# MARMOSET

Some reality checks...

# Mocking Up Gluino Pairs

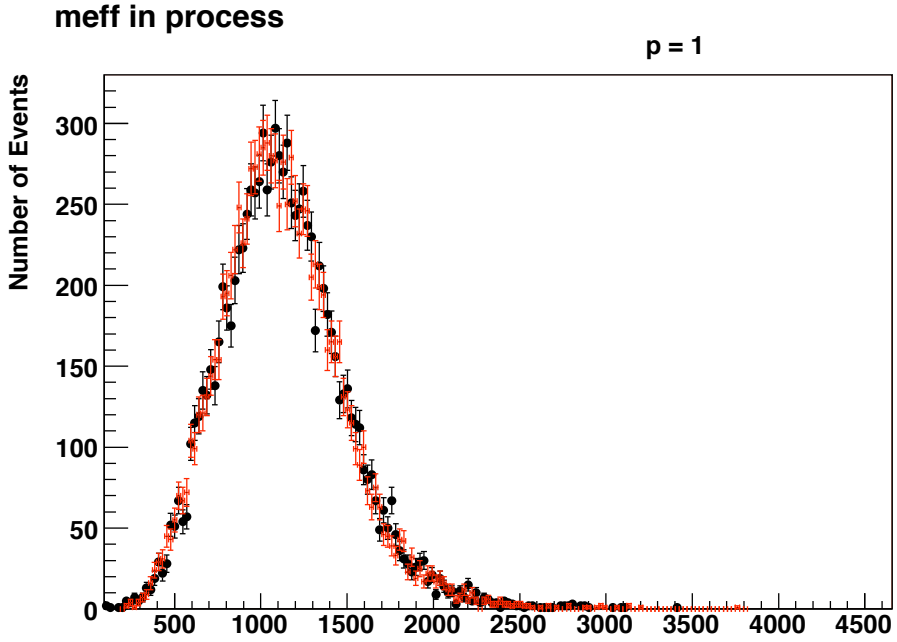



Figure 3: Meff distribution for $|M|^2 = const$

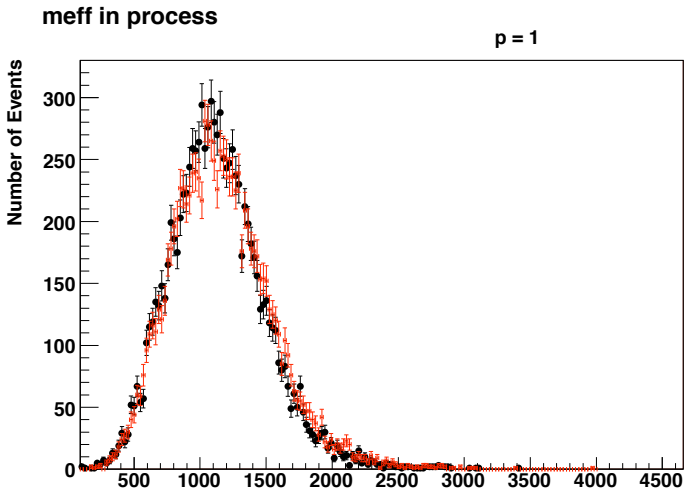



Figure 4: Meff distribution for a $gg \to f\bar{f}$ type matrix element.

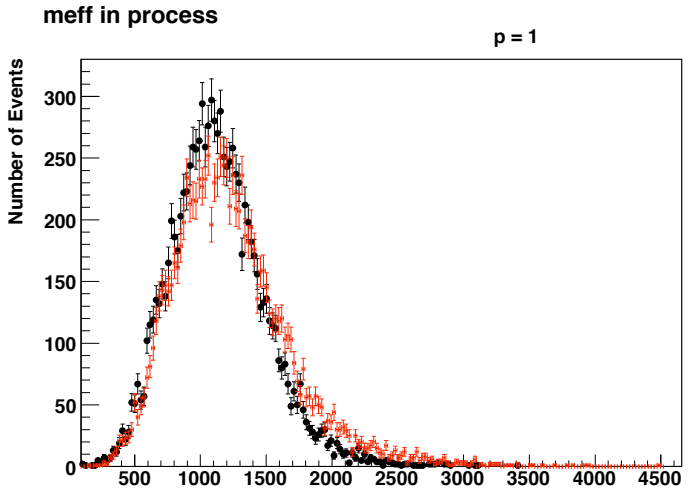



Figure 5: Meff distribution for a $f\bar{f} \to f\bar{f}$ type matrix element.

