

# News Briefs

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## General Developments

*Inquiries about News Briefs, where no contact person is identified, should be referred to the Managing Editor, Journal of Research, National Institute of Standards and Technology, Administration Building, A635, Gaithersburg, MD 20899; telephone: 301/975-3572.*

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### THREE COMPANIES WIN BALDRIGE QUALITY AWARD

President Bush on October 9 announced three U.S. electronics firms as the winners of the 1991 Malcolm Baldrige National Quality Award. The winners are Solectron Corp. (San Jose, CA) and Zytec Corp. (Eden Prairie, MN) in the manufacturing category and Marlow Industries (Dallas, TX) in the small business category. The award, managed by NIST with the active involvement of the private sector, was established by legislation in August 1987 to raise awareness about quality management and to recognize U.S. companies that have a world-class system for managing their operations and people and for satisfying their customers. A maximum of two awards may be given annually in each of three categories: large manufacturers, large service companies, and small businesses. The 1991 winners were honored at a ceremony in Washington, DC, on October 29.

### TECH PROGRAMS ANNOUNCED FOR RURAL INDUSTRY

NIST and the Extension Service (ES) of the U.S. Department of Agriculture have announced an agreement to help improve the access of small, rural manufacturers to technology assistance resources provided by NIST. "This agreement promotes our collaboration with the Cooperative Extension System specialists and agents who are an

unparalleled resource for reaching parts of the country where manufacturing operations are in rural localities," said Donald Johnson, director of NIST Technology Services. Under the agreement, NIST will furnish ES agents and specialists with technology-related materials and information and training in technology assistance, problem identification, and referral to appropriate resources. NIST also will provide the Cooperative Extension System with advice and assistance in solving technological problems.

### STUDY HIGHLIGHTS IMPACT OF AWARD-WINNING RESEARCH

One of NIST's primary goals is to help U.S. industry develop commercial technology. Among the barometers for gauging how well the agency does this are R&D 100 Awards, given yearly by Research and Development Magazine to recognize 100 technical innovations with commercial potential. Now, a new report shows that NIST has a strong track record both for winning the award and transferring technology of the winners to the private sector. According to the 40-page report, NIST has won 71 R&D 100 Awards (note: the agency scored two more awards after the report went to press), ranking it third among all-time winners. As for the commercial potential of technology behind the awards, the report cites eight winners responsible for millions of dollars in products. For example, companies have developed and marketed a NIST cone calorimeter to the tune of \$6 million. The device, a 1988 winner, predicts fire hazard from a small sample of material such as upholstery. For a free copy of NIST R&D 100 Awards—A Technology Transfer Study, send a self-addressed mailing label to Dale Hall, A525 Administration Building, NIST, Gaithersburg, MD 20899.

**PARTNERSHIP TO IMPROVE ACCURACY IN GRAIN TRADE**

U.S. weights and measures officials and the U.S. Department of Agriculture's Federal Grain Inspection Service (FGIS) have formed a partnership to improve the accuracy of grain measurements in trade. The 1990 Farm Bill authorized FGIS to work with the National Conference on Weights and Measures (NCWM) and NIST to establish standards for the evaluation and performance of commercial grain inspection equipment. To carry out the effort, NCWM has established two new sectors for grain equipment under its National Type Evaluation Program Technical Committee. Membership will be limited to one representative from a company or industry association, but participation in the meetings will be open to all interested parties. For information, contact Carroll S. Brickenkamp, P.O. Box 4025, Gaithersburg, MD 20885, 301/975-4005, fax: 301/926-0647.

**CONSORTIUM PROPOSED TO IMPROVE POLYMER PROCESSING**

Producers of plastic and rubber products and instrument manufacturers are invited to join a consortium sponsored by NIST to improve the processing and quality of polymer materials by developing new measurement technology. The goal is to develop in-line measurement technology based on optical methods to monitor important processing conditions. These new measurement tools will enable processors to make critical in-process measurements not now possible. The proposed consortium will be based on an ongoing NIST research program in fluorescence spectroscopy to monitor various processing steps in the production of advanced polymers. Participation in the consortium will require a \$10,000 annual contribution for the 4 year program. NIST will provide research facilities, including new processing equipment to test measurement technologies developed under the program. For information, contact Anthony J. Bur, B320 Polymer Building, NIST, Gaithersburg, MD 20899, 301/975-6748.

