Simulation & Reconstruction Summary

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(SLAC)
LCWS 2010, Beijing
March 30, 2010

Work Plan for 2012

1. Demonstrate proof of principle on critical components.
2. Define a feasible baseline design.
3. Complete basic mechanical integration of the baseline design…
4. Develop a realistic simulation model of the baseline design, including the identified faults and limitations.
5. Develop a push-pull mechanism, …
6. Develop a realistic concept of integration with the accelerator …
7. Simulate and analyze updated benchmark reactions with the realistic detector model.

   Include the impact of detector dead zones and updated background conditions.
8. Simulate and study some reactions at 1 TeV, including realistic higher energy backgrounds, demonstrating the detector performance.

   For 7 and 8, Specific physics channels will be investigated and defined by the Physics Common Task Group and supported by the Software Common Task Group.
9. Develop an improved cost estimate.

Items related to sim/reco highlighted.

Workshop Sessions Overview

- Successful meeting with over 20 talks from all regions, both concepts, and CLIC.
- Good mix of:
  - Core software
  - Detector simulation
  - Event reconstruction
  - Production resources
- Joint sessions with Calorimetry and Tracking.

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10:30 Break (30')

11:00->*12:50* LCWS: Simulation/Rec (Convener: Graham Wilson (*KU*) , Tony Johnson (*SLAC*) , Tomohiko Tanabe (*University of Tokyo*) , Shaomin Chen, Mark Thomson (*University of Cambridge*) , Frank Gaede (*DESY*)) (Bldg8 Rm2)

11:00	ILD Core Software Tools (25') (Slides)	Frank Gaede (*DESY*)
11:25	ILD Simulation - Status and Plans (25') (Slides)	Akiya Miyamoto (*KEK*)
11:50	ALCPG Software Status (25') (Slides)	Norman Graf (*SLAC*)
12:15	A Grid Production System for ILCSoft (20') (Slides)	Steve Aplin (*DESY*)

12:30 lunch (1h30')

14:00->*15:30* LCWS: Simulation/Rec (Convener: Graham Wilson (*KU*) , Tony Johnson (*SLAC*) , Tomohiko Tanabe (*University of Tokyo*) , Shaomin Chen, Mark Thomson (*University of Cambridge*) , Frank Gaede (*DESY*)) (Bldg8 Rm2)

14:00	ILC DIRAC, a grid solution for the LC community (20') (Slides)	Stephane Poss (*CERN*)
14:20	KEK Grid for ILC Experiments (20') (Slides)	Akiya Miyamoto (*KEK*)
14:40	Influence of beam related background on ILD reconstruction (30') (Slides)	Katarzyna Wichmann (*DESY*)
15:10	Simulation of FPCCD Vertex Detector (20') (Slides)	Kohei Yoshida (*Tohoku University*)

15:30 break (30')

16:00->*17:30* LCWS: Simulation/Rec (Convener: Graham Wilson (*KU*) , Tony Johnson (*SLAC*) , Tomohiko Tanabe (*University of Tokyo*) , Shaomin Chen, Mark Thomson (*University of Cambridge*) , Frank Gaede (*DESY*)) (Bldg8 Rm2)

16:00	Status of LCFIVertex (20') (Slides)	Tomohiko Tanabe (*University of Tokyo*)
16:20	Software tools for a semi-digital HCAL (20') (Slides)	Manqi Ruan (*Laboratoire de l''Accelerateur Lineaire (LAL) (IN2P3) (LAL) - Un*) , Gerald Grenier (*IPN Lyon*)
16:40	ILD Muon System Simulation and Analysis (20') (Slides)	Valeri Saveliev (*Moscow Physical Engineering Institute (MePhI)*)
17:00	Consideration of Photon Radiation in Kinematic Fits (20') (Slides)	Moritz Beckmann

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09:00->*10:30* LCWS: Simulation/Rec: joint with Calorimeter (Convener: Graham Wilson (*KU*) , Tony Johnson (*SLAC*) , Tomohiko Tanabe (*University of Tokyo*) , Shaomin Chen, Mark Thomson (*University of Cambridge*) , Frank Gaede (*DESY*)) (Bldg8 Rm2)