# Gluino-Neutralino Associated Production

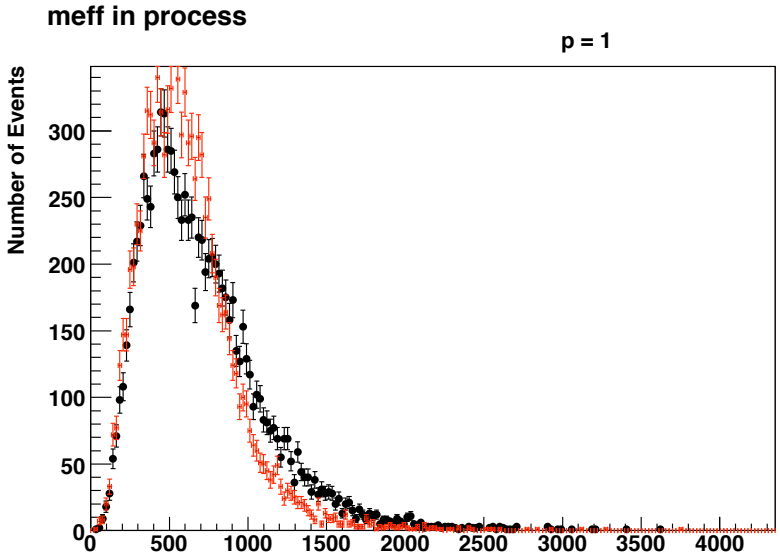



Figure 6: Meff distribution for $|M|^2 = const$

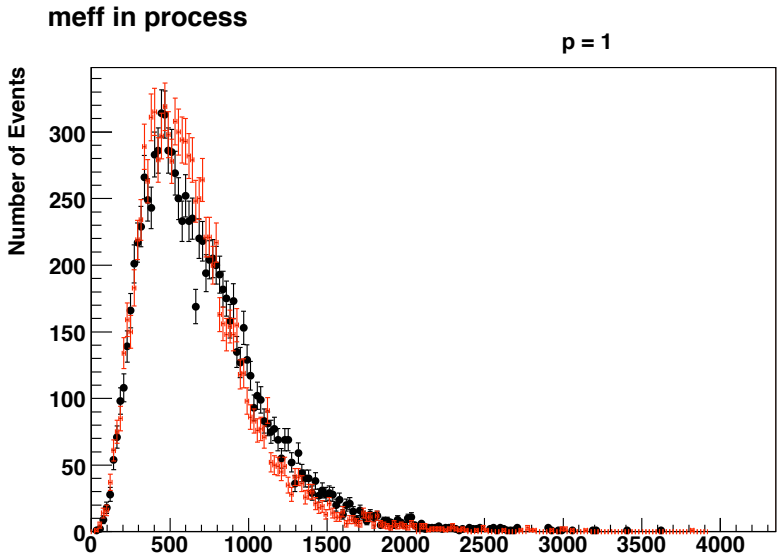



Figure 7: Meff distribution for a t-channel $f\bar{f} \to f\bar{f}$ type matrix element. $m_I = 900$ GeV

Just Gluino Pair in SUSY

| | |
|---|---|
| $\tilde{t}_1$ | 1000.2 |
| $\tilde{b}_1$ | 20000 ** |
| $\tilde{g}$ | 859.1 |
| LSP $\chi_0^1$ | 199.8 |
| $\chi_\pm^1$ | 200.07 |

OSET Model

$$\mathcal{G} \rightarrow t\bar{t}\mathcal{S}$$

$$\mathcal{G} \rightarrow t\bar{b}\mathcal{S},\ b\bar{t}\mathcal{S}(+\text{ soft})$$

