Status Report from the Subgroup* on Physics Above 500 GeV

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Upcoming LC technology discussions will include energy expandibility beyond $\sqrt{s} = 0.5$ TeV

$\Rightarrow$ Physics gains from higher energy running should be fully explored and understood.

To that end it would seem appropriate for this group to undertake a study with the following two objectives:

1. **For several physics scenarios, perform a detailed comparison of the physics programs at $\sqrt{s} = 0.8$, 1.0, 1.2, and 1.5 TeV.**
2. **Determine if there is a natural energy scale above $\sqrt{s} = 0.5$ TeV which the next LC should be capable of attaining through energy expansion.**

Physics Scenarios:

a. SM w/ 115 GeV Higgs Boson + 5 TeV weak SU(2) singlet fermion χ (top-color seesaw)

b. SM w/o Higgs Boson + Something to Make Model Consistent with Electroweak Data + Something to Unitarize WW Cross-Section.

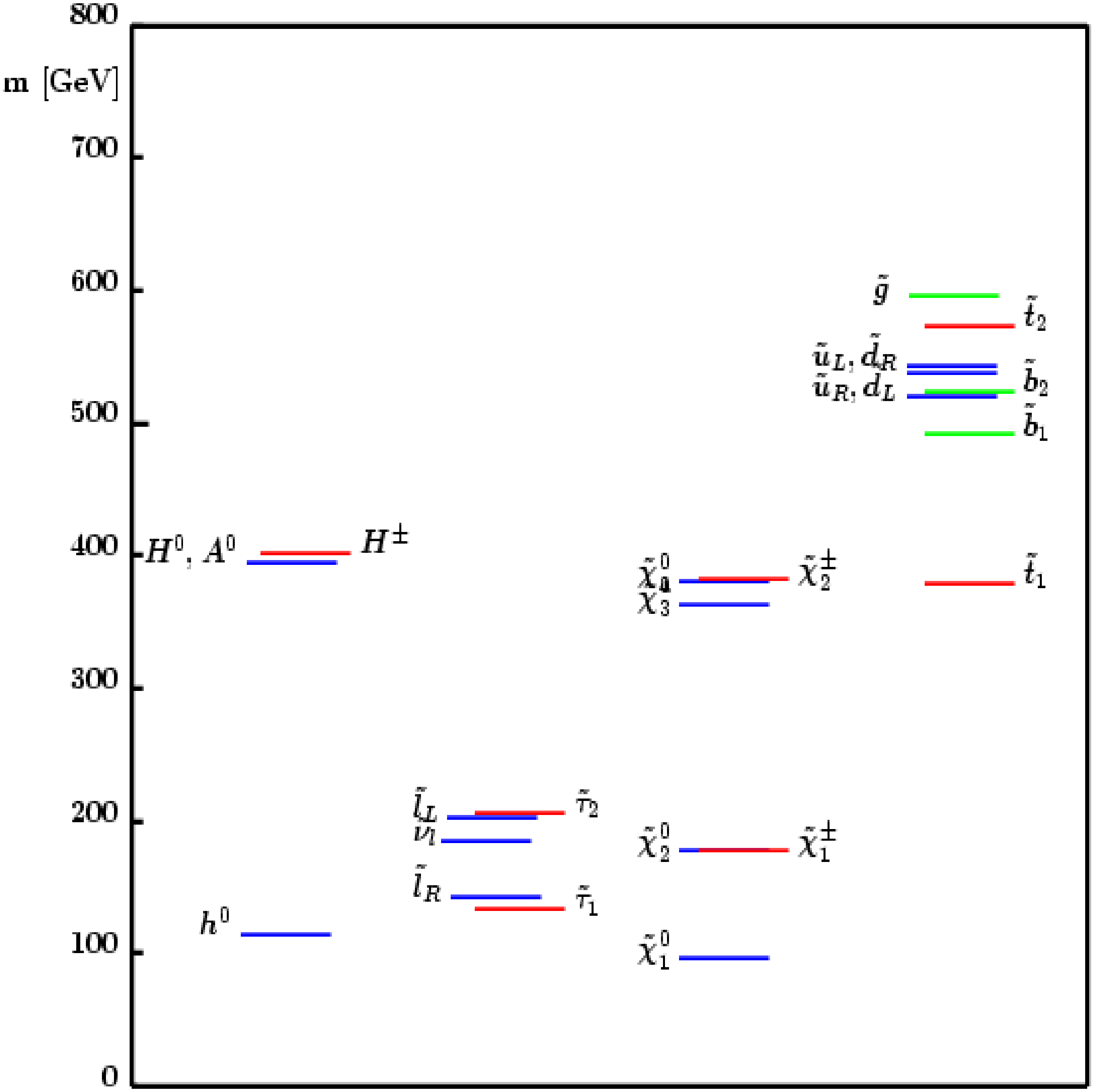
c. SUSY Using Snowmass 2001 Points 1 & 2

d. Extra Dimension Models:

Point	δ	M_D (TeV)
1	3	5
2	3	6
3	6	3

SPS 1 “Typical” mSUGRA: $m_0 = 100$ GeV $m_{1/2} = 250$ GeV

$A_0 = -100$ GeV $\tan\beta = 10$ $\mu > 0$



SUSY SPS 1 Final States at $\sqrt{s} = 500$ GeV

2-resonance

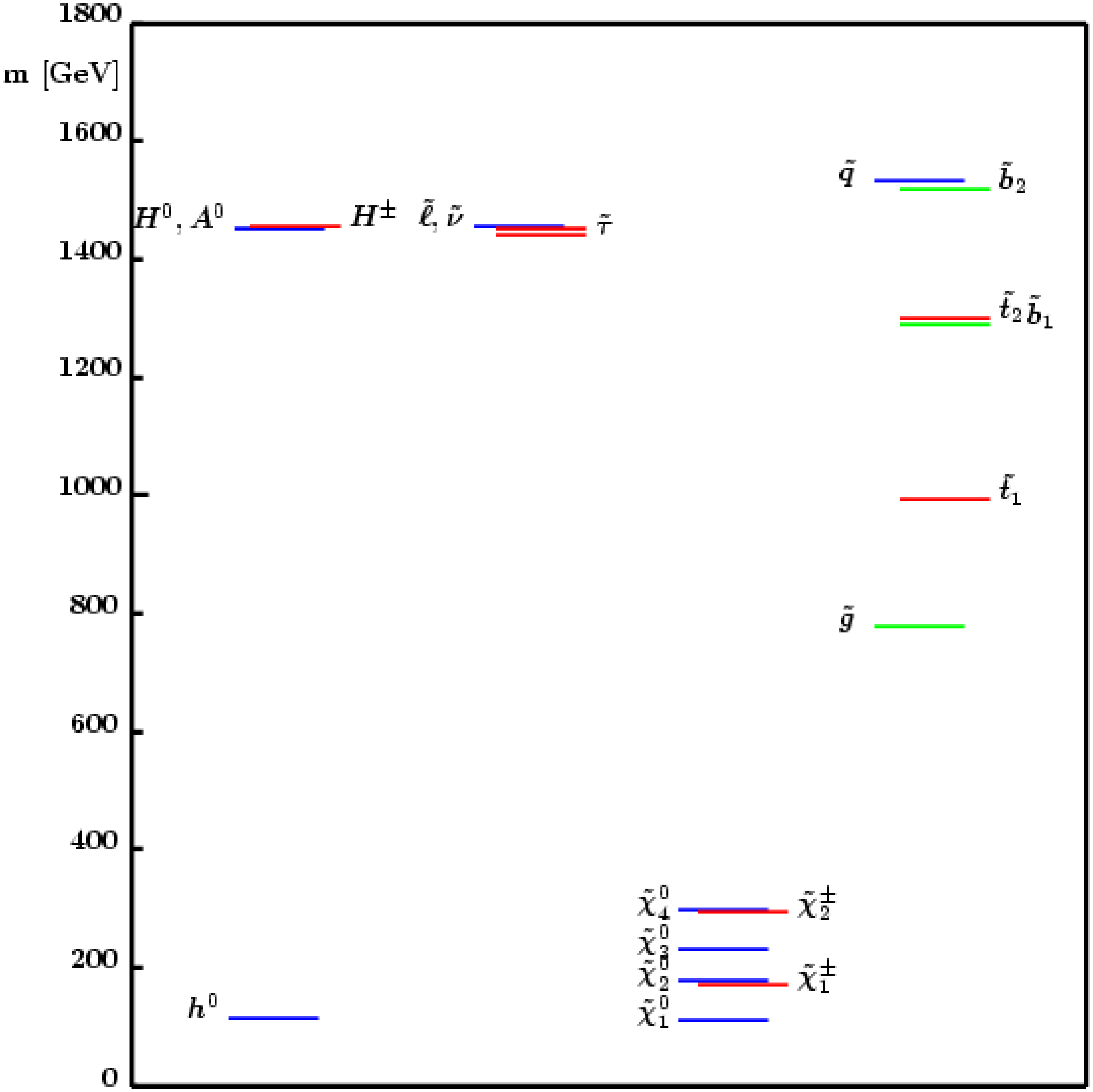
Zh	206.2 GeV
$\tilde{\tau}_1^+\tilde{\tau}_1^-$	266.4 GeV
$\tilde{\chi}_1^0\tilde{\chi}_2^0$	272.9 GeV
$\tilde{e}_R^+\tilde{e}_R^-$	285.9 GeV
$\tilde{\mu}_R^+\tilde{\mu}_R^-$	285.9 GeV
$\tilde{\tau}_1^+\tilde{\tau}_2^-$	339.4 GeV
$\tilde{e}_R^+\tilde{e}_L^-$	345.1 GeV
$\tilde{\mu}_R^+\tilde{\mu}_L^-$	345.1 GeV
$\tilde{\chi}_1^+\tilde{\chi}_1^-$	352.8 GeV
$\tilde{\chi}_2^0\tilde{\chi}_2^0$	353.6 GeV
$\tilde{\nu}_\tau\tilde{\nu}_\tau$	370.1 GeV
$\tilde{\nu}_e\tilde{\nu}_e$	372.0 GeV
$\tilde{\nu}_\mu\tilde{\nu}_\mu$	372.0 GeV
$\tilde{e}_L^+\tilde{e}_L^-$	404.3 GeV
$\tilde{\mu}_L^+\tilde{\mu}_L^-$	404.3 GeV
$\tilde{\tau}_2^+\tilde{\tau}_2^-$	412.3 GeV
$\tilde{\chi}_1^0\tilde{\chi}_3^0$	454.9 GeV

