JULY ISSUE 1996

LOS ALAMOS NATIONAL LABORATORY
WHERE SCIENCE MAKES A DIFFERENCE

DATELINE LOS ALAMOS

COMPUTER SLEUTHS HUNT FOR MEDICARE BANDITS

LOS ALAMOS USES SUPERCOMPUTERS TO CATCH FRAUD PERPETRATORS

Los Alamos is using modern computer science techniques to develop automated methods for detecting and preventing fraud, waste, and abuse of Medicare services. The Laboratory is working under a two-year contract with the Health Care Financing Administration of the U.S. Health and Human Services Department.

Medicare claims are expected to reach 1 billion per year by 2000. This has prompted researchers to look for better methods of detecting Medicare fraud.

HCFA, which administers the Medicare program, processes more than 800 million Medicare claims a year — expected to grow to about 1 billion by 2000 — worth roughly $180 billion. The organization needs to become more efficient in processing claims, and at the same time more effective at detecting, preventing, and prosecuting Medicare fraud, waste, and abuse.

The goal of this project is to produce new algorithms that HCFA can implement in a prepayment process to score Medicare claims for suspiciousness. Examination of highly suspect claims can then determine whether they should be further processed, suspended pending further analysis, or denied before they are paid.

The business of processing and paying Medicare claims is handled by as many as 79 different private contractors. These contractors operate independently to receive claims from health care providers, process the claims, decide whether the claims are appropriate, pay the claims, and then ask HCFA for reimbursement.

HCFA maintains numerous databases containing billions of claims, adding up to many trillion bits of information. This information could help spot fraudulent claims, but the agency's multiple computer systems make it difficult to pull together all these databases. Information in the databases about patients, physicians, medical groups, health maintenance organizations, third-party Medicare providers or insurance companies often is organized in different ways.

Los Alamos scientists are using supercomputers to help the agency and private vendors combine diverse software systems into one data bank and look for patterns that cut across all the databases.

Part of Los Alamos' goal is to develop a thorough understanding of the existing computer systems that contain Medicare data, look for weaknesses in those systems and the software that maintains their security, and suggest improvements.

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EDITOR
Diane Banegas

MANAGING EDITOR
Meredith Coonley
(505) 665-3982 • suki@lanl.gov

STAFF WRITER
Theresa Salazar

CONTRIBUTING WRITERS
Kathy DeLucas • Jim Danneskiold
Ternel Martinez • James Rickman
Steve Sandoval

CONTRIBUTING PHOTOGRAPHERS
John Flower • LeRoy N. Sanchez • Kelly Stoddard

CONTRIBUTING ILLUSTRATOR
Edwin Vigil

PRINTING COORDINATOR
G.D. Archuleta

LOS ALAMOS NATIONAL LABORATORY
PUBLIC AFFAIRS OFFICE, MS P355
LOS ALAMOS, NM 87545

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Much of the project builds on Los Alamos' experience in examining vast amounts of data stored in many different formats, and recognizing patterns or spotting anomalies in such data. That work includes organizing nuclear weapons design and testing information into simulations and seeking patterns in satellite data or export records that might indicate proliferation of weapons of mass destruction.

When HCFA processes a claim from a contractor, it uses a system of specific computer codes called "edits" that look for obvious inconsistencies within the claim. For instance, if the claim is for brain surgery, the edit makes sure it didn't originate with a podiatrist.

The Medicare claims system and the computerized edits have grown up over the past 30 years. Each edit performs a specific operation, but as new edits are developed, they are patched on top of older ones, often increasing the inefficiency of the system.

HCFA and Los Alamos hope the new system can be designed to detect a variety of anomalies systematically. Some examples include simple mistakes like double billing; "unbundling" of medical services, such as a clinic that submits individual charges for 37 separate blood tests when only one blood sample was taken from the patient; obvious overbilling, as when a psychiatrist claims he's seen patients for 27 hours in a single day; and coding errors, such as a neurosurgeon operating on an ingrown toenail.

Los Alamos computer scientists have extensive experience in fraud detection. In a recently completed project for the Social Security Administration, they researched potential security risks involved in a proposed system to give clients access to account information via public kiosks and computer networks, and recommended solutions. They also have worked for two years on a project that helped Internal Revenue Service criminal investigators develop new ways to detect fraud in electronically filed tax returns.

Other Los Alamos projects relevant to Medicare fraud include a multi-year, multimillion-dollar agreement with Citicorp to develop credit management and fraud detection tools; a contract with MasterCard International to detect credit card fraud; and various efforts with government and private industry in anomaly detection, data management, and computer security.

