Status of MadGraph MC Top, W, And Z Samples

Henry Frisch

Progress Since Last Time

Erin Abouzaid, UnKi, Sebastian, Tim Stelzer, Steve Mrenna (apologies to others working on the same thing..)

1. Have generated a 'uniform' set of background samples for dilepton and lepton+jets. (See Table below, plus W+jets up to 4 jets, Z+jets, etc.)
2. Have a proposal for kinematic cuts for generator samples
3. Have a better understanding of Q2 scale, PDF, etc. issues- started discussion of shower mc settings (with Mrenna).
4. Top dilepton (ee) and WZj (eeenuj) have gone through HEPG.
5. Making HEPG for all the sets (UnKi)
6. Started putting samples into MCDB.
7. Have run one sample (WZj) through cdfSim.
8. From the samples set the Ht cut- also other acceptance/effic. studies.

More Progress Since Last Time

1. Sebastian's code to make HEPG is useable- minor fixes still needed, but in CVS and seems to work.
2. Frank W. has given us run numbers for existing datasets.
3. Soushi has made a structural proposal that we use the CDF Pythia for the showering, while the generators stay outside. Still would make STDHEP for the MCDB STKEN storage (i.e. it would be public) at the same time one makes HEPG. He has this for Alpgen- started on MadGraph, and has found some missing items in the Pythia interface. Really nice work.
4. Have made more datasets at UC- have it down to being easy. However some hangups with top and taus with new Template- problem with specifying an intermediate state- also tau width- working on them with Tim.

Next Steps:

1. Finish putting all datasets into HEPG.
2. Finish putting all datasets into MCDB
3. Document these paths (mostly done).
4. Settle on generator defaults for winter conferences
5. Settle on Pythia tuning defaults for winter conferences
6. Resolve remaining discrepancies- e.g. Gervasio's Q2 results, MadGraph/MCFM njet difference (Erin)
7. Run one sample through production using dCache
8. Study and validate Pythia output- compare objects out of production to HEPG (question for Sebastian- are the files we're making ok for the farm?)
9. Run one set through the farm, check it, and document how.
10. Run all them through the farm.
11. Analyze them and validate them.

Cuts used to generate samples: Samples are being put in MCDB - will be run through Pythia and also turned into HEPG. This is a proposal for the winter conferences.

Sample Cuts:

Particle	E_T	η	ΔR
Charged Leptons	1.0	6.0	0.1
Leptons from e^+e^- pairs	6.0	6.0	0.1
Neutrinos	1.0	6.0	0.
Jets	7.0	3.0	0.1
B-quarks	7.0	3.0	0.1

Table 1: The 'Sample cuts' used at generator level to make the samples. The cuts are intended to be loose enough so that the smearing in E_T and η in Pythia or Herwig can reach down below threshold and find those events that will be promoted over threshold. In the case that leptons are made in pairs the thresholds have been raised to be far from the large cross sections caused by the photon pole.

Analysis Cuts (not part of the proposal):

Particle	E_T	η	ΔR
First Lepton	20.0	1.0	0.4
Additional Leptons	12.0	2.5	0.4
Missing Et	20.0	—	0.
Jets	10.0	2.5	0.4
B-quarks	10.0	2.5	0.4

Table 2: The 'Analysis cuts' used to calculate acceptances. No delta-R cuts are applied between any neutrino and any other particle.

Status of Sample Generation. Warning- checks still in progress.