SUSY SPS 1 Final States at $\sqrt{s} = 500$ GeV

3-resonance

WWh	275.8 GeV
ZZh	297.4 GeV
$\tilde{\chi}_1^0\tilde{\chi}_1^0 h$	307.1 GeV
Zhh	321.2 GeV
$\tilde{\tau}_1^+\tilde{\tau}_1^- h$	381.4 GeV
$\tilde{\chi}_1^0\tilde{\chi}_2^0 h$	387.9 GeV
$\tilde{e}_R^+\tilde{e}_R^- h$	400.9 GeV
$\tilde{\mu}_R^+\tilde{\mu}_R^- h$	400.9 GeV
$\tilde{\tau}_1^+\tilde{\tau}_2^- h$	454.4 GeV
$\tilde{e}_R^+\tilde{e}_L^- h$	460.1 GeV
$\tilde{\mu}_R^+\tilde{\mu}_L^- h$	460.1 GeV
$\tilde{\chi}_1^+\tilde{\chi}_1^- h$	467.8 GeV
$\tilde{\chi}_2^0\tilde{\chi}_2^0 h$	468.6 GeV
$\tilde{\nu}_\tau\tilde{\nu}_\tau h$	485.1 GeV
$\tilde{\nu}_e\tilde{\nu}_e h$	487.0 GeV
$\tilde{\nu}_\mu\tilde{\nu}_\mu h$	487.0 GeV

SPS 2 "Focus Point" mSUGRA: $m_0 = 1450$ GeV $m_{1/2} = 300$ GeV $A_0 = 0$ GeV $\tan\beta = 10$ $\mu > 0$



Two classes of activities as we step through the center-of-mass energies:

1. Determine how accurately various parameters can be measured.
2. Determine which parameters should be measured, and explore the improvement in theoretical understanding that can be achieved once these parameters are measured.

Event Simulation and Analysis

Three Levels of Simulation Detail:

1. **Full Detector Simulation** (No physics analysis will be done this way)
2. **Fast MC Simulation** (A few physics analyses will be done this way)
3. **Statistical Error Analysis** (Most physics analyses will be done this way)

Analyses with higher levels of simulation detail are used to validate/calibrate analyses done with a lower level of simulation detail.

SM Processes

WHIZARD is used to generate all of the SM processes $e^+e^- \to f_1 f_2$, $f_1 f_2 f_3 f_4$, and $f_1 f_2 f_3 f_4 f_5 f_6$ including ISR & beamstrahlung (CIRCE). PANDORA is used to produce 6 and 8-fermion processes involving $t\bar{t}$ production. We now have NLC/JLC CIRCE beamstrahlung spectra for all these energies thanks to N. Graf, T. Raubenheimer and Thorsten Ohl. PANDORA now includes CIRCE beamstrahlung simulation.

