



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

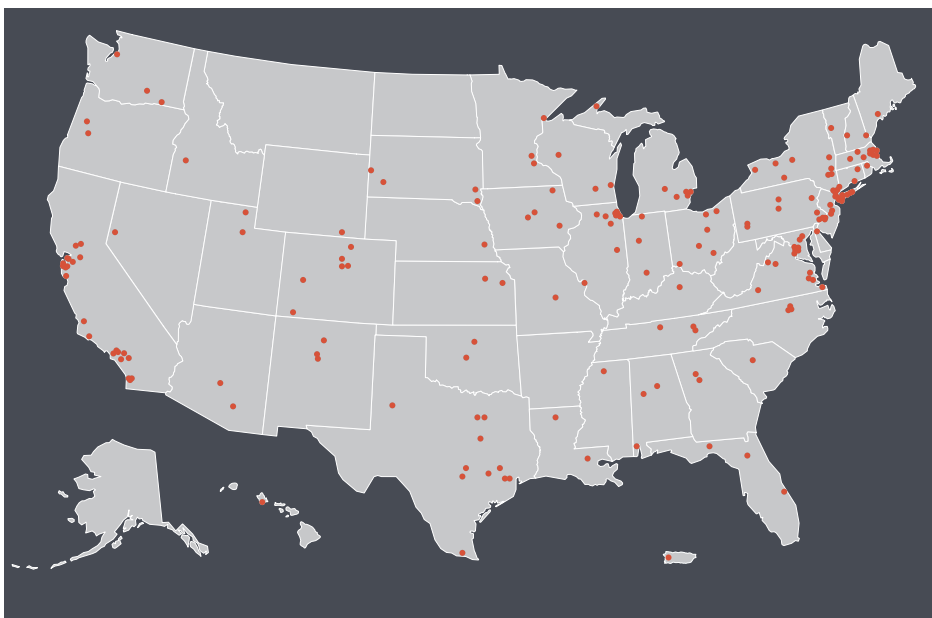
### The top three priorities in 2022

**Strengthen support for particle physics research at universities and national laboratories**, which includes data analysis, R&D, design of new experiments, and a vibrant theory program. As emphasized in the P5 Report, these activities are essential for the success of the field. They are crucial for extracting scientific knowledge from all the great new data, developing new methods and ideas, maintaining U.S. leadership, and training the next generation of scientists and innovators.

**Advance the High-Luminosity Large Hadron Collider (HL-LHC)** accelerator and ATLAS and CMS detector upgrade projects on schedule, continuing the highly successful LHC program and bilateral partnership with CERN.

**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.

**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 180 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. Valuing equity, diversity, and inclusion, the field is committed to increasing participation of underrepresented groups. Particle physics activities in the U.S. attract some of the best scientists from around the world.

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# The P5 strategy has been very successful. Even with extraordinary challenges due to COVID-19, there was great progress.

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## Recent results

The **LHC experiments** reported many important and precise results. The remarkably productive ATLAS and CMS experiments have each produced more than 1,000 refereed publications. The advances in precision are represented well by the new measurement of fundamental symmetry properties of **Higgs boson** decays that test the foundations of the underlying theory. The LHCb experiment also published many new results that are sensitive to **new physics**.

The **Muon g-2** fundamental parameter was measured to much greater precision, which represents another success in the program recommended in the P5 report. Remarkably, the value differs significantly from the theoretical prediction, pointing the way to more scientific progress.

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## Program advances in 2021

**Building upon the historic 2015 and 2017 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. So far, government-to-government agreements with 10 countries have been signed for LBNF/DUNE, PIP-II, and the Short Baseline Neutrino program at Fermilab, with more in progress.

The **Vera C. Rubin/LSST Camera** successfully passed its CD-4 construction completion milestone. The **Dark Energy Spectroscopic Instrument (DESI)**, the world's premiere multi-object spectrometer,

Using the high-temperature superconductor, YBCO, researchers at **Fermilab set a new record for a fast-cycling accelerator magnet**.

The **Dark Energy Survey (DES)** announced many results using data from its first three years of operation.

**Theoretical physicists** have discovered new connections between particle production at **colliders** and fundamental concepts in **quantum field theory**, offering new, more incisive tests. They have also discovered new ways to search for candidate **dark matter** particles.

Intriguing first results from the **MicroBooNE** neutrino experiment, which is a proof-of-principle application of liquid argon for neutrino detectors, tested hypotheses about anomalies from previous neutrino experiments.

began its 5-year survey in May 2021, enabling major advances in the study of the nature of **dark energy** using methods complementary to those of Rubin Observatory's upcoming imaging survey.

**The next-generation cosmic microwave background facility, CMB-S4**, was ranked highly in the NAS Decadal Survey of Astronomy & Astrophysics, opening the path for a partnership in this interdisciplinary science that was also a priority in the P5 report. CMB measurements uniquely probe **physics of the inflationary era in the early Universe** at energies well beyond those of earth-bound accelerators and can also reveal **neutrino properties**.

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## Looking forward

**All eyes are on the LHC**, as its sensitivity to new physics will continue to improve through vastly greater data volumes and new deep-learning data analysis methods. The experiments will extend their discovery reach and probe the Higgs boson's properties with ever greater precision for many years to come. Despite COVID and funding constraints, the HL-LHC upgrade projects are progressing.

**Eagerly anticipated new data** from operating experiments will advance the understanding of the intertwined Science Drivers identified in the P5 Report. At the LHC, the accelerator is on track to resume operations this spring for data-taking by the successfully upgraded experiments.

**Particle physicists are expanding efforts to develop and apply artificial intelligence (AI)** techniques to the operation of accelerators and experiments, data analysis, and simulations, opening new avenues for scientific discovery.

**Theoretical and experimental particle physicists are advancing Quantum Information Science (QIS)**, providing solutions to problems in computation, data analysis, sensors, and simulations.

**The particle physics theory community** will continue to play key roles in interpreting results from current experiments, motivating future experiments, and pursuing answers to the deepest questions.

**Looking beyond the current P5 horizon**, and guided by new results, the U.S. is currently engaged in the Snowmass community planning process, in which opportunities in all areas of the field are discussed in depth. To inform choices, the U.S. is also working with partners worldwide on the development of concepts for facilities that could be hosted in the U.S. and abroad.

**U.S. researchers are pursuing R&D on advanced technologies** to enable future generations of accelerators and detectors with a wide variety of applications in science, medicine, and industry.



# Building for Discovery

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

[usparticlephysics.org](https://usparticlephysics.org)