Some (early) SUSY Observables

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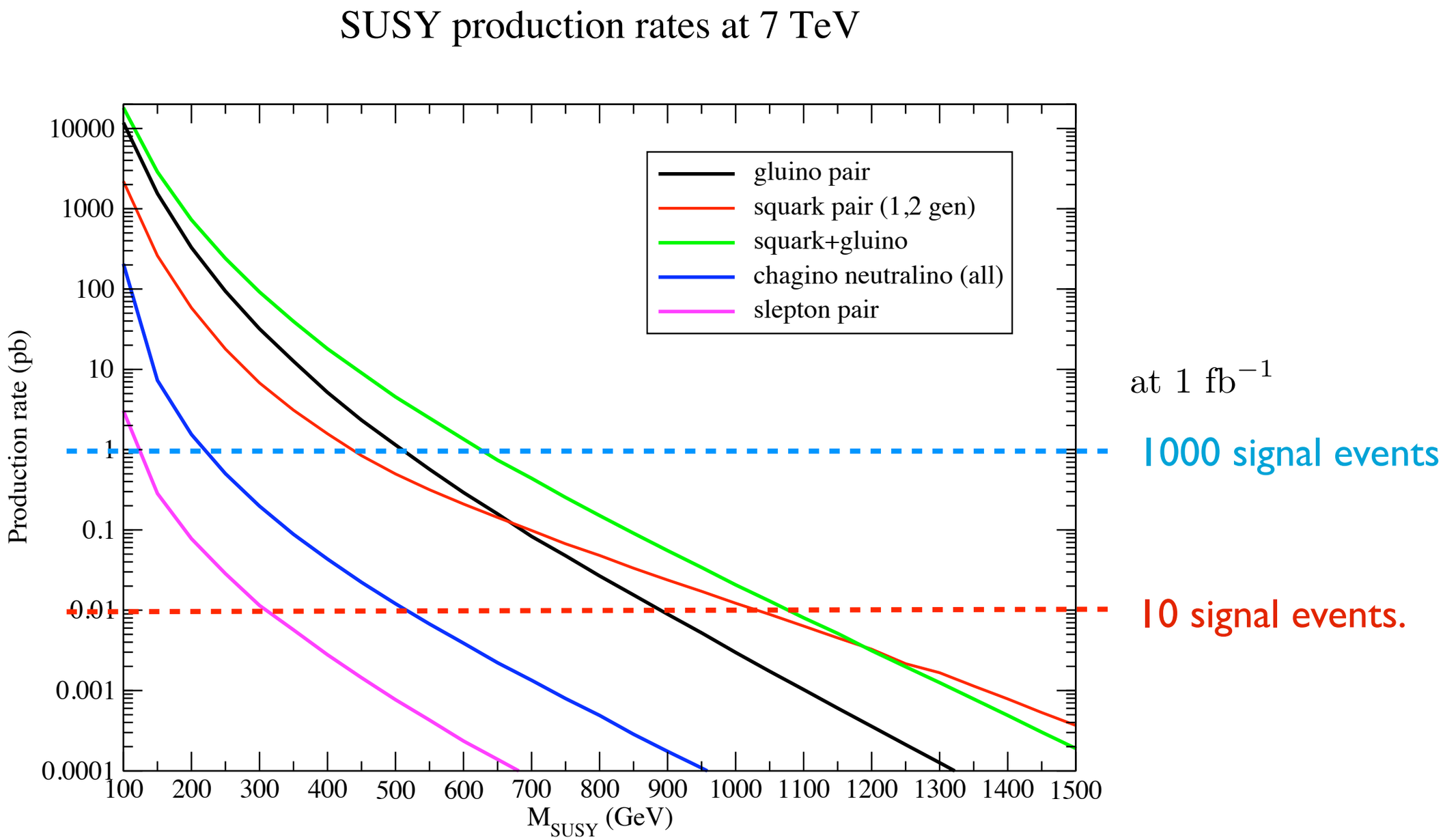
Production.

