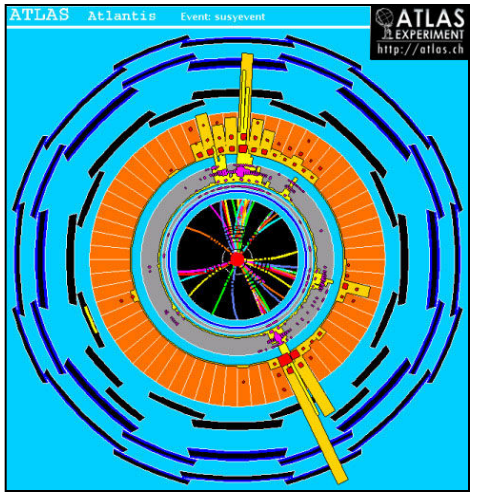
ATLAS SUSY Outputs & Interpretation

```
0000000 6553 7263 7465 6420 7461 2061 6e69 7720
0000010 6968 6863 7720 2065 6964 6373 766f 7265
0000020 7420 6168 2074 6874 2065 6e61 7773 7265
0000030 7420 206f 6874 2065 6c75 6974 616d 6574
0000040 7120 6575 7473 6f69 206e 6572 6c61 796c
0000050 6920 2073 3234 0a2e
```