09:00	Status of simulation tools for ScECAL of ILD (20')	Katsushige Kotera (*Shinshu University, Faculty of Science,*)
09:20	Progress with PandoraPFA (30') (Slides)	John Marshall (*University of Cambridge*)
09:50	Identification of MIP Segments within Hadronic Showers (20') (Slides)	Lars Weuste (*Max Planck Institut für Physik*)
10:10	Simulation of AHCAL tile gaps and non-uniformities (20') (Slides)	Angela Lucaci-Timoce (*FLC, CALICE, DESY*) , Felix Sefkow (*DESY*)

11:00->*12:50* LCWS: Tracking/Vertex: joint session with SIM/REC (Convener: William Cooper (*Fermilab*) , Madhu Dixit, Akira Sugiyama (*Saga Univ.*) , Yulan Li (*Tsinghua University*) , Klaus Dehmelt (*DESY FLC*) , Marcel Vos) (Bldg8 Rm1)

11:00	Tracking Performance at 3TeV with a Silicon Detector in Presence of Background (20') (Slides)	Christian Grefe (*CERN, Bonn University*)
11:20	Kalman-based track reco in MarlinTPC (20')	Bo Li (*Shandong University*)
11:40	Silicon Detector Tracking (20') (Slides)	Norman Graf (*SLAC*)
12:00	GenFit Tracking Tool in Marlin (20') (Slides)	Frank Simon (*Max-Planck-Institut fuer Physik*)
12:20	ILD Tracking code for the DBD (20')	Steve Aplin (*DESY*)

