Report from the LHC/ILC Subpanel

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HEPAP meeting
11 July 2005

Outline

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Who we are

- Jim Siegrist (LBNL), Joe Lykken (Fermilab) co-chairs
- Jonathan Bagger (JHU, EPP2010)
- Barry Barish (Caltech, GDE)
- Neil Calder (SLAC, ILCCG)
- Albert de Roeck (CERN, CMS)
- Jonathan L. Feng (Irvine, ILC Cosmo WG)
- Fred Gilman (CMU, HEPAP)
- JoAnne Hewett (SLAC, HEPAP, ALCPGEC)
- John Huth (Harvard, ATLAS)
- Judy Jackson (Fermilab, ILCCG)
- Young-Kee Kim (UC, CDF, HEPAP, ALCPGEC)
- Rocky Kolb (Fermilab, DE Task Force)
- Konstantin Matchev (Florida, CMS, ILC Cosmo WG)
- Hitoshi Murayama (Berkeley, ALCPGEC)
- Rainer Weiss (MIT, CMB Task Force)

What we are doing

- We have a hard deadline of August 2 for giving input to the EPP2010 NRC committee
- This conflicted with the broader aspects of our charge from HEPAP, and requests we heard during our April 22 meeting with Washington customers
- Solution: we are producing two reports, the first for EPP2010, then a later document for a wider audience
- You have a draft of the EPP2010 document
- The second report will be ready early this Fall

Timeline

- 25 March: first meeting at LCWS Palo Alto
- 30 March: first weekly telecon
- 22 April: meeting in Washington with J. Marburger, M. Turner, R. Staffin, P. Looney, M. Holland, J. Parriott, K. Carroll
- 23 April: writing begins
- 19 May: HEPAP
- 26 May: meeting at Fermilab
- 15 June: meeting at SLAC
- 16 June - 8 July: ten writers/editors iterating on a daily basis
- 24 June: first complete pre-draft sent to R. Staffin and M. Turner
- 1 July: first draft circulated to some leaders of the community
- 8 July: new draft report sent to HEPAP
- 2 August: unveiling to EPP2010
- 3 August - continue with phase two document

Outreach to our own community

- JoAnne is a member of the LHC/ILC Study Group
- We participated in the last ALCPG EC phone meeting
- We are coordinating with the ILC Worldwide Study Group
- Judy, Neil, and Jon B. are in the ILC Communications Group
- Joe and Hitoshi briefed the rest of the DPF EC in Tampa

Outreach to our own community

- We have solicited and received feedback on the first draft from leaders of the LHC: Fabiola Gianotti, Albert De Roeck, John Huth, William Trischuk
- We have solicited and received feedback on the first draft from leaders of the ILC: Jim Brau, Harry Weerts, Ritchie Patterson
- This feedback is already incorporated into the current draft
- We are very encouraged by the constructive tone of the feedback

Outreach to our own community

- Before finalizing our report for EPP2010, we will incorporate feedback from other sources as well:
- Lab directors
- More leaders of the LHC, ILC, and non-collider communities
- HEPAP (i.e. you)
- We will also work with the community post-EPP2010, e.g. at the ILC Snowmass workshop in August

Philosophy of the draft report

- Our guidance from EPP2010 is that they are looking for a whitepaper on the physics related to the LHC and linear collider
- This also fulfills a significant part (but not all) of our charge from HEPAP
- The current draft is a whitepaper with an introduction and a summary table
- The final version will be transmitted to EPP2010 along with a cover letter from FG that addresses the specific EPP2010 questions to HEPAP

Physics First

- The report is organized around the physics
- It begins with the 9 great questions from *Quantum Universe*
- These are mapped into the three basic physics themes that are most relevant for LHC and ILC
- Chapter II explains the three physics themes

