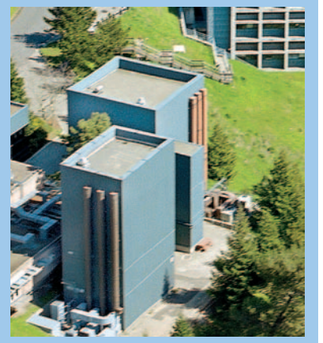
Advanced Light Source, Microscopy Center Celebrate Anniversaries

Two of Berkeley Lab's flagship facilities – the Advanced Light Source (ALS) and the National Center for Electron Microscopy (NCEM) – will be celebrating milestone anniversaries this fall.

It's been 10 years since the ALS, a synchrotron whose x-rays produce light a billion times brigher than the sun, opened its doors to international research. Since then, the machine has made its mark in the study of materials and chemical processes, and in the imaging of biological structures. Its protein characterization work, along with other cutting-edge investigations at 27 operating beamlines, is expected to carry a large portion of Berkeley Lab's scientific load in the next decade. See www-als.lbl.gov/

The Advanced Light Source



The National Center for Electron Microscopy

Its companion in high-tech microscopy, NCEM, is reaching its 20th birthday, still intact as the facility with the strongest collection of electron microscopes in the world. These instruments probe the atom-level reaches of the natural and synthetic world, and they will be key parts of Berkeley Lab's nanoscience initiative. The Molecular Foundry will be built right next door. For more information go to ncem.lbl.gov/

The historic ALS dome, the original construction from Ernest Lawrence's 184-inch cyclotron in the 1940s, remains the Lab symbol and its distinguishing architectural element overlooking the Berkeley campus and the bay.

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Science on the Hill

The Community Newsletter of Berkeley Lab — Fall 2003

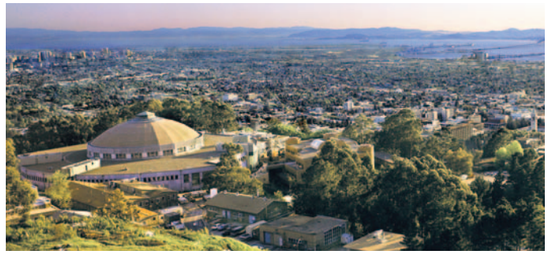
Berkeley Lab Begins Planning For Next 20-Plus Years

Perfect vision is 20/20, and Berkeley Lab is trying to sharpen its institutional vision to that precision – to the year 2020, and beyond. The Laboratory is in the midst of preparing its first Long Range Development Plan (LRDP) in 15 years.

LRDPs establish a framework of land-use principles and policies to guide future growth and change. The plan will also identify projections in both population and building space. All of this will require environmental analysis, pursuant to the California Environmental Quality Act. An Environmental Impact Report (EIR), providing a comprehensive assessment of the proposed project and its potential effects on the environment, will accompany the LRDP.

As it is being prepared, the Berkeley Lab LRDP will serve as a vehicle for dialogue with the community and with those charged with oversight of the laboratory. It will communicate the direction of the physical development and the guiding planning principles to be employed.

LRDPs are being prepared for the University of California, which manages Berkeley Lab. At the same time, UC Berkeley and most of the other UC campuses will be preparing or updating their own LRDPs in the face of unprecedented



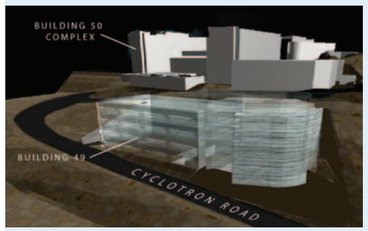
enrollment growth. Although Berkeley Lab doesn't face the same concerns for accommodating new students, it nonetheless envisions the need for changes based upon evolving national challenges within its scientific mission (see related story).

It is anticipated that Berkeley Lab will conduct a "scoping" process this fall and will seek public input at that time. A draft LRDP and the associated draft EIR will be circulated for public review and comment, probably next spring. Interested neighbors and friends will receive notice of the schedule for steps in the process. For information, contact the Community Relations Office at (510) 486-7292.

New Building To Ease Space Challenges

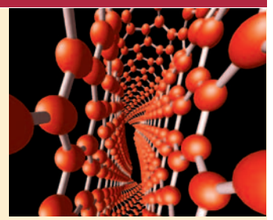
A new building designed to ease the overcrowding of office space at Berkeley Lab has been proposed for construction next year. The six-story, 65,000-square-foot structure would be erected just above the Blackberry Gate and just below the Building 50 complex, on the southeast side of Cyclotron Road. Since the purpose of "Building 49" will be to relocate up to 240 current employees, no net increase of staff or automobile traffic is anticipated. Although the programs to be accommodated in the building have not yet been identified, there will be no research lab space included.

