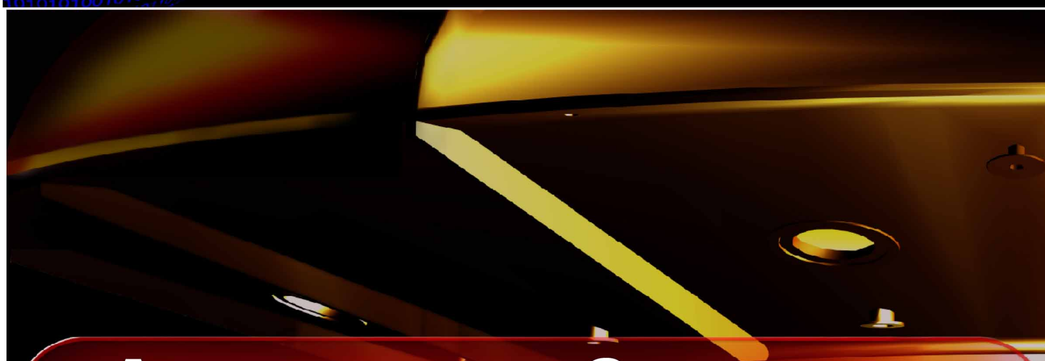
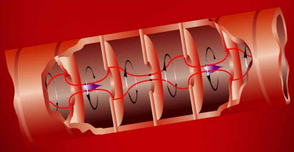
# Data Intensive Science



# ACCELERATOR SIMULATION

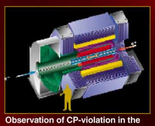


**Particle Accelerators provide the means to explore the laws of Nature, and enable scientific discoveries and important technological advances. Accelerator modeling via computer simulation is essential for their design and cost optimization.**

## DOE Has Led the Nation in Developing Major Accelerator Facilities


## Accelerators Are Crucial to Advances in High Energy and Nuclear Physics, Materials Science, and Bioscience

Searching for the quark-gluon plasma at RHIC.



Observation of CP-violation in the B-sector at PEP-II.

Imaging biomolecular structures using synchrotron light sources.

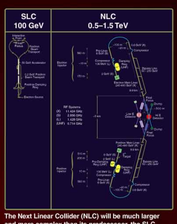
## Advanced Computing is Being Used to Address the Challenges of Proposed Next-Generation Accelerators

The technological advances made possible by accelerators have many applications that benefit the nation's health, environment, and economy.

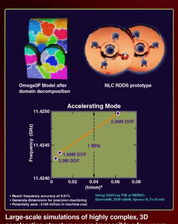
Proton therapy.

Beam lithography.

Investigating bacterial bioremediation.

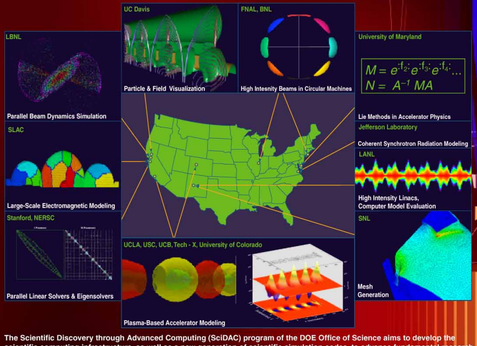


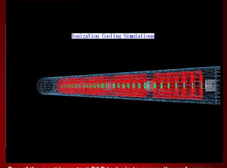

The Next Linear Collider (NLC) will be much larger and more complex than its predecessor, the SLC.



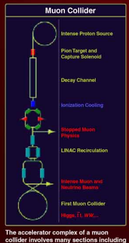

Large-scale simulations of highly complex, 3D accelerating structures were impossible a few years ago. The new parallel electromagnetic code Omega3P is a keystone of the NLC Round Damped Detuned Structure (RDDS) design effort.

## Accelerating Scientific Discovery in Accelerator Technology and Beam Physics through Advanced Computing



One of the most important R&D tasks is to assure the performance of the ionization cooling channel, which "cools" the muon beams so that they can be reaccelerated and provide high luminosity collisions. The monitor above shows simulations of an ionization cooling channel.




The accelerator complex of a muon collider involves many sections including an ionization cooling channel.

The Scientific Discovery through Advanced Computing (SciDAC) program of the DOE Office of Science aims to develop the scientific computing infrastructure, as well as a new generation of scientific simulation codes, to advance fundamental research in several areas related to DOE's missions. Under SciDAC, the Office of High Energy and Nuclear Physics, in collaboration with the Office of Advanced Scientific Computing Research, is supporting a project in Advanced Computing for 21st Century Accelerator Science and Technology. The project's goal is to develop a comprehensive terascale accelerator-modeling capability and to apply it to the design, analysis, and optimization of DOE's next-generation accelerators. Furthermore, the new codes will be used to explore and develop novel concepts such as ultra-high gradient laser- and plasma-based accelerators. As shown above, the SciDAC accelerator modeling project is a multi-disciplinary effort involving accelerator physicists, computer scientists, applied mathematicians, visualization specialists, and other information technology experts.