Increasing Discovery Potential Using Rare SUSY Scenarios

Gluinos

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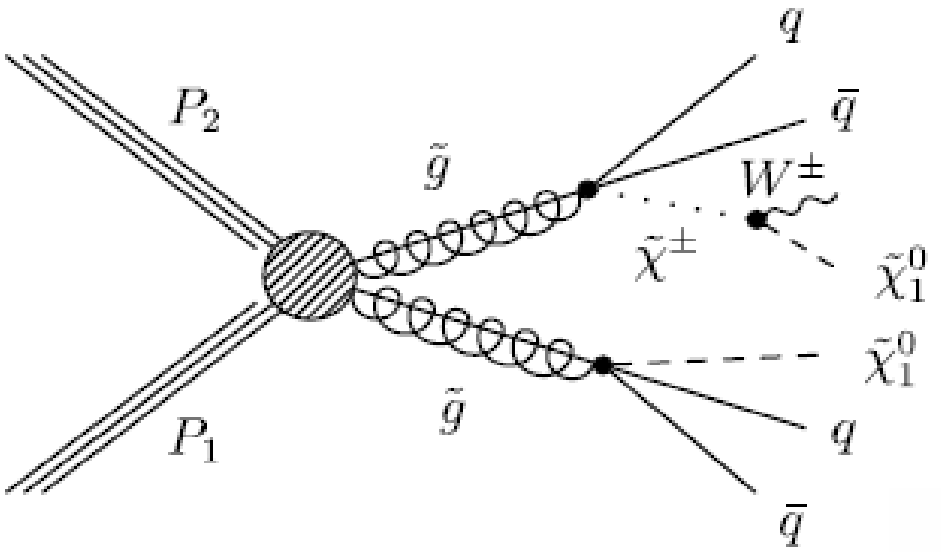
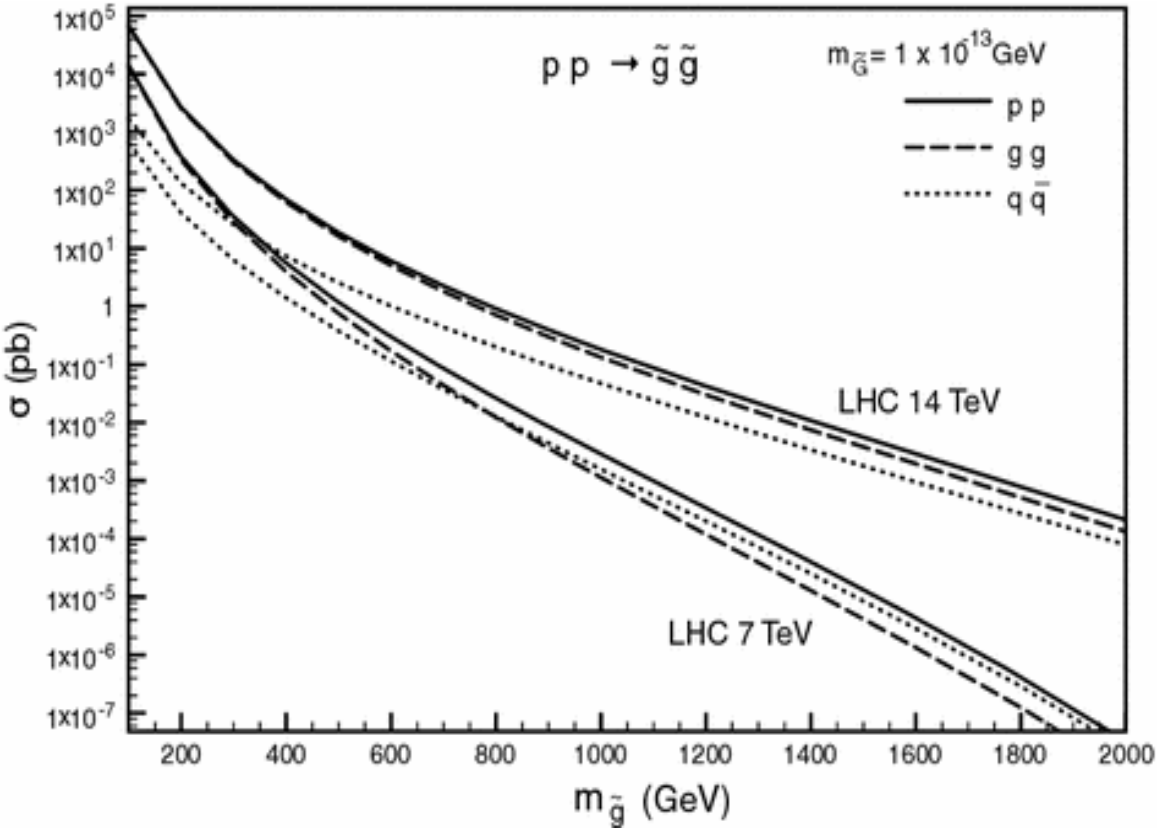