$$\mathcal{G} \rightarrow b\bar{b}\mathcal{S}$$

$$\mathcal{G} \rightarrow j\bar{j}\mathcal{S}\ (\text{first 2 generations}).$$

# MARMOSET Matching

| $M_{\mathcal{G}}$ | $\chi^2$ | $N_{tot}$ | $Br_{bb}$ | $Br_{jj}$ | $Br_{tb}$ | $Br_{tt}$ |
|---|---|---|---|---|---|---|
| 700 | 76.049 | 12584.5 | 0.152869 | -0.00464707 | 0.688244 | 0.163534 |
| 750 | 70.4683 | 12575.3 | 0.12428 | -0.0062921 | 0.739187 | 0.142826 |
| 800 | 73.5309 | 12569.1 | 0.1358 | 0.00535681 | 0.69477 | 0.164073 |
| **850** | **65.387** | **12567.8** | **0.110195** | **-0.00771074** | **0.756638** | **0.140878** |
| 900 | 69.0455 | 12564.3 | 0.107278 | -0.00724091 | 0.757648 | 0.142314 |
| 950 | 75.964 | 12560.8 | 0.0753418 | -0.0000858641 | 0.790581 | 0.134163 |
| MODEL | | 12594 | .149 | 0 | .682 | .168 |

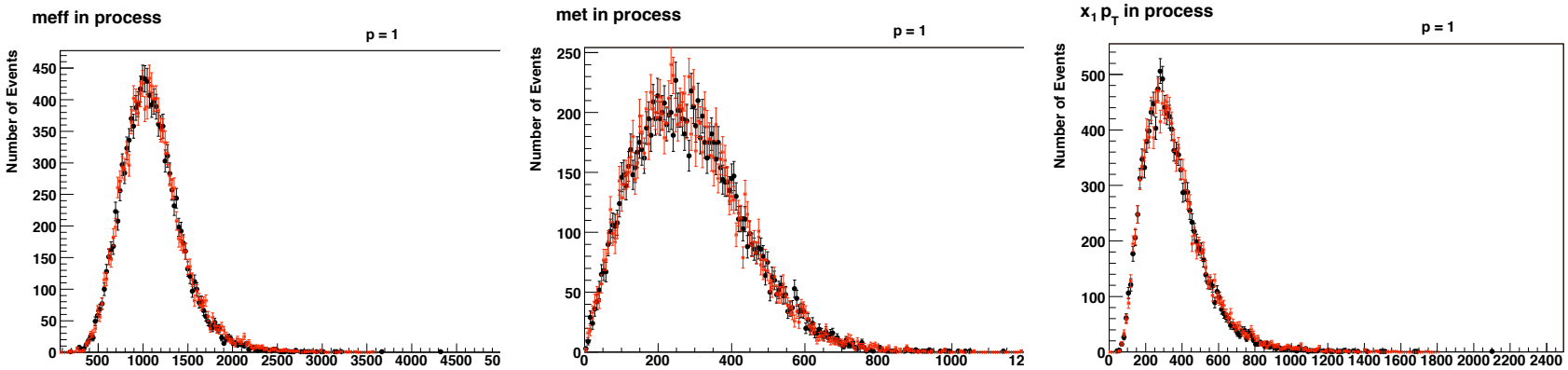



Figure 9: $\sum p_T$, $\not{p}_T$, and hardest-object $p_T$ distributions for the best fit combination of processes in OSET (red) over the pseudodata (black). The OSET analysis is performed assuming $m_{\mathcal{G}} = 850$ GeV.

# MARMOSET

"Fun Box" Challenge

# “Fun Box”

- Inspired by 3rd LHC Olympics
- Simplification of Scott Thomas’ Black Box
- R-parity violating SUSY
- Dominant Signature: “b-jets and leptons”

- (No Standard Model Background)