100% electron *and* positron polarization is always assumed in event generation. Arbitrary electron/positron polarization is simulated by combining e^-_L/e^+_R, e^-_R/e^+_L, ... data sets. 100% positron polarization is simulated in part to encourage collaboration with our European colleagues.

PYTHIA is used for final state QED and QCD parton showering, as well as for fragmention and decay. (Exception: if γ appears in the final state then WHIZARD generates $e^+e^- \to \gamma + X$ and PYTHIA final state QED parton showering is turned off.)

The beam-beam backgrounds $\gamma\gamma \to e^+e^-$ and $\gamma\gamma \to$ hadrons will be superimposed. $\gamma\gamma \to$ hadrons will be simulated using PYTHIA and the CLIC program HADES.

Simulation of machine backgrounds requires full detector MC simulation. Once these studies are completed a fast MC parameterization can probably be developed. NOTE: A rough version for TESLA may already exist in SIMDET, according to Marco B.

$\gamma\gamma \rightarrow$ hadrons Backgrounds

- Use CIRCE to generate the incoming photons
  - Thorsten Ohl has released version 9 which has the JLC/NLC machine configurations we requested at: 0.5, 0.8, 1.0, 1.2, 1.5 TeV cms
- Use PYTHIA to generate the physics processes
  - MSEL=2
  - MSTP(14)=10
    - mixture of VMD, direct, anomalous GVMD
  - MSTP(171)=1
    - allow variable input energies
- Investigating the use of HADES to add the background events to the stdhep structure
  - Own binary format for storing events.
  - Machinery to randomly sample from multiple input streams and add to PYTHIA event.

γγ→ hadrons Backgrounds

N:o	Type	Generated	Tried	Sigma (mb)
0	All included subprocesses	10000	377796	5.086D-04
11	f + f' -> f + f' (QCD)	368	0	2.102D-05
12	f + fbar -> f' + fbar'	5	0	2.829D-07
13	f + fbar -> g + g	6	0	3.431D-07
28	f + g -> f + g	1178	0	6.584D-05
53	g + g -> f + fbar	18	0	9.663D-07
68	g + g -> g + g	501	0	2.719D-05
91	Elastic scattering	821	821	4.253D-05
92	Single diffractive (XB)	768	768	3.656D-05
93	Single diffractive (AX)	735	735	3.630D-05
94	Double diffractive	886	890	4.379D-05
95	Low-pT scattering	4018	6178	1.961D-04
131	f + gamma*_T -> f + g	219	1720	1.067D-05
135	g + gamma*_T -> f + fbar	477	11254	2.701D-05
137	gamma*_T+gamma*_T -> f+fbar	0	0	0.000D+00
1	VMD/hadron * VMD	7273	107221	3.676D-04
2	VMD/hadron * direct	580	10910	3.144D-05
3	VMD/hadron * anomalous	1645	233033	8.413D-05
4	direct * direct	0	0	0.000D+00
5	direct * anomalous	116	2064	6.246D-06
6	anomalous * anomalous	386	24568	1.922D-05

********* Fraction of events that fail fragmentation cuts = 0.00833 *********

SUSY Processes

SUSYGEN is used to generate SUSY processes. ISR and beamstrahlung (CIRCE) are included. As for the SM processes, PYTHIA is used for final state QED and QCD parton showering, fragmention and decay.

WHIZARD is used for the production of the SUSY Higgs bosons. If SUSY decays are negligible then production of Higgs bosons will be simulated by generating the appropriate 4-fermion and 6-fermion processes. If SUSY decays are important then WHIZARD will generate undecayed SUSY Higgs bosons and feed them to PYTHIA 6.2.

For SPS # 2 it might be desirable to generate processes such as $e^+e^- \rightarrow q\bar{q}\tilde{g}\tilde{\chi}_1^0$ and $e^+e^- \rightarrow \tilde{t}_1\bar{t}\tilde{\chi}_1^0$. For processes such as these PANDORA-PYTHIA will be used.

