

Update on Kinematic Fits in the Leptonic Channel

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Hamburg SUSY Meeting
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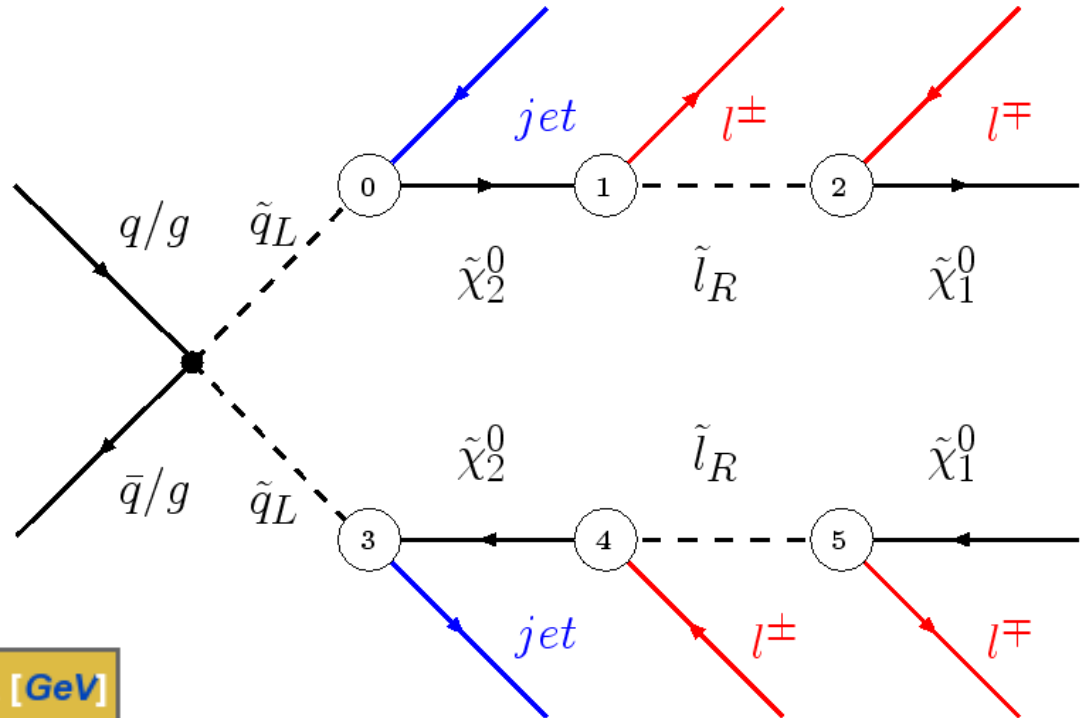
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Benchmarkpoint & Cascade

