Summary of Parallel Session I-A

- Accelerator related -

T. Tauchi, ACFA-LCO3, Mumbai, India, 18 December, 2003
Parallel Session I-A, 16 December, 2003

Accelerator related: Detector Accelerator Interface

09:00 - 09:20  T. Tauchi, KEK, Japan:  
Interaction region and beam delivery system

09:20 - 09:40  D. Miller, University College London, U.K.:  
Measuring the Luminosity spectrum

09:40 - 10:00  T. Sanuki, University of Tokyo, Japan:  
Status and future prospect of the GLCTA  
(Global Linear Collider Test Accelerator)

10:00 - 10:20  G. Blair, RHUL, U.K.:  
The Laserwire System at PETRA
Beam Delivery System (BDS) Layout

Roadmap Report, 2003

Bypass

Switchyard & diagnostics

Collimator

Final Focus System

Beam Dump

Main Linac

IP1

IP2

7 mrad

30 mrad
Apertures?
Shields?
Background: neutrons, photons to be estimated by the BDS-SIM.
Better with large crossing angle of 20 mrad?
2nd FP at 140m

Beam Spot
at the 2nd FP

\[ \Delta E / E \]

\( \begin{array}{c}
\text{0%} \\
\text{-0.2%} \\
\text{-0.4%} \\
\text{-0.6%} \\
\text{-0.8%} \\
\text{-1.0%}
\end{array} \)
IR: Crossing Angle Issue

\[
\frac{2\sigma_x}{\sigma_z} = 4.4 \times 10^{-3}
\]

Small angle: \( \phi \approx \frac{2\sigma_x}{\sigma_z} \),
Large angle: \( \phi \gtrsim \frac{2\sigma_x}{\sigma_z} \)

**Why Small Crossing Angle?**

- Detector cos \( \theta \) coverage
- Timing of crab cavity
- Radiation in the solenoid magnet
  \[ \sigma(\delta y) \propto \phi^{5/2} = 0.074 \text{nm with } \phi = 20 \text{mrad} \]

**Why Large Crossing Angle?**

- Background to the detector
- Multi-bunch crossing instability
- Design of the final quadrupole magnet
- Layout of the beam dump

\[ \frac{\Delta y}{\sigma_y} = \frac{1.8}{0.6} \text{ at } L^* = 3.5 \text{m} \]

(\( \sigma_y \) = 0.5 \( \sigma_y \))
Stabilization R&D: Support Tube

Results 1/10 Model
(Taper flange, 12-M6)

A: 77.5Hz
B: 90Hz
C: 258Hz
D: 522Hz

ANSYS- FEM
76, 256, 489 Hz

H.Yamaoka, 7/30 2003
Summary

- IR studies have been “completed” for $L^*=2m$ and $4.3m$; as in the “Particle Physics Experiments at JLC”, KEK Report 2001-11, Aug. 2001.

- Since the BDS was updated at the "GLC Project", KEK Report 2003-7, Sept. 2003, we are in the process of redesigning the IR and reexamining the relevant issues.

- Stabilization R&D has been active on the support tube, FEATHER and Nano-BPM for nanometer-collisions.

- Instrumentation R&D has been conducted on the pair monitor, laser wire, ODR, X-SR monitors etc. many of which have been investigated at the KEK-ATF.
Why $m_t < 100$ Mev?

Heinemeyer et al (hep-ph/0306181)

predictions for $M_W$ and $\sin^2 \theta_{\text{eff}}$

- $\delta m_t^{\exp} = 2.0$ GeV
- $\delta m_t^{\exp} = 0.1$ GeV

$m_h = 115$ GeV, $\delta \Delta \alpha_{\text{had}} = 7 \times 10^{-5}$

MSSM (SPS1b)

SM

prospective exp. errors 68% CL:

LHC/LC

GigaZ

LC's precision programme!
3 kinds:

- Energy jitter (~0.1%) in real time; measure to $10^{-4}$. Match to Bhabha events.
- Absolute average energy to $10^{-4}$ for $m_\tau$ ($10^{-5}$ for $M_W$). Check with $e^+e^-\rightarrow Z\gamma$.
- Shape (non gaussian) of lumi-weighted energy spread.
Mike Hildreth suggesting “bump” spectrometer insert, upstream, in BDS. Reverts to straight-ahead when currents turned off. Blue discs are bpm’s on precision movers. Follow the beam as it deflects.

