ILC Monte Carlo Data Samples

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(for the LCC physics and detectors WG)

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Overview

- The LC community has been engaged in a number of physics and detector performance exercises over the past ~decade culminating most recently in the CLIC CDR and ILC Detailed Baseline Design (DBD) featuring:
  - Detector designs including dead material, supports, etc. incorporated into detailed Geant4 simulations.
  - Full detector response simulations including charge sharing, electronics shaping, noise, crosstalk, etc.
  - Backgrounds from beam-beam interactions overlaid with correct time structure.
  - Full ab initio pattern recognition in trackers and calorimetry, culminating in a full Particle Flow Analysis.

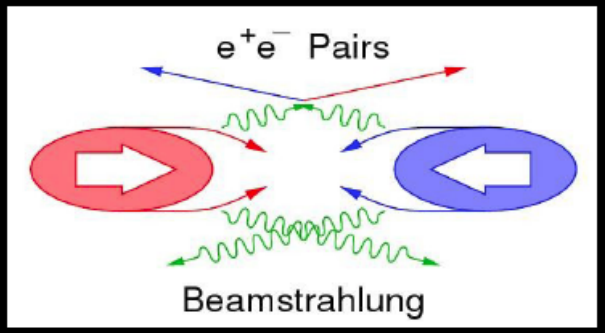
Physics Benchmarking I

- The ILC Letter of Intent (LOI) physics benchmarks targeted cms energies of 250GeV and 500GeV using somewhat more simplified detector geometries. Higgs mass = 120GeV.
- The CLIC CDR physics benchmarks concentrated on 3TeV.
- The ILC DBD Physics benchmarks were primarily aimed at 1TeV cms. Higgs mass = 125GeV.
- Based on the discovery of a 125GeV higgs boson at the LHC, decided to concentrate on a low-energy ILC for the “Snowmass” CSS.
- Snowmass LC studies primarily target 250 & 350GeV

Snowmass Physics Benchmarking

- Begin with e+e- luminosity spectra for the ILC at 250Gev and 350GeV, CLIC @ 350.
- Feed into whizard to generate events
  - Essentially all SM final states simulated
  - Events are WEIGHTED!
- Evolve/decay/fragment using pythia with latest higgs branching fractions for 125GeV and fragmentation from Opal.
- Generate 100% polarization states for all four e+e- initial states.
  - SiD prepared “mixed” samples representing the expected ILC polarization of 80% e- / 30% e+
  - ILD weights the samples as part of their analyses.
- Events generated @ SLAC, DESY & KEK and made available in stdhep format.