CONTACT: MARIANNA KANTOR
COMPUTER RESEARCH AND APPLICATIONS
(505) 665-8310 • E-MAIL: mkantor@lanl.gov

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PHERMEX TAKES IMPROVED SNAPSHOTS OF MOCKUP EXPLOSIONS

INCREASED X-RAY OUTPUT ESSENTIAL TO STOCKPILE STEWARDSHIP

Recent upgrades to a 65,000-pound X-ray machine in existence at Los Alamos since 1963 will give scientists more detailed pictures of mockup nuclear weapons explosions: an important advantage in maintaining the security and viability of the nation's nuclear weapons stockpile in the absence of underground nuclear testing.

The upgrades allowed PHERMEX — shorthand for "pulsed high-energy radiographic machine emitting X-rays" — to set a new record for X-ray output. The old record, set in 1989, was 168 Roentgens. PHERMEX surpassed that record with an output of 380 Roentgens during a recent experiment. A Roentgen is a measure of radiation exposure; 380 Roentgens is roughly equal to 20,000 dental X-rays.

As a mockup weapon is detonated, PHERMEX fires an electron beam that produces intense X-rays upon contact with a dense material. The X-ray flash lasts only 200-billionths of a second, but that's enough time to deposit the radiographic information on X-ray film located on the other side of the test object. The more X-rays generated by PHERMEX, the more detailed the information obtained from each test.

Los Alamos researchers credit the large increase in radiation output to the installation of a new electron gun that has twice as much electron-producing capability, the replacement of all the machine's magnetic lenses, and new computer controls and diagnostics.

A typical explosive test at PHERMEX. The machine is inside the concrete dome.

U.S. nuclear weapons are composed of two components: a primary and a secondary. In a real weapon, the primary

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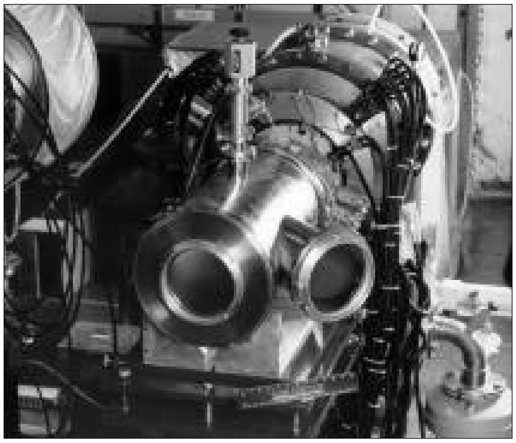
PHERMEX's high-current electron gun sits on a test stand. The ruler at the base of the gun gives an idea as to its size.



contains the plutonium pit and the secondary holds the bulk of the weapon's explosive force. The implosion process that compresses the pit has to work in exactly the right way for the secondary to work.

PHERMEX captures the locations of these materials at a fixed point in time during the implosion process, which gives researchers a better understanding of the weapon component's reliability and a vital experimental benchmark for computer codes.

Although PHERMEX has made great strides in its information-gathering capability, it was designed in the late 1950s and ultimately the technology will not be sufficient to provide adequate stewardship indefinitely in an era without underground testing. For one thing, PHERMEX pictures are only two-dimensional and the machine is reaching the limits of what it can do in terms of radiation generation.

The machine's additional radiographic power will help the Laboratory carry out its stockpile stewardship mission more effectively until construction on the Dual Axis Radiographic Hydrotest Facility, or DARHT, is finished.

DARHT will give researchers more detailed, three-dimensional pictures of a nuclear weapon's inner workings. DARHT will generate X-ray exposures of at least 1,000 Roentgens, more than twice PHERMEX's current capability. DARHT is at least three years away from becoming operational. According to Los Alamos researchers, PHERMEX will bridge the gap and continue to operate at Los Alamos for at least six years after the completion DARHT.

CONTACT: SCOTT WATSON
MACHINE SCIENCE TECHNOLOGY
(505) 665-6233 • E-MAIL: scottw@lanl.gov

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CRASH TEST DUMMIES ARE VIRTUAL HUMANS

COMPUTERIZED LABORATORY IMPROVES AUTOMOBILE SAFETY AND REDUCES THE NEED FOR COSTLY TEST CRASHES

Automotive crash testing will go virtual after Los Alamos develops a new-age safety laboratory for General Motors, which is funding the 1996 project. The virtual safety lab will complement data obtained from actual crash tests and may even reduce by 15 to 20 percent the number of crash tests needed to determine the safety of newly designed vehicles.

