Perspectives from HEPAP

J. Hewett

Snowmass Community Summer Study

Seattle, WA July 2022

SLAC NATIONAL ACCELERATOR LABORATORY

Stanford University | U.S. DEPARTMENT OF ENERGY

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

Spawned numerous U.S. International agreements

- U.S. – CERN Agreement, May 2015
- UK – U.S. Science & Technology Agreement, Sep 2017
- DOE-DAE Project Annex II on Neutrino Research, Apr 2018
- U.S. – Italy Neutrino Agreement, Jun 2018

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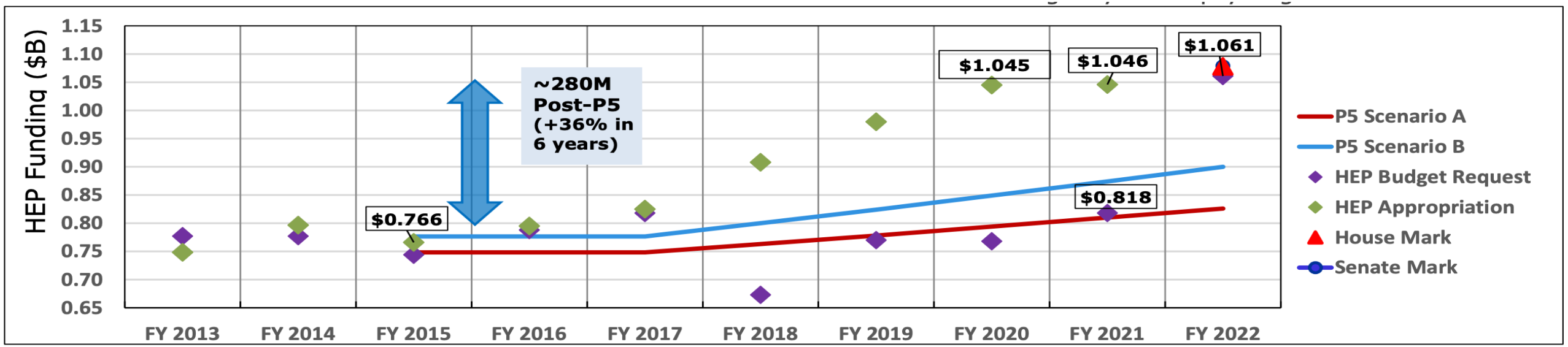
- U.S. – CERN FCC and HL-LHC Agreement, Dec 2020

CERN – FNAL HL LHC Agreement, Mar 2021



HEPAP 2019 Assessment on 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

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
—Alysia Marino
—Meenakshi Narain
—Fulvia Pilat
—Soren Prestemon
—Patrizia Rossi
—Michael Syphers

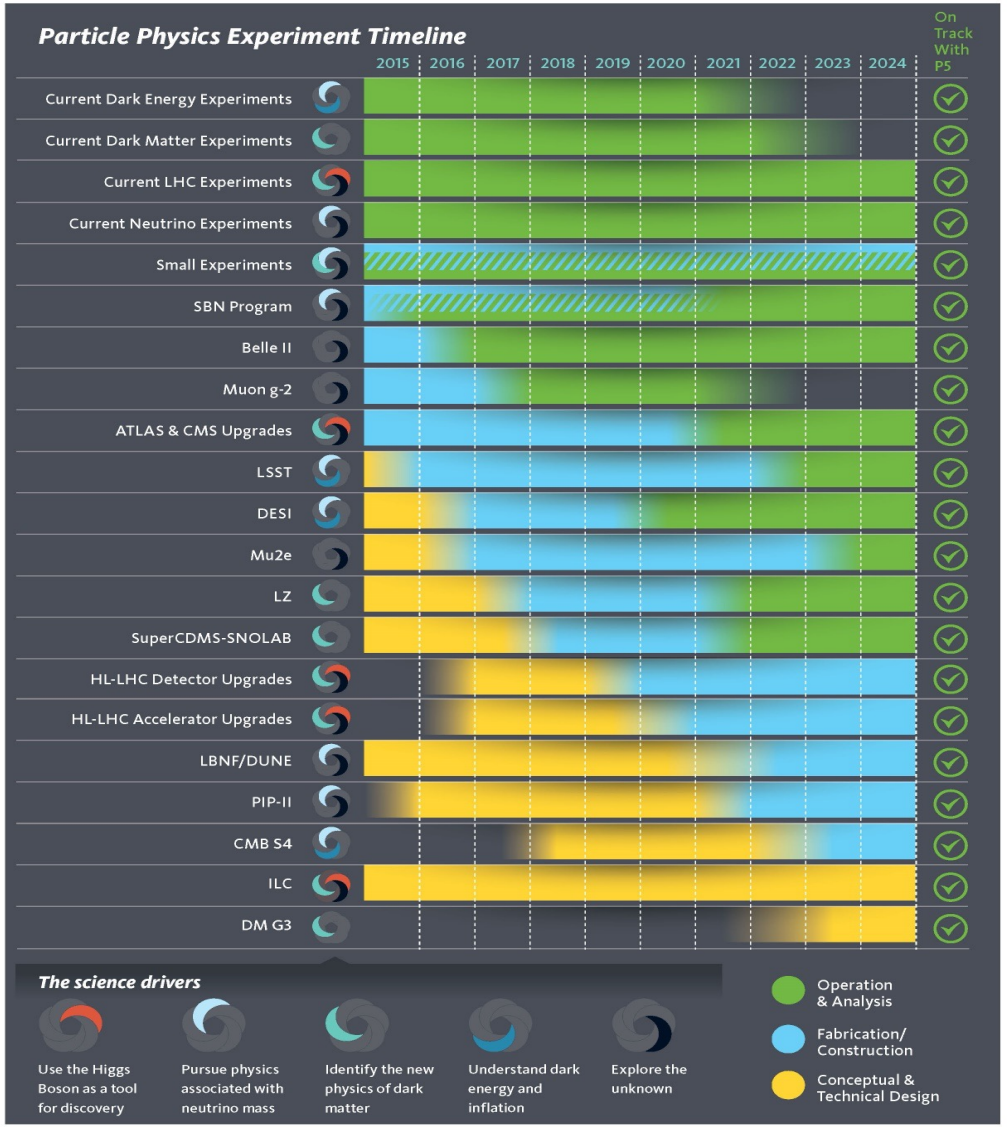
https://science.osti.gov/-/media/hep/hepap/pdf/Reports/HEPAP-Assessment-of-Progress-on-2014-P5-Report-(2020).pdf

