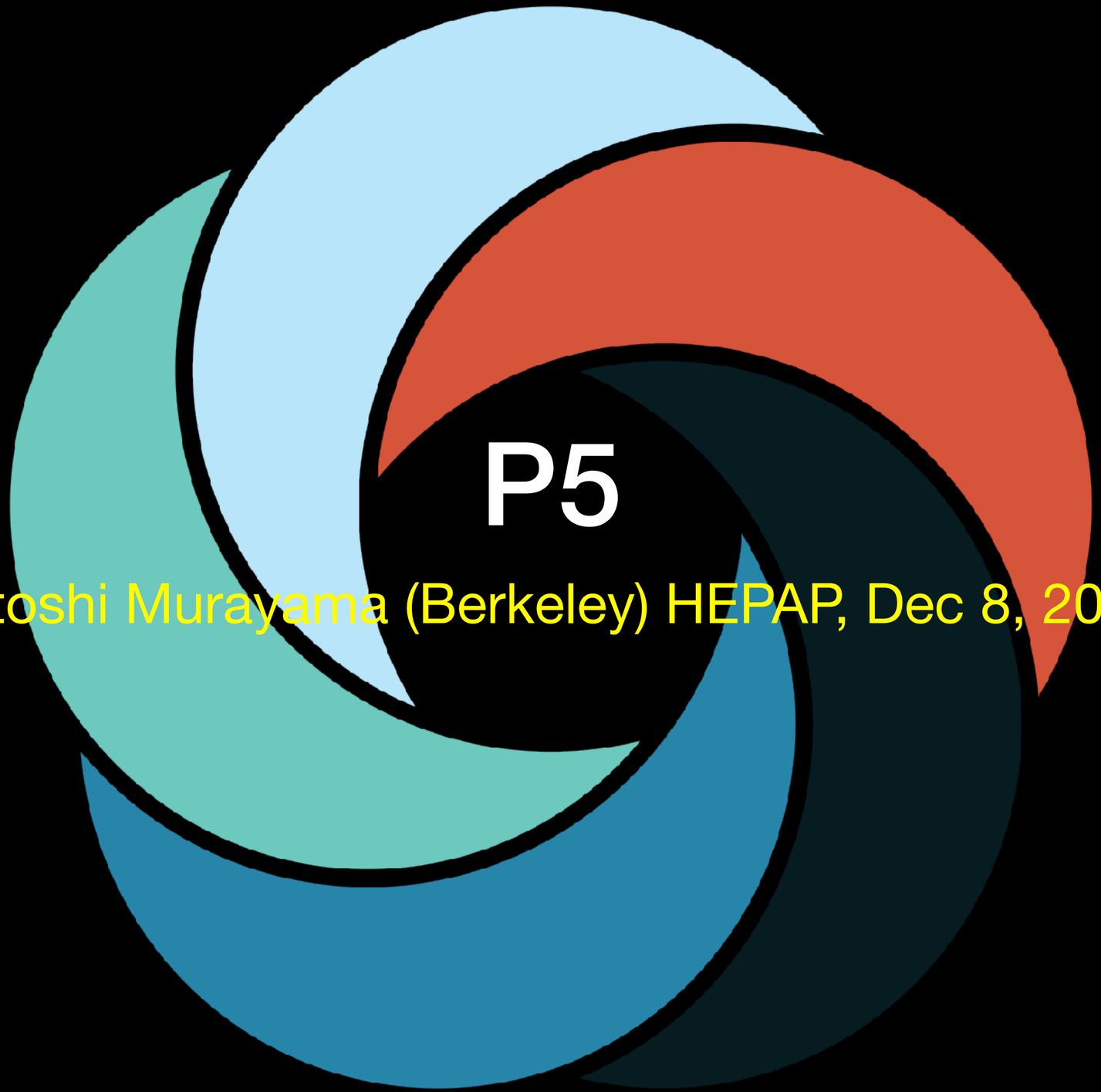
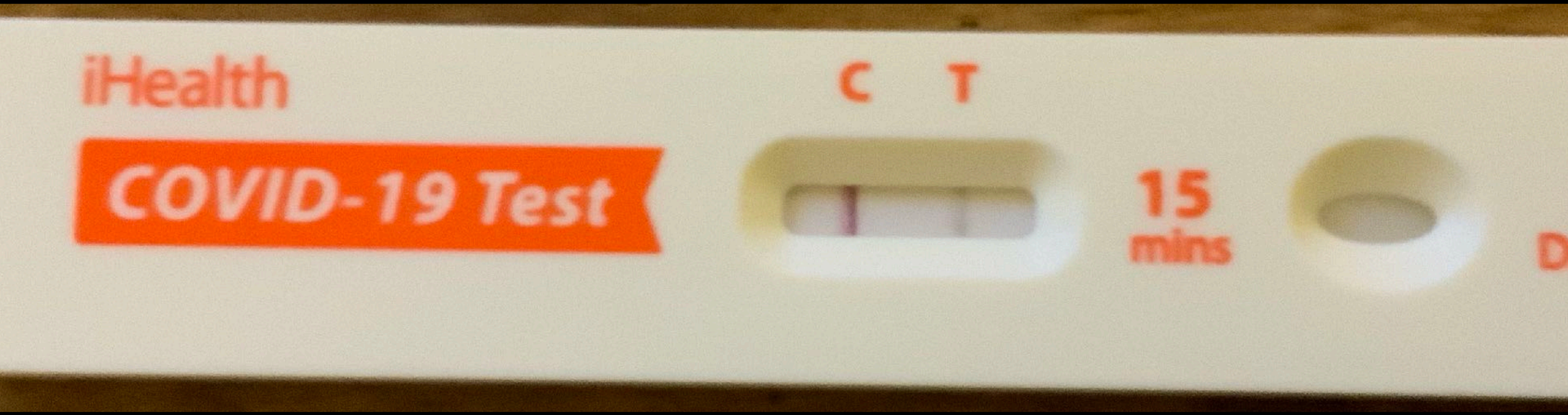