**AGREEMENT ON SOFTWARE DEVELOPMENT SIGNED**

The Center for Advanced Research in Biotechnology (CARB) and IBM are joining forces to develop a user-friendly portable software system for computational structural biology. CARB will merge several of its own software packages to IBM's RISC 6000 Workstation in a new cooperative research and development agreement with IBM. As part of

the agreement, CARB will design a system that can execute more than 20 biotechnology application programs. These programs perform a variety of jobs from computing protein structural data to modeling protein molecules. Most of the programs are public domain software written by CARB/NIST scientists. The software system would make computer studies of biological molecules much faster and easier. The agreement also calls for CARB to provide software for testing at other laboratories. CARB was established in 1984 by NIST, the University of Maryland, and Montgomery County, MD, as a unique center for government, academic, and industry scientists.

**VALIDATION SERVICE STARTED FOR MUMPS**

NIST recently began a validation service to test compilers for the MUMPS programming language to see if they conform to Federal Information Processing Standard (FIPS) 125, MUMPS. MUMPS—Massachusetts General Hospital Utility Multiprogramming System—is a high-level interactive computer programming language for use in developing and effecting interactive information systems with shared databases. FIPS are standards, guidelines, and technical methods issued for government-wide use. The MUMPS validation capability was developed by NIST. For technical information, contact L. Arnold Johnson, 301/975-3247.

**PHASE-NOISE PROBLEM RESOLVED FOR FIBER-OPTIC NET**

NIST researchers have helped resolve an important phase-noise problem for a new, fiber-optic telecommunications system called SONET. Members of an American National Standards Institute subcommittee were having difficulty defining the amount of phase noise to be tolerated by SONET. Phase noise is a random variation or "jitter" in phase of an otherwise regular signal, which enters between the nodes of a telecommunications link and must be characterized and controlled to achieve synchronization in the overall system. NIST scientists analyzed noise data collected from SONET, made recommendations on useful phase-noise measures, and served as the focal point for clarifying new network phase noise specifications.

**GAS STANDARD HELPS REGULATORS ENFORCE CLEAN AIR ACT**

The Environmental Protection Agency and California Air Resources Board are using a NIST gas standard to measure the success of their clean air

efforts. The new standard helps both agencies comply with the requirements for improved measurements of hydrocarbons from industry and auto emissions mandated by the Clean Air Act of 1990. Ongoing uses of the standard include establishing baseline levels of hydrocarbons in polluted areas, assessing the effectiveness of pollution reduction efforts over time, and maintaining a long-term, highly accurate measurement record. The gas standard contains minute amounts of 15 different hydrocarbons found in car exhaust. Under specific conditions, these hydrocarbons can lead to crop damage and lung irritation. The levels in the standard are low, around 5 parts in  $10^9$  (i.e., 5 parts per billion), to correspond to what laboratories would actually find in city air. NIST scientists developed the gas standard specifically for the EPA and California, but hope to expand its application for other laboratories by certifying it as a Standard Reference Material.

#### **FIVE TECHNOLOGIES DOMINATE BIDS FOR ATP GRANTS**

Proposals to develop key technologies in electronics or materials science make up roughly half of the 271 applications submitted by the September 25 deadline for 1991 grants under the NIST Advanced Technology Program (ATP). A significant number of proposals also came from the fields of manufacturing, information technology, and energy. Other technologies represented in the applications include biotechnology, environmental technology, agriculture/food technology, and transportation. NIST expects to award between \$20 million and \$25 million in ATP grants to help U.S. industry develop generic, commercially important technologies. The awards will be announced in early spring, 1992.

#### **DEVELOPMENT OF HARDNESS STANDARD UNDER WAY**

NIST has launched a program to establish a U.S. national hardness standard. Under the program, certified hardness calibration test blocks will be produced to calibrate machines to perform various property measurements such as the Rockwell hardness test. Industry will be provided with uniform hardness standards to measure and characterize hardness indenters. The U.S. standard is expected to be compatible with those maintained by other national authorities worldwide. Development of the NIST facility is being carried out in collaboration with the Instituto di Metrologie "G. Colonetti" (IMGC), Turin, Italy. IMGC will supervise the construction of a duplicate of their dead weight

hardness calibration machine, which is presently used to maintain hardness standards in Europe. IMGC also will assist NIST in establishing a traceable national hardness standard through calibrations, intercomparisons, and selected measurements. For information, contact John H. Smith, B261 Materials Building, NIST, Gaithersburg, MD 20899, 301/975-5960.

#### **STRUCTURE OF SUGAR-TRANSPORT PROTEIN SOLVED**

Scientists at the Center for Advanced Research in Biotechnology (CARB) have solved the three-dimensional structure of a key protein that is indispensable for transporting sugar from the environment into the bacterial cell. The enzyme, known as the IIA domain of glucose permease (previously known as Enzyme III), is one link in a chain of proteins that enable the transport of glucose into the cell. The IIA domain interacts with a second protein, the membrane channel domain, and opens the gate for sugar transport. With the structure of the sugar transport protein in hand, pharmaceutical companies may be able to design new antibiotics that would prevent sugar transport and thereby starve infectious bacteria by cutting off their energy supply. Researchers from NIST and two universities collaborated on these studies at CARB. A paper describing the new protein structure appears in the Oct. 8, 1991, issue of *Biochemistry*. CARB was established in 1984 by NIST, the University of Maryland, and Montgomery County, MD, as a unique center for government, academic, and industry scientists.