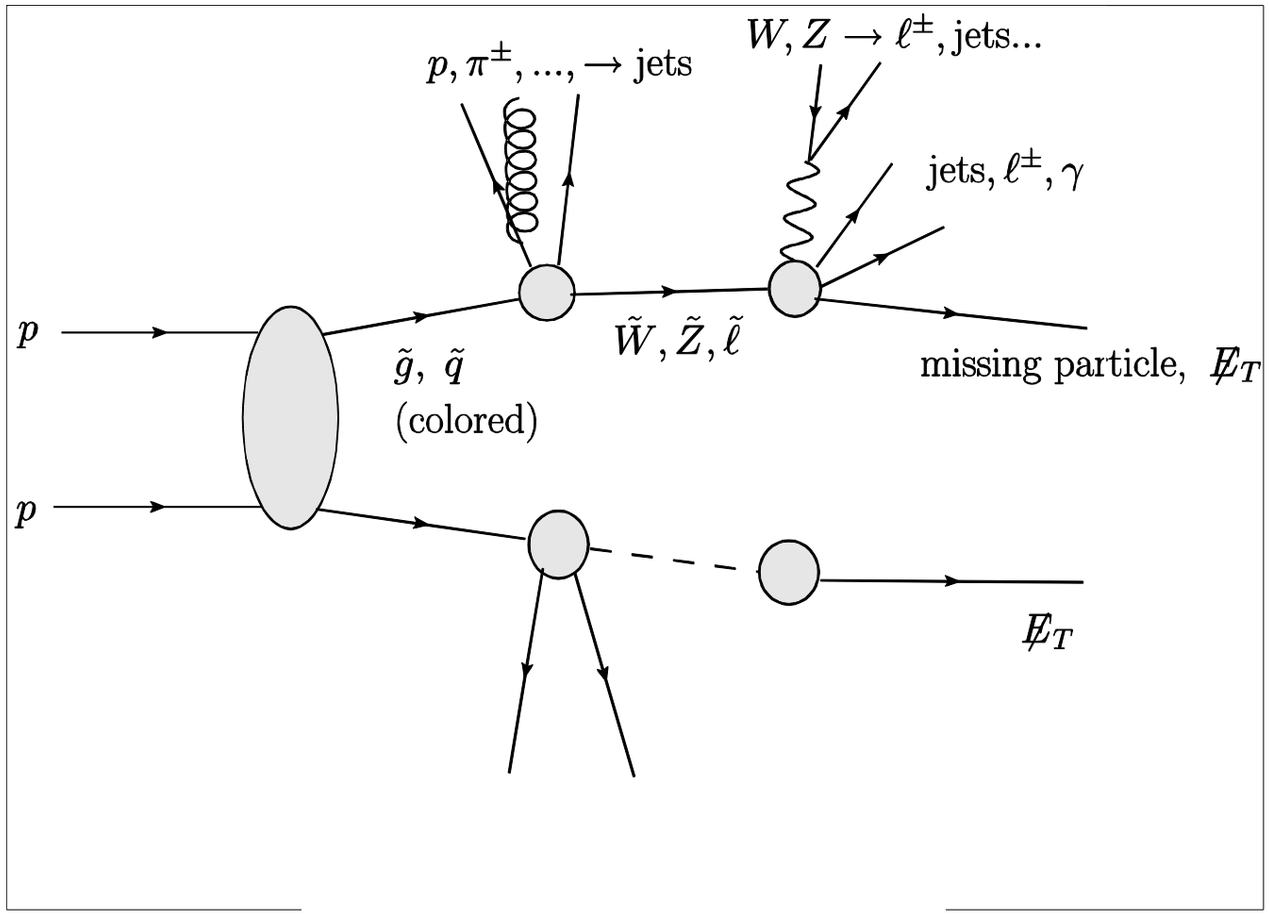


at 1 fb^{-1}

1000 signal events

10 signal events.

Signature of partners



also for generic partners:
Same gauge interactions as the SM particles

$\tilde{g},\ \tilde{q},\ \tilde{W}, \tilde{Z},\ \tilde{\ell}...$
$g^{\mathrm{KK}},\ q^{\mathrm{KK}},\ W^{\mathrm{KK}}, Z^{\mathrm{KK}},\ \ell^{\mathrm{KK}}...$

- If we are reasonably lucky (partners not too heavy), multi-jets multi-lepton channels. Good discovery potential.
- Many studies in the past 2 decades.
- Can be early discovery.