mSUGRA Parameters

	SPS1a
m_0	100 GeV
$m_{1/2}$	250 GeV
A_0	-100 GeV
$\tan(\beta)$	10
μ	>0



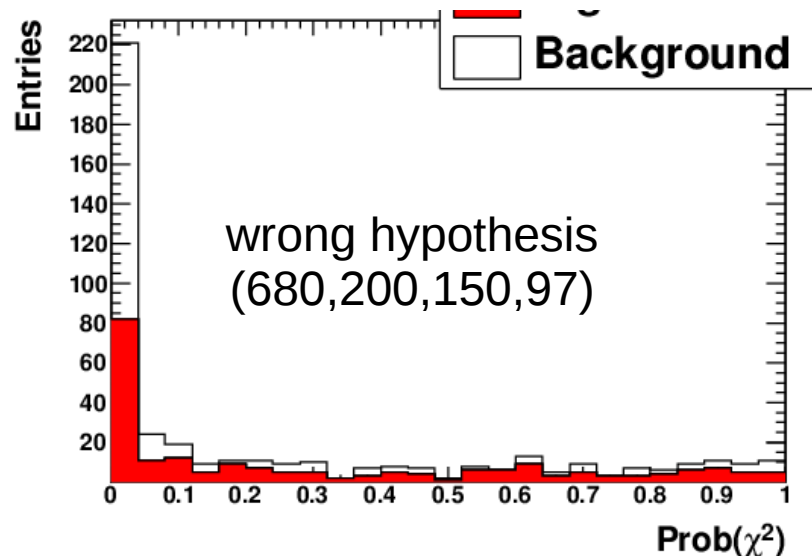
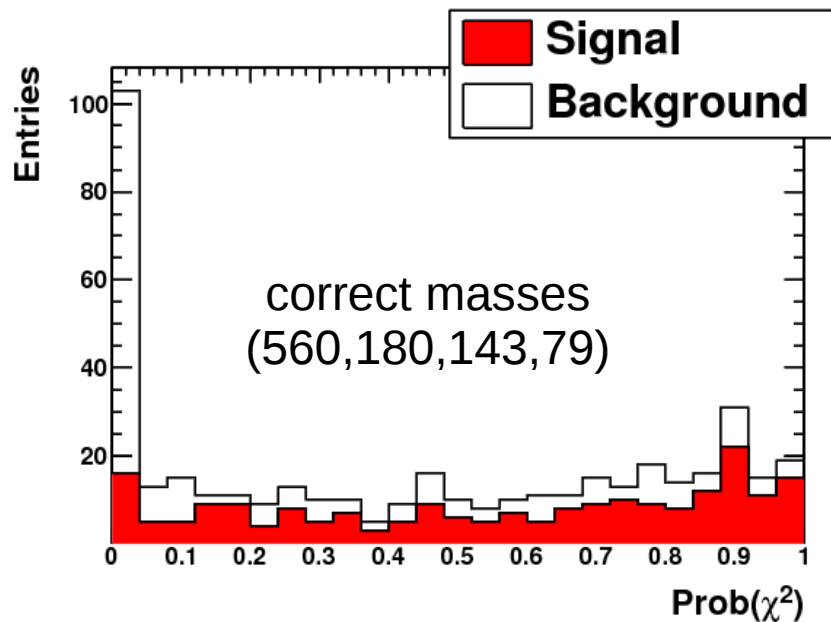
Particle	Mass [GeV]	ΔM to next [GeV]
\tilde{g}	606	39 / 44
\tilde{q}_L	567 (ud) / 562 (cs)	387 / 382
$\tilde{\chi}_2^0$	180	37
\tilde{l}_R^\pm	143	46
$\tilde{\chi}_1^0$	97	

Leptonic Cascade

- 2 jets + 2x2 OSSF leptons
- 16/32 possible combinations
- BR = 1.7×10^{-3}

X-section: ~ 36 pb @ 14 TeV

Likelihood Definition



- Hypotheses close to true masses fit on average better
- Use events' combined fit probability to quantify how good the assumed masses fit.

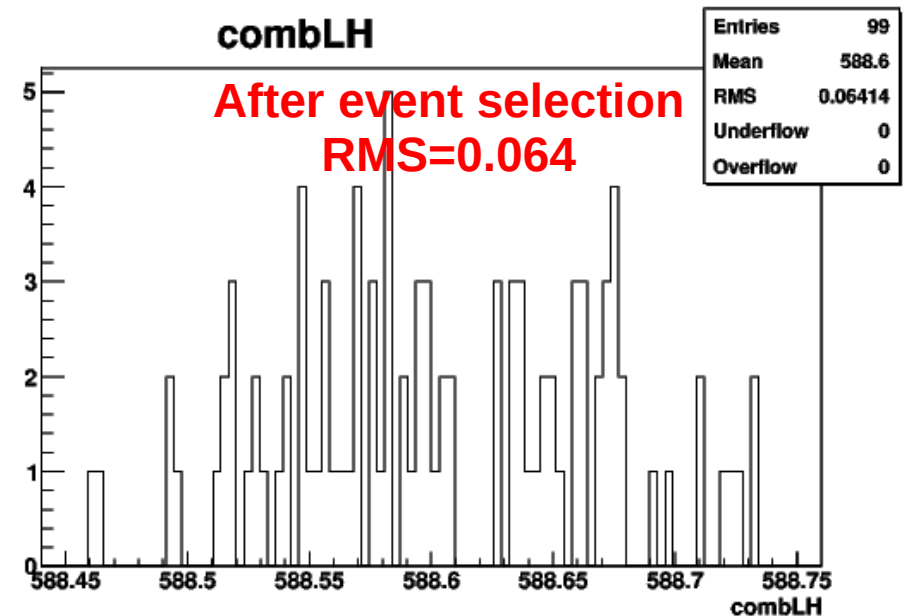
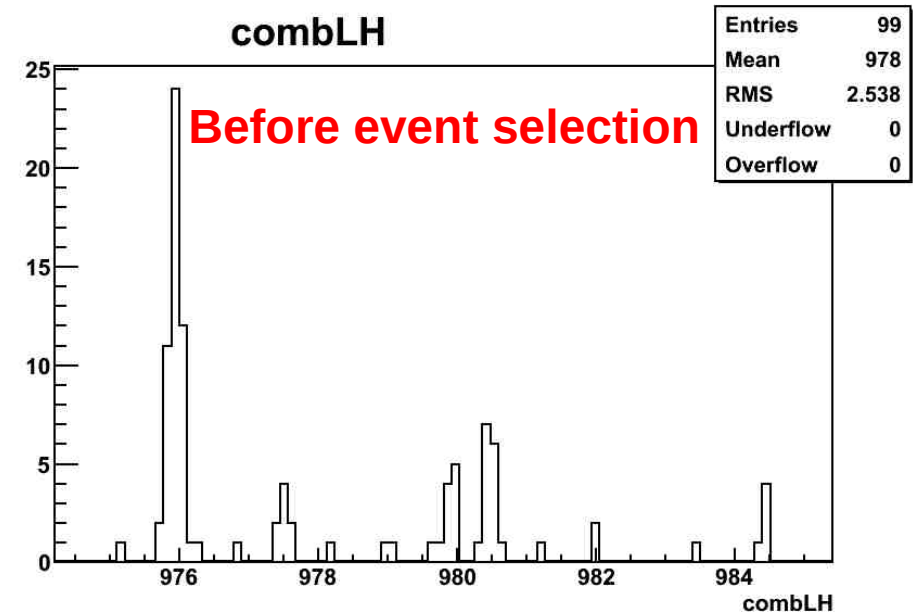
$$\log \mathcal{P} = \sum_i^N \log P(\chi_i^2)$$

