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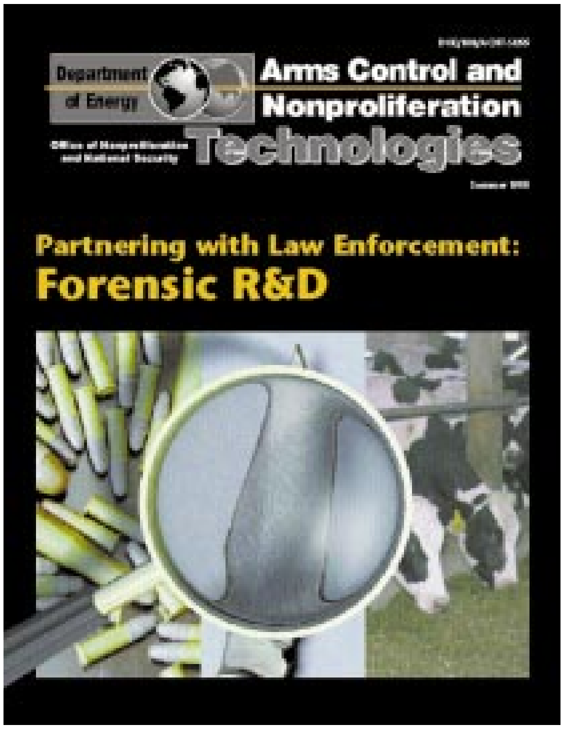
Arms Control and Nonproliferation Technologies

Office of Nonproliferation and National Security

Summer 1999

Partnering with Law Enforcement: Forensic R&D



About the cover

Whenever a crime occurs, law enforcement asks the same questions today that it asked 100 years ago—what happened and who did it. The magnifying glass is an old tool in the crimefighting arsenal. R&D in the forensic sciences is adding new tools to identify metals and recover latent fingerprints. And as technology has evolved, so has crime, which now includes computer theft and threats against the nation’s food supply. R&D is expanding to meet these challenges.

The purpose of *Arms Control and Nonproliferation Technologies* is to enhance communication between the technologists in the DOE community who develop means to verify compliance with agreements and the policymakers who negotiate agreements.

Focus on Forensic R&D

This issue of *Arms Control and Nonproliferation Technologies* covers an exciting new area for the Department of Energy, and we believe our usual readers will find the information to be of interest. DOE formally added support of law enforcement to its general R&D tasks in 1998. It is an important area, and DOE is enlarging the distribution of this particular issue to cover a new audience, the law enforcement and forensic sciences communities. As always, readers are invited to call the ACNT Office for additional information and copies. We also encourage readers to visit the DOE Web site (see the next page for the address).

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The Department of Energy (DOE) complex offers a wide range of expertise and resources across the U.S. through many of its facilities.

Partnering with Law Enforcement: Forensic R&D

On next page: (top) On May 19, 1998, Vice-President Al Gore presided at the signing of Memo-randa of Understanding between DOE and the Departments of Justice and Treasury. (middle) The Vice-President is briefed by an agent on a proto-type system. (bottom) Secretary Bill Richardson signed a new Memorandum of Understanding in August 1998 between the FBI and DOE specializing against terrorism.

Support for law enforcement is a recently formalized initiative for the Department of Energy (DOE), but it is not a new activity for DOE's laboratories. As responsible members of their respective cities and states, the laboratories have for many years provided *ad hoc* scientific and technological support to local law enforcement, as well as diverse levels of support to various federal agencies. Within the last year, however, the Office of Research & Development (NN-20), within the Office of Nonproliferation and National Security, has embarked on an effort aimed at more broadly applying the research-and-development (R&D) resources of DOE to law enforcement's problems. In the spirit of "good government," we are attempting to leverage DOE's ongoing, multi-million dollar investment in science so as to benefit the taxpayers in as many ways as possible.

In this issue of *Arms Control and Nonproliferation Technologies*, we have four goals:

1. Describe the elements of our Law Enforcement Initiative.
2. Demonstrate how recent forensic activities have benefited from previous national security-related R&D.
3. Illustrate the breadth of currently funded forensic R&D efforts.
4. Establish the basis for future collaborative research with the law enforcement and forensic sciences communities.

Over the past 50 years, DOE's laboratories have developed an unparalleled reputation for being on the leading edge of science and technology. Virtually every corner of the scientific world has been and continues to be explored by DOE scientists under the aegis of protecting the national security and, more recently, improving the quality of our environment. Over 70 Nobel laureates have resulted from these scientific endeavors, as well as technological advances too numerous to mention. While the benefits of these scientific breakthroughs have been applied to protecting our country from external threats, much of this knowledge is equally applicable to reducing domestic ones. That is the underlying premise of our Law Enforcement Initiative.

Realizing that DOE in general has little experience in the law enforcement arena and a limited understanding of its attendant requirements and technology gaps, the Office of Research & Development has established as its first order of business the need to develop strong collaborative partnerships with law enforcement agencies at all levels (federal, state, and local). In addition, we have retained and continue to seek distinguished experts in this field to serve as advisors. The beginnings of these efforts are detailed in the first two sections of this publication. Section 1 (**Federal Partnerships**) includes the overarching document that established the foundation for DOE's Law Enforcement Initiative at the federal level—the "Statement of Principles," signed by the Secretary of Energy (then, Federico Peña), the Treasury Secretary (Robert Rubin), and the Attorney General (Janet Reno).

Section 2 (**State and Local Outreach Programs**) shows examples of the types of "good neighbor" programs currently underway at several DOE laboratories. Such outreach efforts serve two extremely valuable purposes: they provide regional law enforcement agencies with a better view of the scientific capabilities resident at their nearby DOE laboratories, and they help educate laboratory researchers as to the specific problems that law enforcement faces.

Though still in its infancy, DOE's law enforcement-related research efforts are already off to a quick start, due largely to the legacy of Cold War-related R&D. Section 3 (**Building on the Past**) provides a representative, but by no means comprehensive, sampling of past and present projects that draws upon DOE expertise originally developed to solve nonproliferation, national security, and even environmental problems.

Finally, Section 4 (**Looking to the Future**) includes examples (once again, due to space constraints, not a comprehensive collection) of recently funded research efforts

that have already evolved from this new partnership with law enforcement. Some are based on specific requirements of the FBI, while others address long-standing gaps identified at the state and local levels.

One final point must be emphasized: this Law Enforcement Initiative is not aimed at creating a new law enforcement mandate for DOE. That charter clearly resides with the criminal justice system and the many other federal, state, and local agencies duly appointed to support it. DOE's focus has been and will continue to be providing the citizens of this country with preeminent science and technology to ensure our national security. So much the better if that scientific arsenal can be applied to the mitigation of crime and criminal activities. Our approach is to first highlight DOE's many scientific resources and then develop the appropriate collaborative mechanisms for continued partnerships between the DOE laboratories and the law enforcement and forensic sciences communities. The Office of Research & Development will facilitate this process, but ultimately, it must be perpetuated through direct sponsorship by the various law enforcement agencies.

Statement of Principles on Crimefighting Partnership Between the Department of Energy and the Department of Treasury and the Department of Justice

Recognizing that better prevention techniques and investigative strategies, tougher punishment, and an increased police presence have proven effective in reducing violent crime in communities throughout the United States;

Emphasizing the importance of close and effective cooperation among law enforcement agencies at the national, state, and local levels;

Recognizing that the United States criminal justice system is undergoing rapid change in investigative methods requiring new technical skills to fight crime on the street while protecting the rights of the accused;

Acknowledging that law enforcement agencies are increasingly challenged by the evolving technologies exploited by drug cartels, organized criminal enterprises, cybercriminals, and terrorists, and by the potential availability of weapons of mass destruction;

Noting the internationally recognized capacity of the Department of Energy national laboratories in advanced materials, advanced instrumentation, biotechnology, engineering, and information technologies:

Now, therefore, the Secretaries of the Treasury and Energy and the Attorney General join with the Vice-President of the United States in resolving to deploy sophisticated technologies developed at the Department of Energy laboratories to aid in the war on drugs, violent crime, white-collar crime, and terrorism. The Secretaries agree with the Vice-President's assessment that "Science and technology hold forth the promise of improving the efficiency of the criminal justice system, enabling law enforcement agencies to better detect, preserve, and analyze the trail of evidence."