An environmental impact report (EIR) has been prepared for the project, and a public meeting will be held on the EIR.



Construction could begin next spring, and the building should be completed by fall of 2005. For more information go to www.lbl.gov/community/env-rev-docs.html

A Spectrum of Future Science



Berkeley Lab's senior managers recently developed a roadmap for laboratory science into the next decade, spanning the spectrum from the tiniest substances on earth to the furthest reaches of the universe. The research directions include:

- Nanoscience, and the building of structures atom-by-atom (the Molecular Foundry should begin construction in a few months)
- Quantitative biology, in which the mechanisms of life are further defined and the microbial world is further elucidated for practical applications
- Astrophysics, and the quest to understand the mysterious "dark energy" of our universe
- Advanced computing to help solve the world's most difficult challenges in areas like climate change, combustion and fusion energy
- Ultrafast science, including the use of x-rays to open the window into understanding dynamic biological and physical events
- Global climate change, and the search for ways to sequester airborne carbon in environmentally safe areas of the ocean or the deep earth
- Neutrino science, and a greater understanding of the elusive and

Science Education

High School Student Research program director Gwen Espino with Lamont Harper, a program participant from Berkeley High School.

Summer of Science for High Schoolers

This summer, 39 students from 12 Bay Area high schools came to Berkeley Lab to learn what cutting edge science is all about. They improved the efficiency of lasers, conducted tuberculosis research, and mastered genetic engineering techniques, among other assignments. Now in its fourth year, the High School Student Research Participation Program gives local high school students the opportunity to come face-to-face with real science and gain work experience in a variety of science, computing, and engineering fields. The program, which is sponsored by the Lab's Center for Science and Engineering Education, has the goal to reinforce classroom learning and to promote careers in science and engineering. Several students who completed the program some years ago are now working in Berkeley Lab's Information Technologies and Life Sciences Divisions while attending college. The internship program is open to high school juniors and seniors. Selection is based on the applicant's academic performance, teacher recommendations, and demonstrated commitment to a future career in the sciences. For more information, go to www.lbl.gov/Education/CSEE/hssrp.html

Local Resident, Global Citizen

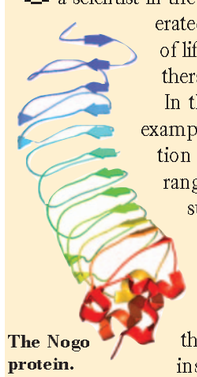
City Will Appoint Liaison to Lab

The Berkeley City Council passed a resolution in July that directs the City Manager to identify a "lab liaison" who will be responsible for coordinating relations between the city and Berkeley Lab. It also directs city planning and environmental staff to conduct preliminary analyses of all major planned development projects here and to provide a written summary of land use and environmental issues. In his recommendation, Mayor Tom Bates said the action will help the city to evaluate lab proposals and coordinate city-lab connections "from land use review to fire safety."

Berkeley Lab Community Relations Officer Terry Powell welcomed the action. "We are always looking for ways to enhance our communications with the citizens and leadership of Berkeley," she said, "and this will provide a useful conduit for the necessary exchange of information and views."

Protein Sleuth Investigates Basis for Drug Resistance, Paralysis from Spinal Cord Injuries

Gerry McDermott wants to know what makes people tick, one molecule at a time. As a scientist in the Physical Biosciences Division, he uses extremely bright x-rays generated at the Advanced Light Source to learn how proteins regulate some of life's most fundamental functions – work that may yield powerful new therapies for everything from bacterial infections to spinal injuries.



The Nogo protein.

In the race to stay one step ahead of drug-resistant bacteria, for example, McDermott and several other scientists obtained high-resolution images of a protein complex found in bacteria that repels a wide range of antibiotics. The images offer new insight into how bacteria survive attacks from different antibiotics, a growing health problem called multidrug resistance. As the team learned, these robust defenses are rooted in the protein complex's remarkable ability to capture and pump out a spectrum of structurally diverse compounds. The research may inform the development of antibiotics that either evade or inhibit these pumps, allowing drugs to slip inside bacteria cells and kill them.