2019 HEPAP P5 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 2022: 8 yrs into the Plan



P5 projects report card

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

- Belle-2, Muon g-2, Phase I ATLAS, Phase I CMS
- CD-4 in 2020: DESI and LZ
- CD-4 in 2021: FACET-II and LSSTCamera

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

- HL-AUP, Mu2e, PIP-II, Super-CDMS

3 Projects at CD-1 (preparing for baseline)

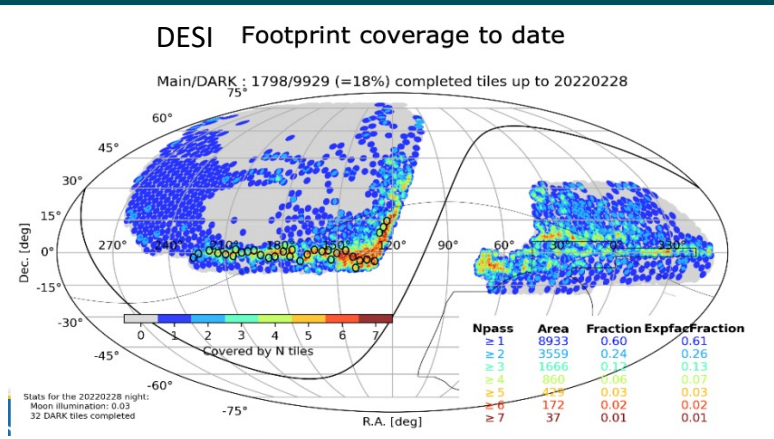
- HL-ATLAS, HL-CMS, LBNF/DUNE

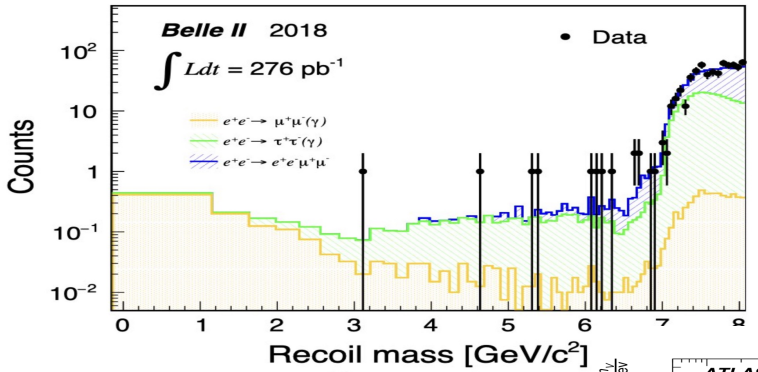
1 Project at CD-0

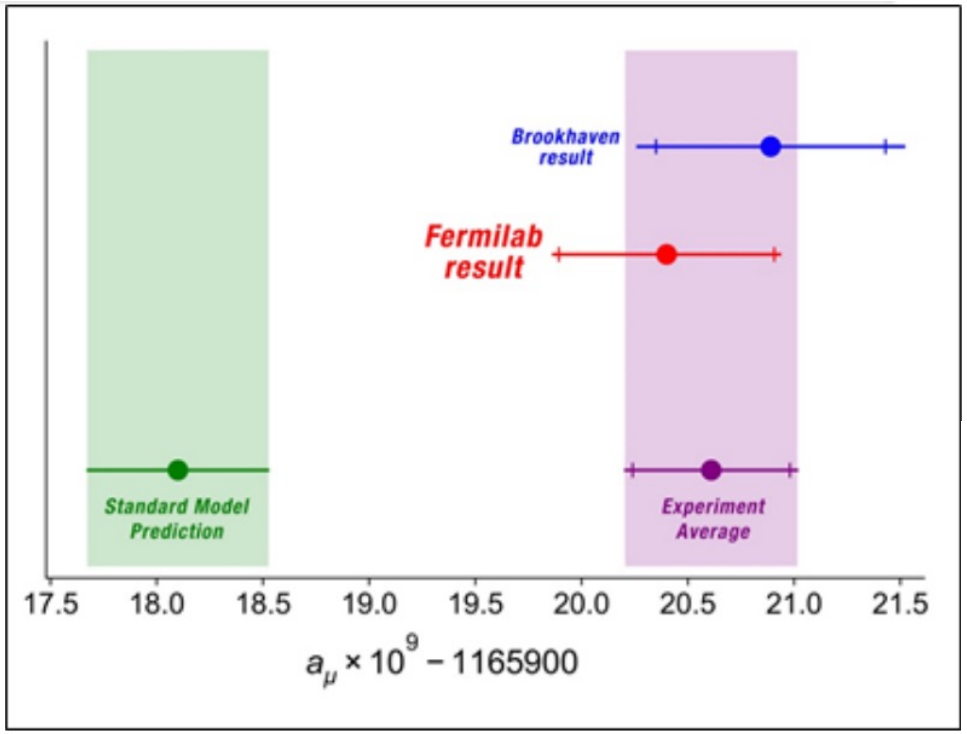
- CMB-S4

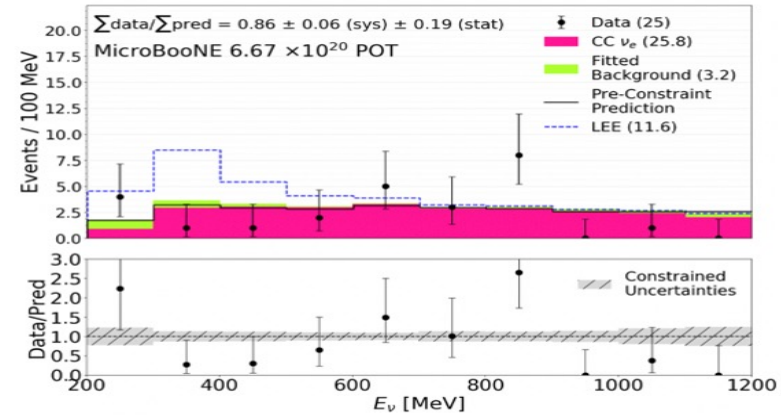
Broad portfolio of small projects from R&D phase to operations

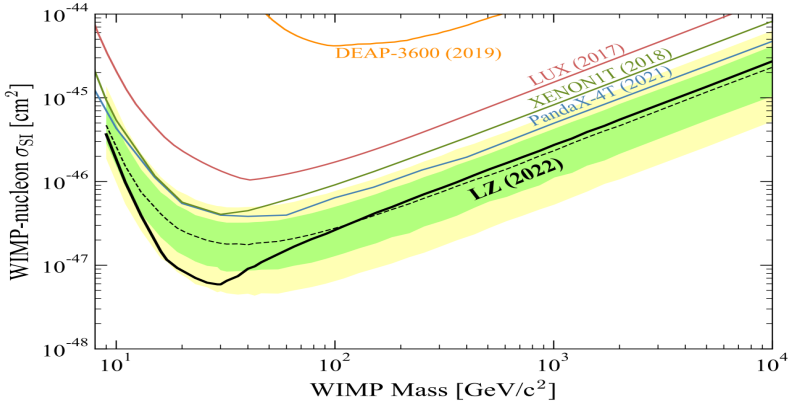
Reaping Science from Recently Completed Projects

