement Standards, we have also focused a significant portion of our research and measurement services activities on addressing contemporary societal needs

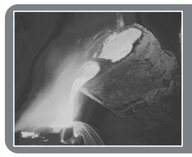
1901

Supporting the Industrial Revolution

Interoperability of fire hose screw threads



Light bulb standards



Standards for Irons and Steels

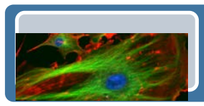
Working with ICC to reduce railway

2015

Advanced communications

Advanced manufacturing

Advanced materials



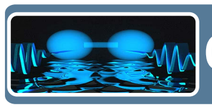
Biosciences

Cyber-physical systems

Cybersecurity

Disaster resilience

Forensic science



Quantum science

Advanced Manufacturing

Building a National Network for Manufacturing Innovation

Today, I'm asking Congress to build on the bipartisan support for this idea . . . creating a network of these hubs and guaranteeing that the next revolution in manufacturing is "Made in America." --July 30, 2013

Current Institutes (Sponsored by DoD and DoE)

- **America Makes** (additive manufacturing) Youngstown, OH
- **Digital Manufacturing and Design Innovation Institute**, Chicago, IL
- **Lightweight Innovations for Tomorrow**, Detroit, MI
- **Power America** (Wide Band Gap Semiconductors) Raleigh, N.C.
- **Institute for Advanced Composites Mfg. Innovation**, Knoxville, TN
- **Integrated Photonics**, New York
- **Flexible Hybrid Electronics Manufacturing Innovation Institute**, San Jose, CA

Coming Soon

- **Clean Energy/Smart Manufacturing**
- **Revolutionary Fibers and Textiles**

NIST Role in NNMI

- **Hosts the Advanced Manufacturing National Program Office that:**
  - Convenes network for collaboration and support among Institutes
  - Provides annual reporting to Congress
  - Shares best practices among Institutes
  - Establishes new Institutes that address private sector needs
- **Providing $11 M split among three of the current institutes** to support measurement science research
- **NIST lab experts are heavily involved in advisory roles and collaborations with Institute researchers**
- **NIST MEP Network linked to NNMI Network** via MOUs, to ensure institute results reach small and medium entities

MEP State Competitions Update

In 2014, NIST initiated a carefully planned, systematic, multi-year recompetition of the national system of Centers.

- Objective: Optimize the impact of the Federal investment on U.S. manufacturing and to allocate additional funds to areas with higher concentrations of manufacturers.
- Goal: Complete competition of the entire 50 State (plus Puerto Rico) national network over three years (by end of 2017)

Round 1 Competition in 10 states (COMPLETED):

- Awards announced February 23, 2015; Start date July 1, 2015
  - CO, CT, IN, MI, NC, NH, OR, TN, TX, VA
- Award Kick-Off Meeting – conducted late July 2015

Round 2 Competition in 12 states

- Competition announced March 2, 2015
- **Awards announced September 21, 2015**; Start date January 1, 2016
  - AK, ID, IL, MN, NJ, NY,OK, WA, WV
  - UT/WI Still under review/negotiations
- Award Kick-Off Meeting – scheduled for December 15-17th

Round 3 Competition in 11 States and Puerto Rico:

- Anticipated publication of FFO - Early January 2016.
  - AL, AR, CA GA, LA, MA, MO, MN, OH, PA, Puerto Rico and VT
- Anticipated Start Date of Awards – July 2016

Round 4 Competition for 11 States:

- Anticipated publication of FFO – July 2016.
  - DE, HI, IA, KS, ME, MT, NV, NM, ND, SC, and WY
- Anticipated Start Date of Awards – January 2017

NIST Programs for Manufacturing

Industry Services

- Hollings **M**anufacturing **E**xt. **P**artnership
- **Advanced Manufacturing Technology Consortia** – grants to industry consortia to identify critical gaps in technology

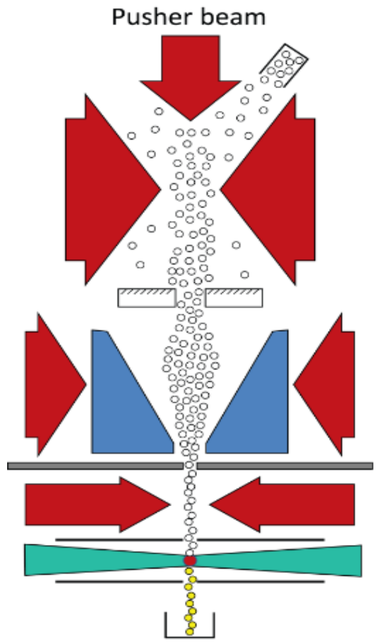
Advanced manufacturing research in NIST Labs