DATA

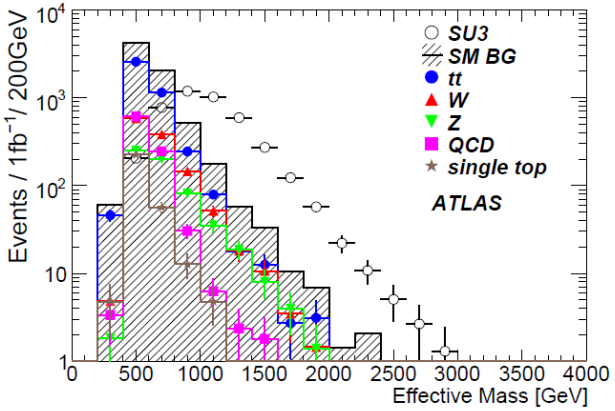
Reconstruction



Projection

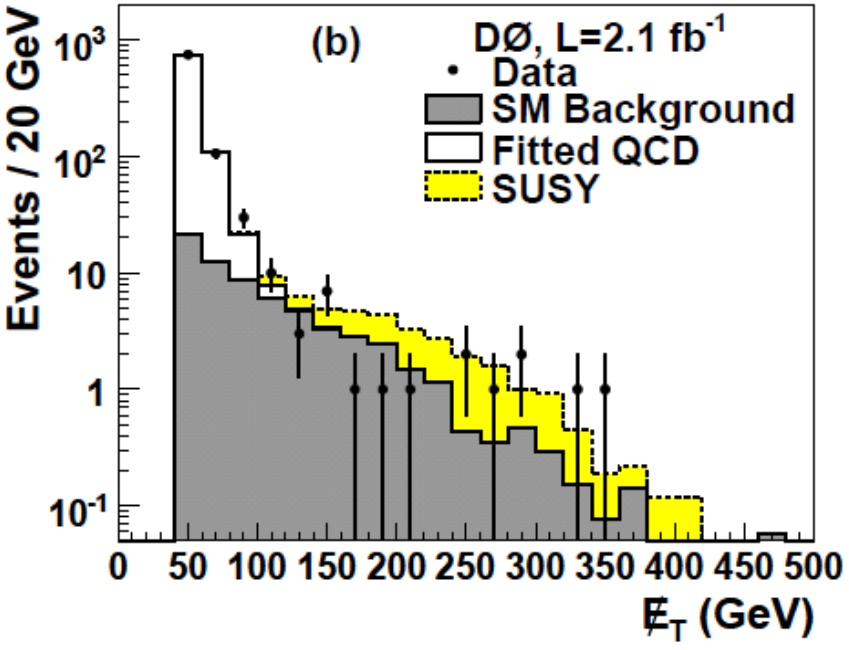
Interpretation

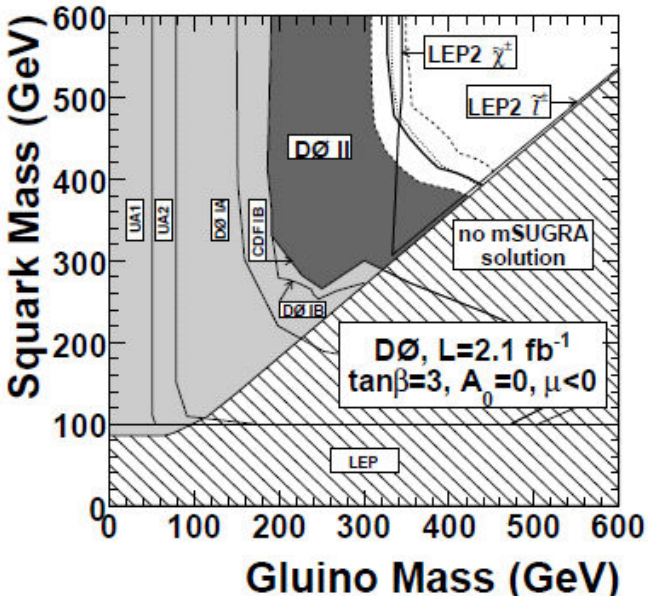
$$
\begin{aligned}
\mathcal{L}^{\rm MSSM}_{\rm soft} \;=\; & -\frac{1}{2}\left(M_3\widetilde{g}\widetilde{g} + M_2\widetilde{W}\widetilde{W} + M_1\widetilde{B}\widetilde{B} + \text{c.c.}\right) \\
& - \left(\widetilde{\overline{u}}\,\mathbf{a_u}\,\widetilde{Q}H_u - \widetilde{\overline{d}}\,\mathbf{a_d}\,\widetilde{Q}H_d - \widetilde{\overline{e}}\,\mathbf{a_e}\,\widetilde{L}H_d + \text{c.c.}\right) \\
& - \widetilde{Q}^\dagger\,\mathbf{m^2_Q}\,\widetilde{Q} - \widetilde{L}^\dagger\,\mathbf{m^2_L}\,\widetilde{L} - \widetilde{\overline{u}}\,\mathbf{m^2_{\overline{u}}}\,\widetilde{\overline{u}}^\dagger - \widetilde{\overline{d}}\,\mathbf{m^2_{\overline{d}}}\,\widetilde{\overline{d}}^\dagger - \widetilde{\overline{e}}\,\mathbf{m^2_{\overline{e}}}\,\widetilde{\overline{e}}^\dagger \\
& - m^2_{H_u}H^*_u H_u - m^2_{H_d}H^*_d H_d - (bH_u H_d + \text{c.c.})\,.
\end{aligned}
$$

