

Early Career Award Network Workshop

U.S. High Energy Physics Program HEPAP View



JoAnne Hewett
June 2023

What is HEPAP's role?

Objectives and scope of activities

The High Energy Physics Advisory Panel **provides advice and recommendations** to the Director, Office of Science (DOE), and the Assistant Director, Mathematical & Physical Sciences Directorate (NSF), on the national high energy physics program, which encompasses the conduct of experimental and theoretical high energy physics research, advanced technology R&D, as well as accelerator stewardship R&D and scientific computing.

Panel activities include

- **Periodic reviews of the program** and recommendations of any changes considered desirable on the basis of scientific and technological advances or other factors such as current projected budgets and status of other international high energy physics efforts ([2019 assessment](#))
- **Advice on competing long-range plans, priorities, and strategies** for the national high energy physics program, including relationships of higher energy physics with other fields of science. ([2023 P5 subpanel](#))
- **Advice on recommended appropriate levels of funding** to assure a leadership position and to help maintain appropriate balance among the various elements of the program ([2023 international benchmarking subpanel](#))
- **Advice on any issues relating to the program as requested** by the Director, Office of Science (DOE), and the Assistant Director, Mathematical & Physical Sciences Directorate² (NSF).

U.S. HEP Strategic Planning Process

The U.S. High Energy Physics program is guided by the strategic plan laid out in the 2014 P5 report

Community Driven Strategic Process

- **“Snowmass” 2013:** a year-long community-wide study of science opportunities, organized by the Division of Particles and Fields of the American Physical Society
- **Particle Physics Project Prioritization Panel (P5) 2014:** High Energy Physics Advisory Panel (HEPAP) subpanel, prioritized scientific opportunities outlined in the Snowmass study within a budget framework