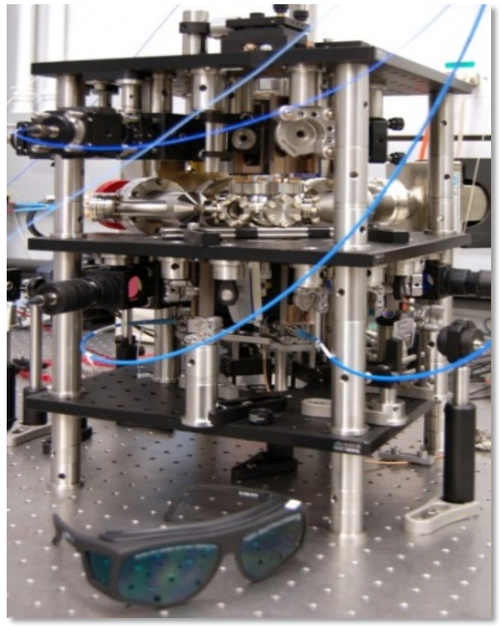
- Advanced Materials
- Smart manufacturing
- 3D Printing/Additive Manufacturing
- Lightweighting
- **Nanomanufacturing**
- Synthetic Biology/Biomanufacturing
- Digital thread (many other fields)

Advanced Manufacturing

Creating new businesses through technology transfer

- Nanomanufacturing requires high precision milling and diagnostics on the nanoscale
- CNST researchers developed new focused ion beam technology based on ***laser cooling*** with higher brightness, better resolution
- Technology patented by NIST, licensed to former CNST postdocs Adam Steele and Brenton Knuffman





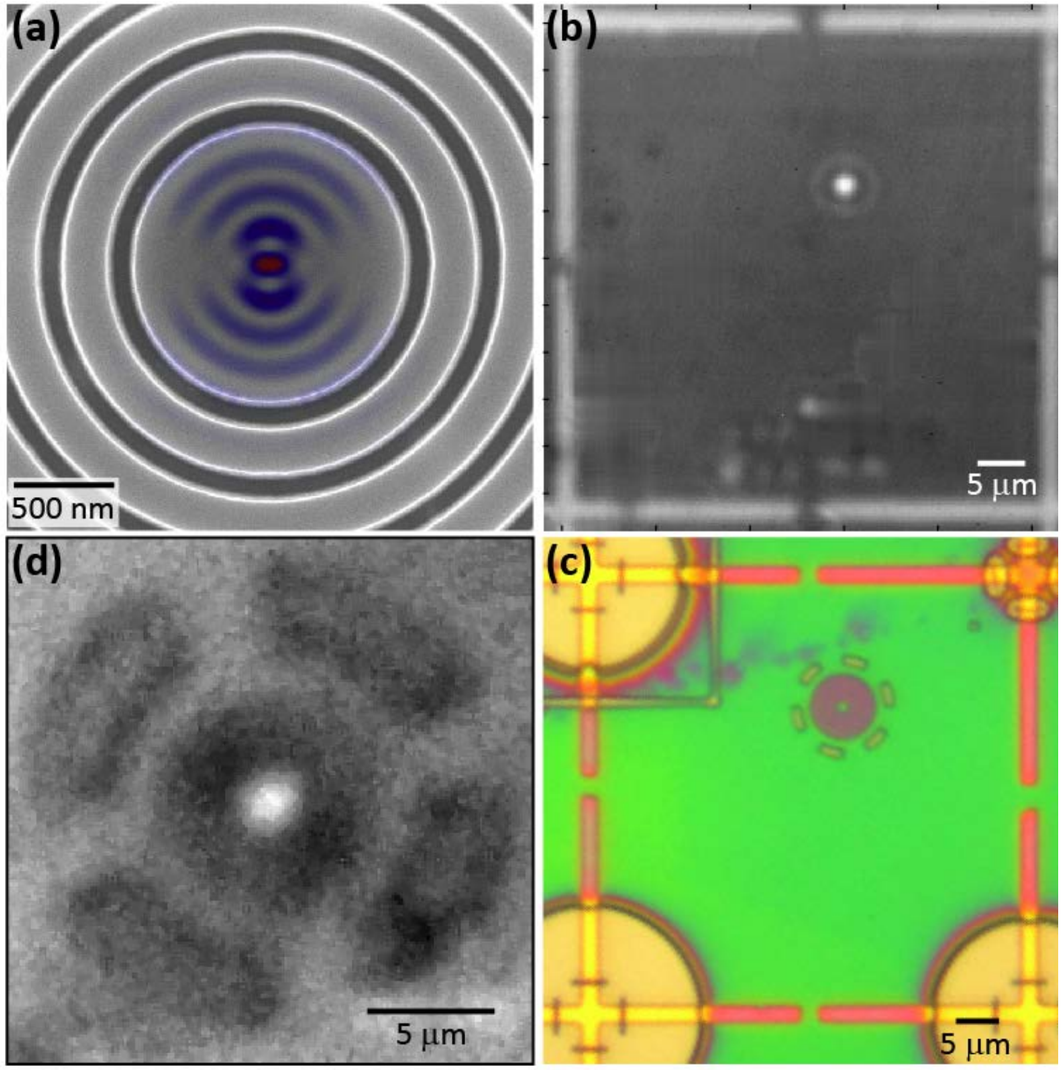
Start-up company launched:

ZERØK NANOTECH

September 2015: zeroK moved into their own space in Gaithersburg with significant funding from corporate sponsorship and NSF SBIR phase II

Jobs created: *Two founders and one PhD physicist hired (so far)*

Nanofabricated quantum dot single photon sources

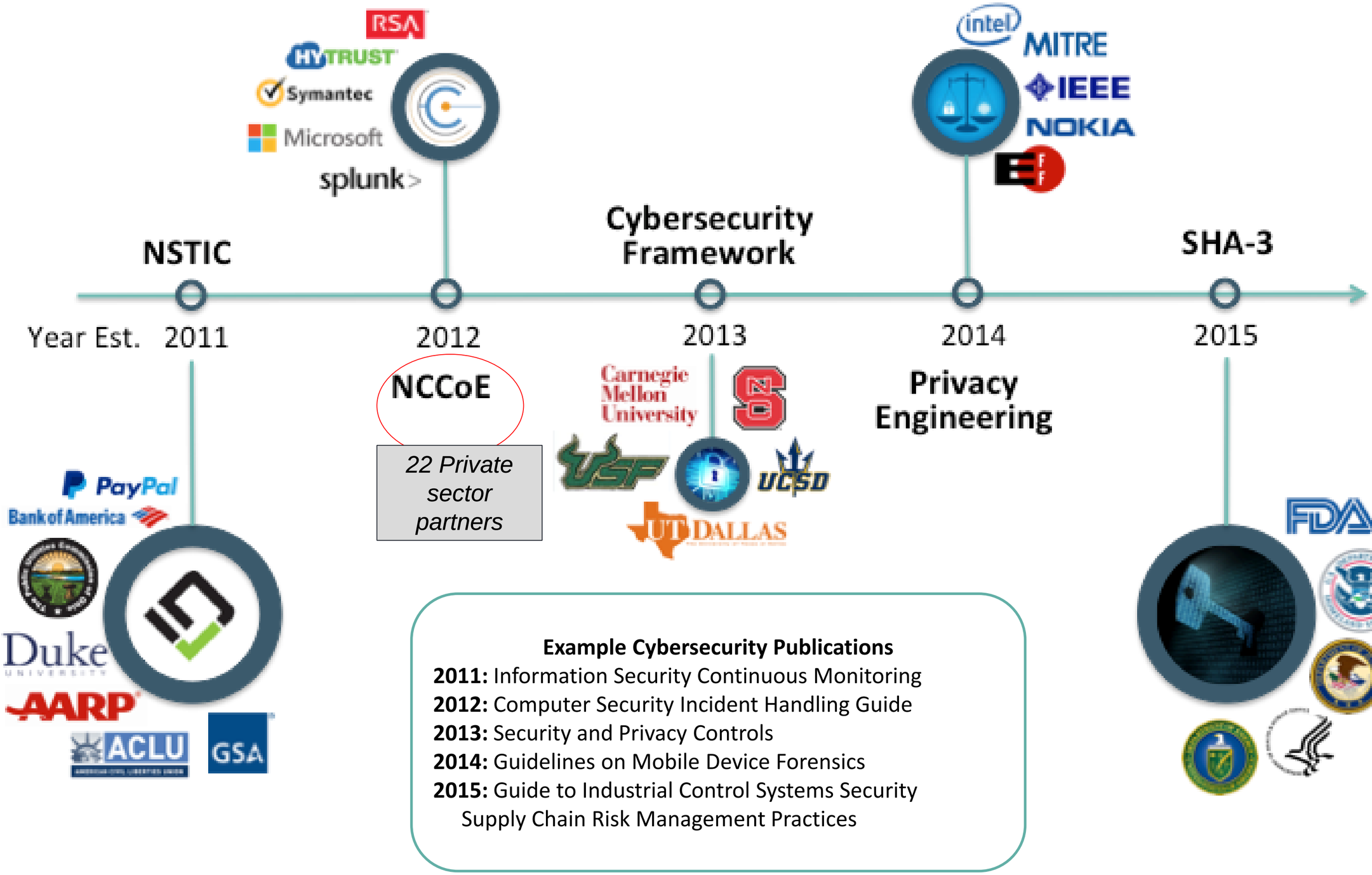


(a) Circular 'bullseye' grating geometry for efficient light extraction; (b) Single semiconductor quantum dot that has been optically located; (c) Lithographically defined grating surrounding the located quantum dot; (d) Completed single photon source

- Single photon source: quantum light source with applications in secure communications, metrology, and quantum computing
- Semiconductor quantum dots: promising solid-state single photon source in a platform compatible with integration and scaling
- Challenge: quantum dots have random spatial location; location information at 100 nm level needed to use photonic elements to extract photons efficiently
- Solution: optical technique to locate single quantum dots with 10 nm uncertainty. Nanofabricate gratings for light extraction once quantum dot positions are known
- Results: source efficiency of 48 % (theoretical limit of 50%); >99% pure single photon emission

Ref: L. Sapienza, M. Davanco, A. Badolato, K. Srinivasan, *Nature Communications*, **6**:7833 (2015) (also see *Tech Beat* article)

Major NIST Cybersecurity Initiatives and Stakeholders



Advanced Communications
Established NIST Communications Technology Laboratory (CTL)

The CTL promotes the development and deployment of advanced communications technologies through the conduct of leading edge R&D on both the metrology and understanding of physical phenomena, materials capabilities, complex systems relevant to advanced communications; and through the conduct of research targeted at supporting a multi-level testbed facility.

