SAA NEWSLETTER

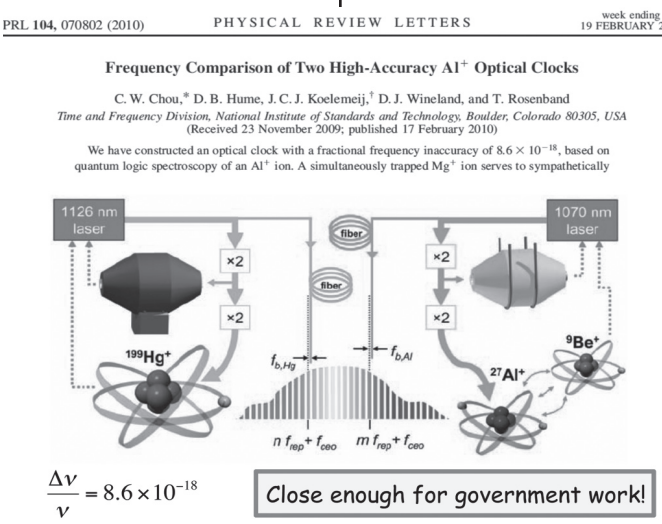
Standards Alumni Association
National Institute of Standards and Technology
<http://www.nist.gov/director/saa>
Celebrating Our First 25 Years!
Founding President: Churchill Eisenhart (1913-1994)

Vol. 26, No. 4 **December 2010**

NBS and the Laser

On the 50th Anniversary of the Laser

The sixth annual Historical Lecture, cosponsored by the NIST Colloquium Series and the SAA, was held on Friday, December 3, in the Green Auditorium. As this year marks the fiftieth anniversary of the development of the laser, there is a world-wide, year-long celebration of its discovery and the remarkable impacts it has had on science, technology, manufacturing and everyday life. This lecture, comprising two talks on some of the more exciting laser work at NIST, was presented by Dr. Howard P. Layer and Nobel laureate William D. Phillips* as a part of Laserfest**, as the celebration is called. Layer worked for many years on fundamental length standards at NBS/NIST and lasers are critical to atomic trapping and manipulation—the area in which Phillips has worked since joining NBS. They were introduced by William Ott, the colloquium coordinator.


PRL 104, 070802 (2010) PHYSICAL REVIEW LETTERS week ending 19 FEBRUARY 2010

Frequency Comparison of Two High-Accuracy Al^+ Optical Clocks

C. W. Chou,* D. B. Hume, J. C. J. Koelemeij,† D. J. Wineland, and T. Rosenband
Time and Frequency Division, National Institute of Standards and Technology, Boulder, Colorado 80305, USA
(Received 23 November 2009; published 17 February 2010)

We have constructed an optical clock with a fractional frequency inaccuracy of 8.6×10^{-18}, based on quantum logic spectroscopy of an Al^+ ion. A simultaneously trapped Mg^+ ion serves to sympathetically

$\frac{\Delta\nu}{\nu} = 8.6 \times 10^{-18}$

Close enough for government work!

The talks were excellent and exciting, with just the right balance of qualitative description to make them informing and thought-provoking to those in the audience.

Layer spoke first, beginning by describing the historical problem of metrology—namely what is the most stable practical means of defining measurement units. He gave several examples of historical standards of length—the Egyptian cubit, a medieval rod and the meter bar. In an essay written in 1863 for the Leeds Astronomical Society, Sir John F. W. Herschel proposed three possibilities for a length standard not based on the dimensions of an object. Two involved light—one its velocity and the other its wavelength. However, it was a long time before the means of working on them were available.

Meanwhile physics was advancing, building on the work in interferometry. In 1960, the definition of the meter was changed, for the first time to be couched in terms of light properties. It was tied to the wavelength in vacuum corresponding to the transition between two specified energy levels in the krypton-86 atom. At last, the meter did not depend upon the properties of an artifact, or object.

Coincidently the laser arrived. Invented at Hughes Research Lab by Theodore Maiman, it brought the advantages of coherency of output and frequency stability to the lab. This and the invention of the metal-insulator-metal diode made it feasible to measure optical laser frequencies with respect to the then-primary U.S. frequency standard, NBS-5, using beat-frequency techniques. One critical result was a 1972 NBS speed-of-light measurement by Evenson, Wells, Peterson, Danielson, Day, Barger and Hall. This improved the accuracy of *c* by a factor of 100 and, with other measurements—including one by Bay, Luther and White—yielding equivalent results, led to the international use of 299 792 458 m s^{-1} exactly for its value. Further work at NBS by Layer, DeLattes and Schweitzer tied the iodine laser optical frequencies to those of cesium clocks with increasing accuracy.

All of this made possible a new definition of the meter as "the length of the path travelled by light in free space during a time interval of 1/299 792 458 of a second" in 1983, which resulted in the adoption of the above value of the speed of light. Since that time frequency standards have improved, also owing to laser technology, such that

CONTENTS

now the best have stabilities of about one in 10^{17}, or about a second in 3.7 billion years. And so length measurements, critical to so many things in industry, transportation and science, will continue to improve. Optical frequency combs, discussed by Phillips in his talk, provide an excellent connection of length measurements to frequency.

Phillips then took over the podium. He proceeded to trace the use of lasers at NBS/NIST in atomic physics research, concentrating on atom trapping. In 1978 he was a post-doctoral fellow at M.I.T. and saw a paper by Ashkin of Bell Labs, proposing trapping atoms using lasers and radiation pressure. Also that year, Wineland, Drullinger and Walls of NBS reported the first observation of optical radiation-pressure cooling, this of magnesium ions in a Penning trap. They had cooled the ions to an average velocity corresponding to a temperature far below 1 K. This was of great interest to the scientists in the Time and Frequency Division. Their clocks, although best in the world, were limited in accuracy by the high velocity of their beam atoms. These papers motivated Phillips to try to cool neutral atoms, something never before done.

Later that year Phillips joined NBS. He and his colleagues John Prodan and Harold Metcalf reported using the Zeeman effect and optical cooling to stop sodium atoms in 1982. A few years later, Ertmer, Blatt, Hall and Zhu in Boulder demonstrated stopped atoms using a laser frequency-changing method. In 1985 came the first observation of neutral atoms trapped magnetically (Migdall, Prodan and Phillips). Also that year Steven Chu (the present Secretary of Energy) and his Bell Labs colleagues measured a temperature in sodium atoms of 240 μK, the calculated limit for Doppler cooling.

Phillips and his NBS colleagues decided to take a closer look. This led to a 1988 paper reporting atoms cooled below this Doppler limit, to a temperature below 100 μK (Lett, Watts, Westbrook and Phillips). In 1995 Kastburg, Phillips, Rolston and Spreeuw reported cooling of cesium to 700 nK. This work and that of others around the physics community led to the development at NIST of atomic fountain clocks, the most stable in the world (Jeffert, Donley, and Heaver).

In 1924, Einstein used the new quantum statistics of S. Bose to predict that at low temperatures and high density an ideal gas of bosonic atoms would undergo a phase transition—Bose-Einstein condensation (BEC). Beginning in the mid 1970s atomic physicists began to pursue BEC seriously. In 1990 Phillips and colleagues briefly thought they had seen this occur. What they did see was an optical lattice, an effect predicted in 1968 by Letokhov. This was later used by Jun Ye and others in Boulder to make neutral-atom clocks.

In 1995 Eric Cornell (NBS) and his colleague Carl Wieman of the University of Colorado used the laser-cooling ideas developed in Gaithersburg to make a magnetic trap, added novel evaporative cooling, and demonstrated BEC of rubidium, resulting in their 2001 *Nobel Prize*. Seeing BEC in Boulder excited more new research. In 1999 DeMarco

and Jin demonstrated the onset of degeneracy in a trapped Fermi gas. In 2003 Greiner, Regal and Jin demonstrated a molecular BEC. Research went in many other directions.

In 2005 Jan Hall shared the *Nobel Prize* with Hänsch and Glauber for the development of laser-based precision spectroscopy, including the development of the optical comb. The optical comb has provided a critical tool for linking the frequencies of optical and radio clocks, thus allowing continuity in the progression to ever-more-stable clocks. The most recent of these involve quantum logic, another field made feasible by the unique properties of lasers. (David Wineland was awarded the 2007 National Medal of Science for his laser cooling and quantum logic work).

Phillips ended his talk by mentioning that the new clocks are so stable that they can be used to see relativistic time dilation with altitude changes smaller than a meter.

The above are only snippets of two very interesting talks! Together they provided a glimpse into the rich history of laser-based research at NBS/NIST, an area in which our agency has become arguably the world's best—a great tribute to the NIST culture of doing things right!

—Norm Belecki, Ed Williams

*Phillips shared the 1997 Nobel Prize in Physics with Steven Chu of Stanford and Claude Cohen-Tannoudji of the Collège de France and the École Normale Supérieure, Paris for their contributions to atom trapping.
**See more on Laserfest at <http://www.laserfest.rog>.

1. MESSAGE FROM PRESIDENT RAUFASTE

My message for this issue centers on our honoring Hans Oser for his many contributions to our organization as a member, SAA vice president and president and, during the past 11 years, the SAA's chief operating officer (COO). Hans has continually advanced the SAA and kept its operations running smoothly. He spent three days per week, 52 weeks a year, for 11 years serving as our COO. This was no small job, as we—the elected SAA officers and volunteers—have learned this year from the "List of Office Duties" Hans generated in preparing for his retirement on the 6th of December. Several board members agreed that over the years we have taken Hans for granted. After each board meeting we just asked him to follow through on decisions made at the meeting—and he did because he was good at his job. We have now begun reassigning some of his duties to the relevant SAA committees.

As perhaps with our parents, we took Hans for granted. When our parents left us we were expected to become adults. So it is with Hans' retirement—the rest of us are assuming greater responsibilities and becoming adults.

Hans took pride in doing his best for any task assigned. It was this dedication that helped advance the SAA to where it is today. I suspect most of us thought, "Don't worry, Hans can do it; he can do anything."

While no one yet has agreed to step up to the plate as Hans' successor, we are fortunate that Edgar Etz, Henri Mitler, and Anne Goldberg agreed to fill-in part time. The SAA board and I thank them. I ask for others who are reading this message to consider volunteering for the position of SAA COO, while pointing out that the amount of work entailed has been significantly reduced by much of it having been spun off into the committees' duties.

It has been our good fortune to work with Hans Oser, a colleague and friend. He will be missed personally and professionally. Hans, your leadership as an active SAA member and as our Chief Operating Officer has been well recognized and treasured! And we all thank you for your hard work!

2. JANUARY 20 QUARTERLY MEETING

If you were around NIST during the 1990s, you will certainly remember the Advanced Technology Program (ATP)—the largest extramural program ever at NBS/NIST. The ATP grew rapidly during its first few years. But, in spite of strong evidence that the program was creating economic benefits for the nation, it became the subject of considerable political controversy and was phased out.

However, innovative extramural R&D is not dead at NIST! Created in 2007 as part of the America COMPETES Act, the Technology Innovation Program (TIP) is a relatively new major extramural program with a number of unique features. Its mission is quite different from that of the ATP. Because the TIP's mission was intentionally designed to engender bipartisan support, it has avoided political controversy so far. Given this program's importance to NIST, every SAA member should be familiar with its features.

The Technology Innovation Program offers competitive, cost-shared funding to U.S. businesses, institutions of higher education and other organizations, such as national laboratories and nonprofit research institutions, to support, promote, and accelerate innovation in the U.S. through high-risk, high-reward research in areas of critical national need. The TIP carries out rigorous and thorough technical evaluations of proposals, careful project monitoring and in-depth study of the benefits that result, as did the ATP. The areas it supports need government attention because the magnitude of the problem is large and societal challenges are not being sufficiently addressed. In 2008 and 2009, TIP made 29 awards to support projects of this kind in two areas of critical need:

- Advanced sensing technologies for the civil infrastructure (17 projects); and
- Manufacturing processes for advanced materials such as nm-scale materials, composites, smart materials and alloys/super alloys (12 projects).

Over the three- to five-year life of these projects, TIP will have committed approximately $234 million in inno-

(continued on next page)

vative R&D ($114 million from TIP; $120 million from awardees). In late 2010, TIP expects to award an additional $25 million in first-year funding for new projects in manufacturing and bio-manufacturing.

Our speaker for this meeting, Dr. Lorel Wisniewski, currently serves as acting director for TIP. She has been its deputy director since the program's inception in 2007, and was deputy director of the Advanced Technology Program from 2005 through 2007. Wisniewski joined the ATP as supervisory economist in the ATP Economic Assessment Office in December 2003.

Before joining NIST, Dr. Wisniewski spent over ten years as principal in an economic-consulting firm in Washington, DC, and previously managed compensation for a large HMO. She spent three years as staff economist and manager of the statistical department for a trade association in the electric-power industry, and nearly ten years conducting economic analysis in the telecommunications industry. She has taught economics at American University and Trinity College. Her career began as a federal junior fellow at NASA Goddard Space Flight Center.

Dr. Wisniewski earned a Ph.D. in economics from American University in 1999. She also has an M.A. in economics from The George Washington University and a B.A. in economics from Franklin & Marshall College.

Unless you are familiar with TIP, you cannot claim to be fully informed about today's NIST, so be sure to turn out for this quarterly meeting. (In the event that NIST is closed for snow on January 20, the talk will be rescheduled for the following Thursday, January 27 and will be held in a conference room to be announced—check the display in the lobby.)

The schedule for Thursday, January 20, is:

11:00 a.m. Lecture Room B
NIST's Technology Innovation Program
Dr. Lorel Wisniewski, Acting Director, TIP

12:15 Lunch in the NIST Cafeteria

(There will be no lab tour associated with this presentation.)

—Brian Belanger

3. THE OCTOBER 21 QUARTERLY MEETING

The attendees at the October 21st SAA quarterly meeting were impressed by the wide range and sophistication of NIST's work in advancing the state of robotics through measurements and standards. Our speaker was Ms. Elena Messina, Group Leader – Knowledge Systems, Intelligent Systems Division. (That division is now part of NIST's new Engineering Laboratory. See the previous *SAA Newsletter* for a complete biographical sketch for Ms. Messina.)

Robotics is at the intersection of computer technology, sensor technology, and complex moving physical systems. Manufacturing is a natural application for robotics, and NIST has made important contributions to manufacturing automation for several decades. However, there are many other applications of this technology receiving attention today. Military applications and disaster search-and-rescue uses are just two examples of robotics areas to which NIST's expertise is being applied. NIST carries out work for other Federal agencies, such as the Defense Advanced Research Projects Agency, the Army Research Laboratory, the Department of Homeland Security and the Department of Transportation. The focus is on the measurement and standards challenges that arise from progress in this field. The Intelligent Systems Division zeroes in on issues related to measurements, interoperability, and safety and security for intelligent robots, automation, and control systems. A key concern today is to develop robots that are more flexible and adaptable—robots that can easily be reprogrammed to do new tasks rather than just one repetitive operation. A long-term goal is to create robots that can sense their environment, exercise judgment and work collaboratively with human workers.

Before one can develop meaningful tests for robotic systems, the desired performance level must be specified. Parameters—how much weight a robot can lift or how precisely it can place an object in a desired location—are fairly easy to quantify, but other characteristics, such as safety performance, are more difficult to evaluate. Today most robots operate behind fences, with the barriers interlocked so that the robot will shut down when a person enters the work area. In the future, robots may share a factory environment with humans, and so safety becomes a critical concern. Can robots be developed that will recognize when a human enters the robot's work zone and react accordingly? What kinds of test methods and standards will be needed to ensure safety under those conditions?

Interoperability standards are also important. A factory might like to purchase robots from more than one company, but if each manufacturer uses a proprietary system, that creates problems. "Plug and play" capability is desirable. Given that companies *claim* that their products are interoperable, what kinds of tests are needed to verify that they really are? There is clearly a role in this for NIST, with its neutral third-party objectivity.

Today one must also be concerned about hackers getting into an automated factory or plant and introducing malicious code. NIST's computer-security expertise is valuable here.

Companies desire adaptability. Traditionally robots have been used for highly repetitive operations. Robots are needed that can easily switch from performing one task to performing a different task without the need for elaborate reprogramming, testing and tweaking.

There are some tasks for which robots are the only solution, for example, in μm-scale manufacturing where the units being made are so tiny that no human operator could

have the fineness of dexterity required to perform the operation repetitively.

Ms. Messina described a company in Baltimore called Marlin Steel Wire Products. This company manufactures custom steel mesh items. They transitioned from making baskets to hold bagels to serving a variety of industries with custom solutions for holding products and in-process parts: anything from baskets used in operating rooms to stowage for telecommunications wire. By using modern flexible robotics technology this company has been highly successful—even selling products to China. Their factory can make small batches of items without extensive retooling, and this enables the company to be competitive in world markets. The company has expanded and hired more workers because of their adoption of robotics. NIST's work helps small companies such as Marlin utilize robotics technology successfully.