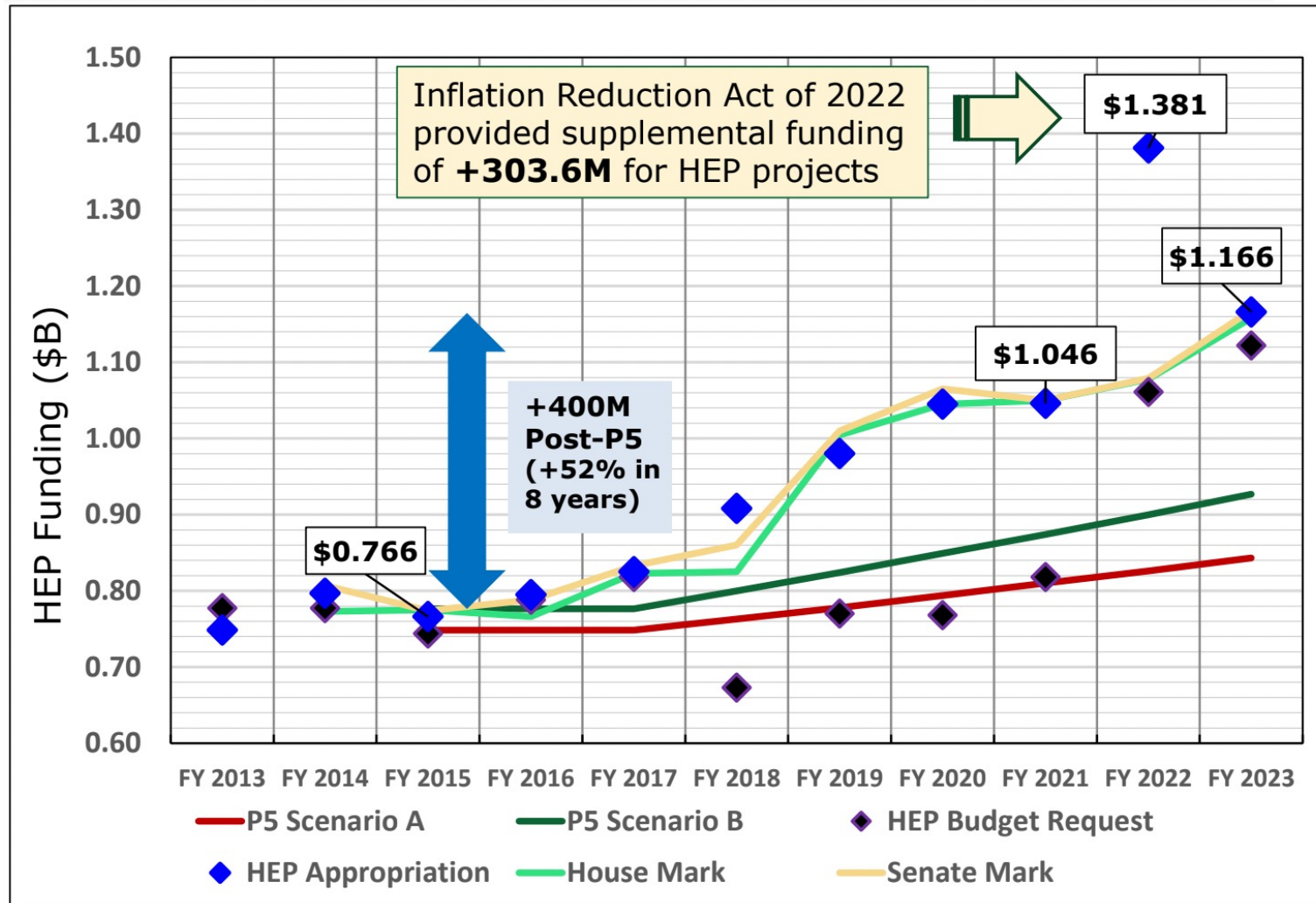
Dovetailed with

- 2010 Astronomy & Astrophysics Decadal Survey
- 2013 European Strategy for Particle Physics

Process defines strategic plan for U.S. HEP for the decade

U.S. Administration and Congress have supported the P5 Plan

52% increase in DOE HEP budget in last 8 years



P5 Plan elements

- Particle Physics is global
- Community made difficult choices
- Increase investment in construction

HEPAP 2019 Assessment on 2014 P5 Plan Progress

Year-long evaluation of progress, halfway into plan's decadal horizon

- Status of the implementation of the P5 vision
- Status of the science drivers in 2019
- Checks and balances in carrying out the plan

Criteria for Evaluation

- Realization of science impact
- Engagement of global partners
- Sustained productivity – science results and construction of projects
- Balance of project scales
- Balance of components: research, operations, & projects

HEPAP Assessment of Progress on 2014 P5 Report

In 2019, halfway through the 10-year strategic plan for U.S. particle physics presented in the 2014 report of the Particle Physics Project Prioritization Panel (P5), the High Energy Physics Advisory Panel (HEPAP) evaluated the plan's implementation. The review concluded that the U.S. Department of Energy (DOE) and National Science Foundation (NSF) have successfully carried out the first five years of the plan, which focused on construction of experimental facilities. Going forward, reviewers said, it will be important to fully support plans for operating those facilities and provide adequate research support to the particle physics community for carrying out the remainder of the plan and achieving its scientific goals.

The 2014 P5 report, "Building for Discovery: Strategic Plan for U.S. Particle Physics in the Global Context," presented a 10-year strategic plan for U.S. High Energy Physics (HEP). The plan emphasized the global nature of particle physics and recommended construction of projects both large and small, including a new international facility in the U.S. to study the nature of neutrinos. These projects would push the field forward by advancing discovery science in five intertwined areas of science that drive progress in the field.

Last year, HEPAP evaluated the implementation of this report to date. The panel heard presentations on the current High Energy Physics science landscape, including developments in each of the P5 science drivers; the status of each project; and how the agencies have been executing the plan.

The assessment concluded that:

- ▶ The five P5 science drivers continue to describe the most urgent questions in our field.
- ▶ The DOE and NSF have closely followed the advice given in the P5 Report and have been successfully executing the plan. All the projects in the plan are

underway, with some projects nearing completion and the rest proceeding in a timely fashion. This suite of projects is expected to yield exciting discovery science for the next decade.

▶ Thanks to generous DOE Office of Science budgets, construction of the Long-Baseline Neutrino Facility and Deep Underground Neutrino Detector is farther along than envisioned by P5. Timely construction of this international facility is critical to achieving our national priorities.

