Improving the Slepton Reach through Cascade Decays at the LHC

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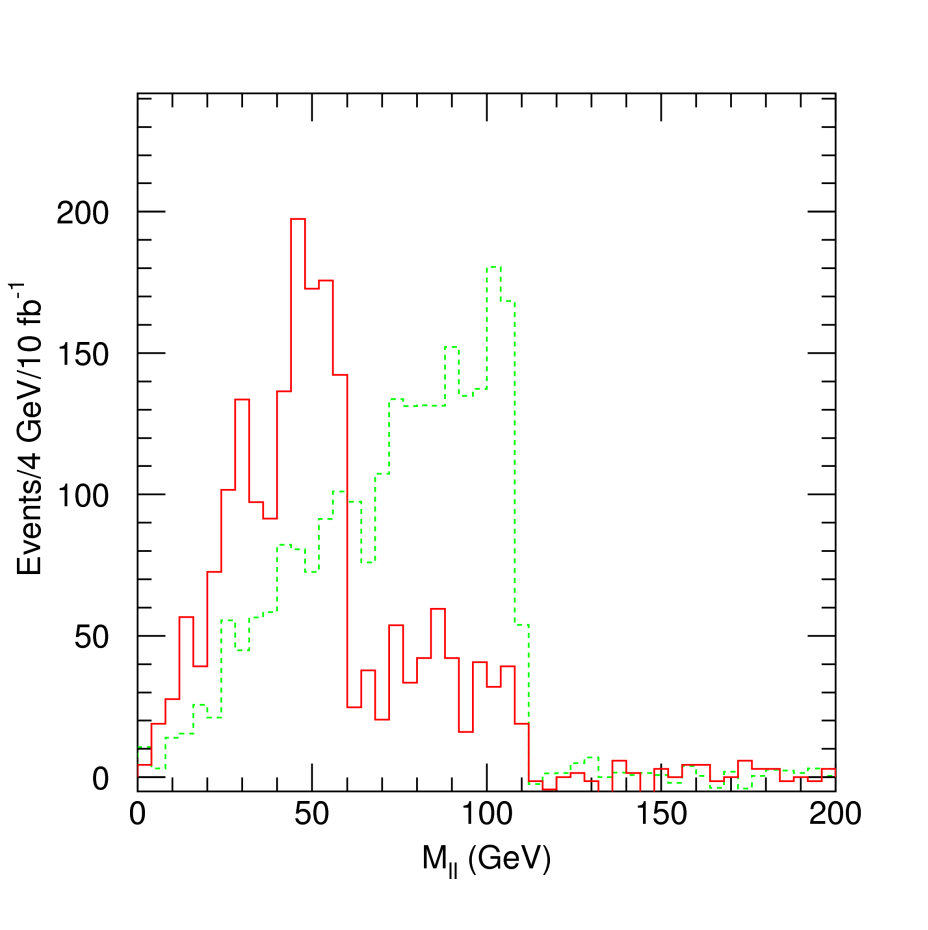
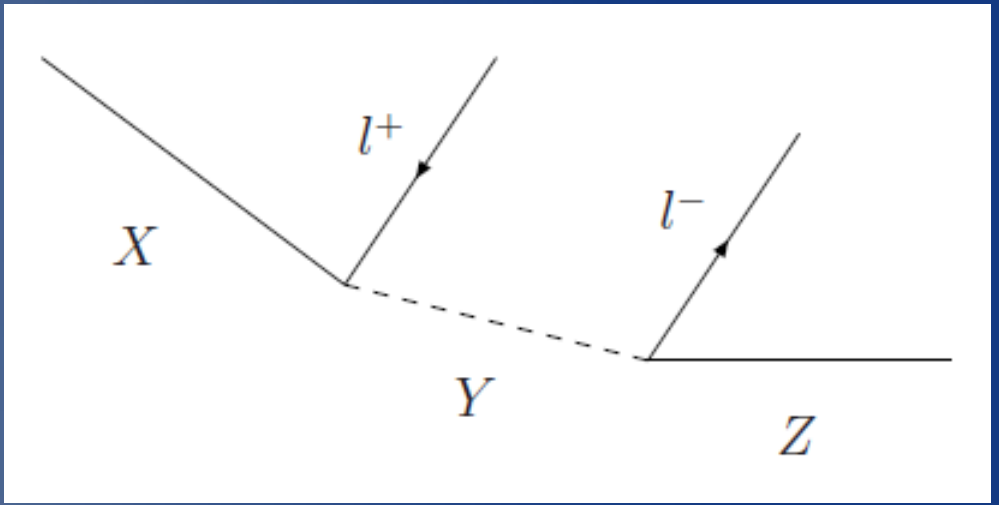
Kinematic Feature