Extra Dimension Processes

PANDORA is used to simulate graviton exchange in $e^+e^- \rightarrow f\bar{f}$, $\gamma\gamma$, W^+W^-, ZZ. (New feature of PANDORA)

SM Final States 0,2,4-Fermion

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	$f \neq \nu$
	$\nu\nu\gamma$	
	$\nu\nu\gamma\gamma$	
	$\nu\nu\gamma\gamma\gamma$	

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

SM Final States 6-Fermion

6-fermion

$e^+e^- \longrightarrow$	$u_i\overline{u}_iu_j\overline{d}_jd_k\overline{u}_k$	125 total
	$d_i\overline{d}_iu_j\overline{d}_jd_k\overline{u}_k$	150 total
	$u_i\overline{u}_iu_j\overline{u}_ju_k\overline{u}_k$	25 total
	$u_i\overline{u}_iu_j\overline{u}_jd_k\overline{d}_k$	65 total
	$u_i\overline{u}_id_j\overline{d}_jd_k\overline{d}_k$	75 total
	$d_i\overline{d}_id_j\overline{d}_jd_k\overline{d}_k$	56 total
$\gamma\gamma \longrightarrow$	$u_j\overline{d}_jd_k\overline{u}_k$	25 total
	$u_j\overline{u}_ju_k\overline{u}_k$	9 total
	$u_j\overline{u}_jd_k\overline{d}_k$	25 total
	$d_j\overline{d}_jd_k\overline{d}_k$	21 total
$e_L^-\gamma \longrightarrow$	$\nu_eu_j\overline{u}_jd_k\overline{u}_k$	25 total
	$\nu_ed_j\overline{d}_jd_k\overline{u}_k$	30 total
$e^-\gamma \longrightarrow$	$e^-u_j\overline{d}_jd_k\overline{u}_k$	20 total
	$e^-u_j\overline{u}_ju_k\overline{u}_k$	10 total
	$e^-u_j\overline{u}_jd_k\overline{d}_k$	20 total
	$e^-d_j\overline{d}_jd_k\overline{d}_k$	21 total
$\gamma e_R^+ \longrightarrow$	$\overline{\nu}_eu_j\overline{d}_ju_k\overline{u}_k$	25 total
	$\overline{\nu}_eu_j\overline{d}_jd_k\overline{d}_k$	30 total
$\gamma e^+ \longrightarrow$	$e^+u_j\overline{d}_jd_k\overline{u}_k$	20 total
	$e^+u_j\overline{u}_ju_k\overline{u}_k$	10 total
	$e^+u_j\overline{u}_jd_k\overline{d}_k$	20 total
	$e^+d_j\overline{d}_jd_k\overline{d}_k$	21 total

SM Final States 8-Fermion

8-fermion

$e^+e^- \longrightarrow$	$u_i\overline{u}_ib\overline{b}u_j\overline{d}_jd_k\overline{u}_k$	125 total
	$d_i\overline{d}_ib\overline{b}u_j\overline{d}_jd_k\overline{u}_k$	150 total
$\gamma\gamma \longrightarrow$	$b\overline{b}u_j\overline{d}_jd_k\overline{u}_k$	25 total
$e^-\gamma \longrightarrow$	$e^-b\overline{b}u_j\overline{d}_jd_k\overline{u}_k$	25 total
$\gamma e^+ \longrightarrow$	$e^+b\overline{b}u_j\overline{d}_jd_k\overline{u}_k$	25 total