▶ While investments over the past 5 years have focused on project construction, it will be fundamentally important to balance the components of the HEP budget to continue successful execution of the P5 plan. Operations of the newly constructed experiments require full support to reap their scientific goals. The HEP research program also needs strong support to fully execute the plan, throughout the construction, operations, and data analysis phases of the experiments, and to lay a foundation for the future.



JoAnne Hewett
Chair, High Energy Physics Advisory Panel

On behalf of the members of HEPAP:

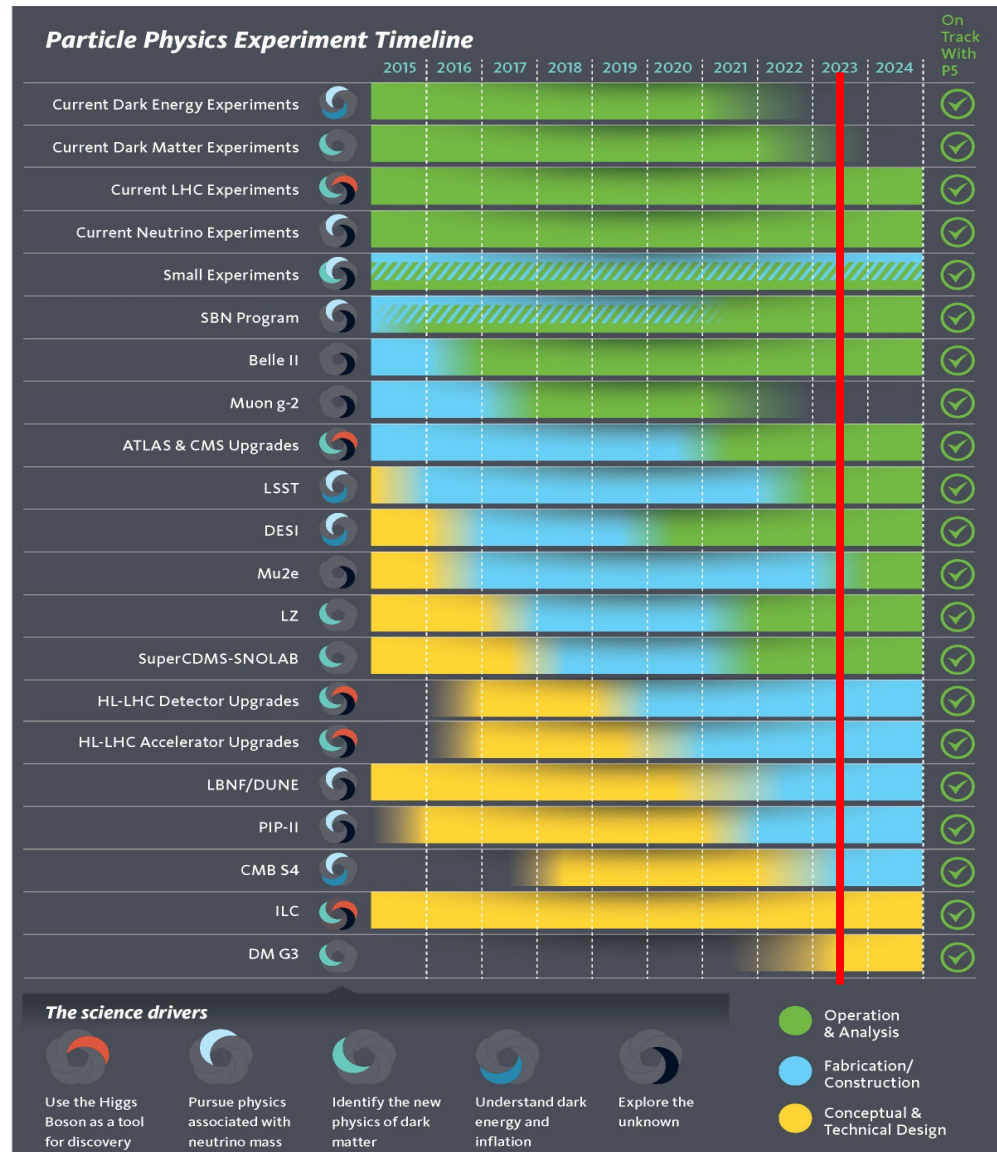
—Timothy Alan Bolton
—Janet Conrad
—Priscilla Cushman
—Rohini Godbole
—Jordan Goodman
—Michael Hildreth
—Kent Irwin
—Donatella Lucchesi
—Alycia Marino
—Meenakshi Narain
—Fulvia Pilat
—Soren Prestemon
—Patrizia Rossi
—Michael Syphers