Beam-Induced Background

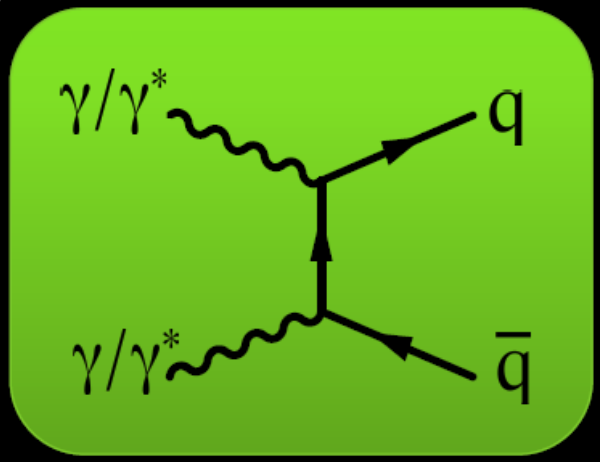


Pair background
1 event per BX
450k particles

Generated by GuineaPig
ascii → hepevt → stdhep

Merged with each "physics" event

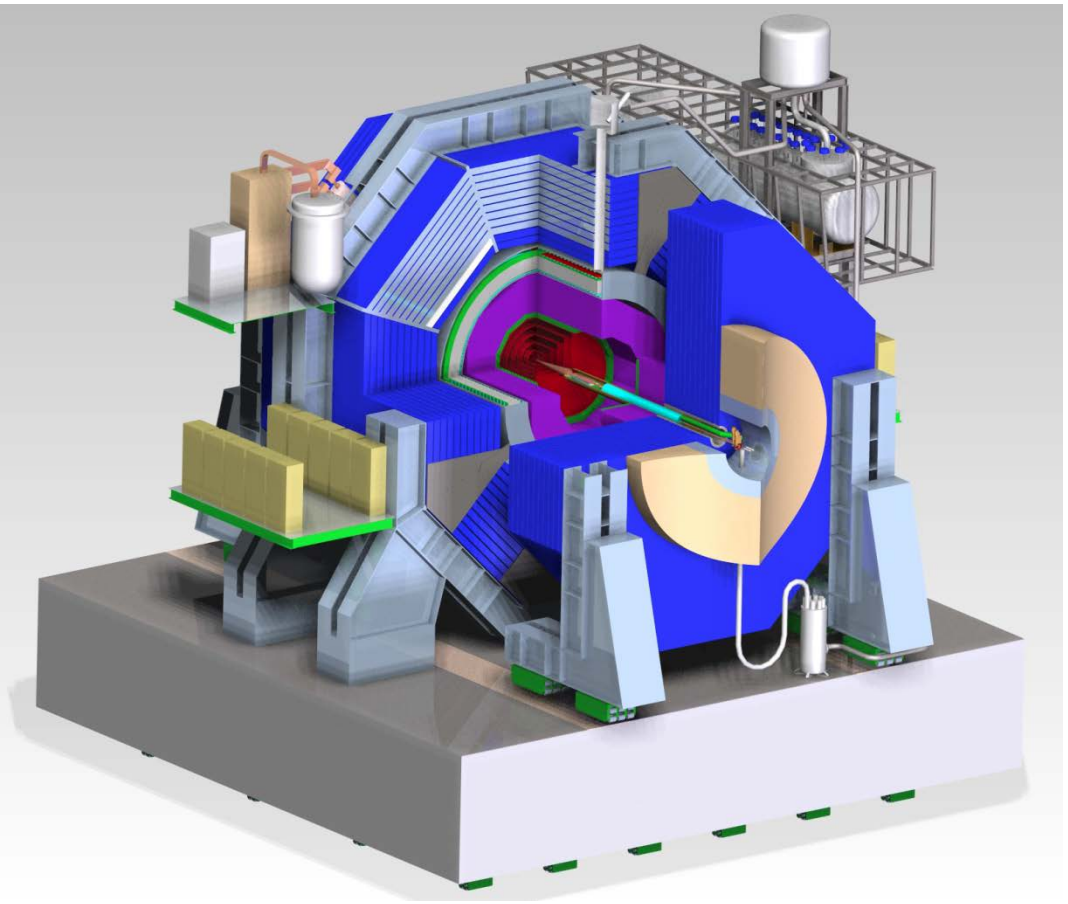
MCParticles that don't make hits are dropped