Process	Sample	Leptons	Met	Jets	ΔR
$t\bar{t}$	100 fb	75 fb	68 fb	66 fb	61 fb
$Z^0 \to \tau^+\tau^-$	683 pb	—	—	—	—
$Z^0 \to \tau^+\tau^- j$	138 pb	—	—	—	—
$Z^0 \to \tau^+\tau^- jj$	58 pb	—	—	—	—
WW	102 fb	68 fb	54 fb	—	54 fb
WWj	60 fb	41 fb	34 fb	25 fb	24 fb
$WWjj$	33 fb	23 fb	20 fb	12 fb	7.9 fb
$WWb\bar{b}$	6.5 fb	5.1 fb	4.7 fb	4.6 fb	4.1 fb
Wjj	244 pb	111 pb	93.3 pb	48.0 pb	37.5 pb
$Wb\bar{b}$	939 fb	470 fb	403 fb	239 fb	207 fb
$Wc\bar{c}$	1640 fb	838 fb	712 fb	382 fb	253 fb
Zjj	70 pb	20.4 pb	—	11.0 pb	8.0 pb
$Zb\bar{b}$	508 fb	208 fb	—	125 fb	103 fb
$Wjjj$	62 pb	28 pb	23 pb	20 pb	14 pb
$Zjjj$	31 pb	9.3 pb	—-	8.0 pb	4.7 pb
$Wjjjj$	26 pb	pb	pb	pb	pb
$Zjjjj$	pb	pb	pb	pb	pb
WZ	4.7 fb	4.7 fb	4.1 fb	—	4.0 fb
WZj	2.8 fb	2.8 fb	2.5 fb	1.8 fb	1.7 fb

Table 3: The cross sections times BR in femtobarns in the top dielectron signature after the successive kinematic cuts of Table 2. 'Sample' refers to the cross section after the 'sample cut's of Table 1. The cases where the background process is missing one of the objects in the signature are indicated by a '—', and no cut is applied to that quantity, except in the cases of WZj and WWj, for which only one jet is required. The numbers for the $Z^0 \to \tau^+\tau^-$ mode, which is expected to be one of the largest backgrounds, are not calculable with MadGraph, and will require the generated events to be passed through a showering Monte Carlo.

Samples are 10000 unweighted events in most cases.

Cross Sections versus Ht cut for backgrounds and top:

Process	Cross Section for Ht>Threshold (GeV)							
	0	180	200	220	240	260	280	300
$t\bar{t}$	61 fb	60 fb	59 fb	57 fb	54 fb	49 fb	42 fb	35 fb
$Z^0 \to \tau^+\tau^-$	—	—	—	—	—	—	—	—
$Z^0 \to \tau^+\tau^- j$	—	—	—	—	—	—	—	—
$Z^0 \to \tau^+\tau^- jj$	—	—	—	—	—	—	—	—
WW	54 fb	6.5 fb	4.2 fb	2.7 fb	1.9 fb	1.4 fb	0.9 fb	0.7 fb
WWj	24 fb	8.5 fb	6.1 fb	4.4 fb	3.3 fb	2.4 fb	1.7 fb	1.4 fb
$WWjj$	7.9 fb	5.2 fb	4.1 fb	3.3 fb	2.6 fb	2.0 fb	1.6 fb	1.3 fb
$WWb\bar{b}$	4.1 fb	4.0 fb	3.9 fb	3.8 fb	3.5 fb	3.2 fb	2.8 fb	2.3 fb
Wjj	37.5 pb	5360 fb	3600 fb	2600 fb	1910 fb	1470 fb	1060 fb	737 fb
$Wb\bar{b}$	207 fb	42 fb	28 fb	21 fb	16 fb	13 fb	10 fb	7.2 fb
$Wc\bar{c}$	253 fb	41 fb	25 fb	21 fb	15 fb	7.8 fb	5.8 fb	2.3 fb
Zjj	7990 fb	1540 fb	1060 fb	745 fb	529 fb	381 fb	285 fb	4.9 fb
$Zb\bar{b}$	103 fb	22 fb	16 fb	12 fb	8.8 fb	6.8 fb	5.2 fb	4.1 fb
$Wjjj$	14 pb	3610 fb	2610 fb	1900 fb	1360 fb	1010 fb	760 fb	575 fb
$Zjjj$	4700 fb	1550 fb	1150 fb	836 fb	607 fb	442 fb	327 fb	241 fb
WZ	4.0 fb	1.4 fb	0.9 fb	0.5 fb	0.4 fb	0.3 fb	0.2 fb	0.1 fb
WZj	1.7 fb	1.2 fb	0.9 fb	0.6 fb	0.5 fb	0.3 fb	0.3 fb	0.2 fb