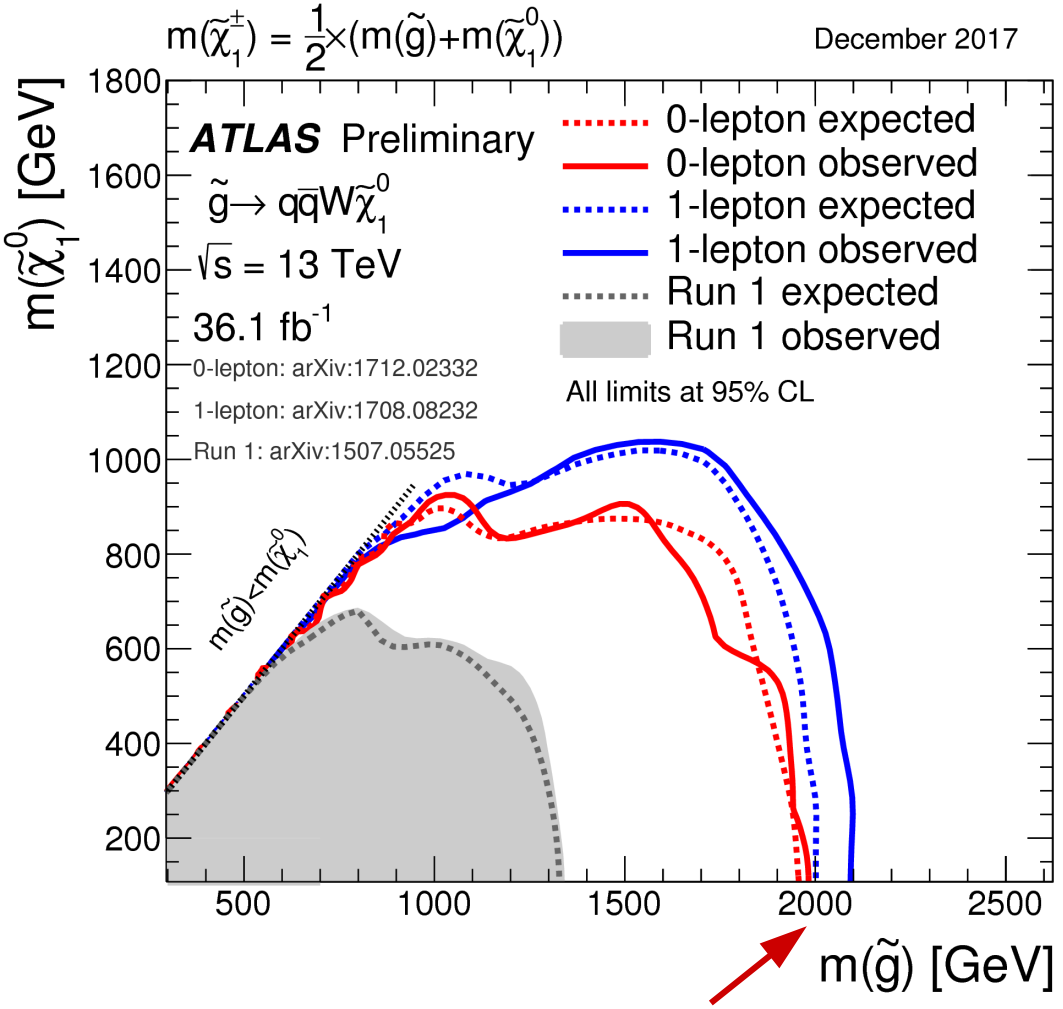
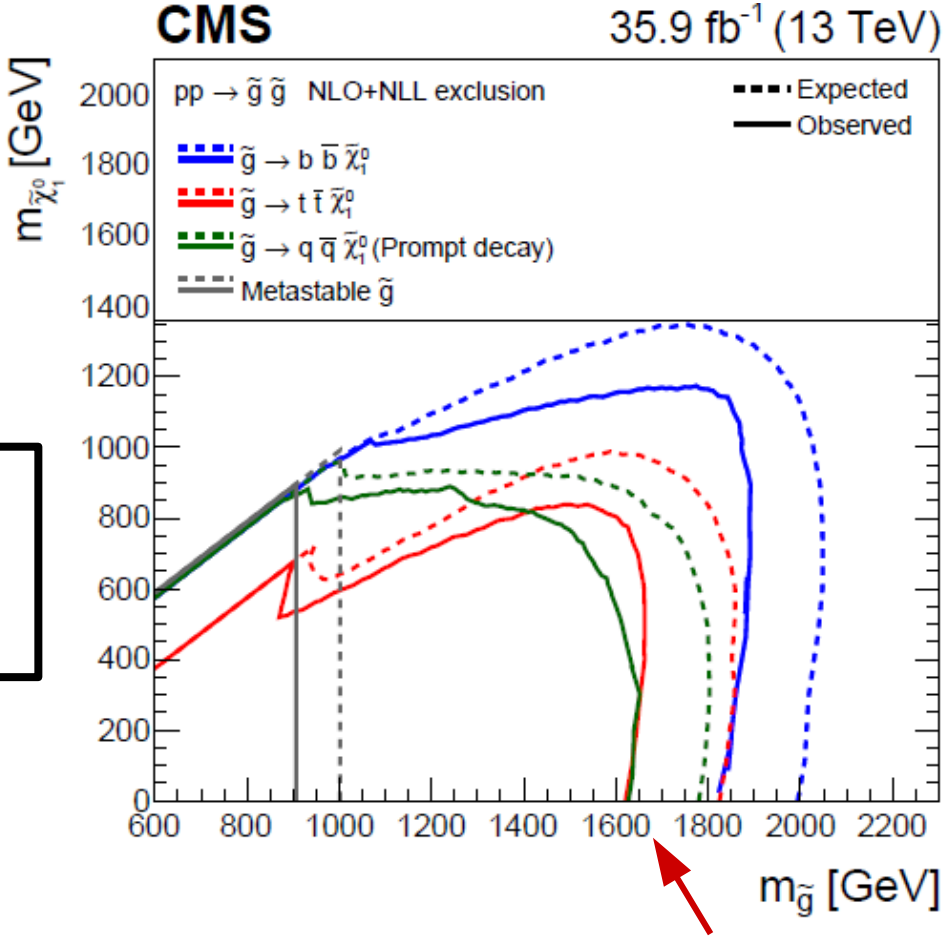
Current Gluino Searches