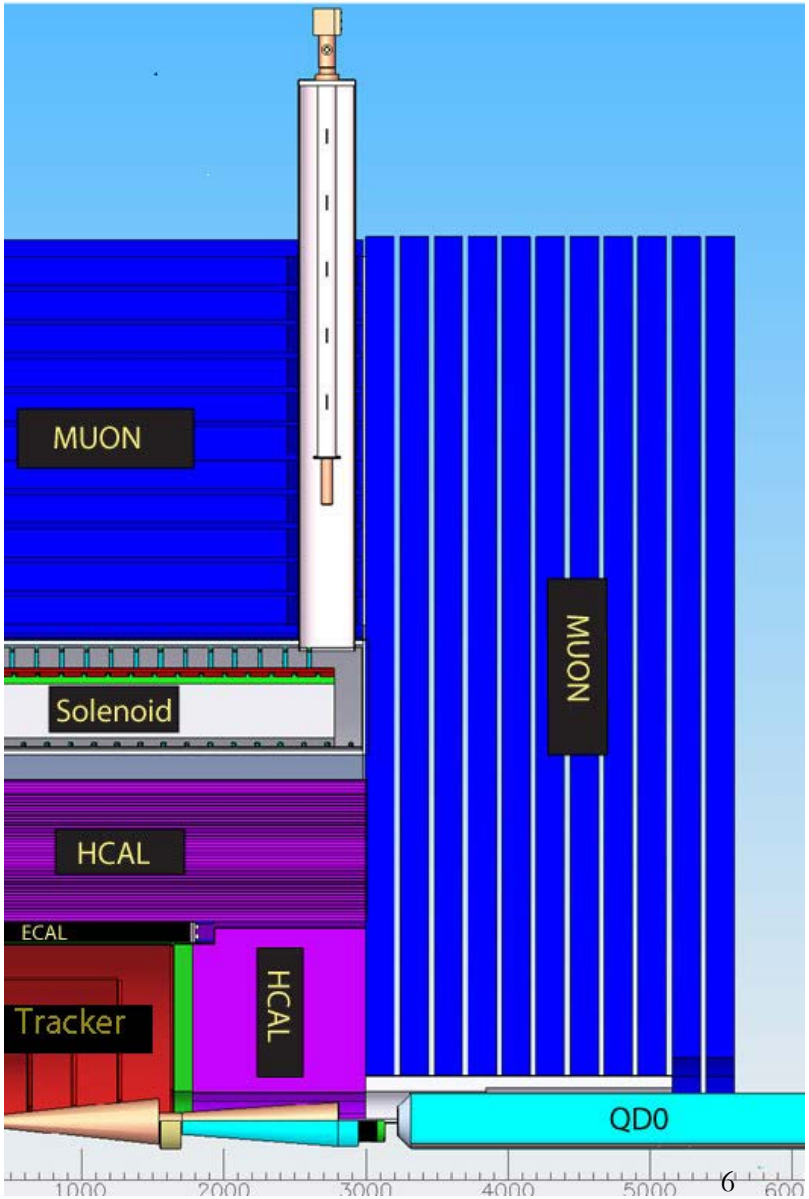


<u>γγ interactions</u>
4.1 events per BX @ 1 TeV
1.7 events per BX at 500 GeV

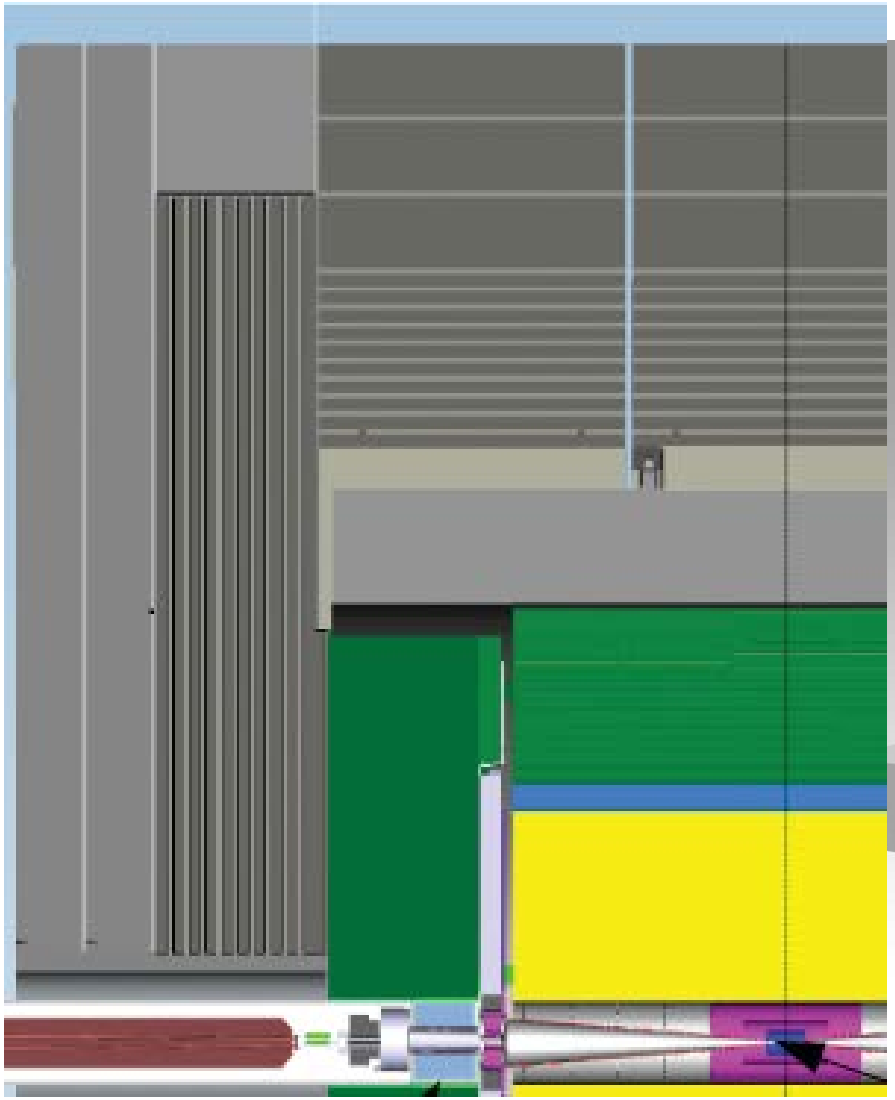
Generated by Whizard

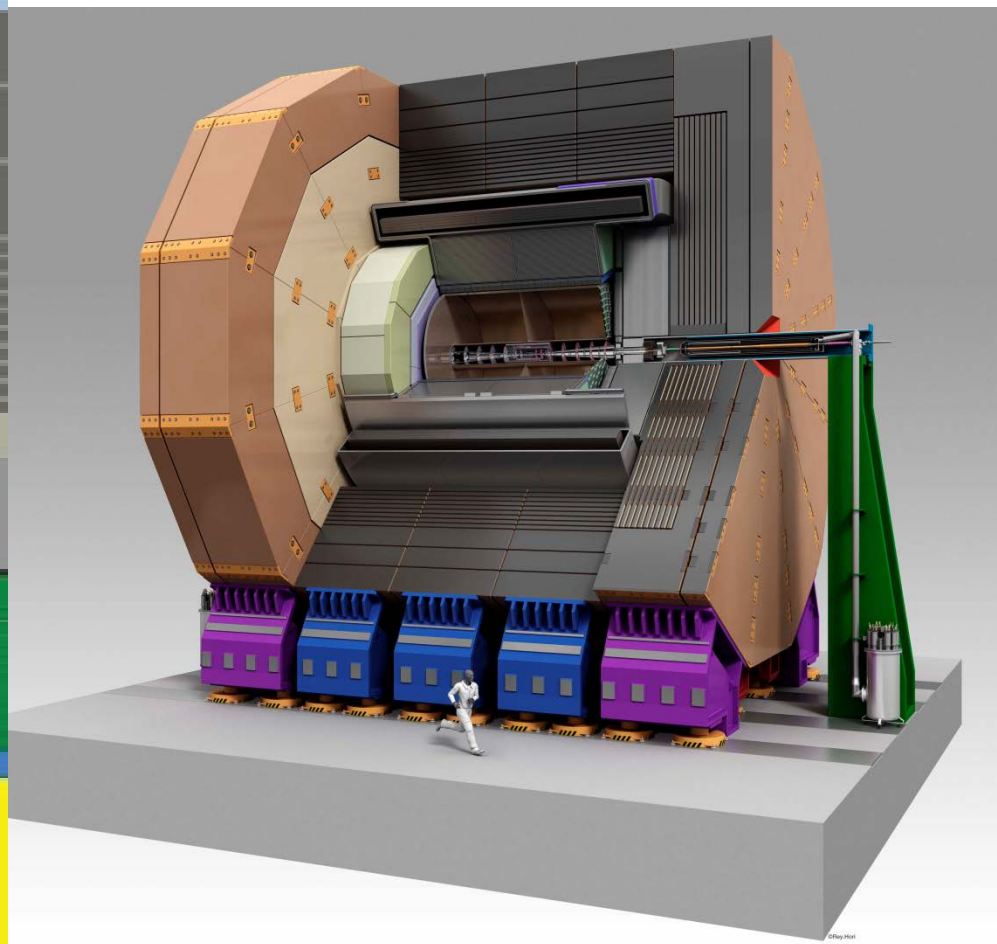
SiD




MUON
Solenoid
HCAL
ECAL
Tracker
HCAL
MUON
QD0
1000
2000
3000
4000
5000