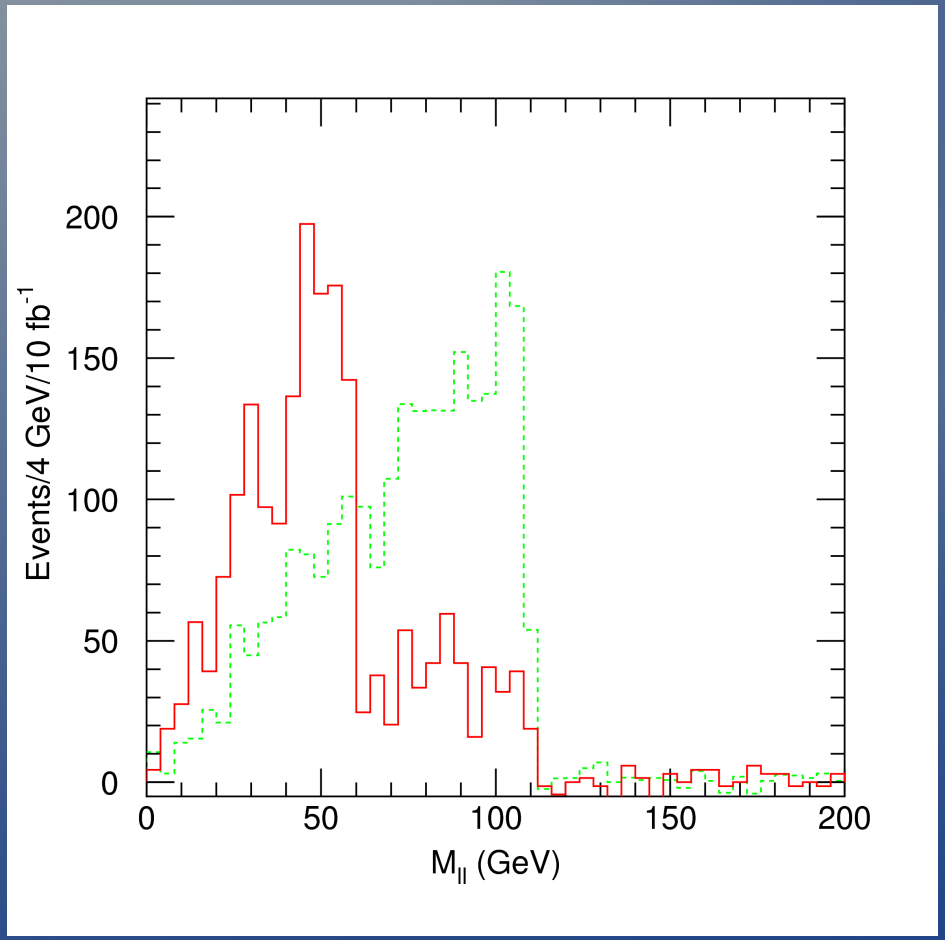


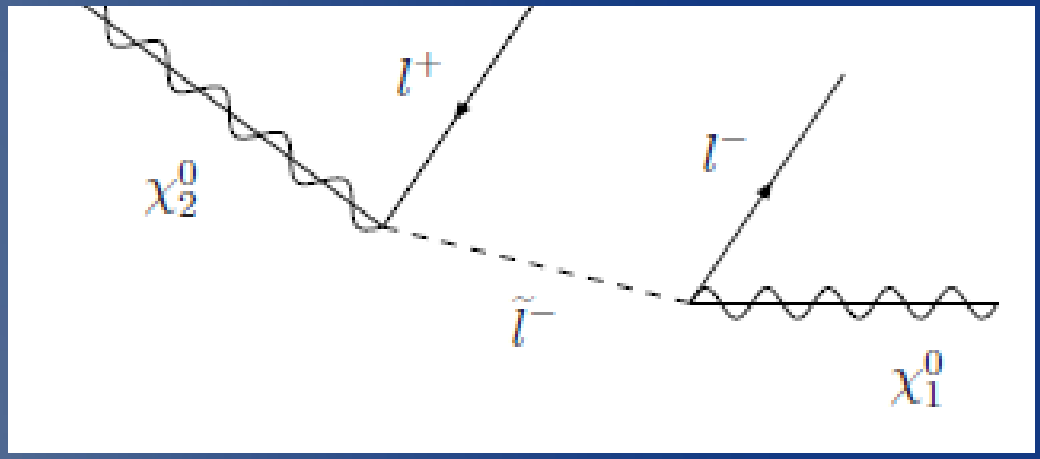
- If Y is on-shell distinctive feature in dilepton inv. mass

$$M_{max} = \sqrt{\frac{(M_X^2 - M_Y^2)(M_Y^2 - M_Z^2)}{M_Y^2}}$$

Bachacou, Hinchliffe, and Paige
Hep-ph/9907518

Kinematic Feature





- If slepton is on-shell distinctive feature in dilepton inv. mass

$$M_{max} = \sqrt{\frac{(M_{\chi_2}^2 - M_{\tilde{l}}^2)(M_{\tilde{l}}^2 - M_{\chi_1}^2)}{M_{\tilde{l}}^2}}$$

