Status of the ALCPG simulation & reconstruction

Norman Graf (SLAC)

TILC09, Tsukuba

April 19, 2009

How did we do?

“As a rule, software systems do not work well until they have been used, and have failed repeatedly, in real applications.”

Dave Parnas

By that definition, we are still not working well…

The LOI Process

- Although still far from “real”, the physics benchmarking requirements presented us with a large-scale, end-to-end exercise which stressed most aspects of the system.
- Event Generation
- Detector Simulation
- Event Reconstruction

Event Generation

- A number of important issues in the common data sample event generation were unresolved at the time of the transition from the WWS, regional-based software working group to the ILC/GDE, concept-based software panel.
- All concepts used events from a common pool, but details varied.
- Despite difficulties in the details, this process worked.

"Fail-Safe"

- If mistakes are made in generation, affects all concepts equally.
- SiD furthered this by creating premixed samples.
  - Each file of the full 2ab^{-1} SM sample corresponds to a particular initial e^- / e^+ polarization and final state.
    - Have to mix polarizations by hand for achievable polarizations.
    - Each file contains only processes of one type, so need to run over complete data set (thousands of files) to get faithful subset.
  - Files were generated with 80% e^-, 30% e^+ polarizations, randomly mixing weighted events from all processes.
    - Not running over the full sample means only a loss in luminosity, not a loss of key signal or background processes.
    - Physics analysis need not worry about polarization mixtures.

250 GeV SM Sample

- We used a copy of the guineapig acc.dat file in which do_isr was turned on to generate the input luminosity files for event generation.
- This resulted in an incorrect beamstrahlung distribution in the MC event samples.
- Plan to regenerate the signal with the correct beamstrahlung distribution.

Simulation and Reconstruction Tools

- Simulation framework has been fairly mature for quite some time, so will not be presented here.
- Have been completely focused on fulfilling the LOI requirements.
  - Full event simulation using the sid02 detector model.
  - Full, ab initio, event reconstruction:
    - Tracker hit digitization, track finding and fitting
    - Calorimeter clustering
    - Track-cluster association
    - Lepton ID (e, μ)

  $\rightarrow$ List of ReconstructedParticle
- Output delivered to physics analysis groups.

Sim & Reco Summary

- The Silicon Detector design, simulation and reconstruction versions were frozen for the LOI at SiD Boulder workshop.
  - sid02, slic v2r5p3, org.lcsim v1.4
- Many millions of single particle and diagnostic physics signals were generated and made available.
- Benchmark physics events and beam backgrounds generated, simulated and passed through the reconstruction.
- Done on dedicated batch system at SLAC, FermiGrid @ FNAL, and Tier1 at RAL.