Robots with autonomous navigation capability would have advantages. Such a robot must have a built-in map of the environment in which it finds itself and the ability to move from one place to another without bumping into machinery or into people and injuring them. That means very sophisticated sensors are needed and the robot's "brain" must have decision-making capability. If a robot could understand verbal commands, that would further increase its value. Perhaps the day will come when a worker will say to a robot, "Go to the storeroom. Bring me a half-inch OD copper pipe elbow." When that day comes, NIST will probably be asked to help develop standard test methods to verify that the robot can carry out such a task accurately and safely.

NIST is also working on simulation systems that can be used by researchers to check out new control algorithms. Once things appear to be working well in the simulation, then tests can be done using the actual physical hardware.

Ms. Messina showed some fascinating videos of robotics competitions. For example, in a search and rescue competition, robots must travel over simulated piles of debris without tipping over and becoming stuck. Just a few years ago this would have not been feasible. Today robots can perform such tasks successfully.

Question and answer session:

Q: What about economics? Robots are expensive to purchase. Unlike human workers, you cannot lay them off temporarily when there is a slowdown in business.
A: Yes, robots are expensive. However, with robots you save health care and pension costs. Each factory must consider these trade-offs. One can certainly find examples of how judicious use of robotics can lead to success, such as the example I cited earlier of Marlin Steel Wire, where the business grew and the company hired more workers than would have been the case without robotics.

Q: How does your division recruit new talent?
A: Budgets have been flat for quite some time, so there has been essentially no hiring, even though we would like to add some younger people to our team. There are several universities turning out graduates with good skills in robotics, such as Carnegie Mellon, M.I.T., Stanford, Georgia Tech, and Case Western.

The Administration is interested in robotics. The U.S. has lost its lead in the field such that today there are few industrial robots produced in the United States. Japan is doing much better than the U.S. The FY 2011 Federal budget may include some new research funding for robotics and advanced manufacturing.

Q: Two questions: Why did the U.S. lose its robotics industry? Aren't there social issues associated with encouraging the use of robotics, because that may result in workers losing their jobs?
A: It is difficult to determine exactly what caused this industry to migrate off shore. The U.S. has traditionally shunned industrial policy, whereas federal governments in other nations often give a high priority to industrial policy (MITI in Japan, etc.). At the time that our robotics industry began to lose ground to Japan, labor rates in Japan were lower than in the U.S. The European Union has invested in robotics research. Tax policy also impacts these situations.

Yes, there are social issues associated with robots doing jobs that might have been done by humans in the past. During the Industrial Revolution many workers were replaced by machines, nevertheless, the industrial revolution created huge economic growth and much wealth for the nations that embraced it. Nations that did not embrace machines were left behind.

There are applications of robots that can enhance our quality of life. Today there is interest in medical robots and robots that can help care for elderly people.

After lunch eight of the attendees followed Ms. Messina to the Shops Building to see NIST's robotics test bed, where research on safety provisions is underway. We saw a robot performing a task slow down when an object approached, and stop when the object entered its work space.

The attendees were suitably impressed with the progress that has been made in this field and the importance of the work currently underway at NIST.

—Brian Belanger

The following SAA members and guests attended the October meeting:

Karma Beal
Brian Belanger
James Comas
Sam Coriell
Edgar Etz
Charles Interrante
Ralph Krause
Suzanne Law
Stanley Meiselman
Janet Miller
Henri Mitler
Hans Oser
Richard Rhorer
Summerfield Tillett
Reeves Tilley
Ralph Veale

4. NEWS OF NIST

Technical News

New Physics from Graphene Quartet's Quantum Harmonies

Using a one-of-a-kind instrument designed and built at the Center for Nanoscale Science and Technology (CNST), an international team of researchers has unveiled a quartet of graphene's electron states. They also discovered that electrons in graphene can split up into an unexpected and tantalizing set of energy levels when exposed to extremely low temperatures and extremely high magnetic fields. Published in the September 9, 2010, issue of *Nature**, this new research raises several intriguing questions about the fundamental physics of this exciting material and reveals new effects that may make graphene even more powerful than previously expected for practical applications.

Graphene is one of the simplest materials—a single-atom-thick sheet of carbon atoms arranged in a honeycomb-like lattice—yet it has many remarkable and surprisingly complex properties. Measuring and understanding how electrons carry current through the sheet is important to realizing its technological promise in wide-ranging applications, including high-speed electronics and sensors. For example, the electrons in graphene act as if they have no mass and are almost 100 times more mobile than in silicon. Moreover, the speed with which electrons move through graphene is not related to their energy, unlike materials such as silicon where more voltage must be applied to increase their speed, which creates heat that is detrimental to most applications.

A CNST team led by **Joseph Stroscio** of the Electron Physics Group recently constructed the world's most powerful and stable scanning-probe microscope, with an unprecedented combination of low temperature (as low as 10 millikelvin, or 10 thousandths of a degree above absolute zero), ultra-high vacuum and high magnetic field. In the first measurements made with this instrument, the team has used its power to resolve the finest differences in the electron energies in graphene, atom-by-atom.

Because of the geometry and electromagnetic properties of graphene's structure, an electron in any given energy level populates four possible sublevels, called a "quartet." Theorists have predicted that this quartet of levels would split into different energies when immersed in a magnetic field, but until recently there had not been an instrument sensitive enough to resolve these differences. The experiment, according to the research team, revealed unexpected complex quantum behavior of the electrons in a high magnetic field at extremely low temperatures. The electrons apparently interact strongly with one another in ways that affect their energy levels.

One possible explanation for this behavior, the team says, is that the electrons have formed a "condensate" in which they cease moving independently of one another and act as a single coordinated unit. If so, the work could point the way to the creation of smaller, very-low-heat-producing, highly energy efficient electronic devices based upon graphene.

In addition to Stroscio, the team includes **Shaffique Adam**, **Young Jae Song** and **Mark Stiles**, also from the Electron Physics Group, and researchers from the University of Maryland, Seoul National University, the Georgia Institute of Technology and the University of Texas at Austin.

** Y.J. Song, A.F. Otte, Y. Kuk, Y. Hu, D.B. Torrance, P.N. First, W.A. de Heer, H. Min, S. Adam, M.D. Stiles, A.H. MacDonald and J.A. Stroscio. High resolution tunneling spectroscopy of a graphene quartet. *Nature*. Sept. 9, 2010.

Source: NIST *Tech Beat*, September 14, 2010.

Changing the Color of Single Photons

Researchers **Matthew Rakher** and **Kartik Srinivasan** of the Center for Nanoscale Science and Technology, **Oliver Slattery** and **Xiao Tang** of the Applied and Computational Mathematics Division, and Lijun Ma, a contractor in the latter division, have demonstrated for the first time the conversion of near-infrared 1,300 nm wavelength single photons emitted from a true quantum source, a semiconductor quantum dot, to a near-visible wavelength of 710 nm. The ability to change the color of single photons may aid in the development of hybrid quantum systems for applications in quantum communication, computation and metrology.

Two important resources for quantum information processing are the transmission of data encoded in the quantum state of a photon and its storage in long-lived internal states of systems like trapped atoms, ions or solid-state ensembles. Ideally, one envisions devices that are good at both generating and storing photons. However, this is challenging in practice. While typical quantum memories are suited to absorbing and storing near-visible photons, transmission is best accomplished at near-infrared wavelengths where information loss in optical fibers is low.

To satisfy these two conflicting requirements, the researchers combined a fiber-coupled single photon source with a frequency up-conversion single photon detector. Both developed at CNST, the frequency up-conversion detector uses a strong pump laser and a special non-linear crystal to convert long wavelength (low frequency) photons into short wavelength (high frequency) photons with high efficiency and sensitivity.

According to Rakher and Srinivasan, previous up-conversion experiments looked at the color conversion of highly attenuated laser beams that contained less than one photon on average. However, these light sources still exhibited "classical" photon statistics exactly like that of an unattenuated laser, meaning that the photons are organized in such as way that at most times there are no photons while at other times there are more than one. Secure quantum communications relies upon the use of single photons.

"The quantum dot can act as a true single photon source," says Srinivasan. "Each time we excite the dot, it subsequently releases that energy as a single photon. In the past, we had little control over the wavelength of that photon, but now we can generate a single photon of one color on demand, transmit it over long distances with fiber optics, and convert it to another color." Their paper* describes how the wavelength conversion of the photons improved their detection sensitivity by a factor of 25 with respect to what was achieved prior to conversion.

*M. T. Rakher, L. Ma, O. Slattery, X. Tang, and K. Srinivasan. Quantum transduction of telecommunications band single photons from a quantum dot by frequency upconversion. *Nature Photonics*. Published online Oct. 3, 2010, doi:10.1038/nphoton.2010.221.

Source: NIST *Tech Beat*. October 13, 2010.

Multitalented Protein Sheds Light on HIV

New insights into the human immunodeficiency virus (HIV) infection process, which leads to acquired immunodeficiency syndrome (AIDS), may now be possible through a research method recently developed in part at the National Institute of Standards and Technology (NIST), where scientists have glimpsed an important protein molecule's behavior with unprecedented clarity.

The HIV protein, known as Gag, plays several critical roles in the assembly of the human immunodeficiency virus in a host cell, but persistent difficulties with imaging Gag in a lab setting have stymied researchers' efforts to study how it functions.

"A better understanding of Gag's behavior might allow researchers to develop antiviral drugs that target the HIV assembly process, which remains unassailed by medical science," said **Hirsh Nanda**, a postdoctoral researcher in the Electron Physics Group and a member of the multi-institutional research team.

The Gag molecule is a microscopic gymnast. At different stages during HIV assembly, the protein twists itself into several different shapes inside a host cell. One shape, or conformation, helps it to drag a piece of HIV genetic material toward the cell membrane, where the viral particles grow. Gag's opposite end becomes anchored there, stretching the protein into a rod-like conformation that eventually helps form a barrier surrounding the infectious genes in the finished virus. But while scientists have been aware for years that Gag appears to play several roles in HIV assembly, the specifics have remained mysterious.

The research team potentially solved this problem by creating an artificial cell membrane where Gag can show off its gymnastic prowess for the neutron probes at the NIST Center for Neuron Research. The center includes a variety of instruments specifically designed to observe large organic molecules like proteins.

"We were able to mimic the different stages of the virus' development, and look at what Gag's conformation was at these various stages," Nanda said. "We saw conformations that had never been seen before."

Nanda described the team's first paper* on the subject as an important first step in describing their observational method, which was a joint effort among NIST, the National Cancer Institute and Carnegie-Mellon University. They plan another paper detailing what the method has revealed about HIV.

*H. Nanda, S.A.K. Datta, F. Heinrich, M. Lösche, A. Rein, S. Krueger, J.E. Curtis. Electrostatic interactions and binding orientation of HIV-1 matrix, studied by neutron reflectivity. *Biophysical Journal*, Vol. 99 (8), Oct. 20, 2010.

Source: NIST *Tech Beat*, October 13, 2010.

'Sí!' to the New SI

Taking the first steps of what would be a major historical advance in the science of measurement, NIST is participating in a worldwide effort to recommend major revisions to the International System of Units (SI), the modern metric system that is the basis of global measurements in commerce, science and other aspects of everyday life. The new SI, which would be based on seven constants of nature, would enable researchers around the world to express the results of measurements at new levels of consistency and accuracy.

In support of a proposal to revise the SI so that it would be based on constants of nature, NIST efforts such as the watt balance experiment offer new ways of determining an accurate value of the Planck constant *h*, thereby contributing to a definition of the kilogram based on physical constants.

The most significant change in the possible future revision of the SI would be in the kilogram, the only one of the SI's seven base units* still defined in terms of a material artifact: a 130-year-old platinum-iridium cylinder maintained at the International Bureau of Weights and Measures (BIPM) in France. The kilogram artifact poses long-term problems because its mass changes slightly over time. The proposed revision "puts the SI on a firm foundation," said Ambler Thompson, a NIST scientist involved in the international effort. "We get rid of the last artifact."

In the current SI it's not only the unit of mass that depends on the kilogram-defining cylinder at BIPM. The definitions of the ampere (electric current), mole (amount of substance) and candela (luminous intensity) ultimately depend on it as well. For example, a mole is currently defined as the number of carbon-12 atoms whose total mass is 12 grams.

The new proposal defines the kilogram in terms of the Planck constant *h***, an important quantum-physics constant that is expressed in units containing the kilogram. Efforts at NIST—such as the watt balance experiment and determinations of the mass of one mole of silicon atoms—offer new ways of determining an accurate value of

(continued on next page)

h, thereby contributing to a more reliable definition of the kilogram.

The new SI would specify agreed-upon values of the seven constants according to the results of an analysis published by CODATA (Committee on Data for Science and Technology) of all of the relevant data. Fixed values of constants would then define all base units. For example, the ampere would be formally defined in terms of the electric charge of a proton, the kelvin (temperature) in terms of the Boltzmann constant***, and the mole in terms of the Avogadro constant. However, before the revised SI could be implemented, additional experiments are needed to obtain more accurate values for some of the constants, especially those mentioned.

The Consultative Committee for Units, of which NIST is a member and which is one of 10 advisory committees of the International Committee for Weights and Measures (CIPM), submitted its proposal for a revised SI for consideration by the CIPM during its meeting in Paris, France, earlier this month. The CIPM, whose membership includes Willie May, director of the Material Measurement Laboratory, modified and approved this proposal on October 15, 2010. Based on this proposal, the CIPM will soon submit a resolution on a possible future revision of the SI for consideration at the next meeting of the General Conference on Weights and Measures (CGPM), the international diplomatic body that has the authority under the Convention of the Metre to adopt such a sweeping change. If the resolution passes and all the technical requirements it sets out are in place, a new SI could be adopted later in the decade.

*The seven SI base units from which all others are derived are the second (time), the meter (length), the kilogram (mass), the ampere (electric current), the kelvin (thermodynamic temperature), the mole (amount of substance) and the candela (luminous intensity).

** Current accepted value: $6.626\ 068\ 96(33) \times 10^{-34}$ kg m^2/s

***The Boltzmann constant relates the change in the temperature of a system (such as a group of atoms and molecules) to the change in its thermal energy.

Source: NIST *Tech Beat*, October 26, 2010.

Shining Light on a Needle in a Haystack

Allison Churnside, Gavin King and **Thomas Perkins** from JILA have a new solution to the "needle in a haystack" problem of nanoscale microscopy, but it's more like the difference between finding the coffee table in a darkened room either by walking around until you fall over it, or using a flashlight. In a new paper* they locate tiny assemblies of biomolecules for subsequent detailed imaging by combining precision laser optics with atomic-force microscopy.

The atomic-force microscope (AFM) has become one of the standard tools of nanotechnology. The concept is deceptively simple. A needle (not unlike an old-fashioned phonograph stylus but much smaller) with a tip at most only a couple of atoms wide moves across the surface of the specimen. A laser measures tiny deflections of the tip as it is pushed or pulled by atomic scale forces, such as electrostatic forces or chemical attraction. Scanning the tip back and forth across the sample yields a three-dimensional image of the surface. The resolution can be astonishing: in some cases showing individual atoms. (A resolution a thousand times smaller than the best optical microscopes can achieve.)

Such amazing sensitivity incurs a technical problem: if your probe can image an object of 100 nm^2, how exactly do you find that object if it could be nearly anywhere on a microscope stage a million times that size? That's not an unusual case in biological applications. The brute-force answer is, you scan the probe back and forth until it runs into something interesting. Like the coffee table in the dark, this has problems. The AFM tip is not only very delicate and easy to damage, but it can be degraded by picking up unwanted atoms or molecules from the surface. Also, in the biosciences—where the AFM is becoming increasingly important—research specimens usually are 'soft' things like proteins or membranes that can be damaged by an uncontrolled collision with the tip. One solution has been to 'label' the target molecule with a small fluorescent compound or quantum dot, so that it lights up and is easy to find, but that means chemically altering the subject, which may not be desirable.

Instead, the researchers opted to use a flashlight. Building upon an earlier innovation for stabilizing the position of an AFM tip, they use a tightly focused, low-power laser beam to optically scan the area, identifying target locations by minute changes in the scattered light. This laser is scanned across the sample to form an image, analogous to forming an AFM image. The same laser and detection technique is also used to locate the AFM tip. Hence the laser serves as a common frame of reference, and it's relatively straightforward to align the optical and the AFM image.

In experiments with patches of cell membrane from single-cell organisms, the group has demonstrated that they can locate these protein complexes and align the AFM tip with a precision of about 40 nm. Relying solely on scattered light, their technique requires no prior chemical labeling or modification of the target molecules.

* A.B. Churnside, G.M. King and T.T. Perkins. Label-free optical imaging of membrane patches for atomic force microscopy. Optics Express. Vol. 18, No. 23. Nov. 8, 2010.

Source: NIST *Tech Beat*, November 9, 2010.

—Norm Belecki, Marvin Cage and Daniel Pierce

Management, Administrative, and Extra-mural Programs News

Budget Update

With none of the 12 Fiscal Year (FY) 2011 appropriations

bills enacted, the entire federal government has been operating under a series of continuing resolutions (CRs) that run through December 18, 2010. CRs are intended to provide only the minimum appropriation necessary to continue operations, so as not to impinge on the prerogatives of the Congress when it finally passes its appropriations bills. These FY 2011 CRs are based on what was appropriated in FY 2010 and how much was obligated in a comparable time period last year, so even though the CR period covers 21.64% of the year, generally NIST is restricted to less than that in all accounts.

