ITRP Questions

- 34 Questions distributed to the major labs
- Questions #30b and #30d are physics related and largely technology independent
- Lab directors asked World-Wide-Study to draft a World-Wide response
- Inter-regional committee was formed to draft a response
- This response has been reviewed by another committee

Inter-regional committee

- Americas: JoAnne Hewett (SLAC)
  Mark Oreglia (Chicago)
- Asia: Akiya Miyamoto (KEK)
  Yasuhiro Okada (KEK)
  Satoru Yamashita (Tokyo)
- Europe: Klaus Desch (Hamburg)
  Georg Weiglein (Durham)

The Questions

30b) How do you make the case for determining the final energy choice for the LC prior to the LHC results? What if the LHC results indicate that a higher energy than design is needed?

30d) Considering the LC will start much later than LHC (although it can have a concurrent operation period), what physics capability does LC have which LHC does not share? Can this be realized at 500 GeV or does it require much higher energy?

Interpretation of questions somewhat problematic…..

30b) How do you make the case for determining the final energy choice for the LC prior to the LHC results?

Physics case for 200–500 GeV LC, upgradable to energies around 1 TeV, is independent of findings at the LHC.

- Emphasize model independence of LC physics
- Stick to 200–500 GeV baseline as important on its own
- Discuss upgrade to around 1 TeV
- State that physics program is common to both technologies

We then delineate the physics issues

- EWSB
  - Light Higgs: model independence & precision of LC results
  - Capability at LC to discover Higgs with decays invisible at LHC via recoil technique
  - Heavier Higgs: Precision EW data implies existence of new physics which LC can probe; high reach via virtual effects
  - Higgsless: Probes New Physics in complementary fashion to LHC
- Hierarchy Problem
  - Supersymmetry: Precision measurements of Superpartners
  - Extra Dimensions: High reach for KK states, cover region relevant to hierarchy via virtual effects, probe geometry
  - Little Higgs: Measure couplings of new states
  - Unexpected: Precision measurements of SM processes allows for high reach

- Dark Matter
  - Measure quantum numbers in WIMP scenario
  - Allows for direct comparison to Astro measurements
- Precision Measurements of the SM
  - Model independent window to TeV Scale
  - Top mass
  - Triple Gauge Couplings
  - Alpha_s
  - Giga-Z option: W mass, weak mixing angle
- Conclusion: Absolute need for 200-500 GeV LC, upgradable to around 1 TeV, regardless of LHC results

Part 2: What if the LHC results indicate that a higher energy than design is needed?

ITRP Panel acutally meant: discuss 800 versus 1000 GeV for final LC energy

Our response: It is difficult to make a strong case for either one. Certainly the higher energy provides a somewhat higher window to new physics, but there is a trade-off with luminosity.

30d) Considering the LC will start much later than LHC (although it can have a concurrent operation period), what physics capability does LC have which LHC does not share? Can this be realized at 500 GeV or does it require much higher energy?

Main point: LC is a precision machine as opposed to LHC being an energy reach machine.

Emphasize unique capabilities of LC:

- Known initial state
- Energy threshold scan with excellent resolution
- Lower backgrounds
- Better measurement of angular dists,
- Polarized Beams

Unique measurement capabilities of the LC

- Observes states difficult at LHC (sleptons)
- Observes narrow resonances
- Determines properties of new physics, through better measurement of quantum numbers
- Precision measurement of SM processes
- Many cases where the sensitivity to new physics via virtual effects at the LC exceeds that of direct searches at the LHC

We then give some physics examples

Question of higher energy is irrelevant as it is demonstrated that 500-1000 GeV LC is essential to exploring the physics at the TeV scale.

We invite your comments!

Look to WWS web page for complete text and place to send comments