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# HIGH ENERGY PHYSICS PROGRAM PLANNING

High Energy Physics Advisory Panel

Dr. Robin Staffin  
Associate Director, Office of High Energy Physics  
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# HEPAP Charge: LHC-ILC Synergy

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- Need to explain to the broad non-scientific community how the ILC and LHC work in tandem.
  - What discoveries would not be made without the ILC?
  - How would an ILC be utilized in understanding a Standard Model Higgs (or whatever fulfills its role)?
  - What would be the role of an ILC in making additional, unique contributions to discoveries beyond the Standard Model (SUSY, Extra Dimensions...), in distinguishing between models, in establishing connections to cosmology?
- We don't want any new physics studies
- We want your help in distilling the existing body of work into a **crisp, accessible and persuasive case**
- Goal:
  - 10-15 pages
  - Accessible to non-experts
    - e.g. members of the EPP 2010 panel, OMB and OSTP staff, etc.

# Planning for the Future

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- The current U.S. accelerator-based program is world-leading, but finite in lifetime
  - PEP-II and the Tevatron will ramp down toward the end of the decade; miniBooNE, MINOS also
- The Linear Collider is our highest priority for a future major facility,
  - but timescale is uncertain and cannot be done without either an increase in resources or a reduction in cost
- LHC participation will be a central piece of the program

## Hence

**We believe we should be planning for a portfolio of medium scale, medium term experiments to start construction in the period 2007-10**

- Scientific opportunities are compelling
  - neutrino physics (APS study); dark matter, dark energy...
- Resources will become available, through redirection

# New Initiatives

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- Some medium-scale experiments that might be considered (not an exhaustive list)
  - A reactor-based neutrino experiment to measure  $\theta_{13}$
  - An off-axis accelerator-based neutrino experiment for  $\theta_{13}$  and to resolve the neutrino mass hierarchy
  - A high intensity neutrino beam for neutrino CP-violation experiments
  - A neutrinoless double-beta decay experiment to probe the Majorana nature of neutrinos
  - An underground experiment to search for direct evidence of dark matter
  - A ground-based dark energy experiment
  - ...

Note: JDEM, ILC are considered to be above “medium-scale.”

# Scale of Program

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- One can go through a straw-man exercise to see if a reasonable subset of these initiatives could be worked into a realistic portfolio
- Make reasonable assumptions about
  - Tevatron and B-factory operations roll-off
  - ILC R&D ramp-up
  - US LHC
    - Exact details don't matter, and would be wrong anyway
- Bottom line is that O(\$50-100M) per year may be available to invest in new initiatives by the end of the decade

## Complications:

- Any \$ envelope will depend strongly on facility operations and LC R&D funding in the out-years
- Not all projects are equal in science or scope, even within a given physics area
  - Need to develop a set of criteria to evaluate projects

# Suggested Criteria

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- **Scientific Potential** : to what extent does the project have the ability to change our fundamental view of the universe?
- **Relevance**: is the science important to DOE/HEP's mission?
- **Value**: does the level of scientific potential match the level of investment?
- **Alternatives**: are there more cost-effective alternatives to get at the same (or most of the same) physics?
- **Timeliness**: will the results come at the right time to have sufficient impact?
- **International**: are similar efforts underway in other countries? Are there potential international partners for this effort?
- **Infrastructure**: Does the project exploit, or help to evolve, existing infrastructure (including human capital)

# Advisory Process

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- Many of the new initiatives involve other agencies: existing advisory panels are not always adequately configured.

A hierarchy of questions to be addressed:

1. Overall shape of field – “grand strategy”
  - National Academies study, HEPAP...
2. What priority to give to medium scale area X vs. area Y? – “strategy”
  - We are asking HEPAP to re-establish the P5 panel to help here
3. What is the best project in area X? – “tactics”
  - Scientific Advisory Group (SAG)
    - Anticipate several of these with different reporting lines to cover the various areas

# NuSAG

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- **A Neutrino Scientific Advisory Group (NuSAG) should be initiated immediately**
    - **Will be asked to address**
      - **Choice of Reactor neutrino experiment**
      - **Choice of Off-axis neutrino experiment**
      - **Choice of neutrinoless double beta decay experiment**
    - **Later, we may ask for action on high intensity neutrino beam(s).**
  - **NuSAG will be a joint subpanel of HEPAP and NSAC**
    - **Reports through HEPAP to DOE-HEP and NSF;**
    - **through NSAC to DOE-NP and NSF**

We are considering how to set up an analogous SAG process for other scientific topics such as dark matter, dark energy and particle astrophysics.

# The Role of P5

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Formally, P5 expired in November 2004 (created in 2002 for two years)

What is the role of P5?

- P5 should address relative priorities of (medium-sized) proposed projects within the program context
- We have therefore asked HEPAP to re-establish P5 for two more years
  - As before, an “umbrella” letter creates the panel, and individual charges will follow

(Ideally) P5 would be asked to compare the recommended options from the SAG process and prioritize relative to one another

(More realistically) P5 will be given a nominal (optimistic but not “blue sky”) envelope of available funding for new initiatives and asked to prioritize within that constraint

# Bigger Questions to HEPAP

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No specific charges at this time - consider this a "Heads-Up"

- **Linear Collider**
  - What is an appropriate planning assumption for the schedule?
  - What level of resources should go into ILC R&D as function of time?
  - What are the decision points (and off-ramps) for ILC?
- **Dark Matter/Dark Energy:**
  - JDEM, LSST
  - What is the appropriate balance between space based and something ground based, faster, but less capable?
- **U.S. accelerator based program:**
  - How long to run B-factory and Tevatron, given limited resources?
  - What is the "right" balance of facility operations/ongoing research/new facility R&D for the next ~ 5 years?
  - Are the HEP labs properly aligned to maximize the program?

# Summary

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## Ongoing:

- National Academies EPP2010 study addresses broad program priorities.

## Now:

- Neutrino SAG addresses choices in neutrino physics.
  - Other SAGs (Dark Energy,...?) formed as needed on specific scientific topics
- P5 renewed and to be charged to compare/prioritize new initiatives within envelope

# Conclusion

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- We have a great program – but the time is now right to start planning a portfolio of medium term, medium scale initiatives that can be launched around 2007-10
  - Scientific opportunities
  - Ramp-down of existing facilities
- SAG's to select “best in class”
- P5 to balance/prioritize areas
- Charge on LC/LHC Synergy
- We have a lot to do
- Let's get to work