Physics Above 500 GeV

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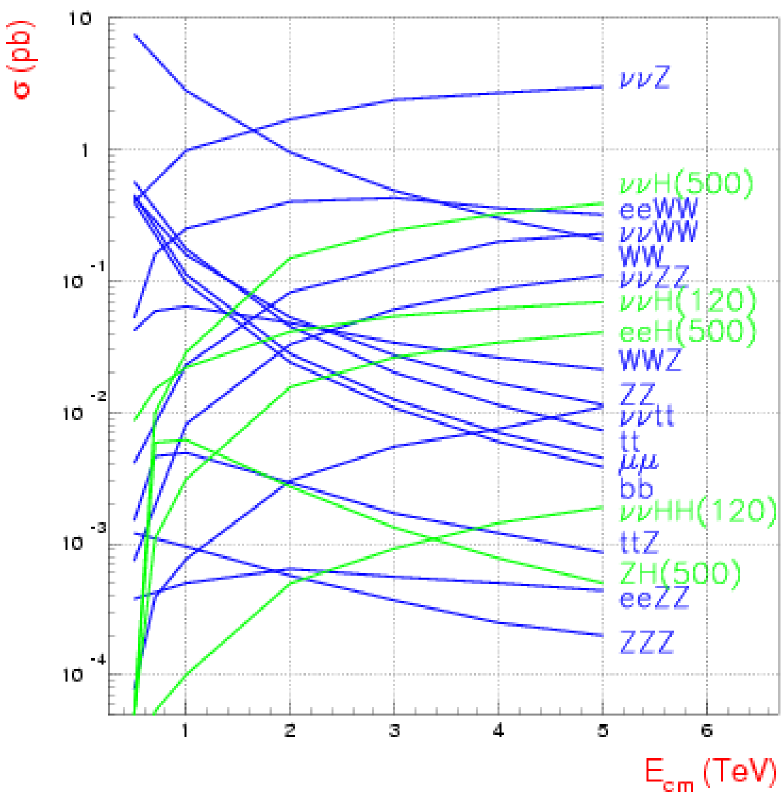
Above 500 GeV Issues

- **Experimental Environment**
- **SM Topics Such as $g_{t\bar{t}h}$, g_{hhh}**
- **Beyond SM Physics Scenarios**
- **Results from LHC and 500 GeV LC**

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

Physics Scenarios Studied by SLAC Group:

a. **Topcolor seesaw model with either a 120 GeV or 1000 GeV Composite Higgs Boson and a 5 TeV weak SU(2) singlet fermion χ.**

b. **SUSY Using Snowmass 2001 Points 1 & 2**

c. **Extra Dimension Models:**

Point	δ	M_D (TeV)
1	3	3
2	3	6
3	6	3

SLAC Working Group Monte Carlo Production

WHIZARD is used to generate all of the SM processes $e^+e^- \to f_1f_2$, $f_1f_2f_3f_4$, and $f_1f_2f_3f_4f_5f_6$ including ISR & beamstrahlung (CIRCE).

SUSYGEN will be used to generate SUSY processes. ISR and beamstrahlung (CIRCE) are included.

PANDORA will be used to simulate graviton exchange in $e^+e^- \to f\overline{f}$, $\gamma\gamma$, W^+W^-, ZZ.

Goal is to generate 2000 fb^{-1} MC data at $\sqrt{s} = 0.5$, 0.8, 1.0, 1.2, and 1.5 TeV.

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.

Fully fragmented MC data sets are produced. PYTHIA is used for final state QED and QCD parton showering, as well as for fragmention and decay.

SM Final States 0,2,4-Fermion

0-fermion

$e^+e^- \longrightarrow$	$\gamma\gamma$	
	$\gamma\gamma\gamma$	
	$\gamma\gamma\gamma\gamma$	
	$\gamma\gamma\gamma\gamma\gamma$	

