Report from Common Task Group for Generators

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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

Why not do as we did for the LOI ?

- Tim will not do it alone, due to his work-load
- 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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- For the DBD, there are new bench-marks:
  - $e^+e^- \to \nu\bar{\nu}h^0$
  - $e^+e^- \to W^+W^-$
  - $e^+e^- \to t\bar{t}h^0$
- All at another E_{CMS}=1TeV
- Machine backgrounds and same-bunch crossing $\gamma\gamma$ events should be overlaid (in some way...)
- At least for $t\bar{t}h^0$, backgrounds with 8 or even 10 fermions might be needed.
- The LHC runs.

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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.
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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
- Eg. low-mass SUSY gets very complicated. SPS1a': 13 open production channels open, 49 decay-channels (40 of which are SUSY cascades), 100's of final states, many with > 6 fermions.

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Generator choice

SM will be done with Whizard

- Whizard version by choice : 1.95. Has
  - CKM correct
  - Colour flow
  - Spin
- Latest version at the time of the decision was 2.0.2, but “Note that some of the features of WHIZARD 1 (esp. ILC) have not yet been re-enabled.” (Whizard home-page).
- Fragmentation: Latest PYTHIA6 (6.422). PYTHIA8 is out but “To some extent this switch is nominal, since 8.1 does not yet offer a complete replacement of 6.4, and is not yet tested and tuned enough to be recommended for major production runs.” (PYTHIA home-page).

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Whizard improvement

- PYTHIA 6.422 is used for hadronisation. After evaluation of the tunings from the LEP collaborations, we decided to use OPAL.
- Tau-polarisation in decay: TAUOLA interface standardised, for polarisation-dependent τ-decays. Also for τ's in fragmentation $W \to \tau\nu$. Verified to work correctly - Thanks for advice Gudi!
- Extension of information in the event record:
  - Colour singlet system information and particle spin.
  - Beam-particles before and after beamstruhlung.
  - Process ID in each event record.
- Coding of FSR.
- Flavour-summed channels. After all, who cares if it is a u,d, or s quark ? 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.
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Whizard improvement: Aliases

Aliases: in the process definition file, eg.:

alias q u:d:s:c:b

Then one can define eg.:

qq e1,E1 q,q omega w:c,c

to get all $e^+e^- \to q\bar{q}$ processes in one go.
However: all masses must be equal !

What does that do to eg. b-fragmentation ??!

Whizard improvement:Aliases

Check fragmentation:

- m_b=5.5 GeV
- m_b=0 GeV
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No problem: fragmentation is in PYTHIA, uses it's own (correct) quark-masses.

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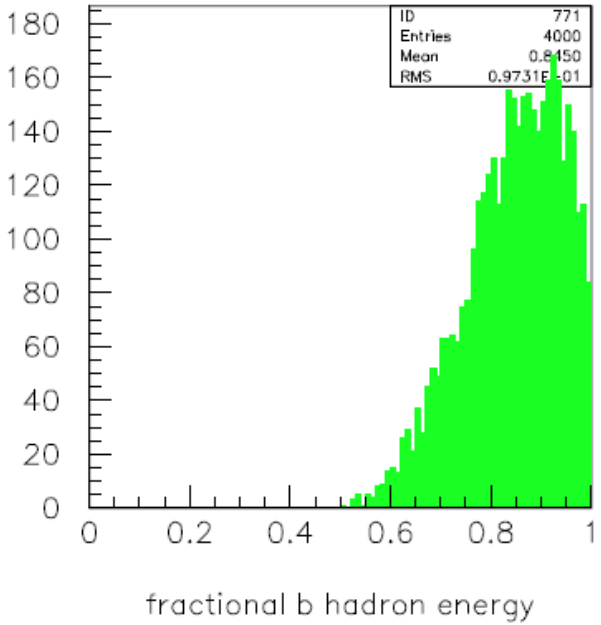