And the Department of Energy, in partnership with the Departments of the Treasury and Justice, will direct the internationally renowned technical capabilities and resources of its laboratories to enhance, modernize, and bring to the field additional crimefighting tools to aid national, state, and local law enforcement agencies. This partnership will draw upon and leverage 40 years of national investment in these capabilities at the laboratories, which have traditionally been applied to national security missions of the United States in the military and nuclear weapon arenas.

And in applying these capabilities to fight crime, the Department of Energy's national laboratories will join the Departments of the Treasury and Justice in their use of advanced technology in the prevention and investigation of crime.

And, the Departments of the Treasury and Justice will partner with the Department of Energy to further improve and enhance crimefighting tools, and will continue their sharing of such tools with law enforcement agencies at the national, state, and local level, relying primarily on their existing intergovernmental networks. The three cabinet agencies recognize that the Memoranda signed today between the Department of Energy and the Federal Bureau of Investigation of the Justice Department, and between the Department of Energy and the Bureau of Alcohol, Tobacco, and Firearms (ATF) of the Treasury Department are the next steps in increased cooperation. These agreements build upon the existing Memoranda of Understanding signed by the Department of Energy with the U.S. Customs Service and the Department of Justice's National Institute of Justice. The three cabinet agencies will work through established channels to facilitate the flow of technologies produced through the partnership to law enforcement agencies at the state and local level.

And we enter into this partnership in an effort to gain additional return from our national investments by applying technologies originally developed for the defense and national security of the United States to our domestic law enforcement efforts.

In witness whereof, we have here unto set our hands this nineteenth day of May, in the year of our Lord nineteen hundred and ninety-eight.

For the Department of Energy
Federico Peña
Secretary of Energy

For the Department of the Treasury
Robert Rubin
Secretary of Treasury

For the Department of Justice
Janet Reno
Attorney General

Bureau of Alcohol, Tobacco, and Firearms
John W. Magaw
Director

Federal Bureau of Investigation
Louis J. Freeh
Director

At a May 1999 technology demonstration on Capitol Hill, Secretary Bill Richardson and senior DOE officials invited members of Congress to see some of DOE's latest projects, including the newest version of a crime scene-processing system called ScenePro.

AMERICAN ACADEMY OF FORENSIC SCIENCES

P.O. Box 669 • Colorado Springs • CO 80901-0669 • 719/636-1100 • Fax 719/636-1993

May 14, 1999

The Honorable Bill Richardson, Secretary
Department of Energy
1000 Independence Avenue, SW
Washington, D.C. 20585

Dear Secretary Richardson:

Forensic science laboratories play a vital role in the administration of justice in our country. The application of science, medicine and technology in bringing the wrongdoer to justice, as well as to safeguard the rights of individuals accused of criminal acts, is the fundamental purpose of our profession.

The Department of Energy's interest in research and development in forensic science is an important development and can only serve to aid our mission. New technologies to enhance forensic science in areas such as biological and chemical terrorism, DNA technology, data processing, communications, automation, etc., are greatly needed, and DOE is well positioned through its national laboratories to help.

We salute your leadership in this area. The American Academy of Forensic Sciences, its members, as well as other key forensic science associations stand ready to work cooperatively with the Department of Energy in areas of common interest.

Sincerely,

Patricia J. McFeeley, MD
AAFS President, 1999-2000

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Federal I.D. Number 87-0287045

AMERICAN SOCIETY

OF

CRIME LABORATORY DIRECTORS, INC.

June 1, 1999

The Honorable Bill Richardson, Secretary
Department of Energy
1000 Independence Ave. SW
Washington, D.C. 20585

Dear Secretary Richardson,

As a representative of the nation's crime laboratories, the American Society of Crime Laboratory Directors appreciates the collaborative relationship that has developed between the Department of Energy Laboratories and the criminal justice community. The country's resources can best be utilized through such coordinated efforts. The DOE laboratories provide a resource for specialized testing while allowing the local crime laboratories to efficiently analyze routine cases.

Most crime laboratories lack the funding and manpower that are necessary to develop new technologies that can be used to analyze physical evidence. The research performed at the DOE laboratories will prove valuable as these high-tech devices and processes are developed into cost-effective methods that can be employed by all crime laboratories. Additionally, much of the past research undertaken by the DOE laboratories can be transferred to the forensic sciences. This technology transfer will more quickly advance the analytical techniques used to analyze physical evidence.

The technologies developed in cooperation with the laboratories will universally increase the speed and sensitivity with which evidence can be analyzed and crimes solved. The social benefits of this effort are great. ASCLD appreciates the opportunity to participate with the Department of Energy and looks forward to continuing our relationship.

Sincerely,

Jami J. StClair

Jami J. St.Clair, President
American Society of Crime Laboratory Directors

▶ This isolation chamber is used to prepare completely unknown samples for forensic analysis. Such samples may contain chemical or biological materials, or other hazardous agents.

LLNL's Forensic Science Center

The Forensic Science Center (FSC) at Lawrence Livermore National Laboratory (LLNL) is DOE's first dedicated facility to support to law enforcement and other government agencies concerned with crime, terrorism, and intelligence. Established nine years ago, the FSC is dedicated to teaching, developing new forensic methods of analysis, designing and building advanced laboratory and field-analysis hardware, and offering unique problem-solving capabilities—all combined in one secure facility.

The FSC applies advanced R&D capabilities to problems of concern to DOE, law enforcement, and the intelligence communities. State-of-the-art methods and instrumentation analyze high-priority samples of all types. The results of these forensic analyses help support investigations and aid policy makers concerned with issues of national and international security (including nonproliferation concerns, nuclear smuggling, and counterterrorism).

A diverse complement of programs includes—

- *Solid-Phase Microextraction*. This novel sample collection and analysis method uses hair-sized fibers to safely and efficiently capture organic vapors so they can be characterized with great accuracy via gas chromatography and mass spectrometry. Not only are we developing new field-collection techniques for the intelligence community, but we are also providing the FBI and first-responders with field kits for the safe and rapid characterization of chemical-warfare (CW) agents. Such tactics allow safe and efficient collections of highly toxic compounds associated with terrorist activities.
- *Portable Gas Chromatography–Mass Spectrometry*. In 1999, the FSC delivered to the FBI a highly sensitive, analytical-chemistry instrument to characterize CW agents. Previously available only in the laboratory, this instrument—with low parts-per-trillion to parts-per-billion sensitivity—can be used in the field (see page 24).
- *Portable Thin-Layer Chromatography–Digital Imaging*. Developed for the Army to characterize propellant stabilizers in munitions, this unique system also characterizes unknown explosives, drugs, and other materials in the field. The system includes a digital camera and laptop computer to facilitate the identification and quantification of target compounds.

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▶ The Weather Center at the Savannah River Technology Center is a resource available to local and state law enforcement.

Savannah River Technical Center

To better understand the needs of law enforcement, researchers from the Westinghouse Savannah River Company met with law enforcement officials in December 1998 to establish a regional Department of Justice laboratory at the Savannah River Technical Center (SRTC) in South Carolina. SRTC is located primarily in Aiken County, but it also borders the state of Georgia (across the Savannah River). The Director of Public Safety for Aiken County organized a meeting between SRTC and 17 state and local representatives from both South Carolina and Georgia, including Aiken City Public Safety, Georgia Bureau of Investigation, Aiken County Sheriff's Office, Richmond County Sheriff's Office, Aiken County Solicitor's Office, and South Carolina Law Enforcement Division.

▲ An ROV, or remotely operated vehicle, is available to dive teams to search for evidence.

These representatives were encouraged to view SRTC as the DOE resource for the southeast region of the United States. Collaborative projects were discussed in forensic technology, operational support, research and development, and technology transfer. Technologies with immediate usefulness were quickly identified, in particular SRTC's Weather Center, particle-analysis instruments, a remotely operated underwater vehicle, and infrared imaging systems.

SRTC initiated four demonstration efforts. The Weather Center is correlating crime statistics with weather conditions over the past few years; Aiken Public Safety is using the Weather Center as a blueprint to design a new command and communications center. The underwater vehicle is searching for evidence in the Savannah River. And an effort is underway to detect chemical effluents from suspect drug-production operations.