As the newsletter goes to print, it appears likely that a restrictive CR will be extended to last the full year. Meanwhile, with a dwindling calendar in the lame-duck session to finish legislative business, House Democrats are expected to get the ball rolling the second week in December by trying to pass a continuing resolution that would fund the federal government through the September 30 end of the fiscal year, Democratic and Republican congressional sources said.

If approved by the House, the package would go to the Senate, where Democrats would seek to attach an omnibus spending measure being drafted by Senate Appropriations Committee Chairman Daniel Inouye, D-Hawaii, the sources said. The package could also serve as a legislative vehicle for a possible deal on extending the 2001 and 2003 tax cuts and other legislative priorities.

Talk of House and Senate action on a year-long CR comes after Senate Republicans on Wednesday wrote Senate Majority Leader Harry Reid, D-Nev., pledging to block any legislation from coming to the Senate floor until the chamber dealt with extending the 2001 and 2003 tax cuts and funding the government.

On Thursday, Inouye said that he was still working on the omnibus spending bill, which would package all 12 annual appropriations bills into one piece of legislation. But he will need a few Republican senators to back the bill in order to overcome any likely filibusters or procedural hurdles.

Asked if he has the required votes to pass the package, he said, "we don't know."

Most observers, including several lawmakers, believe that fiscal year 2011 spending will be provided for in a CR and not an omnibus.

Sources: THOMAS - The Library of Congress and National Journal magazine.

Reorganization Update

NIST has released a fact sheet about the October 1, 2010, major organizational realignment. It can be accessed at <http://www.nist.gov/public_affairs/factsheet/reorg_factsheet.cfm>.

In the revised NIST Laboratories structure, some leadership changes became effective at the start of FY 2011. Those are:

610 - NIST Center for Neutron Research (NCNR)
Robert Dimeo, Director

620 - Center for Nanoscale Science and Technology (CNST)
Robert J. Celotta, Director
Lloyd J. Whitman, Deputy Director

630 - Material Measurement Laboratory (MML)
Willie E. May, Director
Richard C. Cavanagh, Deputy Director

680 - Physical Measurement Laboratory (PML)
Katharine B. Gebbie, Director
William R. Ott, Deputy Director for Measurement Science
James K. Olthoff, Deputy Director for Measurement Services

730 - Engineering Laboratory (EL)
S. Shyam Sunder, Director
William L. Grosshandler, Deputy Director for Building and Fire Research
Howard H. Harary, Deputy Director for Manufacturing

770 - Information Technology Laboratory (ITL)
Cita M. Furlani, Director
James A. St. Pierre, Deputy Director

2010 Baldrige Award Winners Announced

On November 23, Commerce Secretary Gary Locke named seven organizations as recipients of the 2010 Malcolm Baldrige National Quality Award. This marks the first year that three small businesses have been selected at one time and only the second instance in the Award's 23-year history that a total of seven organizations are being honored. The 2010 Baldrige Award recipients (and categories) are:

MEDRAD, Warrendale, PA (manufacturing)
Nestlé Purina PetCare Co., St. Louis, MO (manufacturing)
Freese and Nichols Inc., Fort Worth, TX (small business)
K&N Management, Austin, TX (small business)
Studer Group, Gulf Breeze, FL (small business)
Advocate Good Samaritan Hospital, Downers Grove, IL (health care)
Montgomery County Public Schools, Rockville, MD (education)

MEDRAD receives the Baldrige Award for the second time, having also been selected in the manufacturing category in 2003.

The recipients were selected from a field of 83 applicants. All were evaluated rigorously by an independent board of examiners in seven areas: leadership; strategic

(continued on next page)

planning; customer focus; measurement, analysis and knowledge management; workforce focus; process management; and results. Since 1988, 86 organizations have received the Baldrige Award.

The 2010 Baldrige Award recipients are expected to be presented with their awards at a ceremony in Washington, DC, next year.

Source: NIST *Tech Beat,*November 24, 2010.

MEP Awards $9.1 Million for Projects to Enhance U.S. Global Competitiveness

In September, the Hollings Manufacturing Extension Partnership (MEP) awarded $9.1 million in cooperative agreements for 22 projects designed to enhance the productivity, technological performance and global competitiveness of U.S. manufacturers.

Granted through competitive processes to nonprofit organizations across the United States, these projects will be implemented through MEP's national system of over 400 centers, field offices and partners. The funding will help encourage the creation and adoption of improved technologies and provide resources to develop new products that respond to changing market needs.

The projects address one or more of five areas MEP has identified as vital for strategic growth in U.S. manufacturing. MEP's five Strategic Growth Areas include:

responding to evolving supply chains;

accelerating the adoption of new technology to build business growth;

implementing environmentally sustainable processes;

establishing and enabling strong workforces for the future; and

encouraging cultures of continuous improvement.

Details of the projects, which cover areas from supplying the wind energy industry to introducing advanced manufacturing simulations in small- and medium-sized businesses, are available at <http://www.nist.gov/mep/mep_100510.cfm>.

Source: NIST *Tech Beat*, October 13, 2010.

Grants Awarded for the Construction of Five Science Facilities

Also in September, NIST awarded a total of $50 million in grants to five institutions to support the construction of new or expanded facilities for scientific research in areas of study covered by NIST and the National Oceanic and Atmospheric Administration, including measurement science, nanotechnology, building technology and oceanography. Sponsoring organizations must be institutions of higher education or nonprofit science research organizations. The five grants are:

$13.1 million for the Golisano Institute for Sustainability Research Building at the Rochester Institute of Technology in NY;

$12.2 million for the expansion of facilities at the Center for Civil Engineering Earthquake Research at the University of Nevada, Reno;

$9.5 million for the Center of Excellence in Nano Mechanical Science and Engineering (NAMSE) at the University of Michigan, Ann Arbor;

$9.1 million for a new Center for Ocean Health at Bigelow Laboratory for Ocean Sciences in West Boothbay Harbor, ME; and

$6 million for the Western Institute of Nanotechnology on Green Engineering and Metrology (WIN GEM) at the University of California, Los Angeles.

More details are available at <http://www.nist.gov/public_affairs/releases/20100929_cgp_awards.cfm.>.

Source: NIST *Tech Beat*, October 13, 2010.

Visiting Committee Appointment

Director Patrick Gallagher has named Uma Chowdhry of DuPont to serve a three-year term on the Visiting Committee on Advanced Technology (VCAT). She is Chief Science and Technology Officer Emeritus at DuPont. From 2006 to 2010 she was senior vice president and chief science and technology officer at DuPont, responsible for the company's market-driven science and technology-based innovations.

Source: NIST *Tech Beat*, September 28, 2010.

—Janet Miller

***Tech Beat* Titles Reflect Breadth of NIST Activities**

September 14, 2010—New Wave: Spin Soliton Could Be a Hit in Cell Phone Communication; Research Shows Radiometric Dating Still Reliable (Again); New GSI Web site Experience Puts Product Standards on the Map; NIST Data: Enabling the Technical-Basis for Evacuation Planning of High-Rise Buildings; Sixteen Organizations Chosen to Receive Site Visits for 2010 Baldrige Award; NIST to Host Third Annual Maryland Stem Cell Research Symposium; NIST Finalizes Initial Set of Smart Grid Cyber Security Guidelines.

September 28, 2010—NIST Strengthens Laboratory Mission Focus with New Structure; NIST 'Vision Science Facility' Aims for Lighting Revolution; New NIST 'Standard Cigarette' Available for Fire-Resistance Testing; Growing Nanowires Horizontally Yields New Benefit: 'Nano-LEDs'; NIST Clock Experiment Demonstrates That Your Head is Older Than Your Feet; NIST Residential Fire Study Education Kit Now Available; NIST to Award Up to $15 Million to UMD to Support Nanotechnology Research; Metric Week Begins 10/10/10; NIST Names 15 to New Smart Grid Advisory Committee.

October 13, 2010—JILA Unveils Improved 'Molecular Fingerprinting' for Trace Gas Detection; Faster CARS, Less Damage: NIST Chemical Microscopy Shows Potential for Cell Diagnostics ; NIST Mini-Sensor Traces Faint Magnetic Signature of Human Heartbeat; Baldrige Program

Name Change Emphasizes Performance Excellence; NIST, NTIA Seek Collaborators for Emergency Communications Demo Network; NIST Sponsors Second Cloud Computing Forum and Workshop Nov. 4–5; NIST Releases 2009 Department of Commerce Technology Transfer Report; NIST Identifies Five "Foundational" Smart Grid Standards; *Popular Science* Magazine Names Spielman One of Science's 'Brilliant Ten'; NIST Researcher Wins Presidential Award for Green Innovation ; NIST's Arnold Receives Award for Smart Grid Leadership.

October 26, 2010—NIST Ships First Programmable AC/DC 10-Volt Standard; NIST Microrobotics Challenge Seeks Miniature Medics and Maze Masters; Harvard Researchers Share 2010 *Julius Springer Prize* for Applied Physics.

November 9, 2010—Updated NIST Software Uses Combination Testing to Catch Bugs Fast and Easy; NIST Seeks Comments on Study of Charleston Furniture Store Fire; New NIST Dietary Supplement Reference Materials Could Be 'Berry' Useful; NIST Pings Key Material in Sonar, Closes Gap on Structural Mystery; AFM Positioning: TIP Seeks Comments on Potential Funding Areas and Solicits Suggestions for Future Competitions; New NIST Publication Provides Security Guidance for WiMAX Technologies; NIST Patent Roundup.

November 24, 2010—Quartz Crystal Microbalances Enable New Microscale Analytic Technique; New Guidance for First Responders Collecting Suspected Biothreat Agents; Three NIST Scientists Earn Presidential Early Career Awards.

5. NIST STAFF HONORS AND AWARDS

National Governmental Awards

The *GreenGov Presidential Awards* celebrate extraordinary achievement in the pursuit of President Obama's Executive Order on Federal Leadership in Environmental, Energy and Economic Performance (Executive Order 13514). Eight winners, one a NIST staff member, were selected from more than 300 nominations. The White House Council on Environmental Quality (CEQ) solicited award nominations and, along with a panel of judges, reviewed the nominations and recommended the 2010 award recipients to the President.

On October 7, 2010 a *Green Innovation Award* was given to **Barbara Lippiatt** of the Applied Economics Office of the Engineering Laboratory by the CEQ for her work on a software tool that measures the environmental performance of building materials and biologically based products. She was recognized for developing the Building for Environmental and Economic Sustainability (BEES) Program. This software tool measures environmental performance in building materials by making a life cycle assessment from manufacturing through product use, maintenance, and disposal. According to the White House award citation, "Her vision has resulted in a practical tool for sustainability performance measurement that is unbiased, science-based, quantitative, transparent, and comprehensive."

The *Presidential Rank Award* recognizes and celebrates career members of the Senior Executive Service (SES) and other senior career employees who are strong leaders and who consistently demonstrate strength, integrity, industry, and a relentless commitment to public service. There are two categories, Distinguished and Meritorious.

One NIST scientist received the 2010 *Presidential Rank Award (Meritorious Senior Professional)*:

Stephen E. Stein of the Chemical and Biochemical Reference Data Division "…. is recognized for lifetime contributions in establishing NIST reference data collections as the premier source of chemical reference data for compound identification in the world. Over his nearly 30 years of service to the U.S, his work has been seminal to creating and providing a number of critical reference data products that provide trusted chemical reference data to nearly every scientist the world over. During his career, he has overseen development of innovative computer-based methods for database building, quality control, data analysis and dissemination. His work is of the highest quality and underpins scientific experiments everywhere."

The *President's Early Career Award for Scientists and Engineers* (PECASE) recognizes and honors outstanding scientists and engineers at the outset of their independent research careers in the federal service. The award consists of a special research grant and is based on the candidate's scientific accomplishments and leadership potential and the potential impact of their research on agency goals. The award is coordinated by the President's National Science and Technology Council.

Three NIST scientists received the PECASE for 2009:

R. David Holbrook - Surface and Microanalysis Science Division
"By applying NIST's advanced measurement techniques in combination with his wastewater treatment process engineering, environmental toxicology, and chemical engineering expertise, Dr. Holbrook is recognized internationally as a leader in the field of measurements and analysis of environmental fate and impact of nano-scale material and nanoparticles His seminal study on trophic transfer highlighted the importance of environmentally relevant models and experimental conditions in the study of environmental fate and impact of nanoparticles. He shares his expertise with the broader technical community through publications, presentations, and patents, and also serves as an active mentor."

(continued on next page)

Daniel S. Hussey - Ionizing Radiation Division: "Dr. Hussey is one of the world's most highly recognized experts in neutron imaging. He is currently designing an advanced state-of-the-art cold-neutron phase imaging instrument, and has played a key role in the development and application of cutting-edge neutron metrology techniques for fuel cell research. He is developing techniques for measuring ion transport in Li-ion batteries that are important for the development of efficient batteries for automotive applications. He also has taken the lead in developing a polarized neutron beam, performed crucial spin polarization analyses, and developed magnetic geometry for a novel single crystal based neutron magnetic dipole experiment currently being designed at NIST."

Ian B. Spielman - Atomic Physics Division: "Studying the famous Hubbard model, presumed to explain electrical properties of many materials, Dr. Spielman made the best quantitative measurement of the insulator transition, for which direct calculation is impossible and for which reliable approximation methods only recently appeared. In a series of four recent papers, he invented a way of applying a "synthetic" electric charge and electric and magnetic field to the neutral atoms. One key challenge was using electrically neutral atoms to simulate the behavior of charged electrons. By applying a combination of carefully tuned laser and magnetic fields, Dr. Spielman has been able to simulate the effects of both magnetic and electric fields on charged particles using his cold neutral atoms."

Department of Commerce Awards

In the Sixty-second Annual Awards Ceremony held at the Herbert Hoover Building Auditorium on October 19, 2010, the following NIST staff members received the Department's *Gold Medal Awards for Distinguished Service*:

For Customer Service

Diane J. Simmons -NIST Director's Office: "As a member of an NTIA team, Ms. Simmons and her colleagues [sic] are recognized for the innovative implementation and management of the unprecedented TV Converter Box Coupon Program. The Program informed all Americans how to prepare for the transition to digital TV. NTIA issued more than 64 million coupons to reduce the cost of television converter boxes. NTIA also worked with multiple partners to ensure consumers throughout the country understood and planned for the transition. The Program significantly exceeded expectations and was a critical factor in the United States' smooth and successful transition to digital TV."

Roger D. Kilmer, **Carroll A. Thomas Martin** and **Phillip K. Wadsworth** - Manufacturing Extension Partnership (MEP) program: "As members of a cross-agency DoC team, the group is recognized for developing and delivering timely business focused services and programs more effectively and more efficiently through Commerce Connect Michigan: a Department-wide coordinated "One-Stop Shop". The group provided American businesses in the struggling auto industry with a better, faster and more comprehensive access to Department of Commerce's 60+ technical assistance, grant and information-based programs. This new process enhanced Department effectiveness in meeting program objectives, along with a better Department-wide image and culture of customer service excellence."

For Scientific/Engineering Achievement

Samuel P. Benz, **Charles J. Burroughs**, **Paul D. Dresselhaus**, **Thomas L. Nelson** and **Bryan C. Waltrip** - Quantum Electrical Metrology Division: "The group is recognized for improving the accuracy of electric power metrology by developing the 'Quantum Watt,' the world's first quantum-based electric power standard. The standard integrates new precision measurement techniques with a quantum voltage reference to produce a best-in-the-world calibration system for electric power, with 10-fold improvement in measurement uncertainty. This improved accuracy already provides a significant competitive advantage for U.S. electric power meter manufacturers and will enhance the nation's ability to monitor and control its electric power grid."

Amanda L. Forster, **Kirk D. Rice**, **Michael A. Riley**, and **Nathaniel E. Waters** - Office of Law Enforcement Standards; **Gordon S. Gillerman** - Standards Services Division; **Hazel M. Richmond** - National Laboratory Accreditation Program; **Gale A. Holmes** - Polymers Division; **Joannie W. Chin** - Materials and Construction Research Division; and **James J. Filliben** and **Dennis D. Leber** - Statistical Engineering Division: "The group is recognized for the development of innovative methods to test ballistic resistance and long-term durability of body armor, resulting in a new National Institute of Justice (NIJ) standard for body armor and potentially saving thousands of lives. Their work was precipitated by an incident in Forest Hills, PA, where an officer was seriously wounded in 2003 when his PBO [polybenzoxazole, a polymer fiber] body armor was penetrated by a bullet it was rated to stop. NIJ turned to NIST to unravel the mystery that jeopardized hundreds of thousands of officers nationwide."

Albert J. Fahey, **George A. Klouda**, **Dale E. Newbury**, **Nicholas W. Ritchie**, **John Henry J. Scott**, **David S. Simons**, **John A. Small**, **Barbara B. Thorne**, **Scott A. Wight** and **Cynthia J. Zeissler** - Surface and Microanalysis Science Division: "The group is recognized for developing a world class measurement science and standards program that supports U.S. and international atomic detection systems with critical measurement capabilities including innovative measurement techniques and instrumentation, advanced automation and data interpretation software, and quality assurance procedures including standards and methods validation. Their untiring efforts have led to expanded

analytical capabilities and greater confidence in the U.S. and the IAEA [the International Atomic Energy Agency] data on worldwide nuclear non-proliferation in support of the 1963 Limited Test Ban Treaty."