The Grid

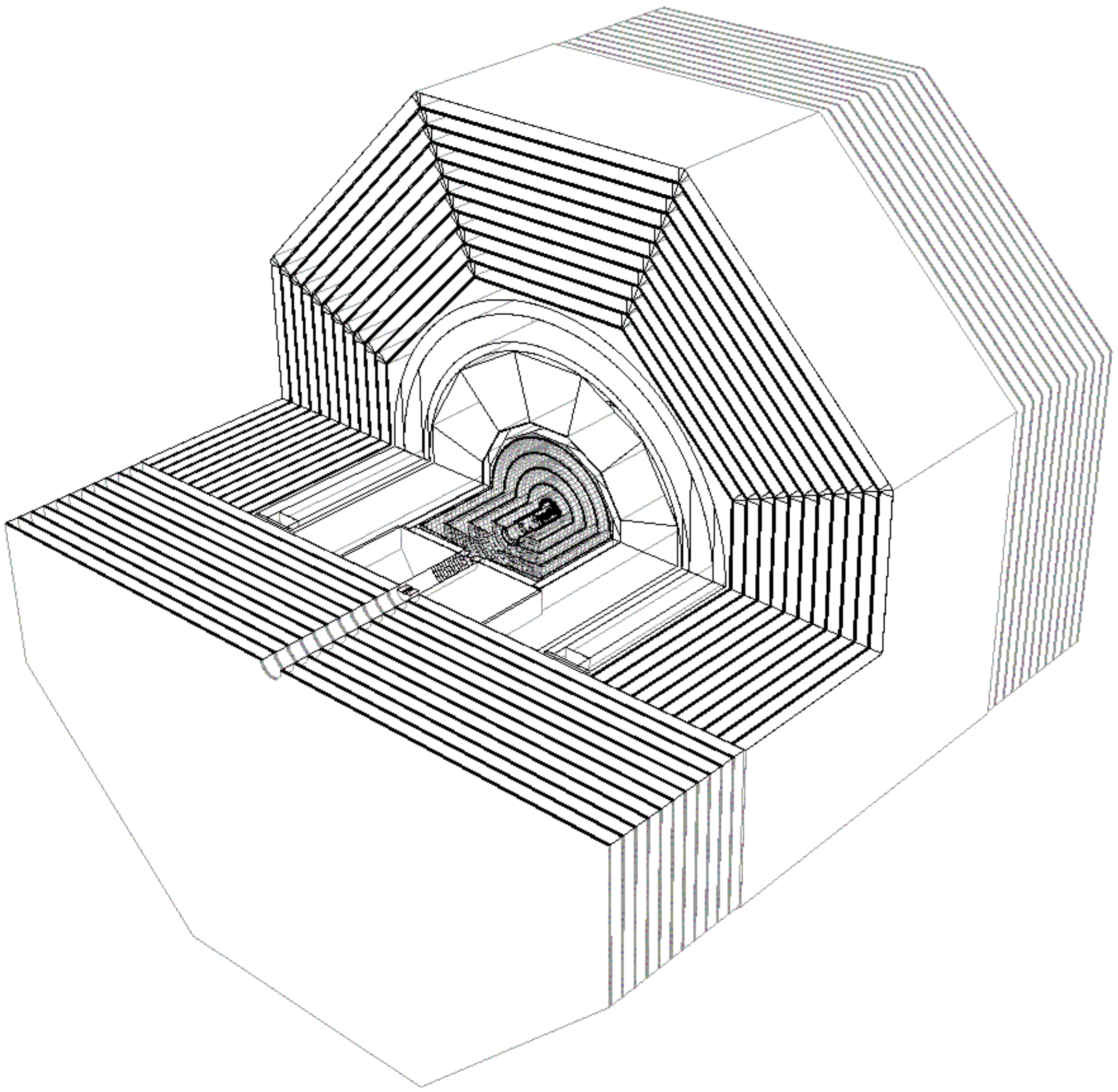
- Bulk of our processing post-LCWS was done on the Tier1 Grid at RAL.
- Number of teething problems
  - some delays in getting and then setting up resources.
  - Disk access by multiple users / processes
  - Copying files (in and out of CASTOR)
  - File validation of various stages / error checking
  - Job monitoring / logging / GANGA
  - Troublesome issues of reliability and broken setups convinced us to only run on “trusted” sites.
- No problems with slic (static executable with no database connections) or org.lcsim (Java just works…).

- Grid is very high-maintenance & still very LHC-centric.
- Thanks to Jan Strube for making this a success.