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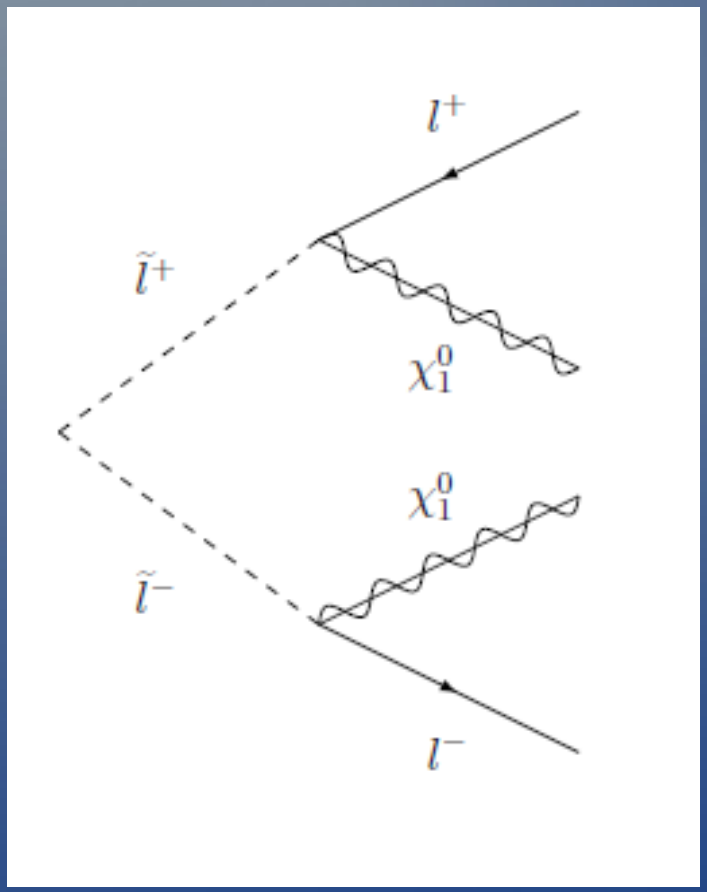
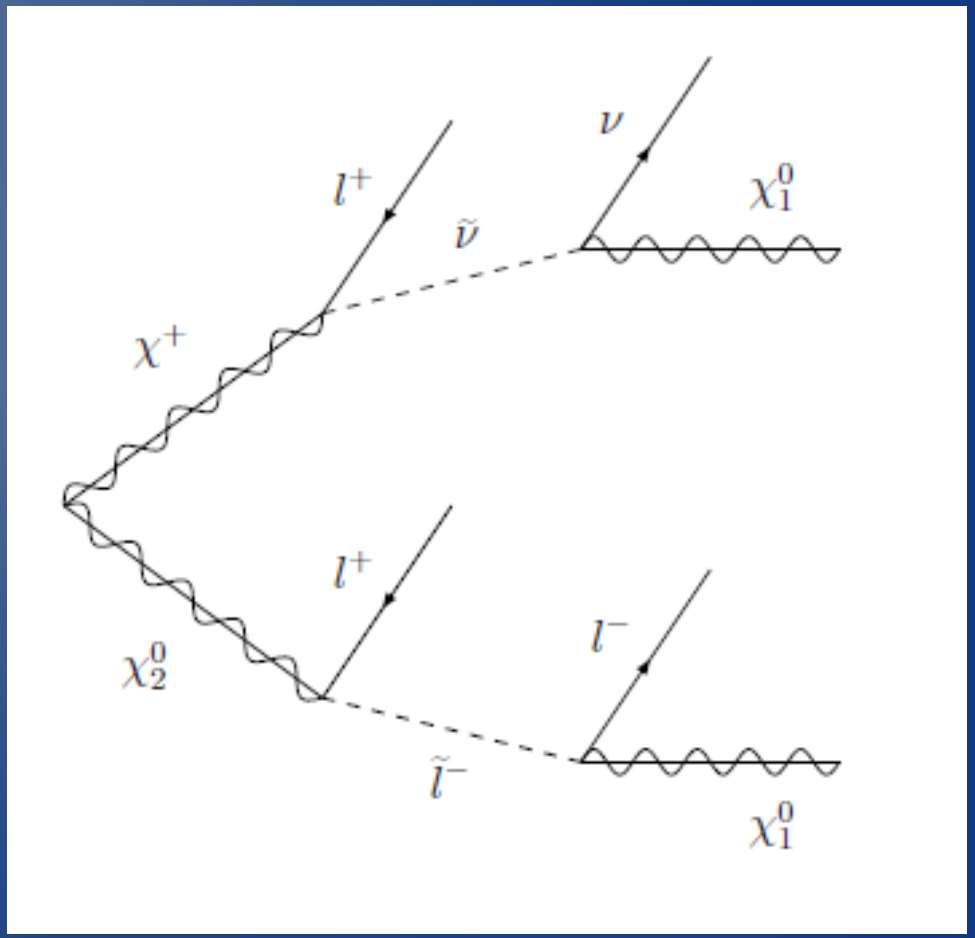
Drell-Yan vs Cascade Decay



