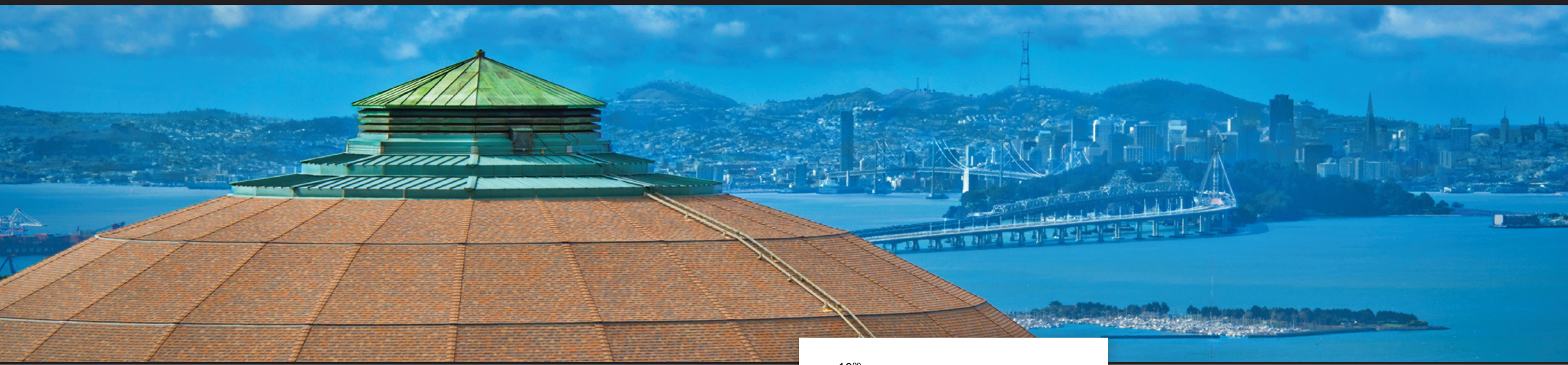
ADVANCED LIGHT SOURCE 2017

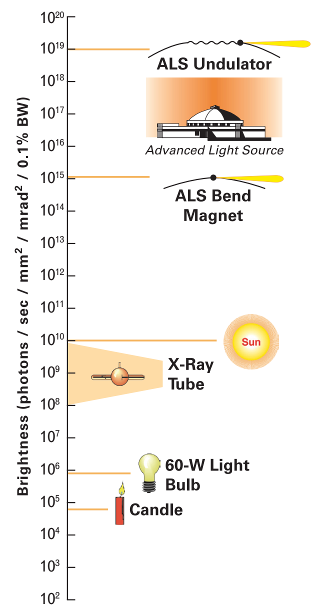
QUICK FACTS



The Advanced Light Source (ALS) is a third-generation synchrotron, a specialized particle accelerator that generates bright beams of x rays for scientific research. It is located in a building originally designed in the 1930s by Arthur Brown, Jr.—architect of the Coit Tower in San Francisco—to house Ernest O. Lawrence's 184-inch cyclotron. In 1987, a $99.5-million construction project, funded by the US Department of Energy's Office of Basic Energy Sciences, began to reconfigure the building to accommodate the ALS accelerator and beamlines. Completed in 1993, the ALS is a national user facility that now attracts more than 2300 researchers and students annually from around the world.

HOW THE ALS WORKS:

Electron bunches traveling nearly the speed of light, when forced into a circular path by magnets, emit bright ultraviolet and x-ray light that is directed down beamlines to experiment endstations.



HOW BRIGHT IS IT?

The ALS produces light in the x-ray region of the electromagnetic spectrum that is one billion times brighter than the sun. This extraordinary tool offers unprecedented opportunities for state-of-the-art research in biology, chemistry, physics, and materials, energy, and environmental sciences. Ongoing research includes semiconductors, polymers, superconductors, magnetic materials, biological macromolecules (proteins, etc.), 3D biological imaging, chemical reaction dynamics, and atomic and molecular structure.

