Generator Group Status Report

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Outline

1. Outline
2. Introduction
3. Whizard 1 $\rightarrow$ Whizard 2
4. Non-whizard issues
5. Conclusions and Outlook

Introduction

- Group formed to select generator to generate physics events for the DBD benchmarks, including all relevant backgrounds.
- $\Rightarrow$ Generate the entire SM at 1 TeV. At least 500 fb^{-1}, except for very high cross-section processes ($\gamma\gamma$, Compton, Bhabha).
- Members:A. Miyamoto, T. Barklow, M. B., CLIC (at the time S. Poss, now P. Roloff)
- Also used to produce 250, 350 and 500 GeV data-sets.
- Presently, the group doesn't really exist - our mandate was for the DBD.
- However, we decided to get back into business, because:
  - New, better Whizard.
  - Developments in reconstruction.
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Whizard 1 → Whizard 2

- Much improved steering: Sindarin.
- Samples from new BSM models much easier to create, using tools like SARAH.
- 8 fermion final states possible (*ttH* !). Was not (practically) possible with Whizard 1.95, so these DBD samples were made with Physim.
- Match hard gluon radiation from Whizard hard process with gluons in parton-shower and hadronisation. Can, within Whizard, compare this with DBD recipe ($\alpha\_s = 0$ in Whizard + Pythia for both parton-shower and hadronisation) ⇒ systematics evaluation.
- Improved treatment of $t\bar{t}$ threshold.
- Easier to study of impact of beam parameters: GUINEAPIG beam-simulation directly input to Whizard (the CIRCE2 component).

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Status of Whizard-2 for ILC: Output format and interfaces

- Correct stdhep output: In latest α release (2.2.8alpha) the stdhep output format is as expected, ie. as it would be by outputting HEPEVT directly after PYTHIA hadronisation. However HEPEV4 output still missing (Spin and colour-flow).
- Fringe-benefit: when it works Whizard can also directly output LCIO.
- Interface to PYTHIA:
  - In Whizard 1.x, this was external to Whizard, and implemented in our user-routine, user.f90 (mostly by Tim)
  - In Whizard 1.95: Colour-flow from Whizard used to to set up the event-record for correct treatment in Pythia, also done by us.
  - In Whizard 2: Interface is internal to Whizard, but the way to transfer Colour-flow changes between versions.
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Status of Whizard-2 for ILC : Polarised τ decays

- Whizard produces correctly polarised τ:s $\Rightarrow$ need to correctly decay polarised τ:s $\Rightarrow$ TAUOLA.
- But: Pythia doesn't handle polarised decays; allows for user plug-in to do τ-decays.
- $\Rightarrow$ Need to "leap-frog" polarisation information from Whizard over the polarisation-blind Pythia to TAUOLA.
- ILC-Whizard-1.95: done in user.f90.
- Whizard-2: no user.f90 anymore $\rightarrow$ How to do it now?
- Whizard authors intend to do τ-decays within Whizard. Timescale?

Status of Whizard-2 for ILC : $H \rightarrow \tau\tau$ or $H \rightarrow \gamma\gamma$

- Obviously, Whizard can only transfer the full spin correlation for τ's it knows about.
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  - Let Whizard *decay* H, with constraint on intermediate state = Higgs, $\Rightarrow$ polarised τ:s ! Caveat: Can one set BR's ?!

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Whizard 2 offers two possibilities

1. CIRCE 2: Do ∼ what user.f90 did - use GUINEAPIG output to automatically create an MC-generator of the beam-spectrum
   - Observed significant (factors >> 1) slow down ⇒ ask Authors to profile CIRCE2
   - Initially, did not work with polarised beams. Now fixed by authors.
2. "direct read-in" of "beam event files": Works, also with polarisation
   - Draw-back: Needs huge statistics in GuineaPig files, probably not efficient for mass- production.
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- Technical requirements for mass production in batch mode:
  - Initially, option to specify maximum file size + automatic file splitting was missing. Now added by authors.
  - Steering by command line options.
- For fast simulation: need callable interface (ie. no intermediate generator files).
- Double counting in $\mathrm{e}^+\mathrm{e}^- \rightarrow e^+e^-f\bar{f}$:
  - Problem: if γ^* and e massless, p_t-kick from Weizsäcker-Williams γ violates 4-momentum conservation $\Rightarrow$ unphysically large p_t-kick on e $\Rightarrow$ cut used to separate $\mathrm{e}^+\mathrm{e}^- \rightarrow e^+e^-f\bar{f}$ from $\gamma\gamma$ and from ZZ etc. fails $\Rightarrow$ double-counting. Routes to solve this:
    1. Do $\mathrm{e}^+\mathrm{e}^- \rightarrow e^+e^-f\bar{f}$ down to $m_e > 0$ without cut-off? $\Rightarrow$ needs quadruple precision in integration and event generation + work of > 1 month
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- gluon matching between ME and PS:
  - Now: no gluons included in ME (setting $\alpha_s = 0$) to avoid double-counting with (unmatched) parton shower in Pythia.
  - Whizard 2 can do it's own parton-shower with "MLM matching".
  - For now: stick with old scheme for mass-production, but make dedicated comparisons for multi-jet final states (eg $t\bar{t}$ background for ttH or ZZH)
- 8 fermions:
  - Whizard 1: Choked on 8 fermion $\rightarrow$: source code generated by O'Mega (the matrix element code generator) could reach several GB in size $\Rightarrow$ Physsim in DBD for ttH
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- Dedicated radiative Bhabha generator:
  - LEP generators with treatment of collinear divergencies etc.
  - BHWIDE used for CLIC luminosity spectrum study (A.Sailer). Do the same? If so, how to implement beam-spectrum ?
  - Work ongoing in CLIC group on new NLO generator (Vladimir Makarenko).
  - Some efforts to use GRACE have also been done.
- $\gamma\gamma$ in general: Pythia is much more elaborate than Whizard. However, Pythia6 out-of-the-box can't handle beam-spectrum for these processes. Possible way:
  - Use Whizard to generate γ:s (virtual or real)
  - Feed these as input photon-beams to Pythia.
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  - Present (DBD) procedure:
    - As above: let Whizard do the γ:s.
    - If M$_{\gamma\gamma}$ > 10 GeV: Use Pythia as above.
    - Else: Cross-section from formula (Amaldi & al.) - final state is two mesons, either $\rho\rho$, $\rho\pi$ or $\pi\pi$, depending on M$_{\gamma\gamma}$
  - Unphysical invariant mass distributions observed on files currently used in overlay.
  - Seems possible to go much lower in M$_{\gamma\gamma}$ with PYTHIA than what was done in the DBD. Not quite to 2 m$_{\pi}$, but does that matter ?
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