P5

Hitoshi Murayama (Berkeley) HEPAP, Dec 8, 2022

Apologies

- Got COVID last week
- Still positive but no symptoms now

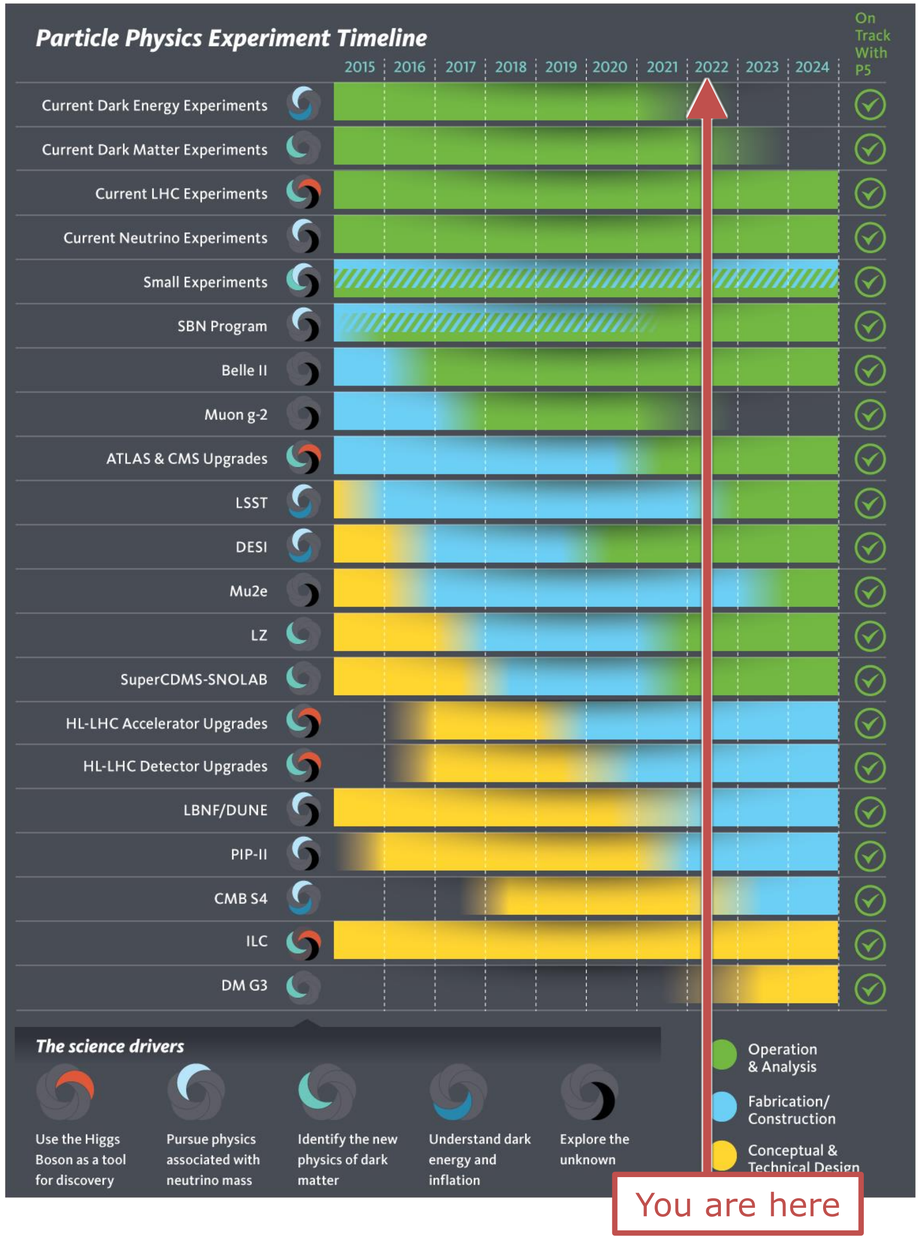


Key Elements of a Successful P5

- Well informed by the science community
- Set a grand long-range vision for U.S. particle physics
- Faced budget constraints realistically
  - "Community made tough choices."
- Balanced portfolio
  - Domestic and international
  - Small, mid-scale, and large projects
- Community engagement critical to success
  - "Bickering scientists get nothing."

Harriet Kung, Snowmass in Seattle

P5 Implementation Status



Successful implementation of the 2014 P5 strategy continues

Continuous physics analyses and output throughout the "P5 envisioned" 10-year plan

Even with extraordinary challenges due to COVID-19, there was great progress!

- **Projects fully funded or ongoing as of FY 2022:**
  - **Initial Phase-1 LHC detector upgrades: ATLAS and CMS**
  - **Mu2e**
  - **SuperCDMS at SNOLAB (DM-G2)**
- HL-LHC accelerator and detector upgrade projects underway