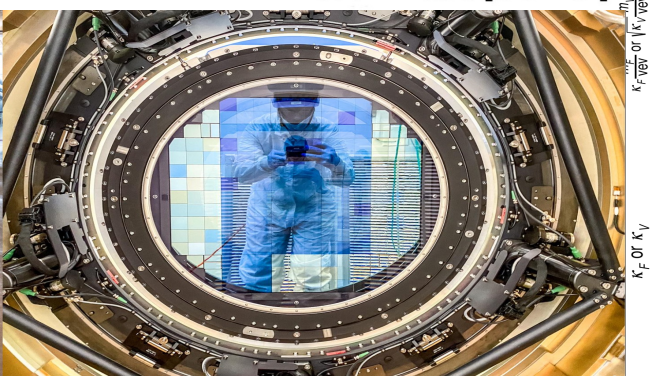


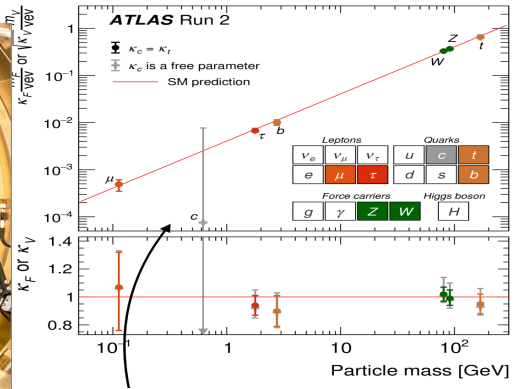


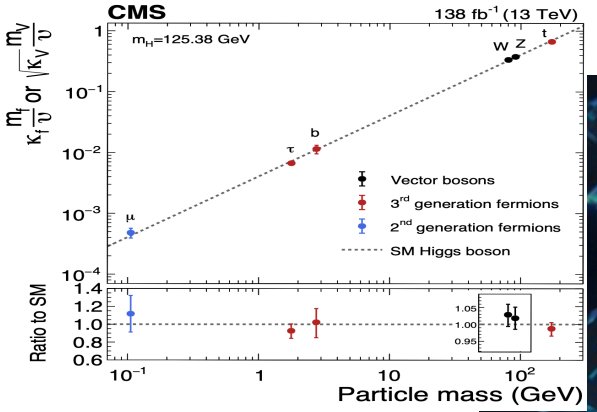








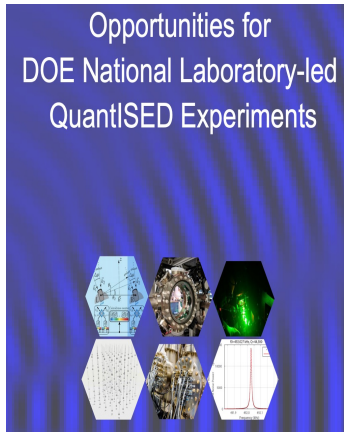


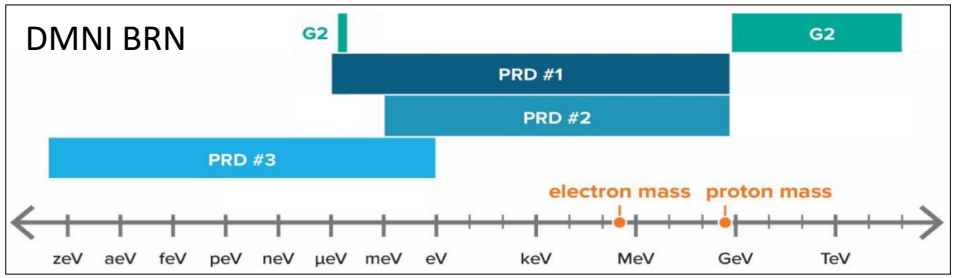


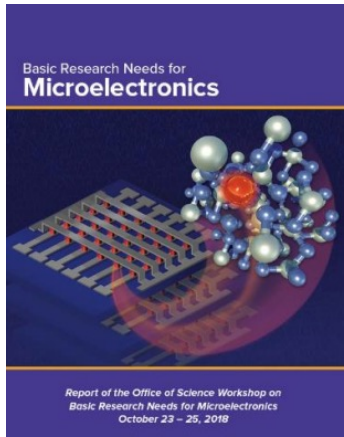
New DOE Programs/Initiatives since P5: Science is Dynamic!

