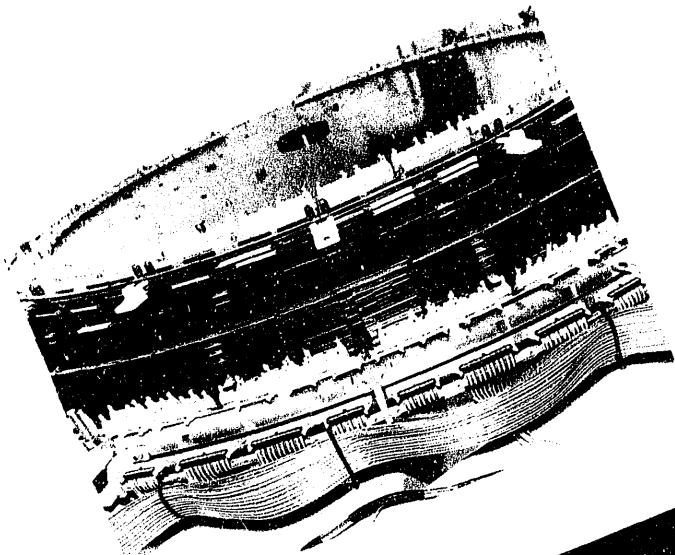


TECHNOLOGY TRANSFER
AT
LAWRENCE BERKELEY LABORATORY

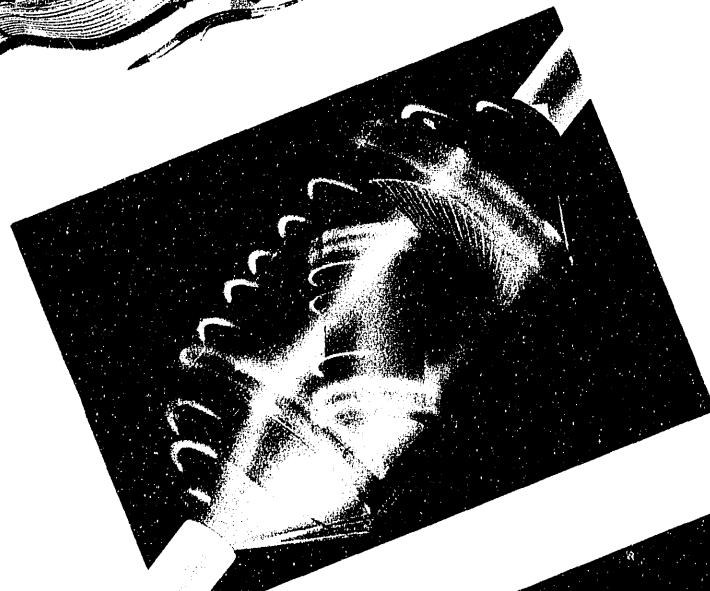


TAKING A CLOSER LOOK



RESEARCH

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RESOURCES



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Cover Photos:

Top photo—The LBL-designed end-cap uranium-liquid argon electromagnetic calorimeter for the D0 detector, a second-generation hadron collider detector. Its primary aim is the precision study of high-mass, large-transverse-momentum phenomena, with particular emphasis on jets (clusters of produced particles), leptons (electrons and muons), and the "missing" transverse momentum indicative of penetrating particles, such as neutrinos.

Center photo—Schematic view of a "double rotation" sample holder. The design allows increased resolution in the nuclear magnetic resonance spectroscopy of a number of solid materials. Rotating the sample in the inner chamber, which in turn rotates in the outer chamber, will allow high-resolution study of nonspherical nuclei.

Bottom photo—The Nicolet P3 x-ray diffractometer. This instrument measures the intensity of x-ray diffraction from crystal specimens. LBL researcher Sung-Hou Kim is optically aligning a crystal specimen to begin collecting data. X-ray diffraction measurement of crystals helps to determine the three-dimensional atomic structure of proteins, such as cancer-causing protein *ras* oncoprotein, and other molecules.

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The first direct image of the helical structure of unaltered DNA was obtained through a scanning tunneling microscope at LBL's Center for Advanced Materials. The average distance between twists (shown as elevated contours in this isometric projection) is 35 Å (vertical axis is 4 × horizontal axis).

TAKING A CLOSER LOOK

- ◆ In a rapidly expanding international marketplace, emerging technology drives the world's economy. The challenge to commercialize new technology will play out in fields such as advanced materials, biotechnology, and electronics, with the winner reaping worldwide economic rewards. Therefore, the value of technology transfer between national laboratories and the industrial community is more important in maintaining America's competitive edge than ever before.
- ◆ At Lawrence Berkeley Laboratory (LBL), we want to work with U.S. industry to meet this challenge. LBL will continue to emphasize research excellence while actively seeking and establishing working relationships with industry across the U.S.
- ◆ Our commitment to research innovation is the foundation for new high-potential technology applications.
- ◆ On the following pages we invite you to take a closer look at the many opportunities and ways to establish working relationships with LBL. The Laboratory encourages your inquiries: these may lead to an active alliance that delivers innovative solutions that create new technologies, products, and systems of value to society.



LBL founder Ernest O. Lawrence



LAWRENCE BERKELEY LABORATORY

- ◆ LBL is a major multiprogram national laboratory managed by the University of California for the U.S. Department of Energy (DOE). LBL has more than 3,000 employees, of which 950 are scientists, theoreticians, and engineers. With an annual budget of over \$250 million, LBL conducts a wide range of research activities, many that address the long-term needs of American industry and have the potential for a positive impact on U.S. competitiveness.
- ◆ The oldest of the nine DOE national laboratories, LBL is located next to one of the world's great universities—the University of California at Berkeley. This environment attracts some of the world's best and most creative investigators. Principal research programs include materials science and chemistry, earth sciences, biology and medicine, conservation and renewable energy, high-energy and nuclear physics, as well as engineering, mathematics, and computer sciences. Using multidisciplinary approaches to conduct research, teams of LBL scientists, theorists, engineers, and technicians employ state-of-the-art equipment to tackle and solve complex technological problems.
- ◆ LBL's role is to serve the nation and its scientific, educational, and business communities through research and development in the energy sciences, biosciences, and general sciences; to develop and operate unique national experimental facilities for use by qualified investigators; to educate and train future scientists and engineers; and to develop productive relationships between LBL research programs and industry.



TECHNOLOGY TRANSFER MEANS BUSINESS

Lawrence Berkeley Laboratory invites you to take a closer look at the many R&D approaches and opportunities available to private industry.

LBL Welcomes Your Inquiries

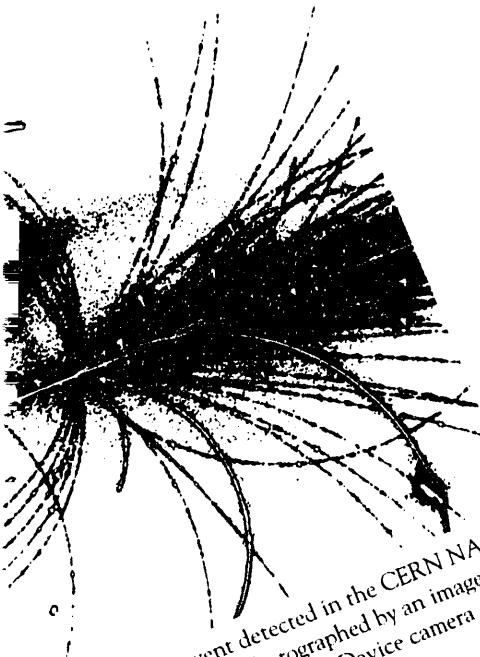
The research areas and administrative structure described in this publication provide general guidelines. LBL's interdisciplinary science approach offers many technology transfer options. DOE policy encourages private-sector use of government-developed technologies. LBL welcomes your inquiries to explore areas of research, technology, and collaboration.

Forging Stronger Ties

As a national laboratory, one mission of LBL is to make research results available to the nation's private sector for rapid commercialization. Private industrialists and entrepreneurs broaden the potential benefit and commercial value of laboratory research. They help translate new discoveries into commercially usable products and processes. Working together, the national laboratories and U.S. industry can help strengthen America's competitiveness in the world marketplace—together, we mean business.

Making Technology Transfer Accessible

To help make effective the transfer of technology from LBL to industry, LBL has streamlined its technology transfer operations. The following departments interact to help move technology and ideas to the marketplace and to handle research proposals and contracts with outside sponsors.



A view of an event detected in the CERN NA35 streamer chamber, photographed by an image-intensified Charge-Coupled Device camera developed at LBL.

Technology Transfer Department

The role of the Technology Transfer Department is to make technology and expertise developed at LBL available to industry.