$$P_i = P_{\text{cut}} \text{ for } P_i < P_{\text{cut}}$$

- Cut-off to avoid numerical fluctuations
- $P_{\text{cut}} = 0.01$

Event Selection after Fit

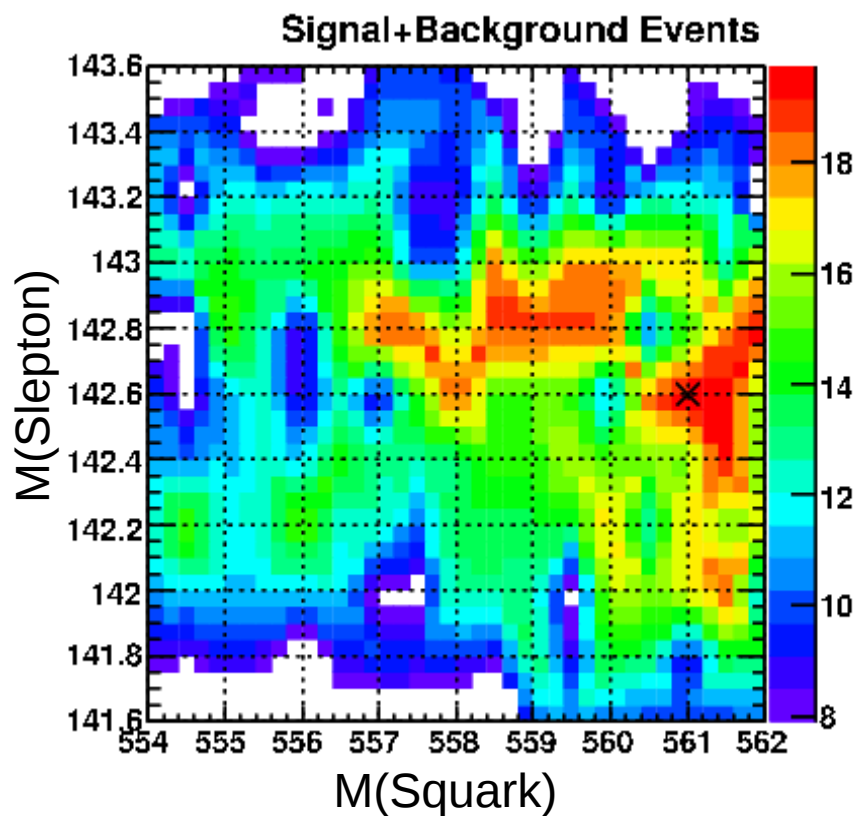
- For each event select best of 500 fits to calculate likelihood, repeat 99 times
- Fluctuations caused by events with very low convergence rate
- New Procedure after fitting:
 - Find hypothesis with best likelihood
 - Select events with a cut on the convergence rate at this point (e.g. $CR > 0.2$)
 - Use this selection for all hypotheses