New programs as envisioned by small projects portfolio in 2014 P5 report

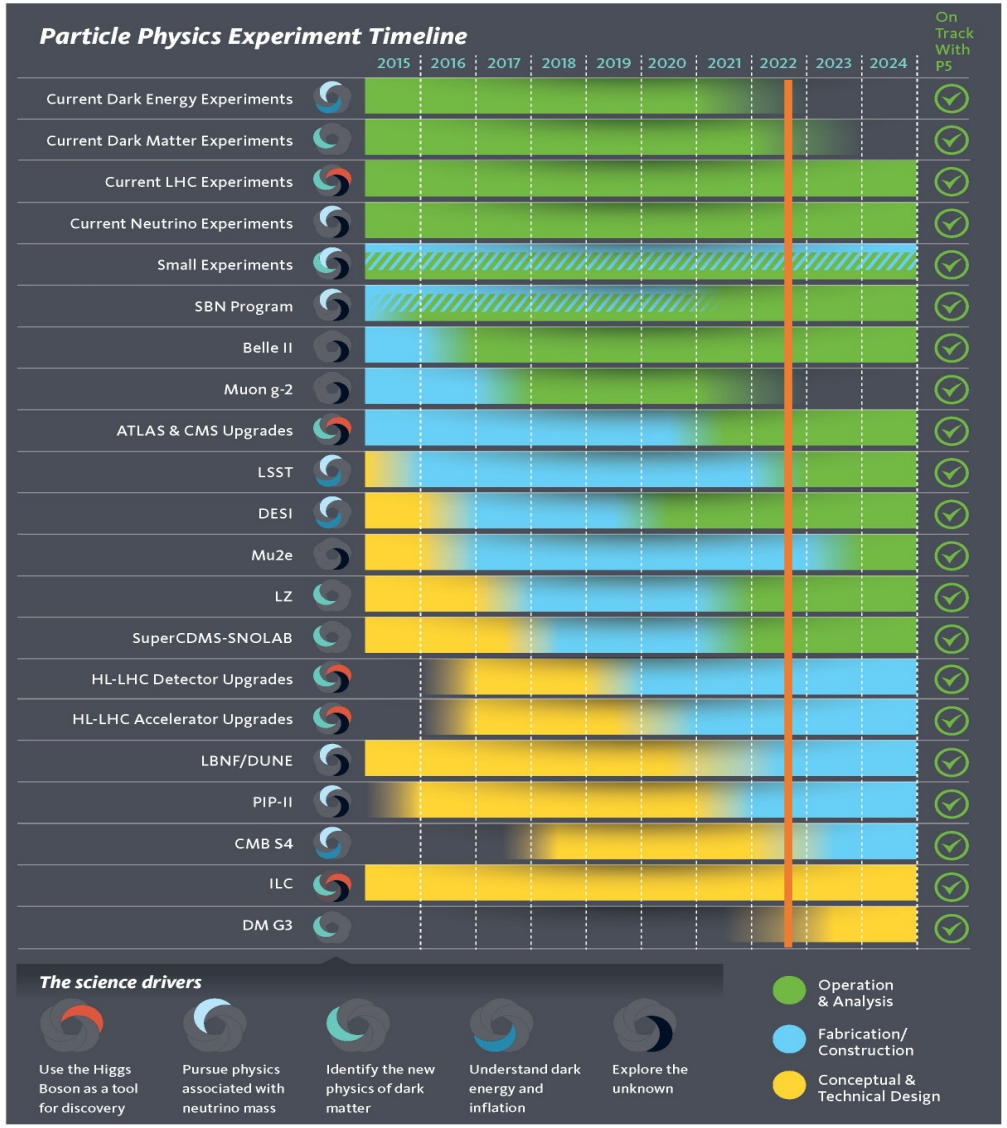
- Quantum Information Science
  - QuantISED program
  - 5 DOE National QIS Research Centers with strong HEP participation
- Artificial Intelligence/Machine Learning
  - Emergent new program
- Dark Matter New Initiatives
  - R&D Funded for 6 novel small-exp't concepts
  - 3 Priority Research Directions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







How do we know the time is right for a new strategic plan?



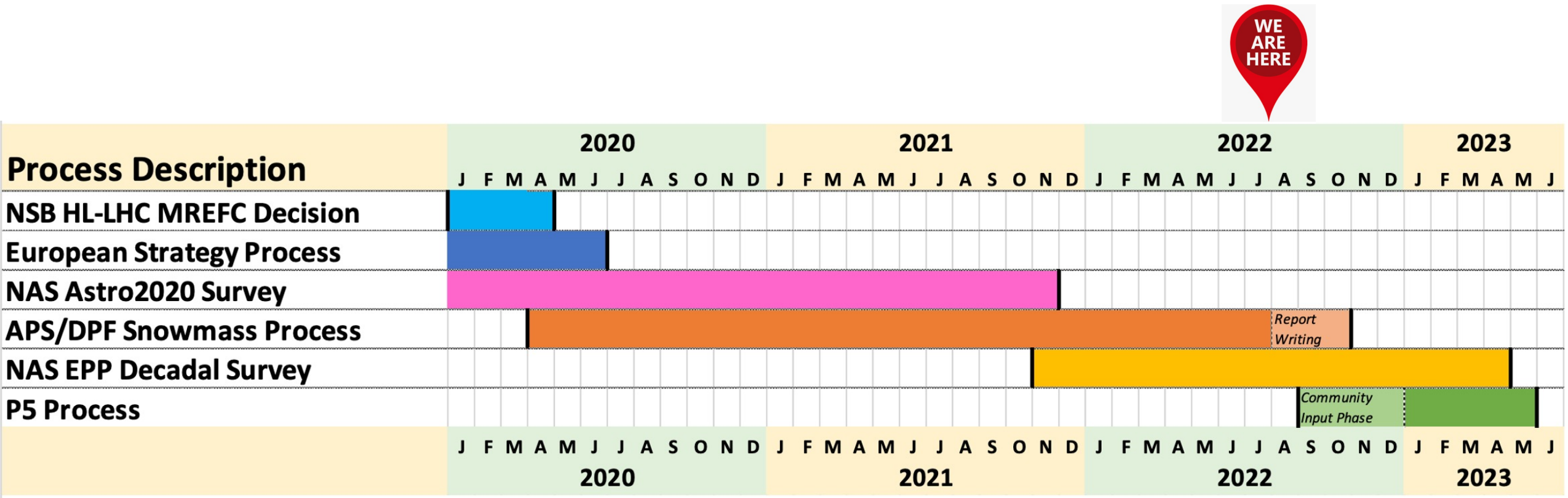
Healthy HEP program requires a mix of project stages

Yesterday's projects lead to today's science

Today's projects lead to tomorrow's science

Planning for the next decade(s)

2020's U.S. Strategic Planning Timeline



There are a lot of moving parts and pieces!

