Machine-Detector Interface

MDI Panel Report

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MDI Panel is one of several World-Wide Study (WWS) panels
(R&D, Detector costing, MDI, 2 IRs)

Interim panel members (thru Snowmass): P. Bambade, T. Tauchi, M. Woods

Present activities of panel

1. ILC baseline design choices
   - help evaluate design choices for ILC baseline configuration that relate to MDI
   - provide a list of these design choices and describe MDI context
   - help prepare questions to pose to machine and experiment communities
2. Machine and Experiment CDRs, TDRs
   - help evaluate MDI issues that impact developing these
   - provide a list of these design issues
   - help prepare questions to pose to machine and experiment communities
3. Facilitate discussions between ILC Accelerator working groups, World-Wide Study and Detector Concept groups.
4. Report on this work at Snowmass; co-ordinate MDI discussions there.

A status report on this was submitted June 15 to
WWSOC, Detector Concept Groups, ILC WG1 and WG4

MDI Issues I: ILC Design Choices

1. Multi-TeV extendibility
2. IR crossing angles
3. 2 versus 1 IR/Detector and their scopes (includes simultaneous or sequential running of 2 IRs/detectors)
4. e-e-
5. e-gamma and gamma-gamma
6. Z-pole running and Z-pole calibration
7. Polarized positrons
8. Fixed Target
9. ILC Parameters: nominal + 3 variants + 1 high lumi option, for both 500 GeV and 1 TeV

Community has a goal to develop an ILC baseline by end of 2005.
A starting point is provided by the LC Parameters document,
www.fnal.gov/directorate/icfa/LC_parameters.pdf

MDI Issues II: Machine and Detector CDRs, TDRs

1. Radius & length of vertex detector; collimation depth
2. L* and minimum veto angle
3. IR quad stabilization
4. IR magnet design
5. Fast feedback: IP beam position monitors, kicker, pair detector
6. Beam parameter diagnostics and beam tuning
7. Electron id, 2-photon veto w/ pair detector
8. Beam instrumentation for lumi spectrum, energy, polarization.
9. EPS (experiment protection system); rad hard specs for accident scenarios; abort kicker system and #bunches in queue
10. Beam RF and other EMI (electromagnetic interference) effects on detector signal processing and DAQ.
11. Evaluation of beam background levels and corresponding detector tolerances.
12. Dark current between bunches (use of Linac rf kicker?)
13. Detector assembly ↔ BDS commissioning

MDI Evaluation of MDI Issues I: ILC Design Choices

Note: this is a starting point and will evolve; need input from ILC working groups (in particular WG1 and WG4), WWSOC and Detector concept groups.

We think highest priority should be evaluation for items 1-3, 7, 9.

1. Multi-TeV extendibility (Linac crossing angles, tunnel design)
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Some examples, extracted from the document

1. Multi-TeV extendibility (Linac crossing angles, tunnel design)

i) MDI context and impact
- Articulation between TeV and multi-TeV physics programs
- Impact on ILC precision physics program from coupling TeV and multi-TeV projects
- Desire for running overlap of TeV, multi-TeV programs/facilities (compare/refer to example of Tevatron, LHC)
- Impact on IR layout and detailed design (ex. crossing angle)

ii) Questions for machine physicists:
- Evaluate dependence of energy reach and luminosity on Linac crossing angles
- Evaluate requirements on tunnel designs (size, depth, straightness) for a later upgrade beyond 1 TeV
- Evaluate additional cost to ensure multi-TeV extendibility in ILC baseline design (size, depth, straightness of tunnels, BDS layout, dumps, other?)

2. IR crossing angle geometries (0 mrad, 2 mrad, 20 mrad)

i) MDI context and impact

- Vertex radius and length, collimation depth
- L* and minimum veto angle
- IR magnet design; solenoid compensation with DID and anti-solenoid; crab crossing
- Fast feedback: IP BPMs & kicker, pair detector
- Beam parameter diagnostics & tuning
- Electron id, 2-photon veto w/ pair detector
- Extraction line beam instrumentation
- EPS
- EMI
- Backgrounds

ii) Questions for experimenters:

- Evaluate background conditions for choices of crossing angle, vertex radius/length, L* and minimum veto angle; compare to tolerance levels
- Evaluate impact of solenoid compensation
- Quantify effect on polarimetry from angle between beam and solenoid axis
- Compare precision of downstream energy & polarization msmts
- Evaluate impact on electron id and 2-photon veto

iii) Common questions to IR design teams

- Support of IR magnets -- dependence on crossing angle; evaluate impact
- Stabilization of IR magnets – dependence on crossing angle; evaluation

7. Polarized Positrons

i) MDI context and impact
- Helical undulator source
- Spin rotators for both beams
- Polarimeters for both beams
- Kickers for spin rotator systems?

ii) Questions for experimenters:
- Evaluate need for polarized positrons in baseline
- How frequently does e+ polarization need reversals

iii) Questions for machine
- Estimate Δcost to provide polarized positrons
- Compare delivered luminosity for polarized vs unpolarized
- Compare technical risk for polarized vs unpolarized

9. ILC Parameter sets

i) MDI context and impact
- Backgrounds
- Extraction line beam diagnostics
- Time separation between bunch crossings

ii) Questions for experimenters:
- Evaluate impact of backgrounds for given parameter sets
- Evaluate reducing bunch spacing to 154 ns
- Evaluate extraction line energy and polarization measurements
- Compare desirability of high luminosity compared to larger beamsstrahlung backgrounds and impact on E,P measurements

iii) Questions for machine
- compare efficiencies for delivering luminosity

Next Steps:

- feedback from WWS, Detector Concepts, ILC WGs
- further develop evaluation:
  - develop further the current status report; it's a working document
  - a large amount of work has been done and can be referenced
  - clarify and prioritize work to be done before Snowmass
  - how to summarize evaluation needs work
- At Snowmass,
  - Present status report
  - Continue evaluation, working with machine and experiment groups