INTRODUCTION

HEPAP Meeting

Bethesda, MD; May 22-24, 2014

Andrew J. Lankford

HEPAP Chair

University of California, Irvine

Announcement

The following new members join their 1st meeting today:

- **Jim Buckley, Washington U.**
- **Bruce Carlsten, LANL**
- **John Carlstrom, U. Chicago**
- **Karsten Heeger, Yale**
- **Hitoshi Murayama, UC Berkeley/IPMU**
- **Gabriela Sciolla, Brandeis U.**
- **Ian Shipsey, Oxford** *(ex-officio, DPF Chair)*

WELCOME !

Thank you for agreeing to represent the particle physics community on this advisory panel.

Thank you also to the continuing members.

Presentation & Discussion of P5 Report

P5 report is being presented to HEPAP

- **for consideration of approval**

If HEPAP approves, report is submitted to DOE & NSF

Today:

Presentation of report in its entirety by Steve Ritz

Followed by Q&A and discussion

- **Q&A will be structured (I will explain later)**
- **For HEPAP primarily, to guide their consideration**
- **Attendees will have opportunity to contribute**

P5 Report

Culmination of a long process

- **Community study – “Snowmass”**
- **Community input - public P5 meetings**
- **P5 deliberation**

P5 Report

Culmination of a long process to shape our future

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Thank you !

- **Members of the community who participated**
- **Members of P5**
  - ***who devotedly committed themselves to this responsibility***
- **Steve Ritz – P5 Chair**
  - ***who tirelessly led process of input, deliberation, & outcome***

P5 Report

P5 developed a coherent program.

- **Optimized for scientific progress**
- **More than a collection of “cool” experiments**
- **10-yr Strategic Plan in context of 20-yr global vision**

Please view the strategic plan as a whole.

- **A plan to address exciting, profound science**
- **A plan to move particle physics forward**

Discussion of the P5 Report

Structure of discussion:

"Conflict of Interest" considerations requires recusal of some HEPAP members from discussion of some projects.

- **Discussion will be discussed in several sections**
- **Each section will consist of: HEPAP discussion, comments from community attendees, HEPAP discussion of acceptance**
- **Discussion of each section will focus first on questions, then on comments**
- **Large number of sections dictates concise, direct discussion**

Discussion of the P5 Report

List of sections:

- **Introduction (excluding Executive Summary), Drivers, Broader impacts**
- **Program-wide recommendations: 1-2; 3-9**
- **Project-specific recommendations: 10-11; 12-15; 16/17/18/21; 19-20; 22**
- **Scenarios B and A, +C, +Changes**
- **Enabling R&D, incl 23-24 + 26-29; 25**
- **Report as a whole**

Introduction, Drivers, Broader Impacts

Discussion:

Project-specific Recommendations

#1-2:

Recommendation 1: Pursue the most important opportunities wherever they are, and host unique, world-class facilities that engage the global scientific community.

Recommendation 2: Pursue a program to address the five science Drivers.

Project-specific Recommendations

#3-9:

3: Develop a 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, from the largest international projects to mid- and small-scale projects.

5: Increase the budget fraction invested in construction of projects to the 20%–25% range.

6: In addition to reaping timely science from projects, the 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: As with the research program and construction projects, 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 Drivers and the P5 Criteria and should not compromise the success of prioritized and approved particle physics experiments.

Project-specific Recommendations

#10-11:

Recommendation 10: Complete the LHC phase-1 upgrades and continue the strong collaboration in the LHC with the phase-2 (HL-LHC) upgrades of the accelerator and both general-purpose experiments (ATLAS and CMS). The LHC upgrades constitute our highest-priority near-term large project.

Recommendation 11: Motivated by the strong scientific importance of the ILC and the recent initiative in Japan to host it, the U.S. should engage in modest and appropriate levels of ILC accelerator and detector design in areas where the U.S. can contribute critical expertise. Consider higher levels of collaboration if ILC proceeds.

Project-specific Recommendations

#12-15:

Recommendation 12: In collaboration with international partners, develop a coherent short- and long-baseline neutrino program hosted at Fermilab.

Recommendation 13: Form a new international collaboration to design and execute a highly capable Long-Baseline Neutrino Facility (LBNF) hosted by the U.S. To proceed, a project plan and identified resources must exist to meet the minimum requirements in the text. LBNF is the highest-priority large project in its timeframe.