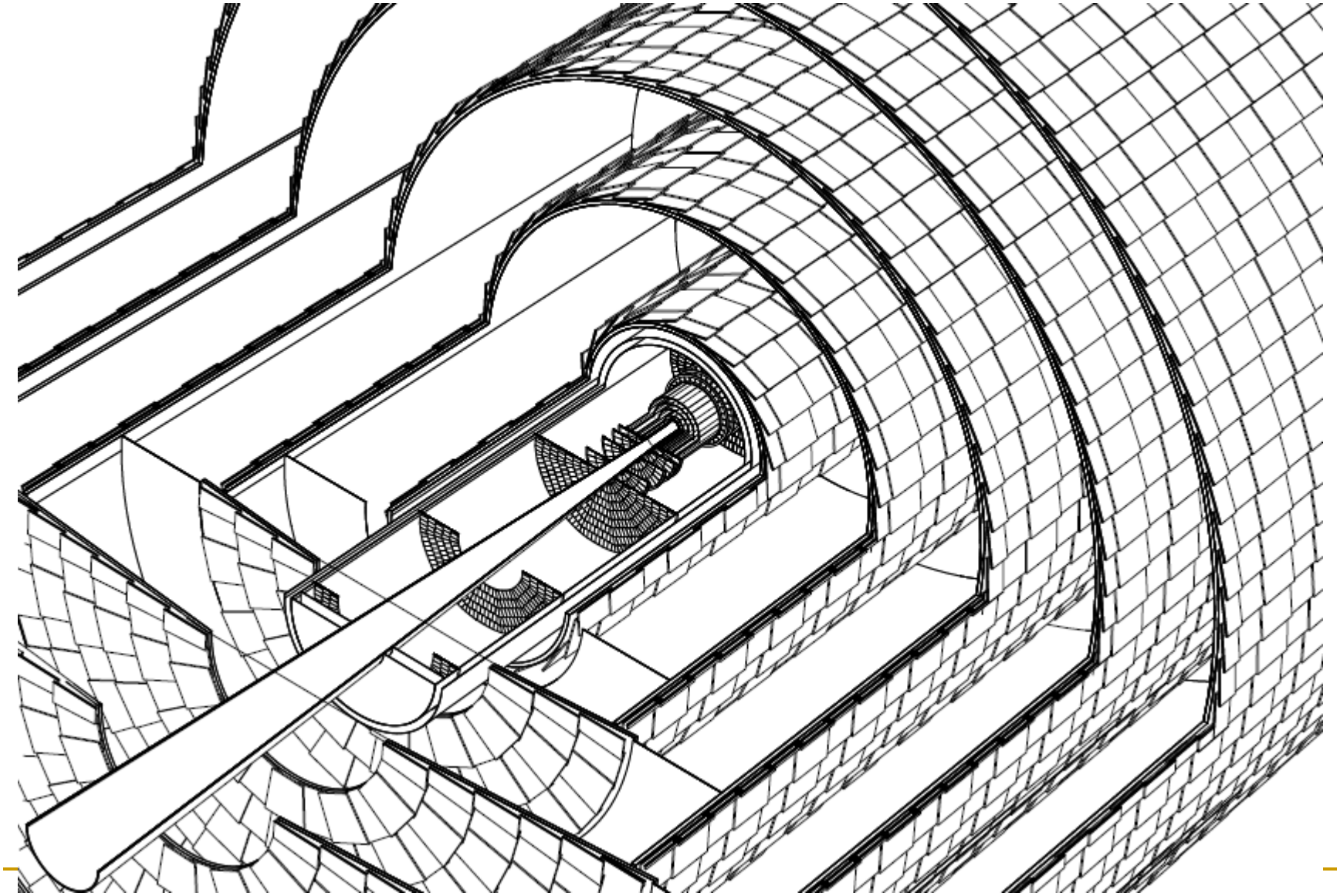
LCIO2.0

- Access to a common event data model and a common persistence format plays a large part in the successful use of cross-concept software packages, e.g. LCFIVertex, new pandoraPFA.
- Improvements under consideration include
  - Improving the event data model
    - 1D, 2D tracker hits, track states/trajectories, user objects
  - Direct access to events, partial reading of events and splitting of events over files.
  - LCIO with ROOT (“here be dragons…”)
- Collaborating under aegis of the Software CTG.

Detector Descriptions

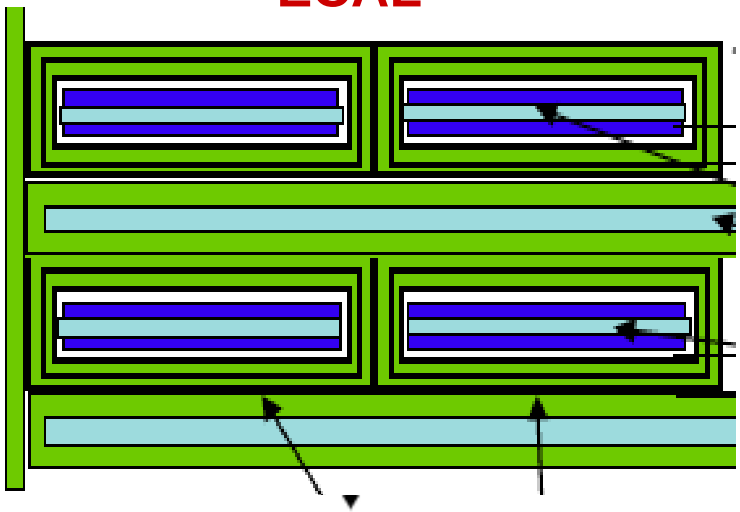
- Develop a realistic simulation model of the baseline design, including the identified faults and limitations.
- Both ILD & SiD reported on improvements to the concept designs, improving the realism of existing subsystems and adding options for subdetector technologies. CLIC is using variants of LOI designs.
- ILD has improved realism of existing subdetectors, expects a complete set of options to be implemented:
  - FPCCD, DHCAL, sDHCAL, Sci/SiW Ecal,...
- SiD has completely new simulation implementation, with detailed VXD & Trackers with planar Si wafers, and segmented stave calorimeters.