Technology transfer depends on communication between those generating knowledge and those able to put it to use. The Technology Transfer Department acts as a focal point to foster productive relationships between LBL research programs and the private sector. If you have questions regarding research areas of interest or wish to have an answer regarding working relationships with LBL, start with the Technology Transfer Department. Call or visit the Technology Transfer Department to

- ♦ Pinpoint research areas of common interest
- ♦ Negotiate rights to LBL's intellectual property
- ♦ Discuss current patent and copyright licensing opportunities
- ♦ Set up meetings with specific investigators; arrange LBL tours
- ♦ Learn the names of people in charge of sponsorships, collaborative projects, and staff-exchange programs

As part of the Technology Transfer Department, the Office of Sponsored Research Administration (OSRA) is the administrative liaison for sponsored research and research collaborations between LBL scientists and the private sector. If your company would like to use LBL facilities or have work performed by or jointly with LBL investigators, contact OSRA. OSRA's experienced staff coordinates proposal submissions and contract negotiations. Call or visit OSRA to inquire about

- ♦ Research performed by LBL scientists under sponsorship by industry
- ♦ Use of LBL User Facilities by industry personnel
- ♦ Collaborative research—sharing of LBL and industry costs, facilities, equipment, or research capabilities
- ♦ Industry support of LBL researchers through gifts, grants, or fellowships
- ♦ Proposal submissions
- ♦ Contract negotiations

Patent Department

The function of the Patent Department is to protect LBL inventions, technology, and software.

Staffed by professional patent attorneys, the Patent Department performs the legal work of LBL in matters relating to LBL inventions. It also performs an advisory and service role for the Technology Transfer Department and the Office of Sponsored Research Administration. To carry out its function, the Patent Department

- ♦ Pursues patents, evaluates patentability of LBL inventions
- ♦ Creates, files, and prosecutes patent applications
- ♦ Registers copyrights with the U. S. Copyright Office
- ♦ Approves all intellectual property-rights clauses in sponsorship contracts and licensing agreements
- ♦ Interacts with DOE to expedite transfer of patent rights to the private sector



CHOOSING YOUR TECHNOLOGY TRANSFER VEHICLE

LBL's research produces innovative technologies and inventions, many with commercial value. LBL's resources, expertise, and project-oriented teams can help make your company's R&D effort more effective. From acquiring written information on a special project to establishing research collaborations or licensing available technology, there are many ways to work with Lawrence Berkeley Laboratory—many ways to leverage your research activities.

Licensing New Technology

LBL's work produces innovative and inventive discoveries, many of which have commercial value and are available for licensing. To discuss licensing possibilities, ideas for new technology applications, markets, or products—contact the *Technology Transfer Department*.

Sponsored Research

A company may sponsor LBL scientists to perform specific research compatible with LBL's research in the company's field of interest. The unique equipment and specialized staff expertise at LBL provide research opportunities that would not otherwise be available. *Discuss research concepts with scientific staff. To coordinate efforts—contact OSRA.*

Visitor/Staff Exchanges

University and industrial scientists may visit LBL to conduct research. Each year DOE sponsors a Laboratory-Industry Exchange Program, offering opportunities for researchers from industry and DOE laboratories to work in areas of mutual interest and benefit at one another's sites. *For more information about this program—contact the Technology Transfer Department or the appropriate research division. For visits or staff exchanges that require a contractual relationship—contact OSRA.*

Collaborative Research and Development Agreements (CRADAs)

Some of the most innovative technology transfer at LBL today involves collaborative projects with industry. In collaborative research arrangements, DOE and industry jointly sponsor a research

project. Costs, personnel, facilities, equipment, or research capabilities may be shared for mutual benefit. This provides industry with an excellent way to leverage research activities. *Discuss technical points with scientific staff. Contact OSRA for proposal, contractual, and administrative matters. Discuss intellectual property arrangements with the Technology Transfer Department.*

Make contact

- ◆ LBL's Technology Transfer Department offers help in determining access to LBL technology.
- ◆ A direct relationship is developed with the scientist or division.
- ◆ OSRA offers the company guidance on contractual approaches.

Initiate discussion

- ◆ A dialogue between the company and LBL technical managers is initiated.
- ◆ Contractual and administrative terms are discussed with OSRA.
- ◆ Intellectual property matters are discussed with the Technology Transfer Department.

Choose a vehicle

- ◆ A choice is made regarding a technology transfer method that will produce the desired results.
- ◆ Administration of industrially sponsored research and research collaboration projects are finalized with OSRA.

Gifts and Graduate Support

Gifts to LBL are received in the form of equipment, research materials, and funds. Gifts may be undesignated or may be designated for a particular research area or research group. A fellowship may be given to support a graduate student's research. If a company is interested in acquiring expertise in a particular area, a specific student may be supported with the intention of bringing the student into the company after graduation. This is an efficient way to transfer technological expertise from LBL. *To coordinate gifts and fellowship support—contact OSRA .*

User Facilities

Certain facilities at LBL and other DOE laboratories are considered "National User Facilities" offering unique opportunities. *User Facility arrangements are administered through OSRA.*

User Facilities are discussed in further detail on page 22.

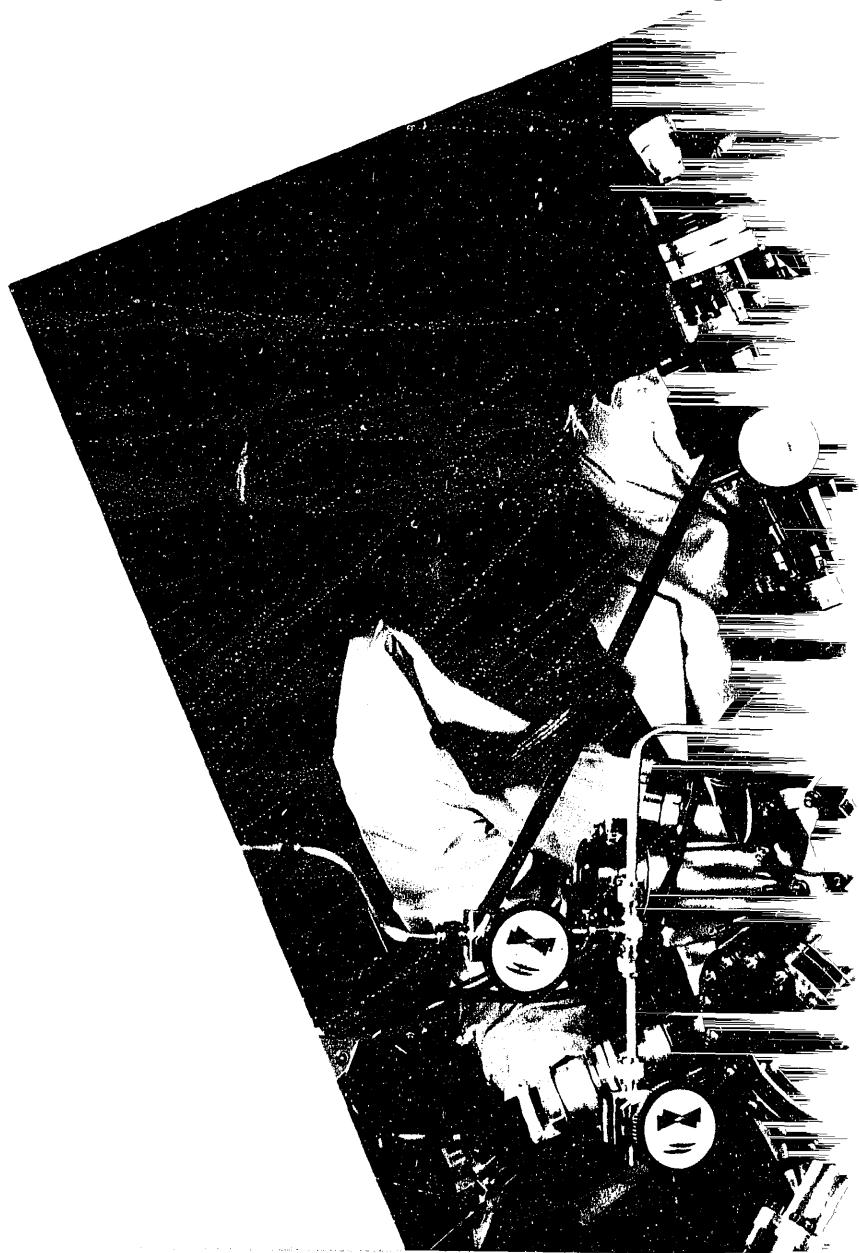


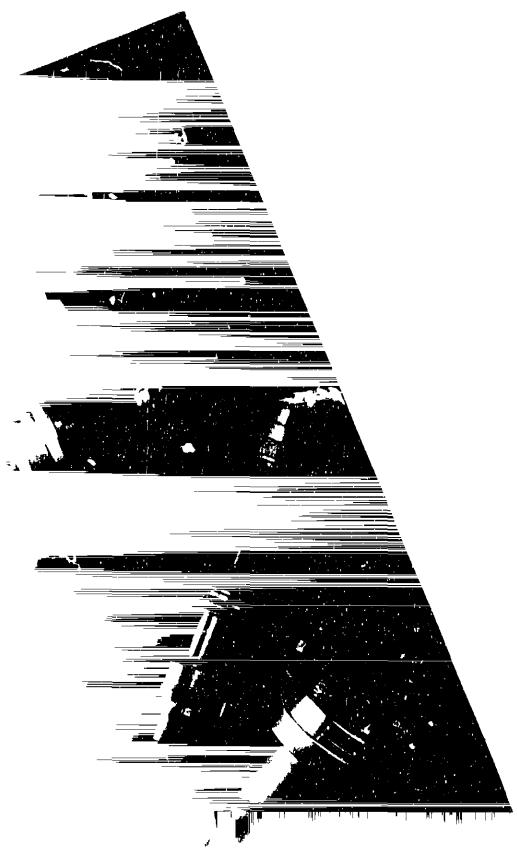
MAJOR PROGRAM AREAS

Research activities at LBL are concentrated in three major program areas: Energy Sciences, General Sciences, and Biosciences. Each program area consists of three research divisions.

