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DOE Laboratory Reviews

HEPAP Meeting
February 25, 2009
Washington, D.C.

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Office of High Energy Physics

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Overview

- Annual Facility Operations Reviews
  - Fermi
  - SLAC (for D&D activities)
  - U.S. LHC operations
- Institutional Reviews
  - All HEP labs, on a rotating basis
- Research Reviews (new)
  - By research thrust, every 3 years
  - Comparative review

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Institutional Reviews

- The focus of the review is the role and importance of the laboratory's program to the national HEP program and an assessment of its performance and planning.
  - Replaces annual site review but similar scope
- This is a 2-3 day site review with outside consultants. Review cycle:
  - 2008 : SLAC
  - 2009 : LBNL
  - 2010 : BNL
  - 2011 : ANL
  - (repeat)...
- For years in which there will not be an institutional peer-review, it is expected that a site visit (or reverse site visit) will be scheduled by our office.
  - Involves OHEP program managers (no consultants)
  - Progress and issues for the laboratory can be presented.

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Research Reviews: Motivation

- OHEP Committee of Visitors 2007:
  - *"We recommend that the office develop a process to globally optimize and comparatively review the balance of support for HEP research at Fermilab, the universities and the other laboratories in light of the evolving program"*
- New OHEP organization
  - Management by physics thrust, not lab/university
- Therefore, make the review process as transparent and as uniform as possible between labs/universities:
  - 3-year proposals
  - Peer review on standard criteria
  - Comparative evaluation

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Research Reviews: Procedure

- Comparative review of the research and technology development activities at the DOE laboratories.
- This is a multi-day panel review at DOE (or nearby). Review cycle:
  - 2008 : Theory, Accelerator Science
  - 2009 : Proton accelerator-based, Detector R&D
  - 2010 : Electron accelerator-based, Non-Accelerator
  - 2011: (repeat)...

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Research Reviews : Recipe

- Step 1 : Identify excellent reviewers
- Step 2 : Issue charge and guidance to focus inquiry
- Step 3 : Stand back and let them have at it
- Step 4: Assemble report
- Step 5: Convey to lab management for action

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Lab Theory Review 2008

Panel Members:

- Wilfried Buchmuller (DESY)
- Miriam Cvetic (University of Pennsylvania)
- Kaoru Hagiwara (KEK)
- Laurent Lellouch (CNRS Marseille)
- Al Mueller (Columbia University)
- Quaisar Shafi (Bartol Research Institute)
- Junko Shigemitsu (Ohio State University)
- Paul Steinhardt (Princeton University)
- Mark Wise (California Institute of Technology)

DOE HEP Theory Groups:

- ANL, BNL, FNAL, LANL, LBNL, SLAC

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Review Charge I

"We are particularly interested in a review of the labs' research contributions (as applicable) along these programmatic thrust lines:

- Phenomenology and Model Building
- Lattice Gauge Theory
- Formal Quantum Field Theory and String/Gravity Theory
- Cosmology and Particle Astrophysics Theory

We asked the labs to present (achievements, plans, budgets) along these thrust lines.

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Lab Theory Groups

	Phenom/ Model	Lattice Gauge	Formal/ String	Particle Astro	Staff (FTEs)
ANL	X				9
BNL	X	X			12
FNAL	X	X	X	X	35
LANL	X	X		X	7
LBNL	X				3
SLAC	X		X	X	25

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Theory Review Charge II

For each individual lab research group, evaluate:

1. Quality and Impact of recent research
2. Merit and feasibility of proposed research
3. Competence and promise of the research group
4. Adequacy of resources and cost-effectiveness
5. Quality of lab support and infrastructure
6. How the group enriches the lab's experimental program (as applicable) and how well the group's activities relate to the HEP mission

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Theory Review Charge III

We also asked for:

- Discussion of the unique and important elements that the laboratory programs bring to bear in addressing these research topics
- Comparative assessment of each lab's overall performance in these areas relative to its peers as well as versus comparable university groups.

This led to many interesting discussions.

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Review and Report Format

- Reviewers discuss issues/questions
- Fast feedback to labs (as desired)
  - What was not clear or not addressed
- Closeout with OHEP management
- Confidential letters to OHEP with overall written assessment
  - Both individual labs and overall research thrusts
  - Incorporated into final reports
- Lab management receives individual report and summary report

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Theory Review Findings I

- The laboratory research groups contain some very prominent members of the theoretical physics community.
- Research at the National Laboratories has been at the forefront of the parts of theoretical particle physics that make direct contact with experiments.
- This includes research on the predictions of the standard model for precision electroweak-physics and the research directed towards understanding the predictions of proposed extensions of the standard model for High Energy Physics that is done, at some level, by all the laboratory groups.

Theory Review Findings II

- One of the most important current topics in high energy theory research is the computation of cross sections for the scattering of elementary particles when the strong interactions are involved and the processes involve several partons in the final state.
  - Lab researchers at did pioneering work in this area and continue to be dominant players in this field.
- Research staff at the National Laboratories have played a crucial role for the development and application of Lattice QCD methods.
- Laboratory research staff have played important roles in the development of effective field theory approaches that have been crucial for understanding various experimental results.
- Monte Carlo event generators for hadronic collisions were pioneered at DOE labs, and they continue to develop more accurate generators.
  - They have become an essential tool for analyzing the very complex events produced in high-energy collisions, and their role may be even more crucial in the search for new physics at the LHC.

