Building for Discovery

Strategic Plan for
U.S. Particle Physics
in the Global Context

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The P5 Report provides the strategy and priorities for U.S. investments in particle physics for the coming decade.

The top four priorities in 2017

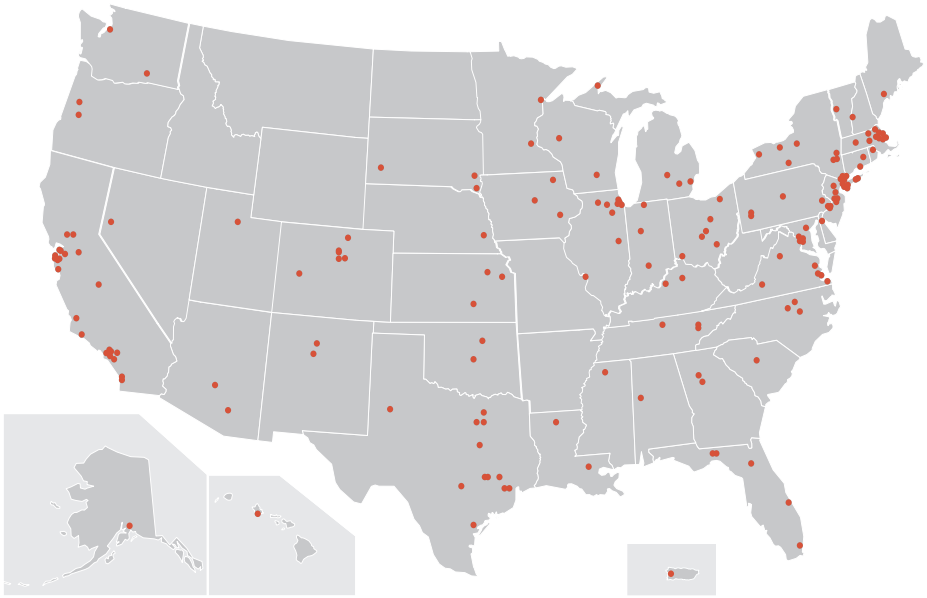
Advance the High-Luminosity LHC (HL-LHC) accelerator and detector upgrade projects on schedule, continuing the highly successful bilateral partnership with Europe. This is P5's highest-priority near-term large project.

Advance the Long-Baseline Neutrino Facility (LBNF) and Deep Underground Neutrino Experiment (DUNE), working with international partners to move forward with the engineering design, construction site preparation, and long-lead procurements. This is P5's highest-priority large project in its time frame.

Support the existing construction projects enabling the next major discoveries in particle physics, including the ATLAS and CMS upgrades, LSST, DESI, Mu2e, Muon g-2, LHCb, LZ, ADMX-G2, and SuperCDMS-SNOLAB.

Balance scientific research with facility operations and the carefully selected portfolio of small, medium, and large projects that together facilitate the success of the community's strategic vision.

These carefully chosen investments will enable a steady stream of exciting new results for many years to come and will maintain U.S. leadership in key areas.



Particle physics is both global and local
Scientists, engineers, and technicians at more than 160 universities, institutes, and laboratories throughout the U.S. are working in partnership with their international colleagues to build high-tech tools and components, conduct scientific research, and train and educate the next generation of innovators. Particle physics activities in the U.S. attract some of the best scientists from around the world.

Recent results

Higgs boson exploration. The LHC outperformed expectations, generating as many particle collisions in 2016 as in all previous years combined and at almost double the energy. On average, about one new Higgs boson was produced per second. At this rate, the LHC will have enormous discovery potential for many years to come.

Promising neutrino results. New measurements by the NOνA experiment started addressing key questions about neutrinos, such as the arrangement of their masses and how much they mix, and the MicroBooNE experiment provided important experience with the technology for DUNE.

Dark matter. The world's best constraints on the identity of the mysterious dark matter were obtained by the LUX experiment.

Accelerator advances. There were several important developments, including operating the world's highest power beams for neutrino physics; constructing a successful prototype of the strongest accelerator magnet ever built, for use in the future High-Luminosity LHC (HL-LHC); accelerating positrons by plasma wake fields; and demonstrating multi-stage acceleration in laser-driven plasmas.

New configurations of matter. The LHCb experiment discovered new states that cannot be explained as ordinary two- or three-quark matter but instead must be made of four quarks.

Program advances in 2016

Building upon the historic bilateral U.S.-CERN agreement, signed in 2015, U.S. scientists continued their highly successful collaboration at the LHC and worked with CERN to advance the international neutrino program hosted at Fermilab.

The community moved rapidly toward a new era of neutrino physics. Development of the Long-Baseline Neutrino Facility (LBNF) and the Deep Underground Neutrino Experiment (DUNE) became truly international, providing a worldwide focus of scientific research hosted at Fermilab. A coordinated set of short-baseline neutrino experiments designed to answer perplexing questions raised by earlier experiments is proceeding.

Next-generation dark matter and dark energy experiments progressed. The selected dark matter experiments SuperCDMS-SNOLAB, LZ, and ADMX-G2 continued toward construction. The Dark Energy Spectroscopic Instrument (DESI) and the Large Synoptic Survey Telescope (LSST) construction projects continued on schedule.

Community efforts are underway to develop the next-generation cosmic microwave background facility, CMB-S4, which will probe in unique ways the physics of the very early Universe at energies far higher than can be achieved in earthbound accelerators and will also reveal neutrino properties.

Looking forward

All eyes are on the LHC as it continues higher-energy searches for new physics.

Eagerly anticipated new data from operating experiments will advance the understanding of the intertwined Science Drivers.

Japan is considering hosting the International Linear Collider (ILC), which would provide new opportunities for discovery beyond the LHC.

The vibrant U.S. particle theory community will continue to play key roles interpreting results from current experiments, motivating future experiments, and pursuing the deepest questions about the foundations of particle physics.