#### **REPORT FEATURES ELECTRONIC MESSAGE HANDLING**

A timely report, *Electronic Data Interchange in Message Handling Systems* (NISTIR 4608), introduces the Message Handling System (MHS), the carrier service for Electronic Data Interchange (EDI) data, and the Interpersonal Messaging Service, the only standardized MHS application, and the model for the EDI Messaging Service. With the MHS, users can transfer EDI data between compatible EDI applications found on different computer systems. The MHS service would advance the interchange of EDI data using Open Systems Interconnection protocols and standards. A detailed review of the EDI messaging recommendations follows introductory material. EDI identifies a family of standards used for the electronic transmission of business-oriented data— invoices and purchase orders, for example. For

technical information, contact Paul Markovitz, 301/975-3606. Available from the National Technical Information Service, Springfield, VA 22161. Order by PB #91-216622 for \$15 prepaid, \$8 for microfiche.

#### **PRECISE MEASUREMENTS MADE OF CLADDING DIAMETER**

NIST researchers, using an in-house developed contact micrometer, have measured the cladding diameter of an optical fiber within 40 nm, one of the most accurate measurements ever made of any such macroscopic object. Cladding is the glass sheath surrounding the fiber core. Precise measurements of the cladding diameter are required by the Telecommunications Industry Association so that single-mode fibers can be connected together with low loss and little manual adjustment. The moving part of the micrometer (spindle) rides on an air bearing and its position is measured by an interferometer. Measurements are performed by closing the spindle against the fiber and using the wavelength of light as a ruler. The fiber deforms slightly and a correction is applied to account for the deformation. As a check on the micrometer, NIST scientists measured the diameters of six optical fiber specimens with the micrometer and a scanning confocal microscope, which confirmed the original measurements. They hope to improve the measurement process by using silica instead of steel contacts to reduce surface roughness. Two papers (#33-91) outlining their findings are available from Jo Emery, Division 104, NIST, Boulder, CO 80303, 303/497-3237.

#### **PROPOSALS SOUGHT FOR PRECISION MEASUREMENT GRANTS**

NIST is seeking project proposals for its 1993 Precision Measurement Grants. The grants range from \$30,000 to \$40,000 for 1 year and may be renewed for up to two additional years. Prospective candidates must submit summaries of their proposed projects and biographical information to NIST by Feb. 1, 1992, to be considered for the current grants, which will run from October 1992 through September 1993. NIST's Precision Measurement Grants are awarded each year to scientists in U.S. academic institutions for work in determining values for fundamental constants, investigating related physical phenomena, or developing new, fundamental measurement methods. For information, contact Barry N. Taylor, B160 Physics Building, NIST, Gaithersburg, MD 20899, 301/975-4220.

#### **NEW SYSTEM IMPROVES FLAW DETECTION IN COMPOSITES**

NIST and industry researchers have developed a low-frequency, ultrasonic system for detecting flaws and characterizing properties in composite materials, such as the polymer-matrix compounds used in the automotive, marine, and aerospace industries. Traditional ultrasonic instruments are designed for flaw detection only, operate at frequencies which are too high, and have a dynamic range which is too low for accurate evaluation of these materials. Researchers at NIST and private industry have solved the problem by designing an automated, computer-controlled measurement system which operates over the 50 kHz to 5 MHz range. The new system provides accurate measurements even on highly attenuating material, supplies data for both attenuation and velocity studies, and performs analyses rapidly. A paper (#34-91) describing the new system is available from Jo Emery, Division 104, NIST, Boulder, CO 80303, 303/497-3237.

#### **WANTED: PARTNERS TO STUDY POLYMER X-RAY SCATTERING**

NIST seeks researchers from industry, academia, or other government labs interested in pursuing advanced studies on x-ray scattering from polymers and polymer composites. Facilities at NIST include a 10 m digital small-angle x-ray scattering camera with a two-dimensional position-sensitive detector and a texture diffractometer for transmission measurements of pole figures (used to study crystalline orientation in materials). The facility supports *in situ* heating and deformation of samples. NIST researchers have used the facility in studies of the microstructure of blown films, fibers, engineering plastics, magnetotactic bacteria, and polymer blends and composites; and in the development of improved methods to analyze three-dimensional microstructure or to interpret the orientation texture of crystalline and semicrystalline materials. The facilities are available for both proprietary and collaborative research. Interested researchers should contact John D. Barnes, B210 Polymer Building, NIST, Gaithersburg, MD 20899, 301/975-6786 or fax 301/869-3239.