Generic SUSY signal and observables.

- Counts.

$$n \text{ jets } + m \text{ leptons} + \not{E}_T$$

Very powerful if $n,\ m \geq 2$

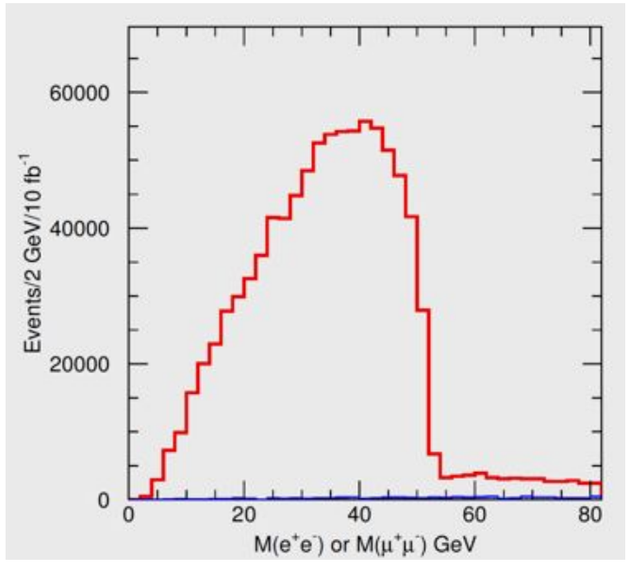
  - Leptons: flavor, charge, all possible combinations.
    - SS2L, 3L, OS2L....
    - Rich information. Disentangle decay chains.
  - For jets: b-tag or not.

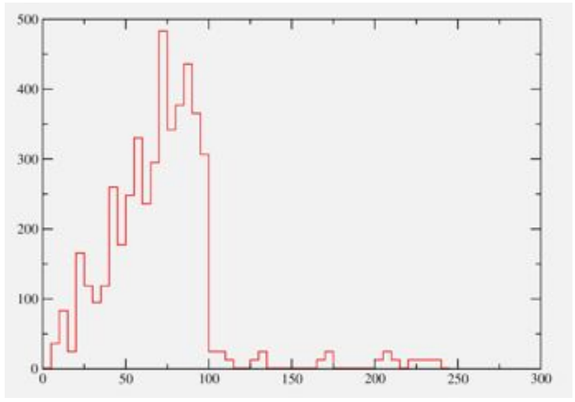
- Transverse variables.

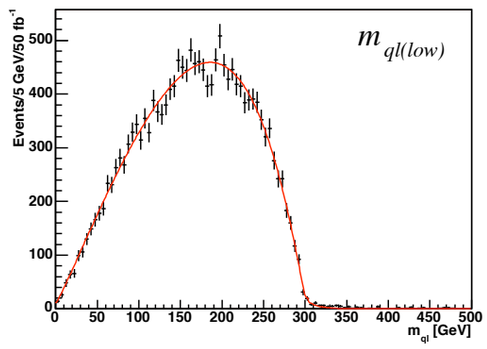
$$M_{\rm eff},\ H_{\rm T}, M_{\rm T2}, \ldots$$

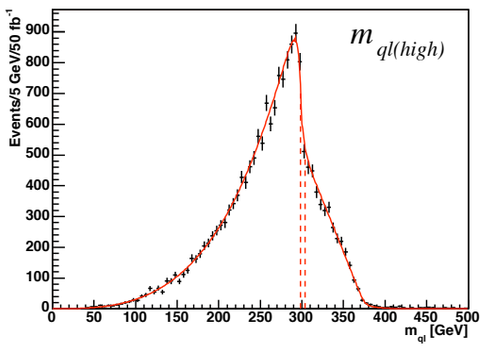
Invariant masses

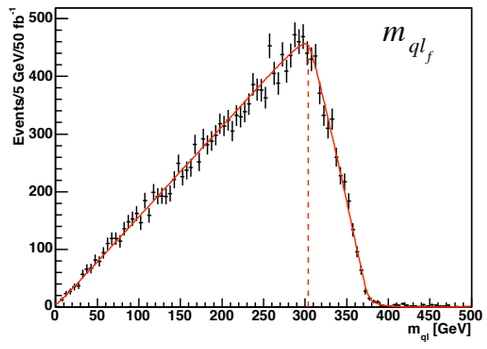
- Sharp feature possible.
  - Very good signal for discovery and measurement.
- Useful to take all conceivable combinations.