SiD Vertex and Tracker Geometry

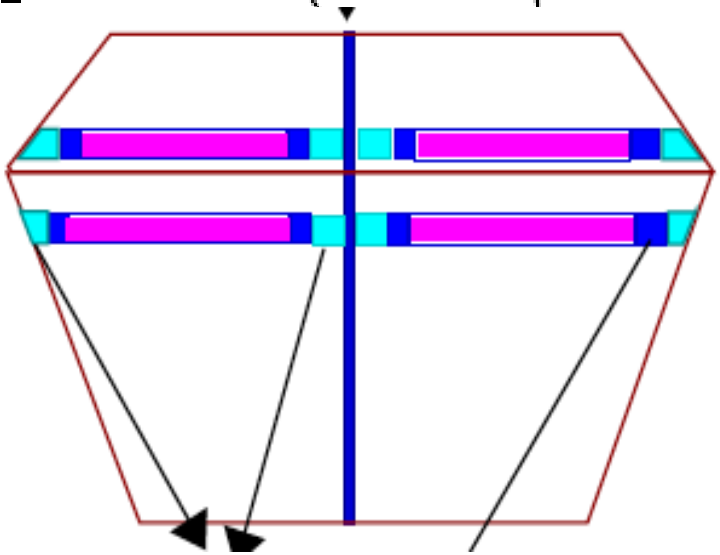


ILD Subdetectors

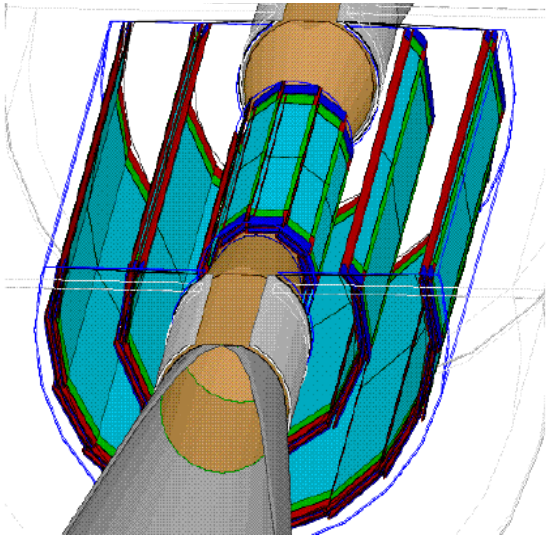
ECAL

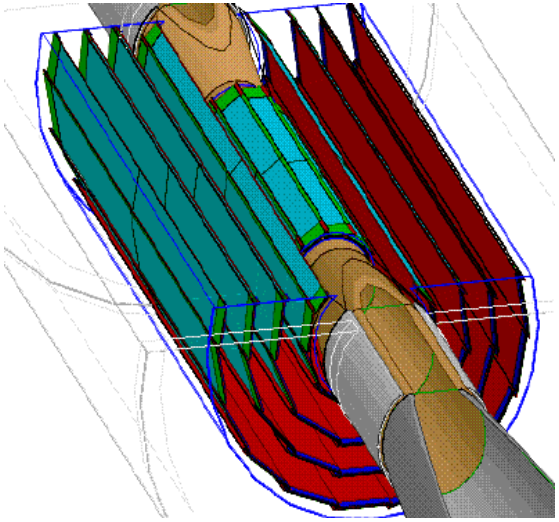


HCAL



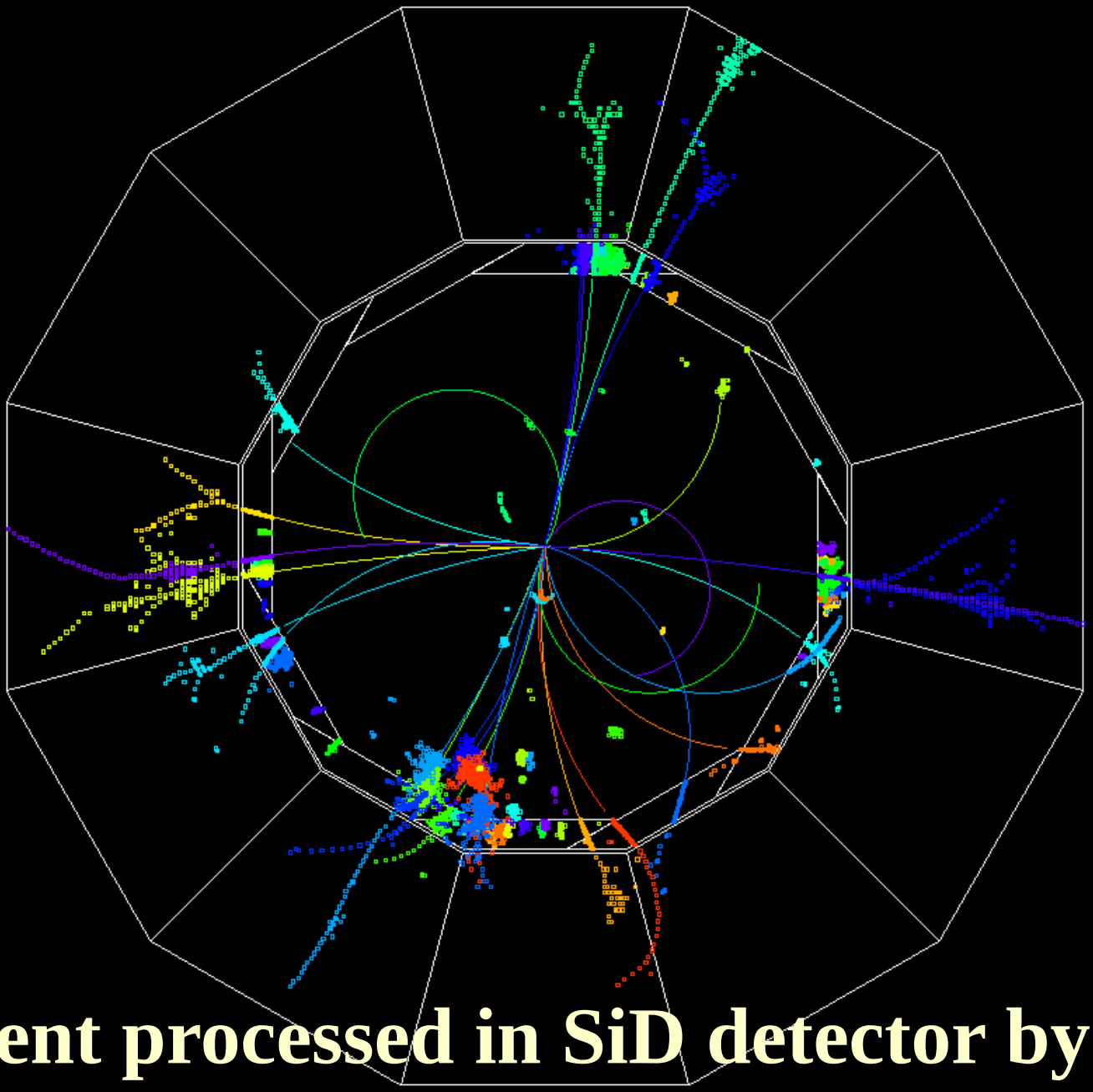
VTX





Reconstruction

- LCFIVertex package now maintained by strong Asian group, with improvements under development.
- PandoraPFA code restructured and rewritten
  - now framework independent
  - re-implemented in Marlin
  - binding to slic output developed (cross-concept use)
  - extensions and improvements of algorithms expected
    - digital calorimeter, scintillator Ecal, …
- SiD PFA algorithm being improved and adapted for use with complex detector geometries.



$t\bar{t}$ event processed in SiD detector by slic, reconstructed using pandoraPFANew.

ILD Tracking

- Current tracking worked for LOI, but revealed some areas for improvement:
  - F77 – software maintenance
  - Forward tracking with backgrounds
  - No treatment of strips (ghosts)
  - Efficiency issues at 1-3 TeV
- Intend to rewrite tracking, based on existing packages. Some candidates were presented:
  - ATLAS tracking
  - GenFit (TU Munich, Belle2)
  - KalTest (KEK, LCTPC)

SiD Tracking

- Digitization improved from the virtual segmentation used in the LOI to full digitization of Monte Carlo hits using detailed drift, diffusion, electronic readout, etc. to produce pixels and strips.
- Full clustering of neighboring hits, and handling of stereo pairs, giving cluster-dependent measurement position and uncertainties.
- Structural & implementation changes to improve tracking performance, especially with large numbers of hits.
- Currently characterizing performance.

Detector Optimization

- Comparing performance of technology options