Antonio M. Possolo - Statistical Engineering Division: "Dr. Possolo is honored for his extraordinary dedication and technical achievements in the application of statistical methods to measurement science to characterize and improve the estimates of areas dedicated to illicit coca cultivation. His realistic assessment of uncertainty of these estimates, and his proposals for how the data may best be exploited, are outstanding contributions that will enable the CIA's [Central Intelligence Agency] Crime and Narcotics Center to enhance its estimates of coca production, a key element in shaping the nation's counterdrug policy."

For Leadership

Thomas R. O'Brian - Time and Frequency Division: "Dr. O'Brian is cited for his leadership in developing and disseminating the Nation's standard of civilian time, the world's most precise absolute measurement of any kind. As Chief of the Time and Frequency Division, he is responsible for programs ranging from basic research, to the development of frequency standards, to the operation of radio stations that broadcast signals used by millions of people throughout North America. The Division's primary clock is precise to better than one second in three million years. Its Internet Time Service averages more than three billion requests each day."

Kelley L. Dempsey, **Peggy N. Himes**, **L. Arnold Johnson**, **Ronald S. Ross**, **Marianne Swanson**, and **Patricia R. Toth** - Computer Security Division: "The group is recognized for its interagency leadership and technical excellence in creating the Risk Management Framework, a methodology for incorporating sound security risk management practices throughout the information system life cycle. This work has been adopted government wide to improve the security of government systems and information. The impact of the work includes preventing compromises of government systems and information, increasing confidence in sharing data and services among agencies, and lowering security operational costs."

In the same ceremony, the following NIST staff members received the DoC *Silver Medal Award for Exceptional Service*:

For Leadership

James S. Clark - Safety, Health and Environment Division.
"Mr. Clark is recognized for his action and initiative throughout the NIST Boulder Plutonium Spill Incident recovery project in his capacity as the Contracting Officer's Technical Representative managing the decontamination contract. The highest standards of safety were adhered to. [sic] The public and the environment were protected from exposure. There is no remaining plutonium anywhere on site. Scientific instruments of national significance were successfully recovered for the continuation of research programs. The affected spaces were all released by the Nuclear Regulatory Commission for unrestricted use."

John R. Hayes, Jr. - National Earthquake Hazards Reduction Program
"Dr. Hayes is recognized for outstanding leadership of the National Earthquake Hazards Reduction Program (NEHRP). Through his leadership, management skills and professionalism, he has reenergized and provided new strategic direction to this critical program. In doing so, he has gained the support and respect of the NEHRP agencies, Congressional staff and the earthquake safety community nationwide. Dr. Hayes' achievements are leading to a substantial reduction in risks of losses of life and property in future earthquakes in the United States."

Lisa J. Carnahan, **John J. Garguilo**, **Mary T. Laamanen**, **William J. Majurski**, **Sandra I. Martinez**, **Gavin W. O'Brien** and **Robert D. Snelick** - Software and Systems Division.
"The Health IT Team is recognized for developing a Health IT Testing Infrastructure to support the exchange of electronic health records nationwide. The team developed an innovative testing infrastructure which is the principal assessment tool by which health IT systems are tested. The innovative design of the testing infrastructure has allowed it to make an impact worldwide. This work is accelerating the adoption of interoperable health IT systems, leading to the improvement of quality and the reduction of costs of health-care internationally."

For Personal and Professional Excellence

Alex Folk - Manufacturing Extension Partnership Program.
"As a member of an ITA [International Trade Administration] team, Mr. Folk and his colleagues were recognized for exceptional performance throughout a two-year period from summit to summit to establish the Department of Commerce's Sustainable Manufacturing Initiative (SMI)—Commerce's first comprehensive effort to identify and address the sustainability needs of U.S. industry. The SMI has succeeded in linking ITA and NIST to significantly improve access to sustainable business programs and resources for U.S. businesses and increase nationwide awareness of sustainable manufacturing benefits."

For Scientific/Engineering Achievement

Craig M. Brown - NIST Center for Neutron Research:

(continued on next page)

"Dr. Brown is recognized for his pioneering research on hydrogen storage materials. His work identifies key factors that govern the absorption of hydrogen in metal-organic framework compounds and highlights the importance of coordinatively unsaturated metal centers in enhancing the binding energy of hydrogen molecules in sorbent materials. His findings address one of the largest obstacles in the road to the development of safe, practical hydrogen storage systems that operate at room temperature."

Thomas J. Bruno - Surface and Microanalysis Science Division: "Dr. Bruno is recognized for developing a method for analyzing complex fluid mixtures, application of this method to important current problems, and transfer of the methodology and results to the industrial and governmental communities that have this requirement. The measurements have been used to analyze such fluids as fuels, (i.e., biofuels, sustainable liquids), crude oils, and mixed wastes. The method is now required prior to certification of the next generation of flight fuels for the U.S. Air Force. A major chemical equipment company is in the process of commercializing the technology."

Thomas A. Germer - Optical Technology Division: "Dr. Germer is recognized for developing innovative light-scattering measurement instruments, standards, and mathematical models to enhance the capability of the micro and nanoelectronics industry to inspect wafers for particle contamination and defects and to ensure critical dimensions are met in fabrication processes. He has demonstrated compelling applications of light scattering in medical imaging, astronomy, satellite calibrations, and high-performance coatings manufacture."

Eite Tiesinga - Atomic Physics Division: "Dr. Tiesinga is recognized for his research enabling the application of cold atoms in precision metrology, atomic clocks, and basic science. He pioneered key theoretical developments on magnetic control of interactions between cold atoms. His work has improved the fundamental metrology of ultra cold atoms, impacted the precision of clocks, and opened new directions for the science of quantum fluids, quantum information and computing, and ultra cold chemistry."

Joseph C. Woicik - Ceramics Division: "Dr. Woicik is recognized for developing the first synchrotron-based X-ray spectroscopy method for direct measurement, independent of atomic structure models, of the nature of individual, site-specific chemical bonds in advanced materials. This capability has already provided accurate measurements of the density of electronic states and energy levels in cutting-edge electronic and catalytic materials. Researchers worldwide have access to Dr. Woicik's method through the DOE General User Program at the National Synchrotron Light Source, Brookhaven National Laboratory."

[Recipients of the annual NIST awards, consisting of the *Bronze Medal Awards for Superior Service* and the so-called 'NIST Name Awards' will be announced in the March issue of the Newsletter. - Ed.]

Elizabeth A. Strychalski and **David J. Ross**, both of the Biochemical Science Division and Alyssa Henry of Applied Research Associates, were presented the 2010 *CSTL Technical Achievement Award* "for their work on "Microfluidic Analysis of Complex Samples with Minimal Sample Preparation using Gradient Elution Moving Boundary Electrophoresis (GEMBE)", work published in *Analytical Chemistry*, Vol. 81 (2010).

Extra-Governmental Awards

Paul C. DeRose, Biochemical Science Division, received the ASTM *International Award of Appreciation* "in recognition of outstanding service in the development of E2719 Standard Guide for Fluorescence – Instrument Calibration and Qualification". The award was presented at the ASTM E13 Meeting held in Orlando, FL on March 2, 2010.

John Elliott, also in the Biochemical Science Division, received the *Robert E. Fairer Award* from ASTM on May 20, 2010, as a pioneer in standards research. The award citation reads, "Dr. Elliott received the *Robert E. Fairer Award* for his work on developing world standards for the medical community."

Patrick Grother of the Information Access Division received the International Electrotechnical Commission (IEC) *1906 Award* for 2010. The award honors achievements that are major contributions to furthering the interest of electrotechnology standardization and related activities. The tribute associated with Grother's award reads, "Patrick is a profuse technical contributor to ISO/IEC JTC 1 SC 37, Biometrics, including a significant contribution derived from performance tests of iris recognition algorithms on standard images. He has served with distinction as editor of conformance testing methodology (CTM) standards for biometric data interchange formats and performance testing."

Henri Lezec of the CNST Nanofabrication Research Group shares the *Julius Springer Prize for Applied Physics 2010* with Federico Capasso of Harvard for their "pioneering achievements in nanoscale physics and applications." The Springer prize recognizes researchers who have made an outstanding and innovative contribution to the fields of applied physics and has been awarded annually since 1998.

They received the award on October 16, 2010 at the Julius Springer Forum on Applied Physics 2010, a special symposium held at Stanford University in honor of the recipients. Attendees heard talks from both prize winners, as well as a series of special lectures given by luminaries in the field of nanoscale physics. Lezec's work spans a broad range of topics associated with the interaction of light with materials and nanoscale structures, i.e. plasmonics and

nanoplasmonics. He is also known for pioneering the now widely applied use of the focused-ion beam in fabricating nanoscale apertures and other structures.

Vladimir Marbukh of the Applied and Computational Mathematics Division, and **Daniel Genin** and **Anastase Nakassis** of the Advanced Network Technologies Division, were awarded *Certificates of Merit* for outstanding contributions to the 2010 International Conference of Information Security and Internet Engineering, held in London on June 30–July 2, 2010. Their paper, "Vulnerability of Selfish Routing to Attacks: Game-theoretic Models and Initial Results," presented a model of a potential strategic attack on a class of network packet-routing algorithms. In it they demonstrated that even a weak attacker can inflict serious damage (as measured by degradation in system performance) in routing algorithms characterized by selfish user behavior.

Ernest McDuffie, of the Federal and Industrial Relations Office and Lead for the National Initiative for Cybersecurity Education (NICE), received a *Professional Achievement Award* for 2010 from his undergraduate institution, Richard Stockton College of Pomona, New Jersey. The award was presented on October 9, 2010, at an awards ceremony during the school's Homecoming Weekend. Each of the eight schools of the college award one of their graduates with the annual honor; McDuffie received the award from the School of Business.

Tinh Nguyen of the Materials and Construction Research Division has been selected as the 2011 recipient of the *Joseph J. Mattiello Award* from the American Coatings Association. The award, the most prestigious in the international coatings scientific community, recognizes individuals who have made outstanding contributions to the field of coatings science and technology. Tinh's research accomplishments have made a substantial impact on the understanding of coatings performance and durability. A symposium in Tinh's honor will be organized at the March 2011 CoatingsTech meeting, in which he will give a keynote lecture.

Till Rosenband, a physicist in the Time and Frequency Division, appeared in the "Fed Faces" column of *The Washington Post* on September 7, 2010. He was chosen for applying "a radical idea in quantum physics to invent the world's most precise timekeeping device. This new atomic clock is considered 30 times better than the current version and will lose only one second in 3 billion years."
Fed Faces is a project of *The Washington Post* and The Partnership for Public Service.

Ari Schwartz, Office of the ITL Director, received the 2010 *Excellence in Public Policy Award* from the Online Trust Alliance for his balanced and pragmatic approach to privacy issues. Prior to coming to ITL, Schwartz served as the vice president and chief operating officer of the Center for Democracy and Technology, where "his valuable input helped hundreds of companies develop consumer-centric policies and solutions positively impacting hundreds of millions of users worldwide."

Mary Satterfield of the Biochemical Science Division received the 2010 *Maryland Association of Science Teachers Award* from the National Science Teachers Association (NSTA), whereby she was recognized "as Educational Outreach Coordinator showing Excellence in Science Education." Dr. Satterfield was presented the award at the NSTA Regional Conference held in Baltimore, MD, November 2010.

—Edgar Etz and Karen Williams

BOULDER BABBLE

The Boulder Scene

Of course the biggest news in Boulder during the past quarter was the Four Mile Run wildfire that started on Labor Day (September 6) after an extremely dry period over the several prior months. The only natural "soaking" that had occurred prior to the fire was 0.4 inch in early August. The fire was caused by 65 mph winds that officials say most probably spread embers from an open fire pit that had been repeatedly stirred and doused. The fire quickly became the most damaging blaze in Colorado history in terms of property lost. There were 6400 acres burned, 169 houses destroyed, and more than $200 million in insurance claims. The cost of fighting the fire was in excess of $10 million. A smoky haze blanketed the city for several days, and people with breathing problems were advised to stay indoors with windows closed. Some NIST staff members sensitive to smoke were permitted to work from home for several days. Now residents of the burned area have to ask themselves if they want to rebuild in a devastated landscape. If they do, they will have to deal with the inevitable flooding, and the lurking possibility of more fires in the years to come.

The owner of the fire pit had been a volunteer with the Four-Mile Fire Department for decades. He lost everything he owned except for the clothing he was wearing when he escaped the fire. No criminal charges were filed against him, the opinion of the district attorney being that they could not be proven beyond a reasonable doubt, based on the available evidence.

The weather has continued to be extremely dry and abnormally warm through both September and October in Boulder. Another fire, designated as the Dome Fire, occurred on October 29 and came within a half-mile of the Boulder city limits. The relative humidity was in the single digits on that day, and winds over 50 mph quickly spread the blaze. However, this fire was brought under control relatively quickly with only minor damage. The 90-day outlook for Colorado from the National Weather Service Climate Prediction Center calls for above- to way-above-normal temperatures, with normal precipitation. This will also be an El Niña winter, typically resulting in more wind than normal.

(continued on next page)

As noted in the October issue of *Bon Appetit*, "Boulder has won just about every shiny happy lifestyle award a city can: Healthiest, Most Educated, Most Bicycle-Friendly—the list goes on. And this year, it can add one more: Bon Appetit's Foodiest Town in America. It turns out that, along with having fit, smart, and eco-conscious citizens, Boulder is home to a number of innovative food companies (Celestial Seasonings, Izze Beverage company, and Bhakti Chai), several top-tier restaurants, and one of the best farmers' markets in the country." The writer of the article—restaurant editor Andrew Knowlton—spent a week in Boulder with his "seldom-used running shoes and his well-worn appetite" to experience both pain (exercise) and pleasure (eating). He wanted to sample Boulder's much-lauded lifestyle and cuisine. Knowlton certainly experienced some of Boulder's most popular running, biking and hiking trails, along with its diverse potpourri of eating establishments. The article was both appetizing and well done.

The election went smoothly in Boulder and Colorado this year with some very tight races. Our local congressional representative (Jared Polis – D) won easily in an overwhelmingly Democratic district. However, state-wise the elections for the U.S. House of Representatives were a reflection of the overall U.S. pattern, going from a 5 – 2 Democratic majority to a 4 – 3 Republican majority. Michael Bennett (D) was elected senator by a margin of less that one percent in a highly charged race with a Tea-Party candidate. He had been appointed to the position two years ago, after Ken Salazar was chosen as the Secretary of Interior by President Obama. In the governor's race a popular Denver mayor (John Hickenlooper) was easily elected, as the Republican party failed to put up a strong candidate after plagiarism charges were brought against its expected choice. Boulder County's open-space tax, which failed surprisingly in the last election, was passed by a narrow margin this year. It will raise the sales tax in the county by 0.15 percent for 20 years. This popular program has been instrumental in allowing Boulder County to preserve its character and natural environment.

NIST Atomic Clocks Show Effects of Gravity Variations within the Laboratory

Einstein's 1915 General Theory of Relativity predicts that gravity slows the flow of time or the ticking of clocks. Gravity decreases as we move away from Earth, so Einstein's theory predicts clocks will tick faster at higher elevations. In 1976 NASA launched a high precision hydrogen-maser clock (a type of atomic clock) onboard the Gravity Probe A satellite that reached a height of 10 000 km. At that altitude, gravity is about 15 % of that on Earth. Einstein's theory predicted the clock would run faster than one on Earth by 4.5×10^{10}. The maser clock, which had a precision, or stability, of 1×10^{14} (1 second in 32 million years), verified Einstein's prediction.

The U.S. civilian time standard is currently kept by the NIST-F1 cesium fountain clock, an atomic clock operating at microwave frequencies and with a precision of 1 second in 100 million years. The frequency of the cesium atom is used to define the international standard of the second, so no clock can be more accurate. However in the last few years, the Time and Frequency Division has focused on atomic clocks operating at much higher frequencies than that of the cesium atom. The latest and most precise clock developed at NIST is an optical atomic clock that is based on the ultraviolet light frequencies associated with a single aluminum ion oscillating between two energy levels at frequencies in the range of 10^{15} Hz. These frequencies are about 100 000 times the microwave frequency of the cesium atom, allowing for a finer division of the second. The first of these was developed at NIST in 2008. This year, NIST researchers **James Chin-wen Chou**, **David Hume**, **Till Rosenband** and **David Wineland** of the Time and Frequency Division made a second quantum logic clock based on the aluminum ion and found that it agrees with the first one to within their precision of about 1 second in 3.7 billion years (1 part in 10^{17}). This second one is now the world's most precise clock.

With this pair of such precise clocks, these researchers could show that gravity has a measurable effect on clocks even within the laboratory. In one experiment where the first clock was 33 centimeters (13 inches) above the second, they observed the higher one ticked faster than the lower one by 1 second in 800 million years (4 parts in 10^{17}), which is in agreement with Einstein's theory. These studies were published in the September 24 issue of *Science*, pp. 1630–1633. Such precise clocks can be used for the study of fundamental constants of nature as well as for geodetic studies of crustal motion and tides. Other possible applications include ultra-precise autonomous navigation, such as using the Global Positional System (GPS) in landing planes.

