



Beam Instrumentation Working Group Report

Santa Cruz Linear Collider Retreat

June 29th, 2002

UC Santa Cruz

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e^+e^- electroweak physics

- m_Z, Γ_Z (LEP I) Energy Lumi
- m_W (LEP II) Energy
- $\sin^2 \theta_w$ (SLC) Polarization

Dependent upon Beam Instrumentation

LCBI Mandate

⇒ Ensure instrumentation for physics needs!

Principle LCBI Topics (L,E,P)

- Luminosity spectrum dL/dE and scale $\int L dt$
- Beam energy scale and width
- Beam polarization

Significant overlap with other efforts

Accelerator, Beam Delivery,
Detector Groups, Physics Groups



June 26th Meeting (SLAC, 8 hours)

- Machine Requirements (M. Ross)
- Beam Energy (E. Torrence)
- Polarization (M. Woods)
- Luminosity (H. Yamamoto for D. Cinabro)

(Shotgun approach)

June 28th Meeting (UCSC)

- Beamstrahlung Monitor (G. Bonvicini)
- Propose BI Precision Targets
- Strawman BI Design
- R&D Directions

⇒ Lots of old faces, a few new faces

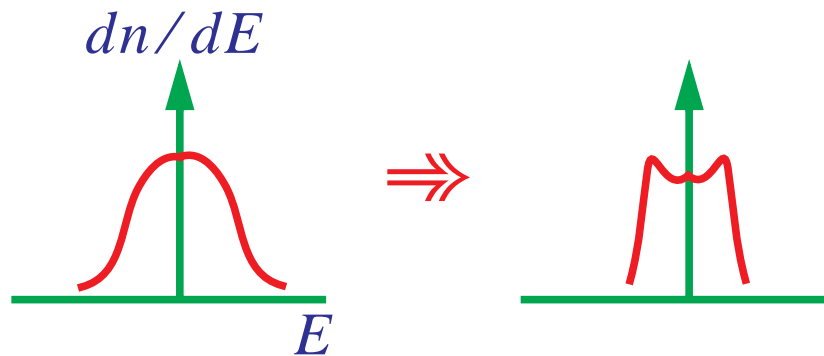
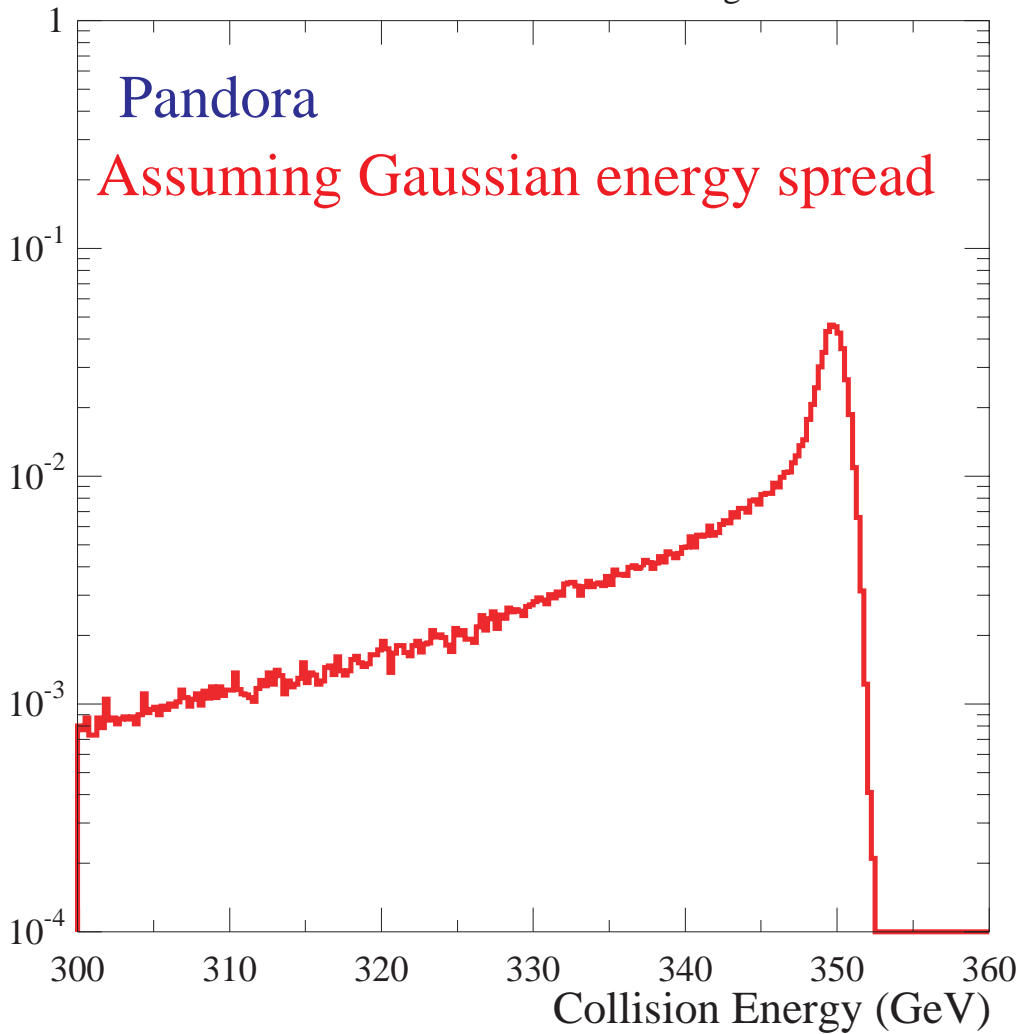
Plenty of interesting work to be done...



