INTERACTION-REGION ISSUES

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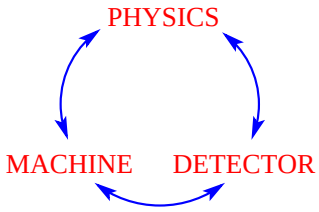
Abstract

The jobs at hand concern everybody in the LC business. Establishing and controlling the e^+e^- luminosity at a level



of $10^{34}\,\mathrm{cm}^{-2}\mathrm{s}^{-1}$ in the interaction region (IR), i.e., from the final quadrupoles to the interaction point (IP), will require a sophisicated interplay of several technologies dealing with gymnastics on nanometer-sized colliding beams. An overview of the issues is given in this contribution to Session[4] of the Nanobeam Workshop[1]-[9].

1 INTRODUCTION

One way to break down the tasks at the IR is to categorize them according to: **V**ibration, beam **O**ptics, **I**nstrumentation, **B**ackgrounds/masking and **E**ngineering, as illustrated in Fig.1. The tasks are highly correlated as evidenced by the repetition in the descriptions below.

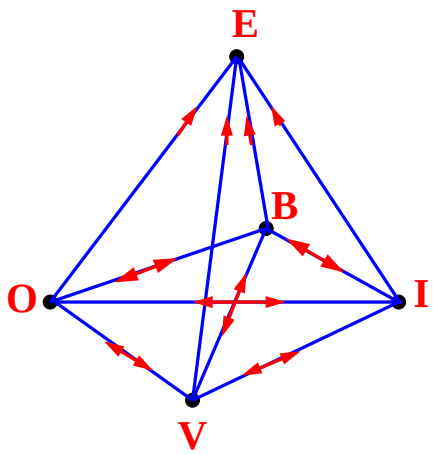


Figure 1:

A detailed account of the LC technological status, including topics in this paper, has been prepared by the International Linear Collider Technical Review Committee (ILCTRC) chaired by Greg Loew[8].

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2 VIBRATION

This is the biggest issue: how to correct/stabilize beams at the IP to the sub-nanometer level. Solutions to the vibration problem involve

- bunch steering – intertrain and/or intratrain using feedback and/or feedforward – at
  – low frequency
  – high frequency
  for which several techniques are being developed as seen in presentations at the introductory session[10, 11], Session[3] and Session[7] of this workshop,
- "mechanical" devices – optical anchor and/or inertial anchor for stabilization, see Session[3],
- masking influence on stability discussed[12] in Session[4],
- final doublet technology – warm vs. cold: influence on vibration, covered by talks[13, 14] in Session[4],
- noise, also a topic for Session[3], arising from several sources:
  – seismic
  – cultural
  – detector.

One word of caution. As much testing as possible with "off-the-shelf" devices and new ideas must be done, but the below-one-nanometer regime is a new ballgame for us (collider/detectors). So we should be prepared for surprises and have sufficient redundancy built into our systems.

3 OPTICS

The IR beam optics is in a state of flux at the moment because new ideas[15], also discussed at this workshop in Session[2], are leading to a change in L^*, the position of the focussing elements and the masking. The issues are

- as already stated, L^*[2],
- crossing angle[16], including
  – crab cavity[17]
  – extraction line choices[8]
  – solenoid-field effects[16],
- final doublet magnets[13, 14]
  – warm PM versus cold SC beam optics
  – $\mathrm{d}G/\mathrm{d}z$ and $\mathrm{d}\beta/\mathrm{d}z$ limits on PM tuning schemes
  – running at different energies
  – alignment.

4 INSTRUMENTATION

In this area there is a lot to be understood, and many of the questions are addressed in Session[7]. There are American, Asia and European groups working on LC beam-instrumentation topics dealing with measurements of luminosity, beam energy and polarization; these can be accessed on the web[18]. A list of items is as follows.

- The devices include
  – IP feedback, Session[3]
  – optical anchor, Session[3]
  – inertial anchor, Session[3]
  – laser wire[19], Session[6]
  – pair monitor[8].