#### **NEW MICROSCOPE TIP IMAGES MICROMAGNETIC FORCES**

NIST researchers have developed a new technique that may simplify the detection of the magnetic field structure of a computer disk's surface. The

technique, known as tunneling stabilized magnetic force microscopy (TSMFM), modifies a scanning tunneling microscope—a device that uses tunneling current to map surface features—by replacing a rigid magnetic tip with a flexible one. As the tip is scanned across a sample, it is deflected by changes in magnetic forces. The resulting images show a combination of disk surface topography and magnetic field variations. NIST has used this probe on a magnetic medium to image recorded data and to create submicron magnetic records. TSMFM offers a relatively inexpensive method for detecting potential disk failure, making it a practical diagnostic tool for the magnetic recording industry. A patent application on the flexible tip filed by NIST is pending. For information, contact Paul Rice, Division 814.05, NIST, Boulder, CO 80303, 303/497-3841.

#### **DIAL UP SYSTEM STARTED FOR GOSIP TESTING PROGRAM**

NIST has begun operating an online database developed for the U.S. GOSIP (Government Open Systems Interconnection Profile) Register Database. It provides information for a list of registers, including: U.S. GOSIP Abstract Test Suites; Assessed Means of Testing; National Voluntary Laboratory Accreditation Program Accredited Test Laboratories; Conformance Tested GOSIP Products; Interoperability Test Suites for Means of Testing Assessment; Interworking GOSIP Products; and Interoperability Test and Registration Services. There are two ways to connect to the database: (1) use the Internet address 129.6.48.100, or (2) use a modem to dial 301/869-0096 using 1200/2400-8-N-1. Log in for both with the user name gossip-db (no password necessary). Address questions, problems, or comments on the database to John J. Garguilo, B141 Technology Building, NIST, Gaithersburg, MD 20899, 301/975-3623. Direct questions on the U.S. GOSIP Testing Program to Stephen Nightingale (same address as Garguilo), 301/975-3616.

#### **SUMMARY OF CALS PROGRAM SUPPORT ISSUED**

A new 25-page report, NIST Support of the CALS Program: 1990 Synopsis, (NISTIR 4609) summarizes overall Computer-aided Acquisition and Logistic Support (CALS) program management, technical support, and administration provided by NIST to the Department of Defense. A 1990 precis is offered in each of the general technical support areas: electronic data interchange, document

standards, raster compression, data management, security, and data communication. This report also offers the titles and brief abstracts of published reports as well as titles and abstracts for NIST CALS documents published in previous years. Most of the NIST reports delivered to the CALS office have already been published for easier access by the CALS community. For technical information, contact Sharon J. Kemmerer, 301/975-3287. The publication is for sale by the National Technical Information Service, Springfield, VA 22161 for \$17 prepaid. Order by PB 91-193821.

#### **REPORT EXAMINES NIST ELECTRIC ENERGY RESEARCH**

A review of several projects aimed at improving electrical power measurements is now available from NIST. The document, one of an ongoing series of progress reports prepared for the Department of Energy, describes four major NIST research projects. One program is creating methods to evaluate and calibrate instruments that gauge magnetic and electric fields near utility power lines or in simulated laboratory setups. Another project is examining the behavior of compressed-gas insulators (dielectrics) used in high-voltage power systems. Understanding the breakdown of liquid dielectrics, such as the oils used to insulate power transformers, is the goal of a third project. NIST is studying the propagation of electrical “streamers,” which are precursors of total insulating fluid breakdown. A fourth project aims to improve the measurement of fast transient pulses such as lightning and power line surges. The report, *Research for Electric Energy—An Annual Report*, is free from Electronics and Electrical Engineering Laboratory, B344 Metrology Building, NIST, Gaithersburg, MD 20899, 301/975-2432.

#### **NEW EDITION OF INTERNATIONAL METRIC GUIDE AVAILABLE**

NIST has issued a new edition of the standard reference and guide to the International System of Units, the modernized metric system. The 1991 edition of *The International System of Units (SI)* (NIST Special Publication 330), incorporates the complete English-language translation of the 1991 edition of *Le Système International d'Unités (SI)*, the definitive reference produced by the International Bureau of Weights and Measures. The text includes the full technical definitions of the official SI units, historical notes on the development of the present-day definitions, brief descriptions of the practical realization of the definitions of some

important units, and, in the NIST edition, special notes concerning U.S. metric usage. Single copies are available from Carolyn Stull, C210 Radiation Physics Building, NIST, Gaithersburg, MD 20899, 301/975-5607.