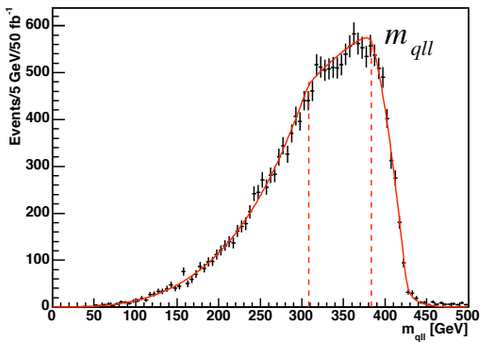












D. Miller, P. Osland, A Raklev, hep-ph/0510356

gluino cascade into 3rd generation

- A well motivated channel, good discovery potential.

$$\tilde{g} \to t\bar{t}\chi_0, tb\chi^{\pm}, bb\chi_0$$
$$pp \to \tilde{g}\tilde{g} \to tttt,\ tttb,\ ttbb,\ ....$$

- Light gluino heavier squark scenrios. (Quite generic.)

- $m_{\tilde{t},\tilde{b}} < m_{\tilde{q}_{1,2}}$
  - Good for flavor CP constraints, tuning.
  - Almost always true due to RGE effects.
    - 3rd gen. channels dominates

$$\frac{\mathrm{BR}(\tilde{g} \to tt, tb...)}{\mathrm{BR}(\tilde{g} \to qq')} \simeq \frac{m^4_{\tilde{q}}}{m^4_{\tilde{t},\tilde{b}}}$$

gluino casecade into 3rd generation

- Final states with several tops and bottoms.

$$\tilde{g} \to t\bar{t}\chi_0, tb\chi^{\pm}, bb\chi_0$$
$$pp \to \tilde{g}\tilde{g} \to tttt,\ tttb,\ ttbb,\ ....$$

- Multiple b + multiple lepton (from top decay)
  - Good discovery potential if gluino is not too heavy.
  - Besides b-tag and lepton counts, also some simple kinematical variables such as

$$m_{b\ell(\mathrm{close})} < m_t^2 - m_W^2$$ if from the same top

- Reconstruction of tops is of course very hard. Some evidence maybe possible.

For a recent study: B. Acharya, P. Grajek, G. Kane, E. Kuflik, K. Suruliz, and LTW, arXiv:0901.3367

Jet substructures, jet shape variables.

- Many recent studies.

http://silicon.phys.washington.edu/JetsWorkshop/talks.html
http://phy-hal.princeton.edu/~liantaow/jets_survey.pdf

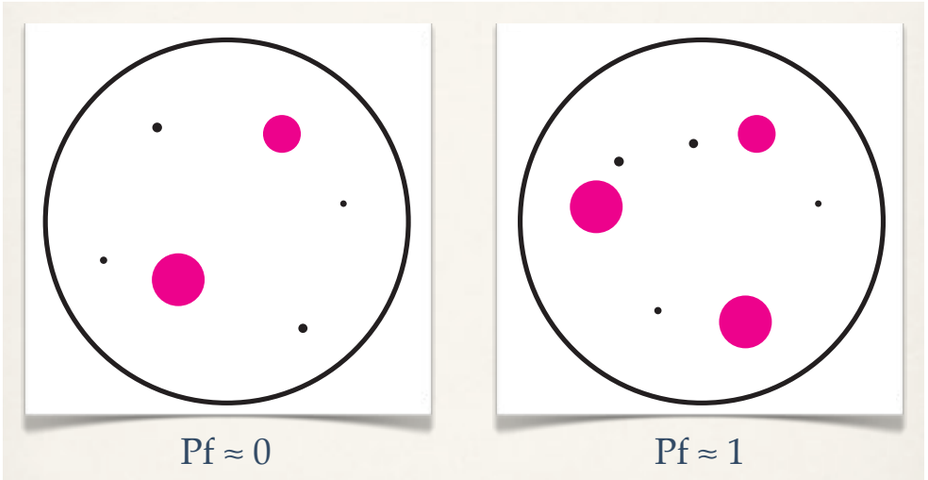
- for (somewhat) boosted massive particles.
  - h, top, W...
  - Jet mass, ySplitter, z-variable, angularity, planar flow...

