Stautus report from the common workinggroup on generators

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KILC12, Daegu, S. Korea , April 23 ,2012

Outline

Common Task Group for Generators

A cross-region and cross-concept working group was created to look into the generator side
Members

- Tim Barklow, SiD/Americas
- Akiya Miyamoto.ILD/Asia
- M.B., ILD/Europe

Since, CLIC has also joined

- Stephane Poss

What is needed for the DBD

- The DBD bench-marks are:
  - $e^+e^- \to \nu\bar{\nu}h^0$
  - $e^+e^- \to W^+W^-$
  - $e^+e^- \to t\bar{t}h^0$
- All at E_{CMS}=1TeV
- Also: Redo on LOI analysis with the new software. For both ILD and SiD: $t\bar{t}$ at E_{CMS}=500 GeV.
- Machine backgrounds and same-bunch crossing $\gamma\gamma$ events should be overlaid (in some way...)

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Why not do as we did for the LOI ?

- Work needs to be shared.
- There are a number of short-comings with the version of Whizard used:
  - Diagonal CKM
  - No tau polarisation in decays
  - Hadronisation tune in PYTHIA
  - Colour-flow and helicity information

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Generator choices

2-6 fermions are done with Whizard

- Whizard version by choice : 1.95. Has
  - CKM correct
  - Colour flow
  - Spin

8 fermions are done with Physim

- Fragmentation: Latest PYTHIA6 (6.422).
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Some words on Whizard

Whizard combines

- Matrix-element calculation (O'Mega, MadGraph or CompHEP; we use O'Mega),
- Phase-space calculation.
- Multi-channel integration

into an efficient generator of un-weighted events.

Features:

- Easily treats up to 6 particles in the final state, can do > 6.
- Does not separate "signal" and "background" sources of the final state $\rightarrow$ interference correctly treated.
- Keeps track of polarisation.
- Knows about beam-strahlung and ISR, hence varying initial-state properties.
- NB. hadronisation and eg. τ-decays are *not* treated by Whizard, but by external programs, supplied by the user.

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- We use PYTHIA for fragmentation and decays.
- Note that PYTHIA doesn't know about polarisation (τ:s, charginos, ... !). Use TAUOLA instead.
- Many models (SM and beyond) known. NP parameters read from LesHouches file.

Problems with Whizard:

- Many channels: SM alone is made of 2348 distinct Whizard channels...
- Non-perturbative processes, eg. $\gamma\gamma$ beyond multi-peripheral.
- Highly singular phase-space, eg. Bhabha:s

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Improvement wrt. LOI

- Extension of information in the event record:
  - Colour singlet system information and particle spin.
  - Beam-particles before and after beam-strahlung.
  - Process ID in each event record.
- Coding of FSR: Mokka modified to be insensitive (as SLiC already was).
- Coding of displaced vertecies: Mokka modified so that the generator decides (B. Vormwald).
- Crossing-angle: generate head-on, Mokka takes care of boosting to the side. NB: Numbers in MCParticle NOT identical to input stdhep-numbers !
- In Whizard, Flavour-summed channels are used. Will reduce the 2348 channels to a few tens. Two options:
  - Sum in phase-space evaluation: Higher gain in simplicity and CPU-time,but less flexible.
  - Channel mixing in generation: Any set of channels can be merged.

  Both options are used, as well as mixes of them.

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Tools for productions of generator samples

- T. Barklow's scripts to run Whizard jobs at the SLAC batch server migrated and adapted to the KEK environment, and to DESY.
- An SVN project holding Whizard source-code, installation scripts and process-description files has been set up at CERN by S. Poss.
- As generation production will now be distributed → An meta-data file with file-locations, generator settings, etc. is updated by each generation job.
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Status of generator samples

Note: The final official 1 TeV beam-parameters from the GDE were final released only on Dec. 23.
GuineaPig simulation and beam-spectra were ready by mid-January.

Status of generator samples : $\nu\nu h$

Assigned to T Barklow (SLAC).

- $\nu\nu h$: Includes $h \to gg$ and WW^*, so need 6-fermion background.
  - Large advantage with aliasing, esp. when Cabibbo suppressed decays included.
  - However: Integration gets very time-consuming with aliasing.
  - Full signal sample is Done.
  - Background sample is Done. Includes all 6-fermion final-states, ie. it contains all $t\bar{t}$ channels.
  - A few technicalities remains to be addressed (file-naming, meta-data).
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Status of generator samples : *ttH*

Assigned to A. Miyamoto (KEK).

- *ttH*: 8 fermions background, Very difficult for Whizard.
- Use Physim
  - ttH (ie. 6fH), ttff (ie. 8f) by Helas (helicity amplitude approach).
  - Same beam-strahlung function as Whizard.
  - Same PYTHIA tune.
  - Same TAUOLA.
  - Same output STDHEP format.
- Several checks done to make sure that there are no important differences wrt. Whizard.

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Status of generator samples : *ttH*

- $e^+e^- \rightarrow t\bar{t}H, t\bar{t}b\bar{b}, t\bar{t}Z$ all fully generated.
- Classified by beam-polarisation, $t\bar{t}$ decay-mode ($6q, l\nu 4q, 2l2\nu b\bar{b}$) and Higgs.
- Always at least 50 kevents, even if 1 ab^{-1} is less.
- Log-files etc. on http://www-jlc-in.kek.jp/ miyamoto/mc-dbd.log/generted/1000-B1b_ws/tth

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Status of generator samples : *WW*

Assigned to MB.

- 4 fermions: All setup at DESY.
  - Integration of all 4 fermion final-states: over-night job, with sub-per mil uncertainty on cross-section. DONE.
  - Generation of 1 ab^{-1} also over-night job for non-electron final states, about a week for single bosons.
  - All DONE.
- 2 fermions:
  - At 1 TeV: Similar cross-sections as 4-fermion $\rightarrow$ also do these.
  - ... except that $e^+e^- \rightarrow e^+e^-$ are strongly restricted.
  - Technical difficulties due to very low generation efficiency - 1 event per 1000 generated accepted: Solved.
  - Status: DONE
- STDHEP:s on grid, log-files, steerings, diagram-plots, etc. on the web (http://ilcsoft.desy.de/dbd/generated/4f_production/)

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- Organisation:
  - Hierarchy: ZZ or WW or ZZWWmix / hadronic or leptonic or semi-leptonic / four beam polarisations
  - Separate single boson ($XXee$,$XX\nu_e\nu_e$ or $XXe\nu_e$) final states (t-channel!) from rest.
  - Total number of cases = 40. Compare: 140 possible 4f final states $\times$ 4 polarisations without aliases+grouping.
  - Similar for 2 fermions: Z / hadronic, bhabha, or leptonic. 8 cases.
- NB: Cross-sections are in the 10 pb range $\rightarrow$ we are asked to fully simulate tens of millions of events !!!
- A. Rosca is in charge of the DBD analysis of *WW*, and will propose how much lumi should actually be full simulated.

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Status of generator samples : Backgrounds and 500 GeV

- Pairs background:
  - About 1300 bunch-crossings = half a bunch train produced with GuineaPig, by A. Hartin.
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File locations:

Sub-directories of:
lfn:/grid/ilc/prod/ilc/mc-dbd/generated/1000-B1b_ws/

Information on samples:

http://ilcsoft.desy.de/dbd/generated/