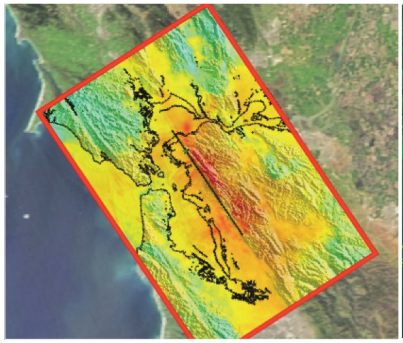
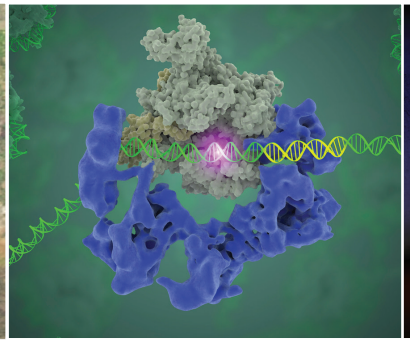
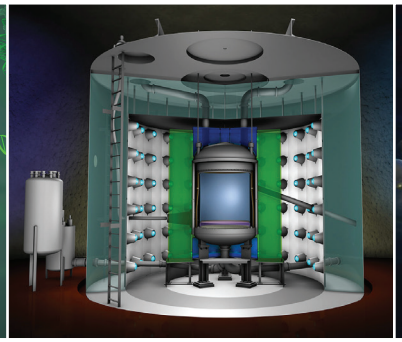
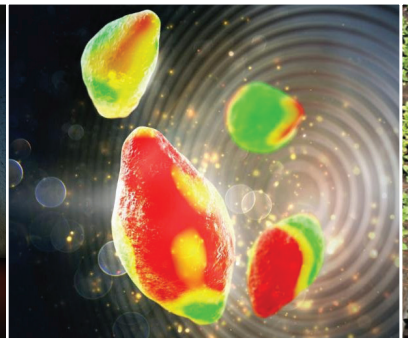
10 ON THE WAY

At Berkeley Lab, we bring science solutions to the world. Here are 10 entries in our 2017 "On the Way" list that are either starting up, moving along, or getting ready to deliver.


Shaking Up Seismic Modeling

Using some of the world's most powerful computers, Berkeley Lab researchers are building the first end-to-end simulation framework to simultaneously capture the geology and the physics of regional earthquakes, and how shaking impacts buildings. To accurately depict responses for a range of infrastructures, they need to resolve high-frequency ground motions at 5-10 hertz (vibrations per second). Shaking at 2-10 hertz or more typically affects buildings and energy infrastructure.

Bioimaging Goes Atomic

Cryo-electron microscopy is revolutionizing the field of structural biology. By shooting electrons through samples that have been flash-frozen, and using high-end detector technology developed at Berkeley Lab to record a movie of the sample, scientists are getting views of biomolecules at near-atomic resolutions that could aid drug development and medical research. The speed with which the images are processed can be greatly enhanced by NERSC supercomputers at Berkeley Lab.

Mile-Deep Hunt for Dark Matter

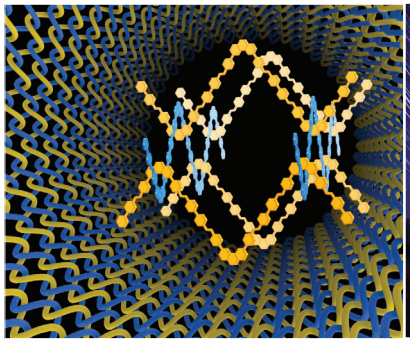
Scientists don't know what makes up 85 percent of matter in the universe. They refer to this "missing" matter as dark matter. Berkeley Lab is leading the construction of the most sensitive U.S.-based experiment designed to directly detect theorized dark matter particles known as WIMPs (weakly interacting massive particles). The LUX-Zeplin project is now taking shape at the Sanford Underground Research Facility 4,580 feet below ground in South Dakota, with project completion expected in 2020.