Through a series of meetings in 1999, the working relationships between the various law enforcement agencies and SRTC will be formalized. The Savannah River site already has protocols in place for emergency response that can be used as templates for law enforcement. The Savannah River site supports local fire and spill-response teams by providing trained personnel and equipment in emergencies. The Savannah River site also responds to radiological emergencies. The vision is for SRTC to provide unique forensic analyses unavailable through traditional resources.

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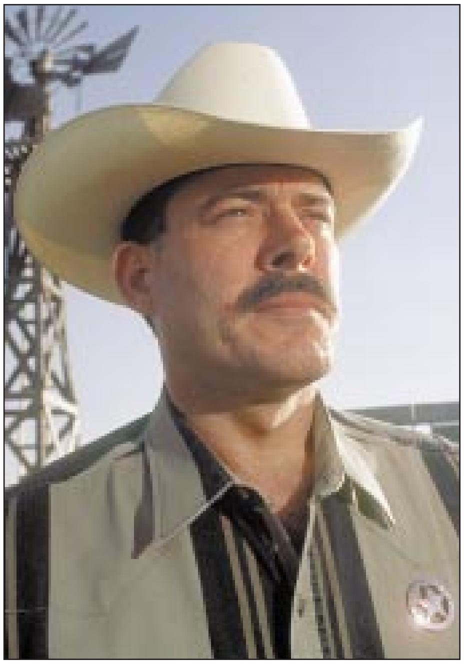
Criminal Investigator Jim Skinner was one of many law enforcement officers trained through Los Alamos' outreach program. Expertise in computer technology is one of the areas that DOE can offer to help solve cyber-crime.



Los Alamos National Laboratory

Opening doors to the judiciary joins existing Los Alamos National Laboratory efforts to aid advancement of forensic science and technology while assisting federal, tribal, state, and local criminal justice. This year, Los Alamos and its corporate allies will hold a conference concerning the exercise of judicial discretion in matters involving digital evidence—during which New Mexico judges will discuss ways to tap the national store of scientific and technical expertise in DOE laboratories in rulings on technical and scientific matters. Recent and developing case law is changing the way federal and many states' judges rule on admissibility of technical expertise. Their evolving "gatekeeper" function presents new challenges for understanding the complexities of state-of-the-art scientific issues that come before them.

Following the judicial conference, state, local, and Native American law enforcement officers will learn how computer crimes are committed in their communities and how those and other crimes can be investigated using computers during two days of hands-on training at the J. Robert Oppenheimer Study Center at Los Alamos. Special emphasis goes to attendees who will multiply their experience by training colleagues back home. The faculties for both conferences are pioneers of information sciences' prosecutions, investigations, and forensics training.

This year, Los Alamos has also assisted in the investigation and prosecution of the murder of a prominent former elected official (in which Los Alamos photo-enhancers were able to show the victim and his since-admitted assailant together just before the victim's disappearance) and the homicide of another former elected official (in which Los Alamos computer scientists found key evidence in the former official's computer). Other cases include an alleged repeated rape involving the possible use of animal tranquilizers, enforcement of state computer network laws, a high-visibility kidnapping case involving sexual slavery, child pornography, multiple public corruption cases, software piracy, and environmental threats. Most of these cases are on-going. Los Alamos was also consulted in several investigations and prosecutions charging violations of securities laws.

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ScenePro is a crime scene-processing system incorporating digital audio and video data and global positioning data with on-line access. ScenePro is an outgrowth of technology developed for arms control.

Pacific Northwest National Laboratory

Pacific Northwest National Laboratory (PNNL) is working with state and local law enforcement agencies in Oregon, Washington, and Alaska to understand their technology needs and either apply existing technology, developed for some other DOE program, or start new R&D. Once a technology is developed, PNNL establishes partnerships with commercial companies to make it available at a reasonable cost. The outreach program gives state and local law enforcement agencies the scientific and technological resources of a DOE laboratory to fight crime at the grassroots level.

One exciting project employs information visualization and analysis technology to examine data amassed on serial homicides: the unsolved Green River Killer case. Working with the King County Police Department and the Washington State Attorney General's Office, PNNL is testing a system called Starlight to analyze the Green River data (see page 19). Massive amounts of data can be explored to find critical, but often subtle, interrelationships among the data, discovering crucial details that might otherwise be missed.

Another serial-crime tool is Computer-Aided Tracking and Characterization of Homicides (CATCH). CATCH is based on artificial neural networks—a system of computerized, interconnected processing elements that simulates human thought to find patterns in data. CATCH is analyzing 200 fields of information from approximately 7,000 homicides and 9,000 sexual assault cases contained in the Washington State Attorney General's Homicide Information Tracking System (HITS). The HITS database includes information on all serial homicides and sexual assaults in the Pacific Northwest, including the Green River Killer.

We collaborate closely with police departments, crime laboratories, and other criminal justice agencies throughout the Pacific Northwest, as well as with federal agencies and professional associations. PNNL also provides selective operational assistance without charge to a requesting agency on cases that have potential for generating R&D opportunities.

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Currently, facial reconstruction is slow, costly, and often unreliable. Oak Ridge teamed with the University of Tennessee to combine artificial intelligence and neural networks to rapidly reconstruct faces from skeletal remains.

As part of a collaboration with Customs and INS, Oak Ridge is developing a cooling system for body armor (bullet-proof vests). Cooled body armor would help officers work in hot, humid environments. This lightweight system, with a rechargeable power supply, can be retro-fitted to existing armor.

CASTLE Program

In a pilot project that began in 1995, Oak Ridge National Laboratory, acting as the coordinator for four DOE laboratories, created a program to support law enforcement with DOE-developed technology. Oak Ridge formed the Center for Applied Science and Technology for Law Enforcement (CASTLE), a partnership of scientific, university, private sector, and law enforcement personnel. The CASTLE program applied DOE technology at the grassroots level to both solve crimes and make the officers' jobs safer and more efficient. CASTLE provided quick solutions, at no cost to the requester, when the need could not be met elsewhere. Solutions were provided in areas such as evidence analysis (e.g., audio and video tapes, and physical and trace substances), operational and tactical support, technical advice, and training. Other CASTLE activities included short feasibility studies that subsequently led to longer-term R&D projects under federal agency sponsorship.

By working closely with personnel in police, sheriffs, and other law enforcement organizations throughout the Southeast U.S., needs were identified and sent to CASTLE. Where it was ascertained that the need could not be met either in the private sector or by organizations such as the Tennessee Bureau of Investigation or FBI, and where Oak Ridge has a specialized or unique expertise, CASTLE attempted to provide a technological solution through its multidisciplinary network of scientists and engineers.

Significant aid was rendered through the CASTLE program, including—

- Numerous armed robberies, several homicides, and other crimes were solved through advanced video enhancement;
- An improved scheduling system for the Atlanta police was developed for the 1996 Olympic Games;
- Computer and intelligent systems technologies provided significant improvements in quality, cost, and production time for cranial-facial reconstruction;
- Forensic analyses of materials provided significant evidence for investigations in several very high-profile national cases;
- Audiotape analyses led to the conviction of several suspects and the exoneration of one.

The key to the success of CASTLE was its linkage to law enforcement personnel at local, state, and federal levels. Though the CASTLE program no longer exists on a formal basis, Oak Ridge continues to support casework when possible in the context of the larger law enforcement effort.

