Physics at LHC

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General Search for susy Strategy

Peter Renkel and Ehud Duchovni

The Problem

We know that supersymmetry must be broken but we don't know how.

Is MSSM the right scheme? → *The neutralino is the LSP*

Is GMSB the right scheme? → *The gravitino is the LSP*

Maybe AMSB the right scheme? Or *XY*SB?

Is R parity conserved at all???

Will SUSY give rise to large missing energy final states

You ain't see nothing

Even if we were told that, say, MSSM is the "right" model we still won't be able to predict the experimental signatures. There are too many free parameter in the model (and different generators give different results is some regions of the parameter space).

So we don't know what we are looking for !!!!

Temporary working assumptions

* R parity is conserved (RPC)
* MSSM

Still unknown parameters

$$m_0, m_{1/2}, \mathrm{sgn}\,\mu, tg\beta, \Lambda$$

Some Hints

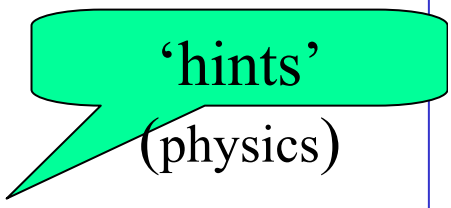
* Look for events in which heavy objects are pair produced.

* Look for events with high missing E_T

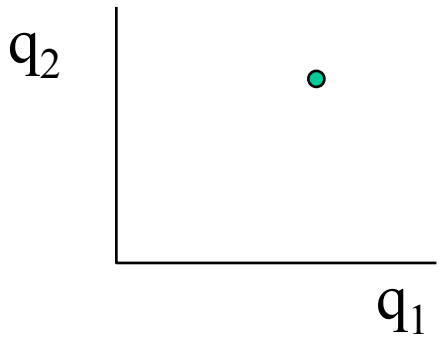
Characterize each event by:

- Missing E_T;
- P_t^{Jet1} – transverse momentum of 1st jet;
- P_t^{Jet2} – transverse momentum of 2ed jet;
- $\sum_{j=1}^{njet} E_t^{jet}$ - sum of the E_t of all jets;