Smoking Gun Signal:Gluino pair production, Missing energy + jets

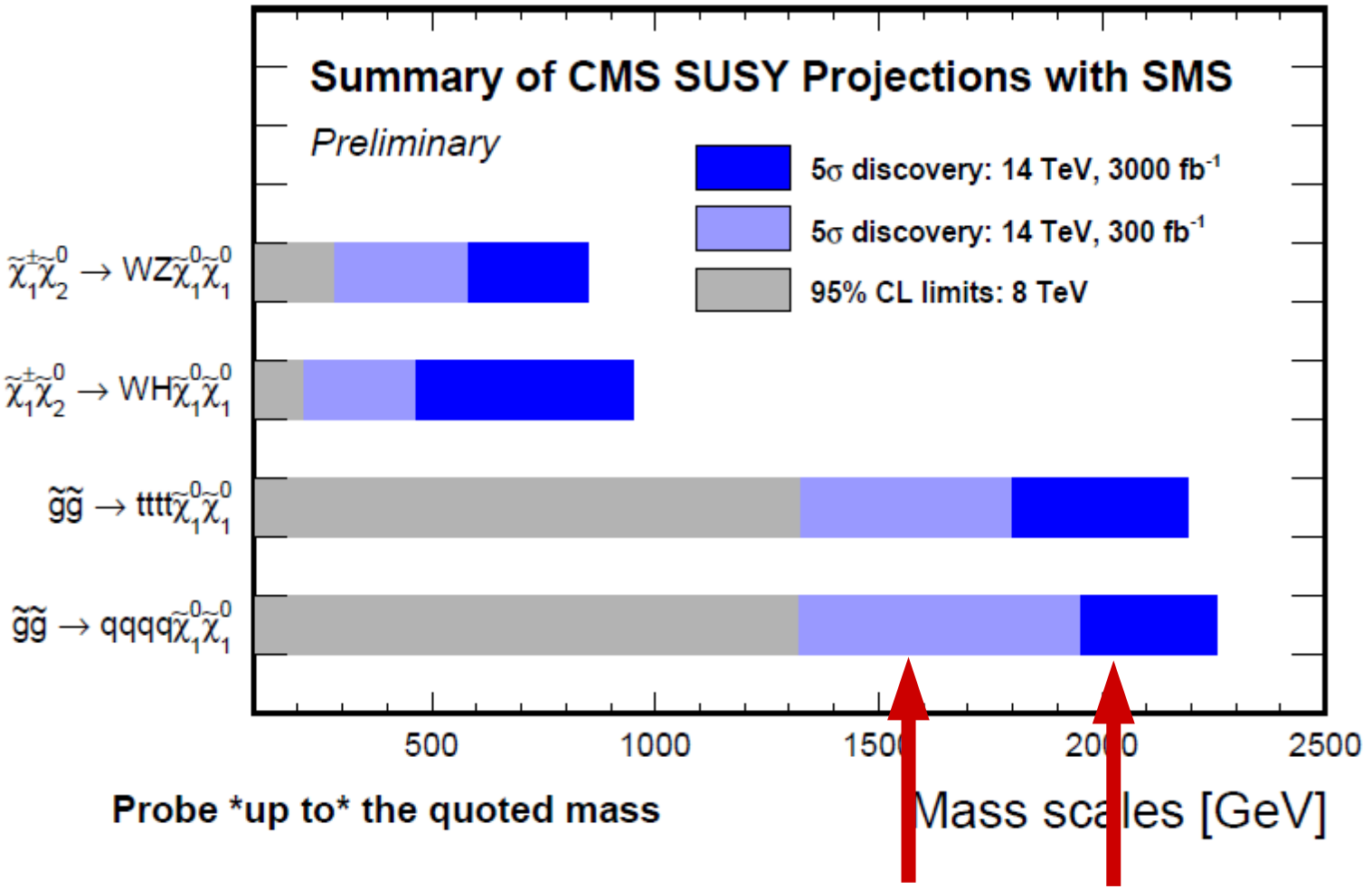






Exclusions in Gluino Parameter Space

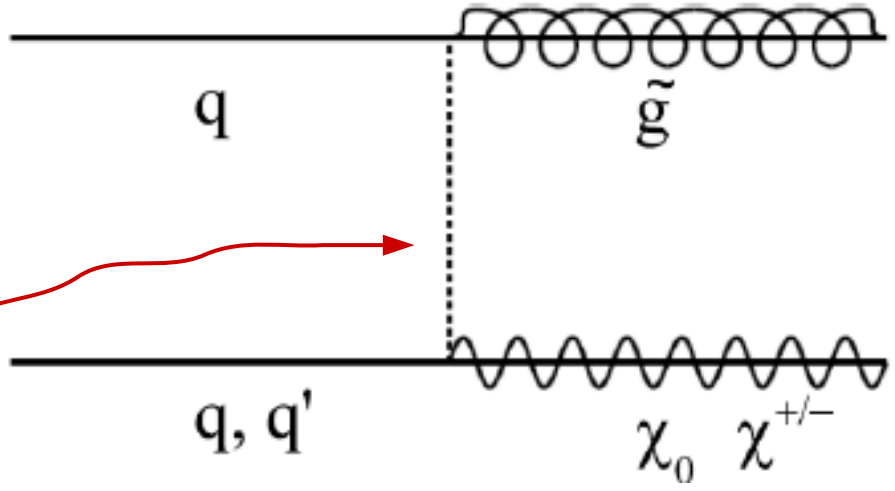
Discovery Projections



Current CMS lower bound

Current ATLAS Lower bound

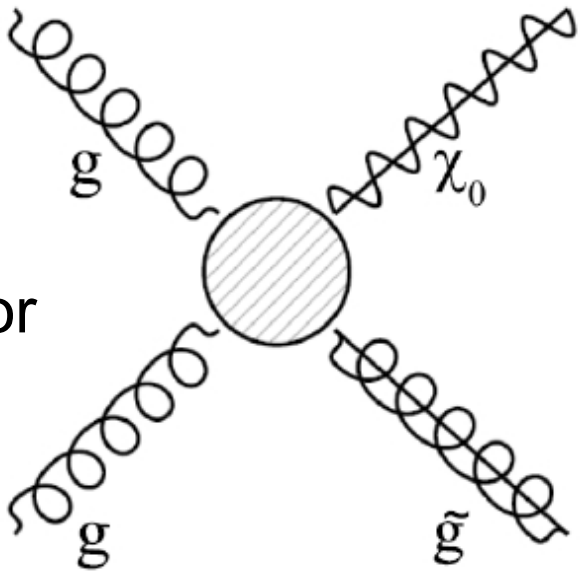
Consider Alternative Production Single Gluino Produced with Weakino