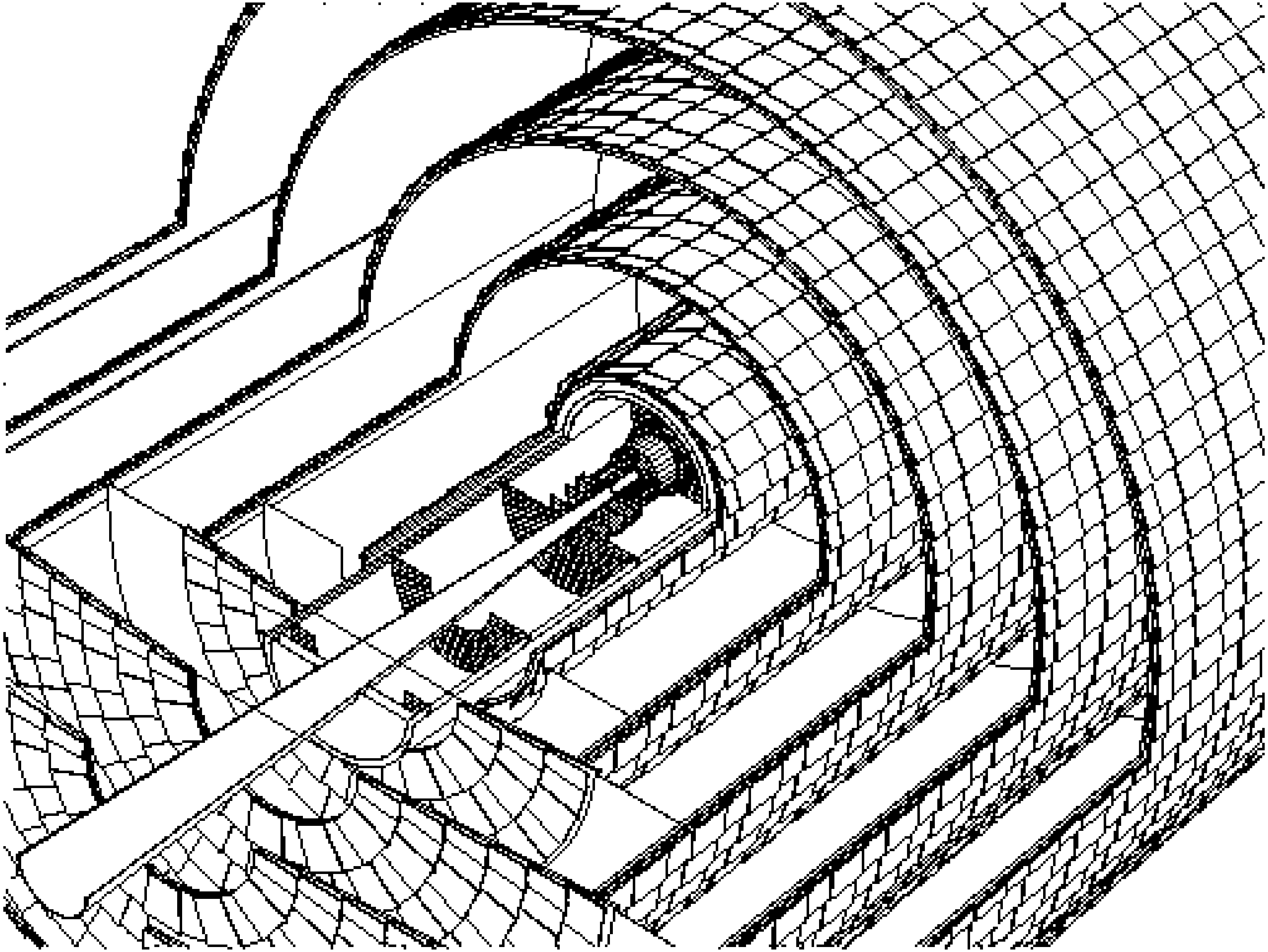
Beyond sid02

- The detector model sid02 was a necessary compromise between the desire to include all the details of the engineering designs and the need to complete the large-scale physics benchmarking simulations in a timely fashion.
- Since then we have implemented models with more realistic subdetector descriptions.
  - Benefits from engineering work done for the LOI.
  - Allows much more realistic subdetector performance studies to be undertaken.

