HEPAP Evaluation of the P5 Report Implementation Status: Evaluation Description and P5 Report Refresher

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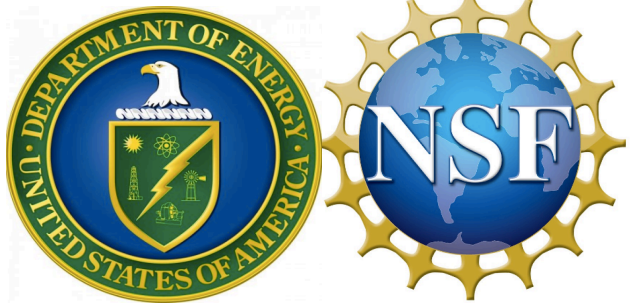

HEP Strategic Planning Process

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

- Time sequence:
  - "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: HEPAP subpanel, prioritized scientific opportunities outlined in the Snowmass study within a budget framework
- Dovetails with
  - 2010 Astronomy & Astrophysics Decadal Survey
  - 2013 European Strategy for Particle Physics

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

Particle Physics Project Prioritization Panel (P5)

Scientific advisory panel (subpanel of HEPAP) tasked to develop a strategic HEP plan to be executed in 10-yr timeframe, in the context of a 20-yr global vision for the field

- Examine current, planned and proposed research capabilities and assess
  - Role & potential for scientific advancement
  - Uniqueness & scientific impact in global context
  - Time & required resources to achieve stated goals
- Provided with 3 budget scenarios to work within
  - Necessitated hard choices
- Community “Snowmass” study served as invaluable input

Signals that time was right for a new P5 in 2013

- Physics landscape changed
  - Higgs discovered at relatively low mass
  - Key neutrino mixing angle measured to be large
  - New technology & innovative approaches
  - 3 Nobel prizes: CKM, Higgs, Dark Energy
- These demonstrate importance of diversity of topics and scale
- Programmatic Changes
  - Tevatron and B-Factory ceased operations
  - DUSEL and JDEM did not proceed
  - Budgets more constrained than considered by 2008 P5
  - International considerations
- Success of 2013 “Snowmass”

P5 Panel Composition

25 member panel

- Representative of U.S. community
- International representation (Canada, Europe & Japan)
- Chosen for expertise & broad view of the field

Hiroaki Aihara (Tokyo)
Martin Breidenbach (SLAC)
Bob Cousins (UCLA)
André de Gouvêa (Northwestern)
Marcel Demarteau (ANL)
Scott Dodelson (FNAL/Chicago)
Jonathan Feng (UCI)
Bonnie Fleming (Yale)
Fabiola Gianotti (CERN)
Francis Halzen (Wisconsin)
JoAnne Hewett (SLAC)
Andy Lankford (UCI)
Wim Leemans (LBNL)
Joe Lykken (FNAL)
Dan McKinsey (Yale)
Lia Merminga (TRIUMF)
Toshnori Mori (Tokyo)
Tatsuya Nakada (Lausanne)
Steve Peggs (BNL)
Saul Perlmutter (Berkeley)
Kevin Pitts (Illinois)
Steve Ritz (Chair, UCSC)
Kate Scholberg (Duke)
Rick van Kooten (Indiana)
Mark Wise (Caltech)

Held several meetings – open & closed

- 6 townhalls, 4 closed meetings, weekly telecons

Program Optimization Criteria

- Science impact
- International context
- Sustained productivity
- Timing
- Cost vs value
- History and dependencies
- Feasibility
- Roles

Many things to consider at once
- Science impact comes first

Principal Conclusions of Report

- Particle Physics is Global
  - The U.S. and major players in other regions can together address the full breadth of the most urgent science questions if each hosts a unique world-class facility at home and partners in high-priority facilities hosted elsewhere
  - Reliable partnerships are essential for the success of international projects
- Urgent science questions drive the field forward
  - Vision for addressing the science drivers using a select set of prioritized experiments
- Mix of projects of all scales
- Balance Research, Operations & Projects
- 29 Recommendations in the report

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

Science drivers are not prioritized

- They are intertwined and dependent on each other
- Vision to address the science drivers represents the P5 plan

Program-wide Recommendations

1. Pursue most important opportunities wherever they are and host world-class facilities
2. Pursue program to address 5 science drivers
3. Develop mechanism to reassess the project priority at critical decision stages if costs and/or capabilities change substantively
4. Maintain a program of projects of all scales
5. Increase budget fraction invested in project construction to the 20-25% range
6. research program should provide the flexibility to support new ideas and developments.
7. Any further reduction in level of effort for research should be planned with care, including assessment of potential damage in addition to alignment with the P5 vision.
8. facility and laboratory operations budgets should be evaluated to ensure alignment with the P5 vision
9. Funding for participation of U.S. particle physicists in experiments hosted by other agencies and other countries is appropriate and important but should be evaluated in the context of the P5 plan

Project-specific Recommendations

Recommendations 10-22 address projects related to the 5 science drivers (not a one-to-one mapping!)