Miniature Magnetic Sensor Detects Human Heartbeat Signals

Electrocardiograms (ECG or EKG) are often taken during a physical exam to determine the health of a patient's heart. The procedure involves attaching anywhere from two to ten electrodes to the patient's chest, and sometimes to the arms and legs. To ensure good electrical contact, the area where the electrodes are attached must be cleaned and sometimes shaved. The electrical signals are processed to provide the familiar trace on paper of the ECG, which is read by a doctor to determine if there are certain medical problems with the heart. Because of the need to attach electrodes, the procedure may take about 15 minutes.

The heart's electrical signals also give rise to complementary magnetic signals that can be detected by a very sensitive magnetometer and used to produce a magnetocardiogram (MCG) with a trace very much like that of an ECG. The advantages of the magnetometer technique is that no contact to the body is required, the magnetic fields pass through clothing, and the device operates at room temperature. A magnetometer to sense the magnetic fields needs only to be located within a few centimeters

of the patient's chest, and the readings can then be taken immediately. Normally MCGs are taken using a Superconducting Quantum Interference Device (SQUID) as the magnetometer, because they are the most sensitive devices to magnetic fields. However, to maintain superconductivity, the SQUID magnetometer must operate at a very low temperature of about 4 K (-269 °C), which requires the use of a bulky liquid-helium Dewar or a large cryocooler. A SQUID can detect magnetic fields of about one femtotesla or 1 fT (10^{-15} T). The magnetic field of the heart is about 50 000 fT (50 pT) and the magnetic field of the Earth is about 0.5×10^{-4} T (50 μT).

Svengja Knappe and **John Kitching** of the Time and Frequency Division, collaborating with colleagues from the Physikalisch-Technische Bundesanstalt (PTB - the German national metrology institute), have compared a new NIST chip-scale atomic magnetometer (CSAM), operating at room temperature, with a SQUID magnetometer for use in producing a MCG [1]. The tests were made in a magnetically shielded room at PTB in Berlin to cancel the effects of the Earth's magnetic field. The NIST miniature sensor was about the size of a sugar cube and contained about 10^{11} (100 billion) rubidium atoms in gas form that were excited to higher energy levels with diode-laser light transmitted to the cell through an optical fiber. The fiber also was used to detect the light signals that register the magnetic field. Although the CSAM generates somewhat more noise than the SQUID, its noise level of a few hundred fT is still significantly less than the magnetic signal produced by the heart. Figure 1 compares the signals from the CSAM (top row) with those from the SQUID (bottom row) taken simultaneously on the same patient. The left column shows the raw signals, and the right column shows the signals after averaging over 200 beats. As the figure shows, the averaged CSAM signal conveys nearly the same information as that from the SQUID. The small size and microfabrication techniques used for the CSAM make it easy to fabricate an array of about 100 sensors for the study of spatial effects around the heart.

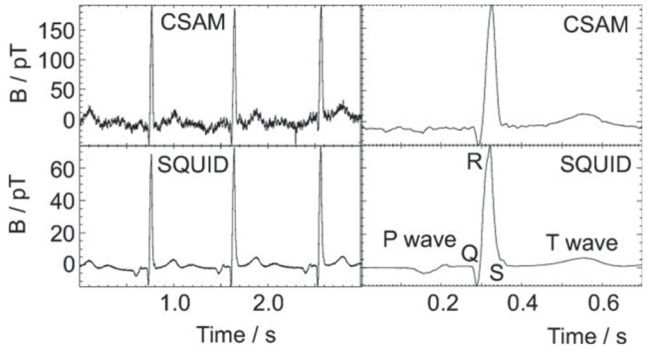


Fig. 1 Comparison of CSAM and SQUID magnetocardiograms taken simultaneously on the same patient.

[1] S. Knappe, T.H. Sander, O. Kosch, F. Wiekhorst, J. Kitching, L. Trahms, *Appl. Phys. Lett,* 97 133703 (2010).

JILA Scientists Develop Laser Micro-heating Technique for Research on Single RNA Molecules

To be functional, ribonucleic acid (RNA) in biological material must fold into three-dimensional shapes. The study of how temperature affects RNA folding and unfolding is valuable for understanding chemical and biological processes. Previous studies of nanoparticle and biological systems at the single molecule level have relied on "bulk" methods of heating entire microscope stages. The time to heat and cool samples with the bulk technique can be too long for the study of some processes of interest in biomolecules or nanoparticles. **Erik Holmstrom** and **David Nesbitt** of JILA have now developed a rapid non-contact technique to locally heat picoliter (10^{-12} liters) volumes of water on a glass slide using a focused near-infrared diode-laser beam [1]. The laser spot size is about 17 μm (micrometers) in diameter (about half the diameter of a human hair). The water then warms single RNA molecules attached to the glass slide. Temperatures in the range of 20 to 90 °C are of interest. Different regions of the sample can be heated by translating the glass slide.

The glass slide is mounted above an inverted fluorescence microscope used to study the folding of tagged RNA molecules. The laser wavelength is just right to excite vibrations in the water chemical bonds, which then quickly turn into heat. Fluorescence excitation of the RNA molecules is accomplished with a different pulsed laser operating at a much shorter wavelength than that of the heating laser to allow separation of the light signals. Temperature measurements in such small volumes are a challenge. Holstrom and Nesbitt relied on a measurement of the temperature-dependent fluorescence lifetime of a dye in the water to determine the temperature with an uncertainty of 0.5 °C. Their measurements showed a response time of less than 20 ms (milliseconds) for heating the water sample, which was the fastest that their temperature measurement technique could respond. Theoretically, the response time was calculated to be less than 1 ms.

[1] E.D. Holmstrom, D.J. Nesbitt, *J. Phys. Chem. Lett.* 1, 2264 (2010)

Emergency Broadband Communications Demo Network

Many reports after major disasters in the U.S. have cited communication difficulties among various emergency workers and agencies. As part of an overall Department of Homeland Security plan to improve such communication, NIST and the National Telecommunications and Information Administration (NTIA) have created a demonstration broadband communications network for the nation's emergency-services agencies. This demonstration system will make use of a portion of the radio-frequency spectrum freed up by the recent transition of U.S. broadcast television from

(continued on next page)

analog to digital technologies. Public-safety agencies are looking to make use of the 700 MHz (megahertz) broadband spectrum that was cleared by the switch.

The NIST-NTIA Public Safety Communications Research (PSCR) program, under the direction of Dereck Orr of the Office of Law Enforcement Standards, is developing the demonstration network to provide a common site for manufacturers, carriers and public-safety agencies to test and evaluate broadband communication equipment and software designed to make use of this new spectrum. The 700 MHz demonstration network locations include the DoC Boulder Laboratories, the Boulder Table Mountain Field Site, the Radio Quiet Zone just north of Boulder, and the Washington, DC metro area. The PSCR is seeking vendors and other telecommunication companies to become Cooperative Research and Development Agreement (CRADA) partners on the demonstration network. In September, Alcatel-Lucent became the first vendor to sign a CRADA with the demonstration project. They will provide the Long Term Evolution (LTE) Bandclass 14 equipment for use on the demonstration network. The second face-to-face meeting for stakeholders is planned for December 1–2, 2010.

People News

Jim Gray, an electrical engineer in the Atomic Standards Group of the Time and Frequency Division, retired in late August after completing 50 years of government service. Jim joined NBS in 1960 working for the Radio and Microwave Materials Section, making measurements on materials such as ceramics used in radomes and ferrites employed in microwave generation.

Jim joined the Time and Frequency Division in 1967. He has worked for many years in operating and maintaining the NIST time scale – the collection of commercial atomic clocks (hydrogen masers and cesium beam standards) with a complex electronic measurement system that serves as the source of all NIST time and frequency measurements. The NIST-F1 primary frequency standard (often colloquially called the "NIST atomic clock") is used to periodically calibrate the time scale. But the direct source of time and frequency for all NIST time and frequency measurements is the time scale that Jim operates, in collaboration with others in the Division. As with any complex system, there are quirks and an art in addition to science and engineering. And Jim has unparalleled knowledge and experience of how to keep everything running to provide the best possible time and frequency information.

Unlike other NIST measurement services, NIST time must be available 24/7/365. That has meant uncountable trips for Jim to NIST in the middle of the night to respond to alarms when something is not going right with the time scale. Of course, many of these alarms occur in the middle of blizzards or other inclement weather. Jim's expertise and dedication have been crucial to NIST's success in providing world-class time and frequency measurements. After retirement, Jim immediately returned to work full-time in the Division as a contractor. Although his service is highly valued and needed – Jim is also being encouraged to take at least a little time to enjoy his "retirement."

Tom Siewert, a metallurgist in the Structural Materials Group of MML's Materials Reliability Division, retired in September after 26 years at NIST. His major research interests at NIST have included pipeline safety, welding, mechanical testing, impact testing, Charpy impact testing, non-destructive evaluation, bridge safety, civil infrastructure, etc. He is probably best known for his development of a world-class program in arc welding at NIST. Through his efforts, NIST has developed and demonstrated methods for computer control of the welding process. This work included collaborations with such partners as the automotive industry and the heavy construction-equipment industry. Tom played a key role in the development of an on-line database for solder properties that emphasized the new lead-free solders. Most recently, he has been involved with a project on hydrogen-pipeline safety to establish the codes and standards necessary to ensure safe distribution of hydrogen fuels. The future hydrogen economy will depend on efficient transport of fuel across the U.S.

Tom has received numerous honors while working at NIST: a DoC *Bronze Medal Award* in 1991, a second in 1993 for an arc-welding diagnostic system, the DoC *Gold Medal Award* in 2003 for facilitating conversion to lead-free solders, the NIST *Judson C. French Award* in 2006 for improving the NIST Charpy Program, a third Bronze Medal in 2009 for developing techniques to measure the crack extension in line pipe at near-explosive rates, and two *Awards for Excellence in Technology Transfer* from the Federal Laboratory Consortium—in 1994 for work on weld sensing and in 1998 for work on solidification sensing. He also received the *Rene Wasserman Memorial Award* for a paper published in the *Welding Journal* entitled, "Preserving a National Landmark," which described the activities of a group of welding experts led by Tom to study the best way to make weld repairs to the cast-iron outer shell of the U.S. Capitol dome to restore it to its original condition. Tom will be moving to the Dallas, TX area in a few months, but will continue to be involved in projects at NIST.

Jan Hall of JILA and the NIST Quantum Physics Division recently received a 2010 *CO-LABS Governor's Award for High-Impact Research* in the area of foundational technology. CO-LABS, incorporated in 2007, is a consortium of federally funded scientific laboratories, universities, businesses, local governments and community leaders organized to establish Colorado as a global leader in research, technology and their commercialization. Hall has led teams of researchers since the 1960s to explore the nature of laser light. His teams ultimately developed the laser as a tool for hyper-precise measurements. By making stable lasers of precisely one frequency (color), it became possible to measure the speed of light with an accuracy 1000 times better than those of previous measurements, leading to major changes in the international system of measurements. The subsequent development of "laser frequency combs" utilizing multiple lasers has led to breakthroughs

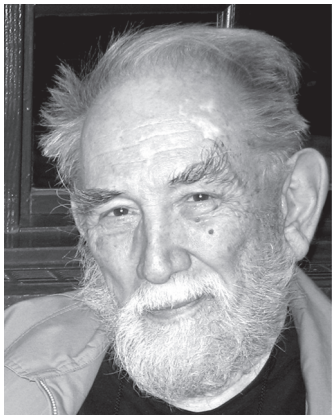
in telecommunications, medical research, semiconductor processing and photonics, and contributed to numerous spin-off companies. He was awarded the *Nobel Prize for Physics* in 2005 in recognition of these discoveries.

—Mickey Haynes and Ray Radebaugh

7. OBITUARIES

Bradford R. "Brad" Bean, 82, an atmospheric scientist and former chief of the NBS Radio Meteorology Section, died on September 12, 2010 in Boulder, CO.

Dr. Bean was born in Boston, MA on September 14, 1927. He received his B.S. degree from the University of New Hampshire in 1949, and his master's from the University of Colorado, Boulder in 1963. In 1966 he was the first recipient of the Ph.D. degree in Atmospheric Science from Colorado State University, Fort Collins, Colorado.



He worked for the U.S. Weather Bureau Observatory, Durham NH (1945–1949), and the Weather Bureau's Central Analysis Unit, Washington, DC (1949–1950) before he joined the Central Radio Propagation Laboratory (CRPL) in 1950 when it was still located in NBS Washington. He moved out to Boulder in 1951 with an early group from CRPL as the lab was being constructed. In 1958 he became chief of the Radio Meteorology Section, which later became part of NOAA. He remained with NOAA until his retirement in 1981.

Bean published more than two dozen scientific papers and monographs over the course of his career. He co-authored *Radio Meteorology* (U.S. Department of Commerce, Washington, D.C., 1966, 435 pages). Because of his visionary understanding of radio meteorology, his publications continue to be cited by radio meteorologists here and abroad.

He received numerous awards and commendations during his career, including a DoC *Silver Medal Award* in 1963 for "Outstanding contributions and leadership in the field of radio wave refraction" and a DoC *Gold Medal Award* for "Outstanding authorship and major contributions to radio meteorology and for dynamic leadership in the development and execution of airborne research in atmospheric turbulence."

Bradford R. Bean's wife, Lila Lee, died in 1998. He is survived by his daughters, Rebecca Levy of Scottsdale, AZ, and Elmdea (Claudia) Bean of Winchester, VA; his grandson Aaron Levy of Scottsdale; his adopted daughter Virginia Johnson of Westminster, CO; and his step-sons John Edwards of Chico, CA, Matthew Edwards of Dallas, TX, and Steve Edwards of La Junta, CO, who will miss his wry sense of humor, his generosity of spirit, and his ability to tell wonderful and engaging stories.

Source: NIST Archives and Elmdea Bean.

William F. "Bill" Egelhoff, 61, a NIST Fellow and physical chemist in the Metallurgy Division, died on August 18, 2010. He had resided in Rockville, MD for 31 years.

Bill was born in Norfolk, VA on July 8, 1949. The eldest of four children, he was a fierce protector of his siblings. He graduated magna cum laude from Hampden-Sydney College in 1971 with a B.S. in chemistry and election to Phi Beta Kappa. He went on to earn a Ph.D. in physical chemistry from the University of Cambridge in 1975. He then completed a postdoctoral fellowship at the California Institute of Technology in Pasadena, CA in 1976, followed by a scientific exchange in Academgorodok (Siberia) where he met his wife, Natasha. They were married on September 3, 1976, in Novosibirsk, Russia.

Egelhoff joined the Surface Science Division of NIST in 1979. While he was in this division, his work on surface-related effects of electrons ejected by X-ray bombardment led to his creation of new tools for the understanding and assessment of nanoscale single-crystal films on surfaces. His work was recognized by the award of the NIST *Bronze Medal* in 1985 for "his innovative use of X-ray photoelectron spectroscopy for the determination of thermochemical, electronic and structural properties of surfaces and surface layers…" and the DoC *Silver Medal* in 1988 for "creative research contributions to the development of the technique of forward scattering in X-ray photoelectron spectroscopy and Auger-electron spectroscopy and in applying it to the fabrication of thin-film materials with novel magnetic properties. This technique has been shown to be crucial for growing ordered ultra-thin films with thicknesses of less than about 5 atomic layers, a range not easily accessible previously." As a result of his achievements he was elected to Fellowship in the American Physical Society in 1991. He also received a NIST *Competence Program Award* that year.

In 1994, Bill moved to the Metallurgy Division, where he worked on giant, tunneling, ballistic, and directionally dependent magnetoresistance effects. In 1998, he received the *Samuel Wesley Stratton Award*—granted to recognize truly outstanding scientific accomplishment—for "world leading developments in the science and engineering of thin-film giant magnetoresistance (GMR) spin valves, the critical element in next generation read heads… By working closely with the National Storage Industry Consortium to spread the benefits of his discoveries to U.S. Industry

(continued on next page)

in real time, he also was partially responsible for the very short nine-year period between discovery of the GMR effect (1989) and a product on the marketplace."

In 2003 he and colleagues at NIST largely debunked the ballistic magnetoresistance effect as a measurement artifact, thus deflating what had been touted as a means to create very large resistance changes and thus even higher densities of computer data storage. Also in 2003, he received another *Competence Program Award* and the DoC *Gold Medal Award* was bestowed on him for: "scientific and engineering contributions to the next generation of magnetic data-storage devices and the establishment of the Magnetic Engineering Research Facility." For his magnetoresistance work he was elected a NIST Fellow in 2005, an honor accorded to only 2 percent of NIST's technical staff. It should also be noted that he served as divisional associate editor of *Physical Review Letters* from 1996 to 2002.