Recommendation 14: Upgrade the Fermilab proton accelerator complex to produce higher intensity beams. R&D for the Proton Improvement Plan II (PIP-II) should proceed immediately, followed by construction, to provide proton beams of >1 MW by the time of first operation of the new long-baseline neutrino facility.

Recommendation 15: Select and perform in the short term a set of small-scale short-baseline experiments that can conclusively address experimental hints of physics beyond the three-neutrino paradigm. Some of these experiments should use liquid argon to advance the technology and build the international community for LBNF at Fermilab.

Project-specific Recommendations

#16/17/18/21:

Recommendation 16: Build DESI as a major step forward in dark energy science, if funding permits (see Scenarios discussion below).

Recommendation 17: Complete LSST as planned.

Recommendation 18: Support CMB experiments as part of the core particle physics program. The multidisciplinary nature of the science warrants continued multiagency support.

Recommendation 21: Invest in CTA as part of the small projects portfolio if the critical NSF Astronomy funding can be obtained.

Project-specific Recommendations

#19-20, 22:

Recommendation 19: Proceed immediately with a broad second-generation (G2) dark matter direct detection program with capabilities described in the text. Invest in this program at a level significantly above that called for in the 2012 joint agency announcement of opportunity.

Recommendation 20: Support one or more third-generation (G3) direct detection experiments, guided by the results of the preceding searches. Seek a globally complementary program and increased international partnership in G3 experiments.

Recommendation 21: Invest in CTA as part of the small projects portfolio if the critical NSF Astronomy funding can be obtained.

Recommendation 22: Complete the Mu2e and muon g-2 projects.

Scenarios & Changes

Discussion:

- **B and A**
- **C**
- **Changes in direction**

Enabling R&D

23-24 & 26-29:

Recommendation 23: Support the discipline of accelerator science through advanced accelerator facilities and through funding for university programs. Strengthen national laboratory-university R&D partnerships, leveraging their diverse expertise and facilities.

Recommendation 24: 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 focused on the dual goals of increasing performance and decreasing costs.

Recommendation 26: Pursue accelerator R&D with high priority at levels consistent with budget constraints. Align the present R&D program with the P5 priorities and long-term vision, with an appropriate balance among general R&D, directed R&D, and accelerator test facilities and among short-, medium-, and long-term efforts. Focus on outcomes and capabilities that will dramatically improve cost effectiveness for mid-term and far-term accelerators.

Enabling R&D

23-24 & 26-29:

27: Focus resources toward directed instrumentation R&D in the near-term for high-priority projects. As the technical challenges of current high-priority projects are met, restore to the extent possible a balanced mix of short-term and long-term R&D.

28: Strengthen university-national laboratory partnerships in instrumentation R&D through investment in instrumentation at universities. Encourage graduate programs with a focus on instrumentation education at HEP supported universities and labs, and fully exploit the unique capabilities and facilities offered at each.

29: Strengthen the global cooperation among laboratories and universities to address computing and scientific software needs, and provide efficient training in next-generation hardware and data-science software relevant to particle physics. Investigate models for the development and maintenance of major software within and across research areas, including long-term data and software preservation.

Enabling R&D

25:

Recommendation 25: Reassess the Muon Accelerator Program (MAP). Incorporate into the GARD program the MAP activities that are of general importance to accelerator R&D, and consult with international partners on the early termination of MICE.

P5 Report

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

Discussion:

Closing Remarks

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All scenarios offer a rich scientific program

- Is the glass half-empty or half-full?
- Full of intriguing questions & exciting scientific opportunities
- Full of science and technology opportunities for the U.S. particle physics community
- No winners, no losers, merely choices.
- The report says “Our field is ready to move forward.” Are we?

Closing Remarks

This report represents a consensus vision developed bottom-up by the physics community with extensive consultation to identify the most exciting and productive areas of research and how we pursue them.

The report recognizes the reality of a challenging funding landscape, where choices have to be made and resources stewarded carefully, and confronts those challenges head on.

The promise/potential of high energy physics has never been greater – far from "settling" the big questions in high energy physics, the discovery of the Higgs boson and other recent milestones in physics have opened many more doors to exploring and understanding our universe.

Even given funding challenges, much important fundamental work can be accomplished and many tremendous scientific opportunities pursued, if we make the right strategic choices as a community.

This is a time of excitement and intellectual fervor that can engage young scientists and provide direction for a rewarding and fulfilling career; this report provides that career blueprint.