2-fermion

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

4-fermion

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

WHIZARD MC uses the CompHEP convention for particle names, and we use them as well when specifying processes:

```
St.Model(Feyn.gauge)
 Particles
 Full  name   | P | aP|2*spin| mass |width |color|aux|
photon       |A  |A  |2     |0     |0     |1    |G
gluon        |G  |G  |2     |0     |0     |8    |G
electron     |e1 |E1 |1     |0     |0     |1    |
e-neutrino   |n1 |N1 |1     |0     |0     |1    |L
muon         |e2 |E2 |1     |Mm    |0     |1    |
m-neutrino   |n2 |N2 |1     |0     |0     |1    |L
tau-lepton   |e3 |E3 |1     |Mt    |0     |1    |
t-neutrino   |n3 |N3 |1     |0     |0     |1    |L
u-quark      |u  |U  |1     |0     |0     |3    |
d-quark      |d  |D  |1     |0     |0     |3    |
c-quark      |c  |C  |1     |Mc    |0     |3    |
s-quark      |s  |S  |1     |Ms    |0     |3    |
t-quark      |t  |T  |1     |Mtop  |wtop  |3    |
b-quark      |b  |B  |1     |Mb    |0     |3    |
Higgs        |H  |H  |0     |MH    |wH    |1    |
W-boson      |W+ |W- |2     |MW    |wW    |1    |G
Z-boson      |Z  |Z  |2     |MZ    |wZ    |1    |G
```

A user-defined external PYTHIA process provides access to the MC data. This external PYTHIA "process" properly sums togther processes with different initial state helicities and different final states. Polarization, $\sqrt{s}$, and specific processes are defined in an input file:

```
&whizdata_input
path_root = '/afs/slac.stanford.edu/g/nld/whizard/'
i_sqrts = 1000
luminosity = 100.
pol_eminus = -0.8
pol_eplus  =  0.5
seed = 520033
process =
  "e1,E1    q,q,q,q"
  "e1,E1    l,q,l,q"
  "e1,E1    l,v,l,v,q,q"
  "e1,A     f,l,l,q,q"
  "e1,A     e1,e1,E1,e2,E2"
/
```

where q,l,v,f,x are defined as:

```
q=u,d,s,c,b,U,D,S,C,B
l=e1,e2,e3,E1,E2,E3
v=n1,n2,n3,N1,N2,N3
f=q,l,v
x=f,A
e3=e3,E3
E3=E3
```

To read out all generated MC data:

```
&whizdata_input
path_root = '/afs/slac.stanford.edu/g/nld/whizard/'
i_sqrts = 1000
luminosity = 3000.
pol_eminus = -0.8
pol_eplus  =  0.5
seed = 520033
process =
  "x,x    x,x"
  "x,x    x,x,x"
  "x,x    x,x,x,x"
  "x,x    x,x,x,x,x"
  "x,x    x,x,x,x,x,x"
/
```

To read out $t\bar{t}$ events:

```
&whizdata_input
path_root = '/afs/slac.stanford.edu/g/nld/whizard/'
i_sqrts = 1000
luminosity = 3000.
pol_eminus = -0.8
pol_eplus  =  0.5
seed = 520033
process =
  "e1,E1    b,b,f,f,f,f"
/
```

To read out ZH events:

```
&whizdata_input
path_root = '/afs/slac.stanford.edu/g/nld/whizard/'
i_sqrts = 1000
luminosity = 3000.
pol_eminus = -0.8
pol_eplus  =  0.5
seed = 520033
process =
  "e1,E1    b,b,f,f"
  "e1,E1    e3,e3,f,f"
/
```