OR

$e^+e^- \longrightarrow$	$\nu_e\overline{\nu}_et\overline{t}$
	$Zt\overline{t}$
	$Ht\overline{t}$
$\gamma\gamma \longrightarrow$	$t\overline{t}$
$e^-\gamma \longrightarrow$	$e^-t\overline{t}$
$\gamma e^+ \longrightarrow$	$e^+t\overline{t}$

```
timb@noric05 $ pwd
/afs/slac.stanford.edu/g/nld/whizard

timb@noric05 $ ls -l
total 29
drwxr-xr-x    4 timb     ei           2048 Mar 13 13:36 0-2-4-fermion
drwxr-xr-x    8 timb     ei           2048 Mar 12 15:58 6-fermion
drwxr-xr-x    4 timb     ei           2048 Mar 15 16:33 8-fermion
drwxr-xr-x    2 timb     ei           2048 Mar 21 12:27 NORIC
drwxr-xr-x   10 timb     ei           2048 Mar 15 11:47 omega
drwxr-xr-x    4 timb     ei           2048 Mar 20 01:01 test8
drwxr-xr-x   16 timb     ei           4096 Mar 20 01:08 whizard-1.21

timb@noric05 $ cd 6-fermion

timb@noric05 $ ls -l
total 12
drwxr-xr-x    4 timb     ei           2048 Mar 13 12:57 ddi-udj-duk
drwxr-xr-x    4 timb     ei           2048 Mar 13 13:00 eminus-gamma
drwxr-xr-x    4 timb     ei           2048 Mar 13 17:41 gamma-eplus
drwxr-xr-x    4 timb     ei           2048 Mar 13 13:02 gamma-gamma
drwxr-xr-x    4 timb     ei           2048 Mar 13 13:03 uui-udj-duk
drwxr-xr-x    4 timb     ei           2048 Mar 13 13:05 zzz

timb@noric05 $ cd ddi-udj-duk/

timb@noric05 $ ls -l
total 33
drwxr-xr-x    2 timb     ei          10240 Mar 15 18:00 processes-src
drwxr-xr-x    2 timb     ei           2048 Mar 18 13:09 results
-rw-r--r--    1 timb     ei           8826 Mar 13 12:27 whizard.prc
```

```
! Process e1e1n1e1e1n1_o:
!    e a-e ->   e a-e nu_e a-e   e a-nu_e     CIRCE_on=T ISR_on=T     94.26 hrs
!  128  64 ->   1   2    4   8  16     32
!
!-----------------------------------------------------------------------------
! It      Calls   Integral[fb]  Error[fb]  Err[%]    Acc  Eff[%]    Chi2 N[It]
!-----------------------------------------------------------------------------
   1     500000  5.3214714E-01  5.66E-02   10.63   75.20*  0.18    0.00   1
!-----------------------------------------------------------------------------
   2     500000  1.8006024E+00  8.99E-01   49.95  353.19   0.12
   3     500000  6.8161373E-01  6.23E-02    9.13   64.58*  0.10
   4     500000  1.2675631E+00  3.05E-01   24.05  170.05   0.05
   5     500000  9.4760289E-01  1.06E-01   11.14   78.78   0.05
   6     500000  2.1845388E+00  5.46E-01   24.98  176.65   0.03
   7     500000  1.4658822E+00  2.07E-01   14.14  100.01   0.03
   8     500000  1.4910964E+00  2.95E-01   19.79  139.97   0.03
   9     500000  2.5125641E+00  1.15E+00   45.58  322.31   0.03
  10     500000  1.4396918E+00  1.01E-01    7.01   49.57*  0.04
  11     500000  1.4882335E+00  1.70E-01   11.41   80.69   0.03
  12     500000  1.3830805E+00  8.53E-02    6.16   43.59*  0.05
  13     500000  1.6583927E+00  1.08E-01    6.53   46.20   0.04
  14     500000  1.3877464E+00  5.89E-02    4.24   30.00*  0.07
  15     500000  1.6324535E+00  1.05E-01    6.43   45.48   0.05
  16     500000  1.7855629E+00  1.60E-01    8.96   63.38   0.04
  17     500000  1.5580397E+00  8.12E-02    5.21   36.86   0.07
  18     500000  1.5160345E+00  5.43E-02    3.58   25.31*  0.08
  19     500000  1.5065847E+00  5.95E-02    3.95   27.93   0.09
  20     500000  1.6064708E+00  6.01E-02    3.74   26.44   0.08
  21     500000  1.5335070E+00  3.24E-02    2.11   14.95*  0.12
!-----------------------------------------------------------------------------
  22    1500000  1.7781601E+00  1.34E-01    7.52   92.11   0.03    0.00   1
!-----------------------------------------------------------------------------
```

```
!    e a-e ->   e a-e nu_e a-e   e a-nu_e