Program areas are supported by a technical resource division.

The following section offers brief descriptions of the divisions and their areas of expertise. Comprehensive overviews of research performed at each division are available from LBL. Lawrence Berkeley Laboratory welcomes both requests for information and proposals to conduct research.





An ultrahigh vacuum chamber and laser beam used for optical second-harmonic generation (SHG) experiments. As developed by LBL researchers, SHG provides sensitive surface-structure analysis of materials on surfaces.

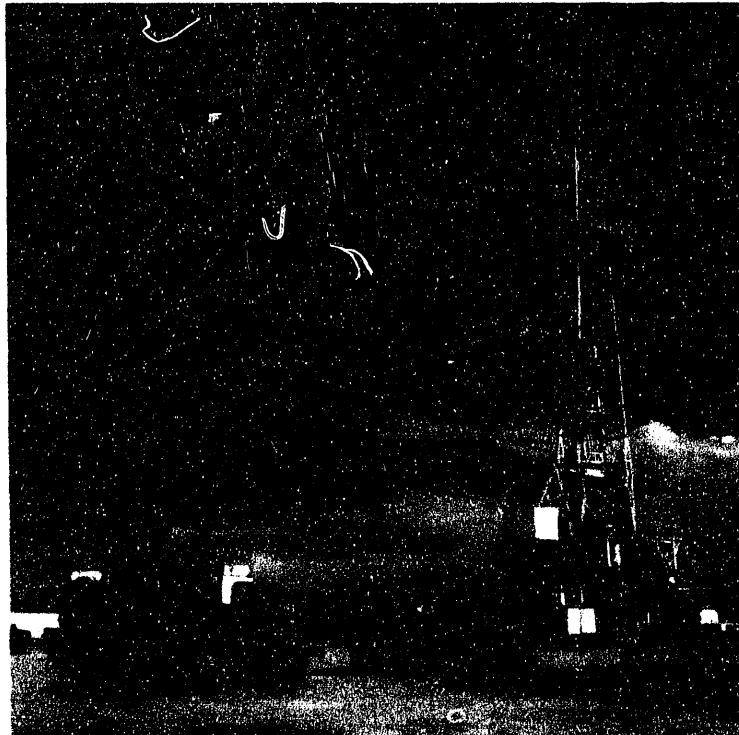


ENERGY SCIENCES

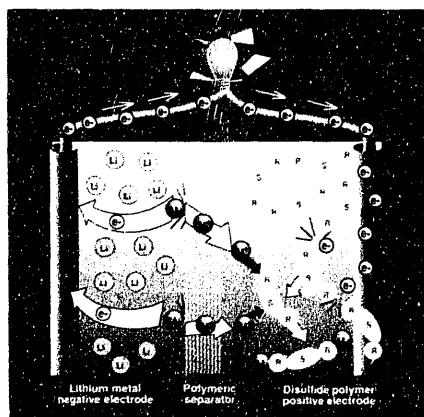
Energy Sciences research at LBL encompasses a wide spectrum of energy sciences and technology that includes programs in materials science, chemistry, physics, geology, and engineering. Energy resources, energy conservation, waste disposal, and the impact of energy technology on the environment are explored.



Energy and Environment. Researcher Ted Chang works at a bench-scale scrubber whose technology could cost-effectively remove more than 90% of the SO_2 and NO_x emitted (as flue gases) from coal-fired power plants.



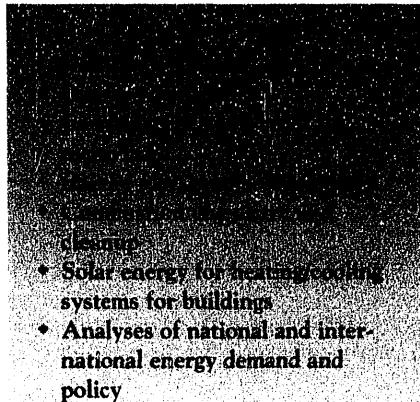
Earth Sciences. Vertical seismic profile survey underway at the Salton Sea Scientific Drilling Project drill site. The two large vehicles are compressional (P) and shear (S) wave vibrators used to generate seismic wave signals.



Materials Sciences. LBL researchers invented a novel all-solid-state rechargeable battery. It uses a new class of polymer cathodes based on redox polymerization and depolymerization. LBL's solid-state lithium battery technology has been licensed to a U.S. company.

Energy and Environment Division

Research conducted in Energy and Environment covers a broad spectrum of areas, with emphasis on providing environmentally acceptable energy options for the future. These include fuels from non-petroleum sources, advanced batteries, conversion of solar energy, and improvements in energy end-use efficiency. The research on energy conservation in buildings, energy-efficient lighting, indoor air quality, solar heating and cooling, and acid rain continue to produce results that enlighten and inform both the public sector and the scientific community.



- **Resource management**
- **Solar energy for heating cooling systems for buildings**
- **Analyses of national and international energy demand and policy**

Research Centers

- **Center for Building Science**
- **California Institute for Energy Efficiency**
- **Center for Atmospheric and Biospheric Effects of Technology**
- **Berkeley Electrochemical Research Center**

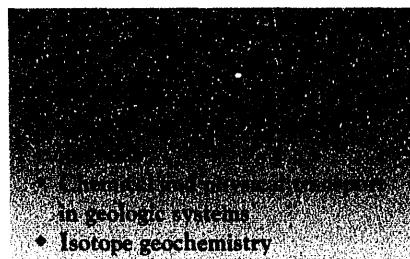
User Facilities

- **Sky Simulator for Architectural Daylighting Design**
- **Mobile Window Thermal Test Facility**

Earth Sciences Division

Investigators in Earth Sciences study the underground environment to accumulate knowledge essential for safe disposal of radioactive and toxic chemical wastes, to exploit geothermal energy, and to develop petroleum and strategic-mineral resources.

Comprehensive research is conducted on the effects of high temperature and pressure on geological materials; the structure and dynamics of the Earth's deep crust and the influence of crustal processes on energy resources; and the behavior of fractured rock formations encountered in mining, geothermal, petroleum-extraction, or waste-disposal activities.



- **Electron microscopy in geological systems**
- **Isotope geochemistry**

Research Centers

- **Center for Isotope Geochemistry**

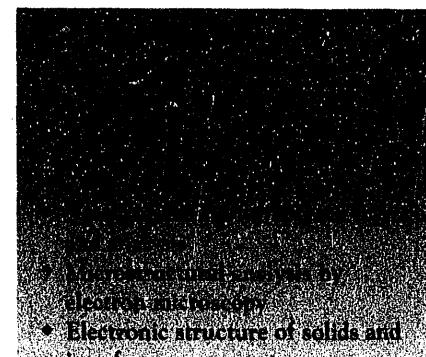
User Facilities

- **Center for Computational Seismology**

Materials Sciences Division

Investigators in Materials Sciences conduct both experimental and theoretical research on a wide range of materials, including high-temperature superconductors, composites, catalysts, ceramics, polymers, biomaterials, and electronic, magnetic, and optical materials. Work includes studying the electronic, structural, and other properties of thin films, surfaces, interfaces, and bulk

materials; developing the science of wear, fracture, and failure modes; extending the understanding of catalysts, including enzymes; obtaining atomic scale control of materials synthesis and processing; and innovating advanced materials characterization techniques and instrumentation.