European Particle Physics Strategy: 2020 Update

Implementation of strategy should proceed in strong collaboration with global partners and neighbouring fields

Chaired by Halina Abramowicz

High-priority future initiatives

- Ramp up R&D effort on advanced accelerator technologies
- Investigate technical and financial feasibility of future hadron collider @ CERN > 100 TeV
- e+e- Higgs and EW factory as a possible first stage

Synergies with neighbouring fields

- Explore boundary between particle and nuclear
- Synergy with particle and astro-particle

Organizational structures and relationships discussed

Other essential scientific activities for particle physics

- Experiments in diverse areas that offer potential high-impact particle physics programmes at laboratories in Europe should be supported
- Continue to vigorously support a broad programme of theoretical research covering the full spectrum of particle physics
- Detector R&D programmes and associated infrastructure should be supported
- Develop computing and software infrastructures

Environmental and societal impact discussed

- Early-career, communication, technology transfer, travel

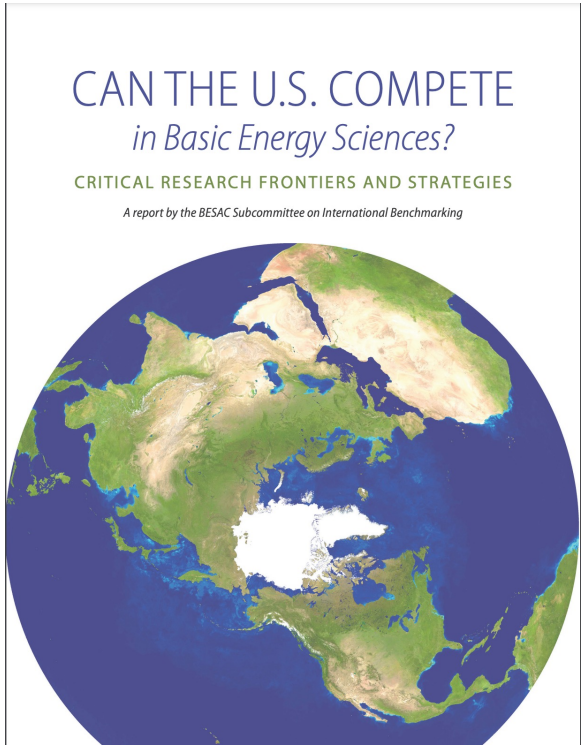
International Benchmarking HEPAP Subpanel

A core tenet of the 2014 P5 Report is that particle physics is fundamentally a global enterprise

Co-chaired by Bonnie Fleming and Patty McBride

Charge Summary

- How can the U.S. particle physics program maintain critical international cooperation in an increasingly competitive environment for both talent and resources?
- Identify key areas where the U.S. currently has, or could aspire to, leadership roles in HEP via its unique or world-leading capabilities, or leading scientific and technical resources.
- How can programs and facilities be structured to attract and retain talented people?