2 lepton + MET

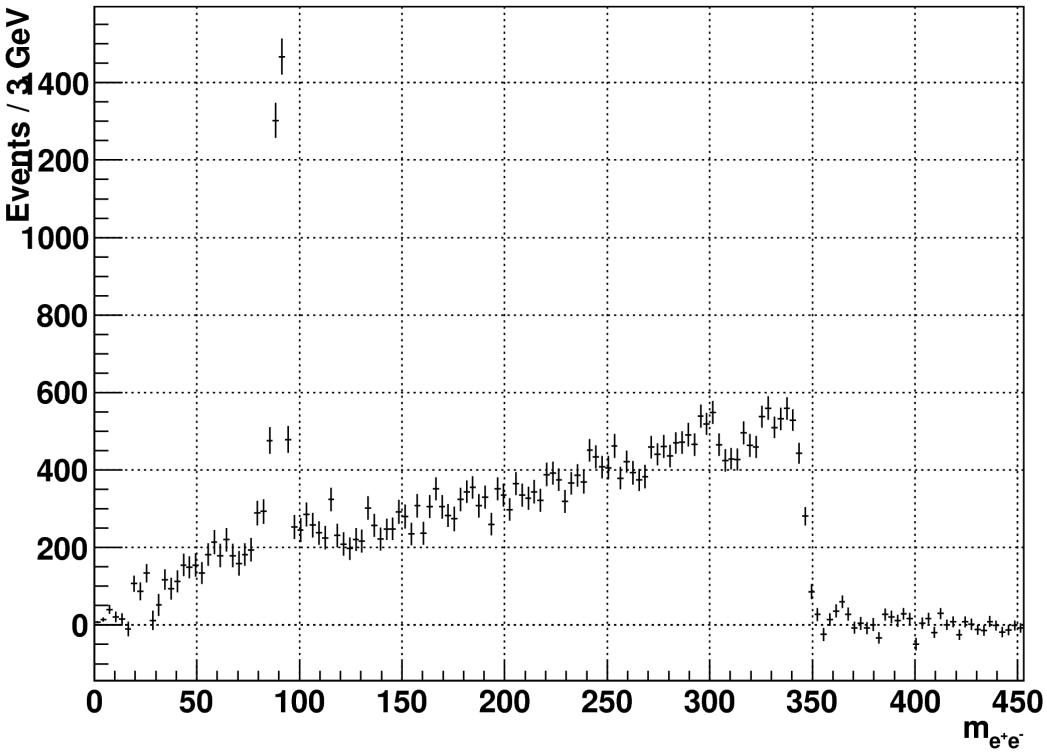


3 lepton

Approach

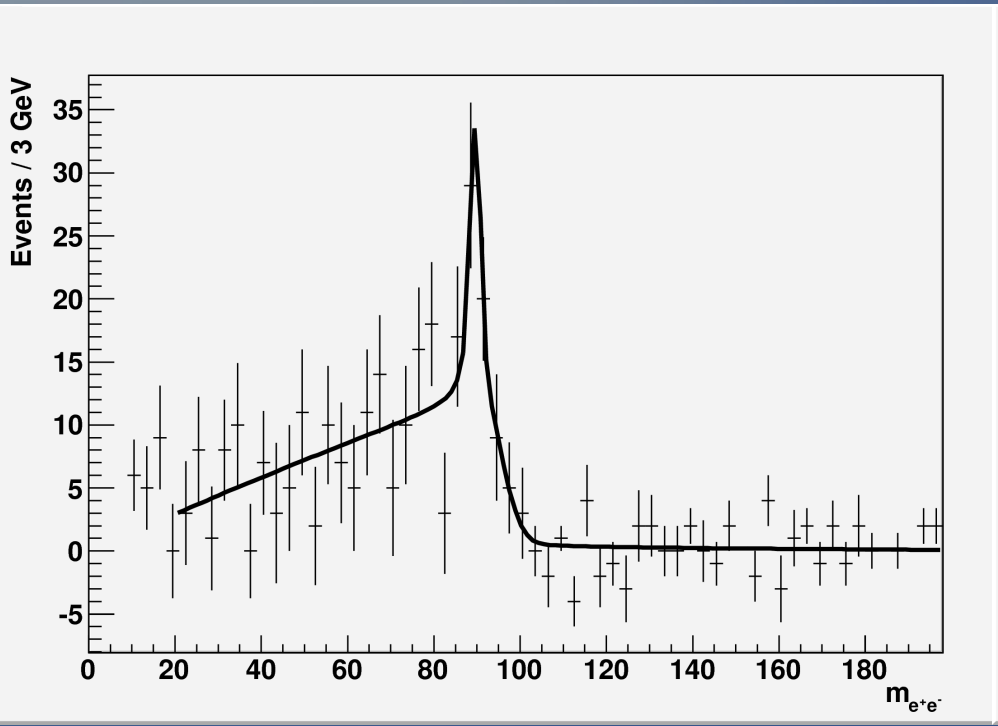
- Madevent → Pythia → PGS to generate MC
- Consider 3 lepton signal
  - Reduce background
  - Cut only on 3 leptons to improve statistics
- Exploit only kinematic shape of slepton decays