# “Fun” Questions

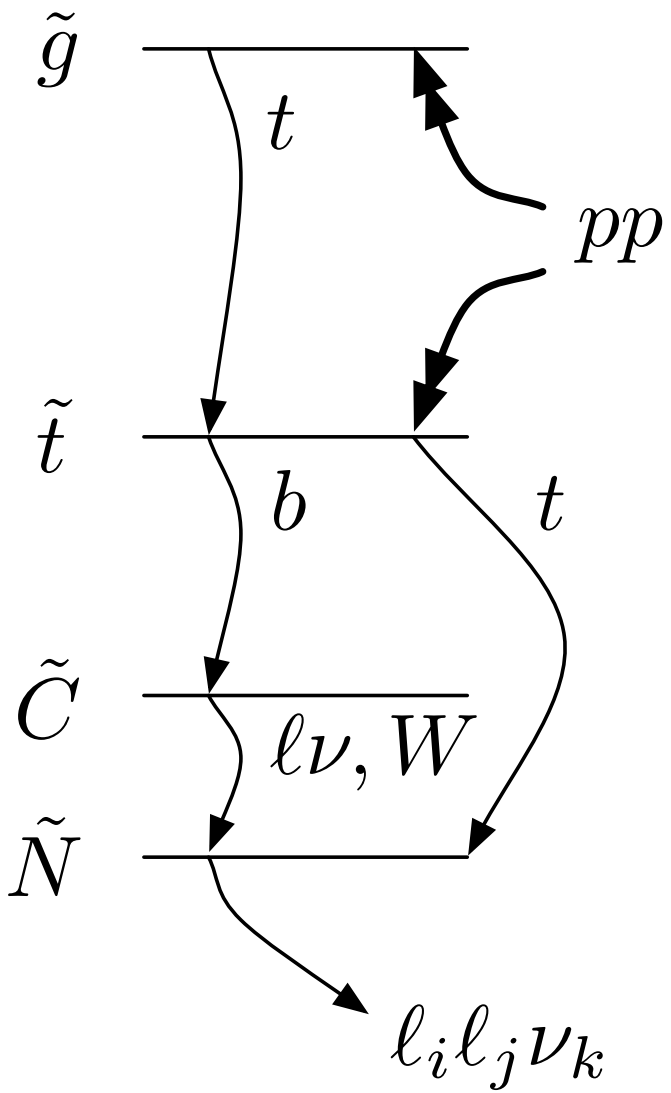
- Can you use MARMOSET to infer...
  - The (non-)existence of tops?
  - Lepton flavor violation?
  - Mass scales?
  - Presence of rare processes?

# Attempt #1

```
GL      :  EM=0 SU3=8 m=950
ST ST~  :  EM=2 SU3=3 m=500
NA      :  EM=0 SU3=0 m=200
CA CA~  : EM=-3 SU3=0 m=400

g g > GL GL   : matrix=2
g g > ST ST~  : matrix=2

GL > ST tbar
ST > NA t
ST > CA~ b
CA > NA e- nu_e (& perm)
CA > NA W-
NA > e- mu+ nu_tau (& perm)
```



# Attempt #1: Need Direct Production!

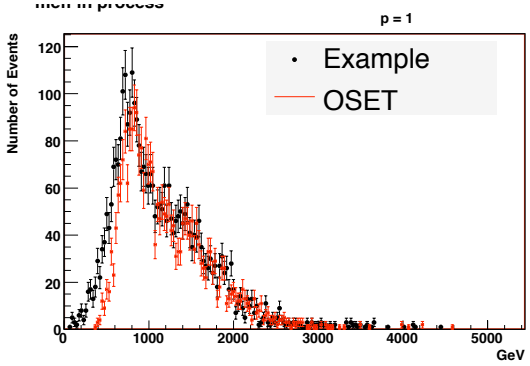
| | | | Target | Best | Error | Pull | +*****\|*****+ |
|---|---|---|---|---|---|---|---|
| l=0 | b=0 | j=0 | 10.0 | 0.3 | 3.3 | -2.2 | **\| |
| l=0 | b=0 | j=2 | 19.0 | 3.4 | 4.5 | -2.8 | ***\| |
| l=0 | b=0 | j=6 | 17.0 | 8.2 | 4.3 | -1.7 | **\| |
| l=1 | b=0 | j=0 | 35.0 | 0.3 | 6.0 | -5.0 | *****\| |
| l=1 | b=0 | j=2 | 49.0 | 19.2 | 7.2 | -3.6 | ****\| |
| l=2 | b=0 | j=0 | 75.0 | 2.3 | 8.7 | -7.5 | +*****\| |
| l=2 | b=0 | j=2 | 114.0 | 63.6 | 11.0 | -4.2 | ****\| |
| l=2 | b=1 | j=4 | 110.0 | 128.1 | 11.0 | 1.5 | \|** |
| l=3+ | b=0 | j=0 | 416.0 | 43.4 | 20.5 | -17.3 | +*****\| |
| l=3+ | b=0 | j=2 | 340.0 | 223.9 | 18.9 | -5.8 | +*****\| |
| l=3+ | b=1 | j=2 | 210.0 | 258.0 | 15.1 | 3.0 | \|*** |
| l=3+ | b=1 | j=4 | 216.0 | 263.8 | 15.3 | 2.9 | \|*** |
| l=3+ | b=2 | j=2 | 61.0 | 80.0 | 8.2 | 2.1 | \|** |
| l=3+ | b=2 | j=4 | 122.0 | 134.5 | 11.4 | 1.0 | \|* |