Initial Areas of Focus of CTL:

- **Public Safety Communications Research (PSCR)** –Increase PSCR technical staff and enhance the LTE laboratory infrastructure to increase support for public safety communications.

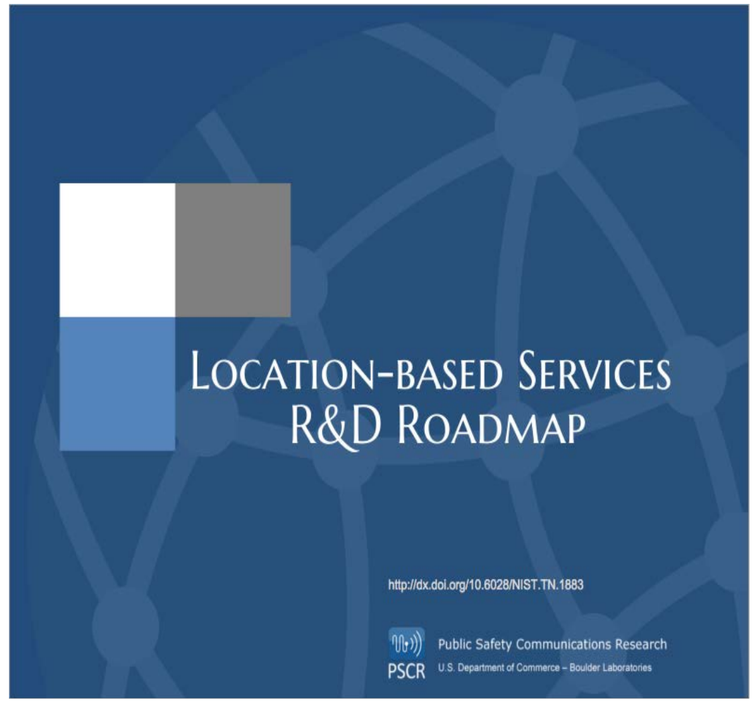
- **Spectrum Sharing** – Develop spectrum sharing metrology, and work through the joint NTIA/NIST Center for Advanced Communications, and the National Advanced Spectrum and Communications Test Network, to create a trusted capability to facilitate spectrum sharing studies, optimize access to engineering capabilities, and engage spectrum users in collaborations.

- **Develop R&D programs** – Work with stakeholders to develop an aggressive R&D program to address longer-term needs, e.g., leading U.S. Government efforts in 5G.

- **The Middle Class Tax Relief and Job Creation Act of 2012 created the First Responder Network Authority** (FirstNet) as an independent entity within the Department of Commerce to provide emergency responders with the first U.S. nationwide, high-speed, broadband network dedicated to public safety.
- **NIST CTL gets $300M to provide the R&D and testing support for FirstNet; $100M now in house**

NIST Develops First Roadmap for Public Safety Communications Research

In May, NIST published a public safety communications research Roadmap, which identifies long-term research topics that support the development of location-based services, which enhance situational awareness for first responders (location of first responders, location of victims, etc.)



The Location-Based Services R&D Roadmap:

- Is based on ideas generated at the 2013 Public Safety Broadband Roadmap Workshop involving 150 participants from the public and private sector

- Identifies critical research in areas such as software & applications, devices, and networks

- Informs how to allocate the $300 million apportioned to NIST from the recent AWS-3 spectrum auction that will support public safety communications research

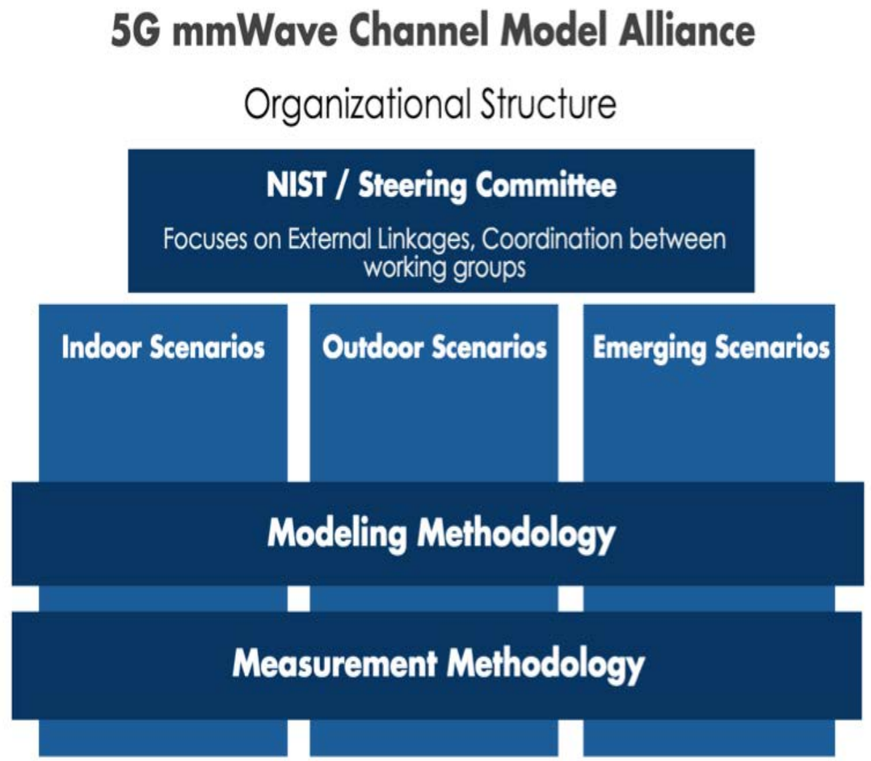
NIST Establishes 5G Millimeter-Wave Channel Model Alliance

