20 Years of Excellence in Computational Science

OLCF

Oak Ridge Leadership Computing Facility

1992–2012

OLCF: The Home of Game-Changing Science

The OLCF delivers the world's most powerful computing resources to leading computational scientists, allowing them to help improve both the world we live in and our understanding of it.

Home to Jaguar, a Cray XT5 capable of 2.33 thousand trillion calculations a second—or 2.33 petaflops—the OLCF combines world-class staff with cutting-edge facilities and support systems. The center serves elite scientists from all areas of the research community through programs such as the Department of Energy's Innovative and Novel Computational Impact on Theory and Experiment (INCITE) program, ensuring it will be a computing powerhouse for the foreseeable future.

Jaguar is the United States' most powerful supercomputer, but researchers need even more. In response, the OLCF is creating a far more powerful system that relies on traditional central processing units combined with graphics processing units. This new system—called Titan—will debut in late 2012 and reach up to 20 petaflops, making it nearly an order of magnitude faster than Jaguar.

Delivering petascale science

The OLCF was established in 1992 and became the nation's Leadership Computing Facility in 2004, charged with developing an unclassified computing resource 100 times more powerful than the systems of the day. The center's response to this challenge is Jaguar. With 37,376 six-core AMD Opteron processors, 299 terabytes of memory, a 10-petabyte file system, 478 terabytes per second of memory bandwidth, and input/output bandwidth of 244 gigabytes per second, Jaguar is the United States' fastest and most powerful supercomputer dedicated to open scientific research.

Jaguar was designed from the ground up as a scientific muscle machine. Powerful processors allow researchers to get the most science out of the fewest processors. Abundant memory allows them to tackle the largest problems ever attempted. And massive file system bandwidth eliminates the possibility of performance bottlenecks.

Scientific achievement

Jaguar's value has been amply demonstrated by its impact on scientific supercomputing. The Gordon Bell Prize is awarded for the world's most advanced scientific supercomputing application. For the past three years it has gone to researchers working on Jaguar.

The prize in 2010 went to a team from Georgia Tech, New York University and ORNL for a simulation of 200 million red blood cells and their interaction with plasma in the circulatory system. The team, led by George Biros of Georgia Tech, used 196,000 of Jaguar's 224,000 processor cores to reach 700 trillion calculations a second (700 teraflops).

In the previous year, the prize went to a team led by ORNL's Markus Eisenbach. Working with colleagues from ORNL, Florida State University, and ETH Zurich, Eisenbach achieved 1.84 petaflops on Jaguar using an application that analyzes magnetic systems and, in particular, the effect of temperature on these systems.

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ORNL 2011-G00047/jbs

The 2008 prize went to a team led by Thomas Schulthess of ORNL and ETH Zurich. Schulthess and colleagues at ORNL and Cray Inc. reached 1.35 petaflops with a simulation of superconductors.

In fact, Jaguar is being used to provide insight in a variety of critical areas of scientific research.

Materials science: Researchers using Jaguar are illuminating the world at the atomic and molecular level to unravel the secrets of processes such as superconductivity, catalysis, and electronic data storage. Success in these endeavors may translate to powerful new technologies that enrich all areas of our lives.

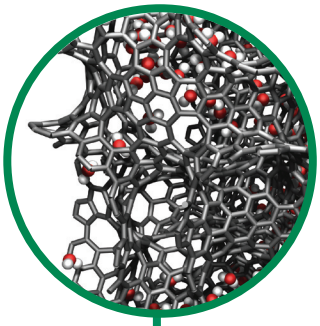
Climate science: The earth's climate is an enormously complex system, and Jaguar is giving scientists the computing power they need to accurately replicate it piece by piece. Besides hosting the world's most in-depth climate model, Jaguar allows researchers to explore specific areas such as abrupt climate change, the effect of clouds, and century-long ocean circulation patterns.

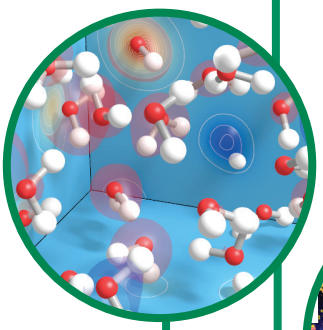
Fusion energy: The process that drives the stars may one day provide us with inexpensive, relatively clean electricity, but scientists must first understand how to control a plasma that is far hotter than the sun. Researchers are using Jaguar to explain critical issues such as the magnetic fields that contain the fuel, the radio waves that heat it, and the turbulence that complicates the process.

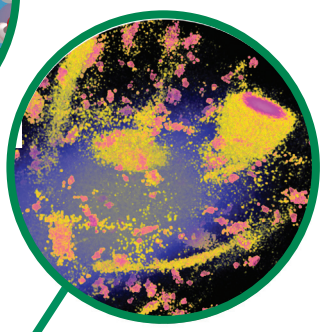
Astrophysics: Scientists from around the country use Jaguar to dissect mammoth stellar explosions, the evolution of galaxies, the mergers of giant black holes, and other events that help us understand our strange and violent universe.

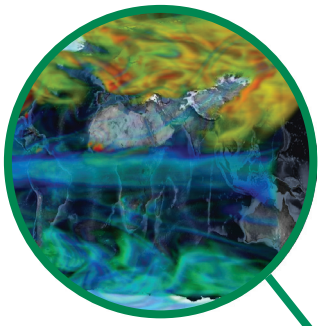
Basic science: Jaguar is helping researchers explain the bizarre, counterintuitive behavior of matter at the smallest scale.

If you think you have what it takes to be part of this community of researchers, contact Director Jim Hack at jhack@ornl.gov.









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