- LBNF/DUNE & PIP-II schedules advanced due to strong support by the U.S. Administration & Congress; Muon g-2 is operating
- DESI, LZ and LSSTCam (for Rubin Observatory) projects completed; CMB-S4 in concept planning
- Broad portfolio of small projects running

Considerations for Next P5

- Grand, long-term, and global vision for U.S. particle physics
- Realistic budget scenarios
- Balanced portfolio of small/mid-scale/large projects
- Must consider a holistic view of program
  - Project costs
  - Operations costs
  - Research program to deliver the science
  - Technology R&D for the future
- Community engagement, including this week's Snowmass study process, remains critical to success

Harriet Kung, Snowmass in Seattle

Hitoshi Murayama

Put Captions Here

Illustration by Sandbox Studio, Chicago with Corinne Mucha

Hitoshi Murayama brings people together

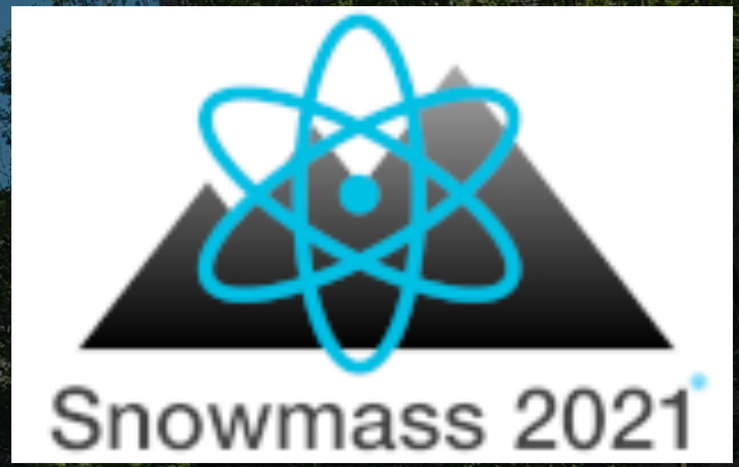
04/19/22 | By Kimberly Hickok

Building international research communities is a cornerstone of Murayama's physics career.

