MC Production news

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Announcement for central production

- REC files were rarely used for physics analyses (except for the need to re-run the PFO selector for some CLIC_SiD samples)
- Storing REC files is not sustainable
  - Limited bandwidth to and from CASTOR ($<$100 MB/), and limited space on EOS (350 TB)
  - E.g.: ee_qqqq 39.5 TB REC files vs. 2.1 TB DST files
  - Processing of REC files operationally involved: recall from tape, process, remove, recall next batch...

⇒ **Discontinue storing REC files**

⟹ **Need to ensure everything needed for physics analyses is available in DST files**

! Let us know if something is missing in the DST files ! → contact Andre Sailer (andre.philippe.sailer@cern.ch)

- SIM files remain available for re-processing as necessary
- REC files for event displays can be created manually (HowTo will be added to the documentation)

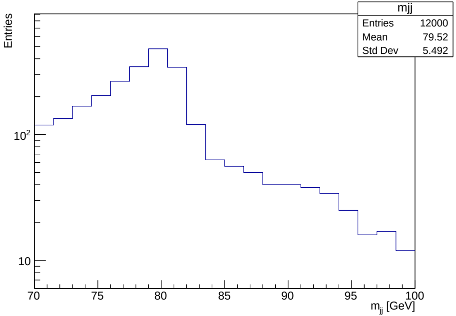
Introduction

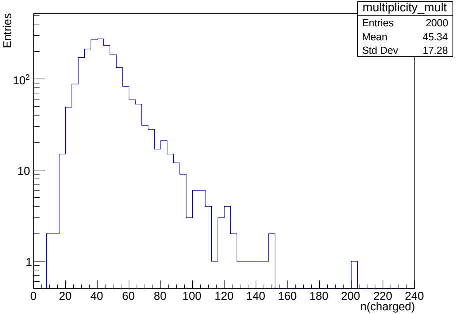
- Monte Carlo Production news
- Taking requests for CLICdet (new detector model) and Whizard 2
- Twiki page with production overview:
  `https://twiki.cern.ch/twiki/bin/view/CLIC/MonteCarloSamplesForCLICdet`
- Current status:

DONE	$e^+e^- \to q\bar{q}$ at 3 TeV
DONE	$e^+e^- \to q\bar{q}q\bar{q}$ at 3 TeV
DONE	$e^+e^- \to Hq\bar{q}$ at 3 TeV
WIP	$e^+e^- \to t\bar{t}$ at 3 TeV (2.5M events)
IN PREP.	$e^+e^- \to ZH$ at 380 GeV (clarify which model, generator, overlay)
IN PREP.	$e^+e^- \to Hee, H\mu\mu$ (HZ with leptonic Z) at 3 TeV (150k events)
IN PREP.	Vector boson scattering processes: ee->4qnunu, 4qll, 4qlnu at 3 TeV
IN PREP.	ZHH at 1.4 TeV (based on exisiting GEN files)

- Validation of multi-quark processes in terms of cuts, cross section agreement with Whizard 1 ($\to$ beam spectra different though), resonance history, ISR pT recoil, polarisation

Validation of the resonance history in a couple of files from the newly produced qqqq production (2000 events of prodID 12960)





$\Rightarrow$ OK

ttbar samples validation

- First step: validate the cross sections
- Split up the ttbar fully hadronic in the same way as in the Whizard 1 production
- For now, focus on the fully hadronic final states for the first batch of production

"l" = mu, tau
"v" = ν_e, ν_μ, ν_τ
"y" = d, s, b
"x" = u, c
here, P(e-) = -80 %

		xsec[fb] Wh1	xsec[fb] Wh2
ee $\rightarrow$ yyveev		16.8	
ee $\rightarrow$ yyveyx		47.8	
ee $\rightarrow$ yyxyev		39.1	
ee $\rightarrow$ yyuyyc	fully hadronic	14.1	15.4
ee $\rightarrow$ yycyyu	fully hadronic	14.1	15.3
ee $\rightarrow$ dduyyu	fully hadronic	12.9	13.3
ee $\rightarrow$ ssussu	fully hadronic	0.013	0.013
ee $\rightarrow$ ssubbu	fully hadronic	0.049	0.046
ee $\rightarrow$ bbubbu	fully hadronic	0.0092	0.0090
ee $\rightarrow$ ddcyyc	fully hadronic	1.38	1.29
ee $\rightarrow$ sscssc	fully hadronic	1.17	1.15
ee $\rightarrow$ sscbbc	fully hadronic	10.3	9.5
ee $\rightarrow$ bbcbbc	fully hadronic	0.0093	0.0092
ee $\rightarrow$ yyvelv		16.3	
ee $\rightarrow$ yyvlev		13.3	
ee $\rightarrow$ yyvllv		13.3	
ee $\rightarrow$ yyvlyx		19.2	
ee $\rightarrow$ yyxylv		19.2	