In the United States, about 30,000 fatal head injuries result each year from car crashes, and these injuries are the leading cause of death and disability for young adults. According to General Motors, if head injuries resulting from automobile accidents were decreased by even 5 percent, hundreds of lives could be saved and the U.S. could expect a $600 million economic benefit.

The goal of the virtual safety lab is to develop an advanced computer modeling system that integrates vehicle mechanical crash responses with passenger responses to assess the injury potential to specific organs, organ systems, or musculoskeletal components. If these two capabilities can be combined successfully into one model, it means that an automotive designer can sit down at a computer and determine whether redesigning an arm rest would have any bearing on the safety of a six-foot, 200-pound adult during a collision as compared with a four-foot, 80-pound child.

The virtual safety lab will save automakers money by reducing the number of actual crash tests needed to verify safety of new models. General Motors researcher Tom Anderson says the new system also will reduce the design-to-production lead time by at least three months.

American automakers attempt to offer different models almost every year. While under development, the safety of these prototypes often can be demonstrated only by a controlled automobile crash test where the driver and passengers are human-shaped, electronically wired dummies that relay crash impact information to onboard computers.

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Crash tests are expensive; each one costs about $750,000. Because different accident scenarios may affect different parts of the human body and the car bodies, automakers perform many different crash tests until the tests prove that the automobiles meet all safety standards. If the result of a crash test, supported by virtual safety lab analysis, brings about a safer vehicle design with fewer actual crash tests, the average taxpayer will notice the economic benefits.

In the virtual laboratory, an automotive engineer will conduct a crash test by accessing a mainframe computer via a desktop workstation. The mainframe computer conducts the numerical calculations for the chosen accident scenario. The engineer will select applications for a specific analysis, such as side impact, and link a human model to a vehicle crash dynamics model. From the simulation, the Los Alamos system will predict the injuries sustained by passengers in relation to the car's reaction to the crash.

A desktop software controller, which tracks the location of information on the system, also will be able to access other mainframes or workstations that contain a human body model and individual detailed models for specific body parts. The automotive engineer can then select different body shapes and vehicle types for various crash simulations. The virtual safety lab will incorporate a variety of government and industry computer simulation models already developed for safety and health analysis.

One of the problems facing researchers is how to develop an integrated software system that is easy to modify and update, yet allows the diverse computer programs to interact. Los Alamos researcher William Wray expects to develop an integrated system of models that will allow the engineer to select the necessary level of complexity for a specific design-related occupant safety issue. This system will be flexible and expandable enough to allow new modules to be added as they are developed and validated.

Initially the program will run on a Cray Y-MP supercomputer, which is capable of one billion calculations per second. The Cray is located at Los Alamos' Advanced Computer Laboratory, one of two National High-Performance Computing Research Centers owned by the Department of Energy. General Motors plans to phase in the use of the virtual safety lab at one or more of its sites as advanced workstations are developed that are competitive with Cray mainframes.

CONTACT: WILLIAM O. WRAY
BIOSCIENCE AND BIOTECHNOLOGY
(505) 667-4496 • E-MAIL: wray@lanl.gov

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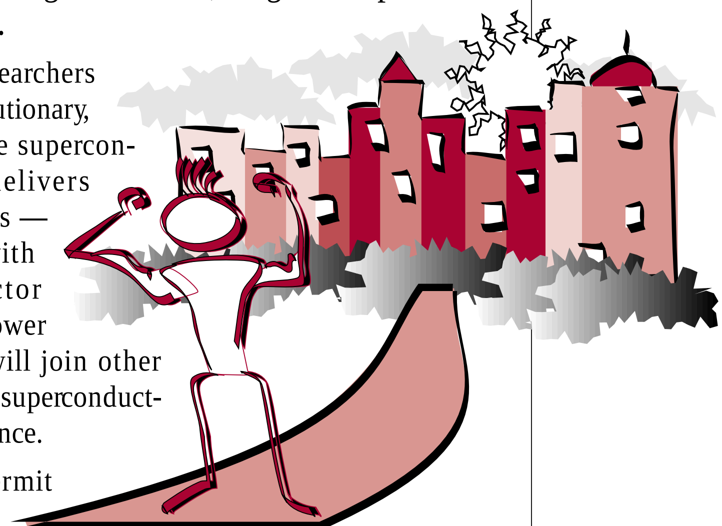
LOS ALAMOS TAKES "SUPER TAPE" TECHNOLOGY TO INDUSTRY

COLLABORATION WILL ADVANCE THE U.S. LEAD IN SUPERCONDUCTIVITY

Researchers at Los Alamos' Superconductivity Technology Center are collaborating with an alliance of industry and research organizations that plans to develop and commercialize future-generation, high-temperature superconducting wires.