During his 31 years at NIST, he developed and applied techniques sensitive to the outermost atomic layers of a sample to characterize the atomic structure of very-thin films. He applied that knowledge to layer atoms on top of other layers to create structures with improved, unusual and unique magnetic properties. According to Bob Shull, group leader in the Magnetic Materials Group within the Metallurgy Division and a longtime colleague, the latter work had an extraordinary effect on the computer industry. "Bill led the world for a number of years in making layered thin-film metallic structures which generated the highest magnetoresistance values in response to weak magnetic fields," said Shull. "The computer industry used his research to develop more sensitive magnetoresistance sensors, which were then used as the read head on hard drives, thereby enabling them to store multiple gigabytes of data on a single disk."

"He was a superb creative scientist, with excitement and enthusiasm bursting forth in a continuous stream," per Frank Gayle, chief of the Metallurgy Division. "He was leading three major NIST efforts, and was at the cutting edge of his field in each case." Egelhoff had very high standards. "He always wanted to get his work done right away and couldn't wait until tomorrow if he needed a new part or a measurement on a piece of equipment," says Gayle. "He constantly challenged us, but I loved every minute of it. It was a thrill as a scientist to be working with him."

According to his colleagues, Egelhoff was an extraordinary intellect, a generous man, thrifty with research funds and possessing an incredible work ethic. He published 282 articles in scientific journals and gave 284 scientific presentations. His NIST lab for the deposition, processing, and *in-situ* characterization of magnetic thin films was "the most elaborately instrumented magnetic thin-film deposition facility in the world" (See his blogsite: <http://billegelhoff.blogspot.com>.)

Egelhoff was the most collaborative of scientists, and one of the most versatile, according to Gayle. He could propose novel approaches on far-flung topics, such as ways to measure the level of corrosion of the steel reinforcing bars embedded within America's aging concrete bridges using an obscure technique: antiferromagnetic resonance. "He considered his most important contribution to physics to be an explanation of an effect in electron-atom scattering that had not been fully understood for 60 years," Gayle reminisces. Egelhoff showed that the scattering phenomenon could be understood in a relatively simple way that gave greater insight than the complex model that had been used previously. His explanation was published in *Physical Review Letters* in 1993.

"He was proud of his many frontier contributions to surface physics and thin-film research, particularly those published in the prestigious *Physical Review Letters* and *Applied Physics Letters*," said Cedric Powell, scientist emeritus in the Surface and Microanalysis Science Division. "Egelhoff's articles were highly cited, with 12 papers each having over 100 citations."

He frequently worked seven days a week. Before the advent of e-mail, he even had a fax machine installed at home so he could receive results from the lab through the night. He didn't take much vacation time, and seems not to have taken any sick leave. At his death, he had accumulated 678 hours of annual leave and 3,236 hours of sick leave.

Despite his strong work ethic, Bill loved to socialize and was an avid gardener. His large garden expanded each year so that he had more to share with family, colleagues, neighbors and many others in the community. On the day before his death he came to work with homegrown tomatoes to share with colleagues. A pilot, with his own plane at the nearby Montgomery County Airpark, Bill would spontaneously invite colleagues to fly over to the Eastern Shore and back for a meal at a restaurant.

He brought his infectious energy, constant smile, brilliant intellect, ceaseless curiosity, and self-deprecating sense of humor with him wherever he went. Despite his outstanding accomplishments and aptitude, he was one of the most humble and down-to-earth people around. Bill was a true gem and a rare specimen. He will be profoundly missed by those who knew him and loved him.

William F. Egelhoff was survived by his wife, Natasha; their son, Tom Alexander Egelhoff and daughter, Helen Brackenridge John; stepson, Roman Kovalev; grandson, Landon William John; step granddaughter, Konstanza Kovalev and step grandson, Aleksandr Kovalev; his parents, Rev. William Frederick Egelhoff Sr. and Caroline Brackenridge Talbot; his sisters, Elizabeth Wright Schusser and Catherine Brackenridge Egelhoff and his brother, Tom Talbot Egelhoff; and five nephews and one niece.

Sources: NIST Archives; Richard Wilkinson, editor, NIST *Connections*; and *The Washington Post* (DN), September 18, 2010.

Alexander J. Fatiadi*, 87, a former member of the Organic Analytical Research Division, died peacefully on September 16, 2010 with his family close at his side. He lived in Takoma Park, MD.

Alexander Johann Fatiadi was born on October 22, 1922 near Kharkov, Ukraine. After World War II, he studied chemistry at the Technical Husbandry Institute of the Universitaet Mainz, Germany and earned the degree Dr. Nat. Sci. in 1950. He came to the Washington, DC area in 1951 and continued his studies at The George Washington University where he held the position of research assistant chemist from 1956 to 1959. He received a B.S. degree in 1957 and a M.S. degree in 1959. In that year he joined the Organic Chemistry Section of the Chemistry Division at NBS as a research chemist.

Alex was hired by Dr. Horace S. Isbell, a carbohydrate chemist, to work on tritium-labeled carbohydrates, but he soon branched out to work on chemical synthesis and other types of compounds of interest to him. He remained in this section from 1968 to 1987 as a project leader, through many reorganizations of NBS/NIST.

Alex was always very passionate about science. His exuberance and enthusiasm for chemistry were boundless. He liked nothing better than being in the lab—synthesizing new compounds, and devising novel synthetic methods. He had great synthesis skills: only he knew the intermediate reaction sequences, and the possible reaction outcomes for these new, difficult, compounds. And, under all circumstances, he wore a fresh white, ironed lab coat!

Alex retired in 1994. His professional honors included the *International Scholars Award* from the International Science Society, Strasbourg, France in 1973, the 1981 *Hillebrand Award* presented by the Chemical Society of Washington, and an honorary D.Sc. degree from the World University, Tucson, AZ in 1985. In 2000 he was named one of the *Outstanding Scientists of the 20th Century* in honor of "outstanding contributions in the field of organic and bioorganic chemistry" by the International Biographical Center in Cambridge, England, and he received the *Twentieth Century Achievement Award* from the Board of Directors of the American Biographical Institute.

He was a member of the American Chemical Society, the New York Academy of Sciences and the Royal Society of Chemistry.

He will be remembered by his friends and colleagues for his zest for all aspects of life; his passionate discussions of current events, politics and world history (especially European history, Genghis Khan and the Mongols—Alex would tell interesting stories about historical events); his love of classical music and opera, Western movies and television shows, including Bonanza, and his fondness for dancing polkas. He was also an avid fan of the Washington Redskins.

His wife of over fifty years, Irena I. Fatiadi, died in 2003. Alex is survived by four daughters: Elena Zahirpour and Irina Weiss, both of Silver Spring, MD, Tamara Stoner of Burtonsville, MD and Julie Steimel of Severna Park, MD; and six grandchildren: Benjamin Zahirpour, Ana, Andrew and Matthew Weiss, Katherine Stoner and Alexandra Steimel.

Sources: NIST Archives, Lorna Sniegoski, Edgar Etz, and *The Washington Post* (DN), September 20, 2010.

Alan D. Franklin*, 87, a research chemist and former chief of the Mineral Products Division, died on August 27, 2010 of a heart ailment at his home in Newville, PA.

Alan Douglas Franklin was born on December 10, 1922 in Glenside, PA, near Philadelphia—the third of four children. Their father, Ben Jr., had a construction business which failed in the Great Depression and the family moved to an apple orchard, also just north of Philadelphia. His father was Alan's role model; he taught by example how to make do, repair and invent handy apparatus, and always do well.

Alan graduated from Cheltenham High School in Elkins Park, PA. In 1939, he began studies at Princeton University but left at the end of his junior year to volunteer in the Army Air Corps. He served as a photographic officer from 1942 until 1945 and was assigned to the 25th Bomber Group in England. After the war, he returned to Princeton and received a bachelor's degree and a doctorate in chemistry in 1946 and 1950, respectively. He was chief of the Magnetics Section at the Franklin Institute in Philadelphia before coming to Washington.

Franklin joined NBS in 1955 to conduct research on the fundamental properties of ferroelectric materials, becoming chief of the Ferroelectricity Group. In 1960 he became chief of the Mineral Products Division. In this new position he directed the Bureau's research on properties of non-metallic inorganic solids, including such industrially important materials as ceramics, glass, refractory oxides, etc. The properties of materials at high temperatures were an important part of this research with a view to supplying techniques and measurement standards for research on the materials that are needed in the design of rockets, missiles, atomic reactors, and other devices operating in high temperature environments.

During 1963–64 Alan held a temporary training assignment as senior scientist to the Theoretical Physics Division, Atomic Energy Research Establishment (AERE), Harwell, England.

From 1966 to 1967 he was on temporary loan to the Department of Defense Advanced Research Projects Agency (DARPA), where he served as deputy director of

(continued on next page)

the Office of Materials. After this he had enough of management and returned to the position of research chemist in the Physical Properties Section of his old division, now the Inorganic Materials Division. He engaged in theoretical and experimental studies of point defects in ionic crystals, particularly alkaline earth halides and simple oxides, and created an internationally recognized materials science group at the Bureau. This led to his receipt of the DoC *Gold Medal Award* in 1970 for "outstanding contributions to national priorities in materials science and the science of point defects in solids." He retired in 1981. But, for Alan, "retirement is opportunity."

He expected to spend his retirement with his wife, Kit, enjoying ten rural acres in Shepherdstown, WV, near Harpers Ferry. Instead, during the first winter Alan lived in a 14th century cottage in Dorchester, England while back in the Theoretical Physics Division at AERE working on a general theory of ionic motion in crystals. The following winter, he was in Adelaide, Australia, working at Flinders University.

Next, Bill Hornyak, a nuclear physicist and physics professor at the University of Maryland, invited him to join in establishing a laboratory in the Physics Department devoted to the use of thermoluminescence (TL)—a subject in which Alan had specialized—to date archeological and geological materials. With Alan as a visiting scientist, they operated this lab from 1983 to 1992, when Hornyak retired from the university and the lab moved to the University of Washington. This was too far for Alan to commute—he had kept old cars at both ends of the train line so that he could commute from Harpers Ferry to the University of Maryland!

While the lab was in operation, Alan and Bill had dated countless items and sediments located primarily in Africa and along the Mediterranean coast, but they were really interested in the physics of the process and published over 20 papers in those ten years. Between 1992 and 1999, Alan had three extended visits to the Physics Department of the University of Adelaide, which has some of the best TL dating laboratories in the world. It also has beautiful beaches nearby that he and Kit enjoyed during their stay. He continued to collaborate with a colleague there until this year, publishing papers on thermoluminescence dating.

He was a Fellow of the American Physical Society and the American Ceramic Society, and a member of the American Chemical Society and the British Institute of Physics. He was also a member of Phi Beta Kappa and Sigma Xi.

Alan had a life-long passion for justice and was a fierce fighter for various causes. In the early 1950s these were particularly concerned with promoting civil rights. At that time he was a member of All Souls Unitarian Church in Washington. The church hosted the Police Boys Club, but terminated their use of the facilities when the club refused to admit African American boys.

Instead, the church started their own club, the Columbia Heights Boys Club (later, when it admitted girls, the Columbia Heights Youth Club). It was the first integrated youth club in Washington. Alan served on its board from 1958 until 1981. He set up a darkroom in the church basement and ran a photography club for boys as part of the Youth Club. He also, with Kit, joined members of the church for the last day of the Rev. Martin Luther King, Jr's march to Montgomery, AL after the murder of the Rev. James Reeb, of All Souls.

After he retired and moved to Newville, Alan's fight for justice turned toward the lesbian, gay, bisexual and transgendered community. His brother Ben, a closeted gay man, had committed suicide. Alan's contribution to the struggle for gay rights was to be a means of coming to terms with his personal sense of having let Ben down by not acknowledging that he was gay and offering him support. He became a dedicated and passionate advocate and ally of the cause. He was instrumental in his congregation's effort to study homophobia and declare themselves to be a Welcoming Congregation: a declaration of congregational support for the struggle and a notice that doors were open to welcome all people regardless of their sexual orientation or gender preference.

He was very proud that he took a leading role in founding and operating the Cumberland Valley Unitarian Universalist Church in Boiling Springs, PA. He participated on the Steering Committee even before the congregation was chartered, and served as chair of the Social Action Council and of the Nominating Committee, as well as in many other roles. His devotion to youth carried on in Cumberland County, where he was a volunteer tutor at Lamberton Middle School. He also served as a mentor to youth, including some in his congregation's coming of age program, where he encouraged intellectual exploration and philosophical learning.

His marriage to Phoebe Taylor ended in divorce.

Alan Franklin's survivors include his wife of 50 years, Katherine McMurdie of Newville; two children from his first marriage: Adrienne Franklin of Westerly, RI, and Christopher Franklin of Newcastle, ME; a sister; and three grandchildren. Sadly, his adopted daughter from his second marriage, Mary Petitt of Janesville, WI died on September 17, 2010.

Sources: NIST Archives, Katherine McMurdie Franklin, and Timothy R. Smith, *The Washington Post*, September 6, 2010.

Gladys H. Fuller, 86, a former guest researcher in the Office of Standard Reference Data (OSRD), died on October 20, 2010. She resided in Bethesda, MD.

Gladys Heinlein Fuller was born on January 21, 1924 in New York City, where she lived through college. She received a B.A. with a major in mathematics from Hunter College in 1945. Gladys then attended the University of Illinois on a teaching assistantship in physics from 1945 to 1950, obtaining an M.A. in physics in 1946. She worked on a theoretical thesis on meson field theories under Professor S. Dancoff but, due to her marriage to Everett Gladding

Fuller—whom she met as a fellow graduate student—and their subsequent move to Montgomery County, MD, she never finished the dissertation for her Ph.D.

After 1950 Gladys worked part-time on nuclear-data compilation with the Nuclear Data Group directed by Katherine Way. This group was first connected with NBS, then moved to the National Academy of Sciences. In 1965 the group moved to Oak Ridge National Laboratory. At that time Gladys and a few others stayed behind as guest researchers under contract at NBS. She worked in the Office of Standard Reference Data (OSRD) until 1976 on a compilation of nuclear moments. She published a 250-page paper on nuclear moments in the *Journal of Physical Chemistry Reference Data* in 1976. After this she was an adjunct professor of physics at Montgomery College for thirteen years.

Her interest in gems and minerals, as well as in teaching, led her to become a docent at the National Museum of Natural History, an activity she continued for over 25 years, until she was unable to walk from the car to the mineralogy floor. She also took materials (rocks) to schools for lectures and demonstrations.

Aside from physics and geology, Gladys had a wide range of interests including astronomy, photography, opera, theater and ballet. She was active at the Metropolitan Academy of Ballet in Bethesda for many years. After the school closed she took classes at the Maryland Youth Ballet where several famous ballerinas like Julie Kent of the American Ballet Theatre were trained. Gladys was always cheerful, always determined to keep up her classes even after a heart operation with the complication of a stroke. She was there in her 80s. Everybody at the school admired her courage. She loved the Adirondacks. She enjoyed traveling to places near and far to meet new people and to learn about geology, history, and different cultures. She went to South America to experience and photograph the sun's eclipse.

Her husband, Everett G. Fuller, who was chief of the Photonuclear Physics Section in the Center for Radiation Research, died in 1995.

Gladys Fuller is survived by her friend, Bob E. Carter; her children: Wendy Fuller-Mora of Washington, DC, Jef Fuller of Brookeville, MD and Susan Conley of Annapolis, MD; seven grandchildren: Louisa, Ella, Lizzy, Anna, Jason, Cheryl and Shawn; and three great-grandchildren.

Sources: NIST Archives, Wendy Fuller-Mora and *The Washington Post* (DN), October 23, 2010.

William Robert "Bill" Hosler*, 86, a long-time physicist at NBS/NIST who specialized in the study of semiconductors, passed away on August 21, 2010, after a long bout with Alzheimer's disease. Bill died peacefully at his home in Poolesville, MD, in the company of his family.

Bill was born on January 1, 1924 in Berwick, PA. In the fall of 1942, he enrolled as a first-year chemistry major at Penn State University. His college education was interrupted by World War II, however. He entered the U.S. Army in November of 1944 and was in training as a cadet fighter pilot when the war in Europe ended. He was discharged from the service in November 1945. Bill returned to Penn State and graduated with a B.S. degree in physics in 1948. While he was a student, he was a member of the Penn State Chemistry and Physics Student Council. After graduation, Bill spent two years assisting a friend in the construction business. During the course of that occupation, he obtained a license as a master electrician.

He joined the National Bureau of Standards in 1950 and began a long and fruitful collaboration with Hans Frederikse and others in the Solid State Physics Division. Bill also continued his science education at the University of Maryland during the period 1953 to 1956. Although he worked on several different projects at the Bureau, Bill's favorite study was semiconductors. With R.G. Breckenridge, he evaluated the electrical properties of titanium dioxide from 1951 to 1953. The two were joined by W. Oshinsky in 1953 in a similar study of indium antimonide. Following that work came a major study of intermetallic compounds, including indium antimonide, gallium antimonide, aluminum antimonide and magnesium stannide, that involved Hosler, Breckinridge, Oshinsky, Frederikse, J. R. Becker, and R. F. Blunt. The papers describing that work have been cited by hundreds of other scientists.

In the late 1950s Hosler and Frederikse began a collaboration on the galvanomagnetic effects in semiconductors at temperatures down to 4.2 K. Bill also collaborated with R. P. Hudson on a study of the magnetic susceptibility of crystals of cerous magnesium nitrate.