!  128  64 ->   1   2    4   8  16     32

 ! Multiplicity = 2,  3 resonances,   1 t-channel line
 grove # 39
 tree   6  24  33  39  88       !    1*  W+ Z a-W+ Z e

 ! Multiplicity = 2,  3 resonances,  s-channel graph
 grove # 40
 tree   9  18  36  54  63       !   41*  Z Z Z h Z

 ! Multiplicity = 2,  3 resonances,  s-channel graph
 grove # 41
 tree   6   9  48  54  63       !   61*  W+ Z a-W+ h Z

 ! Multiplicity = 3,  3 resonances,   2 t-channel lines
 grove # 42
 tree   9  18  36 100 109       !   81*  Z Z Z e e

 ! Multiplicity = 3,  3 resonances,   2 t-channel lines
 grove # 43
 tree   3  12  48  76 124       !  101*  Z W+ a-W+ nu_e e

 ! Multiplicity = 3,  3 resonances,   1 t-channel line
 grove # 45
 tree   3  12  48  51  76       !  121*  Z W+ a-W+ a-W+ nu_e

 ! Multiplicity = 3,  3 resonances,   1 t-channel line
 grove # 46
 tree   6  24  33  39 103       !  141*  W+ Z a-W+ gamma e

                              .
                              .
                              .

 ! Multiplicity = 4,  2 resonances,   3 t-channel lines
 grove # 69
 tree  12  33 144 177 179       !  501*  W+ a-W+ gamma a-W+ a-nu_e

 ! Multiplicity = 4,  2 resonances,   3 t-channel lines
 grove # 70
 tree   3  24  96 100 103       !  511*  Z Z a-W+ e e

 ! Multiplicity = 4,  2 resonances,   3 t-channel lines
 grove # 71
 tree   6  48 176 177 185       !  540*  W+ a-W+ a-nu_e a-W+ a-nu_e


 ! Number of channels total:    3164
 ! Number of channels kept:     540
 ! Number of dominant channels: 396
```

```
!============================================================================
! Weight history [%]:
! ch |  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22
!----------------------------------------------------------------------------
   1 |  0  0  0  0
  11 |  0  0  0  0
  21 |  0  0  0  0
  31 |  0  0  0  0
  41 |  0  0  0  0
  51 |  0  0  0  0
  61 |  0  0  0  0
  71 |  0  0  0  0
  81 |  0  0  0  0  0  0  0
  91 |  0  0  0  0  0  0  0
 101 |  0  0  0  0  0  0  0  0  0  0  0  0  0
 111 |  0  0  0  0  0  0  0  0  0  0  0  0  0
 121 |  0  0  0  0  0  0  0  0  0  0  0  0
 131 |  0  0  0  0  0  0  0  0  0  0  0  0
 141 |  0  0  0  0  0  0  0  0  0  0  0
 151 |  0  0  0  0  0  0  0  0  0  0  0
 161 |  0  0  0  0  0  0  0  0  0  0  0
 171 |  0  0  0  0  0  0  0  0  0  0  0
 181 |  0  0  0  0  0  0  0
 191 |  0  0  0  0
 201 |  0  0  0  0
 211 |  0  0  0  0
 221 |  0  0  0  0
 231 |  0  0  0  0
 241 |  0  0  0  0
 251 |  0  0  0  0
 261 |  0  0  0  0  0  0
 271 |  0  0  0  0  0  0
 281 |  0  0  0  0  0  0
 291 |  0  0  0  0  0  0
 301 |  0  0  0  0  0  0
 311 |  0  0  0  0  0  0  0  0  0  0
 321 |  0  0  0  0  0  0  0  0  0  0
 331 |  0  0  0  0  0  0  0  0  0  0
 341 |  0  0  0  0  0  0  0  0  0
 351 |  0  0  0  0  0  0  0  0  0
 361 |  0  0  1  1  1  1  1  1  1  1  2  2  2  2  2  2  2  2  2  2  2  2
 371 |  0  0  1  1  1  1  1  1  1  1  2  2  2  2  2  2  2  2  2  2  2  2
 381 |  0  0  0  0  0  0  0  0  0  0
 391 |  0  0  1  1  1  1  2  1  1  2  2  1  1  1  1  1  1  1  1  1  1  1
 401 |  0  0  1  1  1  1  2  1  1  2  2  1  1  1  1  1  1  1  1  1  1  1
 411 |  0  0  0  0  0  0  0  0
 421 |  0  0  0  0  0  0
 431 |  0  0  0  0  0  0  0  0  0
 441 |  0  0  0  0  0  0  0  0  0
 451 |  0  0  0  0  0  0  0  0
 461 |  0  0  0  0  0  0  0  0  0
 471 |  0  0  0  0  0  0  0  0  0
 481 |  0  0  0  0  0  0  0  0  0
 491 |  0  0  0  0  0  0  0  0  0
 501 |  0  0  0  1  1  1  1  1  2  2  2  2  2  2  2  2  2  2  2  2  2  2
 511 |  0  0  1  0  0  0  0  0  0
 521 |  0  0  1  0  0  0  0  0  0
 531 |  0  0  1  0  0  0  0  0  0
 540 |  0  0  0  1  2  3  3  3  3  2  2  3  2  2  2  2  2  2  3  2  2  2
```