- **Electron microscopy in geological systems**
- **Electronic structure of solids and interfaces**

Research Centers

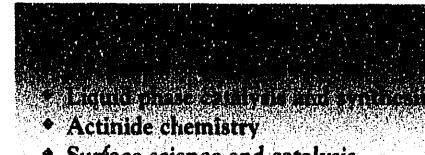
- **Center for Advanced Materials**
- **Center for X-Ray Optics**

User Facilities

- **National Center for Electron Microscopy**
- **2.5-MeV Van de Graaff Facility**

Chemical Sciences Division

The Division conducts research on chemical reaction mechanisms and dynamics in the gas and condensed phase, synthetic chemistry, actinide chemistry, homogeneous and heterogeneous catalysis, thermodynamics and phase equilibria, surface science, and atomic physics. The Division also hosts a major new LBL initiative in combustion dynamics.

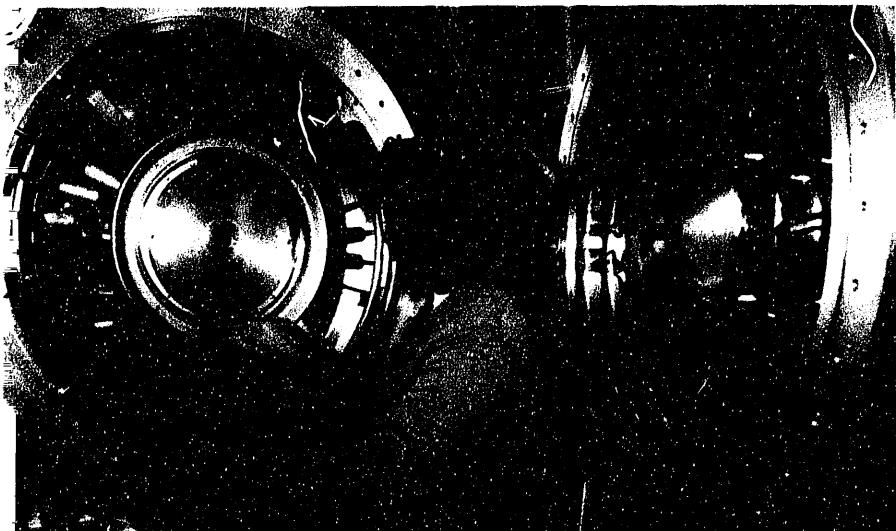


- **Quantum chemistry and synthesis**
- **Actinide chemistry**
- **Surface science and catalysis**
- **Fundamental problems in atomic physics**

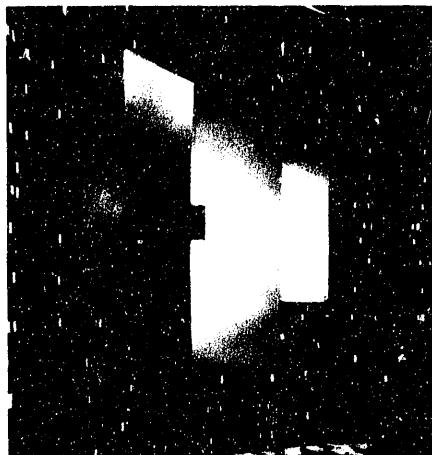


GENERAL SCIENCES

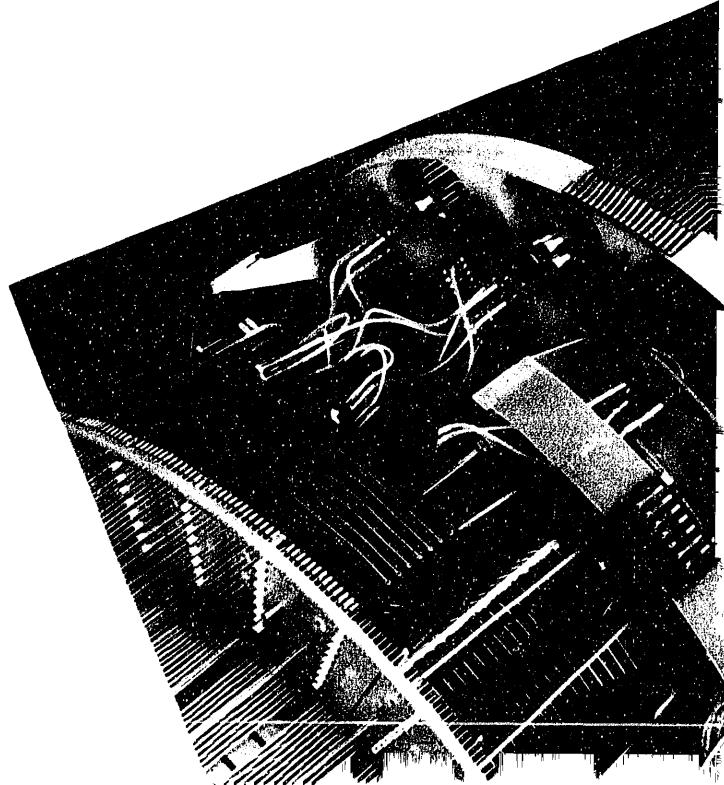
The General Sciences research programs build on LBL's historical work in high-energy physics, increasing our fundamental understanding of the nature of matter and providing a scientific and educational base for other fields.



Accelerator and Fusion Research. The constant-current, variable-voltage accelerator, developed by the Magnetic Fusion Energy Group, features electrostatic quadrupole focusing that reduces the risk of voltage breakdown.

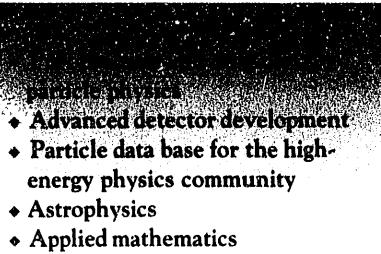


Nuclear Science. This array of plastic detectors was used by Kent State scientists to detect neutrons in coincidence with charged particles in a central heavy-ion collision.



Physics Division

The Division carries out research in experimental and theoretical particle physics, while developing new tools and techniques needed in the study of high-energy particle interactions. The Division's Particle Data Group provides the worldwide high-energy physics community with reference compilations of all existing particle data. The particle physics program has an active component in experimental and theoretical astrophysics, with emphasis on particle astrophysics at the boundary of particle physics and cosmology. In addition to the particle physics program, there is a smaller but highly significant research effort in applied mathematics.



- ♦ Particle physics
- ♦ Advanced detector development
- ♦ Particle data base for the high-energy physics community
- ♦ Astrophysics
- ♦ Applied mathematics

Nuclear Science Division

The principal activity of the Division is the theoretical and experimental investigation of the interactions of heavy ions with target nuclei at various energies, both for their inherent scientific interest and for their use in the synthesis and study of new isotopes and chemical elements. This research program is carried out at LBL's accelerators and at other national and international accelerators. The Division operates the 88-Inch Cyclotron as a National User Facility. It fulfills an educational role with active graduate student and postdoctoral programs.



- ♦ Nuclear theory
- ♦ Nuclear astrophysics
- ♦ Nuclear chemistry
- ♦ Studies of transuranium elements
- ♦ Nuclear data evaluation
- ♦ Advanced instrumentation

User Facilities

- ♦ 88-Inch Cyclotron

Accelerator and Fusion Research Division

The advanced technology of beams—ions, electrons, and photons—is the focus of the Accelerator and Fusion Research Division. The Division is responsible for the operation of most of LBL's accelerators. Its scientists and engineers design new accelerators and devise new accelerator-technology applications ranging from fusion power to cancer treatment. A major effort has been the design and construction of the Advanced Light Source (ALS), a state-of-the-art radiation tool. The ALS is a National User Facility available to qualified U.S. researchers.



- ♦ Ion and magnetic fusion
- ♦ Synchrotron-radiation beamlines and optics
- ♦ Superconducting magnet design and fabrication
- ♦ Advanced Light Source design, construction, and operation

User Facilities

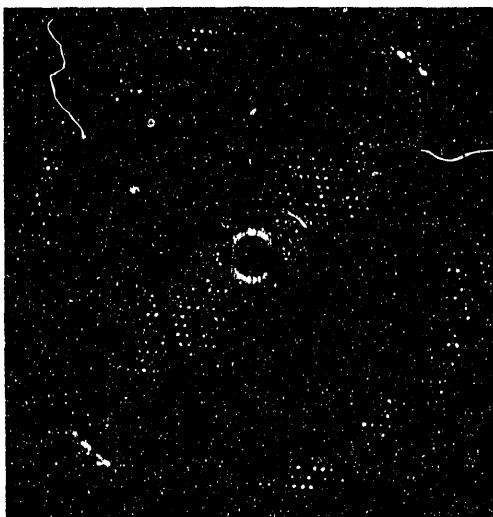
- ♦ Advanced Light Source (first operation 1993)

Physics. LBL's high-precision vertex chamber for the D0 detector at the Fermilab proton-antiproton collider.



BIOSCIENCES

Through the development of biomedical instrumentation, studies of the intricate processes of gene expression, and expanding efforts to link biological structure and function, Biosciences research plays an important role in understanding biological processes and controlling disease.