HEPAP Assessment Conclusions

- Five science drivers continue to describe the most urgent questions in our field
- DOE and NSF have closely followed the advice given in the report and have been successfully executing the plan
- LBNF/DUNE construction is further along than envisioned by P5 thanks to generous DOE Office of Science budgets. Timely construction is critical to achieving our national priorities
- While investments over past 5 yrs have focused on construction, it will be important to balance. The components of the HEP budget to continue successful execution of the plan. Operations of newly constructed experiments require full support to reap their scientific goals and HEP research program needs strong support to fully execute the plan.

P5 Plan in 2023: 9 years in



P5 projects report card:

9 Projects have been completed (and transitioned to commissioning & operations)

- Belle-2, Muon g-2, Phase I ATLAS, Phase I CMS, DESI, LZ, FACET-II, LSSTCamera, sCDMS

5 Projects at CD-2/3 (Baseline/Construction)

- HL-AUP, HL-LHC ATLAS, HL-LHC CMS, Mu2e, PIP-II

1 Projects at CD-1 (preparing for baseline)

- LBNF/DUNE

2 Projects at CD-0

- CMB-S4
- Accelerator Control Operations and Research Network at FNAL

Broad portfolio of small projects from R&D phase to operations

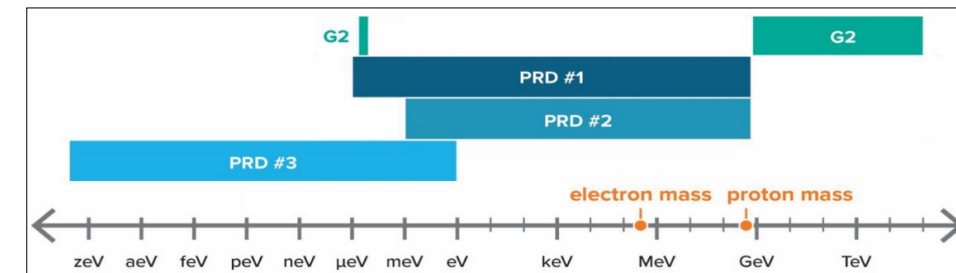
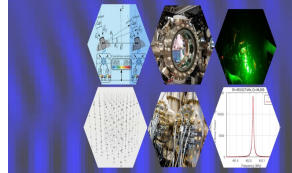
New DOE Programs/Initiatives since P5: Science is Dynamic!

New programs envisioned by small projects portfolio in 2014 P5 report

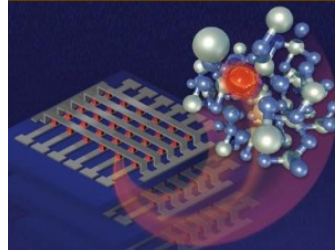
- Quantum Information Science
 - QuantISED program
 - 5 DOE National QIS Research Centers with strong HEP participation
- Artificial Intelligence/Machine Learning
 - Emergent new program
- Dark Matter New Initiatives
 - R&D Funded for 6 novel small-exp't concepts
 - 3 Priority Research Directions identified in 2018
 - **There is more to Dark Matter than WIMPS!**
- Microelectronics
- Accelerator Science and Technology
- RENEW

SLAC

Opportunities for
DOE National Laboratory-led
QuantISED Experiments



Basic Research Needs for
Microelectronics



Report of the Office of Science Workshop on
Basic Research Needs for Microelectronics
October 23 - 25, 2018

Next U.S. HEP Strategic Planning Process almost complete!