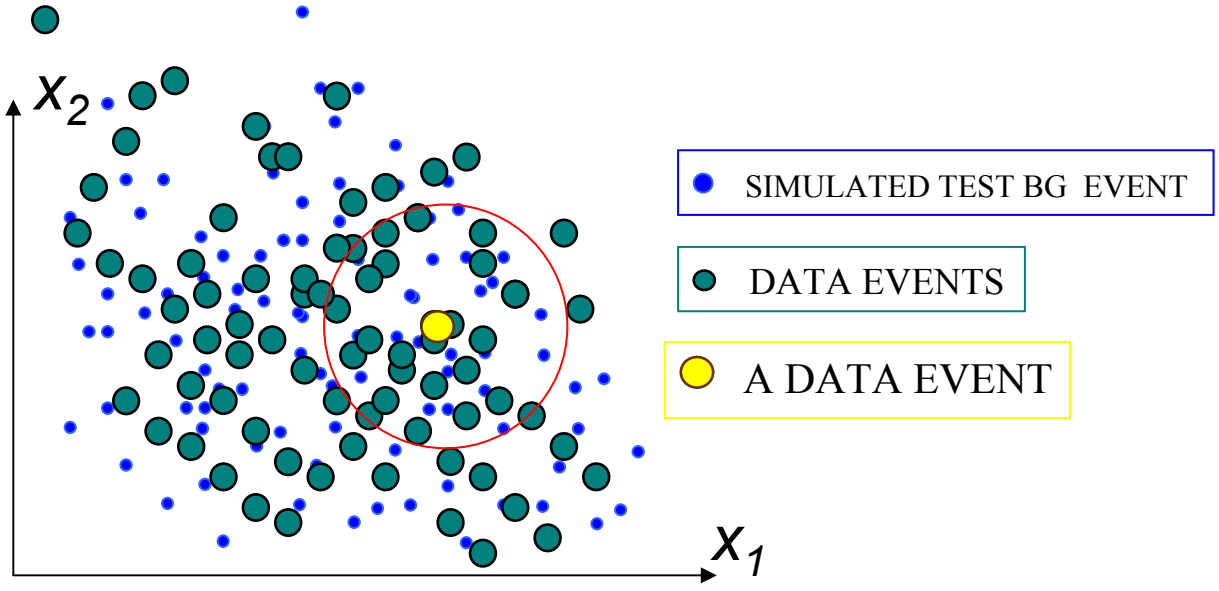
Reminder: how we proceed



- Simulate BG;
- Get Data;
- Select the relevant quantities, say N (separators);
- Normalize the separators to [0,1];
- Build an N-dimensional 'MC data space', from background and data events, where each event is represented by a point.

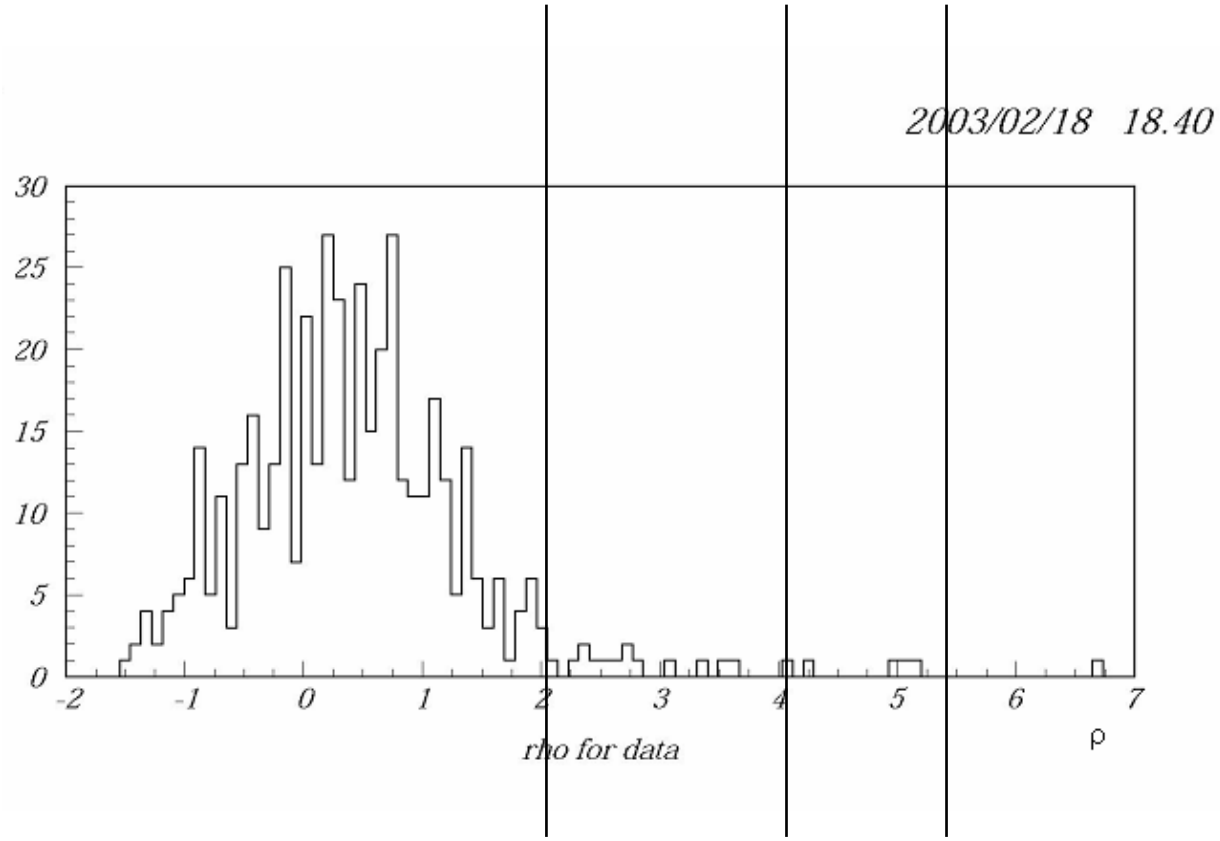


LSL at work.

