



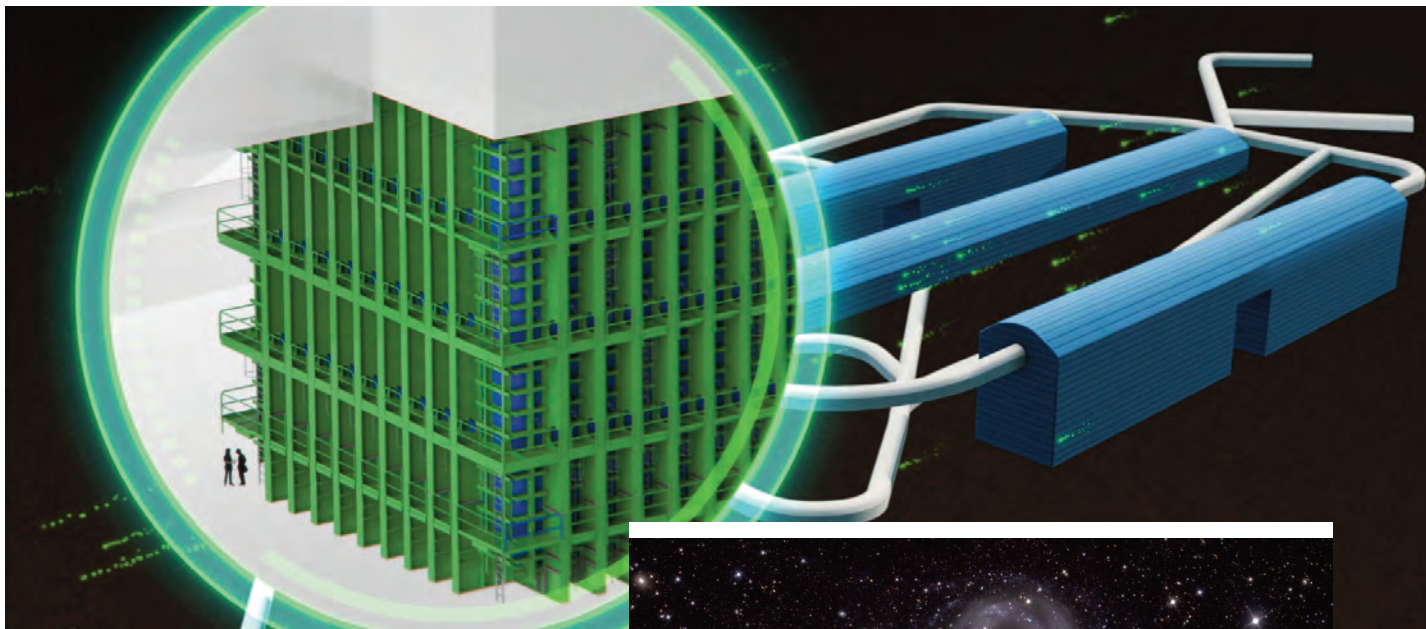
# Particle Physics is Discovery Science

## *Exploring the Universe*

The challenge of particle physics is to discover what our world is made of and how it works at the smallest scales. Particle physics explores the undiscovered universe from the tiniest particles to the outer reaches of space.







The DUNE neutrino detectors one mile underground



Upgrading the CMS experiment



Sky imagery from the Dark Energy Survey

## Leading the World to *New Discoveries*

America's particle physics research program positions U.S. scientists to make the next generation of discoveries at home and abroad. **U.S. university and national laboratory researchers lead in the global search for answers to some of humankind's biggest questions:**

### **What are the fundamental forces of nature?**

Particle physicists from the United States are leaders in the quest to understand the Higgs boson and to search for new particles and forces.

### **What are the building blocks of matter?**

Ghostly and mysterious neutrinos seem to be a keystone in the interplay of elementary particles. U.S. scientists are leaders in using intense neutrino beams and sensitive detectors to uncover the role they play.