# Attempt #1: Need Direct Production!

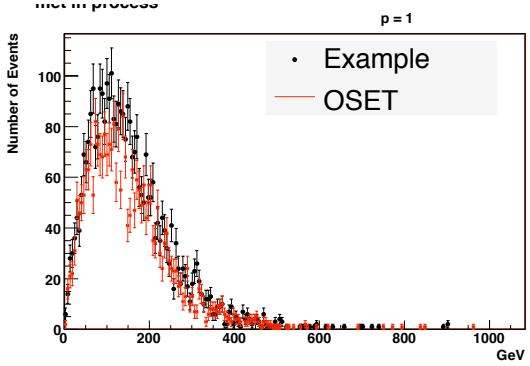
This gives chi-squared of 604.084

| Param | Low | Best | High | Name |
|---|---|---|---|---|
| s0 | 0.0463 | 0.3417 | 0.6371 | Sigma( g g > GL GL ) |
| s1 | 0.3629 | 0.6583 | 0.9537 | Sigma( g g > ST ST~ ) |
| b0_0 | 1.0000 | 1.0000 | 1.0000 | Br( GL > tbar ST ) |
| b1_0 | -0.3565 | 0.7705 | 1.8975 | Br( ST > NA t ) |
| b1_1 | -0.8975 | 0.2295 | 1.3565 | Br( ST > CA~ b ) |
| b2_0 | 1.0000 | 1.0000 | 1.0000 | Br( NA > nu_tau mu+ e- ) |
| b3_0 | -4.1225 | 1.0000 | 6.1225 | Br( CA > nu_e e- NA ) |
| b3_1 | -5.1225 | 0.0000 | 5.1225 | Br( CA > W- NA ) |

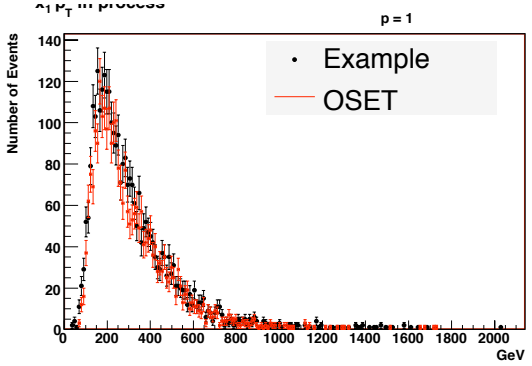
# Attempt #1: More Diagnostics...



