Search for Resonant Slepton Production

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- Collaboration comments from Alan, Darien, Dmitri, Elemer, Greg, Jean-Francois, Jerry, John, Marc and Tom
- All supportive of publication
- Mostly style and presentation
Analysis Summary I: Slepton Production

→ 2 jets and 0, 1 or 2 μ

Require 2 muons to control the QCD multijet background
→ Possible to reconstruct the neutralino and the slepton mass
→ But only ~25% branching ratio
Final state: 2-muon & 2-jet
Three dominant signal channels:

1. \( \tilde{\mu} \rightarrow \tilde{\chi}_1^0 \mu \)
2. \( \tilde{\mu} \rightarrow \tilde{\chi}_2^0 \mu \)
3. \( \tilde{\nu}_\mu \rightarrow \tilde{\chi}_1^\pm \mu \)

→ Analyze each channel separately
→ Give limit on \( \sigma \times \text{BR} \) for each channel, depends only on masses, not models!
Analysis Summary III: Results

Cross section limit

Interpretation within mSUGRA

Plots in the PRL paper are black&white for better readability
Preselection “control plots”

C: Please show the SM uncertainty in the figures
A: dashed line

C: multiply signal by some amount
A: now factor of 5

C: What are the mSUGRA parameters for the signal?
A: The slepton mass is 260 GeV (caption), other parameters are not important (here).

C: change “slepton” to “smuon” mass
A: It’s either the reconstructed smuon or sneutrino mass, depending on signal channel.
Style and Physics comments

C: Please change “D0” to “DØ” everywhere in the paper
A: Style guidelines suggest to use “D0” to enable internet search engines to find the D0 publications easier

C: Are the errors between Signal and SM expectation taken as 100% correlated? Why? E.g. k-factors should be independent.
A: The statistical errors of Signal and SM are uncorrelated. The systematical errors are assumed to be 100% correlated, to be conservative. The signal k-factor does only include NLO QCD corrections and no SUSY-QCD corrections (which are negligible for A₀=0) and is therefore very similar to NLO corrections for “qq → W” or “qq → Z”.

C: Why are you using NLO PDF uncertainties with the LO Susygen generator?
A: We correct the LO Susygen cross section with NLO calculations using CTEQ6.1M. The PDF uncertainties are extracted from the CTEQ6.1M error functions
C: Why is the statistical SM uncertainty not the square-root of the SM expectation?
A: Because the Monte Carlo luminosity is higher than the data’s. The SM is scaled, so that the statistical error is reduced.

C: What is the kinematic limit at the Tevatron for the slepton mass? How far can the cross section limit plot be extended?
A: The cross section limit does not depend on the signal cross section. In principle a cross section limit of \(\sim 2\)pb can be given for a slepton mass of 1.96 TeV (if we had generated signal at this point).

It just would not make a lot of sense to show a cross section limit for slepton masses above 500 GeV, because the potential signal would have a much smaller cross section.
Physics Comments

C: The explanation of the QCD extraction from the data is too terse
A: Reduced it to the essential method:

“Background from multi-jet QCD events was extracted from data using loose muon isolation requirements. At least one isolation criterion with respect to other energy depositions in the calorimeter or to other tracks must not be tight for at least one muon to separate QCD and the data sample.”

C: The final selection procedure is too short. Extent it! (50% of people)
A: The current paragraph is a compromise. The method is described, but no further details are given.

C: Why is the Luminosity error of the SM expectation only 5.5% and not 6.5%, like for the signal?
A: The QCD sample is scaled to the data and has no lumi-error, but a larger uncertainty is considered separately. Since the QCD contribution is approx. 15% in this selection, the lumi uncertainty is 6.5% * 85% = 5.5%.
How Good Is The Result?

C: How much better is the analysis compared to Run I?

A: Run I excluded e.g. a smuon mass of 280 GeV
   for \( \lambda'_{211} = 0.09 \) and \( m(\chi_1^0) = 200 \) GeV

Now a smuon mass up to 358 GeV is excluded,
for \( \lambda'_{211} = 0.09 \) and independent of other masses, e.g. \( m(\chi_1^0) \)

\[ \rightarrow \text{Added this to the conclusion of the paper} \]

A: An other example: (for \( m(l) = 263 \) GeV and \( m(\chi) = 100 \) GeV)
   Run I set a limit \( \lambda'_{211} \leq 0.09 \)
   The limit is now \( \lambda'_{211} \leq 0.028 \)
   Since \( \sigma \propto (\lambda'_{211})^2 \) an improvement of 1 : 10
C: Neat plots
A: ;-) 

C: Labels hardly visible
A: Optimized color and increased size

C: Include Luminosity
A: done.

C: Remove 2nd x-axis (which showed the $\chi^0_2$, $\chi^\pm_1$ masses)
A: done.
Conclusion

• Presented search for resonant slepton production

• Analysis Note and PRL draft are available from the EB032 webpage

• All questions and answers can be found on the EB pages

• Thanks to all who send comments!

• Many thanks to the entire EB32 and especially to the chairs Pierre Petroff and later Marc Besançon!
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