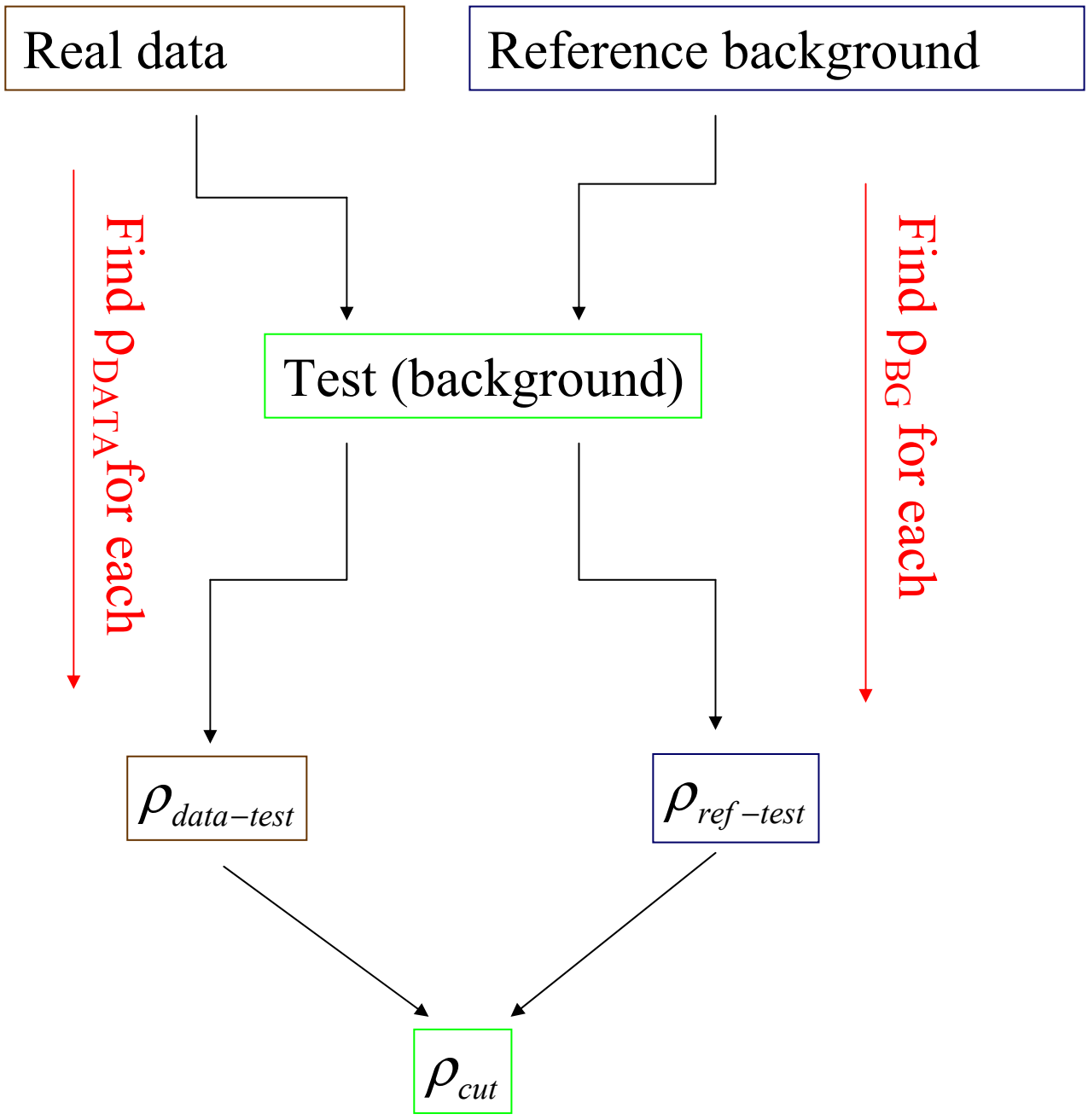


- Simulate background space. Herein after we call it 'test space'
- Place a real data point in the 'test space' and trace N-dim sphere, which contains exactly N_B background events;
- Determine the Radius of the sphere;
- Trace the same sphere at the same location in the data space;
- Count the number of data events inside this sphere;
- Calculate Npseudosignal: Npseudosignal= Ndata – Nbg.
- Calculate the ratio $\rho = \frac{Npseudosignal}{\sqrt{N_B}}$ and assign this value to the data point.
- Repeat for all data points.
- The points, suspected to be signal have large value of ρ and points, suspected to be background points have small value of ρ