- Near-term and mid-term high-energy colliders
- Neutrino oscillation experiments
- Cosmic surveys
- Dark Matter experiments
- Muon, kaon and B-physics experiments

Recommendations on Enabling R&D

1. Support the discipline of accelerator science through advanced accelerator facilities and through funding for university programs.
2. Participate in global conceptual design studies and critical path R&D for future very high-energy proton-proton colliders. Continue to play a leadership role in superconducting magnet technology.
3. Reassess the Muon Accelerator Program (MAP).
4. Pursue accelerator R&D with high priority at levels consistent with budget constraints.
5. Focus resources toward directed instrumentation R&D in the near-term for high-priority projects.
6. Strengthen university-national laboratory partnerships in instrumentation R&D through investment in instrumentation at universities.
7. Strengthen the global cooperation among laboratories and universities to address computing and scientific software needs.

The P5 plan in one glance: Building for Discovery

P5 Plan in 2019

2019 is halfway into the 10-yr strategic plan detailed in the 2014 P5 Report

- Investments in the 2014 P5 plan are being made by
  - HEP community
  - U.S. funding agencies DOE and NSF
  - U.S. Congress
  - International partners

- Useful to evaluate the progress on this investment
  - Status of the implementation of the P5 vision
  - Status of the science drivers in 2019
  - Checks and balances in carrying out the plan

The P5 Report is a HEPAP Report

From the HEPAP Charter

The 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

The charter empowers HEPAP to review the progress on implementing the recommendations contained in the P5 report

Criteria for Assessment

Based on progress of implementation of the P5 recommendations

- 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

Evaluation Process

HEPAP will conduct the evaluation in two stages:

1. Self-assessment by the agencies of the implementation status
   - Spring 2019
2. Assessment of the physics landscape in 2019
   - Spring 2019
3. Assessment by the community
   - Fall 2019

HEPAP will transmit a letter of the panel's findings to the agencies in Fall 2019

Backups

Summary of projects considered

Table 1
Summary of Scenarios

Project/Activity	Scenarios			Science Drivers					Technique (Frontier)
	Scenario A	Scenario B	Scenario C	Higgs	Neutrinos	Dark Matter	Cosm. Accel.	The Unknown	
Large Projects									
Muon program: Mu2e, Muon g-2	Y, Mu2e small reprofile needed	Y	Y					✓	I
HL-LHC	Y	Y	Y	✓		✓		✓	E
LBNF + PIP-II	Y, LBNF components delayed relative to Scenario B.	Y	Y, enhanced		✓			✓	I,C
ILC	R&D only	R&D, possibly small hardware contributions. See text.	Y	✓		✓		✓	E
NuSTORM	N	N	N		✓				I
RADAR	N	N	N		✓				I
Medium Projects									
LSST	Y	Y	Y		✓		✓		C
DM G2	Y	Y	Y			✓			C
Small Projects Portfolio	Y	Y	Y		✓	✓	✓	✓	All
Accelerator R&D and Test Facilities	Y, reduced	Y, some reductions with redirection to PIP-II development	Y, enhanced	✓	✓	✓		✓	E,I
CMB-S4	Y	Y	Y		✓		✓		C
DM G3	Y, reduced	Y	Y			✓			C
PINGU	Further development of concept encouraged				✓	✓			C
ORKA	N	N	N					✓	I
MAP	N	N	N	✓	✓	✓		✓	E,I
CHIPS	N	N	N		✓				I
LAr1	N	N	N		✓				I
Additional Small Projects (beyond the Small Projects Portfolio above)									
DESI	N	Y	Y		✓		✓		C
Short Baseline Neutrino Portfolio	Y	Y	Y		✓				I

Summary of Changes in Directions

Several recommendations resulted in changes of direction

- Increase fraction of budget devoted to construction to 20-25%, and plan with care any further reductions in real funding levels for the research program
- Change of approach for the long-baseline neutrino program
- Upgrade the FNAL accelerator complex to produce higher intensity beams, with redirections towards this effort
- Proceed immediately with generation-2 dark matter direct detection program with investment significantly above previous levels
- Provide increased particle physics funding of CMB research and projects
- Re-align activities in accelerator R&D