- MacAdams Professor of Physics at the University of California, Berkeley
- Faculty Senior Staff at Lawrence Berkeley National Lab
- University Professor, Kavli Institute for the Physics and Mathematics of the Universe, University of Tokyo
  - Member, American Academy of Arts and Sciences
  - Fellow, American Association for the Advancement of Science
  - Fellow, American Physical Society
  - Humboldt Research Prize
  - Breakthrough Prize (KamLAND)
  - Yukawa Commemoration Prize
  - Sloan Research Fellowship
  - Served on SLAC Policy Committee, HEPAP & subpanels, Fermilab Physics Advisory Committee, CERN Scientific Policy Committee, CEPC/SppC International Advisory Committee

My take away from Snowmass

- We have an exciting program lined up
  - Thanks to Steve Ritz, previous P5, agencies!
- We are broader than energy, intensity, cosmic
- We are a forward-looking community
  - We need program beyond what the previous P5 outlined
  - We also need more freedom
  - better balance big, medium, small, projects vs research
- We deeply care about our community
  - Diversity, equity, inclusion, outreach, engagement
- Visited both DOE & NSF in early September
  - I'm still scared of the tasks ahead.
  - Reading Snowmass reports!

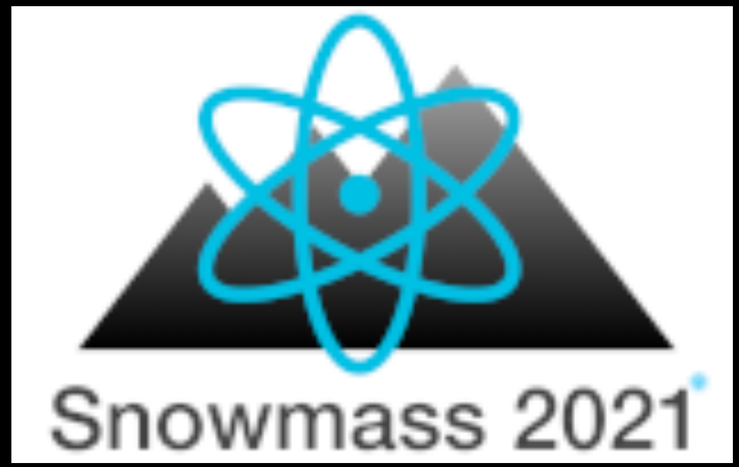


Last P5 science drivers

- 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.
- Still very much true

Changing landscape

- 125 GeV Higgs does look like standard model
  - Previous P5: “Higgs as a new tool for discovery”
- Recognition that dark matter parameter space is *big*
  - Growing in interest in low-energy weakly coupled sector
- ΛCDM + inflation is the new Standard Model
  - But H_0, σ_8 tension
  - Inflation vs swampland?
- DUNE moving ahead
  - Now Hyper-Kamiokande is also happening
- Lattice vs g-2?
- Interesting anomalies
- Gravitational wave! High-energy neutrinos!
- Now 10 frontiers (+costing frontier?)
- Quantum, AI/ML, new instrumentation, computing
- Field is more global than ever



Gina Rameika named the new associate director for high-energy physics at DOE

November 3, 2022 | edited by Lisa Roberts

In her new role with the DOE's Office of Science, Gina Rameika will oversee all high-energy physics research activities in the United States. Photo: Gina Rameika.

The U.S. Department of Energy's Office of Science recently announced that Regina "Gina" Rameika has accepted the role of associate director for its Office of High Energy Physics. In her new role, Rameika will oversee all high-energy physics research activities in the United States at both national laboratories as well as universities. She joins the DOE Office of Science on Nov. 7.

"Gina has demonstrated tremendous leadership in the national laboratory environment with DOE projects and with international science collaborations," said Asmeret Asefaw Berhe, director of the Office of Science. "We are thrilled to have Gina join the Office of Science, given her vast experience and skilled leadership."

Rameika hails from the DOE's Fermi National Accelerator Laboratory where, as a distinguished scientist, she spent much of her career in neutrino science and experimental particle physics. Her responsibilities have ranged from managing particle detector construction projects to leading the Deep Underground Neutrino Experiment, the international science collaboration that plans to carry out the world-leading experiment currently under construction as part of the DOE Long-Baseline Neutrino Facility/DUNE-US Project.

Some of her roles at Fermilab included serving as project manager for the Long-Baseline Neutrino Experiment and for the MicroBooNE Project, as well as the head of Fermilab's Neutrino Division. She was also an elected spokesperson of the 1,400-member international DUNE collaboration, in addition to serving as the DUNE resource coordinator and construction coordinator.

"I'm excited to step into this new position," said Rameika. "I will always value my time at Fermilab and truly appreciate having worked hands-on with the international DUNE collaboration. I believe that serving as the associate director of HEP, I can bring these experiences and lessons learned to help increase and advance physics research in the U.S."