#### **FIVE SBIR CONTRACTS ISSUED FOR 1991**

NIST's Small Business Innovation Research (SBIR) program, which designates 1.25 percent of the institute's extramural research and development budget to fund research by small businesses, has awarded five contracts for 1991. Phase 1 contracts (up to \$35,000 for feasibility studies), for evaluation of new ultraviolet and vacuum ultraviolet radiometric standards; a prototype system to measure robot positioning accuracy; the study of improved crystals for fiber-optic magnetic-field sensors; and design of an improved, large-format real-time x-ray imaging system. A Phase 2 contract (up to \$200,000 for major research and development) was awarded for design and construction of an add-on x-ray concentrator for analytical instruments using an x-ray interference mirror to enhance x-ray output. For information on the SBIR program, contact Edward Tiernan, NOAA, CS/RT, Suitland Professional Center, Room 307, Suitland, MD 20233, 301/763-4240.

#### **PRODUCT DATA EXCHANGE INITIATIVE LAUNCHED**

Corporations, industry and trade associations, and government agencies have begun to join the National Initiative for Product Data Exchange that calls for the acceleration and coordination of all relevant product data exchange (PDE) development and deployment efforts. PDE technology, or the ability to express in computerized or standardized digital format all useful information about a given product, is considered a key to effective computer-integrated manufacturing and concurrent engineering. The development of a PDE standard is expected to dramatically enhance product design, manufacturing, and support processes. Under the initiative implementation plan, developed by an industry-led task force and announced Nov. 12 by Commerce Under Secretary for Technology Robert M. White, all organizations and industry programs involved in PDE activities are invited to develop a coordination program that incorporates agreed-upon priorities and schedules. The IGES/PDES Organization (IPO), which has 550 industrial, governmental, and academic participants engaged in all phases of PDE, has appointed a general manager for the initiative office; this office will

begin operations at NIST in January 1992. Initiative programs will address standards development, testing, software development and deployment, and education and training. For more information or a copy of the plan, contact the PDES/CALS Office, A319 Metrology Building, NIST, Gaithersburg, MD 20899, 301/975-3986, fax 301/926-8730.

#### **MEASURING THE ROLE OF VITAMIN C IN CANCER, ARTHRITIS**

A new procedure developed by NIST and the National Cancer Institute (NCI) for measuring vitamin C is helping scientists study links between the vitamin and two diseases, cancer and arthritis. In cooperation with NCI, a NIST scientist created the new method to stabilize vitamin C in frozen plasma for extended periods (up to 18 months in current studies), allowing its level to be accurately measured over time. Using this method, NIST helped an NCI researcher assess the performance of laboratories participating in NCI studies on the role of vitamin C in cancer. In another study, NIST worked with a physician at the Children's National Medical Center in Washington, DC, to measure vitamin C levels in children with a crippling form of arthritis. The new NIST/NCI measurement method enabled the doctor to correlate vitamin C levels with disease severity.

#### **CHANGES ANNOUNCED IN WEIGHTS AND MEASURES BOOKS**

Two NIST handbooks have been revised and a supplement has been issued to reflect changes adopted at the July 1991 Annual Meeting of the National Conference on Weights and Measures (NCWM). Established in 1905, NCWM is an organization of state, county, and city weights and measures enforcement officials, along with associated business and consumer representatives. NCWM receives technical support from NIST, a non-regulatory agency, through the institute's Office of Weights and Measures.

NIST Handbook 44-1991, Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices, now contains a Tentative Code for Mass Flow Meters that establishes tolerances for measuring the mass of liquids or vapors. When the tentative code is adopted by NCWM as a full code, requirements for mass flow meters that appear in other codes will be deleted. The Hydrocarbon Gas Vapor-Measuring Devices Code also was revised to recognize devices that measure compressed natural gas when sold as a motor fuel.

Handbook 130-1991, Uniform Laws and Regulations, includes a revision to the NCWM recommendation for motor fuel labeling to provide consumers with information on whether or not oxygenates such as methyl-t-butyl ether (MTBE) or ethanol exist in a product. If adopted by the states, the regulation will require pumps to be labeled when the level of oxygenates, or combinations of them, is at least 1 percent by volume.

Supplement 2, 1991, to Handbook 133-Third Edition, 1988, Checking the Net Contents of Packaged Goods, and the 1990 Supplement, contains the latest revisions to inspection procedures for meat and poultry products. Handbook 133 and the supplements have been adopted by the U.S. Department of Agriculture's Food Safety Inspection Service for compliance testing of net weight labeling of packaged meat and poultry. They will take effect Jan. 2, 1992, and cover approximately 8,000 processing facilities in the United States and overseas.