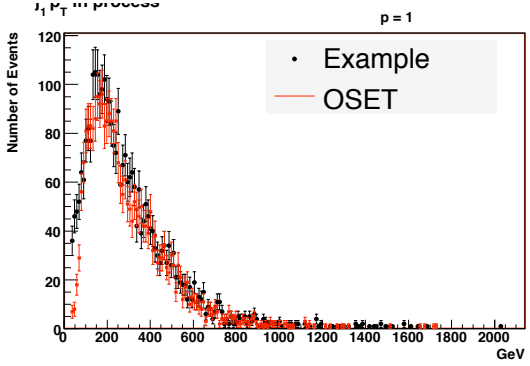

$\sum p_T$



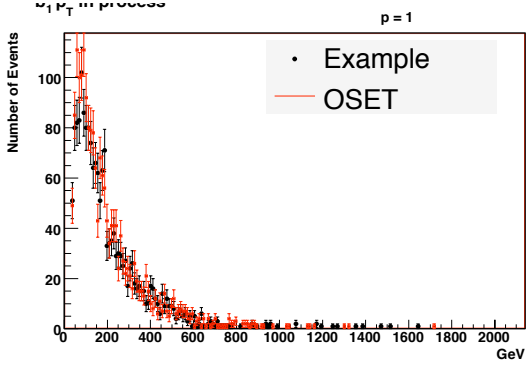

$\not{p}_T$



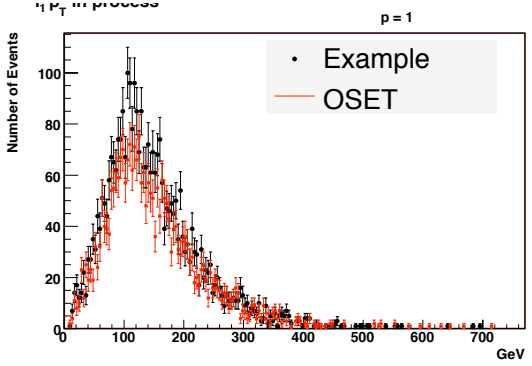

$\max p_T$




$\max p_T^j$




$\max p_T^b$



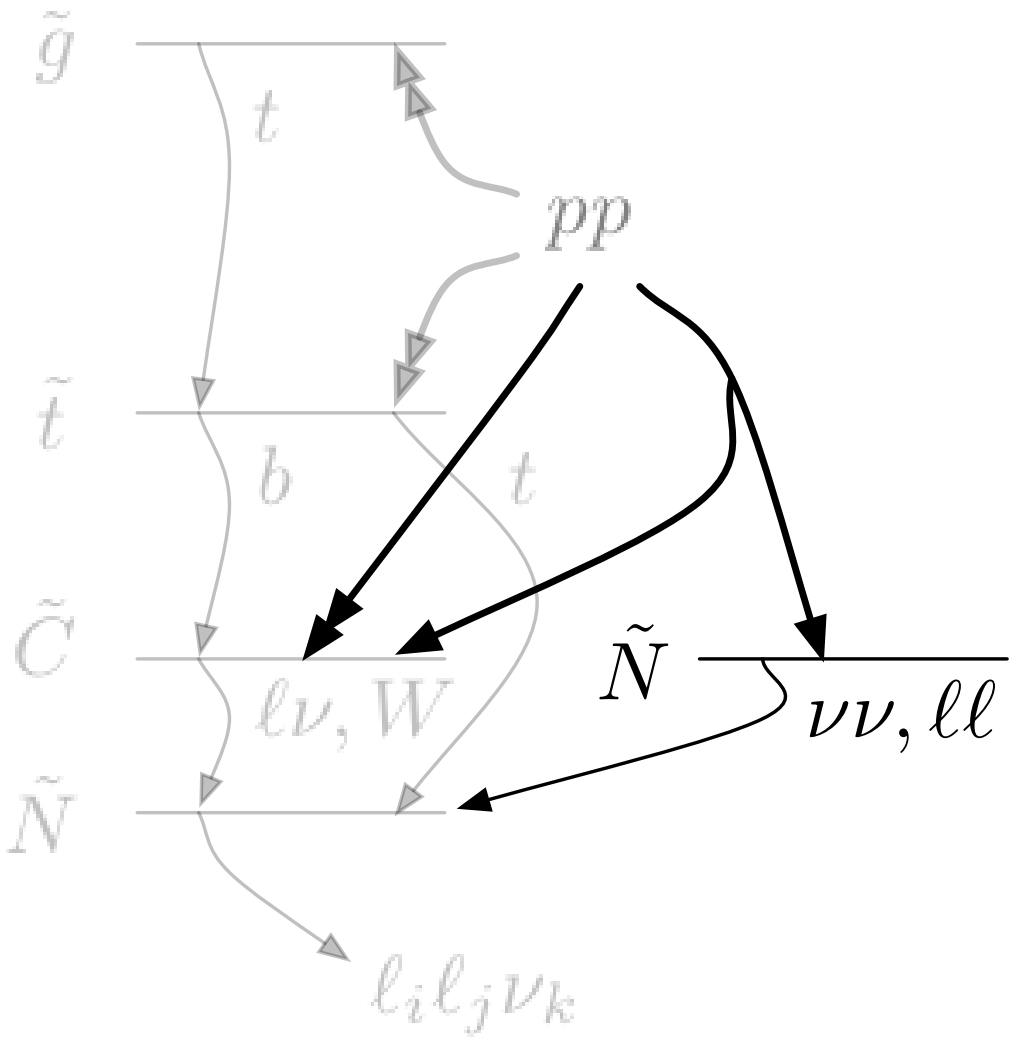

$\max p_T^\ell$

# Attempt #2

```
GL      :  EM=0 SU3=8 m=950
ST ST~  :  EM=2 SU3=3 m=500
NA      :  EM=0 SU3=0 m=200
CA CA~  : EM=-3 SU3=0 m=400
NB      :  EM=0 SU3=0 m=400

g g    > GL GL  : matrix=2
g g    > ST ST~ : matrix=2
u ubar > CA CA~ : matrix=3
u dbar > CA~ NB : matrix=3

GL > ST tbar
ST > NA t
ST > CA~ b
NA > e- mu+ nu_tau (& perm)
NB > NA nu_e nu_mu
NB > NA e- e+ (& perm)
CA > NA e- nu_e (& perm)
CA > NA W-
```