MC Limitations

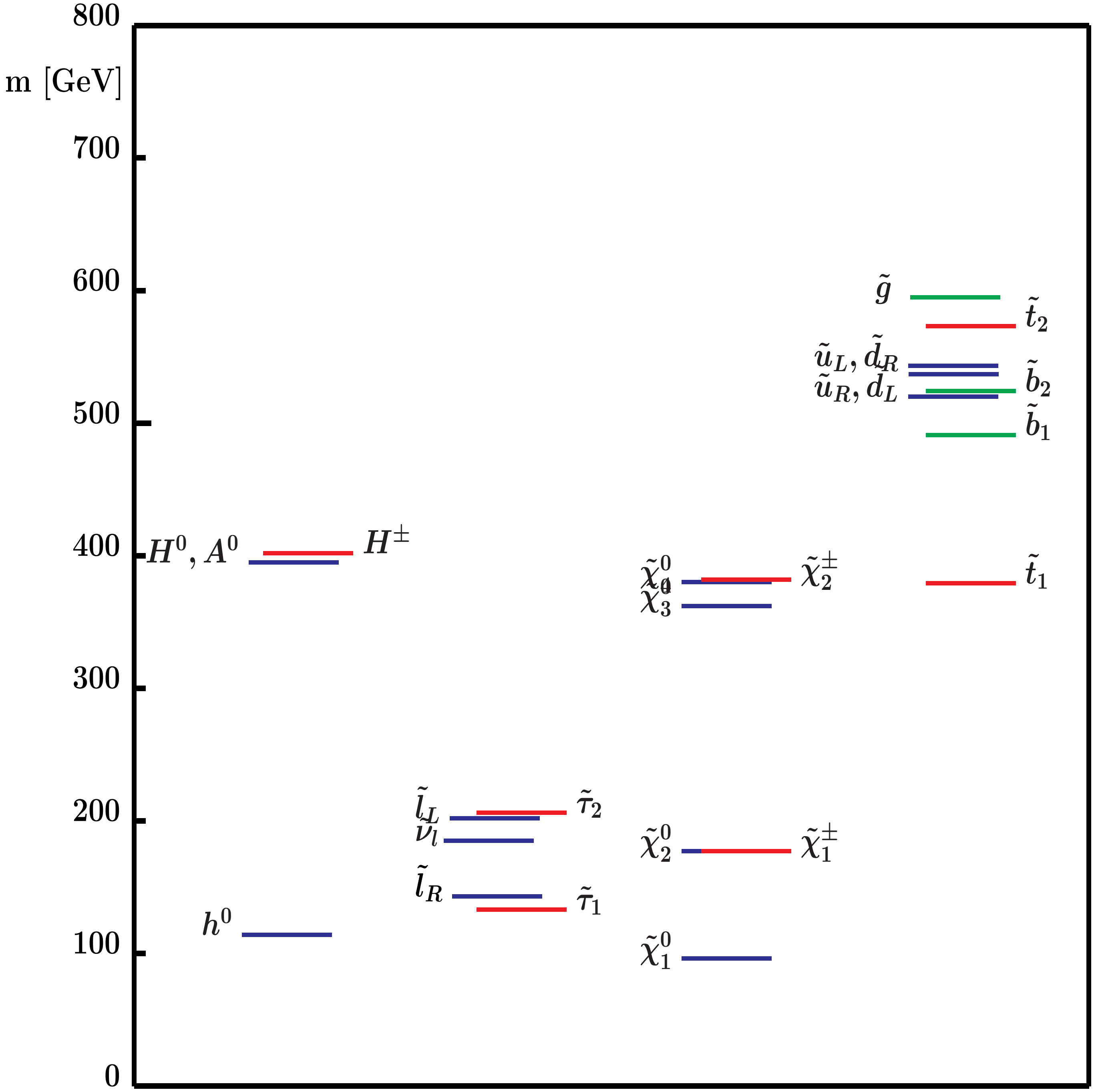
- **Improper treatment of final states with identical quarks such as $u\bar{u}d\bar{d}$.** This is a parton-level generation problem as well as a fragmentation problem, and is due to a deficiency in the OMEGA amplitude calculation program. Eventually it will be fixed by the OMEGA author; in the meantime the parton-level problem can be corrected in principle with reweighting. The size of the effect is unknown, but should only be an issue in non-resonant phase space regions.
- **Events are not completely unweighted.** There is a wide range in cross sections, and we cannot, for example, generate an equivalent number of Bhabha's if we generate 2000 fb^{-1} of $e^+e^- \rightarrow u\bar{u}d\bar{d}s\bar{s}$. If you restrict yourself to high-pt central events, then the event sample will be unweighted. However, as you go out to the forward region you will eventually encounter some events with weight greater than 1 (bhabhas, $\gamma\gamma$ events). Thus one should always consider the event weight which is returned in PYTHIA variable PARI(7) in common PYPARS.

SM MC Production Status

- **Except for some very high cross section process, event generation for 0-2-4 fermion processes at $\sqrt{s} = 1000$ GeV is complete.**
- **Integration of 6 fermion processes at $\sqrt{s} = 1000$ GeV is nearly complete.**
- **MC data sets are currently stored on MSTORE mass storage, with estimated 1.5 Terabytes storage per $\sqrt{s}$ point. External pythia process will handle all the MSTORE details for you.**
- **Good progress on writing code for external pythia process that interprets input file and reads out MC data. Should be ready about a week after Santa Cruz workshop.**