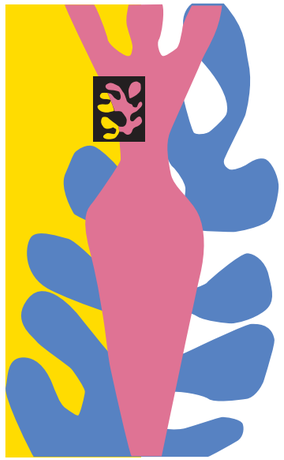
McDermott also trained his sights on the Nogo receptor, a protein that plays a role in blocking the growth of nerve cells. The receptor is found on the surface of thin fibers, called axons, which carry information between neurons in the brain and spinal cord. When the receptor binds with other proteins, nerve cells stop growing. Researchers believe that if they can pharmaceutically block the interaction between the Nogo receptor and these growth-inhibiting proteins, then severed neurons may fuse back together, and paralyzed people could walk again.

Gerry McDermott

Although years away, such drug therapy begins with an atom-by-atom understanding of how the Nogo receptor grabs inhibitory proteins, and this begins with a close-up view of the receptor itself. To kick off this inquiry, McDermott and researchers from Stanford University School of Medicine and Harvard Medical School developed an image that reveals every nook and cranny of the receptor's binding site. For more on the Nogo protein go to www.lbl.gov/Publications/Currents/Archive/Jul-25-2003.html#Nogo

A WORLD OF GREAT SCIENCE AT BERKELEY LAB

Understanding Marin Breast Cancer Statistics



Marin County has the highest incidence of breast cancer of any county in California. Yet little has been known about the personal, genetic, and environmental risk factors among women in Marin for scientists to be able draw any conclusions about the relationship of breast cancer incidence to risk factors specific in Marin County. Dr. Chris Erdmann, a researcher in Berkeley Lab's Environmental Energy Technologies Division, has been working with colleagues at UC Berkeley, UCSF, and Marin community members on two research projects that might help better understand some of the risk factors that may influence breast cancer incidence in the county. With funding from Marin County's Department of Health and Human Services, Erdmann and her colleagues have conducted a pilot study of personal environmental risk factors. Community members provided ideas of possible environmental exposures that may be breast cancer risk factors through mail and email, telephone surveys, and community workshops. A second project, the traditional risk factors study, examined female breast cancer risk factor distributions in Marin County using previously collected data. Both projects are completed, and results will be published soon. For more information on Marin County's breast-cancer research program, see www.co.marin.ca.us/depts/HH/main/epi/research.cfm

New Test Facility for Windows Technology

The Lab's new test facility will help researchers design more energy-efficient windows systems.

Windows are responsible for about 15 percent of the annual energy use of U.S. buildings, at a cost to consumers in the U.S. of about $40 billion per year. Energy-efficient windows can save residents and businesses hundreds of millions of dollars annually. To help realize these savings, researchers at Berkeley Lab have built a new facility to test advanced energy-efficient window systems. Located at the top of a hill, with a sweeping view of the Bay, the new facility has three vista-size openings that have been fitted with prototypes of a "smart" window system based on electrochromic materials. Electrochromic windows gradually change from transparent to a colored state on the application of a minuscule electric charge. In buildings with proper sensors and controls, these windows could darken automatically, cutting down on the amount of the sun's heat, reducing air conditioning use substantially, and thus reducing the demand on the electric grid. Tests performed in the new facility will help manufacturers improve their technologies, and help engineers devise control systems that deliver maximum energy savings. Although it will be several years before these technologies are readily available for purchase, Berkeley Lab has conducted research that can help consumers save money today. To learn more about the Lab's windows research and for links to sites that help consumers select efficient window products, go to windows.lbl.gov

Building Better Artificial Bones

Someday, Antoni Tomsia's handiwork may help people live full lives even as their bones weaken. The Materials Sciences Division researcher recently received a $4.3 million grant from the National Institutes of Health to develop new bone-like materials that could greatly improve implants such as artificial hips and shoulders. Tomsia is harnessing the latest advances in nanotechnology to develop implant systems that can self-repair, adapt to changing physiological conditions, and mesh with surrounding tissue – in other words, behave like real bone. The need for better biomaterials is underscored by the growing demand for bone replacements, and the unfortunate fact that today's implants may only last a few years or damage surrounding tissue. To address these shortcomings, Tomsia will explore new materials with help from a multidisciplinary collaboration of scientists from Berkeley Lab, UC Berkeley and San Francisco campuses, and the Bothell, Washington-based SkeleTech, Inc. "We're at the interface of biology, materials science, and medicine," Tomsia says. "We don't have Leonardo da Vincis anymore. Nobody can do this alone, so we have to work together as a team."

New bone-like materials under development at Berkeley Lab could help implants, such as knee replacements, last longer.