Event Generation

- Currently provide support for:
  - Pythia, Isajet, Herwig + ...
  - Whizard, pandora.

- What higher-order, dedicated generators do you need?

- Have standard sets available as stdhep, plus output from canonical detectors.
  - Zh, qqbar, ttbar, ZZ, WW, ...
  - Developing Grid-based tools to catalog and index.

Talk: H. Baer
WHIZARD Monte Carlo is used to generate all 0,2,4,6-fermion and t quark dominated 8-fermion processes.

1000 fb\(^{-1}\) @ 0.5 TeV & 2000 fb\(^{-1}\) @ 1.0 TeV have been generated so far.

7000 stdhep files, 3 terabytes on SLAC MSTORE.

100% electron and positron polarization is assumed in all event generation. Arbitrary electron, positron polarization is simulated by properly combining data sets.

Fully fragmented MC data sets are produced. PYTHIA is used for final state QED & QCD parton showering, fragmentation, particle decay.

Talks: Tim Barklow  Tony Johnson
Much recent work has been done to systematically generate backgrounds from $e^+e^-\&\mu^+\mu^-$ pairs and $\gamma\gamma\rightarrow$hadrons (T. Barklow, T. Maruyama).

Mask & BDS elements have been included in GEANT4 using LCD XML detector description plus dedicated drivers for the masks, luminosity monitors and beam delivery system (T. Behnke).

G4 event source reads in GuineaPig output (TB).

Started generating data samples.

Machinery to overlay events exists.

Talk: Tim Barklow
154 $\mu^+\mu^-$ pairs / train

56 hadronic events / train
Full Simulation: Geant4

- Geant4 being developed and supported at SLAC.
- LCDG4 being actively developed at NIU.
  - both infrastructure and comparison
- Mokka being actively developed in Europe.
- Comparisons of same geometries in different frameworks useful for QA but recognize that we still need to work to converge.

Talks: D. Wright  G. Lima  H. Videau
Fast Simulation: Lelaps

- It swims particles through detectors, taking into account magnetic fields, multiple scattering and dE/dx energy loss.
- It produces parameterized showers in EM and hadronic calorimeters.
- It converts gammas.
- It supports decays of certain short-lived particles ("V" decays).
- It does all this very fast.

Talk: W. Langeveld
Lelaps (LDMar01)
LC Common IO Format (LCIO)

- Version 1.0 supports C++, Java, Fortran
  - Provides persistency for various data types:
    - MC Particle description (c.f. stdhep)
    - Simulation Output (tracker hits, calorimeter cells)
    - Prototype/Beam-Test storage (TPC, Calorimeter)
    - Reconstruction Output (e-flow) under development

- Used by:
  - Now: Mokka, JAS3, LeLaps, Brahms, test-beam data
  - Soon: LCDG4, hep.lcd reconstruction

- Documentation/more info:
  - Talks by: Tony Johnson, Ties Behnke
More Realistic Tracker Hits

- Have defined “generic” tracker hit information for full simulation output.
  - SimTrackerHit in common LCIO format.
- Defer digitization to post-Geant4 to speed up simulations and investigate effects of readout.
  - e.g. Si μstrip pitch, TPC pad size, CCD pixel size.
- Actively working on digitizing all of the above detector elements. Aiming for LCWS.

Talk: C. Flacco
Improved Reconstruction Goals

- Aim is to demonstrate full “Energy Flow” reconstruction.
- Finishing up $\gamma$-finding high priority (ANL, University of Kansas, Kansas State University, University of Iowa, University of Colorado, SLAC discussion)
- Implement realistic forward tracking.
- Refine track-cluster association.
- Understand remaining neutrals.
- Muon-finding software being actively worked on (C. Milstene).
Reconstruction: Reality Check

- Very few improvements in recent years despite a long list of potential improvements.
- Original developers moved on to other things.
- Needs infusion of new manpower and funds.
- Example is Bob Wilson’s Particle ID package
  - simple, fast, flexible tool to explore PID issues
  - v0 @ Snowmass, few to no users, “on the fringe”
  - Did not submit a continuation LCRD PID proposal:
    - Not enough time to accomplish goals of the previous proposal - funds arrived mid-summer
    - Funding request limitation inadequate to do an adequate job...especially in light of inadequate support infrastructure (at SLAC)
JAS3 & hep.lcd

- Successor to JAS2 which was used for LCD analysis last 3+ years.
- Supports LCIO and access to whizdata.
- Very few improvements in analysis code due to lack of manpower.
- All new work (such as switching to LCIO) will be based on JAS3.
- Encourage users to try JAS3 out (using tutorial) and give us feedback.

Documentation & Communication

- Should be usable, still evolving.
- Geant4 collaboration has found it very useful. Try it out let us know what you think.

- lcsim.org aims to be new home for simulation information. Coming soon...
Simulation Workshops

- Previous workshops have all been quite successful in establishing milestones and spurring development.
- Proposal is to hold next one at ANL June 2-5.
- Geant4 tutorial here at SLAC March 8-10.
- Have several G4 Tutorial CDs available for those interested in getting a head-start.
Announcing the next in a series of Workshops on Simulation and Particle-flow Reconstruction for a future Linear Collider:

Linear Collider Simulation Workshop III
June 2-5, 2004
Argonne National Laboratory

Topics for discussion include: GEANT4 event and particle generation, detector models and performance, Particle-flow algorithm development, standardized geometry and data IO, and tools for reconstruction and analysis... continuing the efforts started at

Linear Collider Simulation Workshop
May 19 - 22, 2003

Workshop on simulation, energy-flow algorithms, and software for the Linear Collider
November 7-9, 2002, Northern Illinois University, DeKalb, IL, 60115, USA
Feedback

- Need feedback from physics and detector groups on their requirements.
- What detector capabilities do we need to benchmark?
- What changes are needed for the canonical detector(s)?
- What do we need to deliver (and when) for you to accomplish your goals for LCWS?
Summary

- Full SM event samples at 500 and 1000GeV.
- Full background sets available, being pushed through the full simulation.
- G4 and LCIO becoming default.
- Near term emphasis on improved detector digitization, esp. CCD, TPC, Si µ-strips.
- Improvements in reconstruction and analysis packages.
- Aiming for results at LCWS incorporating realistic hit reconstruction from “raw” data and in the presence of full backgrounds.