# Attempt #2: Not Bad...

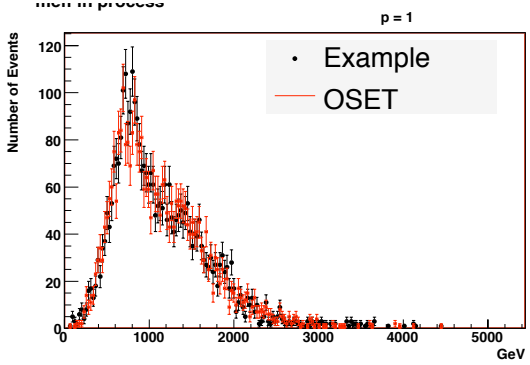
| | Target | Best | Error | Pull +*****\|*****+ |
|---|---|---|---|---|
| l=0 b=0 j=0 | 10.0 | 2.0 | 3.3 | -1.9 **\| |
| l=0 b=0 j=2 | 19.0 | 12.5 | 4.5 | -1.2 *\| |
| l=0 b=0 j=6 | 17.0 | 9.7 | 4.3 | -1.4 *\| |
| l=1 b=0 j=0 | 35.0 | 19.1 | 6.1 | -2.2 **\| |
| l=1 b=0 j=2 | 49.0 | 56.4 | 7.2 | 0.9 \|* |
| l=1 b=0 j=4 | 55.0 | 53.7 | 7.6 | -0.2 \| |
| l=1 b=0 j=6 | 36.0 | 29.8 | 6.2 | -0.9 *\| |
| l=1 b=1 j=4 | 65.0 | 61.2 | 8.2 | -0.4 \| |
| l=1 b=1 j=6 | 46.0 | 49.0 | 7.0 | 0.4 \| |
| l=1 b=2 j=4 | 17.0 | 27.4 | 4.3 | 1.9 \|** |
| l=1 b=2 j=6 | 40.0 | 37.4 | 6.5 | -0.4 \| |
| l=1 b=2 j=8+ | 15.0 | 23.6 | 4.1 | 1.7 \|** |
| l=2 b=0 j=0 | 75.0 | 71.7 | 8.8 | -0.3 \| |
| l=2 b=0 j=2 | 114.0 | 127.1 | 10.9 | 1.1 \|* |
| l=2 b=0 j=4 | 96.0 | 96.3 | 10.0 | 0.0 \| |
| l=2 b=0 j=6 | 50.0 | 43.6 | 7.2 | -0.8 *\| |
| l=2 b=1 j=2 | 52.0 | 56.1 | 7.4 | 0.5 \| |
| l=2 b=1 j=4 | 110.0 | 118.0 | 10.7 | 0.7 \|* |
| l=2 b=1 j=6 | 70.0 | 71.5 | 8.5 | 0.2 \| |
| l=2 b=2 j=2 | 11.0 | 15.6 | 3.5 | 1.0 \|* |
| l=2 b=2 j=4 | 52.0 | 56.6 | 7.4 | 0.5 \|* |
| l=2 b=2 j=6 | 67.0 | 58.2 | 8.3 | -0.9 *\| |
| l=2 b=2 j=8+ | 23.0 | 26.6 | 5.0 | 0.6 \|* |