Copies of the handbooks are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Order Handbook 44-1992 by stock No. 003-003-03114-3, \$12 prepaid; Handbook 130-1992 by stock No. 003-003-03105-4, \$11 prepaid; Handbook 133-Third Edition, 1988, by stock No. 003-003-02855-1, \$16 prepaid; NIST Handbook 133-Third Edition, 1990 Supplement by stock No. 003-003-03049-0, \$3.25 prepaid; and NIST Handbook 133-Third Edition, 1991 Supplement 2 by stock No. 003-003-03111-9, \$1.50 prepaid.

#### **BALDRIGE AWARD CONFERENCE SET FOR FEBRUARY**

A conference featuring the 1991 winners of the Malcolm Baldrige National Quality Award will take place Feb. 3–5, 1992, at the Washington Hilton Hotel in Washington, DC. The Quest for Excellence IV will highlight the quality improvement strategies of the 1991 winners: Solectron Corp. (San Jose, CA), Zytec Corp. (Eden Prairie, MN), and Marlow Industries (Dallas, TX). All three are small to medium-sized electronics firms. Executives from the companies will discuss in detail their winning strategies and the results achieved through quality improvement initiatives. The conference is being sponsored by NIST in conjunction with the American Society for Quality Control (ASQC) and the Association for Quality and Participation. Questions on registration should be directed to ASQC at 414/272-8575. General information questions should be referred to the NIST Conference Program, 301/975-2774.

#### **SURVEY FEATURES RESEARCH ON ALTERNATIVE REFRIGERANTS**

A comprehensive survey of worldwide research on the thermophysical properties of alternative refrigerants to fully halogenated chlorofluorocarbons (CFCs) has been published by NIST. CFC refrigerants are major contributors to ozone depletion. The survey reports on the thermodynamic, transport, and phase equilibria properties of 13 fluids, as well as their dielectric constants and refractive indices. A copy of the publication, A Survey of Current Worldwide Research on the Thermophysical Properties of Alternative Refrigerants (NISTIR 3969), is available from the National Technical Information Service, Springfield, VA 22161. Order by PB 92-112366; the price is \$19.

#### **NIST SINGLE-FLUX-QUANTUM ADVANCES RESULT IN OPERATING DEVICES AND SIMULATION METHODS, CONTRIBUTING TO NATIONAL PROGRAM TO DEVELOP SFQ LOGIC**

NIST scientists have designed, fabricated, and successfully operated at first attempt a shift register and a binary counter based on single-flux-quantum (SFQ) principles and developed simulation methods that predict the operating margins of SFQ logic devices. SFQ logic refers to the representation of the binary states of one and zero by the presence or absence of a single magnetic flux quantum trapped in a direct-current superconducting quantum interference device (SQUID). Each SQUID is an inductive loop element incorporating two Josephson junctions.

The current high interest in SFQ is driven by (1) switching speeds in the 100 GHz range that flip-flop circuits incorporating SQUIDs potentially can provide and (2) feasibility of fabrication from the new high-critical-temperature superconductors. SQUID circuits perform best with non-hysteretic Josephson junctions, the only type of junction that has been made successfully with high- $T_c$  materials. The limitations posed in the past by the narrow range of operating parameters that fabrication methods provide for superconducting electronic circuits typically have restricted the range of devices that can be implemented. The NIST researchers devised simulation methods which they applied to show that the margins for operating parameters for an important class of SFQ logic devices should be usefully large—as much as 30 percent. This class of devices includes AND gates, OR gates, exclusive-OR gates, and full adders.

**NIST MAKES SOFTWARE AVAILABLE TO SUPPORT ANTENNA NEAR-FIELD PLANAR SCANNING RESEARCH**

NIST scientists have developed a personal computer software package for the study of planar near-field measurements that offers a previously unavailable high degree of power, modularity, and flexibility. The package is part of an overall effort to develop software for use on personal computers that incorporates dedicated modules that can be combined to investigate computational tasks involving real or simulated data for research and error analysis in antenna metrology.

NIST invented the near-field method and then pioneered in the application of antenna near-field scanning as a practical measurement tool for determining the performance of antennas. In this method, measurements of phase and amplitude are made with a calibrated probe physically close to an antenna (in its near field) at a large number of points over a defined surface, for example, a plane. The resulting near-field data are processed to yield the desired antenna far-field pattern through NIST algorithms that incorporate estimates of the uncertainty associated with the pattern. Virtually all satellite and phased-array antennas now are measured with near-field methods; NIST calibrates the probes and provides support to organizations seeking to establish near-field ranges. Some 30 U.S. companies and a number of government agencies are using the method in a total of 54 near-field ranges. This large and growing body of users has led to an interest on the part of others in conducting research in near-field scanning and a request that NIST provide computer code for the near-field algorithms that is more accessible to users outside NIST. The new software package consists of a number of FORTRAN modules that can be called from DOS to achieve a wide variety of computational tasks. Personal Computer Codes for Analysis of Planar Near Fields (NBSIR 3970) describes this package.