600

ILD

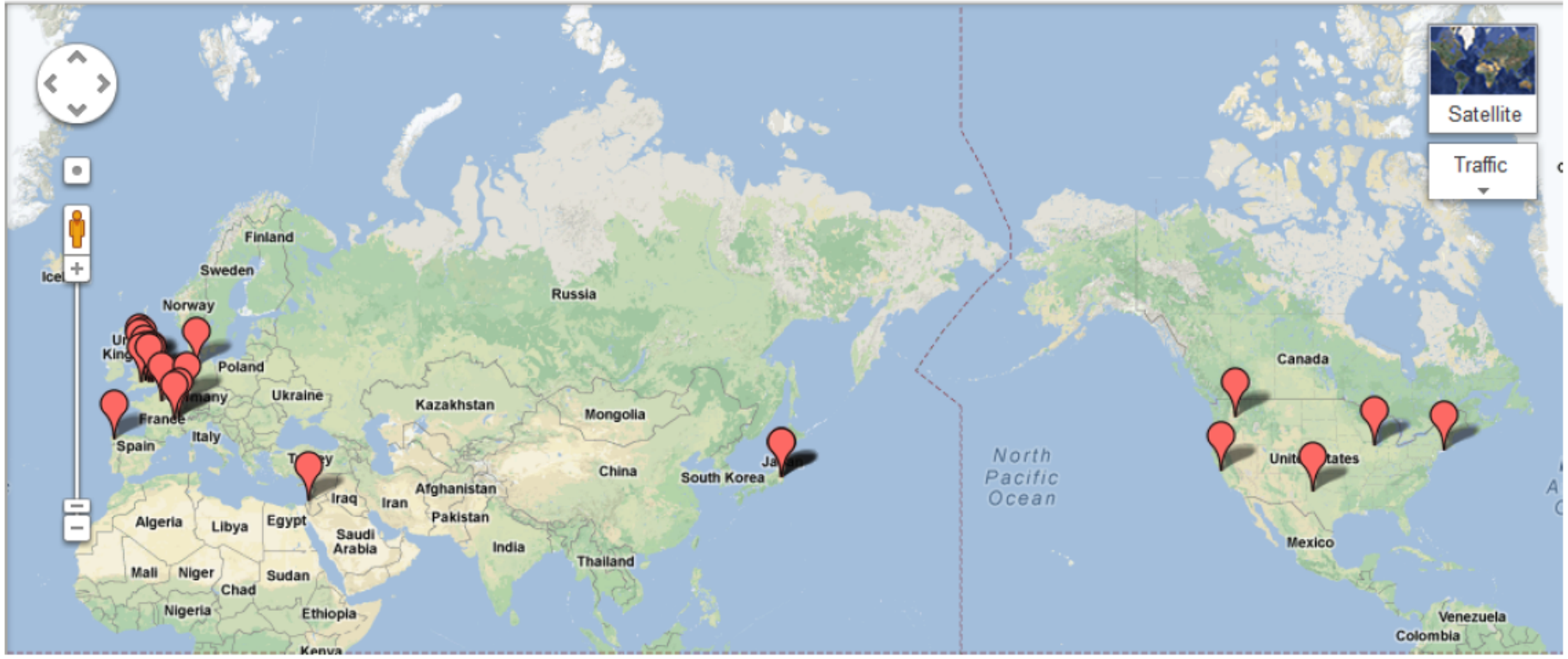




“Luminosity”

Our current “luminosity” is provided not by an accelerator but by a large number of CPUs

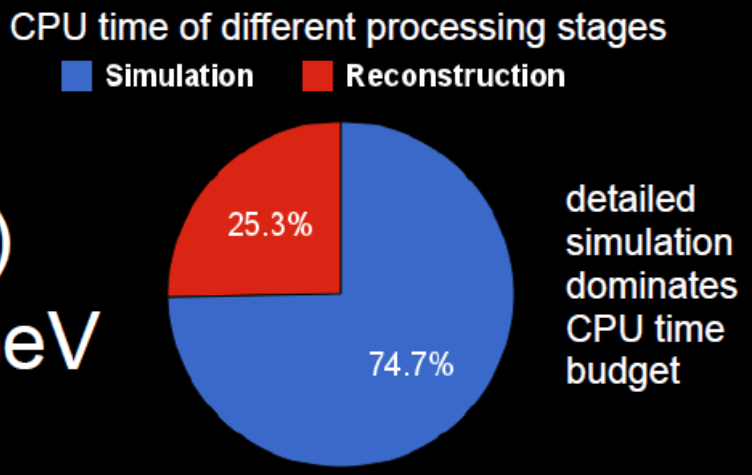
- All detector concepts have heavily used the Grid for the Monte Carlo production using resources in the WLCG and OSG grid sites all over the world and benefited a lot from support by the local computing and Grid groups
- Not much mention of issues with the Grid
- Conclusion: The performance of the Grid is excellent and taken for granted, and the site admins have performed and are performing admirably!