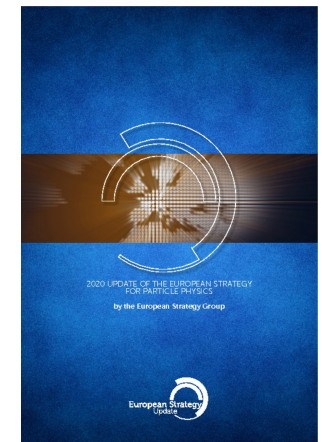
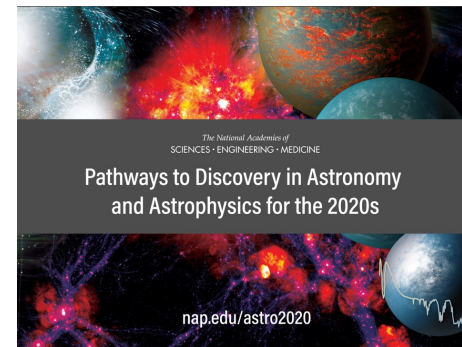
The U.S. High Energy Physics program will be guided by the strategic plan laid out in the 2023 P5 report

Community Driven Strategic Process

- **“Snowmass” 2020-2022:** 2 years-long community-wide study of science opportunities, organized by the Division of Particles and Fields of the American Physical Society
- **Particle Physics Project Prioritization Panel (P5) 2023:** High Energy Physics Advisory Panel (HEPAP) subpanel, prioritized scientific opportunities outlined in the Snowmass study within a budget framework

Dovetailed with

- 2021 Astronomy & Astrophysics Decadal Survey
- 2020 European Update on Strategy for Particle Physics



P5 Charge

Merge aspirations of Snowmass Community Study with realistic budget scenarios

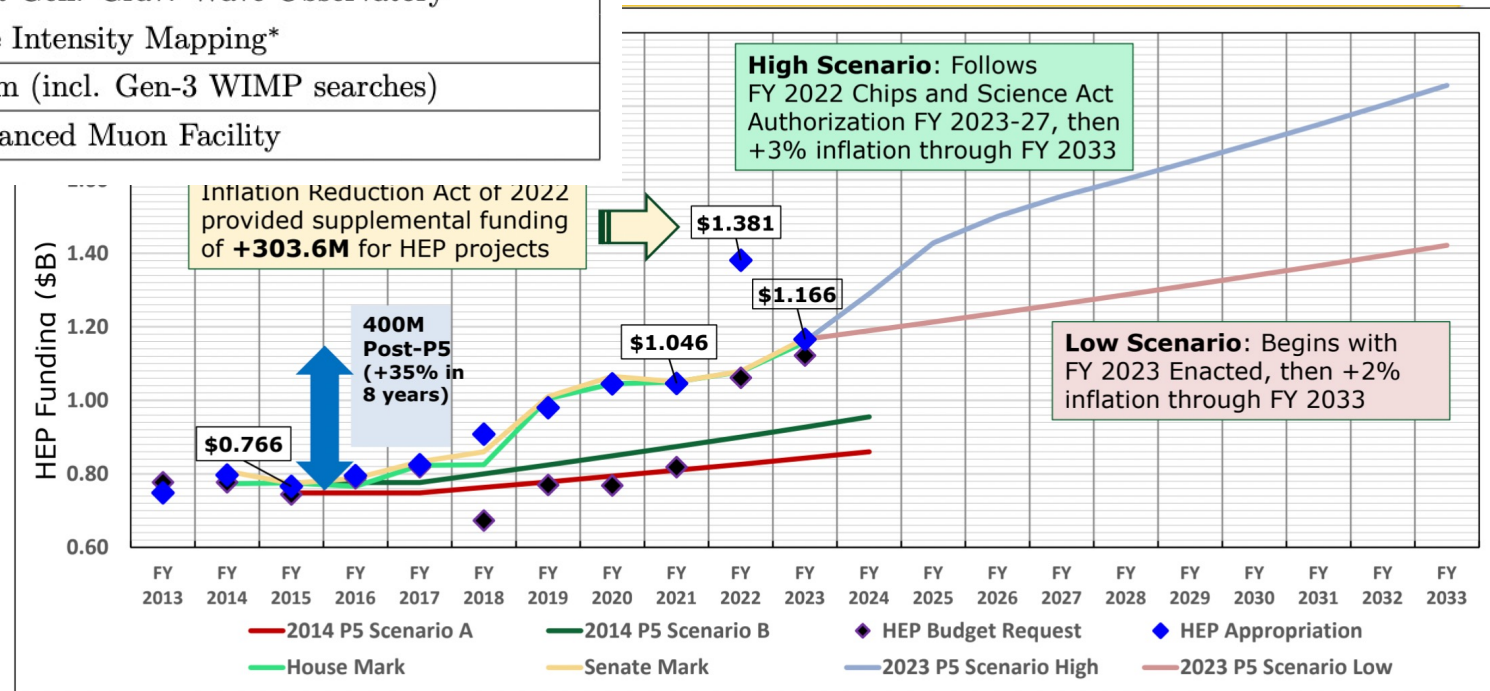
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Summary of the 2021-22 U.S. HEP Community Planning Exercise

