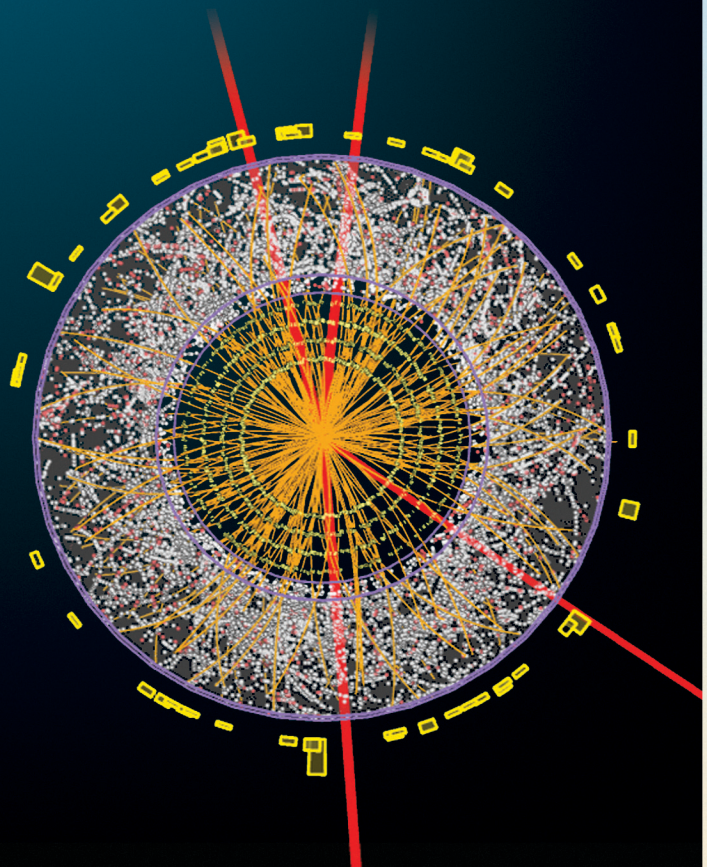
July 4, 2012: Discovery!

October 8, 2013: Nobel Prize!

Groups from across the United States played critical roles in the design and construction of the experiments and the teasing out of the Higgs Boson from the data.

The Higgs Boson was the single missing piece in the 40-year-old Standard Model of Particle Physics. Its confirmation reveals it to be a real particle with mysterious properties.



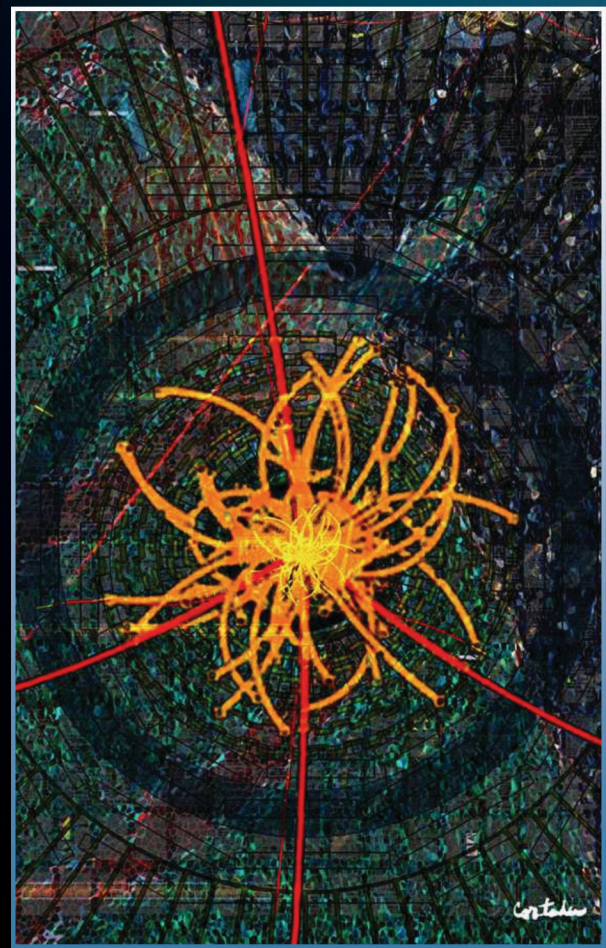
WHO found the Higgs Boson?