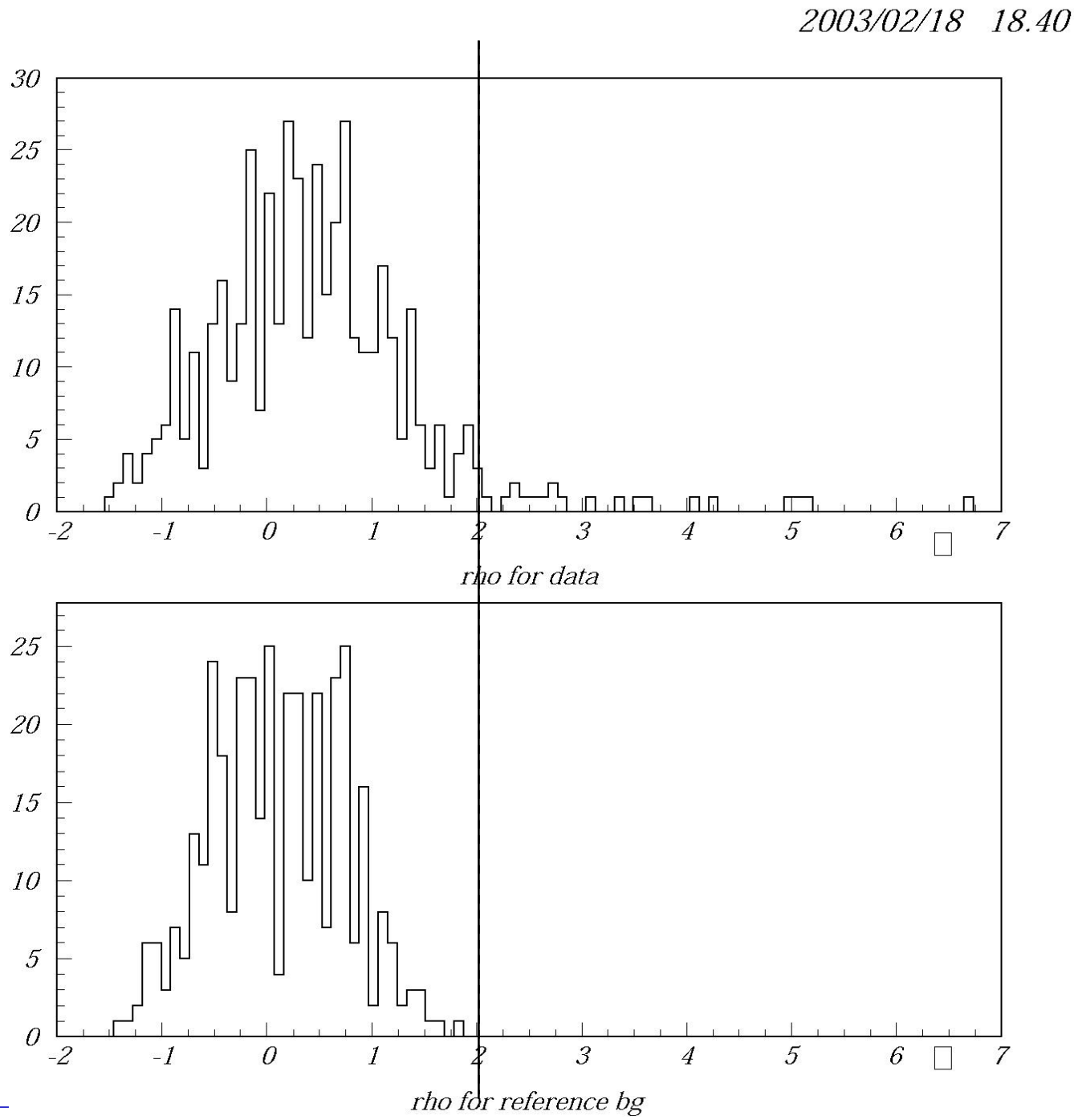
Local deviation for data.