- What needs to be monitored are
  – beam position and angle[8]
  – $\sigma_x, \sigma_y, \sigma_z$ and overlap[8]
  – $\mathcal{L}$uminosity, E_{beam} and $\mathcal{P}$olarization[20, 21], Session[5] (see also [18]).

- How do the backgrounds affect the IP devices?

- How is the background distributed in space, time?

5 BACKGROUNDS/MASKING

Are we sure these points are under control? This question is addressed[12] in Session[4]. Again the list:

- Background dose and rate.

- Masking influence on stability.

- Effect of background on the IR devices.

6 ENGINEERING

All of the above issues in Sections 2–5 must merge into an engineering design. Ideas on the engineering design must be developed now, because several iterations will surely be needed. The presentations in Session[9] cover several steps in this direction.

Finally, thanks go to Tom Markiewicz, one of the conveners of this Session[4], who invited me to give this talk and had started a list which I added to and repackage for this presentation. Tom's original items related mainly to engineering issues; they are
– support tubes across the IP
– cantilevered tubes
– movers, gears, motors, etc.
– springs
– bellows, flanges, pumps, cables
– detector access (!!).
The last item is especially close to the hearts of detector physicists.

7 REFERENCES

[1] The ICFA Nanobeam02 workshop at Lausanne CH, 1–6 September 2000, these proceedings.

[2] **Session 2 – Meam Delivery, Final Focus & Collimation**, *Chairs: Nicholas Walker DESY and Angeles Faus-Golfe U of Valencia*, this workshop.

[3] **Sessions 3,3b – Stabilization**, *Chairs: Andrei Seryi SLAC and Vladimir Schiltsev FNAL*, this workshop.

[4] **Session 4 – Interaction Region**, *Chairs: Fulvia Pilat BNL and Tom Markiewicz SLAC*, this workshop

[5] **Session 5 – Miniworkshop on Energy Measurement**, *Chairs: Mike Hildreth U Notre Dame and Bernd Dehning CERN*, this workshop.

[6] **Session 6 – Miniworkshop on Laser Wire**, *Chair: Grahame Blair Royal Holloway*, this workshop.

[7] Techniques under study may be found at **Session7 – Tuning, Feedback & Diagnostics**, *Chairs: Phil Burrows Oxford U and Susan Smith Daresbury*, this workshop.

[8] The International Linear Collider Technical Review Committee (ILCTRC) chaired by Greg Loew[8] was formed in 1994-95 to document the different designs for a future linear collider. Since then, a large amount of technical progress has been achieved, making necessary a reincarnation of the review last year (2002). The report contains a rather detailed description of all technological aspects of the linear collider, including the topics in this article, and will be available at at http://www.slac.stanford.edu/xorg/ilc-trc/2002/ when ready.

[9] **Session 9 – Engineering Demonstration and R&D Plans**, *Chairs: Günther Geschonke CERN and Witold Kozanicki CEA/Saclay*, this workshop.

[10] Andrei Seryi at introductory Session 1 of this workshop gives an overview of stability and ground motion.

[11] Joe Frisch at introductory Session 1 of this workshop covers some of the innovative technological solutions.

[12] Daniel Schulte's talk on backgrounds, Session[4].

[13] M. Kumada, I. Iwashita and E. Autokhin talks on PM final quads, Session[4].

[14] Brett Parker talk on superconducting final quads, Session[4].

[15] P. Raimondi has introduced new ideas which are causing much rethinking about the design of the beam-delivery optics in all of the linear collider options[2].

[16] Peter Tennenbaum's talk, Session[4].

[17] Joe Frisch's talk, Session[4].

[18] The American site is http://www.slac.stanford.edu/ torrence/ipbi/, where links to the sites in Asia and Europe can be found.

[19] Grahame Blair's talk, Session[6].

[20] Bernd Dehning's talk, Session[5].

[21] Mike Hildreth's talk, Session[5].