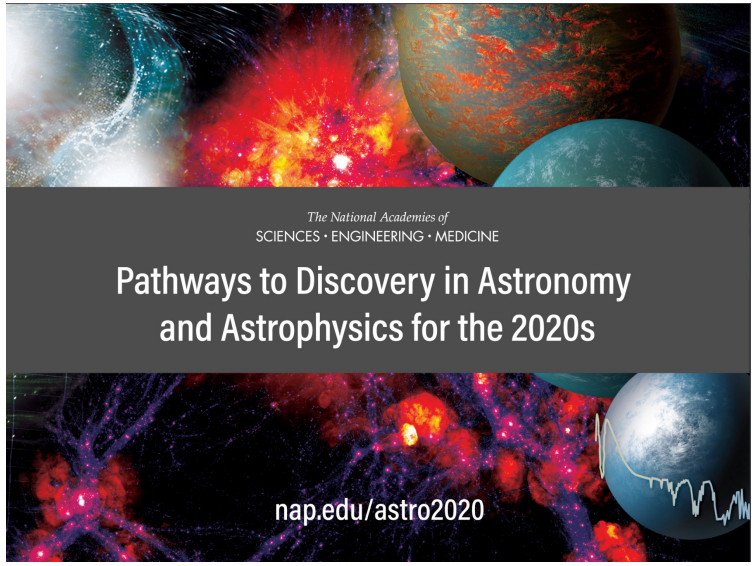


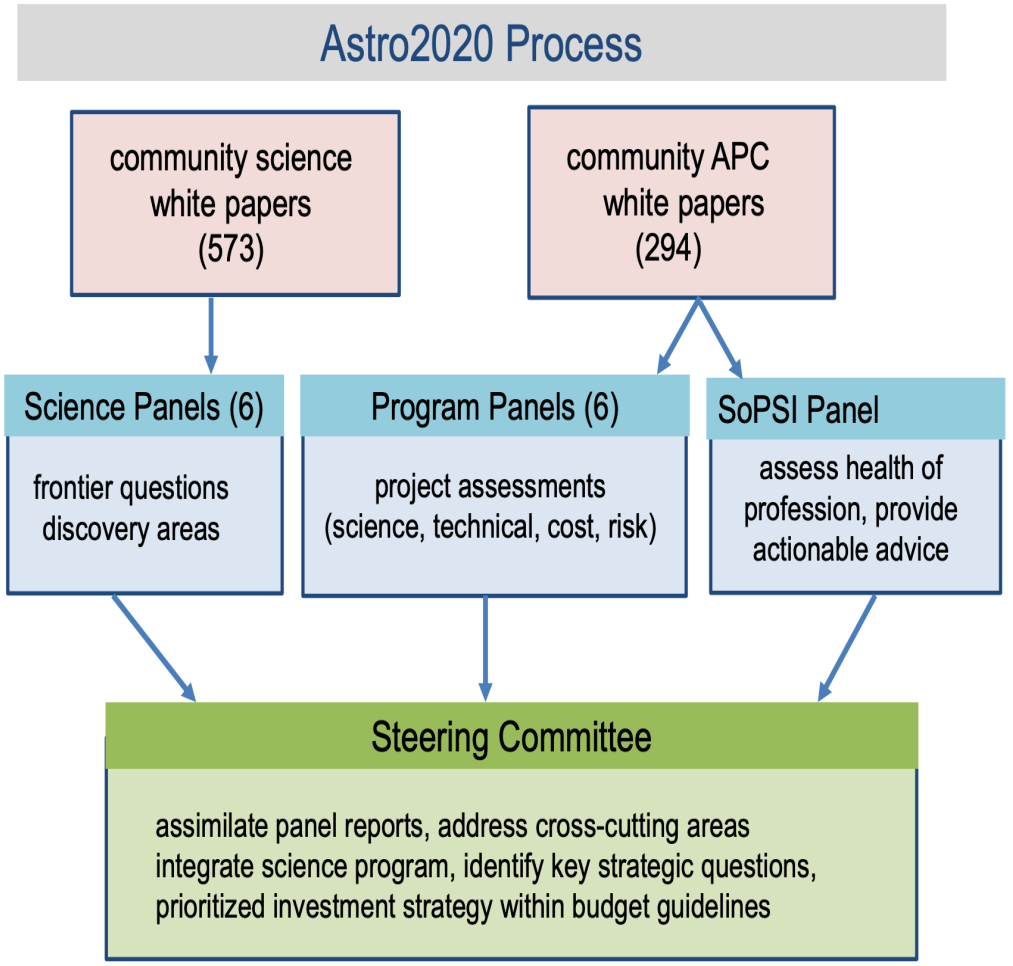
Report due at Fall 2022 HEPAP meeting