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

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



Goals of SUSY Physics with SPS # 1

Measure @ $Q^2 = M_U^2$	m_0	$m_{1/2}$	A_0	$\tan\beta$	$\mathrm{sgn}(\mu)$
Measure @ $Q^2 = M_Z^2$	$M_{\tilde{q}_1 L}$	$M_{\tilde{d}_R}$	$M_{\tilde{u}_R}$	$M_{\tilde{e}_L}$	$M_{\tilde{e}_R}$
	$M_{\tilde{q}_2 L}$	$M_{\tilde{s}_R}$	$M_{\tilde{c}_R}$	$M_{\tilde{\mu}_L}$	$M_{\tilde{\mu}_R}$
	$M_{\tilde{q}_3 L}$	$M_{\tilde{b}_R}$	$M_{\tilde{t}_R}$	$M_{\tilde{\tau}_L}$	$M_{\tilde{\tau}_R}$
	A_t	A_b	A_τ		
	M_1	M_2	$M_{\tilde{g}}$		
	μ	M_A	$\tan\beta$		
Measure @ $\sqrt{s} = .5$ TeV	m_{h^0}	$m_{\tilde{\chi}_1^0}$	$m_{\tilde{\chi}_2^0}$	$m_{\tilde{\chi}_1^+}$	
	$m_{\tilde{e}_R}$	$m_{\tilde{e}_L}$	$m_{\tilde{\nu}_e}$		
	$m_{\tilde{\mu}_R}$	$m_{\tilde{\mu}_L}$	$m_{\tilde{\nu}_\mu}$		
	$m_{\tilde{\tau}_1}$	$m_{\tilde{\tau}_2}$	$m_{\tilde{\nu}_\tau}$		
	$g_{\tilde{\tau}_1^+ \tilde{\tau}_1^- Z}$	$g_{\tilde{\tau}_1^+ \tilde{\tau}_2^- Z}$	$g_{\tilde{\tau}_2^+ \tilde{\tau}_2^- Z}$		
	$g_{L(\tilde{\chi}_1^0 \tilde{\chi}_2^0 Z)}$	$g_{R(\tilde{\chi}_1^0 \tilde{\chi}_2^0 Z)}$	$g_{L(\tilde{\chi}_2^0 \tilde{\chi}_2^0 Z)}$	$g_{R(\tilde{\chi}_2^0 \tilde{\chi}_2^0 Z)}$	
	$g_{L(\tilde{\chi}_1^+ \tilde{\chi}_1^- Z)}$	$g_{R(\tilde{\chi}_1^+ \tilde{\chi}_1^- Z)}$	$g_{L(\tilde{\chi}_1^+ \tilde{\nu}_e e)}$	$g_{L(\tilde{\chi}_1^+ \tilde{\tau}_1^- \nu_\tau)}$	$g_{R(\tilde{\chi}_1^+ \tilde{\tau}_1^- \nu_\tau)}$
	$g_{R(\tilde{\chi}_1^0 \tilde{e}_R^- e)}$	$g_{L(\tilde{\chi}_1^0 \tilde{e}_L^- e)}$	$g_{L(\tilde{\chi}_2^0 \tilde{e}_L^- e)}$	$g_{L(\tilde{\chi}_1^+ \tilde{e}_L^- \nu_e)}$	
	$g_{R(\tilde{\chi}_1^0 \tilde{\mu}_R^- \mu)}$	$g_{L(\tilde{\chi}_1^0 \tilde{\mu}_L^- \mu)}$	$g_{L(\tilde{\chi}_2^0 \tilde{\mu}_L^- \mu)}$	$g_{L(\tilde{\chi}_1^+ \tilde{\mu}_L^- \nu_\mu)}$	
	$g_{L(\tilde{\chi}_1^0 \tilde{\tau}_1^- \tau)}$	$g_{R(\tilde{\chi}_1^0 \tilde{\tau}_1^- \tau)}$			
	$g_{L(\tilde{\chi}_1^0 \tilde{\tau}_2^- \tau)}$	$g_{R(\tilde{\chi}_1^0 \tilde{\tau}_2^- \tau)}$	$g_{L(\tilde{\chi}_2^0 \tilde{\tau}_2^- \tau)}$	$g_{R(\tilde{\chi}_2^0 \tilde{\tau}_2^- \tau)}$	
	$g_{L(\tilde{\chi}_1^+ \tilde{\tau}_2^- \nu_\tau)}$	$g_{R(\tilde{\chi}_1^+ \tilde{\tau}_2^- \nu_\tau)}$			
	$g_{L(\tilde{\chi}_1^0 \tilde{\nu}_e \nu_e)}$	$g_{L(\tilde{\chi}_1^0 \tilde{\nu}_\mu \nu_\mu)}$	$g_{L(\tilde{\chi}_1^0 \tilde{\nu}_\tau \nu_\tau)}$		
	$g_{h^0 b\bar{b}}$	$g_{h^0 \tau^+ \tau^-}$	$g_{h^0 gg}$	$g_{h^0 c\bar{c}}$	
	$g_{h^0 W^+ W^-}$	$g_{h^0 ZZ}$			