Los Alamos — whose researchers last year developed a revolutionary, flexible, high-temperature superconducting tape that delivers world-record current levels — has signed agreements with American Superconductor Corp. and the Electric Power Research Institute, and will join other research organizations in a superconducting wire-development alliance.

These agreements will permit the Los Alamos Superconductivity Technology Center to work with other organizations to refine technologies that will allow the United States to advance its lead in superconductivity. Alliance members will look at ways to enable large-scale manufacturing of huge lengths of superconducting wires, including wires based on the "super tape" Los Alamos developed last year.

The Los Alamos super tape has a current density of more than 1 million amperes per square centimeter at liquid nitrogen temperature — a current density much greater than any other flexible high-temperature superconducting tape yet developed. Current density is a measure of the amount of current that can travel through a cross section of material.

To make the tape, Los Alamos researchers deposited a layer of cubic zirconia, the same substance used for fake diamonds, on top of a flexible strip of nickel. The process, called Ion-Beam Assisted Deposition, or

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Super tape is super flexible — that is, super tape technology serves various applications. An alliance of government and industry is using this technology to produce superconducting wires.

IBAD, aligns the cubic zirconia crystals at a specific angle. A superconducting ceramic, yttrium-barium-copper-oxide, is deposited by pulsed laser on top of the cubic zirconia layer. The precise orientation of the layers obtained through the IBAD process is necessary for superconducting materials if they are to allow high current to flow through them.

According to Los Alamos researcher Dean Peterson, American Superconductor's expertise in manufacturing and Electric Power Research Institute's expertise in identifying technologies that can make U.S. utility companies more competitive will give the alliance great potential.

The wire-development alliance includes Los Alamos and its founders, American Superconductor Corp. and Electric Power Research Institute, and University of Wisconsin's Applied Superconductivity Center, Inco Alloys International, Stanford University, and Lawrence Berkeley National Laboratory. Alliance members also plan to work with other organizations in the future.

American Superconductor Corp. develops commercial applications of high-temperature superconductors for the global electric power industry and is involved in research and development of electromagnetics, cryogenic integration, semiconductors, and engineering applications for electric power. The Electric Power Research Institute manages technical research and development programs for the electric utility industry to improve power production, distribution, and use.

Los Alamos will receive funding of $500,000 a year for two years from American Superconductor Corp. and Electric Power Research Institute to incorporate the super tape technology into the development of superconducting wires.

(See the August 1995 *Dateline: Los Alamos* for a related article on the development of superconducting tape.)

CONTACT: DEAN PETERSON
SUPERCONDUCTIVITY TECHNOLOGY CENTER
(505) 665-3030 • E-MAIL: dpeterson@lanl.gov

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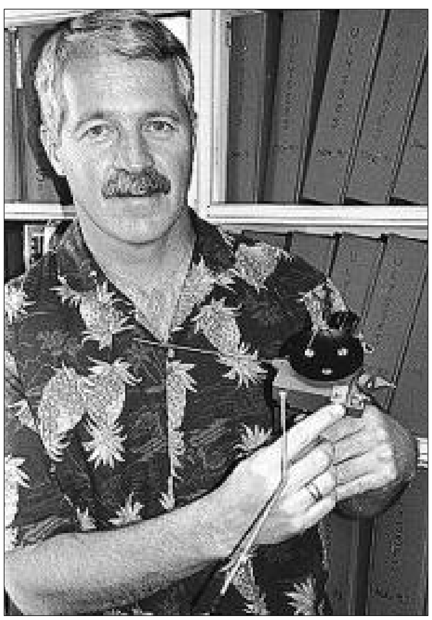
LOS ALAMOS RESEARCHERS ARE SPACE-BOUND

NASA RECRUITS SCIENTISTS FOR ASTRONAUT CLASS OF 1996

Two Los Alamos scientists are among 35 candidates chosen to train in NASA's Class of 1996 astronaut program. The evaluation and training of astronaut candidates will begin Aug. 12 at the Johnson Space Center in Houston and will last approximately a year and a half.