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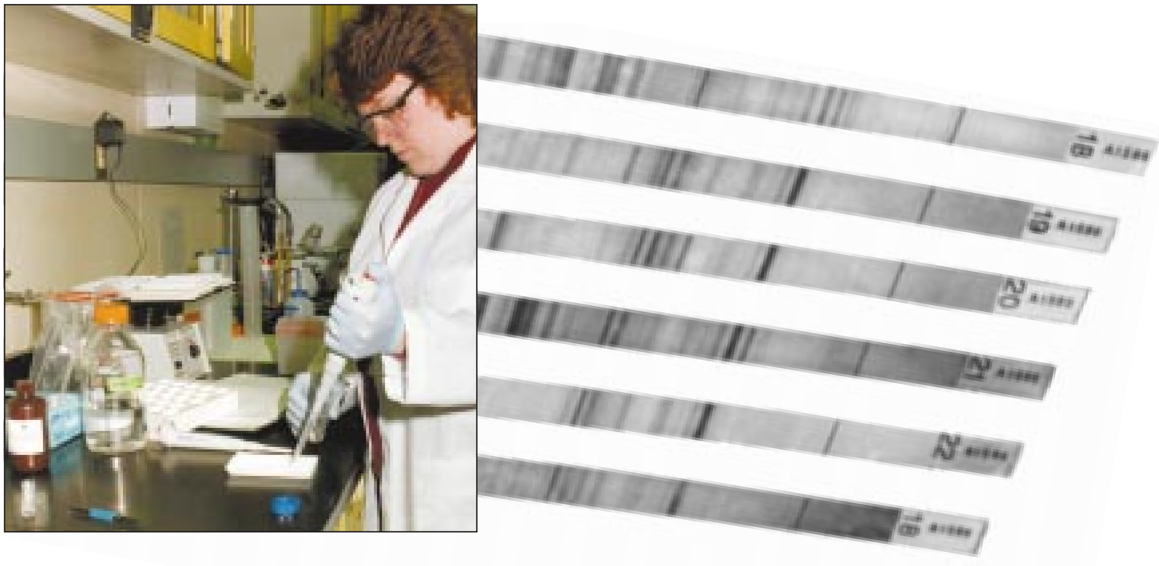
One of INEEL's research projects involves a technique called AbPTM where body fluids are flushed across a strip of paper lined with specific proteins that antibodies cling to—antibodies that are unique to every person. This test can distinguish between identical twins, which a DNA test cannot do.



Idaho National Engineering & Environmental Laboratory

The location, national security requirements, and technological capabilities of Idaho National Engineering and Environmental Laboratory (INEEL) offer a unique resource for the intermountain law enforcement community. INEEL supports local and regional law enforcement through direct assistance as well as federal agencies through programmatic research.

Research includes the successful commercialization of two technologies sponsored by the National Institute of Justice: the RoadSpike™, a licensed INEEL product now manufactured by a West Virginia company to safely deflate tires at checkpoints and during chases and the Concealed Weapons Detector, manufactured by Innovative Engineering Solutions as the SecureScan 2000™. Two INEEL information system projects, sponsored by the Office of National Drug Control Policy (ONDCP), involve establishing test beds for secure data sharing and data access across diverse law enforcement units. These programs involve collaborations with the Idaho Criminal Investigative Bureau, Colorado Bureau of Investigation, and several Colorado police and sheriff departments.

INEEL supports the intermountain region for hazardous materials response (HAZMAT) training and investigations, including SWAT training and range exercises for 35 agencies covering multiple jurisdictions in Idaho, Utah, Colorado, Montana, and Washington as well as for federal agencies such as the Bureau of Land Management, FBI, Forest Service, and the National Park Service. Training in bomb-threat response, hazardous chemical disposal (including methamphetamine labs), and accidental explosions is offered throughout Idaho, Montana, Utah, Oregon, Wyoming, Montana, and Washington.

The Boise and Garden City Police Departments receive assistance in several forensic and drug detection methods. INEEL is minimizing the cost of DNA testing for the Boise Police Department through an antibody profiling method.

Other forensic assistance has resulted in several convictions including a homicide in Ammon, Idaho in which an INEEL scientist was used photography and mathematical methods to relate a footprint at a crime scene to that of a suspect. Time-of-Flight Secondary Ion Mass Spectrometry is being used by the Idaho Bureau of Forensic Services to examine paint traces and identify component of a commercial product in a possible arson case.

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A videotape from a surveillance camera provided the evidence to place a murder suspect in prison.

Image Science

In July 1995, the murder of a convenience store clerk in Chattanooga, Tennessee, during an armed robbery was recorded by the store's surveillance camera. The videotape's quality was very poor, providing little information to the police. Chattanooga Police asked Oak Ridge National Laboratory to analyze the videotape for any information that might help the investigation.

In examining the videotape, an Oak Ridge technician noticed a flash of light near the end of the muzzle of the suspect's weapon. This light appears on the videotape just prior to the store clerk's moving to a rear storage room. The technician believed this could be a muzzle flash from the suspect's handgun. Oak Ridge requested that the police return to the crime scene and fire the handgun while being recorded by the same camera. Oak Ridge then compared the images of the muzzle blast from the police tests to the images from the robbery. The light observed on the robbery videotape was very similar to the muzzle blast observed on the police's videotape. Additional image analysis and calculations confirmed that the suspect had in fact shot the store clerk while in view of the surveillance camera. This proved that the suspect had intentionally, not accidentally, shot the store clerk.

After viewing the videotape, the suspect subsequently plea-bargained to murder in the first degree accepting a life sentence without possibility of parole. The District Attorney's Office stated that the overwhelming evidence from Oak Ridge's videotape allowed them to place the suspect at a specific location in the store while shooting the store clerk. It is estimated that the suspect's plea saved the District Attorney's Office over $100,000 by avoiding a death-penalty trial.

Oak Ridge's Image Science and Machine Vision Group is creating software that could put similar technology into the hands of forensic scientists with personal computers. The software will allow detectives and investigators to use it without needing an engineering degree to understand the process. Oak Ridge is planning to test the software this summer with the Secret Service, FBI, and ATF. The software could be available for outside licensing as early as January 2000.

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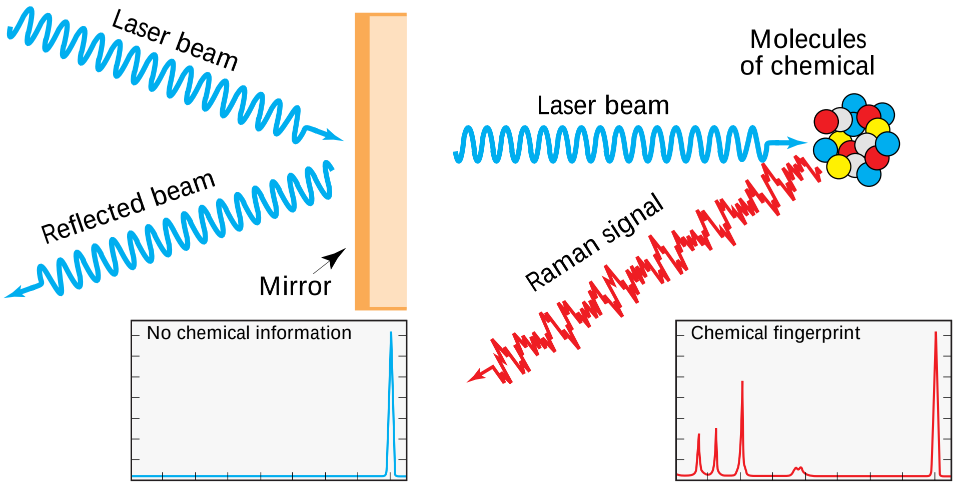

In Raman spectroscopy, laser light scattered off a substance carries information about the chemical make-up of that substance. This Raman signal is unique to each molecule. Just as people can be uniquely identified by fingerprints, so too can chemicals, regardless of their physical state (solid, liquid, and gas).

Mini-Raman Lidar

Brookhaven National Laboratory is developing a short-range forensic tool to screen unknown chemicals in the field. An outgrowth of ongoing research in Raman lidar (short for light detection and ranging), mini-Raman lidar looks for chemicals resulting from nuclear, chemical, or biological weapons; narcotics processing; and accidents involving hazardous materials—whether these chemicals are deposited on the ground, on various surfaces, or on vegetation. Mini-Raman lidar "sees" these deposited chemicals through laser excitation combined with the phenomenon of Raman spectroscopy.

The Mini-Raman Lidar System can look at a spill from a short distance away and interrogate the emanations from the container without touching the substances and endangering first-responders.

Lidar is similar to radar. Pulses of laser light strike a target of interest and the backscattered signals are collected by a receiver telescope. The distance to the target is calculated from the amount of time required for the outgoing laser pulse to reach the target, scatter off the surface, and return to the receiver. The Raman signal is extracted from the information returned to the receiver. A laptop computer contains a library of Raman spectral fingerprints to compare with the chemical fingerprints collected at the scene.