Neutralino Mass Matrix in $(\tilde{B}, \tilde{W}^3, \tilde{H}_1^0, \tilde{H}_2^0)$ basis:

$$\mathcal{M} = \begin{pmatrix} M_1 & 0 & -m_Z c_\beta s_W & m_Z s_\beta s_W \\ 0 & M_2 & m_Z c_\beta c_W & -m_Z s_\beta c_W \\ -m_Z c_\beta s_W & m_Z c_\beta c_W & 0 & -\mu \\ m_Z s_\beta s_W & -m_Z s_\beta c_W & -\mu & 0 \end{pmatrix}$$

Chargino Mass Matrix:

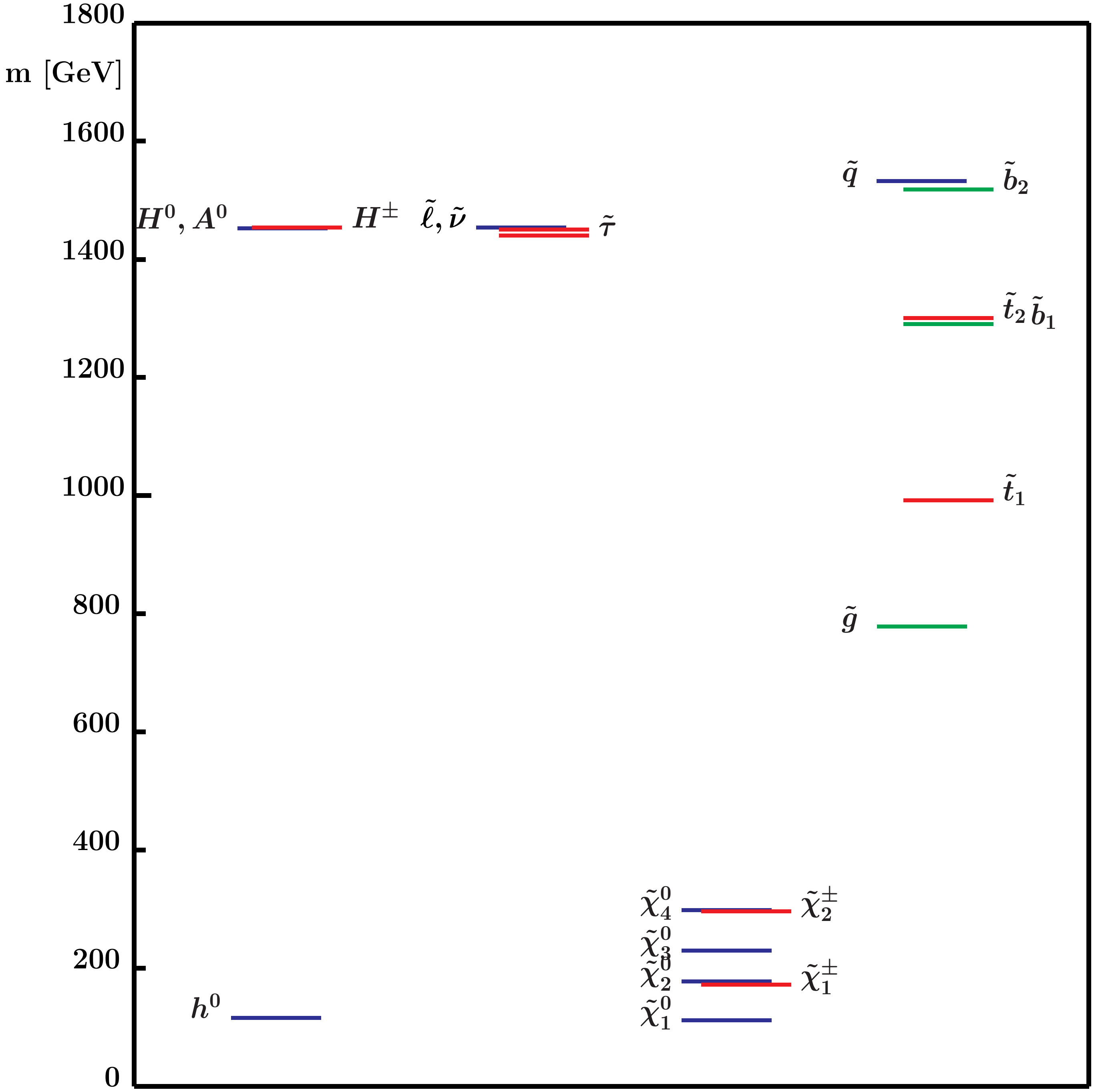
$$\mathcal{M}_C = \begin{pmatrix} M_2 & \sqrt{2} m_W\, c_\beta \\ \sqrt{2} m_W\, s_\beta & |\mu| \end{pmatrix}$$