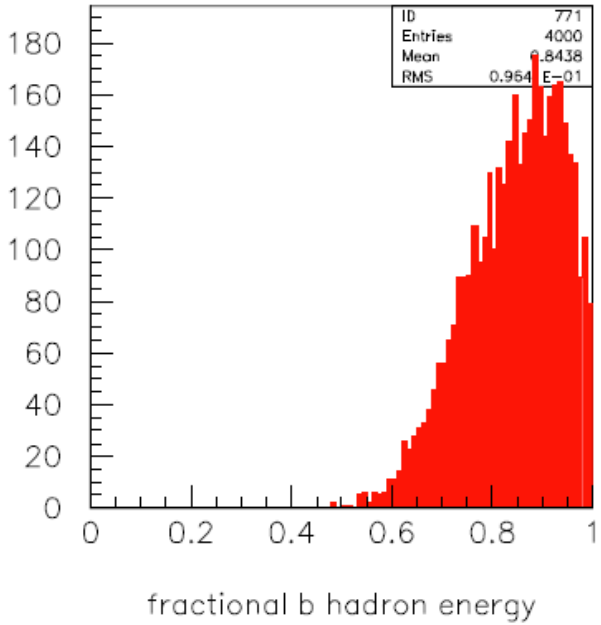

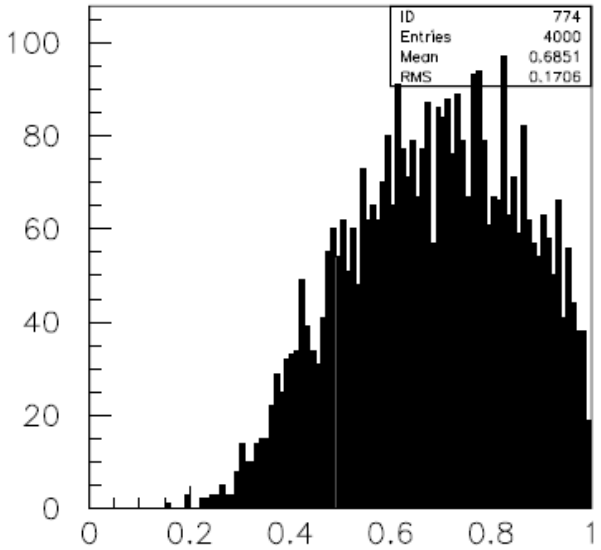

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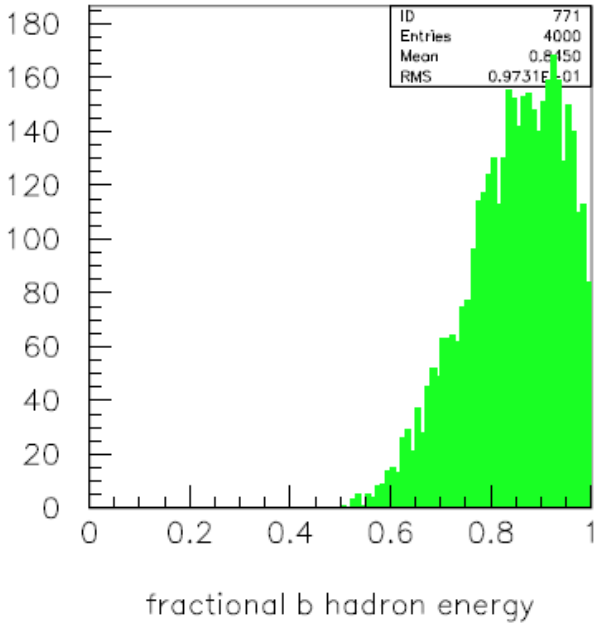