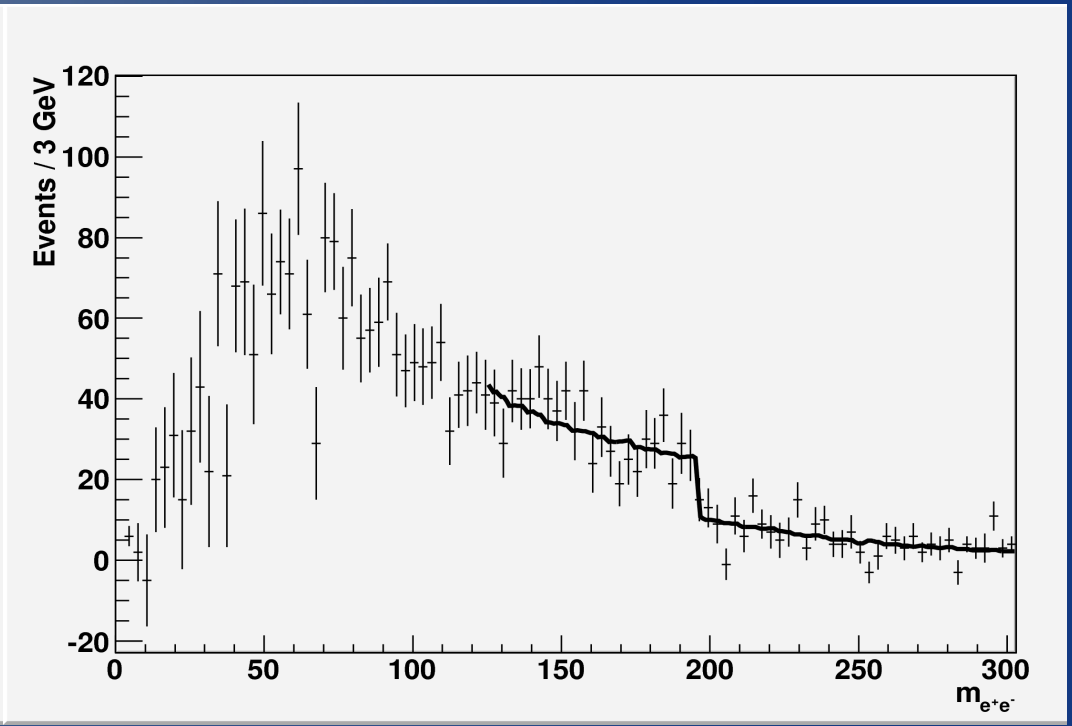
Fitting



- Signal
  - Cutoff, counts, smearing
- Background
  - Zpeak:
    - Amplitude
    - Position
    - Width
  - t tbar + fake:
    - Fake rate