Model – independent search for unknown signal?



Histogramms for $\rho_{data-test}$ and $\rho_{ref-test}$



Advantages and disadvantages:

Advantages:

• Almost model independent. It can be applied to SUSY MSSM, GMSB, RPV models etc.
• Local, takes correlation into account, automatic.
• Approaches statistical limit, as number of events goes to infinity

DisAdvantages:

• Large number of input variables decreases performance. The coarse of high dimensionality.

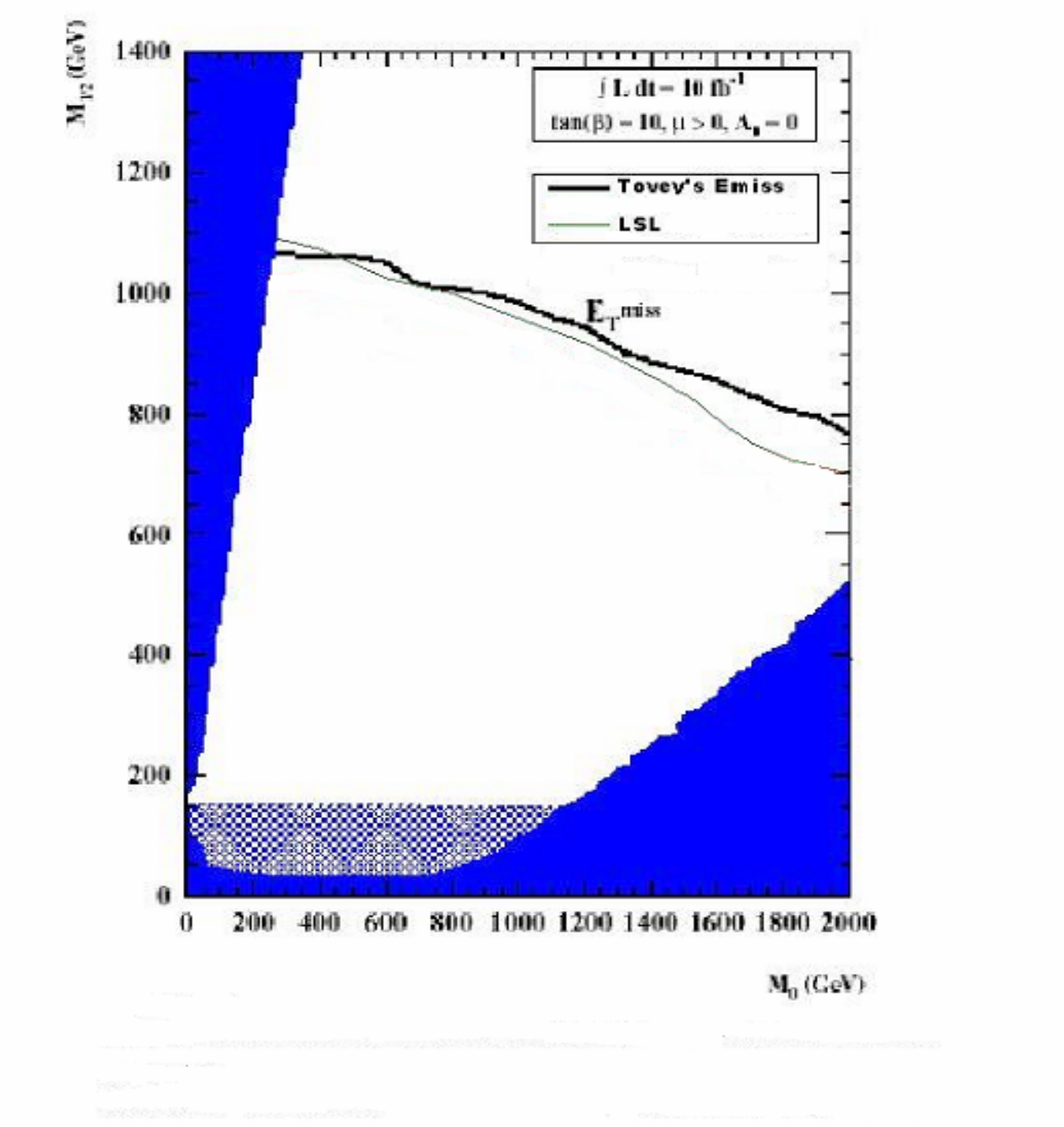
•Requires relatively large number of simulated events.