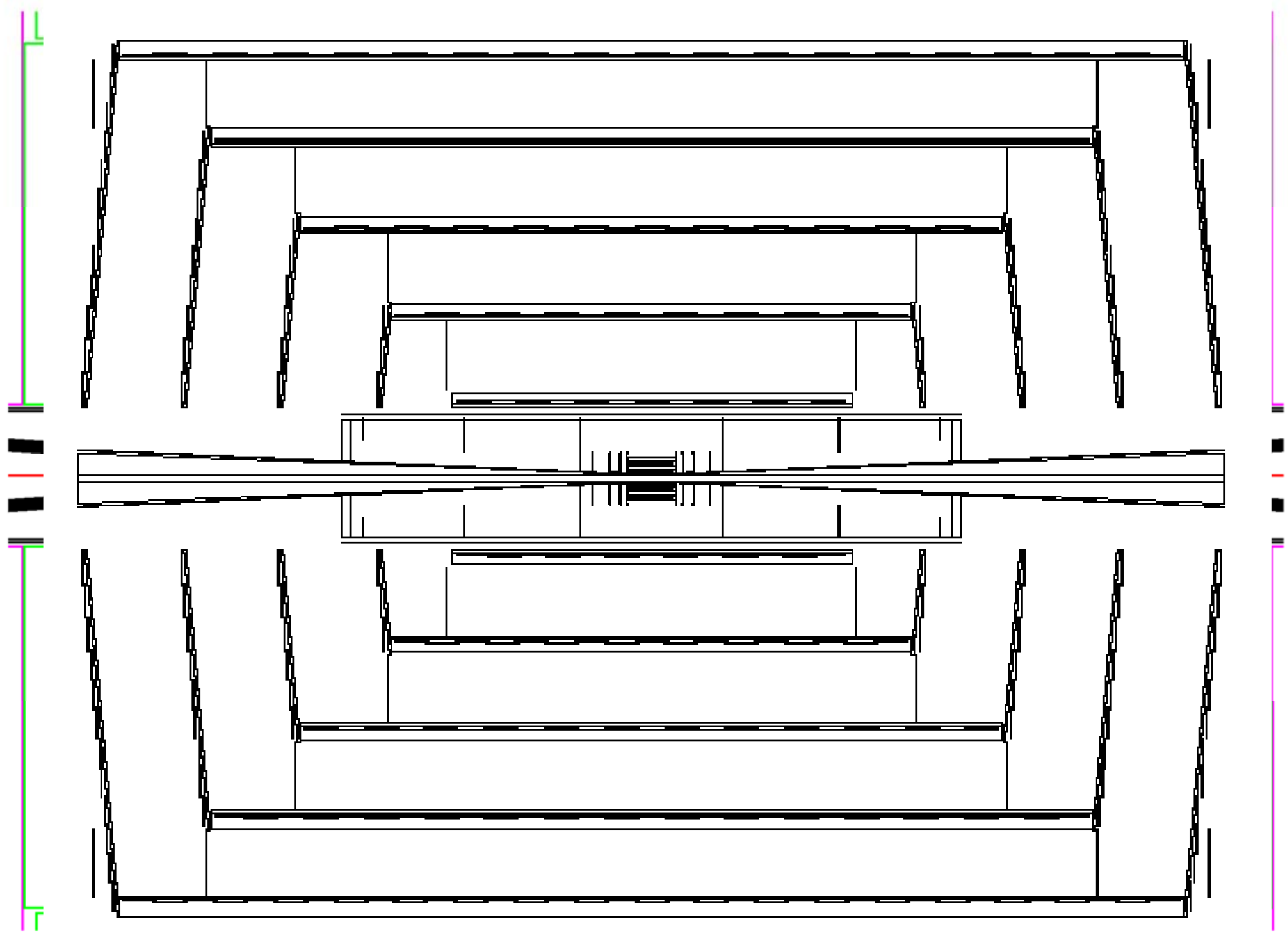
sidloi



sidloi



sidloi Tracker



Detector optimization

- Need to systematically optimize the detector design based on full simulation and reconstruction of events.
- Need to better support subdetector options.

Reconstruction

- Still a lot of work needed to improve and robustify the existing reconstruction code.
- Need to be able to use it as a tool to systematically answer detailed detector questions, e.g.
  - Optimize number and location of tracker sensors.
  - Model specific, detailed readout technologies.
  - Study effects of noise & inefficiencies.
- Optimize for higher energies (at least 1TeV).

- Loss of key individuals and lack of infrastructure support at the labs makes this very challenging.

Going Forward…

- Highest priority will be to respond to IDAG questions regarding LOI.
  - Need to make it past Albuquerque
- Understand needs of TDP-1(Summer 2010?) and TDP-2 (2012)
- Go back and clean up the code, document the performance and work on the neglected infrastructure.

Summary

- With a lot of hard work by a very small number of individuals SiD was able to simulate the detector response to the benchmark physics processes and to then reconstruct the events to provide input to the analysis groups.
- Work is ongoing to move beyond the strict scope of the LOI to improve both the detector model and the reconstruction code to systematically optimize physics performance.
- Much work remains to be done for the TDP.
- Volunteers welcomed.

Conclusions

- We benefitted greatly from the use of common standards, common tools, and common interests.
  - stdhep allowed same events to be used
  - LCIO allowed different packages from different frameworks (e.g. LCFIVertex) to be used.
- We remain committed to the goal of interoperability and collaborative development of software, e.g.
  - Common (or at least interoperable) geometry
  - LCIO2.0 (both Event Data Model & persistency)
- Concerned about support for both software development and package maintenance.