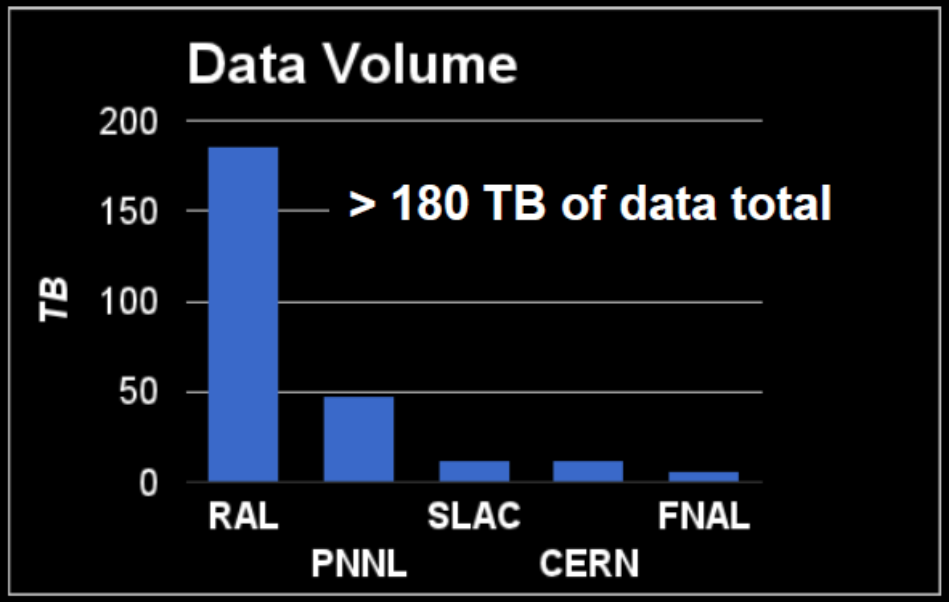


SiD DBD Production in Numbers

Production summary on SLAC confluence

50.7 million events at 1 TeV
(+ 4.7 million gghadrons)
6.55 million events at 500 GeV
(+ 4.4 million gghadrons)





Country	Total CPU Time (years)
UK	100.2
CH	68.2
FR	15.0
US	28.2
TOTAL	211.6

J. Strube

Reconstruction / Analysis

- By default, “event reconstruction” includes track-finding, calorimeter clustering and track-cluster association (PFA) to provide collections of “Particle Flow Objects.”
  - In principle one-to-one match with MC final-state particles.
- Traditionally, jet-finding and flavor-tagging has been analysis-specific.
  - Currently working to define a set of “generic” jet-finding and flavor-tagging algorithms which are “good enough” for most analyses.
- Will provide DSTs for analysis.

Accessing the Samples

- Files residing on Grid Storage Elements require Grid Certificate and membership in the ILC VO.
- Events are stored in LCIO format
  - Bindings provided for Java, C++ & python
  - root dictionary also provided
- SiD is making its most recent set of samples available via anonymous ftp from:

  ftp://ftp-lcd.slac.stanford.edu/ilc4/snowmass/
- Expect DSTs with full reconstruction (including flavor-tagged jets) to be available within a week or two.

Summary and Outlook

- New sets of Standard Model events have been generated at e+e- cms energies of 250GeV and 350GeV with ILC beam parameters for Snowmass.
  - 250 fb^{-1} @ 250GeV and 350 fb^{-1} @ 350GeV
  - Four sets of 100% polarization or one set at expected ILC polarization (80%(e-) 30%(e+))
  - Incoherent pairs and $\gamma\gamma \rightarrow$hadrons generated and overlaid.
  - Processed through fully detailed Geant4 descriptions of the SiD and ILD concepts
  - Full ab initio reconstruction, including lepton ID and quark flavor-tagging.
  - Events accessible on Grid (with ILC VO), SiD events also available via anonymous FTP.
  - Detailed writeup in preparation.