Report from the Energy Frontier

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Charge for this presentation:

1. What are the main messages of Snowmass from the Energy Frontier?

2. What, if anything, did Snowmass miss in the Energy Frontier study ?

3. What do you see as the main issues and decisions emerging from Snowmass that you anticipate P5 addressing?

The main messages ...

1. “The Higgs changes everything.”

The completion of the Standard Model creates a new agenda for particle physics.

Major issues must be addressed at the TeV energy scale: Higgs potential, dark matter.

3-prong program at colliders:

- Study the Higgs boson in as much detail as possible.
- Search for the imprint of the Higgs on W, Z, and top.
- Search for new particles with TeV-scale masses.

2. There is a compelling case for physics at the LHC up to 300 /fb.

new particle searches with x 2 discovery reach

Prepare for discovery, have a plan for machines that can exploit it.

3. There is a compelling case for the High-Luminosity LHC.

look for qualitative improvement in

Higgs coupling precision

Higgs sector resonances

electroweak SUSY, dark matter searches

rare top quark decays

3. There is a compelling case for a lepton collider beyond LHC.

Theory sets the goal in Higgs, top quark couplings as discovery of deviations from the SM at the few-percent level.

Lepton colliders can achieve this level of precision.

ILC, on the table now, can meet this goal.

5. Maintain the vision of future high-energy colliders.

Our study emphasized the importance of a 100 TeV pp collider (VLHC) to address discoveries from LHC (or ILC).

We need to re-invigorate the study of this machine both in the physics and in the accelerator technology.

6. We will realize these goals through global collaboration.

We are fortunate that other regions of the world agree with our goals and are providing high-energy colliders with impressive capabilities.

It is important the US physicists can participate in these programs.

7, 8. Options not favored at Snowmass:

33 TeV pp : considerable study, little enthusiasm

ep collider: interesting physics suggested, but little effort

what did we miss ... ?

1. Study of the allocation of resources to future collider experiments

What should be the scope of the (Phase 2) LHC detector upgrades ?

Strong views expressed that the US must participate in both ATLAS and CMS.

What should be the scope of US participation in ILC ?

US physicists and engineers who would participate in HL-LHC and ILC are largely the same people. ILC, if it is built in Japan, will likely be the only Energy Frontier accelerator in the world in the 2030's.

Is there a vision for a gradual transition between these facilities ?

2. Perspective on benefits to the US from offshore vs onshore experiments

Most contributions to global projects are in-kind.

Most of the money spent for US participation in LHC was spent in the US, much of it to develop US technologies.

We wrote a position paper on this subject, but we were not able to gather the full quantitative information.

3. Studies for higher energy pp colliders

We developed detector models and simulated background samples for 33 and 100 TeV. However, a full physics study has just begun.

4. “Discovery stories”

Imagine a discovery at the LHC before 2020, and trace the path that follows from this discovery through results at the range of future collider experiments.

We sketched out two scenarios in our report; some EF working group reports proposed additional scenarios.

5. Overlaps with Intensity Frontier

Neutrino mass should be a part of the Higgs boson story.

Searches for rare weak decays may be motivated as searches for flavor couplings of TeV scale particles.

The distributed nature of Snowmass made it difficult to follow these connections. Some will be explored at workshops in the next year.

issues and decisions for P5 ...

1. We would like to see P5 formally give significant priority to the main EF program elements listed above.

2. We hope that P5 will understand better the transition of resources into US participation in HL-LHC and then into another EF project in the 2030's.

3. We hope that P5 will gives significant priority to R&D for higher-energy collider technologies.

4. We believe that it is time that detector R&D be adopted formally as a part of the planning of our scientific future.