



“There is nowhere else in the world we could have run this simulation.”

Loukas Petridis,  
Staff Scientist



## Breakthrough Science at Every Scale

Researchers from around the world use the Oak Ridge Leadership Computing Facility (OLCF) to solve problems so challenging they require the world's most powerful computers. OLCF's high-performance computing systems—"supercomputers"—coupled with the expertise of OLCF technical staff solve problems in diverse fields, including improvements to the safety and performance of nuclear power plants, design of new materials that can revolutionize industries, and models of the origins of the universe. Supercomputers allow researchers to study subatomic particle interactions that only exist for fractions of a second and to simulate the volatile conditions inside a combustion or turbine engine, enabling a level of detailed analysis unavailable through traditional experimental means.

### Supercomputers for Solving Problems

OLCF is home to the nation's fastest, most powerful open-science supercomputer, Titan, a Cray XK7 system that debuted in November 2012. Titan has a theoretical peak performance of 27 petaflops, which makes it possible for scientists to solve problems faster than ever before. They are developing increasingly complex models, from human cells to environmental systems to exploding stars, and creating lifelike simulations that accelerate breakthroughs in diverse fields such as advanced materials and understanding the causes of cancer.

OLCF's next supercomputer, Summit, is scheduled to come online in 2018. It will be at least 5 times as powerful as Titan and will address questions about who we are, how we live, and how our universe works with even greater complexity and higher fidelity. Summit will give scientists the capacity to solve problems too complex for today's computers.

**30 petabytes**

Storage capacity of  
OLCF's disk system

**54**

Unique OLCF  
computing  
projects in 2016

**342**

Average OLCF  
publications per  
year from 2012–2016

**16,390**

OLCF publication  
citations since 2012

**1,186**

Researchers  
who worked  
with OLCF in 2016

**151**

US institutions that used  
OLCF in FY 2016, including  
universities, companies, and  
government agencies



# Recent Impacts

**Industrial competitiveness:** General Electric uses Titan to simulate combustion in gas-powered turbines. By using computer simulations, researchers get more designs to evaluate, which means they can make leaps in turbine efficiency that translate to millions of dollars in saved fuel and millions of tons of reduced carbon pollution.

**Inner Earth mapping:** A Princeton University team is mapping the Earth’s interior using earthquake data to act as an ultrasound of the Earth. The team’s first model, completed in 2015, brings prominent subsurface features such as tectonic plates, magma plumes, and subsurface hotspots into focus and adds context to ongoing debates related to Earth’s geologic history and dynamics.

**Drug discovery:** Supercomputer simulations played a key role in the discovery of a new class of drug candidates that holds promise for combatting antibiotic resistance. In a study led by the University of Oklahoma with ORNL, the University of Tennessee, and Saint Louis University, lab experiments were combined with supercomputer modeling to identify molecules that boost antibiotic effectiveness on disease-causing bacteria. The researchers found four new chemicals that seek out and disrupt bacterial proteins called “efflux pumps,” known to be a major cause of antibiotic resistance.

## Titan by the numbers

27 petaflops	If everyone on earth made one calculation per second, it would take 1.5 months to do what Titan can do in 1 second.
8.2 megawatts	Titan uses enough electricity to power 6,000 homes.
2,200 gallons	The amount of chilled water circulated through Titan every minute.
4,352 square feet	Titan’s footprint is about as big as a basketball court.

Contact:  
Oak Ridge Leadership Computing Facility  
help@olcf.ornl.gov, 865-241-7202  
One Bethel Valley Road, Oak Ridge, TN 37831