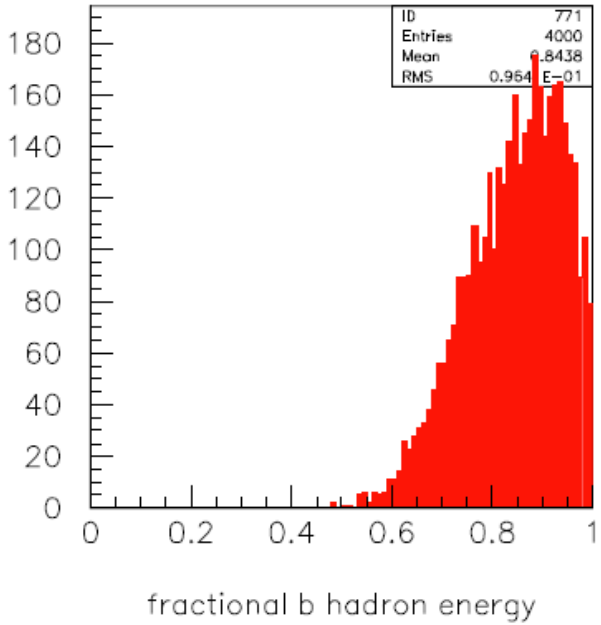

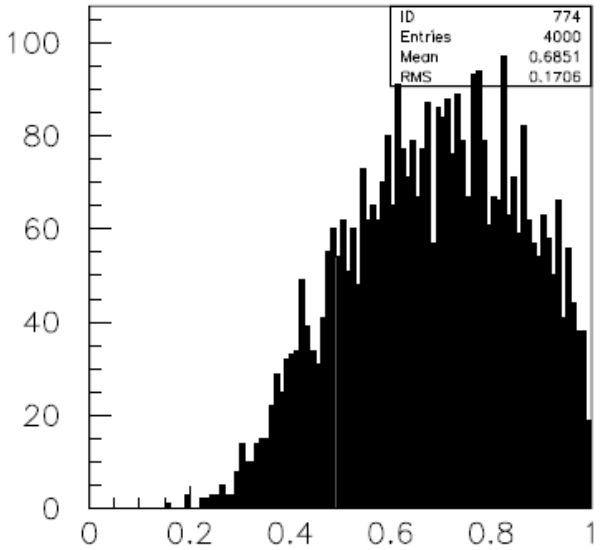

Tools for productions of generator samples

- Tim's scripts to run Whizard jobs at the SLAC batch server migrated 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 Stephane.
- As generation production will now be distributed $\rightarrow$ need conventions and "database"
- SiD: Fermi Pipeline system fits well, but not migratable Tim is preparing the interface.
- Probably ILD will do something similar with the new production system.
- In any case: An information file with file-locations, generator settings, etc. should be updated by each generation job. A proposal by is on the table.

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- ttH: 8 fermion background + No CPU resources in KEK
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  - For the moment, the KEK analysis activity is slowed down.
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  - Integration of all 4 fermion final-states: over-night job, with sub-per mil uncertainty on cross-section
  - Generation of 1 ab^{-1} also over-night job for non-electron final states.
  - STDHEP:s on grid, log-files, steerings, diagram-plots, etc. on the web.
  - Some jobs not completed due to (a detected) infinite loop in PYTHIA. Under investigation.
  - Need some automatic error detection.
- Organisation:
  - Hierarchy: ZZ or WW or ZZWWmix / hadronic or leptonic or semi-leptonic / four beam polarisations
  - Separate *XXee* or $XXe\nu_e$ final states (t-channel!) from rest.
  - Total number of cases = 36. Compare: 140 possible 4f final states $\times$ 4 polarisations without aliases+grouping.

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- The Common Task Group for Generators has been formed, and is working.
- Whizard, the main work-horse of the SM simulation, has been updated to the most current, ILC-usable version.
- Most issues on list of needed amelioration has been solved, both technical and physics ones.
- The way to feed information from generation to the production database must be designed and tested.
- Initial full-scale production of the *WW* sample at 1 TeVhas been done; others advancing well.
- Larger scale test of the physics of new Whizard version and the new tune of fragmentation will be needed
- Work is also going on on background generation and overlay techniques.

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