Rameika has a bachelor's degree and doctorate in physics from Rutgers University in New Brunswick, New Jersey. She has also received multiple awards, including most recently, the 2022 APS Panofsky Prize for contributions to the DONUT Experiment and a 2019 Fermilab Trailblazer Award for contributions to the Long-Baseline Neutrino program.

Fermi National Accelerator Laboratory is supported by the Office of Science of the U.S. Department of Energy. The Office of Science is the single largest supporter of basic research in the physical sciences in the United States and is working to address some of the most pressing challenges of our time. For more information, please visit science.energy.gov.

Tagged: DOE, DUNE, high-energy physics, Office of Science, people

P5 Charge (dated November 2, 2022)  1/8

Dear Dr. Hewett:

The 2014 report of the Particle Physics Project Prioritization Panel (P5), developed under the auspices of the High Energy Physics Advisory Panel (HEPAP), successfully laid out a compelling scientific program that recommended world-leading facilities with exciting new capabilities, as well as a robust scientific research program. That report was well received by the community, the U.S. Department of Energy (DOE) and the National Science Foundation (NSF), and Congress as a well-thought-out and strategic plan that could be successfully implemented. HEPAP's 2019 review of the implementation of this plan demonstrated that many of the report's recommendations are being realized, and the community has made excellent progress on the P5 science drivers.

- The 2014 report was successful
- 2019 implementation review by HEPAP showed progress on the plan

As the landscape of high-energy physics continues to evolve and the decadal timeframe addressed in the 2014 P5 report nears its end, we believe it is timely to initiate the next long-range planning guidance to the DOE and NSF. To that end, we ask that you constitute a new P5 panel to develop an updated strategic plan for U.S. high-energy physics that can be executed over a 10-year timeframe in the context of a 20-year, globally aware strategy for the field.

- 2023 P5 to update strategic plan over 10-yr timeframe in 20-yr context

P5 Charge  2/8

A critical element of this charge is to assess the continued importance of the science drivers identified by the 2014 P5 report and, if necessary, to identify new science drivers that have the potential to enable compelling new avenues of pursuit for particle physics. Specifically, we request that HEPAP 1) evaluate ongoing projects and identify potential new projects to address these science drivers; 2) make the science case for new facilities and capabilities that will advance the field and enhance U.S. leadership and global partnership roles; and 3) recommend a program portfolio that the agencies should pursue in this timeframe, along with any other strategic actions needed to ensure the broad success of the program in the coming decades.

In developing the plan, we would like the panel to take into consideration several particularly relevant aspects of constructing a compelling and well-balanced portfolio:

- Re-evaluate the 2014 science drivers
- Evaluate ongoing projects
- Identify new projects
- Make science case for new facilities and capabilities
- Recommend program portfolio

P5 Charge  3/8

- A core tenet of the 2014 P5 Report is that particle physics is fundamentally a global enterprise. Thus far, the U.S. program has achieved high impact through U.S. researchers participating in the programs at world-class facilities outside the U.S. and international researchers working at world-class U.S. facilities. The recommendations developed for this report should carefully consider the current and future international landscape for particle physics. The panel's report should include an explicit discussion of the choices made in this context, including the extent to which it is necessary to construct, maintain, and/or upgrade leading U.S.hosted high-energy physics facilities so that our leadership position in the global scientific arena continues, while at the same time preserving the essential roles of, and contributions by, the National Laboratories and universities to global collaboration on large-scale initiatives.

- Remember HEP is a global field
- Support decisions to retain US leadership as a global parter
- Preserve essential roles of Universities and National Labs

- A number of the projects recommended by the 2014 P5 report are still being built, and the agencies take their commitments to complete them very seriously. Understanding the continued strength of the science case for these projects is quite valuable, and the panel should provide its assessment of these projects in this context.

- Assess science case for on-going projects

P5 Charge  4/8

- A successful plan should maintain a balance of large, medium, and small projects that can deliver scientific results throughout the decadal timeframe. We do not expect the panel to consider the large number of possible small-scale projects individually, but advice on research areas where focused investments in smallscale projects can have a significant impact is welcome.
- There are elements of DOE HEP-operated infrastructure that are a stewardship responsibility for HEP. Investments to maintain that infrastructure in a safe and reliable condition are an HEP responsibility and are outside the scope of the panel. Major infrastructure upgrades that create new science capabilities are within the scope of the charge and should be considered by the panel.
- Successfully exploiting a newly built project requires funding for the commissioning and operation of the project and to support the researchers who will use these new capabilities to do world-leading science. Funding is also needed for research and development (R&D) that develops new technologies for future projects. Scientists and technical personnel working in experimental particle physics often contribute to all these project phases, while theoretical physics provides both the framework to evolve our fundamental understanding of the known universe as well as the innovative concepts that will expand our knowledge into new frontiers. The panel should deliver a research portfolio that will balance all these factors and consider related issues such as training and workforce development.

