ITRP

Linear Collider Technology Recommendation

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ILCSC/ICFA Special Meeting
IHEP, Beijing
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Deliberating in Korea
6th International Technical Recommendation Panel Meeting
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Departing from Korea
International Technology Recommendation Panel Meeting
August 11 ~ 13, 2004, Republic of Korea

Why ITRP?

- Two parallel developments over the past few years (the science & the technology)
- The precision information from LEP and other data have pointed to a low mass Higgs; Understanding electroweak symmetry breaking, whether supersymmetry or an alternative, will require precision measurements.
- There are strong arguments for the complementarity between a ~0.5-1.0 TeV LC and the LHC science.
- Designs and technology demonstrations have matured on two technical approaches for an e^+e^- collider that are well matched to our present understanding of the physics. (We note that a C-band option could have been adequate for a 500 GeV machine, if NLC/GLC and TESLA were not deemed mature designs).

Why Decide Technology Now?

- We have an embarrassment of riches !!!!
  - Two alternate designs -- "warm" and "cold" have come to the stage where the show stoppers have been eliminated and the concepts are well understood.
  - R & D is very expensive (especially D) and to move to the "next step" (being ready to construct such a machine within about 5 years) will require more money and a concentration of resources, organization and a worldwide effort.
  - It is too expensive and too wasteful to try to do this for both technologies.
  - A major step toward a decision to construct a new machine will be enabled by uniting behind one technology, followed by a making a final global design based on the recommended technology.
  - The final construction decision in ~5 years will be able to fully take into account early LHC and other physics developments.

The ITRP Members

Jean-Eudes Augustin (FRANCE)
Jonathan Bagger (USA)
Barry Barish (USA) - Chair
Giorgio Bellettini (ITALY)
Paul Grannis (USA)
Norbert Holtkamp (USA)
George Kalmus (UK)
Gyung-Su Lee (KOREA)
Akira Masaike (JAPAN)
Katsunobu Oide (JAPAN)
Volker Soergel (GERMANY)
Hirotaka Sugawara (JAPAN)
David Plane - Scientific Secretary

The Charge to the International Technology Recommendation Panel

General Considerations

The International Technology Recommendation Panel (the Panel) should recommend a Linear Collider (LC) technology to the International Linear Collider Steering Committee (ILCSC).

On the assumption that a linear collider construction commences before 2010 and given the assessment by the ITRC that both TESLA and JLC-X/NLC have rather mature conceptual designs, the choice should be between these two designs. If necessary, a solution incorporating C-band technology should be evaluated.

Note -- We have interpreted our charge as being to recommend a technology, rather than choose a design

How ITRP has Approached its Task

- Six Meetings
  - RAL (Jan 27,28 2004) → Tutorial and Planning
  - DESY (April 5,6 2004)
  - SLAC (April 26,27 2004) → Site Visits
  - KEK (May 25,26 2004)
  - Caltech (June 28,29,30 2004) → Deliberations
  - Korea (August 11,12,13) → Conclusion

Our Process

- We studied and evaluated a large amount of available materials
- We made site visits to DESY, KEK and SLAC to listen to presentations on the competing technologies and to see the test facilities first-hand.
- We have also heard presentations on both C-band and CLIC technologies
- We interacted with the community at LC workshops, individually and through various communications we received
- We developed a set of evaluation criteria (a matrix) and had each proponent answer a related set of questions to facilitate our evaluations.
- We assigned lots of internal homework to help guide our discussions and evaluations

Can be found at:
http://www.ligo.caltech.edu/~donna/ITRP_Home.htm

Evaluating the Criteria Matrix

- **We analyzed the technology choice through studying a matrix having six general categories with specific items under each:**
  - **the scope and parameters specified by the ILCSC;**
  - **technical issues;**
  - **cost issues;**
  - **schedule issues;**
  - **physics operation issues;**
  - **and more general considerations that reflect the impact of the LC on science, technology and society**
- **We evaluated each of these categories with the help of answers to our "questions to the proponents," internal assignments and reviews, plus our own discussions**

What did we do?

- **We each traveled at least 75,000 miles**
- **We read approximately 3000 pages**
- **We had continuing interactions with the community and with each other**
- **We gave up a good part of our "normal day jobs" for about six months**
- **We had almost 100% attendance by all members at all meetings**
- **We worked incredibly hard to "turn over every rock" we could find.**

The Recommendation

- **We recommend that the linear collider be based on superconducting rf technology (from Exec. Summary)**
  - **This recommendation is made with the understanding that we are recommending a technology, not a design. We expect the final design to be developed by a team drawn from the combined warm and cold linear collider communities, taking full advantage of the experience and expertise of both (from the Executive Summary).**
  - **We submit the Executive Summary today to ILCSC & ICFA**
  - **Details of the assessment will be presented in the body of the ITRP report to be published around mid September**
  - **The superconducting technology has features that tipped the balance in its favor. They follow in part from the low rf frequency.**

Some of the Features of SC Technology

- **The large cavity aperture and long bunch interval reduce the complexity of operations, reduce the sensitivity to ground motion, permit inter-bunch feedback and may enable increased beam current.**
- **The main linac rf systems, the single largest technical cost elements, are of comparatively lower risk.**
- **The construction of the superconducting XFEL free electron laser will provide prototypes and test many aspects of the linac.**
- **The industrialization of most major components of the linac is underway.**
- **The use of superconducting cavities significantly reduces power consumption.**

Both technologies have wider impact beyond particle physics. The superconducting rf technology has applications in other fields of accelerator-based research, while the X-band rf technology has applications in medicine and other areas.

Remarks and Next Steps

- CLIC, C-Band, GLC/NLC and TESLA researchers have done a fantastic job bringing these technologies to the point where we can move forward toward making a next generation linear collider a reality.
- We especially want to note the importance of the the work that has been done on the warm technology. We need to fully capitalize on the experience from SLC, FFTB, ATF and TTF as we move forward. The range of systems from sources to beam delivery in a LC is so broad that an optimized design can only emerge by pooling the expertise of all participants.
- We endorse the effort now underway to establish an international model for the design, engineering, industrialization and construction of the linear collider. Formulating that model in consultation with governments is an immediate priority. Strong central management will be critical from the beginning.

Remarks and Next Steps

- The linear collider will be designed to begin operation at 500 GeV, with a capability for an upgrade to about 1 TeV, as the physics requires. This capability is an essential feature of the design. Therefore we urge that part of the global R&D and design effort be focused on increasing the ultimate collider energy to the maximum extent feasible. (from Exec Summary)
- A TeV scale electron-positron linear collider is an essential part of a grand adventure that will provide new insights into the structure of space, time, matter and energy. We believe that the technology for achieving this goal is now in hand, and that the prospects for its success are extraordinarily bright. (from Exec Summary)