SLAC Production of WHIZARD Data Sets

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Monte Carlo Production

- WHIZARD Monte Carlo is used to generate all 0,2,4,6-fermion and t quark dominated 8-fermion processes.
- 100% electron and positron polarization is assumed in all event generation. Arbitrary electron, positron polarization is simulated by properly combining data sets.
- Fully fragmented MC data sets are produced. PYTHIA is used for final state QED & QCD parton showering, fragmentation, particle decay.

For Each New Machine Parameter Set There are 4 Steps Needed to Create the Files Needed by our Beamstrahlung Simulation Code

1. Run Guinea-Pig on a new set of Machine Parameters
2. Determine how much Guinea-Pig output is needed for Guinea-Pig Integration jobs and copy data to files such as ***/nfs/slac/g/lcd/ilc_data/whizdata/ILC500/guinea-pig/SB2009_500_TF_extbunches/lumi/ilc500n_lumi_0x.dat***
3. Submit Guinea-Pig MC Integration Jobs

   /afs/slac/g/nld/whizard/ILC/guinea-pig_ini
4. Copy .grd files produced by Guinea-Pig MC Integration Jobs to the directory ***/nfs/slac/g/lcd/ilc_data3/whizdata/ whizard/guinea-pig/energy_spread*** and give them names ***lumi_linker_nnn, photons_beam1_linker_nnn***, etc. where nnn is (our) 3 digit machine identifier.

SM Final States

0-fermion

$e^+e^- \to$	$\gamma\gamma$	
	$\gamma\gamma\gamma$	
	$\gamma\gamma\gamma\gamma$	
	$\gamma\gamma\gamma\gamma\gamma$	

2-fermion

$e^+e^- \to$	ff	$f \neq \nu$
	$\nu\nu\gamma$	
	$\nu\nu\gamma\gamma$	
	$\nu\nu\gamma\gamma\gamma$	
$e^-\gamma \to$	$e^-\gamma$	
$\gamma e^+ \to$	$e^+\gamma$	

4-fermion

$e^+e^- \to$	$\nu\nu\nu\nu\gamma$	6 total
	$u_j\overline{d}_j d_k\overline{u}_k$	25 total
		$\nu_e e^+ e^- \overline{\nu}_e$
		$\nu_e e^+ \mu^- \overline{\nu}_\mu$
		$\nu_e e^+ \tau^- \overline{\nu}_\tau$
		$\nu_e e^+ d\overline{u}$
		.
		.
		$c\overline{s}s\overline{c}$
	$u_j\overline{u}_j u_k\overline{u}_k$	9 total
	$u_j\overline{u}_j d_k\overline{d}_k$	25 total
	$d_j\overline{d}_j d_k\overline{d}_k$	21 total
$\gamma\gamma \to$	$f\overline{f}$	8 total
$e_L^-\gamma \to$	$\nu_e d_k\overline{u}_k$	5 total
$e^-\gamma \to$	$e^- f\overline{f}$	10 total
$\gamma e_R^+ \to$	$\overline{\nu}_e u_k\overline{d}_k$	5 total
$\gamma e^+ \to$	$e^+ f\overline{f}$	10 total

6-fermion

$e^+e^- \to$	$u_i\overline{u}_i u_j\overline{d}_j d_k\overline{u}_k$	125 total
	$d_i\overline{d}_i u_j\overline{d}_j d_k\overline{u}_k$	150 total
	$u_i\overline{u}_i u_j\overline{u}_j u_k\overline{u}_k$	25 total
	$u_i\overline{u}_i u_j\overline{u}_j d_k\overline{d}_k$	65 total
	$u_i\overline{u}_i d_j\overline{d}_j d_k\overline{d}_k$	75 total
	$d_i\overline{d}_i d_j\overline{d}_j d_k\overline{d}_k$	56 total
$\gamma\gamma \to$	$u_j\overline{d}_j d_k\overline{u}_k$	25 total
	$u_j\overline{u}_j u_k\overline{u}_k$	9 total
	$u_j\overline{u}_j d_k\overline{d}_k$	25 total
	$d_j\overline{d}_j d_k\overline{d}_k$	21 total
$e_L^-\gamma \to$	$\nu_e u_j\overline{u}_j d_k\overline{u}_k$	25 total
	$\nu_e d_j\overline{d}_j d_k\overline{u}_k$	30 total
$e^-\gamma \to$	$e^- u_j\overline{d}_j d_k\overline{u}_k$	20 total
	$e^- u_j\overline{u}_j u_k\overline{u}_k$	10 total
	$e^- u_j\overline{u}_j d_k\overline{d}_k$	20 total
	$e^- d_j\overline{d}_j d_k\overline{d}_k$	21 total
$\gamma e_R^+ \to$	$\overline{\nu}_e u_j\overline{d}_j u_k\overline{u}_k$	25 total
	$\overline{\nu}_e u_j\overline{d}_j d_k\overline{d}_k$	30 total
$\gamma e^+ \to$	$e^+ u_j\overline{d}_j d_k\overline{u}_k$	20 total
	$e^+ u_j\overline{u}_j u_k\overline{u}_k$	10 total
	$e^+ u_j\overline{u}_j d_k\overline{d}_k$	20 total
	$e^+ d_j\overline{d}_j d_k\overline{d}_k$	21 total

8-fermion

$e^+e^- \to$	$f\overline{f}t\overline{t}$
$\gamma\gamma \to$	$t\overline{t}$
$e^-\gamma \to$	$e^- t\overline{t}$
	$\nu_e b\overline{t}$
$\gamma e^+ \to$	$e^+ t\overline{t}$
	$\overline{\nu}_e t\overline{b}$

There are currently 14 MC production groups:

- 0-2-4-fermion
- 6-fermion/ddi-udj-duk
- 6-fermion/eminus-gamma
- 6-fermion/gamma-eplus
- 6-fermion/gamma-gamma
- 6-fermion/uui-udj-duk
- 6-fermion/zzz_1
- 6-fermion/zzz_2
- 8-fermion/
- bench-point-5
- ffh
- ffhh
- tesla_bosons
- tth

The production group directories are located in

/afs/slac/g/nld/whizard/xxxx

where xxxx=0-2-4-fermion   e.g.