ABOUT THE ACCELERATOR

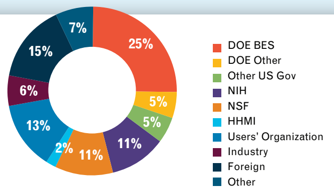
Number of electrons in each bunch	7 billion
Time between electron bunches	$2x10^{-9}$ sec
Size of the electron beam	~0.20mm x 0.01mm (the width of a human hair)
Distance electrons travel in the booster ring (in 0.45 sec)	135,000 km
Electron revolutions around the storage ring per second	1.5 million
Energy of electrons in the storage ring	1.9 GeV
Speed electrons travel at their highest velocity	299,792,447 meters/sec (that's **99.999996%** the speed of light!)
Aluminum foil used per year	20,928 sq ft

USER STATS

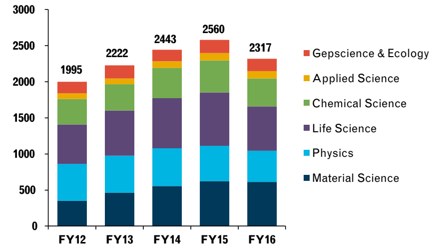
50-100
Users on site at any one time

1 hour to 10 days
Average stay of users

Users by Funding



Users per Discipline per Fiscal Year



FACILITY FACTS

24
Years in operation

~200
Total ALS staff

>950
Refereed publications per year

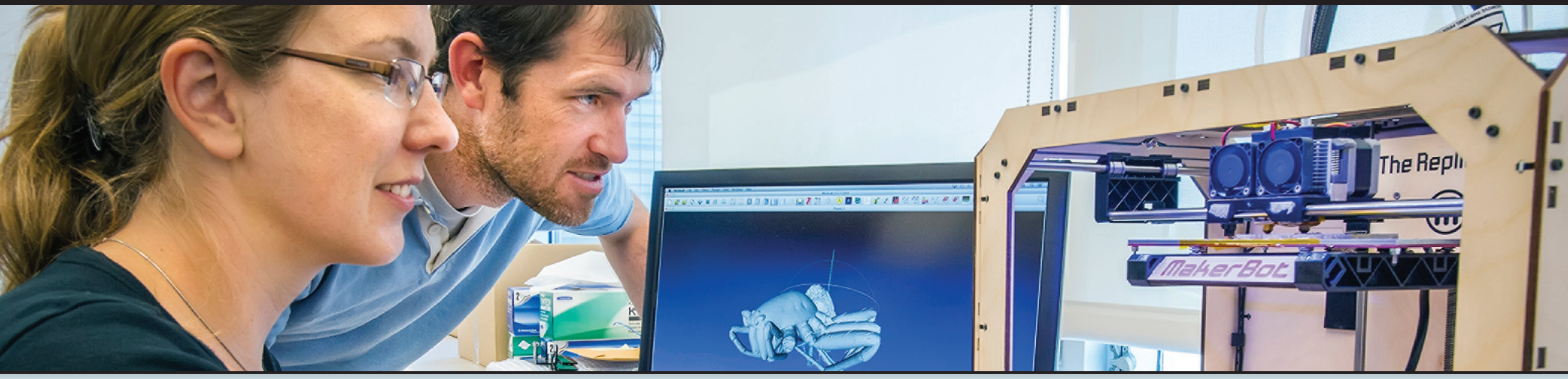
$60M
Average operating budget per year

5000
Average number of operating hours per year

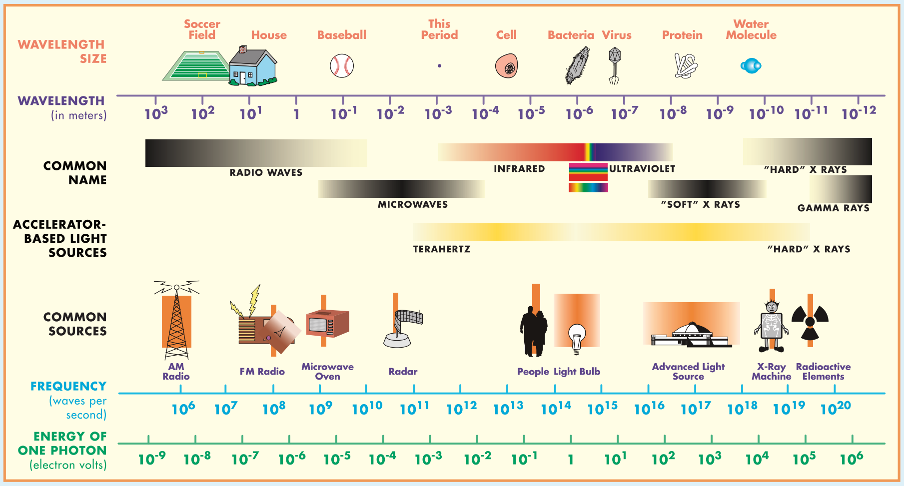
40
Number of beamlines

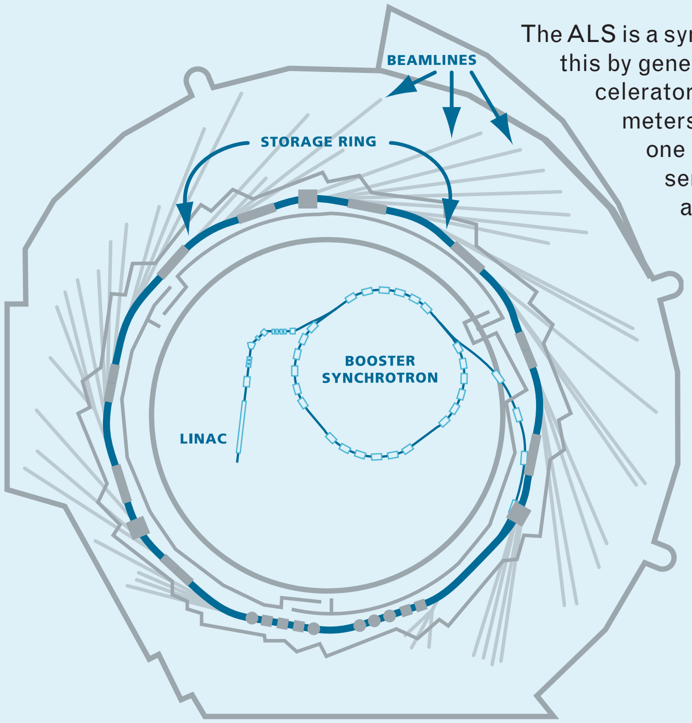
NEW TOOLS

MAKE NEW INVESTIGATIONS POSSIBLE



How and what we "see" depends on the tools we use—be it a telescope, a light microscope, an x-ray machine, or even our eyes. What we see with out eyes is limited to the light that illuminates an object—and how our eyes perceive what they are seeing. Our eyes can only interpret light in the visible region of the electromagnetic spectrum. But what if you want to peer inside a living cell and look at the molecules that form a cell wall? Or probe the surface of a silicon chip—atom by atom? The Advanced Light Source (ALS) produces light in the wavelengths required for "sight" into the world of molecules and atoms. How this unique light is produced and how it is used is a feat of both innovative engineering and pioneering science.





The ALS is a synchrotron that produces light in the form of bright beams of x rays. It does this by generating a hair-thin beam of electrons and accelerating them in a linear accelerator and then in a booster ring to nearly the speed of light (that is 299,792,447 meters/sec—at that speed you could go around the world almost 7.5 times in one second!). The electrons are then "stored" in a 200-meter ring guided by a series of magnets that force them into a curved trajectory. As they travel around the storage ring, the electrons emit synchrotron radiation—energy in the form of photons—that is directed by specialized optics down 12-meter-long beamlines to experiment endstations.

The wavelengths of the synchrotron light span the electromagnetic spectrum from infrared to x-rays and have just the right size and energy range for examining the atomic and electronic structure of matter. These two kinds of structure determine nearly all the commonly observed properties of matter, such as strength, chemical reactivity, thermal and electrical conductivity, and magnetism. The ability to probe these structures allows us to design materials with particular properties and understand biological processes inscrutable to visible light.

April 2017

17-AL-3895