In the US, 1500 faculty, scientists, and students from 90 universities and labs:

• University of Alabama • Argonne National Laboratory • University of Arizona • Baylor University • Boston University • Brandeis University • Brookhaven National Laboratory • Brown University • University of California, Berkeley • University of California, Davis • University of California, Irvine • University of California, Los Angeles • University of California, Riverside • University of California, San Diego • University of California, Santa Barbara • University of California, Santa Cruz • California Institute of Technology • California State University, Fresno • Carnegie Mellon University • University of Chicago • University of Colorado • Columbia University • Cornell University • Duke University • Fairfield University • Fermi National Accelerator Laboratory • University of Florida • Florida Institute of Technology • Florida International University • Florida State University • Hampton University • Harvard University • University of Illinois at Chicago • University of Illinois at Urbana-Champaign • Indiana University • University of Iowa • Iowa State University • Johns Hopkins University • University of Kansas • Kansas State University • Lawrence Berkeley National Laboratory • Lawrence Livermore National Laboratory • Louisiana Tech University • University of Maryland • University of Massachusetts, Amherst • Massachusetts Institute of Technology • University of Michigan • Michigan State University • University of Minnesota • University of Mississippi • University of Nebraska-Lincoln • University of New Mexico • State University of New York at Albany • State University of New York at Buffalo • State University of New York at Stony Brook • New York University • Northeastern University • Northern Illinois University • Northwestern University • University of Notre Dame • Ohio State University • University of Oklahoma • Oklahoma State University • University of Oregon • University of Pennsylvania • University of Pittsburgh • Princeton University • University of Puerto Rico • Purdue University • Purdue University Calumet • Rice University • University of Rochester • Rockefeller University • Rutgers University • SLAC National Accelerator Laboratory • University of South Carolina • Southern Methodist University • University of Tennessee • Texas A&M University • University of Texas at Arlington • University of Texas at Austin • University of Texas at Dallas • Texas Tech University • Tufts University • Vanderbilt University • University of Virginia • University of Washington • Wayne State University • University of Wisconsin-Madison • Yale University

THE HIGGS BOSON

and Particle Physics in the United States



To understand our universe

particle physics addresses two basic questions: What are the most elementary constituents of nature and what are the forces that cause them to interact? The desire to answer these types of questions is a defining characteristic of the human spirit.

Vigorous, coordinated experimentation over past decades have led to significant insights in our understanding of the universe and the properties of neutrinos and other elementary particles. The discovery of the Higgs Boson in 2012 completes the picture of the particle world called the Standard Model – a remarkable achievement.

While triumphant, the Standard Model is not the whole story, and the Higgs Boson's properties are unlike those of any other particle. We need to venture beyond the Standard Model and fully understand this new particle. For that, we need to fully exploit the Large Hadron Collider and plan for the next steps beyond it. These efforts will consume particle physicists into the 2030s as the LHC digs deeper and deeper into the tiniest reaches of space and time.

The U.S. brings the crucial leadership, design talent, technology, practical knowledge, and resources that are essential for progress regardless of where any experiment is located. Just as the Higgs Boson was discovered through world-wide collaboration, future work will also be an international enterprise with the US continuing to be the largest single contributing nation. Since the 1960s hundreds of experiments performed around the world by thousands of physicists from every continent brought us to this point, and now we plan for the future.

What's next
in the Higgs Boson story?

- There has never been a particle like the Higgs particle! Its properties are so strange that physicists suspect that it's a part of a bigger family of yet to be discovered particles, or perhaps made up of even smaller entities. We will address this question at the Large Hadron Collider and at future accelerators.
- The remarkably precise mathematical tools used for decades in particle physics insist that the Higgs Boson mass should be much higher than nature tells us. That could be a clue that new discoveries await us as we further investigate its interactions with "regular" matter. We will explore this at the LHC and future accelerators.
- Why is the universe made of matter, when collisions of particles in laboratories and in cosmic rays produce equal amounts of both matter and antimatter? Something must have happened just after the big bang to cause the antimatter to disappear, leaving behind the tiny fraction of matter that became us! Many theories have been proposed that are beyond the Standard Model and could account for this antimatter disappearing act, and testing their consequences is a major research program at the LHC and neutrino experiments at Fermilab.
- We don't understand what keeps galaxies together: they spin so fast that their outer edges should be thrown off into space like slipping from the edge of a merry-go-round. "Dark Matter" that doesn't shine like stars holds them together. We might produce Dark Matter at the Large Hadron Collider or find left-over bits from the big bang in experiments underground or in orbit!

Enabling the passion of scientific discovery produces many technological applications that improve human well-being in practical ways. So supporting the enterprise of basic scientific research is an investment, since it helps drive technical innovation in instrumentation, computing, and accelerators. Out of necessity, particle physics constantly trains new generations of scientists and engineers to take those technology leaps: new products result and highly trained scientists join our workforce.

Particle physics inspires the young and the old and opens the wonders of the cosmos to us all. It builds enduring partnerships that transcend national borders. With the 2013 Nobel Prize, the *idea* of the Higgs Boson that became the *reality* of the Higgs Boson is now enshrined in the history of science. We celebrate this unprecedented triumph of theory *plus* experiment *plus* international collaboration – and then we get back to work in order to go beyond the Standard Model.