(xxxx will stand for a production group from here on)

For each Production Group There are 5 Steps Needed to Produce (Raw) MC Stdhep Data Sets: (corresponding shell script is shown in italics)

1. Generate Executable
   /nfs/slac/g/lcd/mc/prj/sw/dist/whizard/v1r4p0/whizard-v1r4p0/remake_process_class
2. Submit MC Integration Jobs
   /afs/slac/g/nld/whizard/ILC/multiple_whiz_ini
3. Repair MC Integration Jobs
   /afs/slac/g/nld/whizard/ILC/multiple_whiz_ini_cleanup
4. Submit MC Event Generation Jobs
   /afs/slac/g/nld/whizard/ILC/multiple_whiz_run
5. Repair MC Event Generation Jobs
   /afs/slac/g/nld/whizard/ILC/multiple_whiz_run_repair

1. Generate Executable

remake_process_class copies the file **`xxxx/whizard.prc`** to WHIZARD’s conf directory, does ‘make prg’, and then copies the results of the make to **`xxxx/results`**.

2. Submit MC Integration Jobs

multiple_whiz_ini loops through the processes in **`xxxx/results/whizard.prc`** and submits 4 batch jobs for each process (1 job for each initial state e^+e^- helicity combination).

For each job a directory **`/afs/slac/g/nld/fa/mmmm/whizyyyyy`** is created where **`mmmm`** is the center-of-mass energy in GeV and **`yyyyy`** is a unique 5-digit job number.

multiple_whiz_ini uses the file
`xxxx/results/multiple_cardswhiz_in`
to build the batch job's **`whizard.in`** file

multiple_whiz_ini uses the file
`/afs/slac/g/nld/whizard/ILC/iniwhiz`
to build the batch job's executable script.

3. Repair MC Integration Jobs

multiple_whiz_ini_cleanup loops through the job output in the directories **`/afs/slac/g/nld/fa/mmmm/whizttttt`** through **`/afs/slac/g/nld/fa/mmmm/whizyyyyy`** and verifies that the integration was completed successfully. Here **`mmmm, ttttt, yyyyy`** are input arguments to the script.

If the integration failed then ***multiple_whiz_ini_cleanup*** resubmits the job. WHIZARD saves intermediate integration results, so the new job essentially picks up where the old one left off.

4. Submit MC Event Generation Jobs

multiple_whiz_run loops through the MC integration job output directories **`/afs/slac/g/nld/fa/mmmm/whizttttt`** through **`/afs/slac/g/nld/fa/mmmm/whizyyyyy`** and submits a run job for every MC integration job which had a cross-section above some minimum value.

For each run job a directory **`/afs/slac/g/nld/fa/mmmm/run_output/wkkkkk/run_01`** is created where **`mmmm`** is the center-of-mass energy in GeV and **`kkkkk`** is the 5-digit MC integration job number.

multiple_whiz_run copies most of the files in the directory **`/afs/slac/g/nld/fa/mmmm/whizkkkkk`** into the directory **`/afs/slac/g/nld/fa/mmmm/run_output/wkkkkk/run_01`** . Parameters specific to event generation are added to the **`whizard.in`** file before it is copied to **`/afs/slac/g/nld/fa/mmmm/run_output/wkkkkk/run_01.`**

multiple_whiz_run uses the file **`/afs/slac/g/nld/whizard/ILC/runwhiz`** to build the batch job's executable script.

5. Repair Event Generation Jobs

multiple_whiz_run_repair loops through the MC run job output directories **/afs/slac/g/nld/fa/mmmm/run_output/wttttt/run_01** through **/afs/slac/g/nld/fa/mmmm/run_output/wyyyyy/run_01** and verifies that the jobs completed successfully. If the job failed ***multiple_whiz_run_repair*** resubmits the job. If the job completed successfully but additional runs are required it will submit new run jobs after creating directories of the form

nfs/slac/g/lcd/mc/mmmm/run_output/wkkkkk/run_02

nfs/slac/g/lcd/mc/mmmm/run_output/wkkkkk/run_03

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nfs/slac/g/lcd/mc/mmmm/run_output/wkkkkk/run_nn

Within SiD 2 Additional Steps are Needed to Produce Derived Stdhep Files with Randomized Final States

1. Calculate start and end readout positions for each raw stdhep file given a desired beam polarization, final state composition, and luminosity

   /afs/slac/g/nld/whizard/ILC/ inv_ab_stdhep_ascii_ini

2. Copy raw stdhep files on mstore to /nfs / disk, create necessary directories, and produce derived stdhep files with randomized final states

   /afs/slac/g/nld/whizard/ILC/create_derived_files_ini