In the early 1960s Hosler and his colleagues started a wide-ranging study of strontium titanate, an unusually interesting semiconductor because of its complex Fermi surface. Marvin L. Cohen, a solid-state physicist at the University of California, became interested in strontium titanate and predicted that the semiconductor might become a superconductor if it were cooled to sufficiently low temperatures. Bill collaborated with J. F. Schooley of the Cryogenics Section to test Cohen's theory and found it to be true for temperatures ranging from 0.1 K to 0.3 K. For several years Hosler and Schooley tested samples of strontium titanate prepared with varying concentrations of electronic carriers, roughing out a curve showing the dependence of the superconducting transition temperatures on the carrier concentration. Hosler and his colleagues studied the magnetoresistance and conduction bands of strontium titanate, while Schooley and his colleagues studied pressure effects and the behavior of its critical magnetic field characteristics. The same solid-state-plus-cryogenic-physics group also found a family of superconducting semiconductors in ceramic mixed titanates. Again, these publications were

(continued on next page)

widely used by the general physics community.

In 1967, Frederikse, Hosler, and W. R. Thurber published a study of the magnetoresistance of semiconducting strontium titanate showing clear indications of Shubnikov–de Haas oscillations in high magnetic fields at temperatures ranging from 1.4 K to 2.1 K.

In 1973, Bill was given the DoC *Silver Medal Award* "in recognition of his outstanding contributions to the field of electronic transport in semiconductors and insulators. His vast knowledge of experimental techniques has made it possible to measure the electrical properties of many novel materials over a wide range of external conditions. The results of his investigations not only have provided valuable new data but often have led to basic scientific explanations and significant technological developments." He continued to participate in a wide variety of experimental studies until his retirement in the early 1980s.

In 1953 Bill married Mary Lou Cragoe, daughter of Carl S. Cragoe, one of a group of promising scientists hired in 1917 by NBS Director Samuel Stratton. Bill and his wife sang together for many years, both in their church and around the family campfire. He also made use of his master electrician skills to assist in the maintenance of and improvements to his church and home, and the homes of his friends. In 1986 a new addition to St. Peter's Church was named Hosler Hall in recognition of his extensive commitment of time, talent and devotion to completing the new community hall.

William Hosler is survived by his wife, Mary Lou; two daughters, Nancy Ruhe and Sally Lee; and twelve grandchildren. Their son Brad died in 2007. Bill's easy-going personality and helpful attitude will be missed by his many friends at NIST.

Sources: Mary Lou Hosler, The Special Reference Desk at Penn State University, the Reference Desk: Stacy Bruss and Keith Martin, at NIST, *The Monocacy Monocle*, September 17, 2010 and Jim Schooley.

Robert D. Larrabee*, 78, a research physicist in the Precision Engineering Division at NIST from 1977 to 1993, died on September 2, 2010 at Montgomery Hospice's Casey House in Rockville, MD. He had pancreatic cancer. He lived in Derwood, MD.

Robert Dean Larrabee was born in the New York borough of Queens on November 29, 1931. He received a bachelor's degree in electrical engineering and a master's degree in mathematics in 1953, both from Bucknell University in Lewisburg, PA. He continued his studies at the Massachusetts Institute of Technology where he received a master's degree in 1955 and a doctorate in 1957, both in physics.

Larrabee was a research engineer for RCA Laboratories in Princeton, NJ, from 1957 to 1976, first in the David Sarnoff Research Center until 1971 and then as a senior engineer in the Advanced Technology Laboratory. He also earned an M.B.A. degree from Rider College in 1976.

He joined the Semiconductor Characterization Section of the Electronic Technology Division in 1976. Bob moved on to the Electron Devices Division in 1978 and to the Semiconductor Materials and Processes Division in 1984. He became chief of the Microelectronics Dimensional Metrology Section in 1981 and stayed there through its reorganization into the Precision Engineering Division until he retired at the end of 1993.

His research centered on semiconducting materials and devices: microwave oscillators and amplifiers; the characterization of semiconductors; optical and scanning-electron microscope sub-micrometer metrology.

Larrabee continued his research as a guest researcher until 2000. He received a NIST *Bronze Medal Group Award* in 1999 for "developing a unique optical microscope and the first of several new calibration standards to meet industrial needs in overlay metrology" and he received a *Federal Laboratory Consortium Award for Excellence in Technology Transfer* in 2000, with Michael Postek, Andras Vladar, William Keery and Sam Jones, all of the Precision Engineering Division, and Nien-Fang Zhang of the Statistical Engineering Division for their work in developing the Scanning Electron Microscopy Monitor. He held nine patents.

He was a member of the American Association for the Advancement of Science, the American Physical Society and Sigma Xi, and a senior member of the IEEE.

He also belonged to the Montgomery Amateur Radio Club and the Mid-Atlantic Antique Radio Club.

Since 1999, he had volunteered for the Montgomery County school system, giving science demonstrations to students. He also tutored General Education Development students at the Montgomery County Correctional Facility in Clarksburg, MD. He was a member of St. Paul United Methodist Church in Laytonsville, MD.

Robert Larrabee's survivors include his wife of 57 years, Ramona Rogers Larrabee of Derwood; two children: Susan L. Albohn of Morgantown, PA, and David A. Larrabee of Swiftwater, PA; a brother, Allan Larrabee of Washington state; and five grandchildren.

Sources: NIST Archives, Ramona Larrabee and Lauren Wiseman, *The Washington Post*, September 16, 2010.

Charles K. S. "Chuck" Miller, 79, former chief of the Electromagnetic Fields Division, died of Alzheimer's disease on June 7, 2010, at the Edgewood Vista facility in Billings, MT.

Chuck Miller was born in Newcastle-on-Tyne, in the north of England, on February 5, 1931. He received his early education in England and India, before emigrating to the U.S. with his family in 1948. He served four years

of active duty with the U.S. Air Force in Korea. He married Bonnie Lea Dougherty in 1951 and they subsequently raised four children, all boys. He received the B.S. degree in engineering physics from the University of California, Berkeley, in 1958.

He joined the NBS Radio Standards Laboratory in Boulder in 1961. He developed a specialty in standards of microwave noise (of critical importance for the testing of sensitive receivers) and radio interference. In 1970 he took charge of a major project to develop standards of power, noise temperature, attenuation, reflection coefficient, and antenna gain and pattern in WR-15 waveguide (in the range of frequency from 50 to 75 GHz). The project was funded by the U.S. Air Force, and throughout his subsequent career Chuck was very successful in getting military sponsors for other major projects.

In 1973 he was appointed chief of the Noise and Interference Section of the Electromagnetics Division, and when Hal Boyne retired he became chief of the Electromagnetic Fields Division, which position he retained until his own retirement in 1987.

Al Newell was a close colleague of Chuck, and remembers him as an honest and straightforward person, a pleasure to work with. Bob Kamper also remembers him as a very civil fellow division chief. He kept his home life strictly separate from his job: every evening he would depart for his home in the mountains in his International Scout (an early model SUV), wearing his characteristic porkpie hat. None of his colleagues knew exactly where he lived, and it was rumored that he did not have a telephone up there.

Chuck is survived by his wife, Bonnie, four sons, five grandchildren, and his sister, Rosemary Orth.

Sources: Bob Kamper, Al Newell, Wilbert Snyder (*Achievement in Radio*, 1986).

Clinton W. Phillips*, 91, a mechanical engineer in the Center for Building Technology, died on October 13, 2010 at the Riderwood Village retirement community in Silver Spring, MD. He had congestive heart failure.

Clinton Woodward Phillips was born on April 24, 1919 in Washington, DC, the son of Harry Clinton and Bessie Ellen Phillips. Clinton, a graduate of Central High School, worked in the printing and mailing section of his father's advertising business during his high school years and until 1940. As a teenager, Clinton earned the rank of Eagle Scout, and, until 1939, spent his summers at Boy Scout Camp Roosevelt, Chesapeake Beach, MD. He joined the staff as a counselor and was encouraged by another staff member to study refrigeration. He was already a competent mechanic, having learned all about the construction and operation of the electrified streetcar system in Washington. He had bought a car in 1936 and he worked as an automobile mechanic after graduating from high school. This auto repair job led to his becoming service manager for a division of Carrier Corporation in charge of setting up their first service shop in Washington. In 1940, Clifton married Ethel Catherine Lynch, a sister of the engineer who had encouraged him at Camp Roosevelt.

In 1942, Clinton wanted to study flight and applied to NBS but, with refrigeration on his resume, he was offered a position in refrigeration research and he joined the Heat and Power Division. After he lost his left eye in a lab accident, he set out on a path to develop improved refrigeration standards. Through the NBS work/study program he earned the rank of mechanical engineer in 1950 and obtained his professional engineering license in 1951. He became manager of the air conditioning and refrigeration laboratory in 1960 and was promoted to senior mechanical engineer in 1970.

From his start in refrigeration, Phillips developed an expertise in energy use in large mechanical systems. His work on standards development for refrigerated interchangeable containers—among trucks, trailers, airplanes and ships—was especially important to the frozen-food industry. In 1974 he was co-author of the electro-mechanical section of an early building energy standard that became the basis for current national and international building energy standards and codes.

From 1974 to 1979 he led an NBS team in an interagency project to conduct research on theoretical and actual performance of integrated utility plants and integrated distribution of these services. This research was to determine functional feasibility and long-term economics of such systems for cities and other large groups of buildings. They carried out the instrumentation and observation of the performance of a total energy plant (heating, cooling, electric power) serving a group of high-rise commercial and residential buildings in Jersey City, NJ. Team members presented their research for discussion with students at a number of U.S. colleges and universities and with groups of utility engineers in The Netherlands, Germany, Italy, France and Belgium.

Phillips retired from NBS in 1982 and became an engineering consultant. He was technical director of the North American District Heating and Cooling Institute from 1983. He worked with industry groups to develop more energy-efficient, large-scale combined heating, cooling and power systems on college campuses and in cities. He served on several International Standards Organization's instrumentation committees from 1987 to 1990 and, under the sponsorship of the Department of Energy, he was the U.S. Representative on the International Energy Association's Task Group on Thermal Metering.

He served as international president of the American Society of Heating, Refrigerating and Air-Conditioning Engineers in the year 1982–3. He had been a member of

(continued on next page)

the society since 1945 and was a life member.

His lifelong enthusiasm for wheeled transport included motorcycles. While in Italy, he had visited a motorcycle factory and ordered one that was still being designed. It was shipped to him two years later. Clinton rode motorcycles for sixty years until he moved to Riderwood Village in 2001. He joined the Riderwood Woodcrafters and was an active member. He was a member of the Catholic Church of the Resurrection in Burtonsville.

His first wife, Ethel Lynch Phillips, died in 1981.

Clinton Phillips' survivors include his wife of 27 years, Mary Jane Orloski Phillips* of Riderwood Village; two sons from his first marriage, James W. Phillips of Champaign, IL and Stephen T. Phillips of Owings, MD; four grandsons; and 11 great-grandchildren.

Sources: NIST Archives and Adam Bernstein, *The Washington Post*, November 5, 2010 and *The Washington Post*, May 19, 2009.

Del L. Rollison, 62, a former member of the Plant Division, died on Thursday, September 2, 2010, at The Johns Hopkins Hospital in Baltimore after suffering a heart attack at Hollow Creek Golf Course while golfing on the previous Monday. He was a resident of Middletown, MD.

Born on September 6, 1947, in Washington, DC, he was a son of the late Delbert and Nellie Beatrice Kitts Rollison. He was a U.S. Navy veteran of the Vietnam War.

He was employed for about five years at the Naval Ordnance Laboratory before coming to NBS, where he worked in the Plant Division for the next ten years.

Mr. Rollison left NBS to set up his own reprographics business, RSI, in Frederick, which he operated from 1986 until his retirement in 2006.

He was a member of Holy Family Catholic Community Church, Middletown. He was a life member of Valley Memorial Post 9 of AMVETS, Middletown, and was also a member of the Francis Scott Key American Legion Post in Frederick. He was an avid golfer.

Del Rollison is survived by his wife, Carol Ann Rollison; three children: Michelle Gamba Rollison of Frederick, Micheal Del Rollison of Tampa, FL, and Justin Joseph Rollison of Leesburg, VA; five grandchildren: Owen Gamba, Cole Gamba, James Rollison, Julia Rollison and Brooke Rollison; three sisters: Nancy Saltz of California, and JoAnn Stewart and Donna Mundy, both of Boise, ID; and his mother-in-law, Rosemary Barishek of Frederick.

Sources: NIST Archives and *The Frederick News Post*, September 4, 2010.

Charles Edward Taylor, 87, a machinist and former chief of the Scientific Instrument Shop (section) of the Instrument Shops Division, died on July 29, 2010 at Copper Ridge, an assisted-living residence in Sykesville, MD. He had Alzheimer's disease.

He was born in Cumberland, Maryland and moved to the Washington region after graduating from high school in 1941. He served in the Army Air Forces during World War II and worked as a machinist for the Naval Observatory before and after the war.

He joined the Instrument Shops Division at NBS in 1952 and remained in that division until he retired in 1977. During that time, from his start in Instrument Shop #3 Section, he became chief of that section in 1964, he took charge of a new section in the division: the Contact Shops/ Apprentice Program Section in 1971 and, after the Apprentice Program was dropped in 1975, he remained as chief of the Contact Shops section until mid-1977. He spent the last months of his time at NBS as chief of his old section, now renamed the Scientific Instrument Section. He retired at the end of the year.

Mr. Taylor was a Wheaton, MD resident from 1952 to 2009. He had been a member of Wheaton Presbyterian Church, serving as a deacon and trustee, and was a volunteer with Meals on Wheels.

His wife of 57 years, Kathryn Williams Taylor, died in 2003.

Survivors include four sons: William Taylor of Burke, VA, Bruce Taylor of Wheaton, Douglas Taylor of Silver Spring and Robert Taylor of Monrovia, MD; seven grandchildren; and two great-granddaughters.

Sources: NIST Archives and Lauren Wiseman, *The Washington Post*, August 13, 2010.

Paul Frederick Wacker, 96, a retired theoretical physicist with the Electromagnetic Fields Division, Boulder, died on September 7, 2010 in Redlands, California.

Paul Wacker was born in Lancaster, OH, on May 25, 1914**.** He received the B.A. and M.A. degrees in physical chemistry from The Ohio State University (OSU), Columbus in 1936 and 1939**,** respectively, and the Ph.D. degree in theoretical physics from The Catholic University (CU), Washington, DC, in 1954. While at OSU he met his wife, Stella, and they were married for 43 years prior to her death.

During World War II he worked on the Manhattan project to create the first nuclear bomb, and he has taught mathematics at CU, the University of Colorado, and the National Bureau of Standards. He joined the NBS in 1944**.** His principal interest was the theory of near-field measurements of the radiation patterns of microwave antennas and

he developed the extrapolation method for gain and effective area and the standard procedure for processing spherical near-field scanning data. His work on the theory and numerical analysis of the spherical near-field technique were essential to making it a practical and accurate measurement tool. He received the DoC *Silver Medal Award* in 1974 for "outstanding contributions to electromagnetic theory basic to antenna measurements and creative leadership in their application."

Wacker left NBS in 1979 to devote full time to writing, teaching and consulting. He taught physics and electromagnetic theory as a visiting professor at the Université Catholique de Louvain in Belgium for three years and, as recently as 2006, he addressed a conference at Oxford University on that subject at the invitation of the American and British Biographical Societies. Besides the theory of antenna measurements, his publications treat the measurement of microwave hazards and thermodynamics, and he was the senior author of a number of books on microwave spectra. He was a member of the American Mathematical Society, the Society for Industrial and Applied Mathematics, and Sigma Xi.

Paul F. Wacker is survived by his daughter Margaret Wacker, his grandson Paul Maxim Wacker and his granddaughter Catherine Fatima Wacker, all of Redlands, California.

Sources: Carl Stubenrauch, Ron Wittman, the *Boulder Daily Camera,* the *SAA Newsletter*, Vol.22, No.2 and Bob Kamper.

Stephen G. Webber Sr., 83, who retired from the Office of Standard Reference Materials and was an authority on daylilies, died on October 30, 2010 at his home in Machipongo, on Virginia's Eastern Shore. He had mantle cell lymphoma.

Stephen George Webber was born in Hempstead, NY, and grew up in Port Washington, NY, where his father became police chief. He was a U.S Navy veteran of World War II and a 1951 graduate of the University of Richmond. Mr. Webber spent his early career as a Border Patrol agent and a records and information specialist at the Immigration and Naturalization Service.

He joined the Supply Division, Storeroom Services Section of NBS in 1969 and two years later moved to the Scientific and Professional Liaison Section in the Technical Evaluation and Application Division. He worked in the Office of the Director, Center for Building Technology from 1976 to 1981, when he moved to the Public Information Division. He retired from the Office of Standard Reference Materials in 1983. Through all these changes of affiliation he wrote procedural manuals, among other responsibilities.

Over the years, Webber started a commercial daylily-growing business in Damascus, MD. He wrote *Daylily Encyclopedia* (1988), a guide to 1,000 varieties of the flower. In one entry on the yellow Mary Todd daylily, Mr. Webber noted that "though some have criticized it as resembling, in bud, a bunch of bananas, most repeat this only with appreciative good humor."