The NASA astronaut candidate training program was formally established in 1978. The first 34 weeks of the program are called "basic" training, which is primarily academic instruction. The next 18 to 20 weeks is the "advanced" training where mission specialist candidates learn to operate Shuttle equipment and pilot candidates learn to fly T-38 trainer jets.

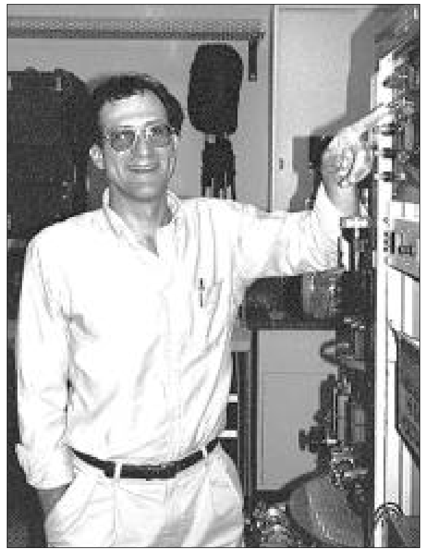


➔ Astronaut candidate and Los Alamos researcher John Phillips holds a miniature model of "Ulysses," the first spacecraft to explore interplanetary space at high solar latitudes. Los Alamos researchers developed a pair of particle sensors for Ulysses, which is sponsored by NASA and the European Space Agency.

John Phillips and Donald Pettit of Los Alamos are among 25 mission specialists in this year's class. The mission specialist astronauts will be assigned to work with the commander and the pilot and have overall responsibility of coordinating Shuttle operations such as crew activity planning and payload operations. Ten pilot candidates also have been selected to participate in the program.

Astronaut candidates will attend classes on Shuttle systems in basic science and technology. Courses in mathematics, geology, meteorology, guidance and navigation, oceanography, orbital dynamics, astronomy, physics, and materials processing are among training requirements. Candidates also will receive training in parachute jumping, space suits, scuba diving, and land and sea survival.

Additionally, candidates will be exposed to the microgravity of space flight. To experience microgravity, a modified KC-135 jet aircraft produces periods of weightlessness for 20 seconds each time it dives from an altitude of 35,000 to 24,000 feet. The aircraft may perform up to 40 dives in one day.



Los Alamos researcher Donald Pettit is one of 35 candidates chosen to train in NASA's Class of 1996 astronaut program. He's pictured here with the equipment he uses in the study of volcanoes.

Phillips holds a doctorate in geophysics and space plasma physics from the University of California at Los Angeles. He is a space plasma physicist conducting research on the atomic particles and electromagnetic fields in space. He serves as principal investigator for the Solar Wind Plasma Experiment aboard the "Ulysses" satellite mission, which is sponsored by NASA and the European Space Agency.

Pettit holds a doctorate in chemical engineering from the University of Arizona. He is a chemical engineer presently working on the Volcano Fumarole Sampling Program. He recently returned from an expedition in New Zealand where his research involved sampling gases from fumaroles — holes in volcanic areas that release gases or vapors — to predict volcanic eruptions and to determine how they work.

Astronaut candidates who successfully complete the candidate training advance to the astronaut formal training where they will be assigned to specific missions. ◆

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BRIEFLY ...

A LOS ALAMOS-PRODUCED VIDEO DOCUMENTARY AND A BOOKLET ABOUT AIDS HAVE BEEN DESIGNATED CRYSTAL OBELISK RECIPIENTS IN THE 1996 SOCIAL RESPONSIBILITY AWARDS COMPETITION OF THE WOMEN EXECUTIVES IN PUBLIC RELATIONS. The "Our Faces" video was produced as part of the Laboratory's comprehensive approach to addressing HIV, the AIDS-causing virus, and AIDS in the work place. It featured interviews with HIV-positive individuals, HIV health-care providers, and family members and friends of HIV-positive people. The 54-page booklet, "HIV/AIDS in the Workplace: A Positive Approach," includes questions and answers about the HIV virus and dispels myths about the AIDS disease. It has been distributed to more than 15,000 Lab employees and subcontract personnel and is being used by the entire Department of Energy complex for HIV/AIDS awareness training. The video was produced by Dan Curry and the booklet was developed by Debbi Wersonick. Both are members of Los Alamos' Human Resources Division. Other Crystal Obelisk winners include American Express, Avon, the Chevrolet Motor Division of General Motors, Sara Lee Corp., and the Campaign for Tobacco-Free Kids.

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