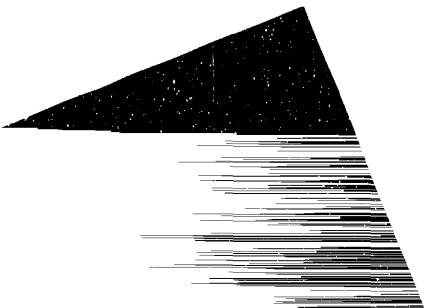
Life Sciences. PhoE porin, a transmembrane channel found in the outer membranes of Gram-negative bacteria. It has been reconstituted into highly coherent two-dimensional crystals using a novel crystallization technique.



Life Sciences. LBL's patient-immobilization and beam-shaping system used in charged-particle radiation therapy.

Life Sciences Division

The Life Sciences Division consists of three departments: Cell and Molecular Biology, Molecular and Nuclear Medicine, and Subcellular Structure. The Division is also home to the Human Genome Center (discussed under centers). One goal of the Division is to develop a deeper understanding of DNA replication and gene expression. This includes determining how tissue-specific genes are regulated in response to cues from their microenvironment, with a particular emphasis on breast cancer and hematopoiesis. Life Sciences investigators are studying the biological effects of DNA-damaging agents at a cellular and molecular level, as well as the health risks associated with such damage. The Division has developed new techniques in elucidating the organization and structure of membrane proteins and, in conjunction with the Advanced Light



Source, has embarked on a program to determine the possible role of soft x-ray microscopy in characterizing subcellular structure.

Other important goals are the development and application of advanced procedures for the diagnosis and treatment of human disease, focusing on disorders of the cardiovascular system and the brain. Division researchers are designing and testing molecular and genetic probes for disease susceptibility, based on studies of mechanisms at the biochemical, cellular, and clinical levels; studying genetic variants in humans and transgenic mouse models; and using the tools of nuclear chemistry and instrumentation to create improved diagnostic technologies for magnetic resonance imaging and positron-emission tomography, which are being applied in clinical research.



- Macromolecular structures
- Radiation biology and DNA repair
- Medical-imaging instrumentation
- Radiotherapy and radiosurgery
- Biochemical mechanisms of disease
- Atherosclerosis and aging

User Facilities

- Heavy Charged-Particle Biomedical Facility

Structural Biology Division

Research work in Structural Biology contributes to the understanding of the relationship between structure and function in biological macromolecules. Projects include the study of the molecular mechanisms of photosynthesis and the involvement of structural modification of protein involved with oncogenesis. Nuclear Magnetic Resonance and x-ray crystallographic techniques are used to probe the molecular structure of complex biomolecules and to study the fundamental chemistry of electronically excited molecules.



- Photochemistry and mechanisms of mutagenesis
- Structural and molecular biology of nucleic acids and proteins

User Facilities

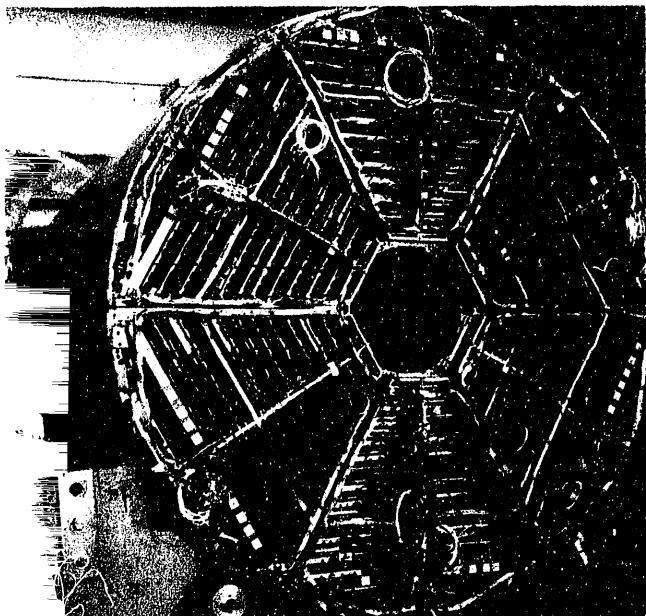
- National Tritium Labeling Facility

Structural Biology. Monoclonal antibodies provide a diverse class of receptors that will bind molecules ranging from nucleic acids to synthetic small molecules. LBL has developed a method to make these receptors

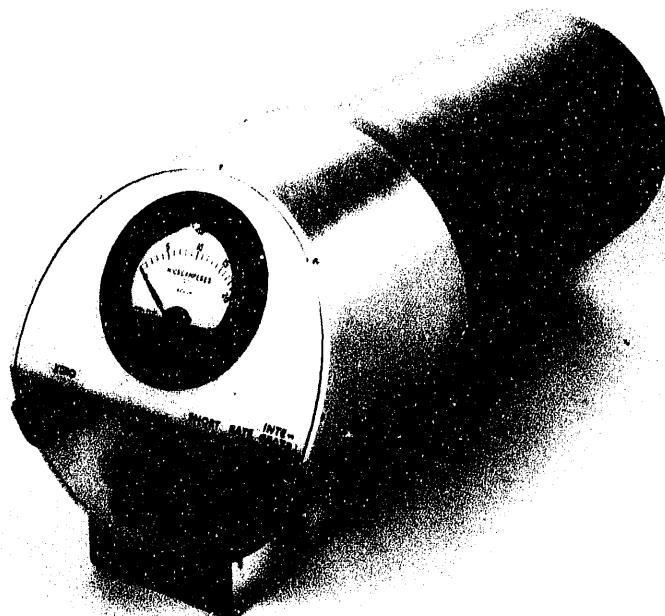


LABORATORY OPERATIONS

The Laboratory's Operations organization provides scientific and technical resources in support of LBL's research divisions. It provides engineering and computer science expertise to those divisions to accomplish the Lab's research goals. Its research programs yield innovative cutting-edge technology.



Engineering. The Time Projection Chamber (TPC), a particle detector invented at LBL that detects and identifies subatomic particles. The TPC reconstructs the three-dimensional ionization tracks of energetic subatomic particles over a time interval.



Environment, Health & Safety. This LBL-developed radiation detector measures the amount of ionizing radiation from such sources as radioisotopes, x-ray generators, charged-particle accelerators, and natural background.



Information and Computing Sciences. An example of LBL's visualization and graphics work. The image shows the integration of two data sets: a head of a child via x-ray computer tomography, and the identification of a region of the brain to be treated. This work is being done with the Life Sciences Division.

Engineering Division

Technical resources to support the research programs and the major research facilities of LBL are provided by Engineering. Many engineers and technicians are assigned outside the Division as team members to the various programs and research facilities, bringing the expertise of the engineering disciplines to bear on the objectives of the research or operations teams. Two offices, Electronics and Mechanical Engineering, administer the outside assignments of personnel, operate the central electronics and mechanical shops, and conduct basic research in the fields of nuclear instrumentation, semiconductor detectors, and magnet technologies.



- Expert fabrication/technician shops
- Integrated CAD-E-M technologies
- Development of unique semiconductor and ionization-track detector systems

User Facilities

- Low-Background Counting Facility

Information and Computing Sciences Division

Information and Computing Sciences (ICS) operates computing and networking facilities, libraries, and technical publishing facilities to support LBL's scientific programs. ICS also conducts a program of computer science research and development in technologies appropriate for present and future scientific programs. This includes advanced software architectures, networking, data management, imaging, and visualization. An important aspect of the program is the evaluation of new hardware and software products and the integration of new technologies into scientific computing. ICS also provides application programs in several key areas, such as the Human Genome project and Biostatistics.



- Data-management techniques
- Research into future-generation data-management techniques
- Development of new software architectures, distributed computing technology, and high-speed networking systems
- Biostatistics systems

Environment, Health & Safety

Environment, Health & Safety (EH&S) is responsible for making sure that LBL remains a safe and healthy work place. In addition to continuing advanced work in personal dosimetry, EH&S has invaluable experience with radiation-protection systems for particle accelerators and is playing a major role in the design of these systems for new accelerators.



- Accelerator technology
- Radiation dosimetry, and measurements
- Waste management
- Environmental surveillance
- Industrial hygiene
- Transportation and packaging of radioactive materials



RESEARCH CENTERS

Lawrence Berkeley Laboratory has established multidisciplinary research centers with the specific objective of fostering research with industry and educational institutions. LBL's research centers apply skills, expertise, and instrumentation in many subject areas to specific research problems. Many centers focus on problems of special interest to the private sector. Each research center offers a unique multidisciplinary approach to research areas of national interest, all of which have a potential for positive impact on the American economy.



Center for Advanced Materials.
Scanning electron micrograph of a high-temperature superconductor made of bismuth-strontium-calcium-copper oxide.