SPS #1 Remarks

- Should be able to measure with very good accuracy at $\sqrt{s} = 0.5$ TeV the following parameters: $M_{\tilde{e}_L}$, $M_{\tilde{e}_R}$, $M_{\tilde{\mu}_L}$, $M_{\tilde{\mu}_R}$, $M_{\tilde{\tau}_L}$, $M_{\tilde{\tau}_R}$, A_τ, M_1, M_2 μ, $\tan\beta$. This is sufficient to pin down all the parameters at $Q^2 = M_U^2$ assuming mSUGRA.
- What is missing after $\sqrt{s} = 0.5$ TeV (and ignoring LHC) are the squark mass terms $M_{\tilde{q}_1 L}$, $M_{\tilde{d}_R}$, $M_{\tilde{u}_R}$, etc.; A_t and A_b ; $M_{\tilde{g}}$; M_A . It might be possible to use the Higgs couplings $g_{h^0 b\bar{b}}$, $g_{h^0 gg}$, etc. to access M_A and A_t. Also, M_A might be accessible through $e^+e^- \longrightarrow b\bar{b}A^0$.
- $\sqrt{s}$ thresholds in GeV for associated production: $q\bar{q}\tilde{g}\tilde{\chi}_1^0(700)$, $\tilde{t}_1\bar{t}\tilde{\chi}_1^0(650)$, $\tilde{b}_1\bar{b}\tilde{\chi}_1^0(600)$, $b\bar{b}A^0(400)$.
- Possibility of CP violating phases in soft-SUSY breaking parameters as well as non-zero off-diagonal terms in $M^2_{\tilde{q}_1 L}$ matrices has not been considered.