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Theory Review Findings III

- Research on String Theory/Quantum Gravity at the Laboratories is not a large effort.
  - But it is noteworthy that the researchers…in this area, are of very high caliber and have had a significant impact on recent research trends in that field.
- Cosmology and Particle Astrophysics have played an important role in shaping our ideas about physics beyond the standard model and in constraining possible extensions of the standard model.
  - Hence, DOE OHEP support for theoretical research in this area is appropriate.
  - Currently the groups…[working in this area] perform research directed more towards what would be considered astrophysics than the type of Particle Astrophysics and Cosmology that was originally done by the Fermilab Particle Astrophysics group.

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The Role of Lab Theory Groups

- Over the years the [lab] staff members and their postdocs and visitors have helped to define the High Energy Physics program being advocates for new initiatives and contributing to an understanding of the physics reach of various proposed experimental facilities.

- Laboratory high energy groups grew up within accelerator laboratories and tended to focus their research more on the experimental programs that these laboratories ran for outside, university, users and in-house experimenters.
  - In addition to the direct impact theorists could have on an experimental program they were also important for creating an environment of intellectual activity that is crucial for understanding and promoting the experimental research being done at a laboratory.
  - Currently total DOE support of high energy laboratory theory groups is about the same as for all the DOE supported theory groups in universities, although the number of permanent theorists in laboratory groups is only about one-fifth that in universities.

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The Role of Lab Theory Groups

- Over time the nature of high energy experimental laboratories in the US has changed, and recently the model for theory funding has changed, with laboratory and university theory groups now in a more direct competition for funds based on their contribution to physics thrusts determined by the DOE.
  - Although no longer so closely associated with experiments run at their laboratories, laboratory theory groups and laboratory theorists still have a major role to play. It is mainly they who are responsible for the theory support necessary to make the US high energy experimental physics program successful.
  - Besides providing support to the high energy experimental program, the laboratories also play an important role in the US Lattice QCD effort, by hosting the supercomputers required to perform state of the art calculations in that field.

The reviewers found that the DOE/HEP labs had varying degrees of success at fulfilling these unique roles.

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Particle Astrophysics and Cosmology Theory

- The panel enthusiastically endorses the quality of the research done by the Particle Astrophysics and Cosmology groups. They are comparable in quality to very good university groups.
  - However, there are some concerns looking to the future

- The panel would like to see the DOE-OHEP supported theory efforts more aligned with what would traditionally be considered Particle Astrophysics and Cosmology.
  - What constitutes a particle astrophysicist or cosmologist that should be supported by DOE-OHEP theory is difficult to define precisely. Possible criteria:
    - Research should be aimed primarily at proposing new elements of particle physics to explain astrophysical phenomena, or exploring astrophysical phenomena to test new ideas in particle physics
    - Researchers are well-versed in both particle physics and astrophysics/cosmology

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Theory Concluding Remarks

- Many panel members noted that laboratory theorists cost much more to the DOE than university theorists, by a factor of about four to five per permanent theorist depending on the laboratory.
  - This is partly due to the fact that university theorists have their base salary paid by the university, but is also due to...the fact that laboratory theory groups have more postdocs per permanent staff member than do university groups.

- Many panel members felt that it is important that laboratory groups clearly identify missions that will distinguish them from university groups and that will allow them to make important contributions to High Energy Physics that would normally not be done in a university group
  - In the case of particle astrophysics and cosmology, the focus should be on issues that have an impact on particle physics and particle physicists

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Accelerator Science Review

December 2-4, 2008 in Gaithersburg MD

Review Panel:

- Ronald Davidson, Princeton Plasma Physics Lab
- David Douglas, Thomas Jefferson National Accelerator Facility
- Stuart Henderson, Oak Ridge National Lab
- Karl Krushelnick, University of Michigan
- Howard Milchberg, University of Maryland
- Ken Peach, Oxford University
- Kaoru Yokoya, KEK

DOE HEP Accelerator Science Groups:

- ANL, BNL, FNAL, LBNL, SLAC

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Accelerator Science Review Charge

"We are particularly interested in a review of the labs' research contributions (as applicable) along these programmatic thrust lines:

- Accelerator and Beam Physics
- Novel Accelerator Concepts
- Muon Collider/Neutrino Factory
- High Gradient Acceleration
- Beam Sources and Instrumentation

We asked the labs to present (achievements, plans, budgets) along these thrust lines.

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Accel. Science Review Charge II

For each individual lab research group, evaluate:

1. Quality and Impact of recent research
2. Merit and feasibility of proposed research
3. Competence and promise of the research group
4. Adequacy of resources and cost-effectiveness
5. Quality of lab support and infrastructure
6. How the group enriches the lab's experimental program (as applicable) and how well the group's activities relate to the HEP mission

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Accel. Science Review Charge III

We are also requesting the reviewers provide general findings and comments about the current status and future promise of the programmatic thrust areas…for example:

- What are the expected deliverables of this research thrust in the next 5-10 years? Approximately what level of investment is needed to achieve these goals?
- What is the benefit of additional investments in this particular thrust? What are the likely impacts of reduced investments?
- Is the current level of investment appropriate, given the current technical status, near-term milestones, and long-term promise?
- Does this programmatic area have sufficient technical and management infrastructure to reliably deliver its goals and respond to new developments**?"**

This led to many interesting discussions.

Next Steps

- Discussing response to Theory Review with labs
- Accelerator Science Review Report
  - Final to labs by next month
- Proton Research Review in June
- Detector R&D Review in July

Feedback we have received on these reviews has mostly been very positive. We appreciate HEPAP's comments and suggestions as well.