- Maintain balance of large, medium & small projects
- Advise on science topics to focus small projects

- Assess infrastructure upgrades that create new science capabilities

- Remember costs of R&D, commissioning, and operations for future projects
- Remember that a balanced core research budget is paramount to producing science from current projects and developing ideas for new ones

P5 Charge  5/8

- Both NSF and DOE are deeply committed to diversity, equity, inclusion, and accessibility principles in all the scientific communities they support. Creating a more diverse and inclusive workforce in particle physics will be necessary to implement the plan that this panel recommends, and the panel may further recommend strategic actions that could be taken to address or mitigate barriers to achieving these goals.
- Broad national initiatives relevant to the science and technology of particle physics have been developed by the administration and are being implemented by the funding agencies. These include, but are not limited to, investments in advanced electronics and instrumentation, artificial intelligence and machine learning, and quantum information science. Potential synergies between these initiatives and elements of the recommended portfolio should be considered.

- Remember that a diverse workforce results in improved science
- Address synergies with broad national initiatives

P5 Charge - budget scenarios  6/8

We request that the panel include these considerations in their deliberations and discuss how they affect their recommendations in the report narrative.

The panel's report should identify priorities and make recommendations for an optimized particle physics program over 10 years, FY 2024–FY 2033, under the following budget scenarios:

1) Increases of 2.0 percent per year during fiscal years 2024 to 2033 with the FY 2024 level calculated from the FY 2023 President's Budget Request for HEP.
2) Budget levels for HEP for fiscal years 2023 to 2027 specified in the Creating Helpful Incentives to Produce Semiconductors and Science Act of 2022, followed by increases of 3.0 percent per year from fiscal years 2028 to 2033.

The recommended projects and initiatives should be implementable under reasonable assumptions and be based on generally accepted estimates of science reach and capability. Estimated costs for future projects and facility operations should be given particular scrutiny and may be adjusted if the panel finds it prudent to do so. Given the long timescales for realizing these initiatives, we expect the funding required to enable the priorities the panel identifies may extend well past the 10-year budget profile, but any recommendation should be technically and fiscally plausible to execute in a 20-year timeframe.

- Scenario A: 2% increase per year
- Scenario B: Budgets in Chips and Science Act, followed by 3% increase per year

- Evaluate projected project costs
- Plan should be executable in 20-yr timeframe

P5 Charge  7/8

In addition to articulating the scientific opportunities that can and cannot be pursued in the various scenarios, the panel may provide their opinions on the approximate overall level of support that is needed for core particle physics research and advanced technology R&D programs to be successful in the context of the science goals of the recommended plan.

We expect the "Snowmass" community planning reports and HEPAP's 2022 study on international benchmarking of scientific resources and capabilities will be useful inputs and that the panel will make efforts to maximize community input and participation in the overall process. Coordination and congruence with the National Academies of Sciences, Engineering, and Medicine's recent and ongoing decadal studies in astronomy, astrophysics, and particle physics are also important considerations.

- Evaluate level of core research budget and technology R&D programs

- Include Snowmass report and Benchmarking subpanel report in deliberations
- Strive towards coordination and congruence with EPP2024

P5 Charge 8/8

Finally, effective communication about the excitement, impact, and vitality of particle physics that can be shared with a general audience and other disciplines continues to be critical when advocating the strategic plan. It would be particularly valuable if the panel could re-state the key scientific questions that drive the field so that they are accessible to non-specialists and crisply articulate the value of basic research and the broader benefits of particle physics on other sciences and society.

We would appreciate the panel's preliminary comments by August 2023 and a final report by October 2023. We recognize that this is a challenging task; nevertheless, your assessments will be an essential input to planning at both the DOE and NSF.