Center for Advanced Materials

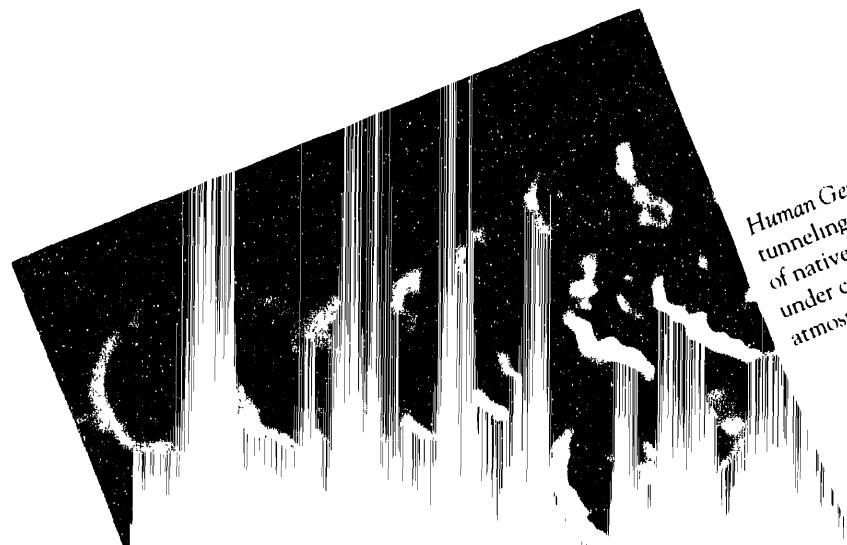
The Center for Advanced Materials (CAM) works in close partnership with industry and universities to perform fundamental materials science research in areas of prime importance to industry. CAM provides high-quality materials research that is directed toward the long-range needs of high-technology energy-related disciplines. The major areas of research activity in the Center for Advanced Materials are

- ◆ High-T_c superconductivity
- ◆ Electronic materials
- ◆ Polymers and composites, including enzymatic synthesis
- ◆ High-performance metals
- ◆ Surface science and catalysis including instrumentation for surface science
- ◆ Ceramic science

Human Genome Center

Activities at the Human Genome Center are concentrated in three areas: automation of existing physical mapping methods and development of new ones, evaluation and enhancement of existing sequencing technologies, and improvement of methods for interpreting and analyzing maps and sequence data. Current research endeavors within the three areas include

- ◆ Constructing an ordered library for chromosome 21
- ◆ Improving YAC cloning methods
- ◆ Linking large DNA fragments and YACs by sequencing
- ◆ Improving pulsed-field gel electrophoresis
- ◆ Developing automated methods for image enhancement, image analysis, and map construction



Human Genome Center. A scanning tunneling microscope (STM) image of native, unstained DNA molecules under conditions of normal atmospheric pressure.

Center for Building Science

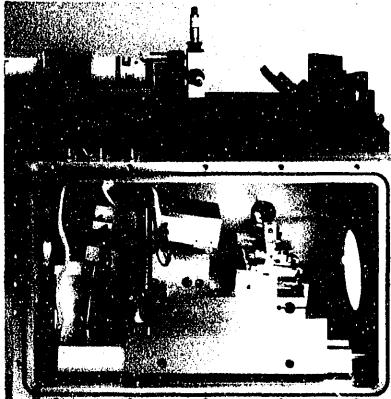
The Center for Building Science provides a cohesive working environment to perform joint research, to develop new research areas, and to transfer successful building R&D results to industry. **Windows, lighting, and daylighting:** development of advanced, efficient lamps and controls; studies of human performance under varied lighting conditions; thin-film coatings and other approaches to advanced window design; window performance measurements and modeling.

Indoor air quality: pollutant characterization and control; ventilation and infiltration; building performance monitoring; exposure assessment; sampling and analysis methods; predictive models.

Systems and Analysis: DOE-2 whole-building energy analysis program and advanced simulation techniques; advanced HVAC systems; databases of measured building performance; environmental policy; appliance standards; Least Cost Utility Planning; international energy use.

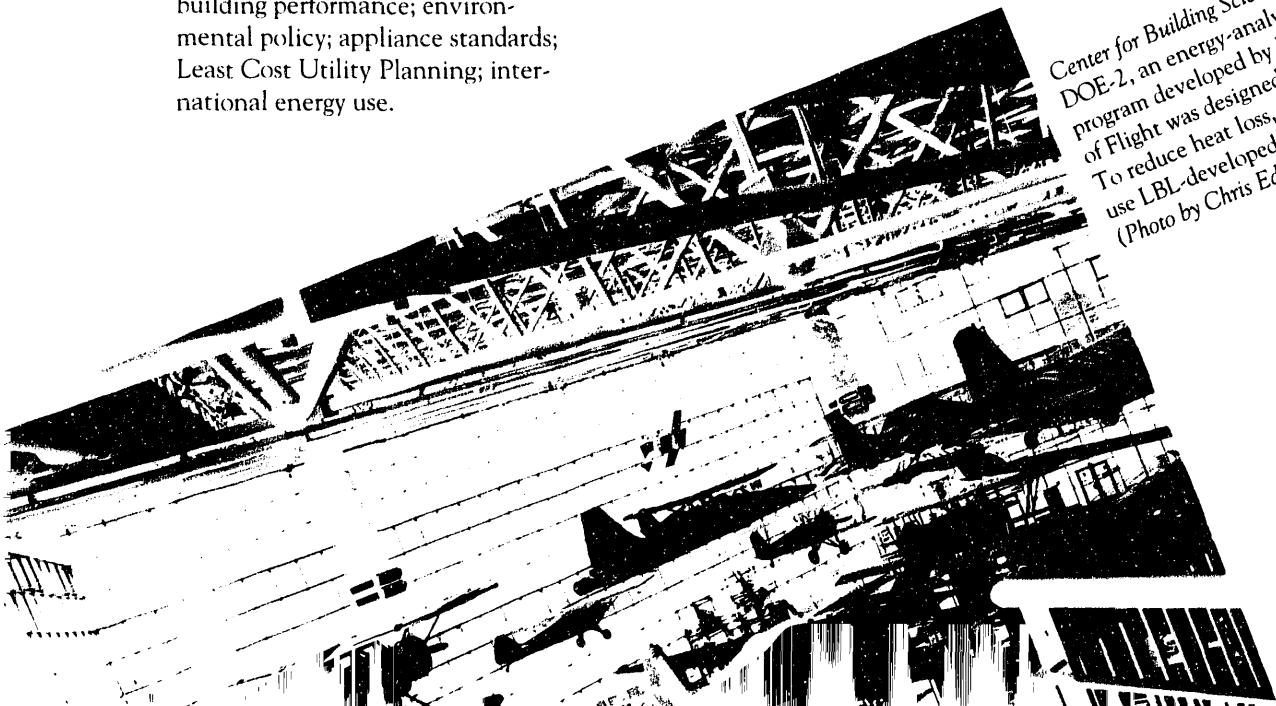
Center for X-Ray Optics

The Center develops means for generating, transporting, focusing, and detecting radiation with photon energies from approximately 10 eV to 10 keV. Continuing research programs include diffractive x-ray optics to develop x-ray lenses for scanning and imaging materials, reflective x-ray optics to develop high-reflectivity multilayer coatings for hard x-ray studies for materials and biological systems, monochromator and spectrometer development, high-brightness x-ray source development, and x-ray holography research. The Center conducts a wide range of research on the fundamental interactions of x-rays with matter and develops advanced beam lines at national synchrotron facilities, including the Advanced Light Source.



Center for X-Ray Optics. Designed at LBL, the High-Resolution Erect-Field Spectrometer/Monochromator analyzes electromagnetic radiation from the extreme ultraviolet and soft-x-ray regions.

Center for Building Science. Through use of DOE-2, an energy-analyzing computer program developed by LBL, Seattle's Museum of Flight was designed for energy efficiency. To reduce heat loss, the museum's glass walls use LBL-developed low-emissivity coating. (Photo by Chris Eden)





Berkeley Electrochemical Research Center (BERC)

The Berkeley Electrochemical Research Center carries out collaborative interdisciplinary research in the areas of electrochemical energy conversion and electrochemical engineering. BERC is the Lead Center for the DOE's Technology Base Research Project for Electrochemical Energy Storage. The aim of this project is to advance the development of high-performance rechargeable batteries and fuel cells for applications such as electric vehicles and load leveling. Center efforts include exploratory R&D on new electrochemical systems; supporting research for advanced rechargeable batteries; and electrochemical research to improve electrochemical energy-conversion efficiency and fuel-cell technology.

California Institute for Energy Efficiency (CIEE)

Hosted by LBL and financed through a Cooperative Research and Development Agreement (CRADA), CIEE is a collaborative scientific effort among the state's utilities, research institutions, and energy-related government bodies. Researchers from LBL's Energy and Environment Division and universities within California work on technology to improve the efficiency of energy use in the state. Through research to eliminate energy waste, CIEE focuses on alleviating such problems as urban smog, global warming, and the rising cost of and demand for electricity. CIEE's research seeks to reduce dependence on imported oil and avoid the need to construct new energy supply facilities, with their associated environmental impacts.