Picture is LEP version. LC longer (P.T.), more, smaller bends.

Tradeoffs
- bpm bandwidth
- bpm resolution
- length of insertion
- bend angle

Jitter within train?
Emittance dilution

Do precision RF bpm’s work in a beamline? Will only find out if we try.
Spectral Shape Measurement

* Synchrotron swathes from a pair of bends
  (downstream only, like SLD WISRD?)

* Laserwire at dispersed focus for spectrum, maybe even upstream
  so could use all the time, not just pulse sampling?

Building a collaboration for beam tests

Talking to Mike Woods(SLAC), Mike Hildreth(Notre Dame), Eric Torrence(Oregon),
Stan Herzbach(Amherst), David Ward(Cambridge) about a test-beam campaign
using SLAC End Station A. Heinz-Jürgen Schreiber(Zeuthen) and collaborators
have DESY based plans.

All of us striving for funds to do proper experiments.
Goals

We need a well engineered spectrometry design before the Beam Delivery System is finalised.

It would be wise to prove we can measure $m_t$ and $m_h$ to the claimed precision before funding agencies send referees to check in 2006, ahead of final approval.

So we had better start the spectrometry tests soon to match progress on Bhabha acollinearity.

We will also need a strategy for $\Delta p/p \sim 10^{-5}$ measurements before anyone will fund a GigaZ upgrade. There are not enough of us; happy if Asia can join in.
Status and future prospect of the GLCTA by T. Sanuki

ATF -> GLCTA

- GLC electron injector complex
  +
- GLC 1/5,000 of main linac

Realistic demonstration of GLC accelerator
Current system

Acc. Structure

Klystron #1

Klystron #2
Current situation

Ready for operation on October 1st.
Construction/power source
Accelerating structure
Schedule (example)

- **SLED II**
  - 2003: Blank
  - 2004: Construction
  - 2005: Blank
  - 2006: Blank

- **Modulator**
  - 2003: Blank
  - 2004: Test
  - 2005: Blank
  - 2006: Blank

- **PPM Klystron**
  - 2003: Blank
  - 2004: Blank
  - 2005: Blank
  - 2006: Blank

- **RF Component**
  - 2003: Blank
  - 2004: Blank
  - 2005: Blank
  - 2006: Blank

- **Acc. Complex**
  - 2003: Blank
  - 2004: Blank
  - 2005: Blank
  - 2006: Blank

- **GLC demonstration**
  - 2003: Blank
  - 2004: Blank
  - 2005: Blank
  - 2006: Blank
Scanning of finely focused laser beam through electron beam
Detection of Compton photons (or degraded electrons) as function of relative laser beam position
Challenges
- Produce scattering structure smaller than beam size
- Provide fast scanning mechanism
- Achieve efficient signal detection / background suppression
Laserwire for PETRA

HERA
U = 6.3 km

PETRA
U = 2.3 km

e⁻

QUAD

DIPOLE

DETECTOR

16th December 2003
G. Blair, RHUL
First Photons 31.07.03

Laser on

Calorimeter

Q-switch

Photodiode at IP

Laser off
Results 04.12.03 Data

- Slopy Gaussian approximation of beam shape
  - \( m = (68 \pm 3 \pm 20) \) \( m \) at low current
  - \( m = (80 \pm 6 \pm 20) \) \( m \) at high current

![Vertical Scan Low Current](image1)

![Vertical Scan High Current](image2)

16th December 2003 G. Blair, RHUL
Conclusions

ACFA-FFIR subgroup

- Updating the Beam Delivery System (new final focus system with longer L* etc.), interaction region is re-designing together with background re-evaluation.

- Especially, (large) crossing angle issue should be carefully investigated from both sides of experimentation and accelerator.

Worldwide (in all three regions)

Many high energy physicists have played important role in R&D on the stabilization, instrumentation and accelerator, cooperating with accelerator physicists.