Decadal Overview of Future Large-Scale Projects		
Frontier/Decade	2025 - 2035	2035 -2045
Energy Frontier	U.S. Initiative for the Targeted Development of Future Colliders and their Detectors	
		Higgs Factory
Neutrino Frontier	LBNF/DUNE Phase I & PIP- II	DUNE Phase II (incl. proton injector)
Cosmic Frontier	Cosmic Microwave Background - S4	Next Gen. Grav. Wave Observatory*
	Spectroscopic Survey - S5*	Line Intensity Mapping*
	Multi-Scale Dark Matter Program (incl. Gen-3 WIMP searches)	
Rare Process Frontier		Advanced Muon Facility

Snowmass Summary Report, Butler et al

P5 Budget Scenarios



EPP2024: Elementary Particle Physics: Progress and Promise

Take a long-term view without budgetary constraints

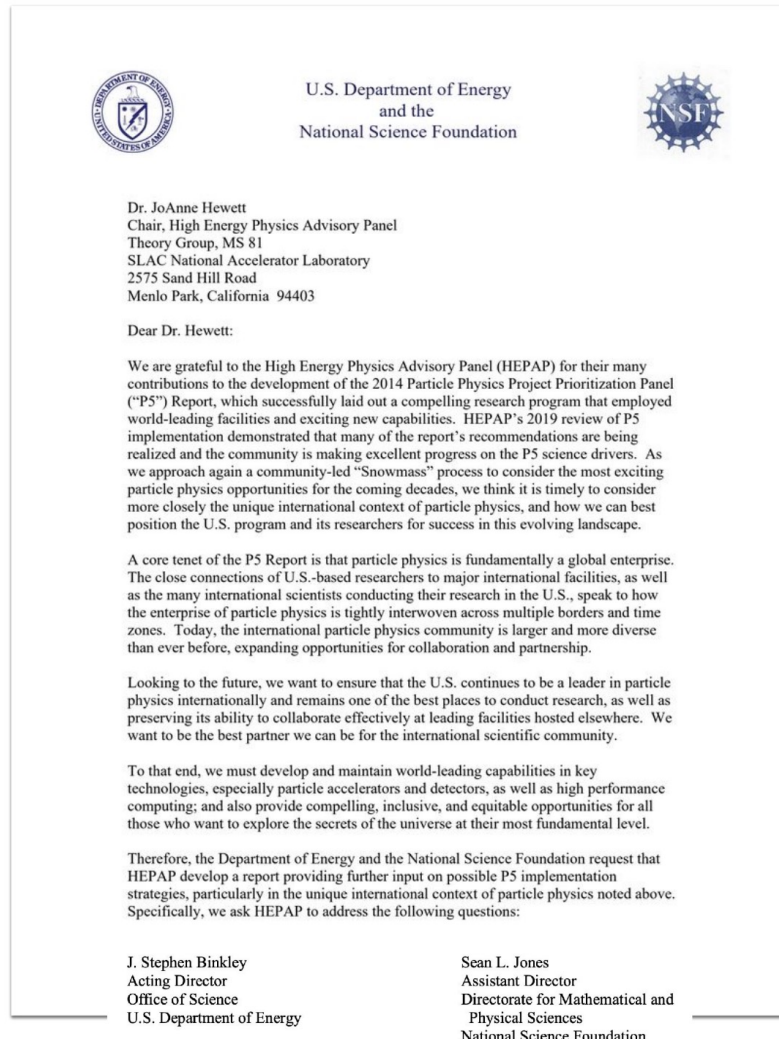
The National Academies of Sciences, Engineering, and Medicine will convene an ad hoc committee to:

- Identify the fundamental questions in particle physics that could motivate research in the next decade and beyond, irrespective of the tools and techniques to address them.
- Distinguish which of these questions could be addressed with available experimental and theoretical tools in the coming decade and which could require new techniques or approaches.
- Suggest technical research areas that could provide particle physics with new tools needed to enable new techniques and approaches.
- Suggest different ways of thinking and alternative approaches from other areas of science that could be incorporated into and benefit the overall particle physics enterprise.

HEPAP Subpanel: International Benchmarking

B. Fleming
2022 HEPAP update

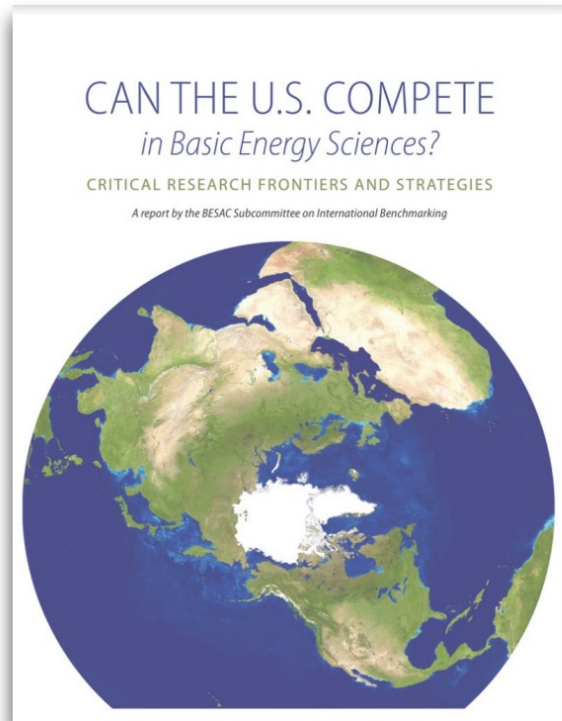
Charge emphasizes that particle physics is global



“it is timely to consider more closely the **unique international context of particle physics**, and how we can best position the U.S. program and its researchers for success in this evolving landscape”

“ensure that the U.S. **continues to be a leader in particle physics internationally** and remains one of the best places to conduct research, as well as **preserving its ability to collaborate effectively at leading facilities hosted elsewhere**. We want to be the best partner we can be for the international scientific community”

“**develop and maintain world-leading capabilities** in key technologies, especially particle accelerators and detectors, as well as high performance computing; and also provide compelling, inclusive, and equitable opportunities for all those who want to explore the secrets of the universe at their most fundamental level”



The charge to HEPAP was motivated by the recent BES report on International Benchmarking

“In particular, basic scientific research, which is driven by the desire to understand fundamental principles, often leads to unexpected discoveries. These in turn provide the basis for innovation and technical developments: indeed, many of today’s most important technologies originated in U.S. basic research from decades past. Without continued investment in basic science today, future discoveries and technological innovation will languish.”

From the report by the BESAC Subcommittee on International Benchmarking

The flavor of the BESAC report leans more towards global competition.