**TUNNELING-STABILIZED MAGNETIC FORCE MICROSCOPY APPLIED TO VERTICAL BLOCH LINE MEMORIES IN COLLABORATIVE RESEARCH WITH JPL**

At the request of Jet Propulsion Laboratory (JPL) NIST scientists are applying the NIST tunneling-stabilized magnetic force microscope (TSMFM) to the study of domain walls in magnetic garnet as part of the JPL program to develop practical Vertical Bloch Line (VBL) memories. The TSMFM provides image information on the magnetic fields

arising from very small regions of the surface of magnetic materials, for example, from individual bits on magnetic storage media. A VBL memory element consists of a thin film of magnetic garnet, patterned with various permalloy structures, used to control the magnetic domains and walls in the garnet. NIST initially is using the TSMFM to provide the highest resolution images available from any source of the domain walls of bulk specimens from JPL, providing information useful for JPL's development of VBL memory. Later, JPL is expected to provide specimen memory elements for examination.

The concept of VBL memories is exciting because of the potential to provide fast access, high packing density, and the capability of retaining stored data even when the system of which they are a part is turned off. Most fast-access computer memory currently is restricted to powered memory chips. Another attractive feature of VBL memories is that the data they hold can be actively manipulated rather than having to be rewritten. Magnetic garnet exhibits strong perpendicular anisotropy which defines narrow domain walls. Since these walls are transitions between domains, the direction of magnetization in the wall can be reversed. The point where the two magnetization directions meet is called a Bloch line. In contrast to conventional disk-based memory, which stores data statically with domain magnetization, the Bloch lines themselves store data in VBL memories.

**NIST HELPS INDUSTRY AND NASA SOLVE ROBOT STABILITY PROBLEM**

NIST scientists have been supporting the NASA Goddard Space Flight Center in the development of the Flight Telerobotic Servicer (FTS), the two-armed robot that will build and maintain Space Station "Freedom." Recently, the prime contractor for the space qualified version of the FTS, experienced a curious instability in their robot control algorithm. They found that the robot was stable when in contact with some environmental stiffnesses, but unstable for others. As NIST researchers delved deeply into the problem, an important and fundamental set of design criteria for robot control systems emerged. Analysis showed that the control system could become unstable when passivity is violated. In order to stabilize the system, the frequency at which passivity is violated must be greater than the torque loop resonant frequency. These results were then verified empirically on a seven degree-of-freedom robot at NIST. Based on this work, a paper will be



published in the Proceedings of the IEEE Robotics and Automation Conference in 1992. These results could have significant impact on industry outside of space applications. Private industry can use these results in another project, the Next Generation Controller, where the controllers for robots, machine tools, and coordinate measurement machines are coalesced into the same standard structure.

#### **WAY PREPARED FOR 0.01 PERCENT RADIOMETRIC CALIBRATIONS**

A core problem in radiometric physics is to reference optical power measurements to SI units. NIST is now preparing to do this 10 times better than ever before. Over the years, many physical principles have been employed, such as the power spectra from hot bodies (Planckian radiation) and accelerating charges (synchrotron radiation), as well as the solid-state physics of silicon photodiodes. The latest technique, which promises the best accuracy over the greatest spectral range, is cryogenic radiometry. It is a refinement of electrical substitution radiometry, whereby optical power absorbed in a black cavity is balanced against electrical resistive heating. Both raise the temperature of the cavity, as compared to a stabilized reference temperature. The cryogenic aspect of the radiometer reduces systematic errors, such as cavity reradiation and convective cooling, and provides favorable operating conditions, such as a low specific heat and high thermal conductivity of the cavity.

The high-accuracy cryogenic radiometer (HACR) provides an absolute measure of optical power at about 1mW, referenced to the volt and ohm, with a design accuracy of better than 100 parts per million. An intensity-stabilized laser light source is alternately measured by the radiometer and the detector under test. These detectors include transfer standards, such as silicon photodiodes combined in the "trap" arrangement, which have comparable precision to the HACR and are portable. Using these, the HACR becomes the root of all detector-based calibration at NIST, as well as a facility for specialized customer needs.

This newly completed cryogenic radiometer is the second one at NIST. The first is dedicated to the low-background infrared radiometer facility and was optimized for use at the low power levels encountered in aerospace work.