Physics scenarios

- Chapter III describes 10 of the most likely and robust scenarios addressing this physics at LHC and ILC
- Each scenario begins with a specific LHC discovery
- Each scenario ends with an ILC discovery triggered by the LHC discovery
- Typically there are intermediate discoveries for which the relative contributions of LHC and ILC depend on details of the physics, and on uncertainties in the reach of LHC analyses

500:1 compression ratio

- The physics scenarios are summarized in a table
- The table also shows the explicit connection between LHC discovery, the resulting opportunities that require an ILC, and the QU questions that are addressed in each case
- The information in the table is coarse-grained, but the overall message is an accurate reflection of the 20 page narrative in Chapter III
- Chapter III is itself an accurate distillation of the 500 page LHC/ILC Study report and other studies

Technical level

- Our report retains the meat of the LHC/ILC study despite a 96% reduction in size
- At the same time the technical level was converted to something like Scientific American, with almost all concepts and jargon defined in the document itself
- This was very difficult to accomplish

Highlights of the report

The table on page 6

Three physics themes on page 5:

- Mysteries of the Terascale
- Light on dark matter
- Einstein's telescope

Resolving the mysteries of the Higgs and supersymmetry

- The LHC should discover the Higgs
- It should also discover supersymmetry or some other new principle that explains the Higgs' existence
- The linear collider would resolve the hidden messages of the Higgs, the superpartners and their Terascale relatives

Determining what dark matter particles can be produced in the laboratory and discovering their identity

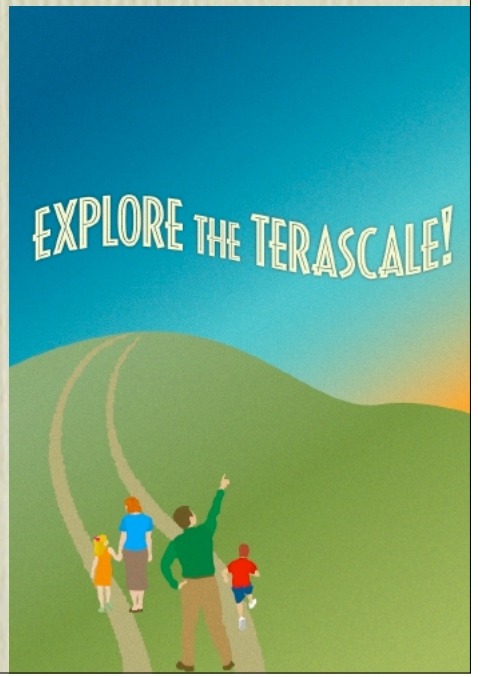
- Most theories of Terascale physics contain new massive particles with the right properties to contribute to dark matter
- Such particles would first be produced at the LHC
- Experiments at the linear collider would establish whether they are actually dark matter

Connecting the laws of the large to the laws of the small

- From a clear vantage point at the Terascale, the linear collider could function as a telescope to probe far higher energies
- This capability offers the potential for discoveries beyond the direct reach of any accelerator that could ever be built
- In this way, the linear collider could bring into focus Einstein's vision of an ultimate unified theory

La Terascala

- The report shows how a variety of evidence points to the TeV energy regime as a gateway to revolutionary discoveries
- This is why we are so excited about the LHC
- However “TeV scale” is a lousy name
- So we borrowed “Terascale” from our friends in high-performance computing



Dispelling misconceptions

- There is a misconception that if LHC discovers more and measures more, then there is less motivation for the ILC
- Our report makes it clear that the opposite is true

Dispelling misconceptions

- There is a misconception that once LHC discovers a Higgs particle, the rest is details
- Our report makes it clear that the discovery of a Higgs particle would raise urgent questions leading to even greater discoveries

Dispelling misconceptions

- There is a misconception that the only thing colliders do is discover particles
- Our report explains how particles are the tools that we use to resolve mysteries and to discover new laws of nature
- See the p11 sidebar: “Particles tell stories”

How you can help us

- Make comments on the draft!