$\Rightarrow$ Fully hadronic cross sections are in good agreement with Whizard 1 (up to 10 % differences are acceptable)

Long integrations in Whizard

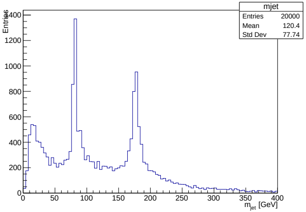
- Hadronic final states (for now)
- Integration times more than 2 days, especially for the channels with d:s:b (=y) it takes quite a bit longer to get sub-percent precision
- Whizard apparently discards the integration grids when I run again on the process
- Reason: CIRCE2
- Workaround: `?check_grid_file = false` recommended by the Whizards

Currently running the integrations with very high precision (need several days), will then upload the produced files to the grid and generate events from them

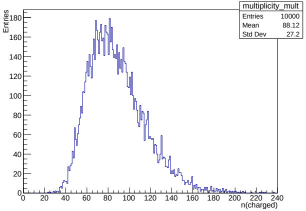
Resonance history in ttbar

- Validated the resonance history in ttbar as well, but only for the default setting (limit = 16, turnoff = 8).
- For the processes sscbbc and yycyyu
- Jets reconstructed as VLC jets, N=2, R=1
- Looks good, resonance peaks are visible

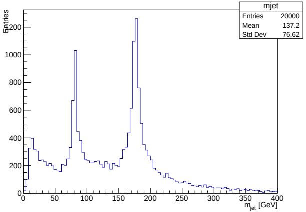
yycyyu:



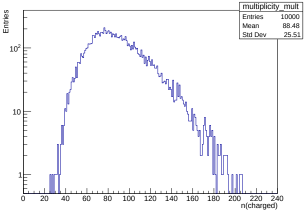
yycyyu:



sscbbc:



sscbbc:



Chargino pairs for stub tracks study

See also Emilia's talk; BSM Yellow Report

- Process: chargino pair production, i.e. $e^+e^- \to \chi_1^\pm \chi_1^\pm$ where the χ_1 decay to a neutralino and a pion: $e^+e^- \to \tilde{\chi}_1^+ \tilde{\chi}_1^- \to \tilde{\chi}_1^0 \pi^+ \tilde{\chi}_1^0 \pi^-$
- The pion is not reconstructed due to its very low pT, and the neutralino is not reconstructed at all
- Thus a short track from the chargino might be reconstructed, depending on the lifetime of the chargino
- Since they come in pairs, the analysis can look for 1 or 2 stub tracks
- PDGID of the chargino1: 1000024, neutralino1: 1000022
- Based on 1901.02987 (primary references 1212.5989 and hep-ph/9804359) the mass difference between the chargino1 and the neutralino1 is 160 (355) MeV for the wino (higgsino) LSP scenario → the chargino1 has a lifetime of 0.2 (0.023) ns for the 3 TeV wino (1 TeV higgsino) scenario at the thermal limit. ⇒ neutralino mass is $m_{\tilde{\chi}_1^0} = m_{\tilde{\chi}_1^\pm} - 160(355)$ MeV
- First attempt: Let Whizard do the decay chain to neutralino and pion
  - For Pythia to read the SUSY Les Houches Accord file and treat the neutralino as stable, add these to the `$ps_PYTHIA_PYGIVE` parameter list: IMSS(1)=11; IMSS(21)=71; IMSS(22)=71
  - In principle this works (event production) but there is no secondary, displaced vertex in the slcio/stdhep/hepmc event record – this might be easier to accomplish by doing the decay in Pythia and modifying the decay tables (widths/lifetimes)
- Alternative: Let Whizard produce $e^+e^- \to \chi_1^\pm \chi_1^\pm$ and have Pythia decay the charginos
  - Work in progress

Additional material

List of parameters and common settings

In Whizard 2.7.0 and above, masses of particles over which flavor summation is done need to be the same. For the purpose of these samples, massless quarks are fine.

- ms = 0
- mc = 0
- mb = 0
- mtop = 174 GeV
- wtop = 1.37 GeV
- mW = 80.45 GeV
- wW = 2.071 GeV
- mZ = 91.188 GeV
- wZ = 2.478 GeV
- mH = 125 GeV OR mH = 10000 GeV for samples with at least 2 $q\bar{q}$ pairs
- wH = 0.00407 GeV
- circe2 file for 3 TeV: `/cvmfs/clicdp.cern.ch/software/WHIZARD/circe_files/CLIC/3TeVeeMapPB0.67E0.0Mi0.15.circe`

- Beam spectrum 3 TeV; Overlay 3 TeV; ISR with pT kick
- Polarisation scheme 4:1: 80 % (20 %) of the sample with $P(e^-) = -80\,\%(+80\,\%)$ $\Rightarrow$ will make one sample per polarisation (separate production IDs)
- $\alpha_s = 0$ in matrix-elements to remove overlap between the multiplicities
- Pythia OPAL tune