#### **PHASES OF X-RAY DIFFRACTION DATA FROM BIOLOGICAL MACROMOLECULES BY MAXIMUM ENTROPY**

The development by scientists at NIST and the Chalmers University of Technology (Gothenburg, Sweden) of methods for applying the principle of maximum entropy to the determination of the phases of x-ray diffraction data has greatly expanded capabilities for determining the structures of biological molecules such as proteins. A computer program that makes extensive use of fast Fourier transform (FFT) techniques and exploits space group symmetries to make further reductions in necessary computational resources has been written. It has already been used to explore a variety of strategies for determining phases for large data sets (tens of thousands of reflections) starting from a minimum of prior information, possibly no more than the two to four phases that may be chosen arbitrarily to define an origin and an enantiomorph. FFT routines for a wide range in the number of grid points per period enable the study of the effect of resolution on the quality of the resulting density map.

The technique has been applied to diffraction data from the protein bovine heart creatine kinase, in collaboration with scientists from the Center for Advanced Research in Biotechnology (CARB), to produce an electron density map in which features of secondary protein structure such as  $\alpha$ -helices and  $\beta$ -sheets are clearly visible. Application to structure studies of other proteins is proceeding in collaboration with scientists at the Naval Research Laboratory and the University of California at San Diego.

#### **ASPHALT CHEMISTRY ADVANCEMENT BASED ON NIST RESEARCH**

The results of research performed at NIST for the Strategic Highway Research Program (SHRP) have been instrumental in the development of a new model of asphalt structure, which explains the mechanical performance characteristics of asphalt binders and cements. NIST researchers have shown that the "micellar" model of asphalt, widely used as a description of asphalt microstructure, is inconsistent with recent measurements. Asphalt samples are difficult to characterize owing to their complex chemical composition. Employing the technique of solid-state nuclear magnetic resonance, the NIST researchers were able to determine upper limits for the minimum-length dimension across domains of like chemical substances in heterogeneous asphalt. This upper limit

of typically 4 nm is too small to be consistent with micellar structure. Other researchers participating in a coordinated SHRP program on asphalt chemistry and performance have used this insight for developing an alternative model, which can explain asphalt behavior. SHRP expects the research to enable manufacturers to modify asphalts to improve performance.

#### **GLASSES FOR PROTECTION OF EYES FROM LASER DAMAGE**

University researchers have shown that certain glasses prepared by NIST can reduce the intensity of a laser beam in an optical system to below that at which retinal damage may occur. The operating principle is thermal lensing in which the change of refractive index with temperature,  $dn/dT$ , is so strong that the heating due to an impinging laser beam will automatically defocus the beam, thus reducing the intensity reaching the eye of an observer. NIST scientists prepared a series of borate, phosphate, germanate, and silicate glasses, which university scientists tested. Sufficient understanding was obtained to prepare another group of glasses, which were also tested. The best glasses turned out to be silicates with high contents of lead and some europium. These glasses have combinations of high  $dn/dT$  and low thermal diffusivity and thermal conductivity, the latter two properties being important for ensuring that the heating of the glass by the laser beam is sufficiently rapid to activate the thermal lensing. The ready formability and relative low cost of the silicate glasses suggest that they will find considerable use in industrial and military applications.

#### **NEW PUBLICATION FOCUSES ON SECURITY IN ISDN**

In the 1990s, ISDN (Integrated Services Digital Network) standards will provide worldwide digital communications service and will play a key role in the transition to electronic documents and business transactions. Government and business are increasingly concerned with security in ISDN. NIST Special Publication 500-189, Security in ISDN, discusses the standards needed to implement user security. ISDN security standards should take advantage of, and be compatible with, emerging standards for Open Systems Interconnection security, including confidentiality, access control, authentication, data integrity, and non-repudiation. The publication provides a broad discussion of user security needs and suggests possible solutions.

#### **NIST PUBLISHES COMPUTER SECURITY BULLETIN BOARD USER'S GUIDE**

NISTIR 4667, Computer Security Bulletin Board User's Guide, assists users in accessing and utilizing the many features of this electronic bulletin board which focuses on computer security issues. Examples of posted information include an events calendar, software reviews, publications, bibliographies, lists of organizations, and other government bulletin board numbers. The bulletin board operates 24 hours a day, charges no fee, and is accessible to anyone who has a computer or terminal with a modem or network connection. The bulletin board numbers are (301) 948-5717 for 300, 1200, or 2400 baud modems; (301) 948-5140 for 9600 baud modems.

#### **HIGH-INTEGRITY WORKSHOP PROCEEDINGS ISSUED**

NIST Special Publication 500-190, Proceedings of the Workshop on High Integrity Software; Gaithersburg, MD, Jan. 22-23, presents the results of a Workshop on the Assurance of High Integrity Software sponsored by NIST. Workshop participants addressed techniques, costs, and benefits of assurance, controlled and encouraged practices, and hazard analysis. The workshop prepared a preliminary set of recommendations and proposed future directions for NIST to coordinate a comprehensive set of standards and guidelines for the assurance of high-integrity software.