This new sensor was demonstrated during New York City's Interagency Chemical Exercise terrorist drill on November 9, 1997, by the Mayor's Office of Emergency Management. Mini-Raman lidar is designed for the first-responder community—hazardous materials personnel, firefighters, and police—to identify chemicals at safe distances (feet to tens of feet).

Current technology requires that solid (soil) and liquid samples be collected first and then analyzed. Such procedures are complex, time-consuming, and potentially hazardous, depending on the contaminants. Mini-Raman lidar simplifies the process by providing real-time screening of chemicals (and potentially biological contaminants) at the scene without having to touch the substance or prepare the samples for interrogation. Different molecules have unique Raman spectral fingerprints that can be used to identify unknown chemicals in much the same way as fingerprints identify individuals.

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▶ The power supply for the prototype LIFI system is small enough for a backpack. The laser head and camera are hand-held.

▼ An artist's concept shows how LIFI maps a crime scene. Body fluids are documented where they are located.

Laser-Induced Fluorescence Imaging

A laser-induced fluorescence imaging (LIFI) system—being developed by the Special Technologies Laboratory—detects, characterizes, and monitors contaminants in the environment. Originally developed to detect uranium contamination on surfaces at former nuclear-weapon production facilities, this technology is also potentially useful to forensic investigations because it "sees" traces of materials, such as body fluids, at crime scenes.

LIFI detects compounds by irradiating them with laser light. If the substance being investigated has unique fluorescence properties, its fluorescence response identifies the substance. Although fluorescence spectra have been measured for decades, LIFI is innovative because it is a digital imaging system that maps surfaces—a critical need not only for cleaning up contaminated environments but also for mapping forensic evidence at crime scenes.

LIFI can detect and characterize fingerprints, blood, and other body fluids. Some body fluids can be detected directly by their natural fluorescence (semen, saliva, and sweat). Blood is detected indirectly by spraying it with a fluorescent reagent. A number of fluorescent reagents are used by law enforcement. LIFI technology, however, extends the "vision" of current technology to daylight use and to materials that are not seen with the naked eye. As more fluorescent reagents are developed as evidence locators, LIFI technology is a natural choice for detection systems.

The LIFI system includes ultraviolet and visible laser sources, intensified charged-coupled device (CCD) cameras, and real-time image processing for instantaneous viewing on a television monitor. Compared with non-laser imaging sensors, LIFI has greater spectral selectivity and sensitivity. Compared to existing forensic techniques, LIFI will allow fluorescent images to be viewed in all light conditions except in the brightest sunlight.

The power supply is smaller than a carry-on luggage case and can be carried in a backpack. The laser head and camera are directed by hand at elements in a crime scene, observing fluorescence in real time. Data are stored digitally for easy retrieval into standard word-processing programs.

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(left) Samples of air collected with SUMMA canisters were taken near the suspected clandestine drug lab in a residential neighborhood, and (right) analyzed by inductively coupled plasma mass spectrometry.

Evidence picture taken inside the house, showing the chemicals and other drug paraphenalia.

Clandestine Drug Lab

In July 1996, a detective from the Tri-City Metro Drug Task Force in Washington state contacted the Pacific Northwest National Laboratory (PNNL) to confirm the existence of a clandestine drug lab suspected to be operating in a residential neighborhood. Three people living in surrounding houses had reported noxious odors emanating from one particular residence. They reported nausea, headaches, and vomiting at times consistent with the presence of the odors. The most severely affected neighbor, an 87-year-old man, was forced to leave his home and stay elsewhere during periods in which the odors were particularly intense. Local police had ruled out carbon monoxide or natural gas leaks, but they did not have probable cause to search the suspected residence.

PNNL provided the investigators with two types of sample collection devices, SUMMA canisters (which draw ambient air into the canister when a valve is opened), and a dehumidifier, which converts water vapor in the air to water that can be collected in bottles. The police and one of the neighboring homeowners remotely sampled the air when the noxious odors were detected and when wind direction and other weather conditions were consistent with the odors coming from the suspected residence. The dehumidifier ran for several hours and water samples were periodically collected.

The water samples were analyzed by inductively coupled, plasma mass spectrometry, and iodine levels were found at three to five times that of background levels. The iodine levels, consistent with methamphetamine production, were significant in relation to the times that the neighbors detected the odors. Based on this and other information, the police obtained a search warrant and seized methamphetamine from the residence.

PNNL scientists testified at a pre-trial hearing in the county's superior court about the analysis, sampling, testing, and results. The judge found their testimony to be completely credible, and several days after the hearing, the suspects pleaded guilty to illegal possession of methamphetamine. The prosecuting attorney stated the PNNL testimony was instrumental in convicting the suspects.

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At a White House ceremony presided over by Vice-President Al Gore, Investigator Jim Skinner represented law enforcement officers who have benefited from cyber-training at Los Alamos National Laboratory.

Training the Trainers

Misapplied technology and lack of resources, lack of access to high technology, and lack of training often place state, local, and Native American forensics at a disadvantage compared to the criminals they investigate and prosecute. Los Alamos National Laboratory has teamed with several corporations and the Department of Justice to provide basic and advanced training to state and local law officers faced with these problems, particularly in the information sciences. Annual training has helped send organized gamblers, high-tech rip-off artists, pedophiles, and murderers to jail and helped uncover public corruption for appropriate prosecution. Los Alamos has also helped exonerate the innocent, deported those looking for an illicit life in America, investigated child kidnapping, and solved mysteries surrounding American MIAs in Vietnam. Direct access to law officers and forensic scientists helps Los Alamos better understand the world of crime, providing further insight for the research and development of high-tech solutions.

The Los Alamos training sessions have significantly multiplied state and local training investment by centering on those committed to training others. One of Los Alamos' "students" was singled out last year by Vice-President Gore as illustrating the successful marriage of his own good police work with Los Alamos' science and training. An already successful criminal investigator in a farm and ranch community in eastern New Mexico, Jim Skinner has used his Los Alamos training impressively. He has—

- Stopped an international cell-phone cloning ring;
- Sent two Internet predator pedophiles to prison for 10 years each;
- Shut down an international computerized boiler-room operation defrauding older Americans; and
- Arrested a hacker who stole trade secrets regarding the Hubble space telescope.

Los Alamos is currently designing the next round of training sessions based on the needs of the law enforcement and forensic sciences communities.

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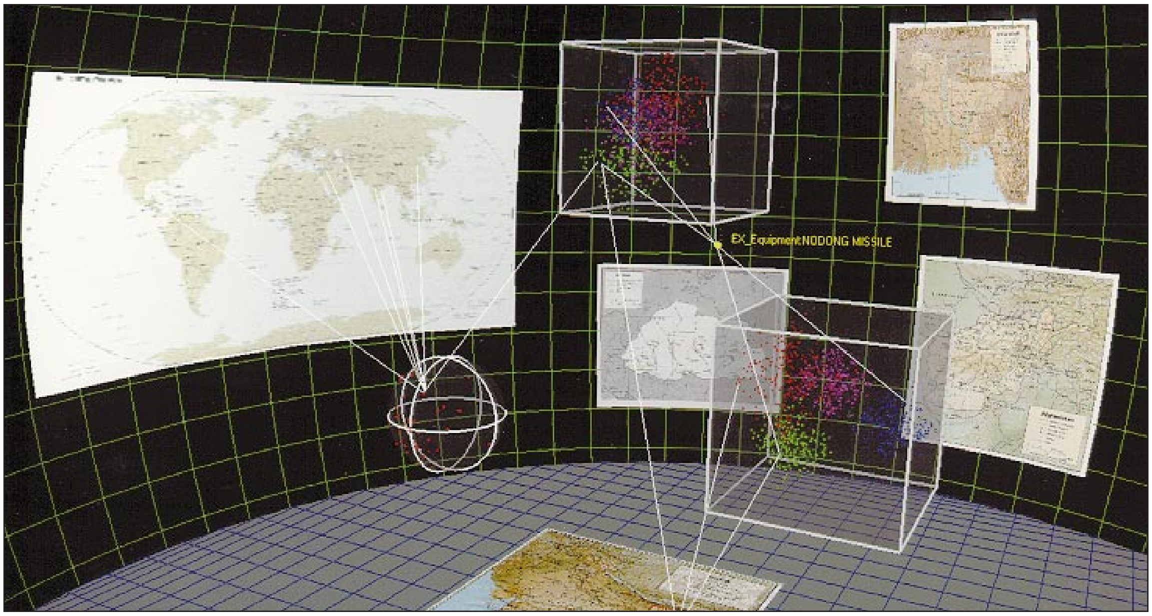

The Starlight workspace enables users to sift through massive amounts of information generated from a variety of media, including maps, all forms of text, object-oriented or relational data, and video and satellite imagery.