### **How did the universe develop into its present form?**

Dark matter and dark energy make up 96% of the content of the universe and built the structure of galaxies that we see today. But what are dark matter and dark energy? U.S. scientists are leaders in Earth- and space-based experiments to answer these questions.



LSST under construction



The Large Hadron Collider



# Particle Physics Propels U.S. Progress

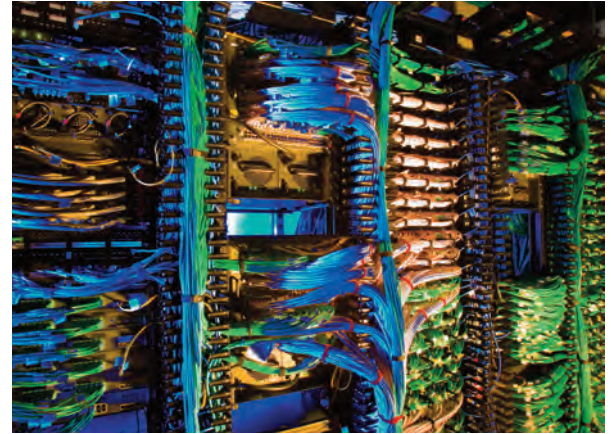
The quest to better understand our world inspires and educates tens of thousands of students across the country every year and creates a globally competitive, highly trained workforce in the United States. Advanced research and development (R&D) in particle physics drives innovation that benefits other sciences and improves the nation's health, wealth, and security.

**Here are just a few examples of the ways in which particle physics works for you.**

- ▶ **Medicine:** Particle accelerators help develop more effective drugs to fight disease.
- ▶ **Security:** Particle physics detector technology enables advanced cargo screening.
- ▶ **Computing:** Particle physicists push the frontiers of big data analysis.
- ▶ **Manufacturing:** Radial tires are made stronger and lighter using particle accelerators.
- ▶ **STEM:** Research in particle physics inspires young people to engage with science.