CPU and Storage Requirements

Assume 2000 fb^{-1} Lumi at $\sqrt{s} = 1000$ GeV

Process	σ (fb)	ini time (hrs)	# gen	gen time (hrs)	size (GB)
$e^-e^+ \to e^-e^+\nu_e e^+ e^- \overline{\nu}_e$	1.778	10	10000	63.4	.006
$e^-e^+ \to \nu_e \overline{\nu}_e c\overline{s}\mu^-\overline{\nu}_\mu$	2.495	7	10000	2.1	.007
$\gamma\gamma \to \nu_e e^+ d\overline{u}$	26.29	6	52580	1.9	.027
$e^-e^+ \to \nu_e e^+ e^- \overline{\nu}_e$	1291.6	10	2583200	189.5	1.330
$e^-e^+ \to \nu_e e^+ d\overline{u}$	1959.4	3	3918800	82.8	2.018

Process Class	# Processes	avg ini time (hrs)	avg gen time (hrs)	avg size (GB)
4 fermion final	120	5	80	1
6 fermion final, e^+e^- initial	496	10	10	.01
6 fermion final, $\gamma\gamma$ or $e\gamma$ initial	332	5	5	.05

18320 hrs CPU and 122 Gbytes storage per $\sqrt{s}$
Ask for 15000 hrs CPU and 1000 Gbytes storage

(Larger storage required because gluon showering and fragm. not included above)

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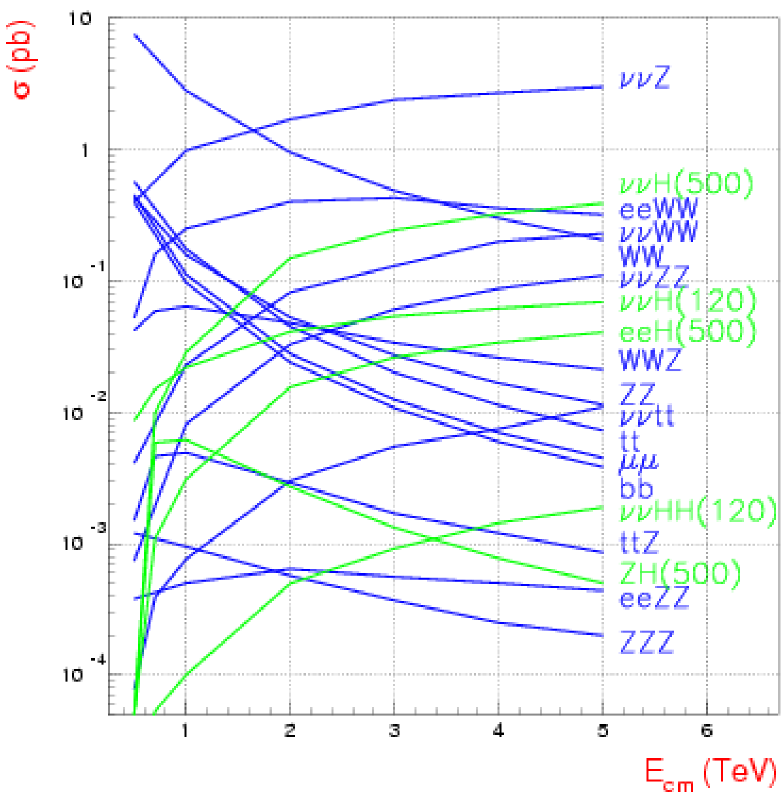
Cross Sections



Event Rates/Year (1000 fb^{-1})	3 TeV 10^3 events	5 TeV 10^3 events
$e^+e^- \to t\bar{t}$	20	7.3
$e^+e^- \to b\bar{b}$	11	3.8
$e^+e^- \to ZZ$	27	11
$e^+e^- \to WW$	490	205
$e^+e^- \to hZ/h\nu\nu$ (120 GeV)	1.4/530	0.5/690
$e^+e^- \to H^+H^-$(1 TeV)	1.5	0.95
$e^+e^- \to \tilde{\mu}^+\tilde{\mu}^-$ (1 TeV)	1.3	1.0

LC Computing Needs

- The goal is to generate an inclusive set of MC events with all SM processes as well as backgrounds arising from beam- and brems-strahlung photons and machine-related particles represented.
- This sample will be used for realistic physics analyses and will be served up to the international LC physics community to represent a “standard” sample.
- Samples will be generated at several energy points to study the benefits of higher energy.
  - 0.5, 0.8, 1.0, 1.2, 1.5 TeV cms
- Produce 2000 fb^{-1} per $\sqrt{s}$ point, including all 0,2,4, and 6 fermion SM processes:
  - 15000 hrs of "BARB" CPU time and
  - 150 Gbytes of storage per $\sqrt{s}$ point
- Parton showering and fragmentation will increase the CPU time requirement by only a little bit, but will significantly increase the storage requirements.
- We will need ~1000 Gbytes storage per $\sqrt{s}$ point in order to include showering and fragmentation.
- CPU and disk needs are estimates and will be refined as we gain experience (e.g. $t\bar{t}$ events are under study).