Table 4: The cross section times BR for producing the state $e^+e^- \not{E}_t jj$ passing the relevant cuts of Table 2. The symbol W represents $\mathrm{W}^\pm \to e^\pm\nu$; the symbol Z represents $Z^0/\gamma \to e^+e^-$. In those cases where the signature does not have the intrinsic properties of the cuts, e.g. such as $Zb\bar{b}$ in which there is no $\not{E}_t$ at LO or $W+3$ jets in which there is only one lepton, the cross section is given with the unsatisfiable cut waived. In these cases it will require the sample to be run through a shower monte carlo (e.g. Pythia) and the detector simulation to generate some $\not{E}_t$ or to get the rate after a jet fakes an electron; one can, however, make cruder but helpful estimates now by multiplying the tabulated cross section by standard fake rates. The numbers for the $\mathrm{Z}^0 \to \tau^+\tau^-$ mode, which is expected to be one of the largest backgrounds, are not calculable with MadGraph, and will require the generated events to be passed through a showering Monte Carlo.

1 The Ht cut Rejection versus Threshold

Process	Rejection factor for Ht>Threshold (GeV)							
	0	180	200	220	240	260	280	300
$t\bar{t}$	1.0	0.99	0.94	0.97	0.88	0.80	0.70	0.57
$Z^0 \to \tau^+\tau^-$	—	—	—	—	—	—	—	—
$Z^0 \to \tau^+\tau^- j$	—	—	—	—	—	—	—	—
$Z^0 \to \tau^+\tau^- jj$	—	—	—	—	—	—	—	—
WW	1.0	0.12	0.08	0.05	0.04	0.03	0.02	0.01
WWj	1.0	0.35	0.25	0.18	0.14	0.10	0.07	0.06
$WWjj$	1.0	0.65	0.52	0.42	0.33	0.25	0.20	0.16
$WWb\bar{b}$	1.0	0.98	0.95	0.91	0.85	0.77	0.67	0.56
Wjj	1.0	0.14	0.10	0.07	0.05	0.04	0.03	0.02
$Wb\bar{b}$	1.0	0.21	0.13	0.10	0.08	0.06	0.05	0.03
$Wc\bar{c}$	1.0	0.16	0.10	0.08	0.06	0.03	0.02	0.01
Zjj	1.0	0.19	0.13	0.09	0.07	0.05	0.04	0.03
$Zb\bar{b}$	1.0	0.22	0.15	0.11	0.09	0.07	0.05	0.04
$Wjjj$	1.0	0.27	0.19	0.14	0.10	0.07	0.06	0.04
$Zjjj$	1.0	0.33	0.24	0.18	0.13	0.09	0.07	0.05
WZ	1.0	0.36	0.22	0.14	0.09	0.06	0.04	0.03
WZj	1.0	0.70	0.51	0.37	0.27	0.20	0.15	0.11

Table 5: The fraction of events that have already passed the kinematic analysis cuts of Table 2 which pass the Ht cut for different Ht thresholds. In those cases where the signature does not have the intrinsic properties of the cuts, e.g. such as $Zb\bar{b}$ in which there is no $\not{E}_t$ at LO or $W + 3$ jets in which there is only one lepton, the cross section is given with the unsatisfiable cut waived. In these cases it will require the sample to be run through a shower monte carlo (e.g. Pythia) and the detector simulation to generate some $\not{E}_t$ or to get the rate after a jet fakes an electron; one can, however, make cruder but helpful estimates now by multiplying the tabulated cross section by standard fake rates from Run I.

Summary:

- Have a large number of bckgd processes made with same cuts, input parameters.
- Working to get these through Pythia,HEPG, Sim, and Production
- Path through HEPG, cdfSim, Prod still needs some work- better, but..
- Soushi developing separate path through cdf Pythia - will allow CDF-standard Pythia tuning for all sets.
- Mrenna working on standard Pythia tuning
- Goal is to have datasets done with simulation for next meeting.
- Would like to join our efforts with those of others to define the most efficient path to having MC datasets for the winter conferences. Some discussions started.