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 2018

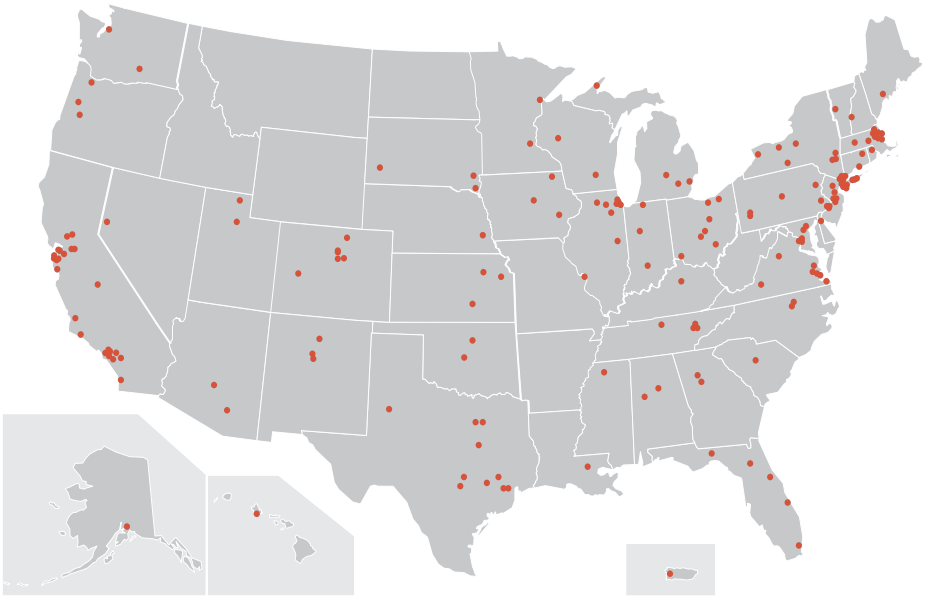
Advance the High-Luminosity LHC (HL-LHC) accelerator and ATLAS and CMS detector upgrade projects on schedule, continuing the successful bilateral partnership with Europe. This is P5's highest-priority near-term large project.

Advance the Long-Baseline Neutrino Facility (LBNF), Deep Underground Neutrino Experiment (DUNE), and Proton Improvement Plan II (PIP-II), working with international partners on the design, prototypes, initial site construction, 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 LSST, DESI, Mu2e, LHCb, LZ, 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. The P5 Report provides the strategy and priorities for U.S. investments in particle physics for the coming decade.

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

The LHC experiments reported many exciting results, including evidence of **Higgs boson** interactions with additional known particles, an important and challenging milestone in the program to use the Higgs as a new tool for discovery.

New constraints on the characteristics of the mysterious **dark matter** were obtained by the IceCube, LUX, SuperCDMS, ADMX, and XENON1T experiments.

The **Dark Energy** Survey (DES) published measurements of cosmological parameters using its first year of data. The precision of these results demonstrates that DES is now pushing into new territory, showing great promise for its full five-year data set.

Observatories that were **made possible by particle physics research**, including the Fermi Gamma-ray Space Telescope (FGST), provided essential information about the LIGO/Virgo gravitational wave event in August 2017.

Program advances in 2017

Building upon the historic 2015 bilateral U.S.-CERN agreements, U.S. and CERN scientists successfully continued their cooperative partnership at the LHC and the international neutrino program hosted by Fermilab. Addenda signed in May 2017 provide the framework for investments by the United States and CERN in each other's programs.

The community continues to move 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. For example, the UK recently committed to large contributions to LBNF/DUNE and to the PIP-II accelerator at Fermilab.

The Muon g-2 experiment construction was completed successfully, and its first physics run is now underway.

Fermilab achieved record proton beam power, enabling the MicroBooNE experiment to produce its first results, and delivered the first antineutrino beam to the NOvA experiment. In addition, the ICARUS neutrino detector was moved successfully from CERN to Fermilab for its short-baseline neutrino program.

Next-generation dark matter and dark energy experiments progressed. The selected dark matter experiments SuperCDMS-SNOLAB and LZ continued toward construction, and a recent community white paper highlighted the importance of complementary small-scale dark matter experiments. 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 its sensitivity to new physics will continue to improve for many years to come.

Eagerly anticipated new data from operating experiments will advance the understanding of the intertwined Science Drivers identified in the P5 Report.

Japan is considering hosting the International Linear Collider (ILC), which would provide new opportunities for discovery beyond the LHC. A Higgs Factory configuration of the ILC was recently endorsed by the Japan Association of High Energy Physicists and by the International Committee for Future Accelerators.

The vibrant U.S. particle physics 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.

Particle physicists are exploring Quantum Information Science (QIS) techniques for solving problems in theory, data analysis, sensors, and simulation, which in turn will help advance QIS and other areas of science and technology.