Sifting Through a Blizzard of Information: Starlight Software

Pacific Northwest National Laboratory is bringing crimefighting into the next century using computer technology and state-of-the-art equipment. The Department of Energy's Law Enforcement Initiative is helping agencies in Washington, Oregon, and Alaska tackle tough investigations. The initiative brings innovative science and technology solutions to unique criminal and forensics problems. Through this initiative, Pacific Northwest's staff work with local, state, and federal law enforcement and forensic scientists on actual cases to develop potential solutions.

Advanced data sources and rapid communication technologies generate massive collections of information rich with facts. However, such an information overload can hide critical details and subtle relationships integral to effectively interpreting the data, especially across space and time. Software sophisticated enough to handle large amounts of information and still be simple to use would be an asset to any criminal investigation.

Starlight is an easy-to-use, interactive investigative tool for exploring and integrating data needed for decision-making. Originally developed by Pacific Northwest for the U.S. Army Intelligence and Security Command, Starlight's versatility enables users to analyze massive volumes of information contained in various media, including multiple relational or object-oriented databases, structured and unstructured text, maps, and video and satellite imagery. Users can analyze information content as well as complex interrelations among individual elements of large information collections via Starlight's powerful linkage analysis tools.

Pilot programs are underway with several police departments using Starlight for crime analysis. Starlight offers a powerful tool to investigators for the analysis of information that was previous difficult or impossible to correlate—using an entirely new visual context. Starlight is a tool that can be used by the actual case detectives with only a few hours invested in training, as opposed to submitting requests to data analysts or statisticians. Starlight integrates well with Geographic Information Systems, providing a complete package for the analysis of spatial-temporal relationships.

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▶ The Anthropological Forensic Research Facility at the University of Tennessee maintains a collection of cadavers whose time since death is known. Using this collection in field settings allows Oak Ridge researchers to discover chemical and biological markers that will improve the ability of medical examiners and forensic scientists to establish time since death.

Determining Time Since Death: Chemical and Biological Markers

In contemporary crime fiction, medical examiners definitively pinpoint the time since death of homicide victims in a very rigorous and quantitative approach. In real life, medical examiners are not so lucky. Estimates of time since death typically rely on gross anatomical characteristics, many of which are environmentally dependent. Until very recently, there have been little or no technological or scientific advances to the "art" or "science" of determining time since death. For the very recently deceased, the time since death can be given within a few hours' range, but a few hours can make a considerable difference when examining alibis. For longer periods, it is nearly impossible to accurately estimate the time since death except for a range of days, weeks, sometimes months or years. Working with forensic anthropologists at the internationally known Anthropological Forensic Research Facility at the University of Tennessee, and with pathologists and medical examiners, Oak Ridge National Laboratory scientists are examining different chemical and biological markers in hopes of gaining a rigorous understanding of the cadaver-decay process. Cell and tissue death are accompanied by an incompletely understood series of biochemical changes, some of which are expected to be somewhat environmentally independent. The aim is to develop a protocol that will be used by medical examiners and forensic scientists to accurately establish time since death, thus giving law enforcement the ability to focus on those suspects who may have had the opportunity (and motive) to have committed the crime in question. This tool is expected to significantly enhance the criminal investigative process.

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A criminalist with the Knoxville Police Department and an Oak Ridge scientist are studying the differences between children's and adults' fingerprints. Children's fingerprints contain more volatile chemicals while adults' fingerprints tend to have longer lasting chemicals. In the future, there may be a specific test for juvenile fingerprints.

Finding Information in the Chemicals in Fingerprints

The crime was horrendous: a three-year-old girl had been kidnapped, raped, and murdered, apparently by a friend of the family who confessed to the crime while under the influence of drugs and alcohol. He recanted his confession when he sobered up, much to the dismay of Knoxville Police, who then needed compelling physical evidence to further prosecute the case. When they dusted the suspect's car for the girl's fingerprints, they were shocked to find none even though they knew for certain that the child had been in the car.

The Knoxville investigator was both disheartened and intrigued by the lack of fingerprints—what had happened to them? He did a small study of his own by asking children and adults to handle glass bottles, then placing the bottles in different environments such as the hot trunk of his car and his cool basement. At intervals, he dusted for prints and found, to his surprise, that the children's fingerprints "disappeared" from the glass surfaces much faster than the adults', sometimes in a matter of hours! He came to Oak Ridge National Laboratory and asked for help in understanding this phenomenon.

Thus began an on-going study with widespread ramifications for everything from non-invasive drug testing through profiling criminal suspects. Oak Ridge found that the lack of certain chemical compounds in children's fingerprints made them much more volatile than adults' fingerprints. Also, a number of interesting substances are left in fingerprints, including tobacco, prescription medications, testosterone, and varying levels of cholesterol. Oak Ridge is studying this further to identify some of those key elements and understand their longevity and reproducibility in fingerprints. If legal and illegal drugs can be identified and quantified, perhaps a non-invasive drug test protocol can be adopted to replace current urine and hair tests. If tobacco, cholesterol, testosterone, and other substances can be identified and quantified, then it might be possible to determine the age range, sex, and habits of suspects through their fingerprints alone, considerably narrowing the suspect database.

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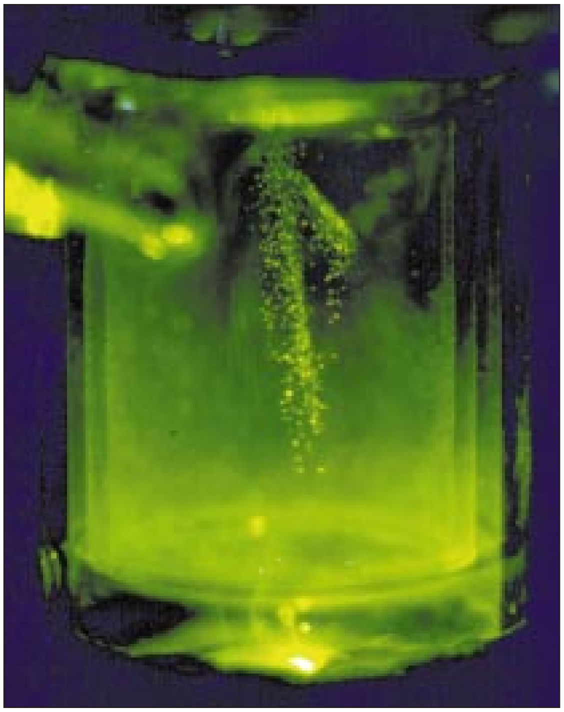

(left) This cell is used in a diagnostic tool called laser ablation –inductively coupled plasma–mass spectrometry (LA–ICP–MS). The bright spark at the bottom is ionized gas generated by the laser pulse. A plume of particles is ejected by the laser ablating the sample's surface. (right) LA–ICP–MS of steel objects and machine tailings resulting from their production may be forensically matched by comparing the trace elemental composition of both materials. The light-colored, large-diameter circles on this NIST standard illustrate the minute quantity of material consumed during an analysis.

Fingerprinting Metal Evidence: Laser Ablation

Accurate identification of metal fragments found at crime scenes is crucial in determining the sources of such materials. Metal fragments can be analyzed using a technique that combines laser ablation with mass spectrometry. This technique can identify trace elemental impurities in metals to tie the source of the fragments of interest to particular suspects or even to countries of origin.

The strength of this evidence would far surpass that provided by conventional techniques such as x-ray fluorescence, which simply determines material type by measuring major components, or conventional inductively coupled plasma–mass spectrometry (ICP–MS) using dissolved samples, which destroys the evidentiary material in the analysis process.