*Students engage with physics concepts*

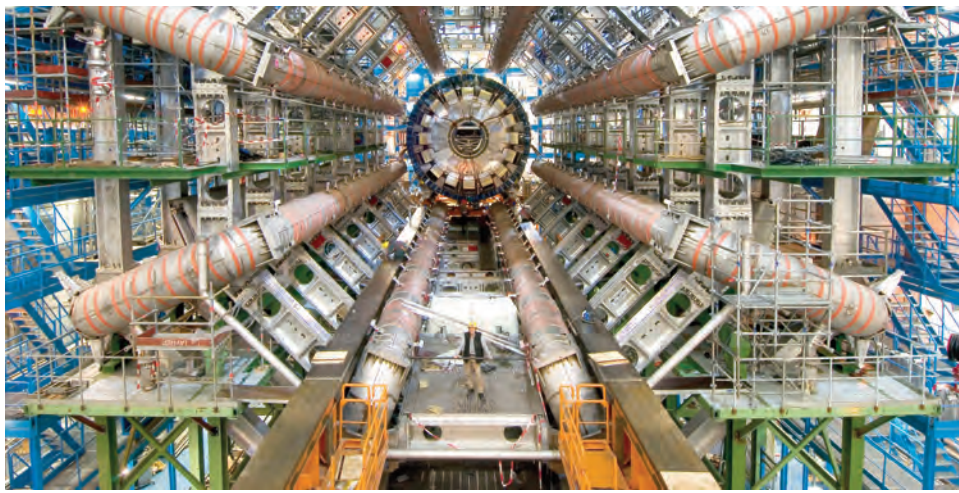


*Particle physics challenges computing limits*

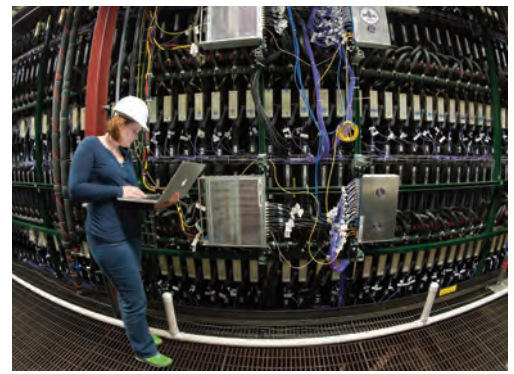
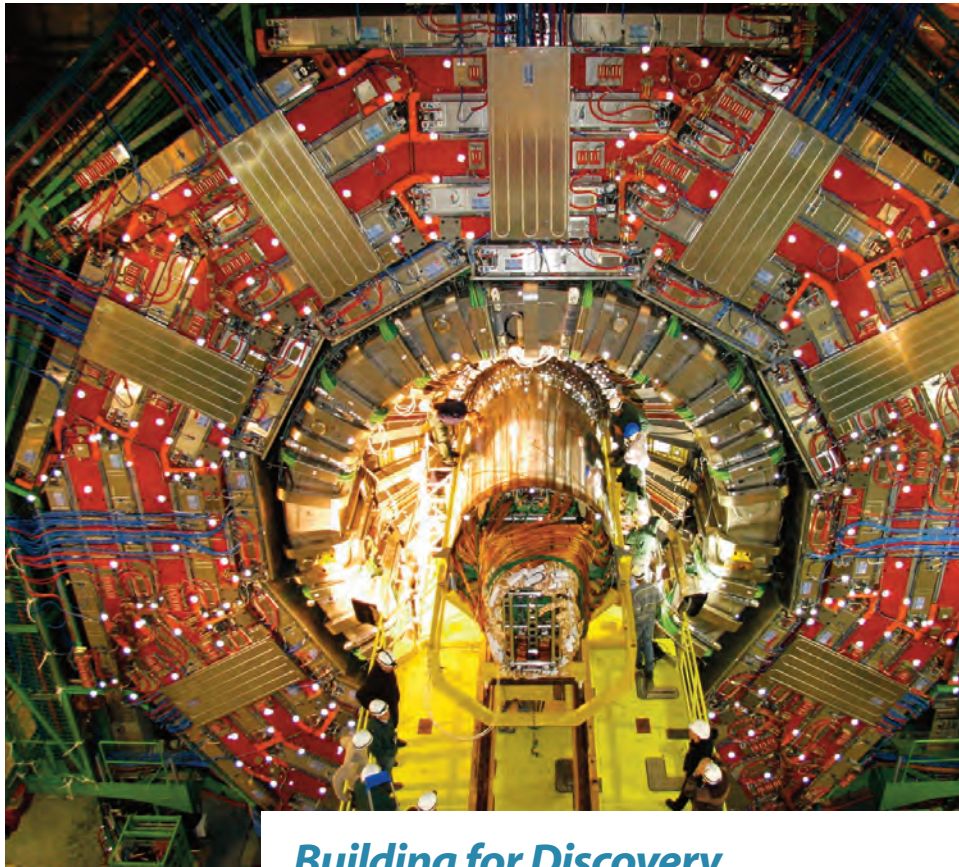


*Particle accelerators improve medical implants and devices*





ATLAS detector at CERN (above); CMS detector at CERN (below).



NOvA neutrino experiment



Construction of the Mu2e detector



Developing the LZ dark matter detector

Images courtesy CERN, Fermilab, LSST, SLAC

## Building for Discovery

**The United States has entered a new era of discovery.** The U.S. particle physics community is implementing its vision for the future, based on five intertwined science drivers that show great promise for discovery:

- ▶ Use the Higgs boson as a new tool for discovery
- ▶ Pursue the physics associated with neutrino mass
- ▶ Identify the new physics of dark matter
- ▶ Understand cosmic acceleration: dark energy and inflation
- ▶ Explore the unknown: new particles, interactions, and physical principles

The report of the Particle Physics Project Prioritization Panel (P5) provides the long-term strategy and identifies the priorities for U.S. investments in particle physics that will enable discovery and maintain the U.S. position as a global leader.

**Find all the details at**  
[usparticlephysics.org](https://usparticlephysics.org)