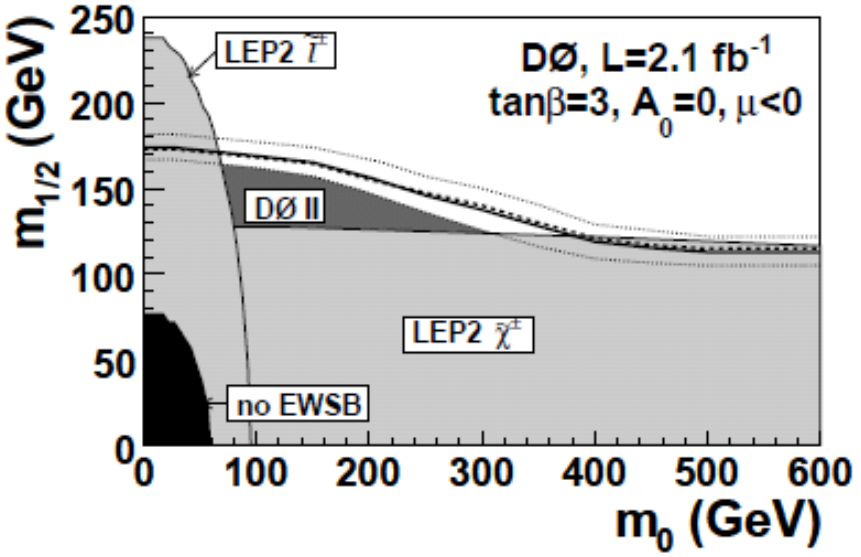


25 March 2010

External example: D-Zero



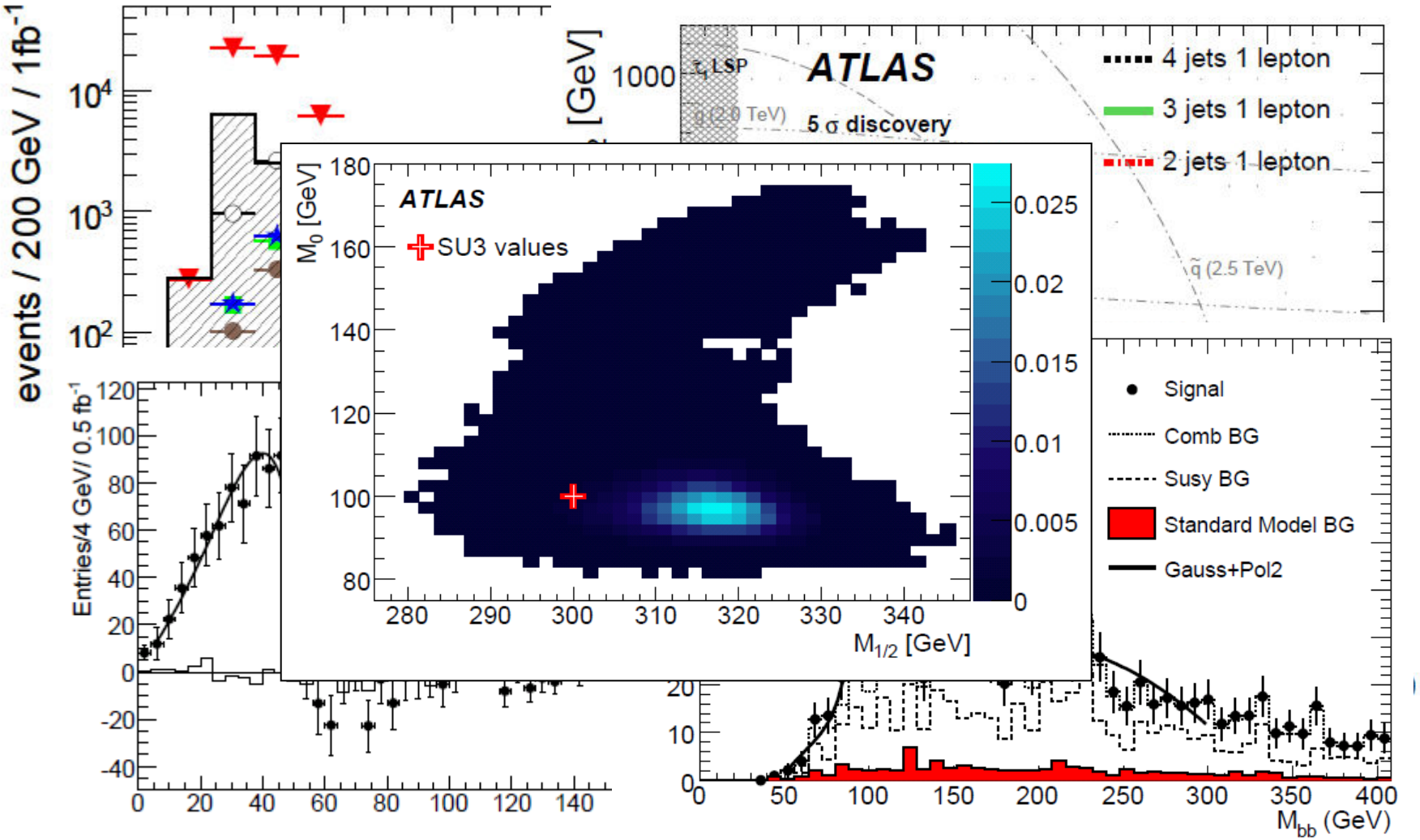




"Search for squarks and gluinos in events with jets and missing transverse energy using 2.1 fb–1 of p⁻ p collision data at ps =1.96TeV"

Phys.Lett.B660:449-457,2008

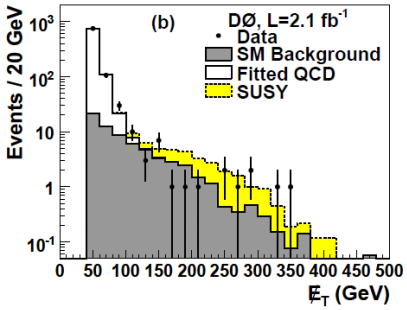
ATLAS example: CSC note

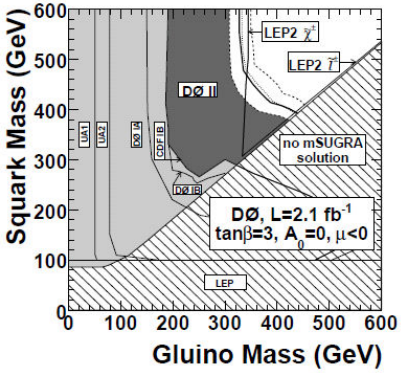


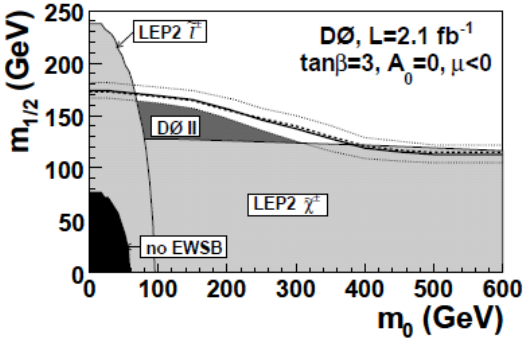
Expected performance of the ATLAS detector **arXiv:0901.0512**

What level of interpretation is useful?