# Attempt #2: Not Bad...

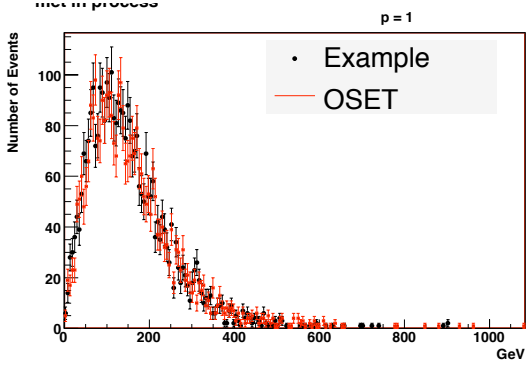
This gives chi-squared of 68.5241

| Param | Low | Best | High | Name |
|---|---|---|---|---|
| s0 | 0.2262 | 0.3144 | 0.4026 | Sigma( g g > GL GL ) |
| s1 | 0.3369 | 0.4466 | 0.5563 | Sigma( g g > ST ST~ ) |
| s2 | -0.8406 | 0.0001 | 0.8408 | Sigma( u ubar > CA CA~ ) |
| s3 | -0.6077 | 0.2389 | 1.0855 | Sigma( u dbar > CA~ NB ) |
| b0_0 | 1.0000 | 1.0000 | 1.0000 | Br( GL > tbar ST ) |
| b1_0 | -0.0893 | 0.6116 | 1.3124 | Br( ST > NA t ) |
| b1_1 | -0.3124 | 0.3884 | 1.0893 | Br( ST > CA~ b ) |
| b2_0 | 1.0000 | 1.0000 | 1.0000 | Br( NA > nu_tau mu+ e- ) |
| b3_0 | -0.6020 | 0.5884 | 1.7787 | Br( CA > nu_e e- NA ) |
| b3_1 | -0.7787 | 0.4116 | 1.6020 | Br( CA > W- NA ) |
| b4_0 | -0.8210 | 0.7831 | 2.3872 | Br( NB > nu_mu nu_e NA ) |
| b4_1 | -1.3872 | 0.2169 | 1.8210 | Br( NB > e- e+ NA ) |

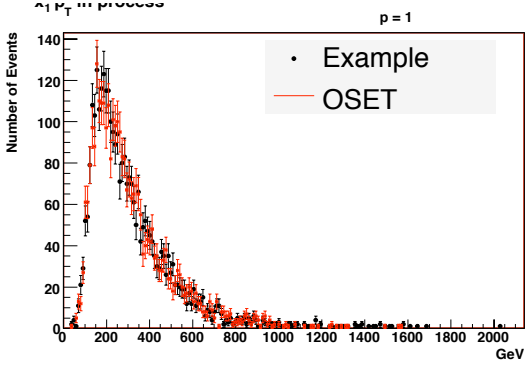
# Attempt #2: Not bad at all...



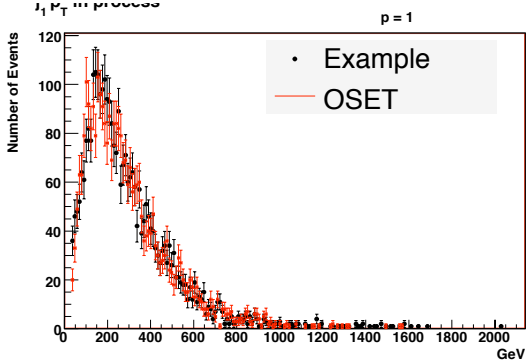

$\sum p_T$



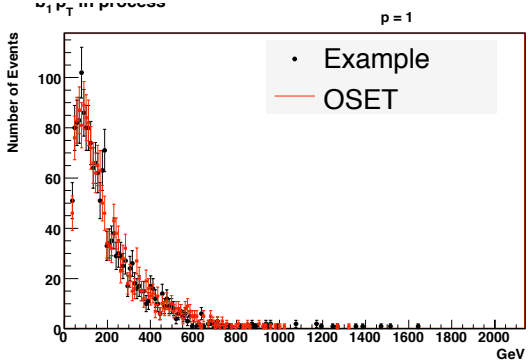

$\not{p}_T$



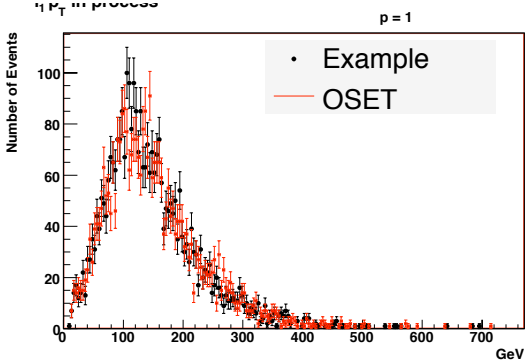

$\max p_T$




$\max p_T^j$




$\max p_T^b$




$\max p_T^\ell$

# “Fun Box” Lessons

- MARMOSET is not completely crazy.
- Matching data vs. making measurements?
- Easy to extend:  more signatures, more plots, more diagnostic information.
- Is this the half-way point between theory and experiment?