Fitting





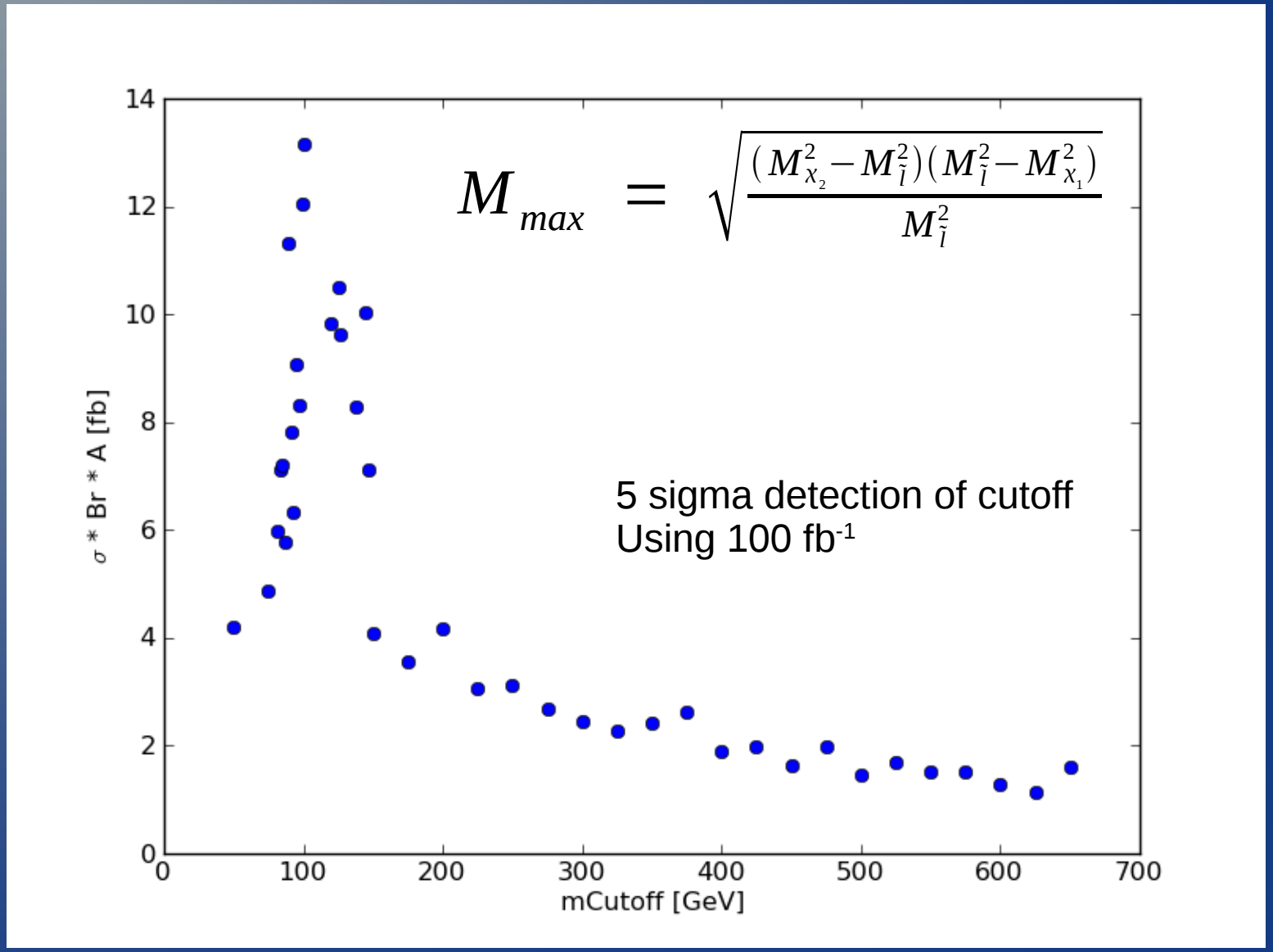
Difficult to detect cutoff near Z peak

$M_1 = 50$ $M_2 = 225$ $M_{slep} = 200$ GeV

Easier to detect cutoff at high energies

$M_1 = 50$ $M_2 = 250$ $M_{slep} = 112$ GeV

Required Cross Section



Simple Application

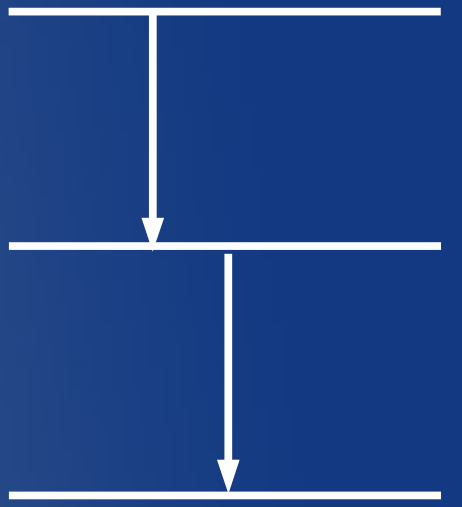
- We consider case
  - pure Bino χ_1
  - pure Wino χ_2