Laser-ablation sampling is sensitive and fast, requiring no chemical preparation. It uses a minimal sample, consuming little evidence. A metal fragment is inserted into a cell and a laser is focused onto the sample to vaporize a small area. The sample vapor consolidates into fine particles, which are swept out of the cell and injected into an ICP. The ICP is an atmospheric-pressure electrical discharge hot enough to convert the particles into ions. The ions are extracted into a mass spectrometer, which identifies the elements from the mass-to-charge ratios of their characteristic isotopes.

Although tracking down the sources of metals and matching them based on their elemental composition is difficult because they are recycled extensively, it should be possible to match one metal specimen to another based on their trace elemental composition. This work will extend these matching measurements to other materials and very small samples, such as filings or scrapings. With the better detection limits, precision, and accuracy provided by the laser-ablation technique, less abundant elements or combinations of elements will become available as valid markers for a particular sample, providing a "fingerprint" of the metal.

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(left) The fingerprint on the left was developed by a new process that produces dark brown-colored prints by organic-vapor deposition. The print on the right was dusted in the traditional way with carbon powder. (right) The knife print was developed by a process that adds blue by organic-vapor deposition. This photograph was taken four months after the color had developed.

Seeing Latent Fingerprints with Cyanoacrylate

A relatively recent development in crime-scene analysis uses cyanoacrylate (known commercially as "superglue") vapors to reveal fingerprints on surfaces that would not yield usable fingerprints before. Cyanoacrylate is presently used worldwide by forensic investigators, but it has two drawbacks: (1) the technique is subject to environmental and other factors, many of which are not understood, so it does not work consistently and predictably, and (2) cyanoacrylate causes the fingerprint to appear white, necessitating a second step for light-colored backgrounds (for example, white walls) to colorize the fingerprint enough so that it can be seen.

Understanding the basic chemistry of the cyanoacrylate process is a necessary prerequisite for developing improved processes for fingerprint development. For this reason, studies have been directed toward the polymer initiation and propagation mechanisms, latent-print aging processes, and the effects of environmental conditions on latent prints. A better understanding of these basic areas is expected to aid in choosing and developing a colorization process. One such process could involve the synthesis and trial of a colored cyanoacrylate derivative that yields a colored print.

The objective of Oak Ridge National Laboratory is to develop and demonstrate a reliable, one-step technique that colorizes cyanoacrylate-fumed fingerprints. This technique will extend the application range of cyanoacrylate-fuming, aiding forensic personnel at crime scenes. The technique's-portable process will be highly sensitive to latent fingerprints and applicable to fingerprints on various surfaces (such as plastics, wood, styrofoam, metals, and rocks).

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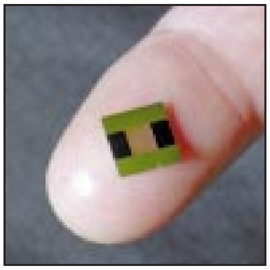
(left) A typical laboratory GC–MS requires a fair amount of space. (right) The prototype GC–MS, recently delivered to the FBI, weighs about 50 pounds.

(top) A new project is aimed at miniaturizing the GC part. (bottom) The GC itself is micromachined onto silicon, similar to the process for microchips.



Portable GC–MS

Gas chromatography (GC) combined with mass spectrometry (MS) has been used to identify unknown chemicals for 30 years. Parts-per-billion sensitivity has meant its successful use in court. All GC–MS instruments work the same way. The gas chromatograph separates a mixture of chemicals as it travels down a 30-meter capillary column. Organic compounds separate according to their vapor pressures, with the more volatile vapors migrating first down the column and into the mass spectrometer. The mass spectrometer bombards the vapors with an electron beam, fragmenting the molecules into pieces called ions. Just as human fingerprints are unique, chemicals produce unique fingerprints of ions. Ion plots are sorted and displayed on a computer with a library of chemical fingerprints. Samples as small as a grain of salt can be analyzed and identified.

Current laboratory GC–MS instruments weigh about 250 pounds, including the capillary column to separate the mixture, an oven to heat the mixture, a vacuum pump to remove any air that might interfere with the analysis, and a computer. Though most lab systems are smaller than they were even ten years ago, a 250-pound unit requires a fair amount of space and electric power in a lab setting. Shrinking GC–MS instruments for field applications have driven commercial vendors to develop systems that weigh around 100 pounds, hardly portable.

Our GC–MS system, being developed for the FBI, weighs about 50 pounds total. Tiny, twin turbomolecular pumps maintain a low operating vacuum while a new quadrupole mass spectrometer is used in a custom vacuum housing. A newly designed gas chromatographic oven uses commercial capillary columns and is sensitive to low ppb levels. A laptop computer runs the system and analyzes the data. Because the entire system is lightweight, the same highly sensitive GC–MS analyses can be performed in the field as we have come to expect in well-controlled lab settings.

Field applications are pushing miniaturization of traditional lab tools even further. A miniaturized gas chromatograph and ion-mobility detector, all on a silicon wafer, is the latest tool being developed at Livermore. The gas chromatograph itself is micromachined on silicon, similar to way microchips are made for computers. Spiral microchannels etched on a silicon wafer replace the capillary column of traditional GC instruments. Another silicon wafer and a tiny heater replace the oven. Packed in a ceramic insulating fiberglass that resembles cotton, the unit can be operated at 250°C. With its detection electronics, it is the size of a handheld calculator and is intended to have the same performance as laboratory GC instruments.

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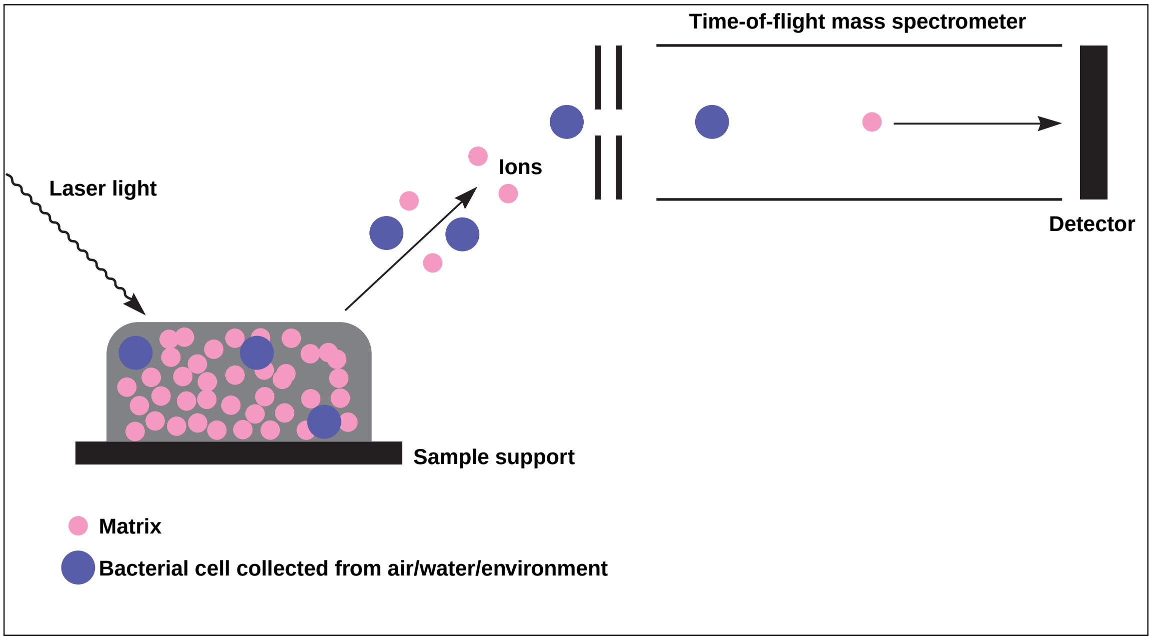
Pacific Northwest National Laboratory is using MALDI time-of-flight mass spectrometry to develop a fast, accurate, and standardized system that identifies biological organisms. PNNL is also creating statistically based software to create a bacterial library for automated identification and non-biased interpretation of the data.



