IP Beam Instrumentation Summary

ALCPG Linear Collider Workshop
January 10th, 2004
SLAC

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University of Oregon

• Current Status
• Technology Issues
• Testbeams
Ensure adequate beam instrumentation to meet physics needs of LC

Prime topics

- Luminosity
- Beam Energy
- Polarization

We try to take a broad view...

International effort

Problems transcend regional and thermal differences
Move from conceptual to more concrete designs

Polarimetry

• Pretty good shape

Luminosity (Spectrum)

• Sketch of hardware is there, need to flesh out details
• Understanding Lumi spectrum not in hand

Need to engage physics groups!

Beam Energy

• Need ‘real-estate’ planning
• Understand role of beam-based vs. physics
Specify geometry detail for both Gas Cherenkov and 3D Silicon detectors in this region

Must be fast (1 ns) to avoid pair pileup in far-forward region (warm)

T. Maruyama
Warm vs. Cold?
• Big push in Europe to study this for Paris

• Many issues: IP layout, backgrounds, physics acceptance, extraction-line design, risk

• being well covered by Beam Delivery & NLC

• Also BI issue of downstream instrumentation

Nice talk from G. Wilson on physics and hermeticity in the forward detectors

Biggest question: is this really an issue at all?

Meeting at Zeuthen January 19th
Please attend (at least virtually) if you have input
1.4ns sounds hard
337ns sounds easier

Need a much more quantitative statement

Understand needs for fast diagnostics

Example: To what precision do we need Ebeam pulse-to-pulse? With what frequency?

Assess impact or risk on physics!
Ugly profile for warm, broader width
Need real numbers on physics from real analyses

Guinea Pig Simulation
With ‘realistic’ beams
NLC500
Beam Instrumentation Tests for the Linear Collider using the SLAC A-Line and End Station A

M. Woods, *et. al.*

SLAC-LOI-2003.2

27 Physicists, 10 Institutions

Letter of Intent submitted Nov. 2003
Well received by SLAC EPAC and lab

Testbeam for Beam Instrumentation Detectors
Exploit infrastructure/knowledge from E158

Test some of the high risk BI components
Start a facility for beam instrumentation R&D

Eric Torrence 9/12 January 2004
### X-band Comparison

<table>
<thead>
<tr>
<th></th>
<th>E158</th>
<th>NLC</th>
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<tbody>
<tr>
<td>Charge/pulse</td>
<td>$6 \times 10^{11}$</td>
<td>$14 \times 10^{11}$</td>
</tr>
<tr>
<td>Rate</td>
<td>120 Hz</td>
<td>120 Hz</td>
</tr>
<tr>
<td>Energy</td>
<td>45 GeV</td>
<td>250 GeV</td>
</tr>
<tr>
<td>Pulse Train</td>
<td>270 ns</td>
<td>267 ns</td>
</tr>
<tr>
<td>uBunch spacing</td>
<td>0.35 ns</td>
<td>1.4 ns</td>
</tr>
<tr>
<td>Beam Loading</td>
<td>13%</td>
<td>22%</td>
</tr>
<tr>
<td>Energy Spread</td>
<td>0.15%</td>
<td>0.16%</td>
</tr>
<tr>
<td>Intensity Jitter</td>
<td>0.5%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Energy Jitter</td>
<td>0.03%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Transverse Jitter</td>
<td>5% of spot</td>
<td>20-50%</td>
</tr>
</tbody>
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For X-band, current beam very comparable (except energy and spot-size)

Thin radiator can replicate disrupted beam

Good infrastructure currently exists, but no physics planned for ESA!
Disrupted Beam

NLC 500
ESA 25 w/ target

M. Woods, L. Keller

10% \(X_0\) carbon target LE Pairs
Testbeam Proposals

- User-driven proposals
- Need technical descriptions
- Combine requests into blocks, run plan

Proposal to SLAC EPAC by May 2004

First Phase

- IP BPMs - fast feedbacks
- Energy BPMs
- Synchrotron-stripe diagnostics (WISRD)

Starting with ~1 week in 2005

Later Phase(s)

- Pair-monitor tests
- Beam diagnostics, “wire” scanners
- Spectrometer prototype
- Polarimeter prototype
- Your good idea!

Expect 1-2 weeks per year

Please contact M. Woods or E. Torrence
Greater participation is welcome