- **"Distributions only"**
  - As TH unbiased as we can get
  - Only give 1d (or 2d) projections of data
  - Potential for lots of information loss
  - [After which corrections]
- **Constraints on effective theories**
  - OSET/ small parameter pMSSM @ LO?
  - Can use full EXPT information (e.g. Likelihood)
  - Introduce TH uncertainty
- **Unification-scale models**
  - Compare performance with previous expts
  - Even more TH uncertainty (RGE, …)
  - Not portable to other models
- **"Something else"**
  - Public 4-vectors?







What distributions are most important?

- Early…
  - Straightforward?
    - p_T, p_T^{miss}, invariant masses, scalar sums (H_T, M_{eff}), …
  - Kinematic/topologically-motivated?
    - m_T, m_{T2}, m_{CT}, …
  - Double differential…
  - Motivated by particular hierarchies?

- Something different if an excess is discovered?
  - Motivated by model discrimination?
    - Lepton non-universality?
    - Ratios of branching ratios?
    - Sensitive to chirality?
    - Spin-sensitive?

Non or low missing E_T SUSY signatures

gauginos	decay mode	LLE	LQD	$\bar{U}DD$
$\tilde{\chi}_1^0\ \tilde{\chi}_1^0$	direct	$4\ell + \not{E}$	$1\ell + 4j + \not{E}$ $2\ell + 4j$ $4j + \not{E}$	$6j$
$\tilde{\chi}_1^+\ \tilde{\chi}_1^-$	direct	$2\ell + \not{E}$ $4\ell + \not{E}$ 6ℓ	$1\ell + 4j + \not{E}$ $2\ell + 4j$ $4j + \not{E}$	$6j$
$\tilde{\chi}_2^0\ \tilde{\chi}_1^0$	indirect	$4\ell + \not{E}$ $4\ell + 2j + \not{E}$ $6\ell + \not{E}$	$1\ell + 4j + \not{E}$ $1\ell + 6j + \not{E}$ $2\ell + 4j + \not{E}$ $2\ell + 6j$ $3\ell + 4j + \not{E}$ $4\ell + 4j$ $6\ell + \not{E}$	$8j$ $6j + 2\ell$ $6j + \not{E}$
$\tilde{\chi}_1^+\ \tilde{\chi}_1^-$	indirect	$4\ell + 4j + \not{E}$ $5\ell + 2j + \not{E}$ $6\ell + \not{E}$	$1\ell + 6j + \not{E}$ $1\ell + 8j + \not{E}$ $2\ell + 4j + \not{E}$ $2\ell + 6j + \not{E}$ $2\ell + 8j$ $3\ell + 4j + \not{E}$ $3\ell + 6j + \not{E}$ $4\ell + 4j + \not{E}$ $8j + \not{E}$	$10j$ $8j + 1\ell + \not{E}$ $6j + 2\ell + \not{E}$

Prompt RPV

λ,λ',λ'',bilinear. Many permutations.

Basic topology measurements made.

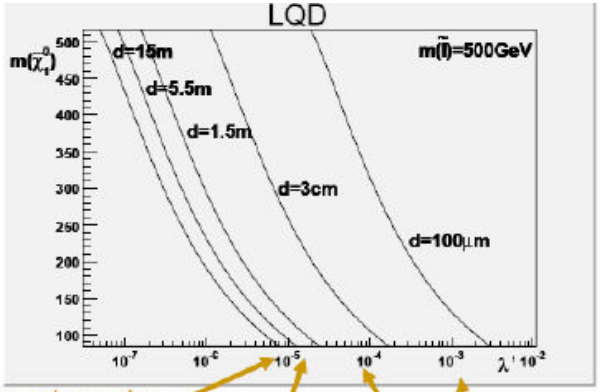
Which specific phenomenologies to be pursued as well ?

Displayed vertices and stable massive particles

Decay length:

$$d \sim \left(\frac{m_{\tilde{l}}^4}{\lambda^2}\right)\frac{\alpha_\chi^2}{m_\chi^5}\beta\gamma$$

Effective coupling



Consistent interpretation within RPV ?
Which ”minimum assumptions” should be used for results:
Eg direct squark, gluino, slepton production ?
Specific bench-mark models ?