Henry Mitchell, a *Washington Pos*t gardening writer, once described Mr. Webber as a "passionate authority on daylilies," and he called Mr. Webber's guide a "delightful and useful book."

Webber was a Rockville resident and a member of the Unitarian Universalist Church of Rockville and the Vedanta Center of Greater Washington, a spiritual center in Silver Spring.

His marriages to Bosha Webber, Olga Shwetz and Marion Trio ended in divorce.

Stephen Webber's survivors include his wife of 26 years, Margaret Chalkley of Rockville; four children from his third marriage: Eileen Kline of Hagerstown, MD, Stephen Webber, Jr. of Brunswick, MD, Karen Harrell of Chesapeake, VA, and Russell Webber of Sharpsburg, MD; two stepsons: Neal Chalkley of Davidsonville, MD and Philip Chalkley of Monrovia, MD; a foster brother; and eight grandchildren.

Sources: NIST Archives and Adam Bernstein, *The Washington Post*, November 6, 2010.

We have recently learned that **Philip W. Boesch**, who spent the early years of his career in the Sound Section at NBS, died on November 5, 2010; **Nils Hans Anders Swanson**, 80, a former member of the Ceramics Division, died on November 1, 2010; and that **Louis John Zapas**, 88, a former member of the SAA and of the Rheology Section, Polymers Division, died on October 25, 2010. We hope to have their obituaries in the next newsletter.

And, with regret, we report the death on August 28, 2010 of **Ralph E. King**, husband of the late Elizabeth L. "Betty" King*, a former administrative officer to the director of the Physics Laboratory.

—Rosemary MacDonald

* Indicates SAA member

8. NEWS OF ALUMNI

Turning over a Leaf

After more than 15 years of volunteering for the Standards Alumni Association it is time to retire again, probably the fifth time in my life, first from government service in 1986, then from a stint in Philadelphia with the Society for Industrial and Applied Mathematics, where I held the position of Technical Director. Returning to Washington in 1988, I joined the Joint Board on Mathematics, the lobbying voice of the three major mathematical societies in the United States. It was an exciting time to follow the legislative activities of the U.S. Congress and to prepare members

(continued on next page)

of the mathematics community for presenting testimony before the science subcommittees. This work drew the attention of the Board on Mathematical Sciences of the National Research Council and I was invited to move over to their main building on Constitution Avenue where I stayed until 1993. After my fourth retirement, I got a call from Manny Horowitz who, at the time, was serving (again) as president of the Standards Alumni Association, due to the illness of Elio Passaglia who was forced to step down.

I became vice president of the SAA and subsequently served for two years as president.

After that I felt that there was work to be done at SAA and I decided to join Reeves Tilley for three days a week in the SAA office. This turned out to be a very fruitful collaboration and I was asked by one of the presidents to assume the title senior operations officer, later modified to chief operating officer. For the last decade or so, I have witnessed an enormous amount of change and progress in the association's involvement, both with the membership programs, i.e., the quarterly meetings, the April dinner meeting and the traditional holiday lunch in December, and those activities aimed at supporting the NIST culture of excellence.

But even more significantly, the relationship with the management of our host institution, NIST (after 1988), became profoundly deeper. The SAA played a major role in the preparation of *NIST at 100: Foundations for Progress*, a collection of the 100 best papers published by NBS/NIST during the first 100 years of its existence. SAA members served on nearly every one of the committees that were asked to sort through nearly 900 submissions and to help prepare the short summaries of each of the chosen papers.

The SAA has had the charge to maintain and select the portraits in the NBS/NIST Gallery of Distinguished Scientists, Engineers and Administrators since 1985. Not only was I privileged to witness the increase to over 250 portraits in that gallery, but also, due to the diligence of Anneke Sengers, the establishment of a process of nominating and selecting the candidates each year that attracted the full attention of subsequent directors of the host institution.

A decade ago, we had to take down and replace the Newton Apple Tree that stood on the old site of the Bureau of Standards at van Ness Street NW since the year 1964 (a replacement for an earlier one tracing back to Woolthorpe and the original one). During Samuel Kramer's presidency we held a ceremony, jointly with the U.S. State Department, which is responsible for the landscaping areas around the foreign chancelleries there, placing a memorial plaque in front of the newly planted tree. I was delighted to see just a few years later, that the young tree already had 29 apples on it. I often go by there to see how the tree is growing on that beautiful lawn. By the way, the SAA office still has a box with pieces of that old tree and they can be had for the asking. There seems to be a certain interest in those because the first box which I had set out in the hall two weeks ago with the sign: "Help Yourselves" was completely gone (the box too).

But most gratifying to me is the fact that we have been able to grow in the association's membership, and that in spite of the many obituaries that we publish in our newsletter every three months. The fact that we have strong committees that operate quite independently from the front office that makes it easy for me to bring down the shingle from outside and retire again. It has been a lot of fun to be of service for these years and I recommend it as therapy, if nothing else!

Thank you for your support over all these years.

—Hans Oser

Ambler Featured in *Lowcountry Life*

Former NBS Director Ernest Ambler and his wife Alice were recently interviewed by Justin Paprocki of the Island Packet, a local newspaper in Hilton Head, SC, where they live. The article, entitled "A classic tale of Brit meets girl," appeared in the September 26 issue as a part of a monthly series of "Love Stories." As this suggests, the interview covered mainly their personal relationship and its beginnings. To read it on the Internet, go to <http://www.islandpacket.com/> and search the site for "Ambler."

—Reeves Tilley

Russell Kirsch

During a September trip to see family in Oregon, I visited with Russell Kirsch and his wife Joan in their home on the west side of Portland for a few hours. Kirsch, who worked at NBS beginning in the late 1940s, is most often remembered for his work on the first stored-program digital computer—the Standards Eastern Automatic Computer (SEAC)—and being the first person to scan a document, a photograph of his son Walden. They both enjoy good health and are very convivial hosts. We had a extremely nice visit. Joan is an accomplished artist and examples of her work are to be seen all over their house.

Russell is still active, having recently published (in the May/June 2010 issue of the *NIST Journal of Research*) a paper on a new mathematical technique for enhancing scanned images by mitigating the effects of pixel geometry. He showed me his computer room and some of the projects on which he is working. Russ gave me some excellent advice about extending the lifetime of my aging Macintosh computers, circa 1999 and 2004, based on his own practices. He is very much intellectually engaged and stimulating, and I was fortunate to be able to talk with him.

—Norm Belecki

9. ASSOCIATION NEWS

Candidates for SAA Executive Board Sought

Elections will be held in March for President, two Vice Presidents, and four Directors of the Alumni Association. If you have an interest in getting more involved in SAA activities and would like to run for office or if you wish to nominate someone else, please contact Nominating Committee Chair David Lide at 301-738-7147 or by e-mail at drlide@post.harvard.edu. Suggestions must be received by January 15.

—David Lide

2011 Portrait Gallery Nominations

The NIST Portrait Gallery of Distinguished Scientists, Engineers and Administrators honors NBS/NIST alumni for outstanding career contributions to the work of NBS/NIST. Portraits and biographies of those selected are displayed in the corridor of the NIST cafeteria at Gaithersburg. Portraits of at most ten additional persons will be added to the Portrait Gallery in 2011.

Any current or former NIST or NBS staff member may make a nomination. Nominations are welcome for alumni who were administrators of either programmatic or support units. For persons who were nominated last year but not selected, a new nomination may be submitted. If a person is not selected after two successive years of nomination, that individual will not be considered in the following year.

Nomination instructions are available from the Standards Alumni Association (SAA), Room A-42 Admin, Mail Stop 0952, NIST, Gaithersburg, MD 20899-0952; telephone 301-975-2486; by e-mail: alumni@nist.gov; or from the SAA web site: www.nist.gov/director/saa. Nominations shall be received by the Standards Alumni Association on or before February 11, 2011, by mail or by e-mail to the above addresses. No exceptions will be made to this deadline.

—Richard Wright

2011 Portrait Gallery Jurists

Retired SAA members are encouraged to volunteer for the 2011 Portrait Gallery Jury by February 11, 2011. All are eligible except those who have served on all of the last three juries. Please inform the Standards Alumni Association, by mail at Room A-42 Admin, Mail Stop 0952, NIST, Gaithersburg, MD 20899-0952; by telephone at 301-975-2486; or by e-mail: alumni@nist.gov. Please provide your name and contact information (address, telephone and e-mail). The Jury will meet at NIST Gaithersburg for one day in late March or early April, the date yet to be decided.

The 2011 Portrait Gallery Jury will evaluate nominations for the NIST Portrait Gallery and recommend no more than ten to the NIST Director. The Portrait Gallery subcommittee, after closure of the 2011 nomination process, will propose, for approval of the SAA Board, a jury with balanced representation of retired scientists, engineers, and administrators (of both programmatic and support organizational units), with representation from all NIST units in whose areas nominations were received, and with fewer than 2/3 continuing from the 2010 jury.

The process for selecting the honorees is outlined below:

Overview of Process

Call for Nominations in December 2010 Newsletter to SAA members and by e-mail in December 2010 to NIST staff (note that no more than 10 additions will be made to the PG from the 20–30 nominations usually received; the limit assures a real honor and a practicable ceremony). Nominations are due 2/11/11. Any present or former staff member of NBS/NIST may make nomination(s).

1. Instructions for Nominations give the format and criteria for selection, which are excellence and impact of work performed while at NIBS/NIST.
2. Nominees are not informed of their nomination and nominations are confidential to the jury.
3. Balanced jury empaneled in March or April 2011. (Preferably, early April.) The jury discusses nominations and recommends 10 to NIST Director.
4. Director approves additions to PG.
5. SAA notifies honorees and their nominators.
6. SAA prepares portraits, background material and 75 minute ceremony installing honorees on October 14, 2011.
7. SAA works with NIST to stimulate attendance of younger staff at the Ceremony.
8. Portrait Committee has luncheon after ceremony to critique the whole process.
9. Chair writes Thank You letters, by October 31, 2011, to those who helped with Ceremony.

SAA Jury Process

1. Achieve balance among OUs, and scientists, engineers, and support and programmatic administrators.
2. Make an open call for volunteers in December 2010 *SAA Newsletter* for jury from SAA membership. Jurors to be members of SAA and not current NIST employees. Responses due February 11, 2011.
3. Jury panel to be named by SAA Board on March 2, 2011.
4. Jurors to be limited to three successive years of service with not more than two-thirds of the jurors to serve on successive juries.
5. Co-chairs of Nominations and Elections Subcommittee and the Senior Operations Officer (who are not limited to three successive years of service) to be non-voting support for jury.

—Richard Wright

NIST to Revamp Lobby Exhibits

The NIST Public and Business Affairs Office is asking for our help. In conjunction with a volunteer committee that includes SAA member Jim Schooley, they are launch-

(continued on next page)

ing a one-year effort to completely update the exhibits in the Bldg. 101 lobby in Gaithersburg and in the Radio Bldg. in Boulder. A key theme of the exhibit in Gaithersburg is planned to be a celebration of NIST history and culture of measurement excellence. They are looking for suggestions of topics, artifacts, interactive displays, and other ideas that would be of interest to the more than 15,000 visitors who come to the campus each year for conferences, workshops, research collaboration, or other activities. If you have anecdotes, photos, artifacts or just a good idea you would like to suggest be included, please send an e-mail to Jennifer Huergo at <Jennifer.huergo@nist.gov> or call on (301) 975-6343.

—Gail Porter, Chief, Public and Business Affairs

10. HISTORICAL ACTIVITIES

More NBS Laser History

Note 1: The following is the first appearance of the word "laser" in the title of an article in the TNB.

Note 2: *Celebrating the 50th Anniversary of the Laser: NIST's Role in Laser Measurements and Applications* can be found at <http://www.nist.gov/public_affairs/factsheet/laserfest.cfm>.

NBS *Technical News Bulletin*
May 1963

NBS Laser Produces Interference Fringes over 200-meter Optical Path

In recent experiments at the Bureau, interference fringes were obtained with a modified Michelson interferometer over an optical path of approximately 200 m. This result, achieved by use of a helium-neon laser (Light Amplification by Stimulated Emission of Radiation) as the infrared light source for the experiments, becomes significant when it is realized that the interference fringes obtained by means of conventional light sources may be observed, at best, over paths of less than 2 m.

The present work was undertaken by T. Morokuma, K.F. Nefflen, T.R. Lawrence, and T.M. Klucher of the engineering metrology laboratory, to investigate the possibility of using lasers for accurate determinations of much longer distances. At present, two separate measurement steps are required to determine the standard meter by means of the krypton 86 lamp whose 6057-Å spectral line is the international standard of length.

With advances in modern technology, the need for accurate methods of measuring long distances is constantly increasing, and the Bureau has been conducting intensive research to provide such methods. For example, the invar tapes used in surveying missile-tracking sites are now mechanically calibrated by the Bureau to about a part in a million. But if the present research results in the use of the laser as a standard light source, it is anticipated that this accuracy may be increased a hundred times.

—Jeffrey Horlick

11. COMMUNICATIONS

There was a brief announcement from Kevin Runyon in the Biomaterials Group of the Polymers Division announcing the retirement of Joseph Antonucci, with 51+ years of federal service the NIST 'dean of staff.'

12. MISCELLANY

2010-2011 NIST Colloquium Series Schedule – 12/10/10

DATE	SPEAKER	TITLE
12/17/10 Green (1107)	Michael Schellenberger, President, and Ted Nordhaus, Chairman, Breakthrough Institute	Energy, Climate, and Environment: the Politics of Possibility
1/7/11 Green (1107)	Luca Turin, Center for Biomedical Engineering, MIT	Is Smell a Quantum Phenomenon?
1/21/11 Green	Peter Shor, Department of Mathematics, MIT	Quantum Money
2/11/11 Green	John Hessler, Library of Congress	Mathematical Methods for the Study of Ancient and Early Maps
2/25/11 Green	Larry Gold, Department of Molecular, Cellular and Developmental Biology, University of Colorado and Chairman and CEO, Somalogic Inc.	Proteomics for Drug Development and Personalized Medicine: Biomarker Discovery
3/11/11 Green	Jeffrey Jonas, Chief Scientist and IBM Distinguished Engineer, IBM Entity and Analytics	Space-Time Travel Data: Your Movements Speak for Themselves
3/25/11 Green	Harry Meade, Senior Vice-President of Research and Development, GTC Biotherapeutics, Inc.	Transgenics and Human Protein Production
4/8/11 Green	Thomas Fuerst, Co-Founder and Scientific Director for Osteoporosis, CCBR-SYNARC	Diagnostics for Bone Disease
4/29/11 Green	Chad Mirkin, Appointee, President's Council of Advisors on Science and Technology, Dept of Chemistry, Northwestern University	The Polyvalent Gold Nanoparticle Conjugate: Materials Synthesis, Biodiagnostics, and Intracellular Gene Regulation
5/13/11 Green	Charles Clark and Daniel Lozier, DLMF Editorial Board Members, NIST	Digital Library of Mathematical Functions: Capabilities and Uses

Talks are scheduled from 10:30am – 11:30am unless otherwise noted.

2011 NIST PORTRAIT GALLERY NOMINATION INSTRUCTIONS

Instructions

1. Nominee must be a former NBS/NIST scientist, engineer or administrator and the nominator must be a present or past NBS/NIST employee. For the information requested below, the Jury, on a case-by-case basis, may consider employment as a guest worker or research associate at NBS/NIST, or with the NBS/NIST-affiliated programs of JILA and CARB, as equivalent to employment at NBS/NIST.
2. Nominations shall be received by the SAA Portrait Gallery Committee preferably by email at alumni@nist.gov, or by mail to the SAA Office, A-42 Admin, Mail Stop 0952, NIST, Gaithersburg, MD 20899-0952, no later than c.o.b. February 11, 2011 (no exceptions).
3. Nomination may not exceed two pages, single spaced, in Times New Roman 12 or similar sized font, with 25 mm minimum margins.
4. Nomination must be presented in the format given below, either as an electronic file (preferably), or in hard copy.
5. Nomination must be confidential and may not be divulged to the nominee.

Format

1. Nominee's name and, for a living nominee, address, telephone and email. If the nominee is deceased, please provide, if possible, the name, address, telephone and email for an heir:

2. Years at NBS/NIST: 19xx –

3. Citation/Impact (nominee's claim to honor in thirty or fewer words):

4. Birth date and Birthplace:

5. Education (post secondary)(universities, degrees, dates):

6. Principal positions held at NBS/NIST, with dates:

7. Describe outstanding work at NBS/NIST, including scientific, technical, managerial or administrative contributions, and cite its impacts:

8. List, at most, six significant examples of products of work at NBS/NIST such as publications, patents and administrative products. If relevant, give the total number of publications and patents based on NBS/NIST work:

9. Important external professional and governmental committee memberships and work, while employed at NBS/NIST, and cite the impacts of this external work:

10. Recognitions, awards and distinctions, within and external to NBS/NIST, as a consequence of work performed at NBS/NIST:

11. Name and contact information for the nominator and for one additional current or former NBS/NIST staff member willing to support the nomination:

This page intentionally left blank.