Evolving the ILD Detector Design

(a personal take on what we should be doing
from a detector optimization perspective)

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Overarching Goal

- Do outstanding science with a high energy e^+e^- collider as soon as reasonably achievable (ASARA)
  - This has many facets, not least of which is securing timely approval for the linear collider project
  - In ILD, we now have at hand the tools to continue evaluating the detector performance at a rather realistic level
    - Study technological options, detector layout and improve the design
      - We have the opportunity and a responsibility to try to do things right
    - We should welcome feasible design evolutions with potential for significant positive impact, and actively encourage such studies
      - Establish a fair review based on scientific merit and welcome new collaborators.
      - Best detector for the science (not necessarily the one that supports in-house R&D)
    - Understand eventual detector performance
    - Extend and enhance the physics case with credible and improved detector and reconstruction tools
      - In the current climate: more necessary than ever.
    - The goal of the DBR timeline is not to twiddle our thumbs en attendant (encore, depuis 2000) LHC

Detector Performance Optimization

- During the LoI phase, a first optimization of global detector parameters was done – based largely on p-flow performance.
- It is important to revisit this in more detail now that we can address integrated detector issues, and with growing insight into p-flow inner workings
  - ECAL compactness, longitudinal segmentation
  - TPC Endplate thickness
  - Octagonal TPC or 12-fold ECAL.
  - Electron reconstruction (material).
  - Tracking, vertexing, calorimetry in the presence of background.
- We should avoid linking our work plan too closely to the timelines imposed by full simulation of SM physics background events
  - The “physics-benchmarking” exercise so far has been of little value in evolving the detector design per se.
  - It is good for putting the physics case on a firmer footing – but channels need to be chosen appropriately. What exactly are we trying to learn?
- We should put the emphasis on detector performance optimization using single particle and di-jet events under realistic conditions.
  - This should have priority for computing resources

Reconstruction Tool Development

Lot's to do !

- Feasibility
  - Bunch crossing ID
  - Backgrounds
    - TPC Patrec
    - VTX track finding
    - BeamCAL
  - Calibration & Alignment
- Physics Scope
  - Electron ID in jets
  - Muon ID in jets
  - Vertex Charge, Tau Vertexing
  - Beam-spot determination
- ILD Specificity
  - dE/dx
  - V0's
  - Scintillator timing
- Acceptance
  - Low pT tracks, forward tracks
  - Low E photons
  - Forward MIPs
- Particle Flow
  - Kinematic Fitting
  - Jet Specific Energy Errors
  - Software Compensation
  - Leakage/Coil/Muon System
  - Full Event Reconstruction ?
- Jet Energy Scale
  - Bottom-up or empirical ?
  - p-scale, EM-scale, NH-scale
- Physics-based Beam Diagnostics
  - ECM (Z γ), dL/dE (MABB)

ILD Detector Design Weaknesses

- Material Budget
- TPC Endplate thickness (ETD pourquoi ?)
- ECAL barrel/endcap overlap
- LCAL design appears over-optimized for Lumi & not optimized enough for hermeticity.

- All are interesting areas for dedicated studies and improved design.

Critical Path Planning

- In the spirit of science ASARA, we should develop an understanding of which detector items may be close to the critical path to first physics.
  - Eg solenoid
  - A light Higgs discovery could lead to an early start ! (2012 ??)
- While R&D may be on-going, we do need to develop a fair and appropriate way to make the best current decision on appropriate timescales.
  - At least one feasible solution
  - We need to make sure that there are no show-stoppers and make it abundantly clear that ILD is ready

Conclusions

- We have an opportunity to advance significantly the ILD detector concept, and the linear collider physics case too – let’s take advantage of it.