U.S. HEP Strategic Planning Process: Astro Decadal Survey

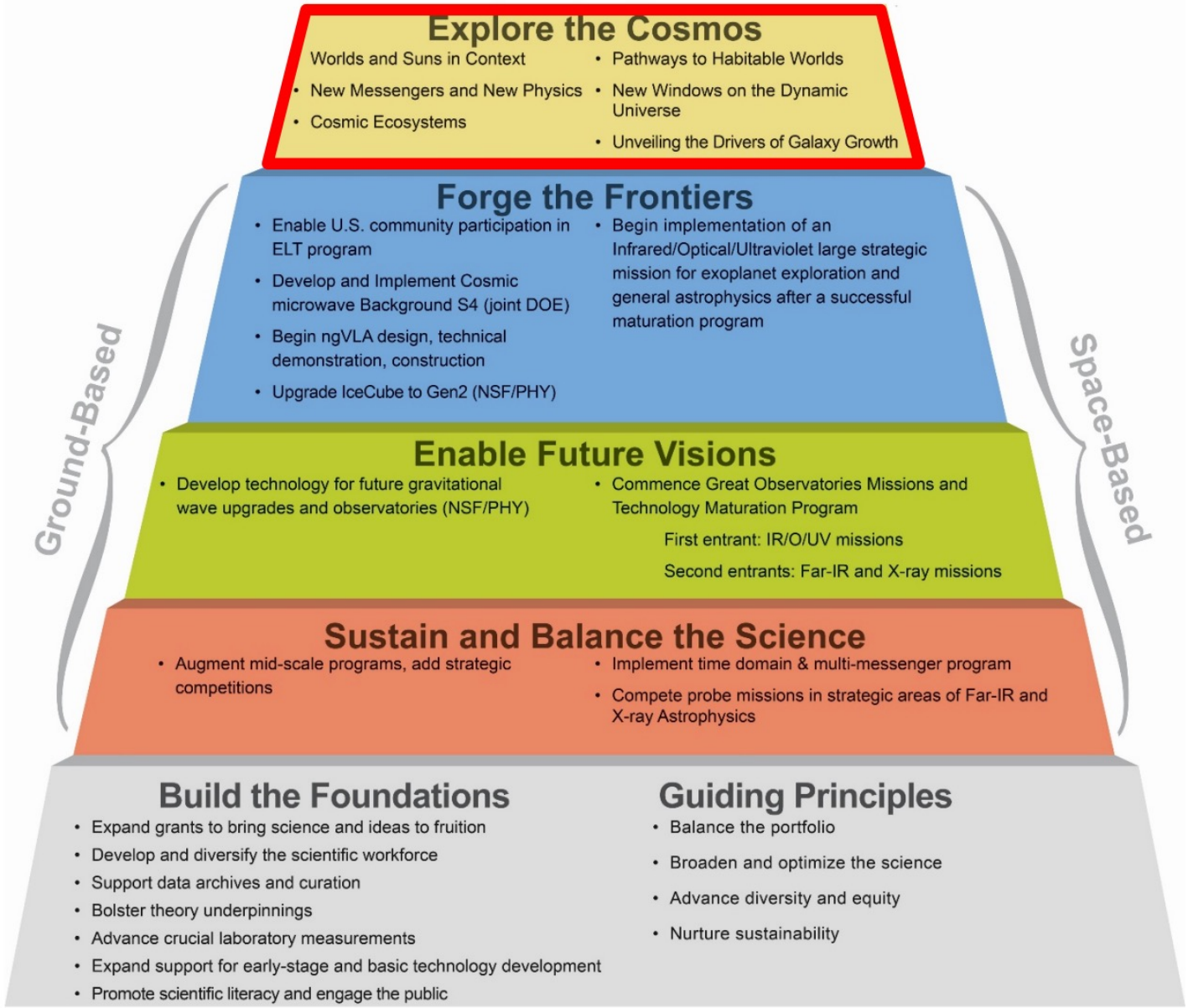
Astronomy & Astrophysics Decadal Survey: 2020-2021