New Mass Scan

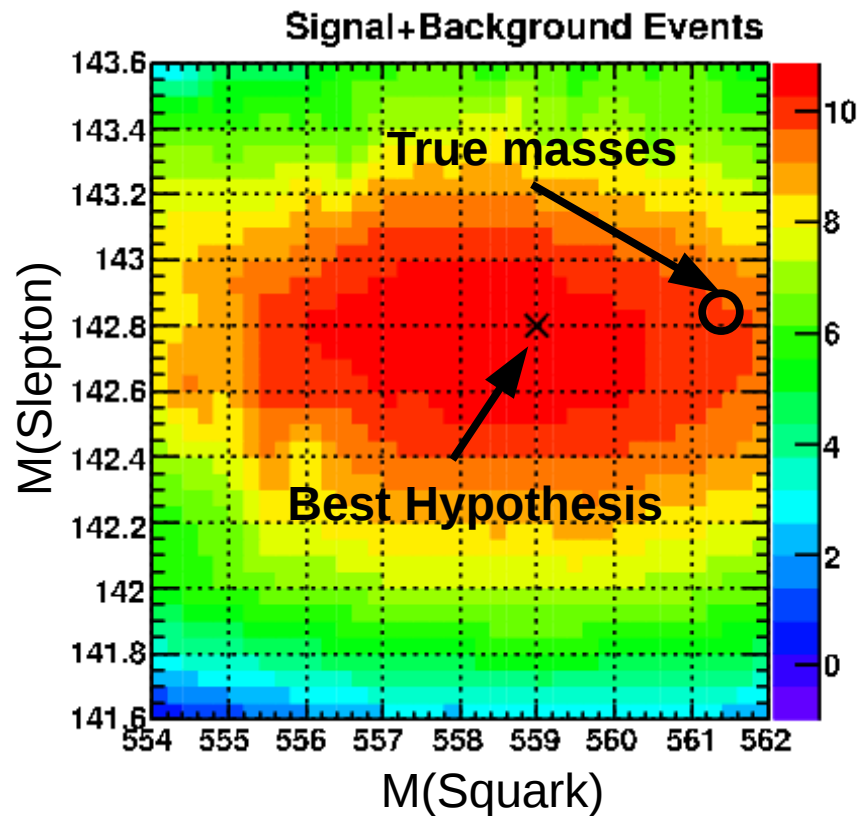
- Mass scan in two dimensions
- 500 fits per hypothesis
- Signal + Background