NIST has launched the 5G mmWave Channel Model Alliance to provide a forum for supporting the development of more accurate, consistent, and predictive channel models for millimeter-wave communication systems above 6 GHz.

- Development of channel models is needed before commercial wireless communication systems can be deployed.

- The Alliance is composed of over 50 representatives from industry, academia, and government organizations.

- **NIST convened the Alliance's first meeting on July 8-9, in Boulder, to discuss the present state of channel measurement and modeling and to develop plans for the Alliance's organization and future activities.**



National Precision Medicine Initiative

“Doctors have always recognized that every patient is unique, and doctors have always tried to tailor their treatments as best they can to individuals. You can match a blood transfusion to a blood type — that was an important discovery. What if matching a cancer cure to our genetic code was just as easy, just as standard? What if figuring out the right dose of medicine was as simple as taking our temperature?”

President Obama, January 30, 2015

What do we need to know to do to make personalized medicine a reality?

Linking outcome of genomics, proteomics, metabolomics, microbiome measurements to a specific disease state

Ability to put all of these sources together to determine what are most important factors or combination of factors that link to disease and predict outcome of therapies

Big data analytics, models

Providing Confidence in Genomics Measurements: Genome in a Bottle

NIST led consortium with more than 75 public, private, academic partners

- Developing whole genome reference materials and bioinformatics tools for quality assurance of whole genome sequencing technologies (next gen and next/next gen).
- FDA used this to approve the first high-throughput DNA sequencer.

NY Times (5/14/15): ***"The federal government opened a new era of genetic medicine on Thursday by introducing a standard way to ensure the accuracy of DNA tests used to tailor treatments for individual patients."***

Changing Climates: Green House Gas (GHG) Measurement Program

***Problem*: Accurate spectroscopic data** is required for the measurement of greenhouse gas concentration, flux, and modeling of radiative forcing in climate models.

Significant need for SI-traceable and precise laser-based measurement techniques for GHGs as applied to *remote sensing from satellites and aircraft, ground-based atmospheric observation networks, and mobile GHG monitoring systems.*

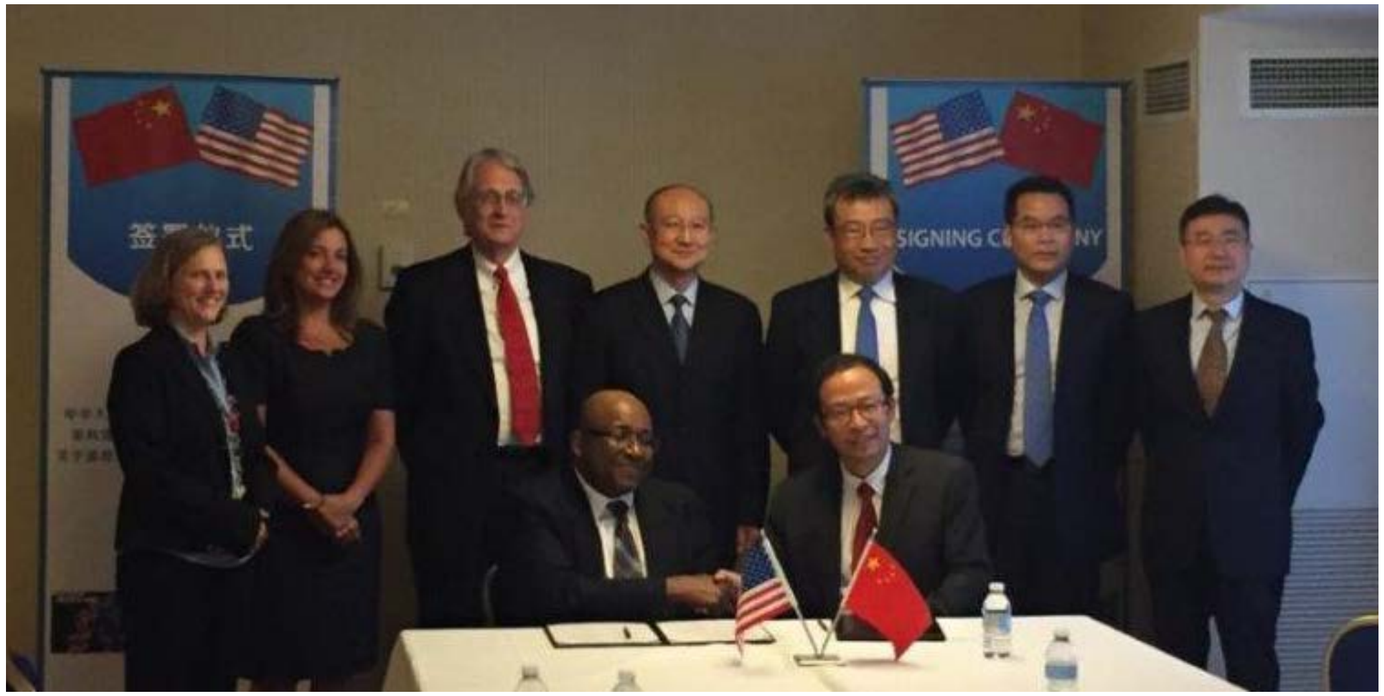
Data to Support the Orbiting Carbon Observatory-2