Beyond ISR



350 GeV Machine + ISR + Beamstrahlung + 0.3% Linac



Luminosity spectrum highly dynamic!



Luminosity Needs



Many Unanswered Questions

- True dL/dE tolerance? (tails and core)
- Motivation for precise **absolute** lumi?

⇒ Physics groups must provide...

- LEP/SLD-style lumi monitor **useful/optimal**?
- Any real proposal for **RT** lumi monitoring?

Lots of conceptual work needed

⇒ Not at all an easy problem



Luminosity Proposal*



*Very Speculative

Luminosity Needs

- Target dL/dE precision at 1%
- Target relative L precision at ??%

Threshold Scans

- Recognize desire for absolute $L < 1\%$

Hadronic cross-section

⇒ Need Input from Physics Groups

Strawman Luminosity Proposal

- Forward Bhabha calorimeter
- Forward tracking 200-500 mRad
- Pair monitor
- Beamstrahlung diagnostic monitor
- Radiative Bhabha monitor downstream

⇒ Also, other machine diagnostics



Beam Energy Proposal



Energy Needs

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

$$\Delta m_t, \Delta m_H \sim 50 \text{ MeV}$$

- Recognize desire for 50 ppm at $2m_W \dots$
 \Rightarrow Are we missing something?

Strawman Energy Proposal

- BPM-style at upstream 1mRad bend

RF BPMs

- WISR-style at post-IP chicane

Energy width?

- Forward tracking 200-500 mRad

\Rightarrow Also, machine diagnostics for width ...



Polarization Proposal



Polarization Needs

- Target $\delta P/P = 0.25\%$ per beam
SM, SUSY, other asymmetries
- Recognize desire for $\delta P_{eff}/P_{eff} = 0.1\%$
 \Rightarrow Positron Polarization

Strawman Polarization Proposal

- Compton polarimeter at post-IP chicane
- 2-5% pulse stealing for undisturbed beams
- WW (t-channel) asymmetry
 \Rightarrow Forward tracking...



Other Interesting Items



Beamstrahlung Monitor at CESR

(G. Bonvicini, Wayne State)

- Powerful IP diagnostic
- Easier at NLC energies
- Bunch length also possible (coherent)

Positron Polarization Demo at SLAC

(J. Sheppard, SLAC)

- Install short undulator in FFTB
- Demonstrate γ and e^+ production
- Need help with polarimetry at 50 MeV

Time Scale: 22-42 months

Gas Cherenkov Calorimeter

(Olexi Artamento, Iowa State)

- Radiation hard
- Background resistant ($E > 10$ MeV)



Beam Energy (E. Torrence)

- Spectrometer designs (BPM and WISR D)
- Physics channels $\mu\mu\gamma$ or WW, ZZ
- Forward tracking...

Polarization (M. Woods)

- Compton polarimeter design
- Upstream detector possible?
- Spin transport/diffusion/beam-beam issues
- Physics polarimetry WW or ???

Luminosity (D. Cinabro)

- Physics needs for dL/dE and $\int L dt$
- Acolinearity analysis in e^+e^-
- Many detector issues...
- Pair monitor, other RT beam instrumentation

Global

- Energy - Lumi - Pol correlations
- Simulation tools

⇒ Simulations/study emphasized over hardware