SPS 2 "Focus Point" mSUGRA: $m_0 = 1450$ GeV $m_{1/2} = 300$ GeV

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



Goals of SUSY Physics with SPS # 2

Measure @ $Q^2 = M_U^2$	m_0	$m_{1/2}$	A_0	$\tan\beta$	$\mathrm{sgn}(\mu)$
Measure @ $Q^2 = M_Z^2$	$M_{\tilde{q}_1 L}$	$M_{\tilde{d}_R}$	$M_{\tilde{u}_R}$	$M_{\tilde{e}_L}$	$M_{\tilde{e}_R}$
	$M_{\tilde{q}_2 L}$	$M_{\tilde{s}_R}$	$M_{\tilde{c}_R}$	$M_{\tilde{\mu}_L}$	$M_{\tilde{\mu}_R}$
	$M_{\tilde{q}_3 L}$	$M_{\tilde{b}_R}$	$M_{\tilde{t}_R}$	$M_{\tilde{\tau}_L}$	$M_{\tilde{\tau}_R}$
	A_t	A_b	A_τ		
	M_1	M_2	$M_{\tilde{g}}$		
	μ	M_A	$\tan\beta$		
Measure @ $\sqrt{s} = .5$ TeV	m_{h^0}	$m_{\tilde{\chi}_1^0}$	$m_{\tilde{\chi}_2^0}$	$m_{\tilde{\chi}_3^0}$	$m_{\tilde{\chi}_4^0}$
	$m_{\tilde{\chi}_1^+}$	$m_{\tilde{\chi}_2^+}$			
	$g_{L(\tilde{\chi}_1^0\tilde{\chi}_2^0 Z)}$	$g_{R(\tilde{\chi}_1^0\tilde{\chi}_2^0 Z)}$	$g_{L(\tilde{\chi}_1^0\tilde{\chi}_3^0 Z)}$	$g_{R(\tilde{\chi}_1^0\tilde{\chi}_3^0 Z)}$	
	$g_{L(\tilde{\chi}_1^0\tilde{\chi}_4^0 Z)}$	$g_{R(\tilde{\chi}_1^0\tilde{\chi}_4^0 Z)}$	$g_{L(\tilde{\chi}_2^0\tilde{\chi}_2^0 Z)}$	$g_{R(\tilde{\chi}_2^0\tilde{\chi}_2^0 Z)}$	
	$g_{L(\tilde{\chi}_2^0\tilde{\chi}_3^0 Z)}$	$g_{R(\tilde{\chi}_2^0\tilde{\chi}_3^0 Z)}$	$g_{L(\tilde{\chi}_2^0\tilde{\chi}_4^0 Z)}$	$g_{R(\tilde{\chi}_2^0\tilde{\chi}_4^0 Z)}$	
	$g_{L(\tilde{\chi}_3^0\tilde{\chi}_3^0 Z)}$	$g_{R(\tilde{\chi}_3^0\tilde{\chi}_3^0 Z)}$	$g_{L(\tilde{\chi}_3^0\tilde{\chi}_4^0 Z)}$	$g_{R(\tilde{\chi}_3^0\tilde{\chi}_4^0 Z)}$	
	$g_{L(\tilde{\chi}_1^+\tilde{\chi}_1^- Z)}$	$g_{R(\tilde{\chi}_1^+\tilde{\chi}_1^- Z)}$	$g_{L(\tilde{\chi}_1^+\tilde{\chi}_2^- Z)}$	$g_{R(\tilde{\chi}_1^+\tilde{\chi}_2^- Z)}$	
	$g_{h^0 b\bar{b}}$	$g_{h^0\tau^+\tau^-}$	$g_{h^0 gg}$	$g_{h^0 c\bar{c}}$	
	$g_{h^0 W^+W^-}$	$g_{h^0 ZZ}$	$g_{L(h^0\tilde{\chi}_2^+\tilde{\chi}_1^-)}$	$g_{R(h^0\tilde{\chi}_2^+\tilde{\chi}_1^-)}$	
	$g_{L(\tilde{\chi}_1^+\tilde{\nu}_e e)}/m_{\tilde{\nu}_e}^2$		$g_{L(\tilde{\chi}_2^+\tilde{\nu}_e e)}/m_{\tilde{\nu}_e}^2$		
	$g_{R(\tilde{\chi}_j^0\tilde{e}_R^- e)}/m_{\tilde{e}_R}^2$		$g_{L(\tilde{\chi}_j^0\tilde{e}_L^- e)}/m_{\tilde{e}_L}^2$		

SPS #2 Remarks

- Should be able to measure with very good accuracy at $\sqrt{s} = 0.5$ TeV the following parameters: M_1, M_2 μ, $\tan\beta$. This is sufficient to measure $m_{1/2}$, $\tan\beta$, $\mathrm{sgn}(\mu)$ at $Q^2 = M_U^2$ and to predict $m_{\tilde{g}}$ assuming mSUGRA.
- At $\sqrt{s} = 0.5$ TeV the only handle on mSUGRA parameters m_0 and A_0 is through the Higgs couplings $g_{h^0 b\bar{b}}$, $g_{h^0 gg}$, and through measurements or limits on $g_{L(\tilde{\chi}_1^+ \tilde{\nu}_e e)}/m^2_{\tilde{\nu}_e}$, $g_{R(\tilde{\chi}_j^0 \tilde{e}_R^- e)}/m^2_{\tilde{e}_R}$, etc. The Higgs couplings depend on M_A at tree-level, and on A_t through rad. corr. Using μ and $\tan\beta$ measured in gaugino production and decay, it might be possible to extract M_A and A_t from Higgs coupling measurements.
- Measurement of additional Higgs-gaugino-gaugino couplings might be possible though processes such as $e^+e^- \to h^0 \tilde{\chi}_1^+ \tilde{\chi}_1^-$.
- $\sqrt{s}$ thresholds in GeV for associated production: $q\bar{q}\tilde{g}\tilde{\chi}_1^0(900)$, $\tilde{t}_1\bar{t}\tilde{\chi}_1^0(1250)$, $\tilde{b}_1\bar{b}\tilde{\chi}_1^0(1380)$, $b\bar{b}A^0(1450)$.