***NIST Solutions*:**

- Accurate measurement of line-by-line parameters of CO_2, H_2O, O_2 ,CH_4, N_2O
- Measurements lead to 7-fold reduction in uncertainty of O_2 line intensities
- Most accurate (0.1% unc.) measurements of H_2O and CO_2 intensities, used to benchmark theoretical calcs.
- Development of competitive technology for deployable, stable, precise and accurate atmospheric CO_2 monitors

Customers and Partners

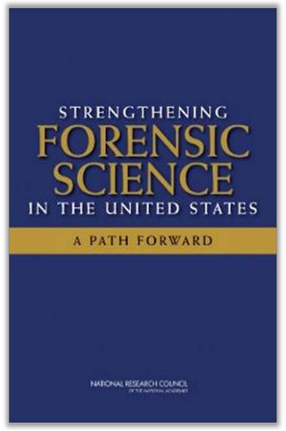
NIST and NMI-China sign a Statement of Intent to Cooperate on Standards for Green House Gas Measurements and Precision Medicine



Signing Ceremony, DC on Sept. 22, 2015

NIST Director and NIM Director Xiang Fang signed Statement of Intent in the presence of AQSIQ Minister Zhi Shuping

Strengthening Forensic Science in the U.S.



National Commission on Forensic Science (NCFS)

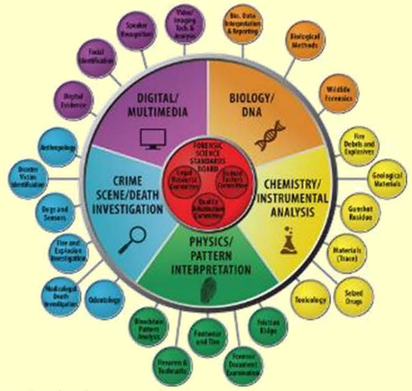
Department of Justice FAC co-led by NIST

Policy-focused

http://www.justice.gov/ncfs

Organization of Scientific Area Committees (OSAC)