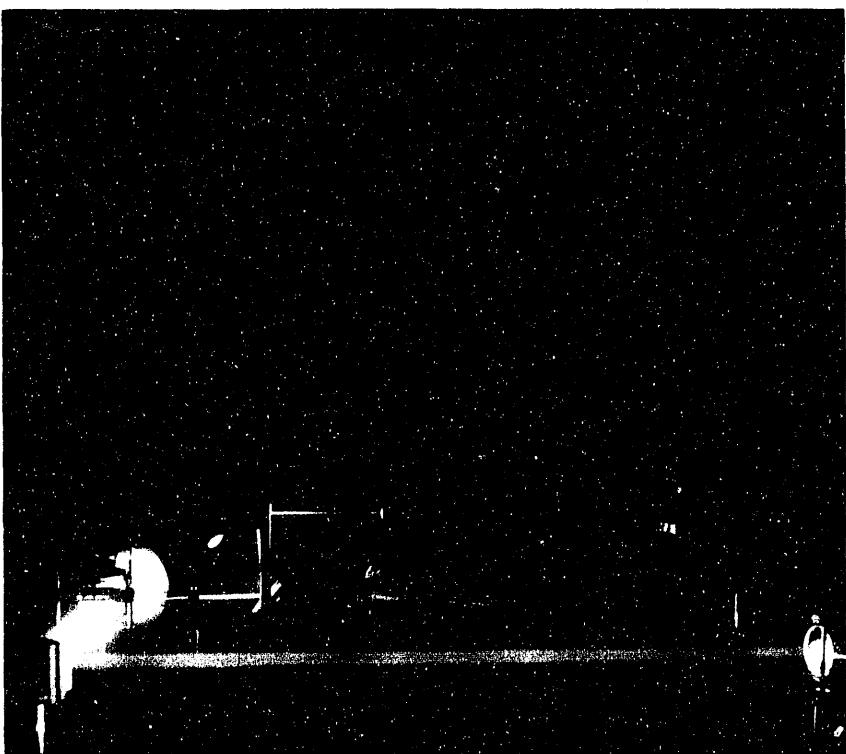
Berkeley Electrochemical Research Center. This novel cell elucidates the electrochemical reactions occurring at an electrode's surface. A laser beam is directed at the electrode, scattered light is then collected by optical fibers, sequentially allows electrode particle sizes to be varied.

Center for Isotope Geochemistry

The Center for Isotope Geochemistry was established in the Earth Sciences Division. Assisting investigators around the world, Center scientists from LBL and UC Berkeley analyze geological materials and develop basic technologies and applications for precision measurement of geological isotopes. Isotope ratios can determine the age of sediments in petroleum-bearing rock formations, elucidate past climatic conditions, and provide fundamental insights into the dynamics of hydrological systems for geothermal and environmental applications.



Center for Isotope Geochemistry. LBL researcher Don DePaolo uses a mass spectrometer to obtain precise measurements of isotopic ratios—information that holds clues to the geologic history of Earth.



California Institute for Energy Efficiency. A researcher adjusts the laser diagnostics on the subscale burner test stand at the UC Irvine Combustion Laboratory. The laser diagnostics experiment is part of a project managed by CIEE to study ultralow NO_x industrial natural gas burners.

Center for Atmospheric and Biospheric Effects of Technology (CABET)

Research within CABET focuses on the environmental effects of current and future innovations in technology. Emphasis is placed on studying the composition and behavior of direct emissions from particular technologies, as well as on developing the mechanisms for emission abatement. Also of interest to CABET are the health and ecological effects of these emissions as well as the global changes they may cause.



USER FACILITIES AVAILABLE TO INDUSTRY

LBL offers a range of unique research facilities to qualified investigators from universities, industry, and government. User Facilities designated as "National User Facilities" have national Program Advisory Committees to review research proposals by qualified investigators. DOE allows proprietary work by industry under some circumstances. Many sponsored projects take advantage of User Facilities.

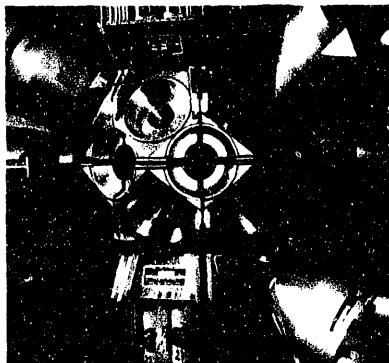
The 88-Inch Cyclotron

The accelerator provides light ions, polarized protons and deuterons, and intense and high-charge-state beams of heavy ions at energies as high as 55 MeV per nucleon. The cyclotron facility has experimental areas for conducting research in nuclear science, biomedicine, atomic physics, and radiation damage in semiconductors. A large complement of detectors located in the experimental areas includes a 21-element array of Compton-suppressed high-resolution germanium

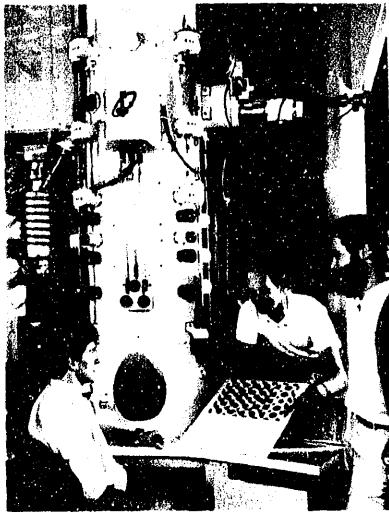
detectors for studies of nuclei at high spin, three large NaI gamma-ray spectrometers for a 60-element particle hodoscope of phoswich detectors, a high-resolution magnetic spectrometer, a time-of-flight spectrometer, and an on-line isotope separator for studying exotic nuclei.

The National Center For Electron Microscopy

The Center operates two major transmission electron microscopes: The High Voltage Microscope ac-



A view of the 21 Compton-shielded germanium x-ray detectors and the central bismuth germinate ball that make up the high-energy-resolution array.



The Atomic Resolution Microscope offers the highest resolution of any microscope in the world (1.6 Å).

celerates electrons to energies of 1.5 MeV (the most powerful microscope of its kind in the U.S.); the Atomic Resolution Microscope operates in the 0.4 to 1.0 MeV range and offers the highest resolution in the world. The two microscopes allow materials scientists and biologists to study samples under the most realistic conditions possible and to distinguish individual atom columns even in closely packed metallic and ceramic structures. A third microscope, the Analytical Electron Microscope, operates at 0.2 MeV and provides state-of-the-art microanalytical capabilities.

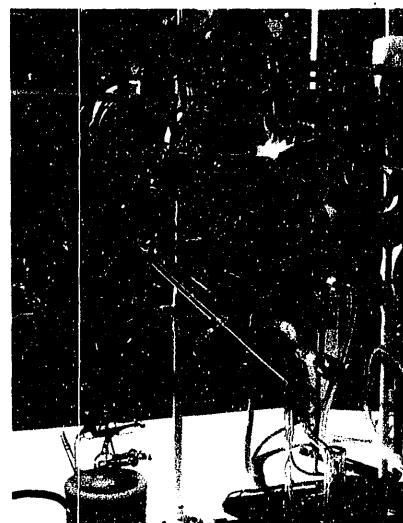
The Advanced Light Source (ALS)

Scheduled for initial operation in 1993, the ALS will provide photon beams of unprecedented brightness and coherence and with 30-psec

time structure. With it, materials scientists will tackle questions that can lead to new generations of semiconductor devices; chemists will be able to study chemical reactivity at a new level of precision, and biologists plan to watch processes unfold in living cells.

The National Tritium Labeling Facility (NTLF)

In this facility, compounds are labeled with tritium to serve as tracers in chemical and biomedical research. The tritium-labeled compounds are then used by researchers at their home laboratories. Labeling is accomplished by microwave discharge, catalytic tritio-hydrogenation, iodo displacements, and catalytic exchanges. A significant activity of the NTLF is the training of scientists in the safe handling and use of tritium.