Our charge incorporates the inherent international nature of the science that we do

FESAC also received a similar charge

Benchmarking subpanel organization

Subpanel focus areas

Charge questions principal points

- U.S. as a partner of choice
- Identify U.S. leadership areas
- Recruit and train the best talent

4 sub-committees

- Big experiments
- Small experiments
- Accelerator program
- Workforce

Subpanel members – draw across national and international experience

Expertise spans across 2014 P5 science drivers

- Co-Chairs: Bonnie Fleming, (FNAL/Uchicago), Patricia McBride (FNAL),
- Mei Bai (SLAC, Marcela Carena (FNAL), Scott Dodelson (CMU), Dan Dwyer (LBNL), Tova Holmes (UTK), Tsuyoshi Nakaya (Kyoto), Andy Lankford (UCI), Wim Leemans (DESY), Reina Maruyama (Yale), Sekazi Mtingwa (NRC), Brian Nord (FNAL), Ian Shipsey (Oxford), Stefan Soldner-Rembold (Manchester), Lindley Winslow (MIT)
- Ex-officio: JoAnne Hewett (SLAC)

HEP Community Congressional Annual Visit

Organized by FNAL, LHC, and SLAC users communities

Objectives of the activity

Aim of the trip is visit with:

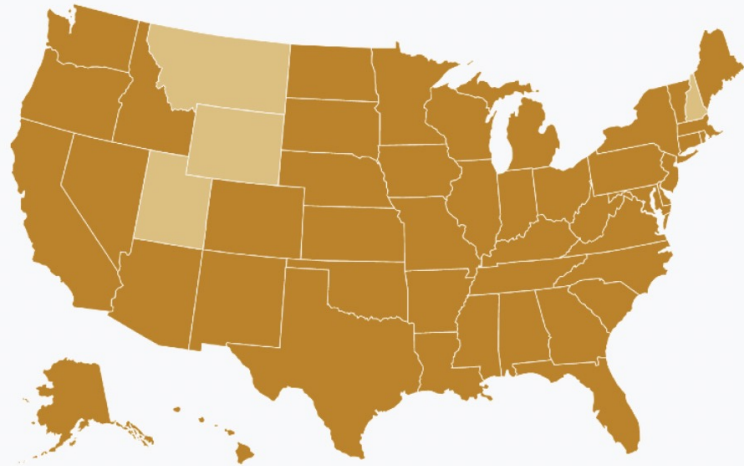
- Congressional offices
- Congressional appropriations and authorization staff
- The Administration (Office of Management and Budget, Office of Science and Technology Policy)
- Funding agencies (DOE and NSF)

Our message:

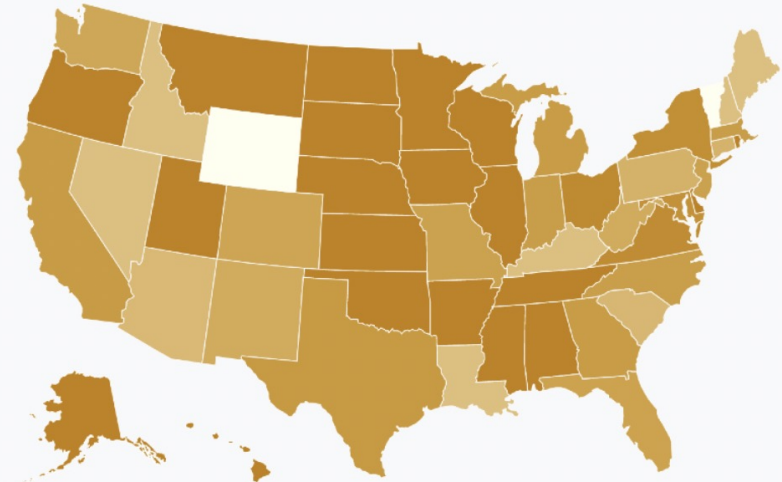
- Share our excitement about our research
- Thank everyone for their continued support
- Help convey the value added to the society by HEP
- Deliver our Ask

2021 Annual visit congressional office coverage

Senate Connection Coverage — 96.0%



House Connection Coverage — 80.5%



2021 Advocacy effort status:

- 435 contacted → 298 scheduled/met (~69%)
- Packets delivered to 328 out of 537 offices (~61%)

Very similar stats compare to last year

- Meetings over zoom longer and in some cases more engaging

Summary

Thanks to the community for their tremendous effort in executing the planning process!

Next round of strategic planning is almost complete

Several reports will be completed soon to guide our path forward