Organization of OSAC Scientific Area Committees for FORENSIC SCIENCE



NIST-administered

Establishing standards and best practices

http://www.nist.gov/forensics/osac.cfm

NIST Funded Internal Research Programs

NIST FORENSIC SCIENCES

~$7.5M/year invested

NIST Forensic Science Center of Excellence

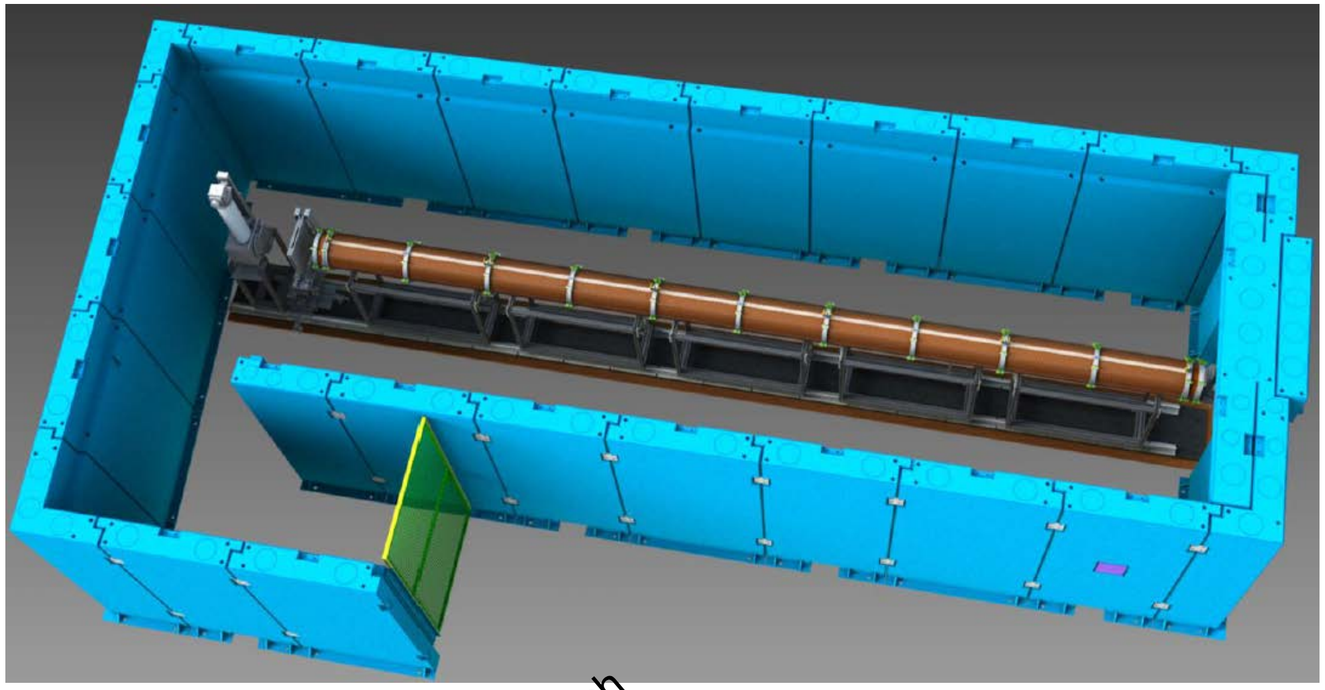
IOWA STATE · CARNEGIE MELLON UNIVERSITY · UNIVERSITY OF CALIFORNIA IRVINE · UNIVERSITY OF VIRGINIA

CoE: ~$4M/year invested for 5 years (2015-2020)

International Symposium on Forensic Science Error Management

www.nist.gov/director/orals.cfm

Cold neutron imaging instrument

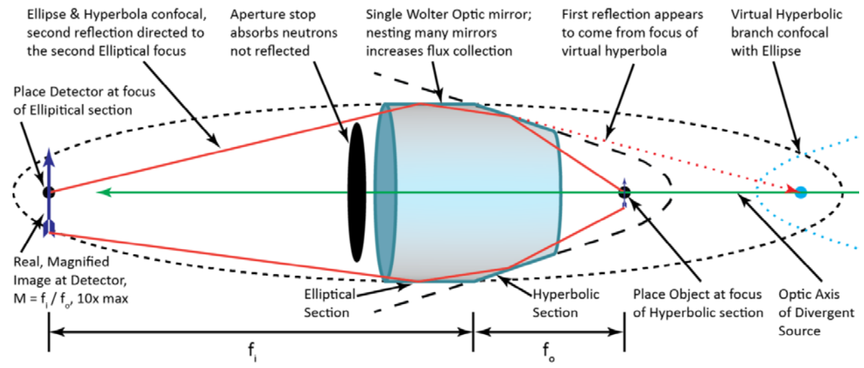


Bragg edge imaging (e.g. strain mapping)

Higher sensitivity & better contrast than thermal neutron imaging

Neutron microscope (NIST-IMS project) to be installed on cold neutron imaging instrument

Microscope based on Wolter Optics (used on Chandra X-Ray telescope)



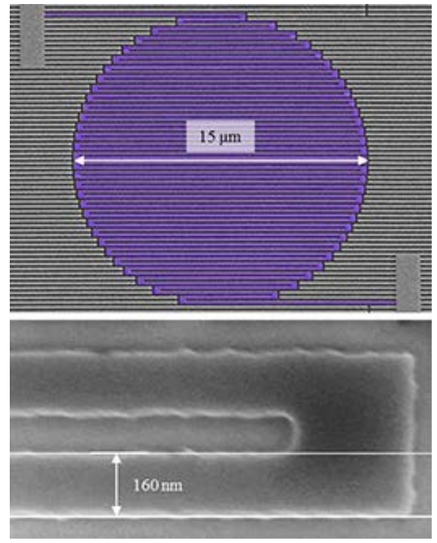
100× increase in time resolution at 10 μm enables

- 2D imaging of transient processes
- Rapid 3D tomography

Radiograph with 1 μm resolution in 2-20 minutes

Quantum Teleportation over 100 km of Optical Fiber

- Quantum “teleportation” means faithfully recreating
  a complex quantum-mechanical state at a distance
- Teleportation is potentially useful in both quantum communications and quantum computing
  - For unbreakable encryption and advanced code-breaking, respectively
- NIST smashed record distance for teleportation through an optical fiber: 4x, to 100 km
- Key enabling technology is new, novel photon detector
  - Superconducting nanowires made of molybdenum silicide
  - Patent prosecution in progress