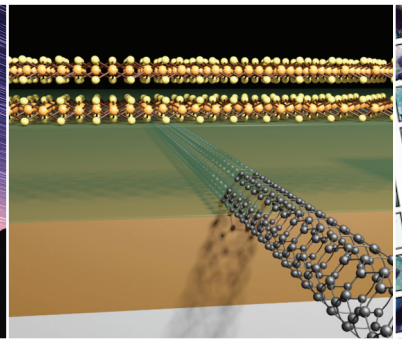
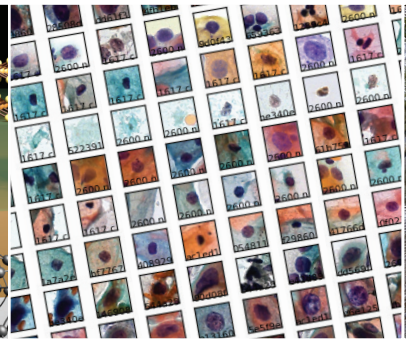
Building Better Batteries

There's a new tool in the push to engineer rechargeable batteries that last longer and charge more quickly. A technique recently developed at Berkeley Lab's Advanced Light Source uses the brilliant X-rays generated from the synchrotron particle accelerator to image nanoscale changes inside lithium-ion battery particles as they charge and discharge. The real-time images provide a new way to learn how batteries work and how they can be improved for electronics, vehicles, or even grid storage.

Lighting the Way to Better Crop Yields

Berkeley Lab scientists are manipulating the way plants use light energy to improve the efficiency of photosynthesis, and in turn increase crop productivity. They're tweaking the chemical pathways or modifying the expression of genes that regulate the way plants switch between using and dissipating light. Such techniques have already shown promise in increasing crop yield, as shown through joint research with the University of Illinois.




Designer Materials for Cleaner Energy

Berkeley Lab scientists are engineering new classes of clean-energy nanomaterials. Examples include metal-organic-frameworks (MOFs) that trap enormous quantities of molecules because they boast a huge internal surface area (a teaspoon-sized sample, if unpacked, would cover a soccer field). Scientists are designing MOFs to capture carbon dioxide from smokestacks and to generate water from dry, ambient air. They're also creating catalysts that convert carbon dioxide into ingredients for liquid fuel, solvents, and renewable feedstocks.

A Bigger 3-D Map of the Universe

The Dark Energy Spectroscopic Instrument (DESI) will provide a deeper look at dark energy, which is driving the unexplained, accelerating expansion of the universe. Dark energy's initial discovery earned Berkeley Lab astrophysicist Saul Perlmutter a Nobel Prize, and Berkeley Lab scientists are now leading the development of DESI. It will create a giant 3-D map of bright, distant objects in the universe by detecting the ancient light from millions of galaxies and other objects to reveal how fast they are moving away from us.

Incredible Shrinking Electronics

It's easy to take for granted that integrated circuits will continue to scale down in size, but the laws of physics can limit how small electronic components can go. Not one to shrink from a challenge, scientists at Berkeley Lab used materials that better control the flow of electrons to create a transistor with a working 1-nanometer-long gate. For comparison, a strand of human hair is about 50,000 nanometers thick. This breaks through a key size barrier in physics for the component and could help ensure the continuation of Moore's law.

Better Tools to Automate Image Recognition

Science is awash in images. In a perfect world, these images would be annotated. In reality, ever-advancing technologies are collecting information far too fast to analyze and catalog in real time. Berkeley Lab researchers are developing automated machine-learning tools such as pyCBIR to catalog and retrieve a range of scientific data from images in fields such as biology and physics. Possible future applications include quickly identifying cancerous cells from among thousands of healthy cells, which will speed up diagnosis and treatment.

Banking on Groundwater

Can we store water from rainy times to use during periods of drought? Berkeley Lab scientists and partners from UC Davis and the Almond Board of California are testing on-farm banking, a new approach that has the potential to manage groundwater more sustainably. On-farm banking "banks" groundwater by spreading excess surface water on agricultural land such as vineyards and almond orchards during times of heavy rainfall. This replenishes subsurface water and increases the reliability and resiliency of California's groundwater supply.

BERKELEY LAB

Visit us at lbl.gov

For more about our science, see newscenter.lbl.gov
Contact: communications@lbl.gov

@BerkeleyLab

17-PA-4353