MALDI Time-of-Flight Mass Spectrometry

One of DOE's objectives in its Law Enforcement Initiative is supplying law enforcement and forensic agencies with tools that cannot be provided by state and federal sources or the private sector. At the Pacific Northwest National Laboratory, scientists are combining matrix-assisted laser desorption / ionization (MALDI) with time-of-flight mass spectrometry (TOFMS) to rapidly identify bacteria. The combined MALDI–TOFMS is designed to analyze biological substances in less than five minutes, providing vital information to help direct the response of emergency and investigative personnel.

Only minute amounts of material from forensic samples are needed. MALDI bombards samples with photons, generating molecular ions of bacterial components such as proteins. The TOFMS detects the ions based on their mass-to-charge ratio. Different groups of ions are produced by different types of bacteria.

Analytical chemists, microbiologists, and statisticians are teaming to demonstrate the feasibility of MALDI–TOFMS for the unique identification of bacteria.

Statistically based data analysis for automated identification and non-biased interpretation is being developed at Pacific Northwest. Using replicate spectra, specific biomarkers are extracted and compared. A standardized bacterial fingerprint is determined based on the ions reproducibly obtained from MALDI–TOFMS analysis of the same bacterial species. This standardized fingerprint is then compared to unknown sample sources for identification.

Although the mass spectrum of a complex sample contains many fingerprints that overlap one another, statisticians are developing novel methods to identify the bacteria present in a sample by recognizing the unique set of ions produced by different bacteria. Obtaining the degree of association enables a quantitative, statistically based match of an unknown sample to the reference bacteria or source sample.

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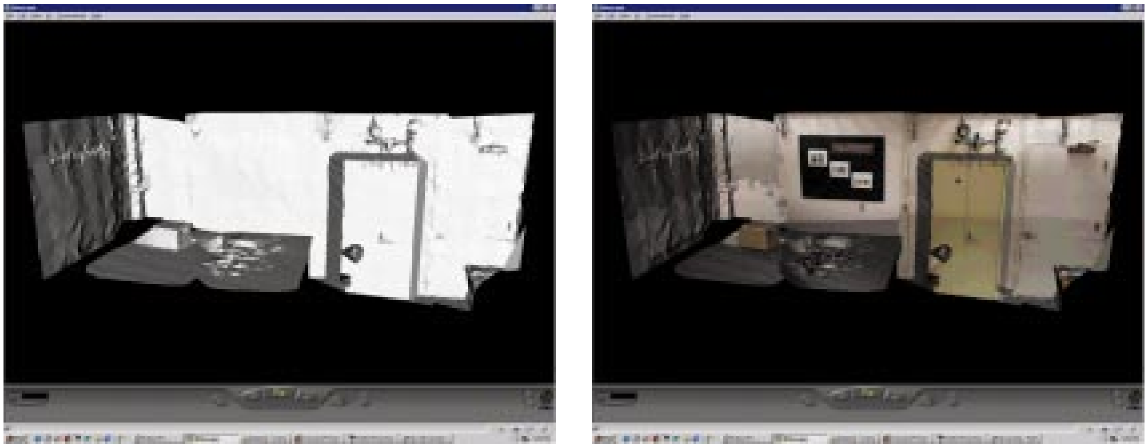
(left) Black-and-white surface image from 3D range data. (right) same surface image with added texture mapping of color image.



Reconstructing a Crime Scene: 3D Ranging and Imaging

Sandia National Laboratories is building a prototype of a fast and accurate 3D measurement and imaging system to support the FBI and other law enforcement agencies in quickly and accurately documenting a crime scene. Traditionally, law enforcement has relied on tape measures and cameras to record a crime scene, which are slow and cumbersome. A portable, 3D imaging system that can rapidly record a crime scene, measure relative positions of crime-scene objects, and add color images would help record significant forensic data.

Sandia's 3D imaging system will—

- Enable agents to reliably collect and validate range and intensity data at the crime site;
- Display a geometrically accurate, 3D rendering of the crime scene,
- Quantitatively measure the reconstructed 3D crime; and
- Give investigators the capability to communicate this information to others.

The images above show a 3D surface rendering. The scene in this case is a lab wall, with an optical bench in the foreground. A storage cabinet is against the wall next to the door, a poster hangs on the wall, and a box and tools sit on the bench. The image on the left is a surface map generated from 3D range data from a single view. Geometry is captured to the extent of the sensor. This data set began with close to 100,000 data points and has been reduced to roughly 2,000 points. Data reduction is often essential for a useful model to be built and viewed in real time. The right-hand image is the same surface data with video-camera images texture-mapped onto it. The geometry provides the quantitative measurements, while the images allow users to select points of interest.

The project includes range sensors as well as cameras, and the display, recording, and analysis of data. Sandia will leverage existing 3D-model software and graphical user interface experience. This includes scanning 3D range sensors, image collection, data reduction, filtering, surface generation, and texture mapping.

Much of Sandia's previous work in 3D modeling has come out of robotics research. This synergism may be used to couple 3D sensors with mobile robotics to provide a wider application of scene reconstruction for this and other high-hazard areas, from waste cleanup to bomb squad work.

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As computers become more sophisticated, so too does the criminal element. Today's highly integrated computer networks offer volumes of personal and proprietary information that can be mined by cyber-thieves.

Cyber-Crime and Information Sciences

Los Alamos National Laboratory is helping to define a secure atmosphere for electronic commerce by coat-tailing on some five years of research on locating anomalies indicative of fraud in the databases of the U.S. Health Care Financing Administration and the Internal Revenue Service. State and local law enforcement and forensic scientists face a new wave of fraud, larceny, and extortion through the quickly growing medium of the Internet. Additionally, public-securities industry regulators anticipate new opportunities for illegal market manipulators. Stuck between the concerns of profit and regulation are private-industry compliance officers who must diligently police their companies to maintain consumer confidence and profits, and to limit criminal and civil liability.

Problems arising from such a complicated mix of competing and complementary interests—coupled with the enormous potential for profit and abuse—warrant attention from DOE's multidisciplinary national laboratories, which have a long history of solving complex problems with high risks and enormous payoffs. Currently engaged in the technical characterization of problems associated with electronic commerce, Los Alamos is seeking to field the next generation of automated tools that can search the Internet to find illegal or malfeasant activity for private-industry compliance officers protecting their company holdings and market share and for law enforcement seeking to protect the investing public.

A new information-sciences forensic laboratory is devoted to researching new ways to extract and use information from computers, networks, digital images and sounds, and large databases and to model complex crime problems and systems. This facility will also look at authentication methods to protect shoppers and shopkeepers using the Internet.

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▶ Terrorist acts against the nation's food supply will require quick response from anywhere in the country. To meet this eventuality, Ames Laboratory scientists are compiling an electronic network of veterinary experts, laboratories, and capabilities.

Protecting Our Food Supply: Network of Veterinary Experts

If terrorists use animal diseases as biological warfare agents, the FBI wants quick access to veterinary experts and laboratories to identify those agents. Ames Laboratory and the Iowa State University Veterinary Diagnostic Laboratory plan to develop an electronic network of researchers, practitioners, and facilities throughout the United States who could rapidly investigate such incidents.

This network of experts would work to establish the instruments and procedures needed to conduct field investigations as well as to catalog available techniques for the quick detection of toxins, pathogens, and microorganisms harmful to the nation's food supply, including those diseases that could be transmitted to humans. Ames Lab scientists are working to adapt techniques in analytical chemistry for use in counter-terrorism applications.

Collaborators on the project include the National Veterinary Services Laboratories (NVSL), a specialized diagnostic facility for the Animal and Plant Health Inspection Service of the USDA), and the National Animal Disease Center. Both facilities are located in Ames, Iowa. Currently, if a terrorist event occurs, a local veterinarian who saw a suspicious loss of animals would contact state regulatory officials, who would seek help from the NVSL. The NVSL would then send out personnel to collect samples and run appropriate tests. This process takes time and allows the pathogens to spread before officials can make a diagnosis.

With an electronic network in place, however, NVSL officials could identify a veterinary laboratory close to the source of the outbreak that could begin collecting samples immediately. Also, officials want to develop standardized tests and analytical methods so that these laboratories can conduct a variety of tests—not just those specifically designed for local or regional needs.

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