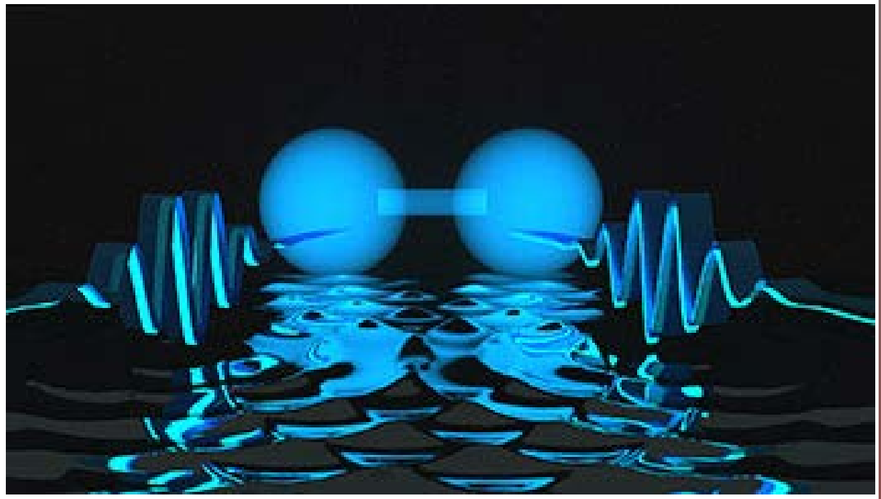


Novel, Efficient, Polarization Independent, Single Photon Detector

Enabling technology for record quantum teleportation. Fast detector, able to count nearly a billion photons per second, with a low dark rate (false counts).
U.S. Patent Application 20140087952A1.

“Molecules” Made of Light

- Forces between photons are extraordinarily weak
  - Beams of light can intersect without affecting each other
- In 2013, researchers at Harvard and MIT (including current NIST researcher / JQI Fellow Alexey Gorshkov) realized an exception to this rule:
  - Photons in a certain type of non-linear, quantum medium can act ***as if*** there is a force of attraction between them
- In a recent paper, these researchers further refined the theory:
  - Photons can be made to travel side by side, a specific distance from each other, like atoms in a molecule
- Full implications of this not yet known
  - Light with the ability to both communicate and control expands the toolbox for innovation in photonics



Researchers show that two photons, depicted in this artist’s conception as waves (left and right), can be locked together at a short distance. Under certain conditions, the photons can form a state resembling a two-atom molecule, represented as the blue dumbbell shape at center.

Topics: NIST Update

- Safety and Site Security Update
- Update on Director's Priorities
- NIST Budget Status
- Selected Staff Awards/Achievements
- Strategic Research and Programmatic Updates
- Discussion Topic: External NIST Reviews
- Agenda Review

External NIST Reviews

- NIST has three complementary methods for external review

  – **Visiting Committee on Advanced Technology (VCAT)**
    - *What should NIST currently be doing in response to its Mission?*

  – **National Research Council (NRC) Board on Assessment**
    - *What is the quality of the research being carried out in each Laboratory Organization in support of the NIST Mission*

  – **International Peer Review of NIST Measurement Services**
    - *Review by International Peers of the quality of the measurement services being delivered by NIST*

Regarding NIST External Reviews

Discuss:

Begin focusing a VCAT Meeting on Analysis of NRC Panel and International Measurement Services Feedback/Reports?

- *Suggest beginning with the VCAT Fall Meeting of 2016 and every 4 years thereafter*

Topics: NIST Update

- Safety and Site Security Update
- Update on Director's Priorities
- NIST Budget Status
- Selected Staff Awards/Achievements
- Strategic Research and Programmatic Updates
- Agenda Review

Further Questions/Discussion??

VCAT Webinar Meeting Agenda: October 6, 2015

Overview and Safety

9:30 am	Call to Order, Roberto Padovani, VCAT Chair
9:40 am	NIST Update and Agenda Review, Willie E. May, Under Secretary of Commerce for Standards and Technology and NIST Director
11:00 am	Safety Update, Richard Kayser, Chief Safety Officer
11:20 am	Break

NIST Partnerships

11:30 am	Context Setting and Follow-up on Bio and IT Research Portfolios Willie E. May, Under Secretary of Commerce for Standards and Technology and NIST Director Laurie Locascio, Director, Material Measurement Laboratory (MML) Jim St. Pierre, Deputy Director, Information Technology Laboratory (ITL)
12:00 pm	Evolution of NIST Partnerships, Jason Boehm, Director, Program Coordination Office
12:15 pm	Partnership Model: Joint Initiative for Metrology in Biology (JIMB), Marc Salit, Leader, Genome-Scale measurements Group, MML Drew Endy, Associate Professor of Bioengineering, Stanford
1:00 pm	Lunch
1:30 pm	Partnership Model: Centers of Excellence, Jason Boehm, Director, Program Coordination Office Center for Hierarchical Materials Design (CHiMad), Eric Lin, Chief, Materials Science and Engineering Division, MML Peter Voorhees, Co-Director CHiMad
2:15 pm	Partnership Model: NIST Labs working with the National Network of Manufacturing Institutes, Richard Cavanagh, Acting Associate Director for Laboratory Programs (ADLP)
3:00 pm	Break
3:10 pm	Partnership Models: JILA & Joint Quantum Institute (JQI), James Olthoff, Director, Physical Measurement Laboratory (PML)
3:55 pm	VCAT Administrative Business
4:15 pm	Meeting Adjourn