Sincerely,

Asmeret Asefaw Berhe
Director, Office of Science
U.S. Department of Energy

Sean L. Jones
Assistant Director
Directorate for Mathematical and Physical Sciences
National Science Foundation

- Effectively communicate the 2023 P5 plan once it's finished

- Preliminary comments in August 2023
- Report due by October 2023

My first tasks

- Form the P5 committee that can respond to the charge
  1. Scientific excellence
  2. Broad representation of the community
  3. Forward-looking, young group
  4. International context
- A highly-nontrivial task
  - Worked with JoAnne, both DOE and NSF

U.S. DEPARTMENT OF ENERGY | Office of Science

NSF

Deputy Chair: Karsten Heeger

Yale University
2002 Ph.D. from UW Seattle
Chair, physics department
Director, Wright Laboratory
Focus on Neutrino experimental science
Served on HEPAP, NSAC, DPF executive committee
APS Committee on International Scientific Affairs
2015 Nuclear Physics Long Range Planning Study
US ATLAS project advisory group
Co-Chair of DPF CPAD (Coordinating Panel of Advanced Detectors)
2003 APS Dissertation Award
DOE Outstanding Junior Investigator award
Sloan Fellowship, Kavli Fellow, APS Fellow
2016 Breakthrough Prize in Fundamental Physics as a member of SNO, KamLAND and Daya Bay

Broad representation

- Snowmass frontiers
  - Energy
  - Neutrino
  - Rare & precision
  - Cosmic
  - Theory
  - Accelerator
  - Instrumentation
  - Computational
  - Underground
  - Community
- Diversity
  - Geography
  - R1, R2, RUI





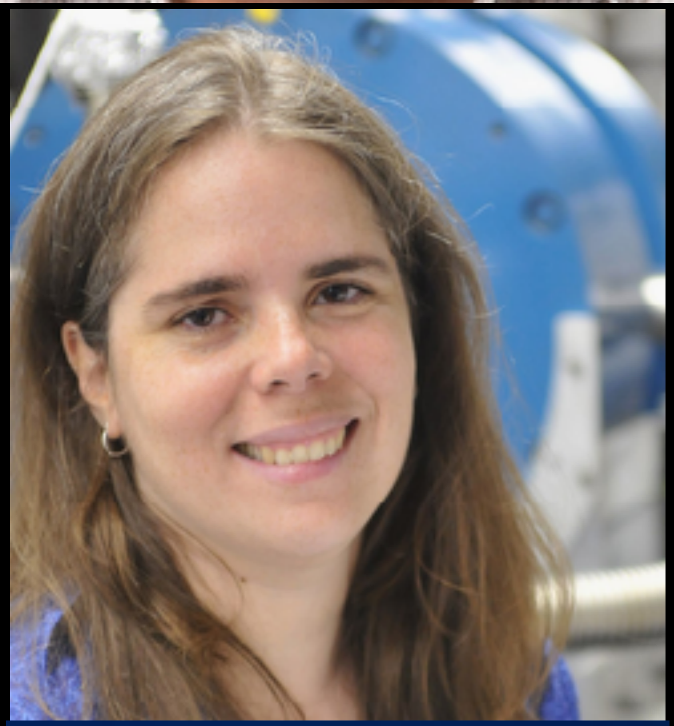














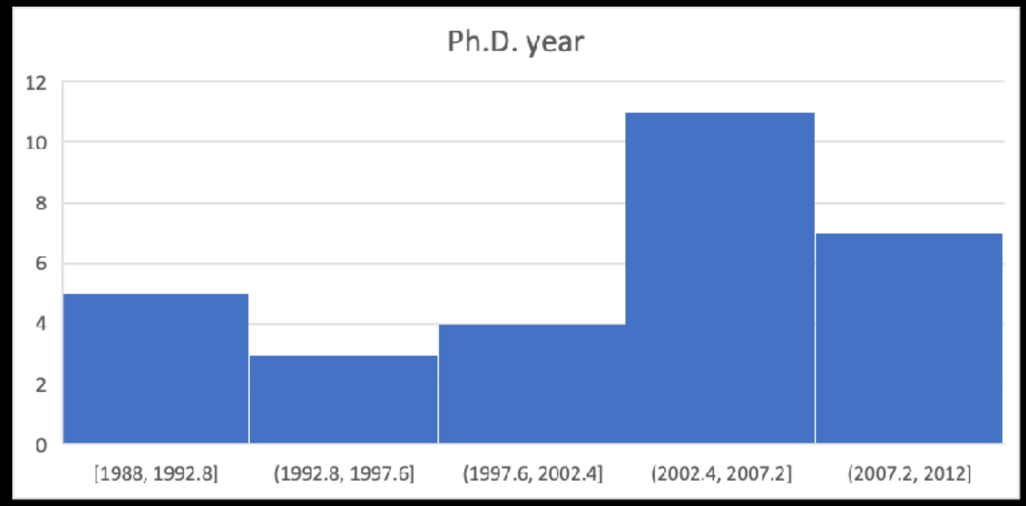

International:



+1

Tulika Bose	Wisconsin
Kyle Cranmer	Wisconsin
Francis-Yan Cyr-Racine	New Mexico
Sarah Demers	Yale
Cameron Geddes	LBNL
Patrick Huber	Virginia Tech
Kendall Mahn	Michigan State
Rachel Mandelbaum	Carnegie Mellon
Jelena Maricic	Hawaii
Petra Merkel	Fermilab
Christopher Monahan	William-Mary Coll.
Meenakshi Narain	Brown
Peter Onyisi	Texas Austin
Mark Palmer	Brookhaven
Tor Raubenheimer	SLAC
Mayly Sanchez	Florida State
Richard Schnee	South Dakota School of Mines and Technology
Jesse Thaler	MIT
Abigail Vieregg	Chicago
Amanda Weinstein	Iowa State
Lindley Winslow	MIT
Tien-Tien Yu	Oregon
Bob Zwaska	Fermilab
Beate Heinemann	DESY
Christos Touramanis	Liverpool
Shoji Asai	Tokyo
Karsten Heeger	Yale
JoAnne Hewett	SLAC
Hitoshi Murayama	UC Berkeley/LBNL

5 EPSCOR states
R2, RUI institutions
14 female, 15 male
7 labs, 21 universities, 1 both
Both DOE & NSF support
Nobody “older” than HM & JLH
Average Ph.D. year 2001



Straw-person schedule

- 4 town halls: LBNL, Brookhaven, SLAC, Fermilab from January to April
- Virtual town halls, especially early career scientists
- 4 in person closed meetings from May to July
  - Make sure to build consensus
- Preliminary version in August
- Final report in October
- Probably need a sub-subpanel for cost and risk evaluations
- Followup with outreach to congress, other fields, public

Finally, the Importance of Positive, Clear, and Actionable Messages

- Snowmass can provide clear questions and viable options. Nothing should be off the table for consideration.
- Realism is important, but so are well-motivated, big aspirations. Snowmass can provide these, too. From the 2014 P5 Report:
  - *As work proceeds worldwide on long-term future-generation accelerator concepts, the U.S. should be counted among the potential host nations.*
  - *We had the responsibility to make the tough choices for a world-class program under each of these scenarios, which we have done. At the same time, we felt the responsibility to aspire to an even bolder future. These are not contradictory responsibilities: an annual budget is a balance sheet, but investment in fundamental research is a powerful expression that our culture and economy have greater potential in the long run. Our society's capacity to grow is limited only by our collective imagination and resolve to make long-term investments that can lead to fundamental, game-changing discoveries, even in the context of constrained budgets.*
- Diversity, Equity, and Inclusion are also areas of necessary attention and different thinking.
- Cutting across "Frontiers" is important
  - Suggest how to think about activities in a given area and how they connect to everything else.
- The evolving international context remains essential.

And then, after P5, it's important to work together for the whole program in a unified manner.

- https://www.usparticlephysics.org
- https://www.usparticlephysics.org/wp-content/uploads/2022/03/Particle-Physics-Progress-and-Priorities-2022.pdf

- Every year, working with DPF, and Users Groups, and others, materials about the whole field are developed and updated for interactions with decision makers in Washington and elsewhere.

Building for Discovery

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

usparticlephysics.org

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

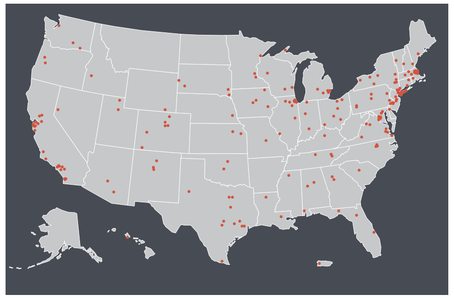
The top three priorities in 2022

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.

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

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.

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.

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, 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**.

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

Interface to EPP2024

- I was on EPP2024 until I was appointed as the P5 chair
- JoAnne and I participated in the recent November meeting
- Invited back again for the December meeting
- Will invite all EPP2024 members to P5 town halls to make sure we get the same inputs from the community
- Will keep informing EPP2024 about our progress and vice versa


Need help from all of you!