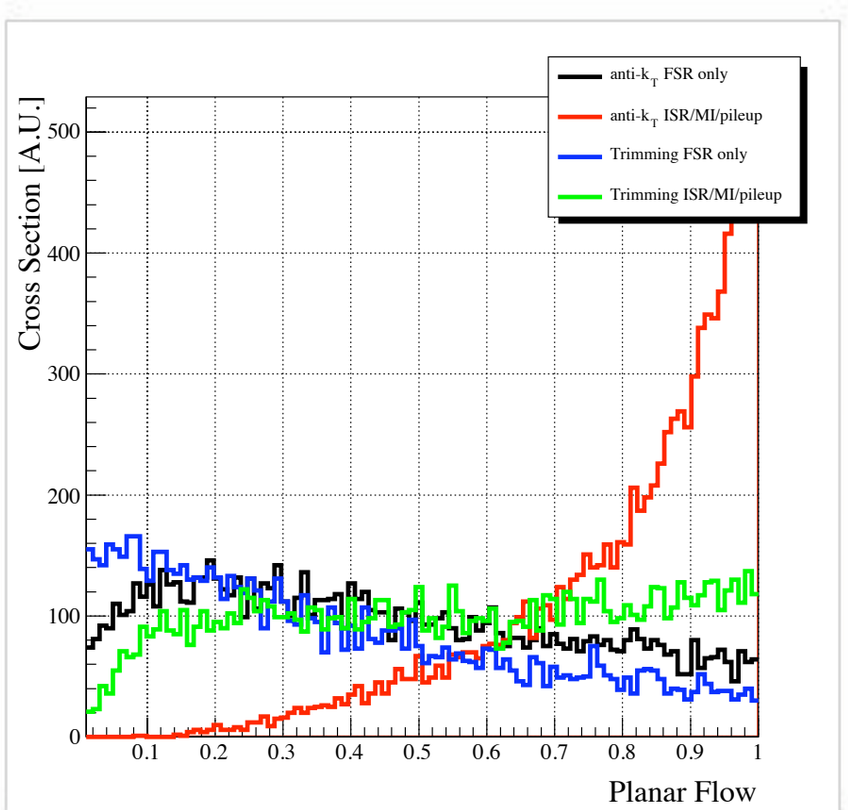
- Could be useful in the SUSY decay chains.

J. Butterworth, J. Ellis, A. Raklev, hep-ph/0702150
J. Butterworth, J. Ellis, A. Raklev, G. Salam arXiv:0906.0728
G. Kribs, A. Martin, T. Roy, M. Spannowsky, arXiv:0912.4731

Example of jet shape

$$\mathrm{Pf} = \frac{4\lambda_1\lambda_2}{(\lambda_1+\lambda_2)^2} \qquad I_w^{kl} = \sum_i E_i \frac{p_{i,k}}{E_i}\frac{p_{i,l}}{E_i}$$





Trimming: Krohn, Thaler, LTW: 0912.1342
Filtering: Butterworth, Davison, Rubin, Salam: 0809.2530
Pruning: Ellis, Vermilion, Walsh:0912.0033

Brief thoughts on other questions.

- Bounds on individual channel.
  - Rate x BR for particular final states is always very useful.
  - Model independent representation is very useful.

Alwall's talk.

- Constraints on high scale models, benchmarks.
  - Useful. But, there are too many of them. Very likely, none of them is realized in nature.
  - For outside "users", gain information of efficiencies, etc.