Before event selection



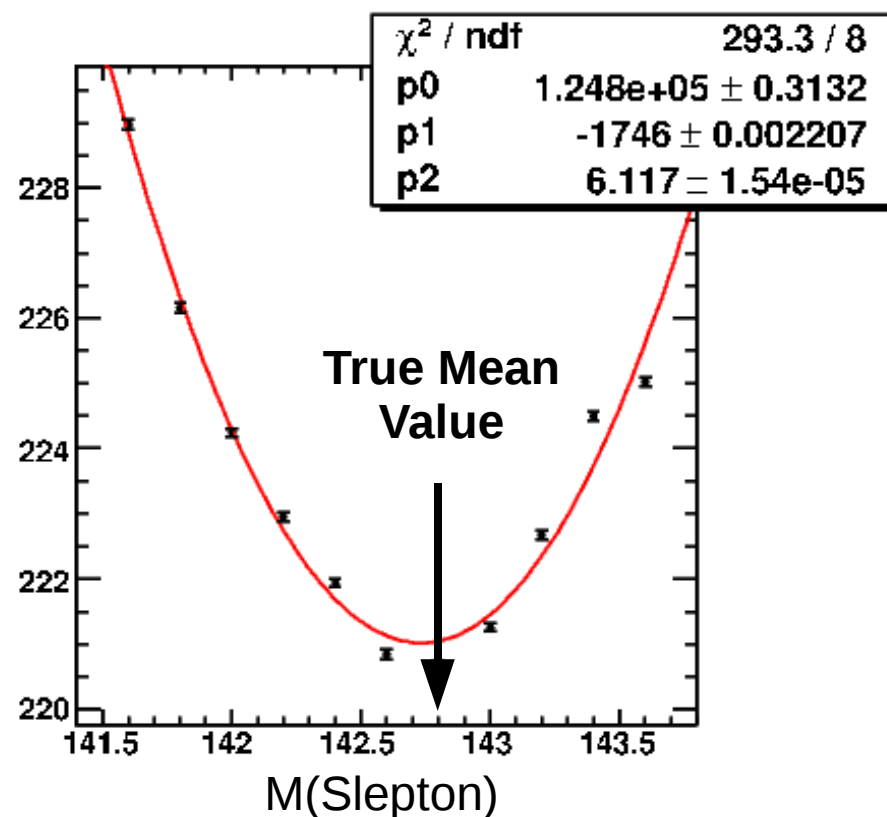
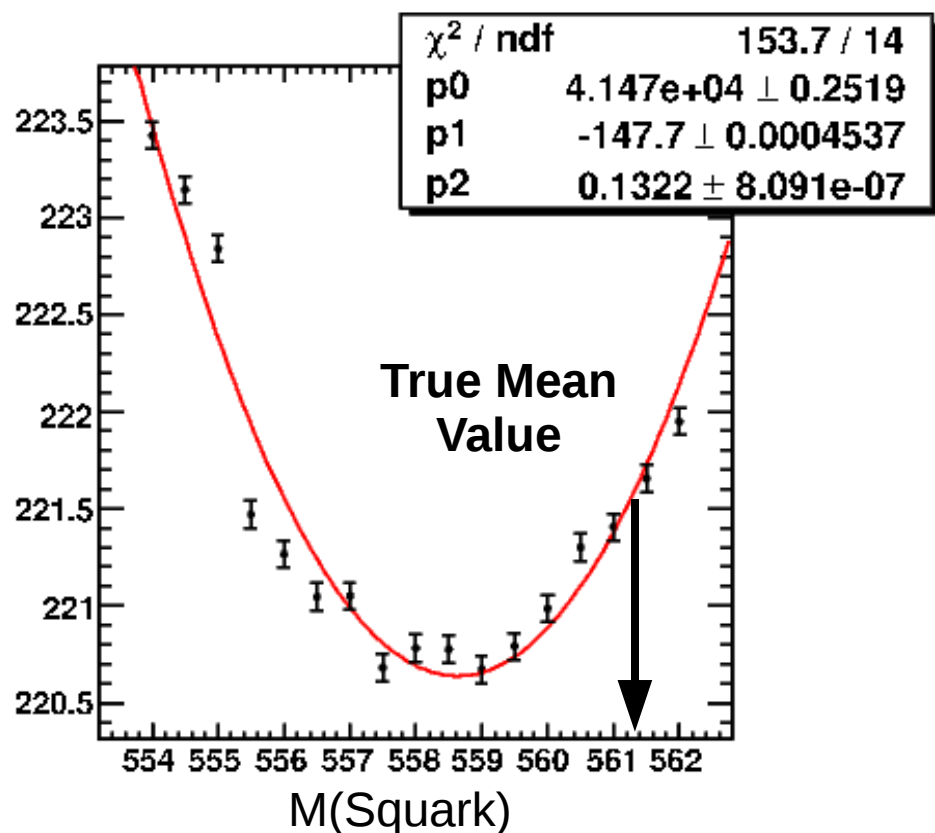
- Areas of same likelihood nicely connected after cut on convergence rate
- Best Hypothesis close to true masses