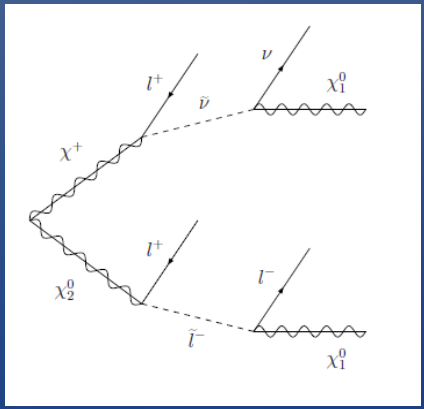
$$\chi_2^0 \quad \chi^{\pm}$$

- Drell-Yan production of Winos

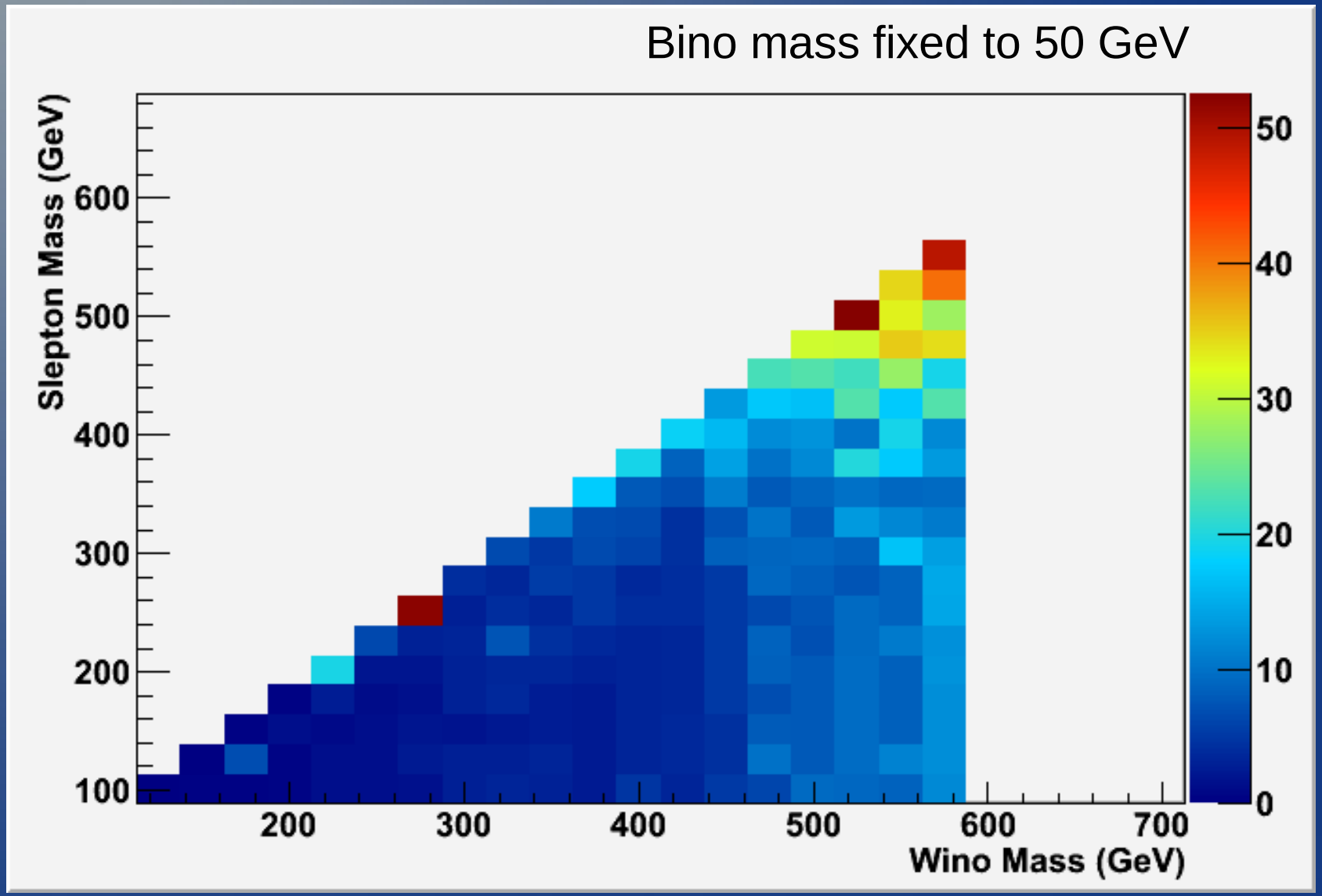
$$\tilde{l}_L \quad \tilde{\nu}$$

$$\chi_1^0$$



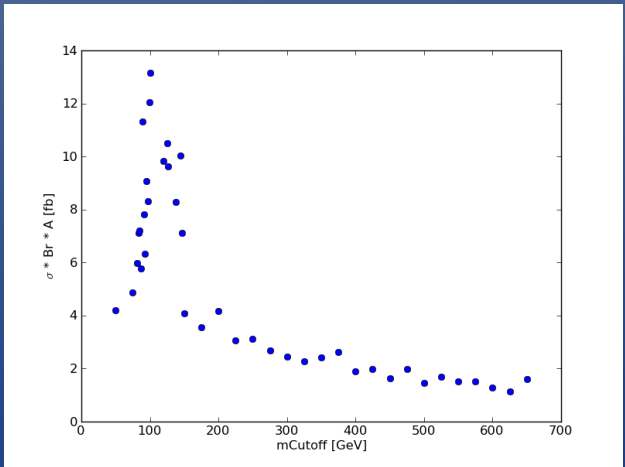


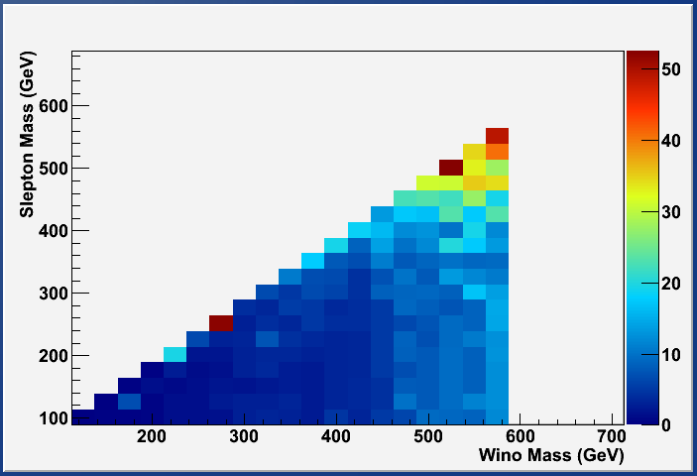
Luminosity Reach



Conclusions

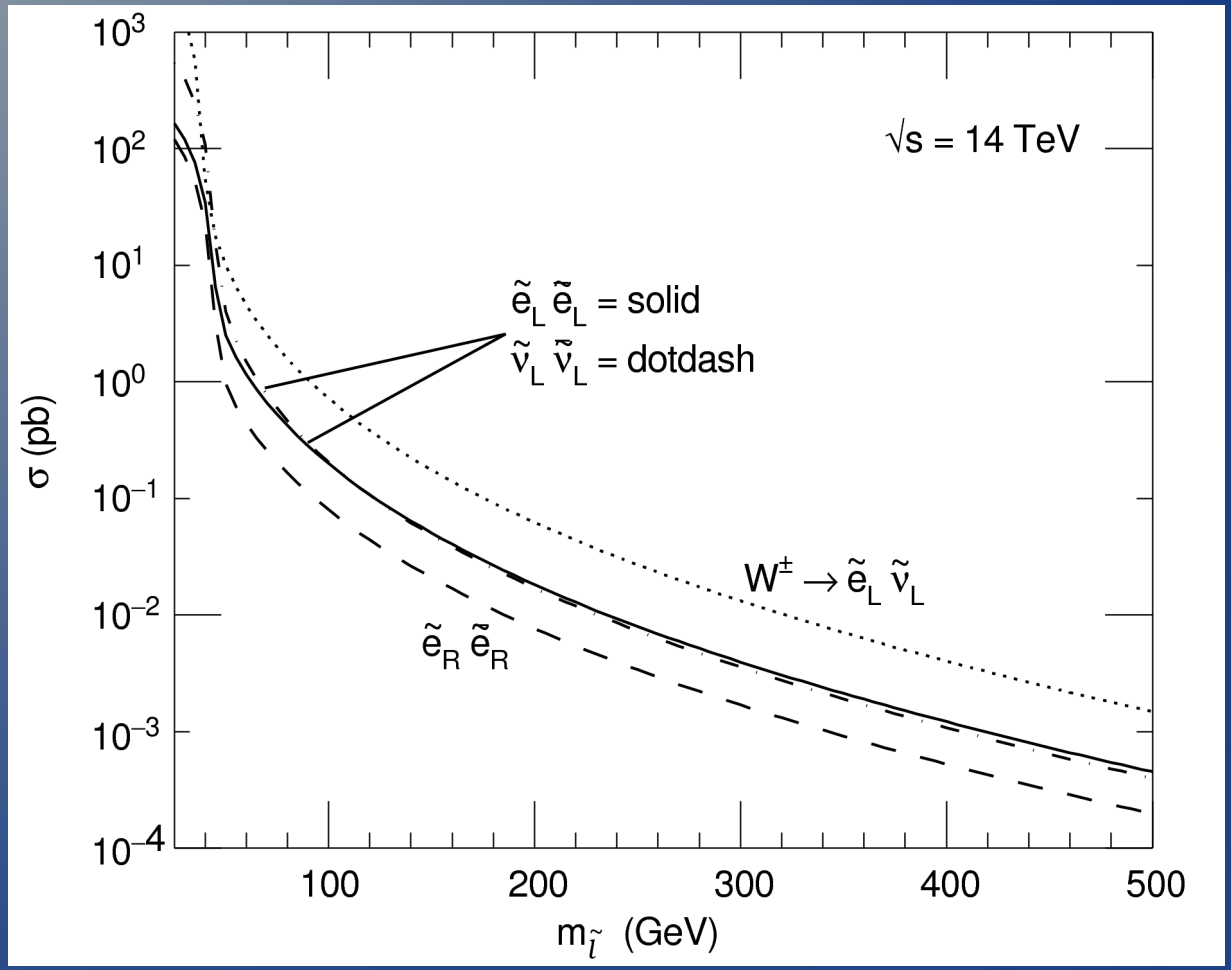
- Kinematic triangle is a good indicator
- We express the detectability of this signal in a model independent way
- Use a simple model in the MSSM to illustrate the effectiveness of the method





Backup Slides

Total Drell Yan Slepton Production Cross Section



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SM Backgrounds

- Selecting trilepton avoids large SM backgrounds
  - WW, Z + jets, t tbar
- Remaining backgrounds
  - WZ, t tbar + V
- Ttbar + fakes , comparable to WZ
