Beam Instrumentation
Working Group R&D Report

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UC Santa Cruz

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• Brief Motivation
• R&D Interests
• Where does this belong?
Luminosity spectrum highly dynamic!

Assuming Gaussian energy spread

Pandora

\[
\frac{dn}{dE} \Rightarrow \text{Luminosity spectrum highly dynamic!}
\]
Production
Threshold

Kinematic Fits

Common Scale Uncertainty

\[ \frac{\delta M_W}{M_W} \approx \frac{\delta E_{Beam}}{E_{Beam}} \]
Unique sensitivity using helicity manipulation

\[ P_e^- = 80\% \quad P_e^+ = 0 - 60\% \]
**Luminosity**

- Target $dL/dE$ precision at 1%
- Recognize desire for absolute $\int L dt \sim 1\%$

⇒ Strong desire for RT (relative) lumi

**Beam Energy**

- Target 200 ppm from $2m_t < \sqrt{s} < 1\,TeV$

  $\Delta m_t, \Delta m_H \sim 50\,MeV$

- Recognize desire for 50 ppm at $2m_W$ ...

**Polarization**

- Target $\delta P/P = 0.25\%$ per beam

  SM, SUSY, other asymmetries

- Recognize desire for $\delta P_{eff}/P_{eff} = 0.1\%$

⇒ Positron Polarization
Current State of Working Group

• Many fundamental issues still need work

• Physics studies in particular need effort

• Current emphasis on studies not hardware

• Not all groups will submit R&D proposals

⇒ Many more items identified than subscribed...
Physics Issues

• Identify $dL/dE$ requirements

(Dayne State)*

Detector Issues

• Čerenkov calorimeter technology

(Iowa State)

Machine Development

• Pair Luminosity Monitor

(Tohoku)*

• Beamstrahlung beam monitor

• Coherent synchrotron bunch length

(Wayne State)*

Many Uncovered Topics

• Bhabha counter development (and needs)
• Forward tracking studies/design
• Fast luminosity monitor (radiative bhabha)
Physics Issues

- Physics processes (e.g., $\mu\mu\gamma$) for $\langle \sqrt{s} \rangle$
  (Kansas)

Instrumentation Design

- WISRD-style spectrometer
  (Oregon, U.Mass)
- BPM-style spectrometer
  (Notre Dame*, Berkeley)

Uncovered Topics

- Forward tracking studies/design
- Higher precision techniques (WW threshold)
- Other possible physics processes (e.g., WW)
Instrumentation Design

- Downstream Čerenkov detector
  (SLAC, Tennessee)

Spin Issues

- Spin diffusion and transport
- Beam-beam depolarization
  (SLAC)

Positron Polarization Demonstration

- Positron/Photon polarimetry
  (South Carolina, Tennessee)

Uncovered Topics

- Upstream polarimeter
- WW t-channel Polarimetry
Where does this belong?

Option 1: All detector-related

Option 2: All machine-related

Option 3: Divide by individual topic

Option 3 makes the most intuitive sense

BUT by definition this is stuff which machine people put at a low (or zero) priority...

Ex: Beam simulations for precision energy spect.