

***HEPAP Discussion***  
***April 10<sup>th</sup>***

**HEPAP Meeting**

*Newport Beach, CA; December 9-11, 2015*

**Andrew J. Lankford**

**HEPAP Chair**

*University of California, Irvine*

# Neutrino Oscillation Program

***P5 # 12: In collaboration with international partners, develop a coherent short- and long-baseline neutrino program hosted at Fermilab.***

***P5 # 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.***

***P5 # 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.***

***P5 # 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 FNAL.***

# Large Hadron Collider

***P5 # 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.***

- The enormous physics potential of the LHC, entering a new era with its planned high-luminosity upgrades, should be fully exploited.
- **The HL-LHC is strongly supported and is the first high-priority large-category project in our recommended program. It should move forward without significant delay to ensure that accelerator and experiments can continue to function effectively beyond the end of this decade and meet the project schedule.**

# DOE & NSF Agency Reports

*Further questions?*

**Comments on other aspects of P5 implementation?**

# Letter from Grannis & Peskin

This letter was sent to me with HEPAP members in cc:.

## The first paragraph of the letter:

We are writing to you in your role as the chair of HEPAP, to ask you to confirm the priority given by the P5 panel to the ILC as a future facility for high energy physics in the period after the LHC. Such a statement would be very timely at this moment as the Japanese government is considering hosting the ILC. We support the ordering of priorities given by P5 and see no need for a change in these. But it would be useful to affirm that the recommendations of the P5 panel report relevant to ILC are still in place.

## The body of the letter calls attention to 4 points (my summary):

1. **We need a plan now for the post-LHC era.**
2. **ILC provides a coherent plan.**
3. **P5 discussed and endorsed this plan to the extent possible within the current funding constraints.**
4. **Loss of the ILC will create a gap in exploration at the energy frontier which will have serious consequences for the field**

# Letter from Grannis & Peskin - 2

## This letter cited the P5 report as follows:

The P5 report unanimously approved by HEPAP singled out the ILC among future collider facilities beyond LHC. The second of the project-specific recommendations, after that on the HL-LHC, read:

*“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.”*

The discussion of the Higgs boson in the report more specifically addressed the issue we have described above:

*“The HL-LHC will operate in the 2020s, increasing the precision of the available measurements as data accumulates. As the pioneering HL-LHC program ramps down in the early 2030s, the complementary ILC could launch operations. A decade or more will then be needed to achieve the target precision for Higgs boson measurements at the ILC. Together, the HL-LHC and ILC provide a stream of data using the Higgs boson as a tool for discovery for several decades.”*

# Letter from Grannis & Peskin - 3

## Input from HEPAP member Tao Han:

I share the same concerns with Paul Grannis and Michael Peskin regarding the explicit support to the ILC project currently considered in Japan. I believe that the P5 recommendations related to the ILC should be reiterated and we at HEPAP should encourage our funding agencies to follow them up. Supporting the ILC is important not only for pushing forward for the next generation of collider projects, but also strengthening our international collaboration relevant to our domestic projects including DUNE etc.

# Letter from Grannis & Peskin - 4

## My view:

- Overall, the physics context and range of scientific opportunities have not changed since P5's deliberations.
- While no formal decisions or agreements regarding the ILC have yet been made, P5 did not expect an ILC decision before ~2018-19.
- P5 made tough choices in difficult budget scenarios, and it was only possible to recommend R&D for ILC within the base scenarios.
- The favorable reception that the P5 plan has received is based on the clear path that it defined and on the broad community support that it received.
- It is important to maintain a stable strategic plan.
  - Stability is important for dialogue with our government, especially during its early years of implementation.
  - Stability is also essential to our credibility with our international partners, looking across both oceans.
- The next strategic planning, which will plan into the period following the decade covered by P5, should happen on the timescale of 2018-2019.
- **It is appropriate to respond with an affirmation of the continued validity of the P5 strategic plan, including the recommendation concerning ILC.**

December 7, 2015

Dear Andy,

We are writing to you in your role as the chair of HEPAP, to ask you to confirm the priority given by the P5 panel to the ILC as a future facility for high energy physics in the period after the LHC. Such a statement would be very timely at this moment as the Japanese government is considering hosting the ILC. We support the ordering of priorities given by P5 and see no need for a change in these. But it would be useful to affirm that the recommendations of the P5 panel report relevant to ILC are still in place.