  - e.g. SiW vs ScintW ECal, RPC/GEM/Micromega HCal
- Performance studies of subdetectors
  - Number of ECal layers, HCal absorber material, …
- Global optimizations such as
  - rz aspect ratio, HCal thickness, TPC endplate thickness
- Robustness in presence of backgrounds
- Performance at higher center of mass energies
- Exploit synergies between ILC & CLIC studies.

Physics Benchmarking

- Simulate and analyze updated benchmark reactions with the realistic detector model.
  - Physics CTG has first draft proposal.
  - Iterating with IDAG.
  - See plenary presentation by M. Davier.
- Simulate and study some reactions at 1 TeV, including realistic higher energy backgrounds, demonstrating the detector performance.
  - Requires machine parameters.
  - Should overlap with CLIC studies.
- DESY, KEK & SLAC will share the event generation.

Monte Carlo Event Production

- Concepts made extensive use of both the LCG and OSG Grids for the LOI.
  - No problems with the concept software
- Number of new Grid pipeline management tools being investigated to manage bookkeeping.
- Grid production being institutionalized, automated and coordinated between ILD, SiD & CLIC within the ILC VO.
- Not clear what the impact of LHC usage will be on next round of production.

Summary

- Much was done for the LOI, but much more will need to be done for the 2012 DBD exercise.
- More realistic detector descriptions are being implemented, along with technology options.
- Reconstruction being improved and adapted for complex geometries, backgrounds and 1 TeV.
- Workflow being streamlined & automated.
- Expect a round of detector optimization studies before major event production.
- Continuing collaboration between SiD, ILD and the CLIC community benefits all.