- Other processes contain a Z boson or small rates

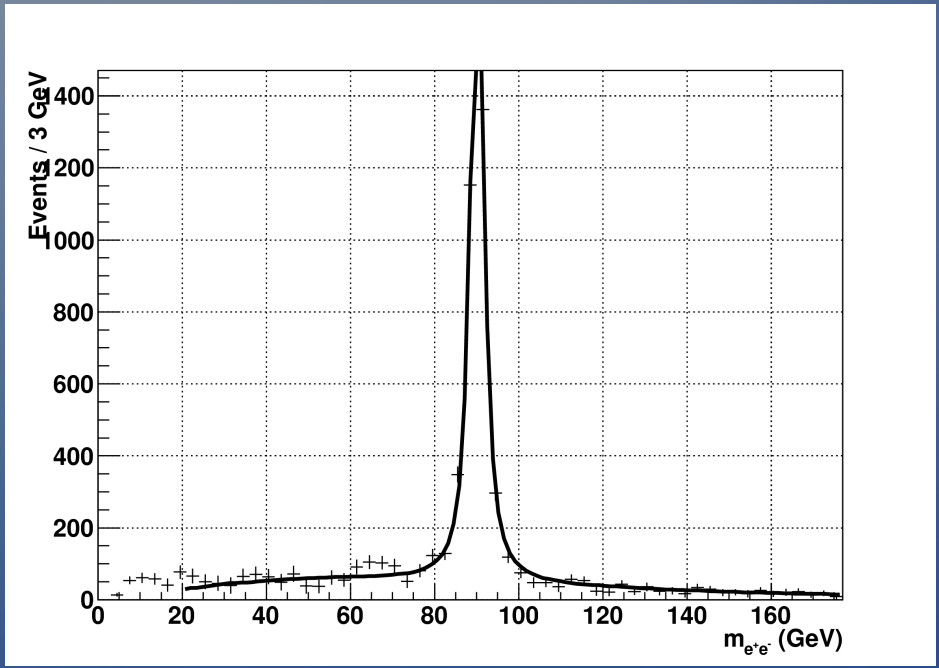
SUSY Backgrounds

- Trilepton in SUSY decays
- Signals with a Z boson in final state
  - Similar to SM backgrounds
- Lepton flavor mixing small
  - Turn off completely
- At most two kinematic triangles in each channel

Pseudo-Experiment

- Madevent → Pythia → PGS to generate MC
- Straightforward for signal + Z peak background
- T tbar + fake MC gives poor statistics
  - Instead use 2-lepton t tbar sample and noise

Fit Function background



- Z peak
- Fit: Width, position, amplitude
- Ttbar
  - Fake rate

Fitting Signal

- Kinematic triangle exact at parton level for correct pair
- Distortions:
  - Same sign subtraction
  - Bremsstrahlung and detector effects
- Fit:
  - cutoff, counts, smear

Fitting Signal