After event selection



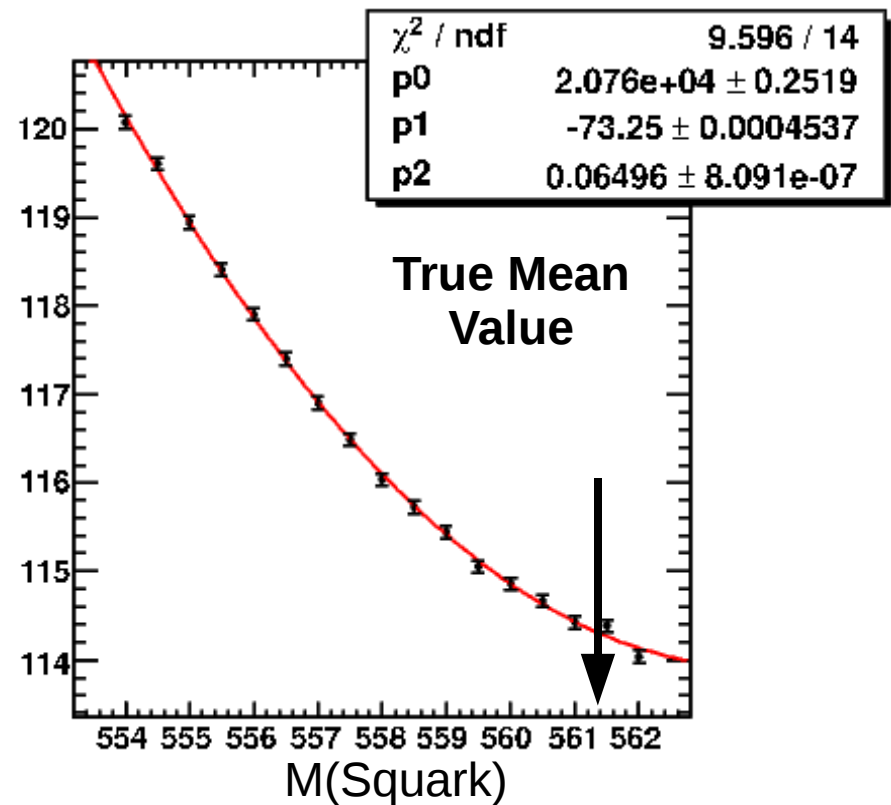
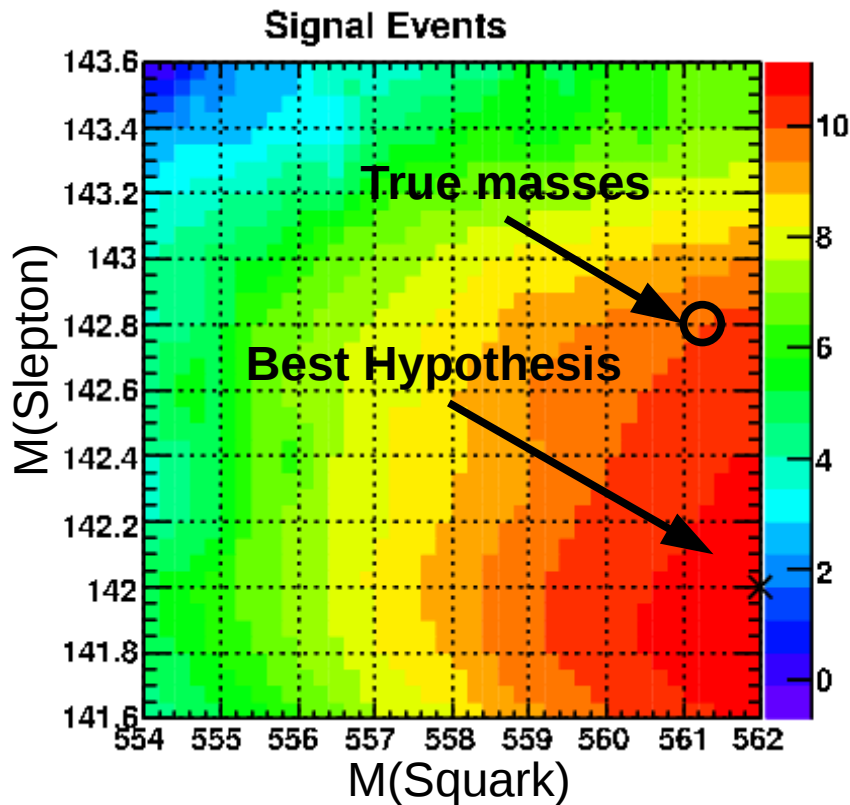
New Mass Scan

- Error bars from RMS of likelihood (slide 4)
- Squark Mass
 - True mass about $\Delta LH=1$ i.e 1σ away from fit minimum
- Slepton Mass
 - Minimum very close to true value



Mass Scan: Signal Events

- Scan range not large enough:
 - extend to see entire peak
 - Smaller best slepton mass
- Perfect parabolic shape of the likelihood for $M(\text{squark})$
 - Minimum shifted to larger masses



Next Steps

- Extend fit range
- Reduce CPU time
 - Decrease no. of fits/hypothesis
 - Optimize convergence criteria
 - Split event sample
- Scan all 4 masses
- Study angular variables to improve association of jets & lepton to decay branches
- Use Fast Simulation events