LSL with SUSY MSSM.

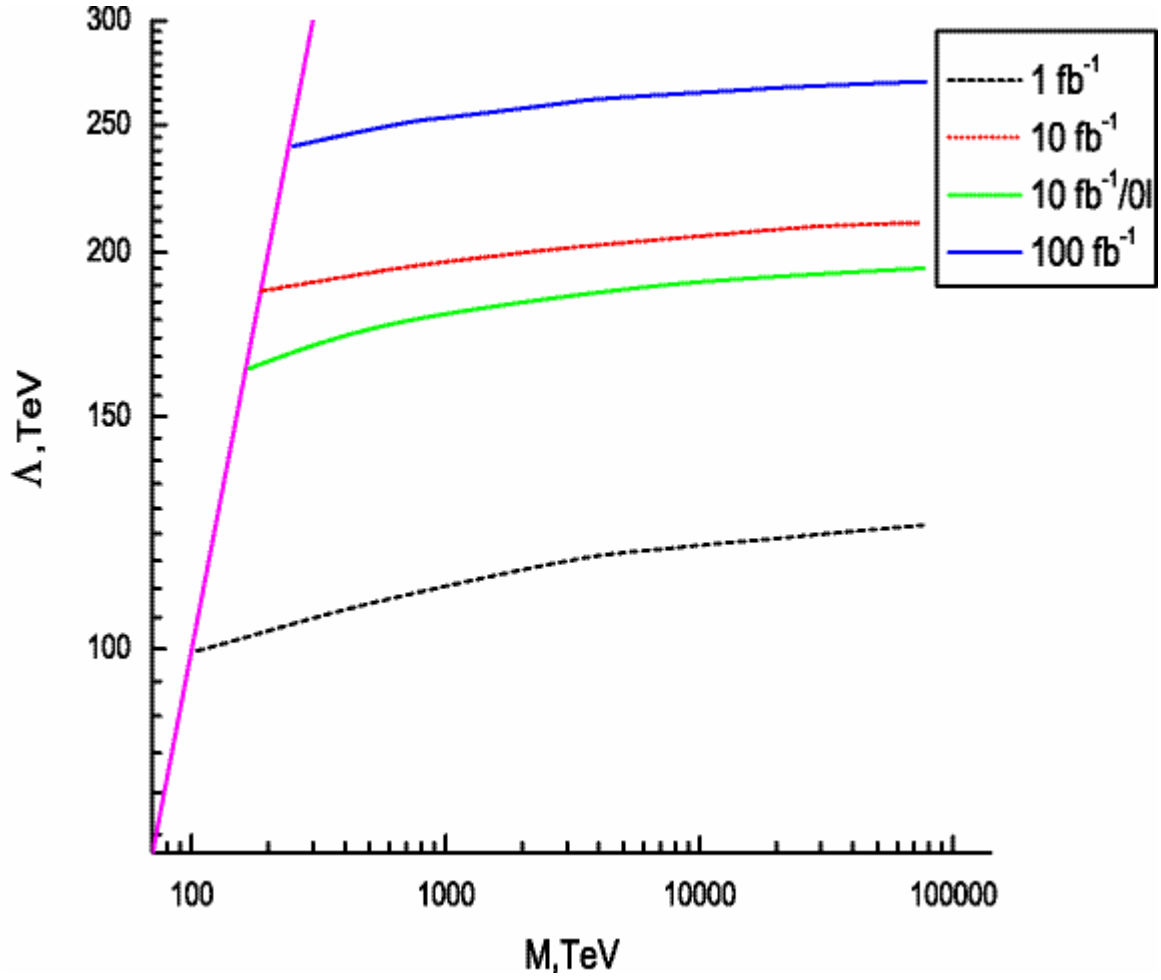
- Discovery map for MSSM.
- Background processes:
  - QCD
  - tt
  - Zj
  - Wj
- Input quantities:
  - $E_{\perp}^{miss}$
  - $p_{\perp 1}$
  - $p_{\perp 2}$
  - $\sum p_{\perp}$

hep-ph/0403270 “A New Algorithm for Inclusive Search of SUSY Signal”
Authors: Ehud Duchovni, Eugene Prosso, Peter Renkel
Sent to be approved as a Scientific Note and published in Nuclear Physics B.

