

Discovering the Quantum Universe: The International Linear Collider

A revolution has begun in the way we see the universe.

In 1514, Copernicus discovered that the earth revolves around the sun—not the other way around. It caused a revolution in human understanding.

Now, in the 21st century, a new revolution is underway. Experiments and observations of recent years have revealed a universe far stranger and more wonderful than scientists ever suspected—a universe of dark matter and dark energy, where familiar matter is only a tiny minority. The next generation of particle accelerators will stretch the imagination with new forms of matter, new forces of nature, new dimensions of space and time.

Questions for the Universe

Twenty-first century particle physics asks a set of fundamental questions about the universe.

1. Are there undiscovered principles of nature: new symmetries, new physical laws?
2. How can we solve the mystery of dark energy?
3. Are there extra dimensions of space?
4. Do all the forces become one?
5. Why are there so many kinds of particles?
6. What is dark matter? How can we make it in the laboratory?
7. What are neutrinos telling us?
8. How did the universe come to be?
9. What happened to the antimatter?

Along with observations in space and experiments underground, scientists use particle accelerators to discover the answers.

Particle Accelerators: Gateway to the Quantum Universe

“Starting with the discovery of the electron, particle physicists have ventured successively deeper into the unseen world within the atom. They have discovered a structure and simplicity neither expected nor predicted, even by Einstein. Their discoveries have redefined the human conception of the physical world, connecting the smallest elements of the universe to the largest, and to the earliest moments of its birth.” - The Quantum Universe

The next generation of particle accelerators will open up a new territory of discovery, the Terascale, named for the trillions of electron volts of accelerator energy that will open it up for scientific discovery. By exploring the Terascale, scientists expect to find answers to their questions, defining a revolutionary new view of the universe and its physical laws—the Quantum Universe.

Physicists around the globe are working together to design and build the most advanced accelerators ever conceived. In the ultra-high-energy particle collisions of the Large Hadron Collider, now nearing completion in Europe, and the proposed International Linear Collider, the unknown Quantum Universe will come clearly into view.

The Next Generation of Accelerators: The LHC and the ILC

Scientists eagerly await discoveries at the nearly completed Large Hadron Collider at CERN in Europe, a 16-mile circular proton accelerator. Like the mapping of an uncharted continent, the exploration of the Terascale at the LHC will transform forever the geography of the universe. But there will be limits to the LHC's view. Along with the LHC, physicists propose a second particle accelerator, one that would use different particles — electrons instead of the LHC's protons — and different technology. This 20-mile-long International Linear Collider would provide a key perspective on the Terascale. It would function as an all-terrain explorer of the Terascale, adaptable to investigate in depth what the LHC discovers. The more information the LHC uncovers about the Terascale, the more discoveries the ILC would make.

In addition to being a watershed event in scientific discovery, the ILC is also breaking ground as a truly international project. A Global Design Effort is underway to harness the efforts of hundreds of accelerator scientists and particle physicists in the Americas, Europe, and Asia. The ILC will be designed, funded, managed, and operated as a fully international scientific project.