There is reason for our international partners to see ambiguity here. Most of the P5 project-specific recommendations have been granted substantial funding by the DOE Office of High-Energy Physics. Only the recommendation on the ILC (and on the Cerenkov Telescope Array) have not seen a boost in support in the wake of the P5 report. At the same time, ILC is increasingly discussed in the context of other proposed future facilities such as large circular colliders.

We feel that the perception that decisions on ILC can be postponed to the future misses a serious problem for the collider physics community that must in fact be addressed in the next few years. At this moment, our community is fortunate to have the LHC running at close to its design energy and with good prospects for a high-luminosity stage in the 2020's. However, we have reached the point where there should be a plan beyond that, and there is none. The last major LHC accelerator and detector upgrades will be completed in 2023. The next CERN project cannot begin until then and likely will not be completed until the 2040's. The LHC program will likely begin to wind down around 2030. This potentially leaves a long gap with limited opportunity to make discoveries at the energy frontier and to train a new generation of high-energy physicists, unless a successor machine can be approved for construction within the next few years. There is no precedent for such a gap. In the 2000's, CERN had no collider program, but active experiments at the Tevatron, PEP-2, KEKb, and other facilities were essential to the preparation for the LHC.

There are limited options for this successor facility. Historically, new proposals for such large machines have always seriously underestimated their timelines and their technical readiness. There is only one proposal on the table that could realistically address this problem. That is the ILC. This statement is based on two strong arguments.

First, the ILC provides outstanding physics opportunities. Its program of precision measurements on the Higgs boson and the top quark builds on the physics knowledge that we are obtaining from the LHC. It will allow us to explore further into the unknown regions where we expect to find new fundamental interactions. This program should be attractive to a large part of the LHC community. It is also a program that is justified based on results that the LHC has already achieved, independently of what will be learned there in the future.

Second, the ILC is a mature proposal. It has a completed technical design that has withstood extensive cost and technology reviews. It is the only proposal on the table receiving significant public attention from a potential host government. The ILC has powerful political and industrial supporters in Japan who see this project as one with not only physics interest, but also tangible economic and social benefits.

We should have learned by now that our community has no entitlement to future accelerators. Every project is uncertain, with many difficulties in its path. Protracted discussion of alternate projects whose design and cost are not mature gives political leaders ample excuse to defer a commitment. When there is an opportunity to make a project real, we need to grasp it.

The government of Japan is now evaluating the hosting of the ILC through a formal process led by the MEXT cabinet ministry. One of the criteria is that the ILC should be a global project that has very strong support of the world particle physics community. It is essential that MEXT should have no doubt about this.

The P5 report unanimously approved by HEPAP singled out the ILC among future collider facilities beyond LHC. The second of the project-specific recommendations, after that on the HL-LHC, read:

*"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."*

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US particle physicists need to make clear to the Japanese government, and to our own government and funding agencies, that we want this to be the next major project at the energy frontier, and that, individually and collectively, we see it as a part of our future. A statement by HEPAP recalling and emphasizing these conclusions of the P5 panel will help send this message. If we cannot state clearly our support of ILC, we risk losing this opportunity, and we put at risk the whole global program of collider physics.

Sincerely,

Paul Grannis and Michael Peskin

# Thoughts on the Timing of the Next P5

- The next strategic planning will plan the period following the decade covered by the 2014 P5 plan.
- It should likely happen on the timescale of ~2018-19.
  - A number of things converge on this rough timescale:
    - the physics results of LHC Run 2,
    - the Japanese government's decision regarding whether or not to host the ILC,
    - approval of the LBNF/DUNE baseline
    - the process of the next European Strategy Update,
      - with which we should roughly synchronize and coordinate our U.S. strategic planning process.
- I would not fix that time now.
- In case of major new developments, timescale could be different.

# List of Reports for Future Meetings

In addition to regular follow-up on ongoing activities, e.g.:

- Development of implementation of P5 plan
- *Etc.*

Reports (partial list):

- ASCR
- CPAD
- Evolution of HEP Research Program
  
- Further reports on connections with other disciplines
- Reports from other regions (Europe, Japan, China, etc.)

**Suggestions for further topics welcome.**