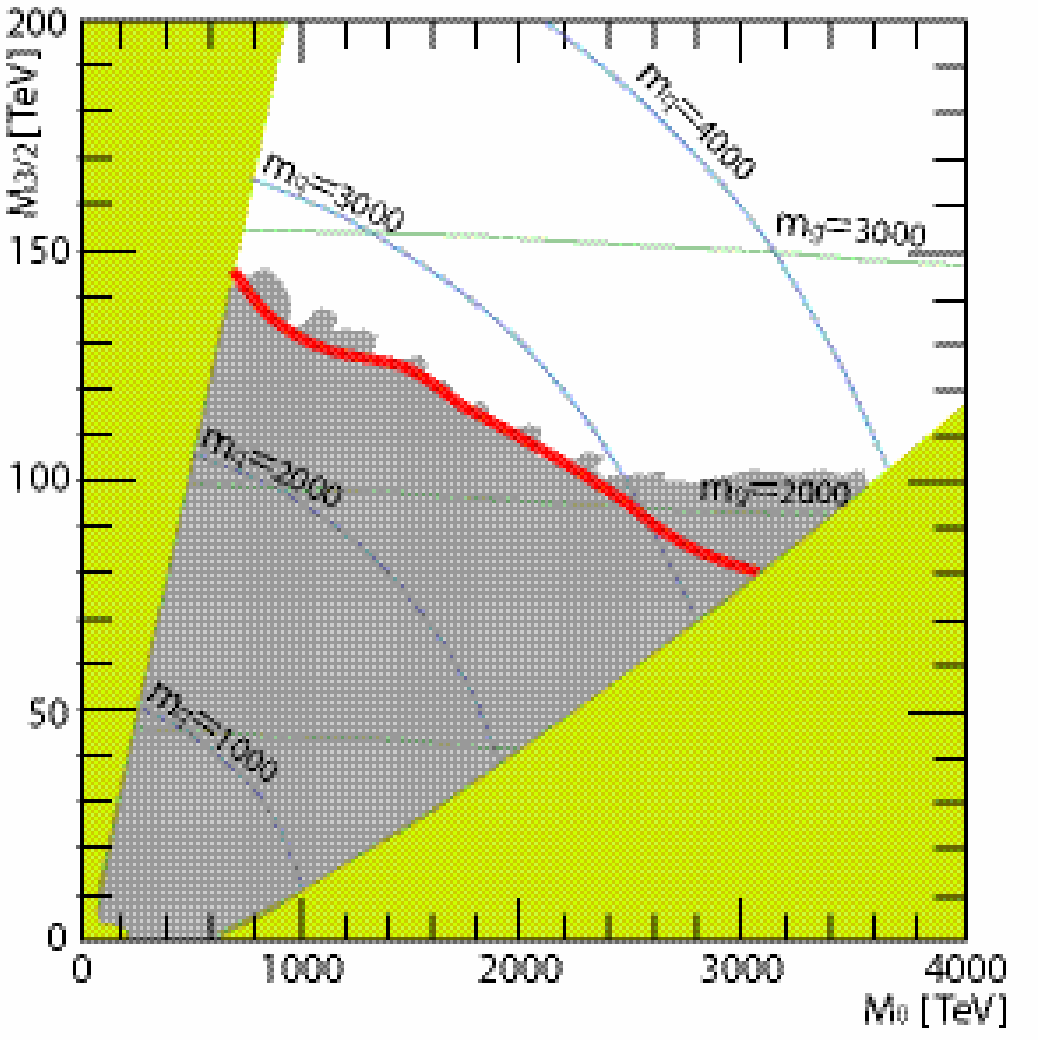
Discovery map for MSSM.