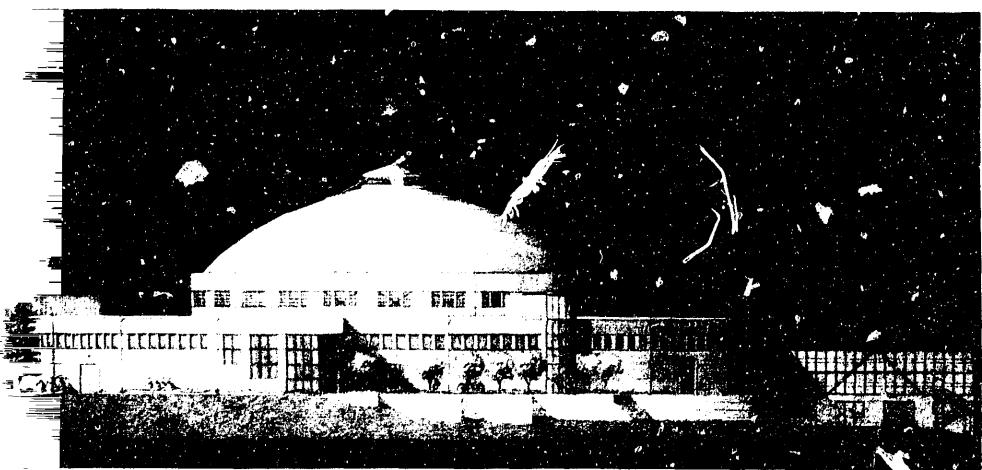


Tritium, shown glowing in the center of the photo in the excited state in a microwave excitation apparatus.

Other User Facilities

Other user facilities not designated as "National User Facilities" are made available to qualified scientists and engineers.

- ◆ Center for Computational Seismology
- ◆ Sky Simulator for Architectural Daylighting Design
- ◆ Mobile Window Thermal Test Facility
- ◆ Low-Background Counting Facility
- ◆ Heavy Charged Particle Biomedical Facility
- ◆ 2.5-MeV Van de Graaff Facility

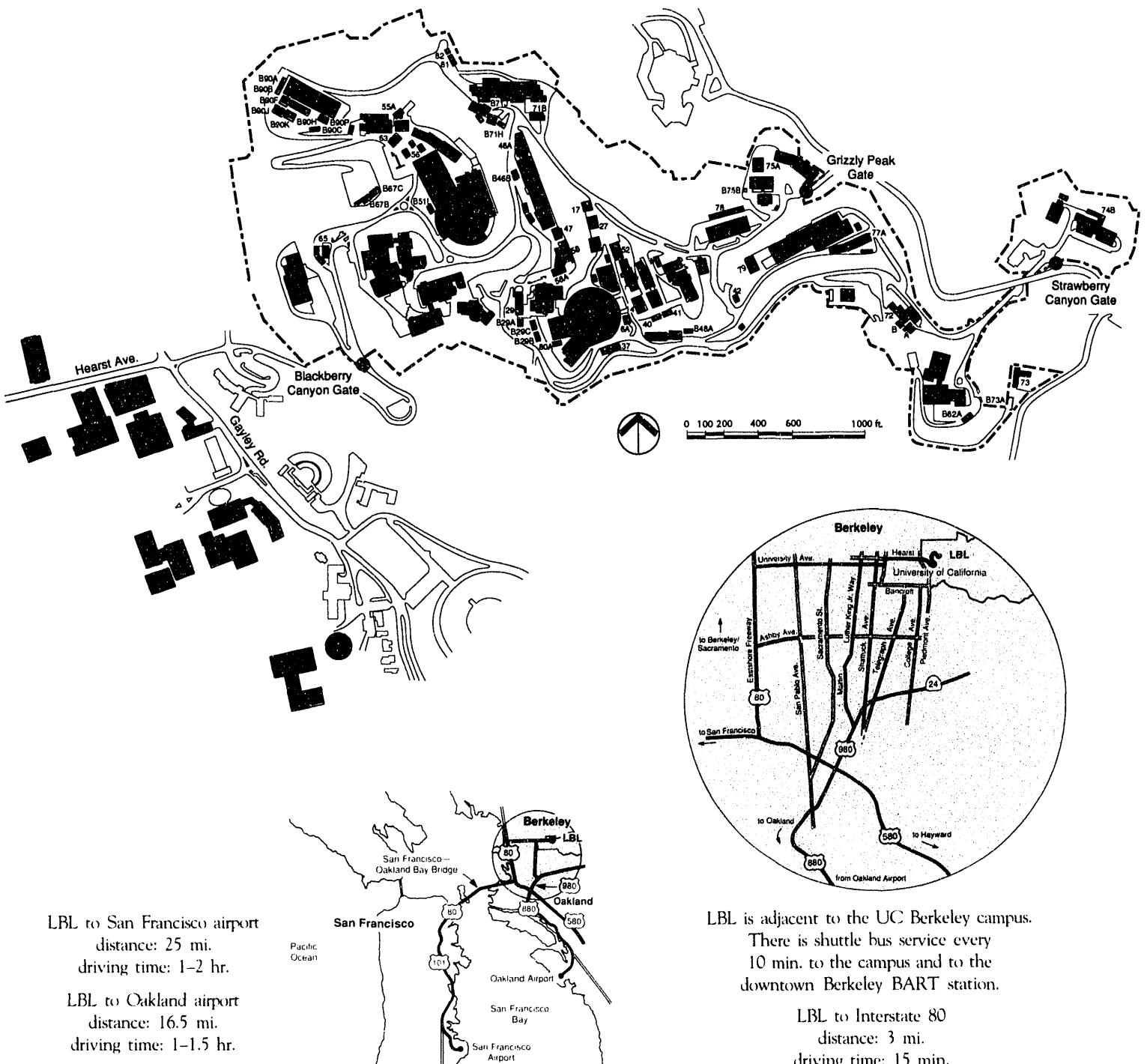


Advanced Light Source

KEY TO LBL BUILDINGS

Bldg. No.	Occupants	Bldg. No.	Occupants
2	Advanced Materials Laboratory; Center for X-Ray Optics	70	Nuclear Science; Energy & Environment; Earth Sciences
4	Magnetic Fusion Energy	70A	Nuclear Science; Chemical Sciences; Earth Sciences
5	Magnetic Fusion Energy	71	Heavy Ion Linear Accelerator (HILAC)
6	Advanced Light Source	71A	HILAC Rectifier; Exploratory Studies Group
7	Stores; Electronics Shops	71B	HILAC Annex
10	Life Sciences; Photographic Services	72	National Center for Electron Microscopy
14	Accelerator & Fusion Research; Earth Sciences	72A	High-Voltage Electron Microscope
16	Magnetic Fusion Energy Laboratory	72B	Atomic Resolution Microscope
17	Environment, Health & Safety; Energy & Environment Lab	72C	ARM Support Lab
25	Mechanical Technology	73	Atmospheric Aerosol Research
25A	Electronics Shop	74	Life Sciences
26	Medical Services	75	Radioisotope Services; National Tritium Facility
27	High-Voltage Test Facility & Cable Shop	76	Construction & Maintenance Craft Shops
29	Electronics Engineering; Life Sciences	77	Mechanical Shops
31	Chicken Creek Maintenance Building	77A	Ultrahigh Vacuum Assembly
40	Electronics Development Lab	78	Craft Stores
41	Magnetic Measurements Lab	79	Metal Stores
42	Salvage	80	Advanced Light Source Operations (future)
44	Indoor Air Pollution Studies	80A	Advanced Light Source
45	Fire Apparatus	81	Liquid Gas Storage
46	Advanced Light Source; Accelerator Development; Systems Engineering	83	Cell Biology Laboratory
46A	Systems Engineering	88	88-Inch Cyclotron
47	HIFAR Group	90	Energy & Environment; Employment; Engineering; Personnel; Protective Services; Technology Transfer; Environment, Health & Safety; Center for Science & Engineering Education
48	Fire Station		
50	Physics; Accelerator & Fusion Research; Nuclear Science		
50A	Physics; Director's Office; Planning & Development; Administration; Patents; Earth Sciences		
50B	Physics; Information and Computing Sciences; Telephone Services		
50C	Public Information; Earth Sciences		
50D	Nuclear Science		
50E	Earth Sciences		
50F	Technical Illustration; Computing Resources		
52	Magnetic Fusion Energy Laboratory		
53	SuperHILAC Development		
54	Cafeteria		
55	Life Sciences		
55A	Nuclear Magnetic Resonance		
56	Cryogenic Facility		
58	Accelerator Research & Development		
58A	Accelerator Research & Development Lab		
60	Physics High Bay Laboratory		
62	Materials Sciences; Chemical Sciences		
63	Accelerator & Fusion Research		
64	Accelerator & Fusion Research		
65	Data Processing Services		
66	Chemical Sciences; Materials Sciences; Surface Science & Catalysis Laboratory		
69	Material Management & Purchasing; Mailroom		
			UC CAMPUS BUILDINGS WHOLLY OR PARTIALLY OCCUPIED BY LBL
		1	Donner Laboratory
		3	Calvin Chemical Biodynamics Laboratory
		8	Hearst Mining
		18	Gilman Hall
		19	LeConte Hall
		19A	Birge Hall
		21	Giauque Hall
		22	Latimer Hall
		24	Etcheverry Hall
		38	Lewis Hall
		39	Cory Hall
		905	Hesse Hall
		983	Wurster Hall
		984	Davis Hall
			Not shown: Life Sciences Building (near the western edge of the campus)

LBL MAP



END

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6 / 17 / 93

