National User Facilities at Berkeley Lab

Where the World's Scientists Bring Their Experiments

Berkeley Lab is not just home to 4,200 scientists and staff – it also hosts each year thousands of researchers from nearby and around the globe. The Lab's five national user facilities offer select scientists direct access to the brightest X-ray light sources, the most powerful electron microscopes, and some of the fastest computers on Earth. The five are part of a U.S. Department of Energy program providing highly specialized equipment to the best researchers, whose work is regularly cited in top scientific journals. Drawn from universities, government, and private industry, science teams compete for time to analyze materials and run experiments, tapping into extraordinary instruments and expertise unique to Berkeley Lab.

Advanced Light Source

Located inside Berkeley Lab's signature dome, the Advanced Light Source is one of the most sophisticated scientific instruments ever built. It produces hair-thin beams of X-rays and ultraviolet light, precisely focused and a billion times brighter than the sun. The ALS hosts more than 2,000 visiting scientists annually. Between 50 and 100 of them run experiments here each day in fields that range from environmental, materials, and energy sciences to physics and biology. ALS beams have revealed the structures of nearly 3,300 proteins and analyzed the biochemistry of bacteria found in the plume of the Gulf of Mexico oil spill. Its beamlines are vital analytical tools for researchers leading the effort to create better medicines, stronger materials, and more efficient solar cells and batteries.

National Energy Research Scientific Computing Center

Scientists don't have to visit Berkeley Lab to tap into NERSC, the U.S. Department of Energy's most scientifically productive supercomputing center, where more than 4,000 users log on to the systems from laboratories and universities across the country. Each year, NERSC users generate about 1,500 scientific papers based on their use of these machines. The fastest at NERSC — the second most powerful supercomputer in the United States — is clocked at 1.05 quadrillion calculations per second. Advances in physics, materials science, and chemistry would be impossible without this kind of computer horsepower. Scientists use NERSC to model climate change, visualize reactions in biofuels and fusion, model clean combustion, and simulate the birth and death of stars.

The Molecular Foundry

As a center focused on all aspects of nanoscience, the Molecular Foundry provides skilled researchers the opportunity to make and understand structures and devices that are smaller than light itself. Through a collection of diverse capabilities that span the breadth of the field, scientists are able to create new materials with features built around single molecules or atoms. Merged with the Foundry in 2014, the National Center for Electron Microscopy enhances the ability to understand these new materials at the atomic scale through the use of some of the world's most powerful microscopes. Because ordinary materials behave in extraordinary ways at this size, nanoscience is opening new frontiers in energy, electronics, health, and engineering.

Energy Sciences Network

Berkeley Lab is headquarters for ESnet, the ultra-fast data highway for all laboratories affiliated with the U.S. Department of Energy. If supercomputers like NERSC provide the horsepower for data-intensive science, ESnet provides the connectivity. Large-scale collaborative research is the heart and soul of the modern scientific enterprise. Researchers today share data sets in the petabyte range — a million times the size of files familiar to consumers. The network links tens of thousands of researchers at more than 40 institutions, at high speed and securely. ESnet engineers are developing a new network technology that will boost data transmission rates to 100 gigabytes per second — 10 times faster than today's.

Joint Genome Institute

Berkeley Lab's Joint Genome Institute in Walnut Creek, California, is one of the busiest gene-sequencing facilities in the world. Nearly 1,800 researchers from six continents are users of JGI, which opened its doors in 1999. Banks of DNA-reading machines sequence the genetic codes of plants, animals, and complex microbial communities — one-fifth of such projects in the world are carried out at JGI. Unraveling the genetics of living creatures might help us combat climate change and develop more sustainable sources of energy. For example, JGI collaborators sequenced the entire genetic code for an algal species that plays a crucial role in the global carbon cycle by scrubbing vast amounts of CO_2 from the sea. And genes from microbes living in a cow's stomach may show us recipes for breaking down cellulose, a vital step in the making of biofuels.