GMSB


300
250
200
150
100
Λ,TeV
100
1000
10000
100000
M,TeV
1 fb-1
10 fb-1
10 fb-1/0l
100 fb-1

AMSB


200
150
100
50
0
$M_{3/2}$ [TeV]
0
1000
2000
3000
4000
M_0 [TeV]
$m_{\tilde{\tau}}$=4000
$m_{\tilde{g}}$=3000
$m_{\tilde{g}}$=3000
$m_{\tilde{\chi}}$=2000
$m_{\tilde{g}}$=2000
$m_{\tilde{\tau}}$=1000

Conclusion.

- LSL can guide us to the suspected regions in which signal might be seen.
- LSL sensitivity to unknown signal is comparable to one achieved by designing the analysis on a predicted signal.
- It is hard to believe that such an algorithm can replace the dedicated searches and probably a combination of both will have to be used.

Stability Tests

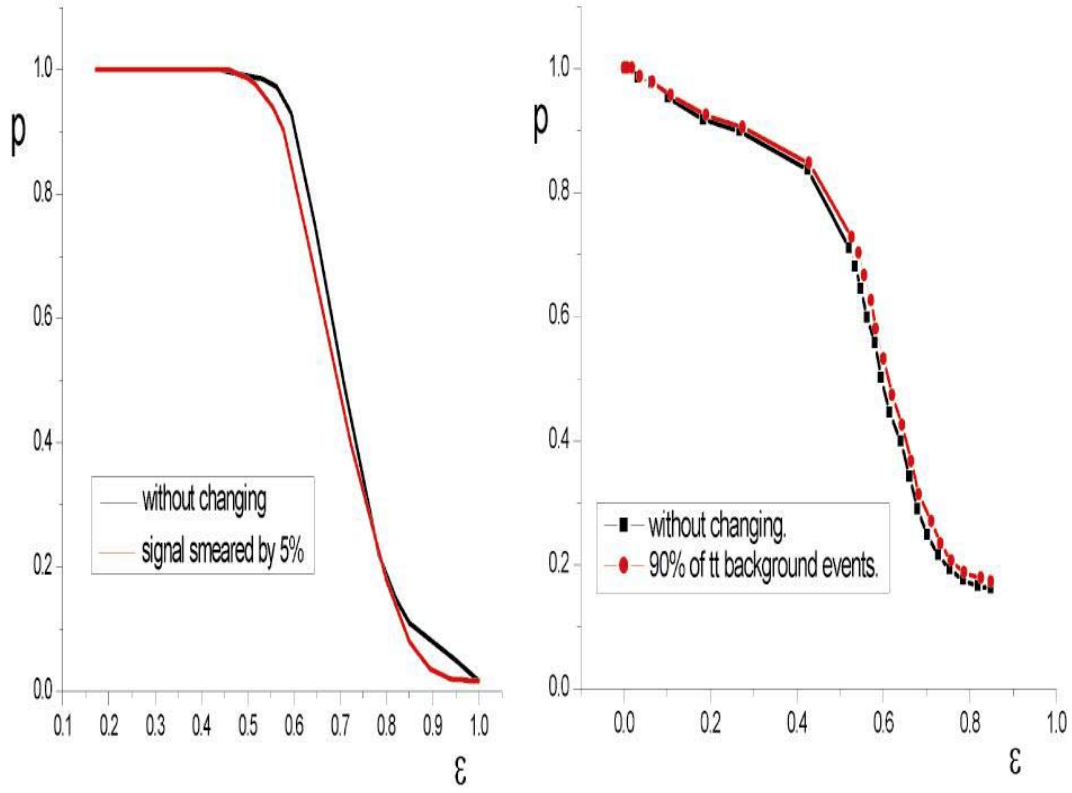
Few stability tests have been applied (more to come) like:

- Scaling up/down the various ratios of b.g. processes;
- Different normalization of input parameters;
- Up/down shifts in values of input parameters.

Generally speaking the outcome is stable

Inefficient when too many (O(10)) input parameter are used

Stability Results



hep-ph/0403270