- NCR & NAS
- Chaired by Fiona Harrison & Robert Kennicutt
- Report released Nov 21





Realizing the Astro2020 Program: Pathways From Foundations to Frontiers



NAS Study on Elementary Particle Physics: Progress and Promise

Setting a vision for the field of Elementary Particle Physics

Co-chaired by Maria Spiropulu and Michael Turner

Charge

- Identify the fundamental questions in particle physics that could motivate research in the next decade and beyond, irrespective of 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

Snowmass is critical piece of U.S. strategic planning

Unique, key elements of Snowmass

- Community driven
- Science driven
- Everyone can contribute
- Full coverage of the field
- Vision of what could be
- Brings science communities together
- Brings different generations of researchers together
- Defines key scientific questions and approaches

Snowmass results guide the direction of the field and are the scientific input to the next P5

1984 DPF Summer Study on the Design and Utilization of the Superconducting Super Collider (SSC) (Snowmass 84)

23 June-13 July 1984. Snowmass, CO, United States (C84-06-23)

Part of the SNOWMASS series

Note: CN changed to QCD184:S7:1984 (SSC), and back to follow Snowmass series

Physics of the Superconducting Supercollider: Proceedings, 1986 Summer Study, June 23 - July 11, 1986, Snowmass, Colorado

R. Donaldson (LBL, Berkeley)(ed.), J.N. Marx (LBL, Berkeley)(ed.)
1986

770 pages

Contribution to: Snowmass '86 Summer Study on the Physics of the Superconc

Published: 1988 in New York by American Institute of Physics

High-energy physics in the 1990s. Proceedings, Summer Study, Snowmass, USA, June 27 - July 15, 1988

Sharon Jensen (SLAC)(ed.)
1989

914 pages

Contribution to: 1988 DPF Summer Study on High-energy Physics in the 1990s (Snowmass 88)

Report number: SLAC-REPRINT-1988-002

Proceedings of the 1996 DPF/DPB Summer Study on New Directions in High-energy Physics

Proceedings, 2005 International Linear Collider Physics and Detector Workshop and 2nd ILC Accelerator Workshop (Snowmass 2005)

Norman A. Graf

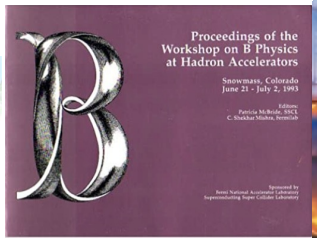
Jun 21, 2006

Contribution to: 2005 International Linear Collider Physics and Detector Workshop and 2nd ILC Accelerator Workshop

Report number: SLAC-R-798

Proceedings of Snowmass 2001

Snowmass Village, Colorado
June 30--July 21



How to Snowmass®: These 10 days will be very busy!

Snowmass is finally here!

Much has been accomplished over the last 2 years

- Much, much, much work has been done!
- Studies are 99% complete
- Whitepapers are written
- Talks have been given

Do's

- Reach outside your sphere of knowledge!
- Learn something new!
- Meet somebody new!
- Attend meetings outside of your own frontier!
- Participate as fully as humanly possible!
- Learn to appreciate the full breadth and wonder of HEP!
- Discuss versus presentation!
- Be cognizant of the folks that are attending virtually!

We are one community – we speak with one voice that represents all