Tree level t-channel production

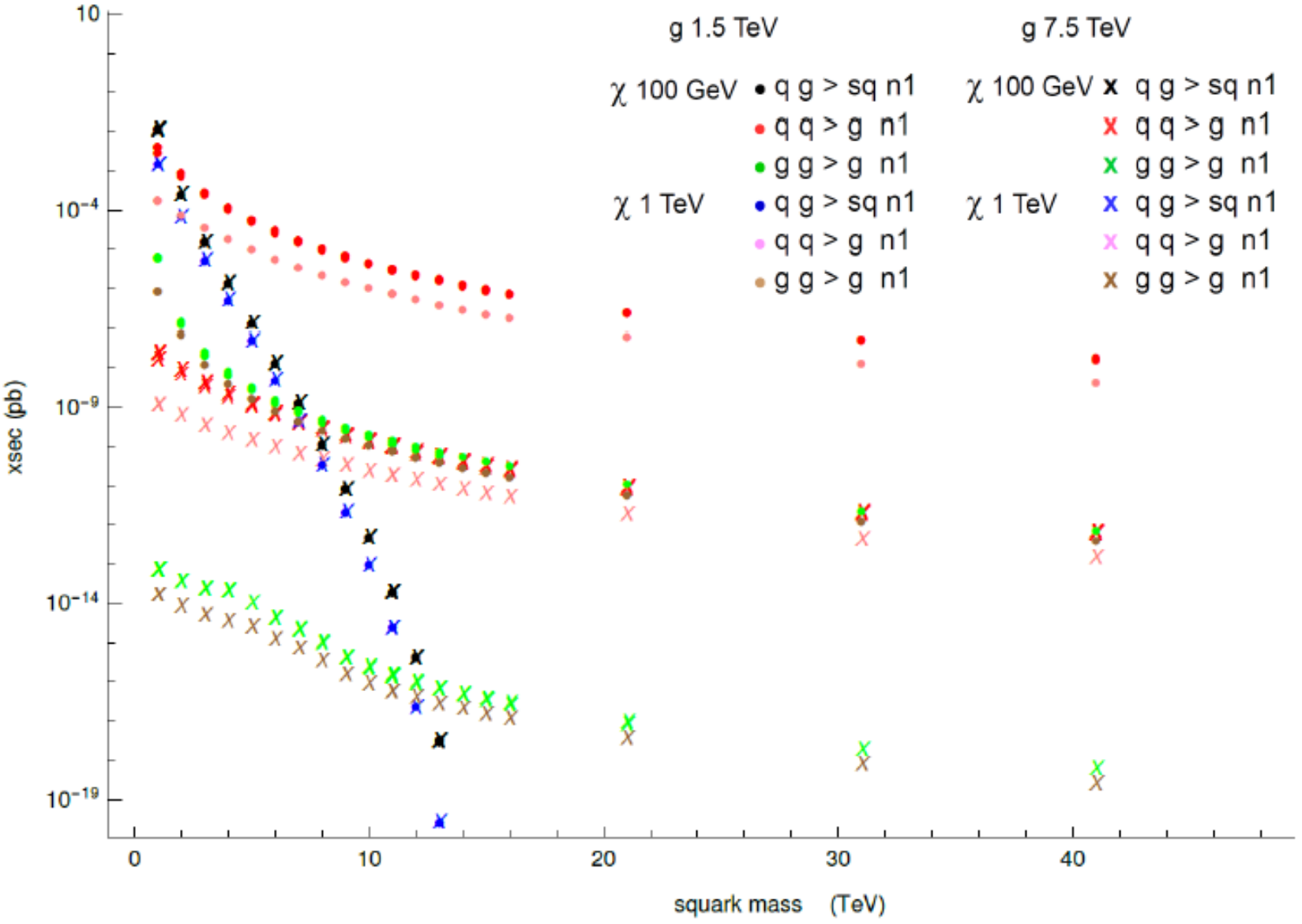
Off shell squark

Loop level operator



Main Background Z+jets,ZZ,WZ

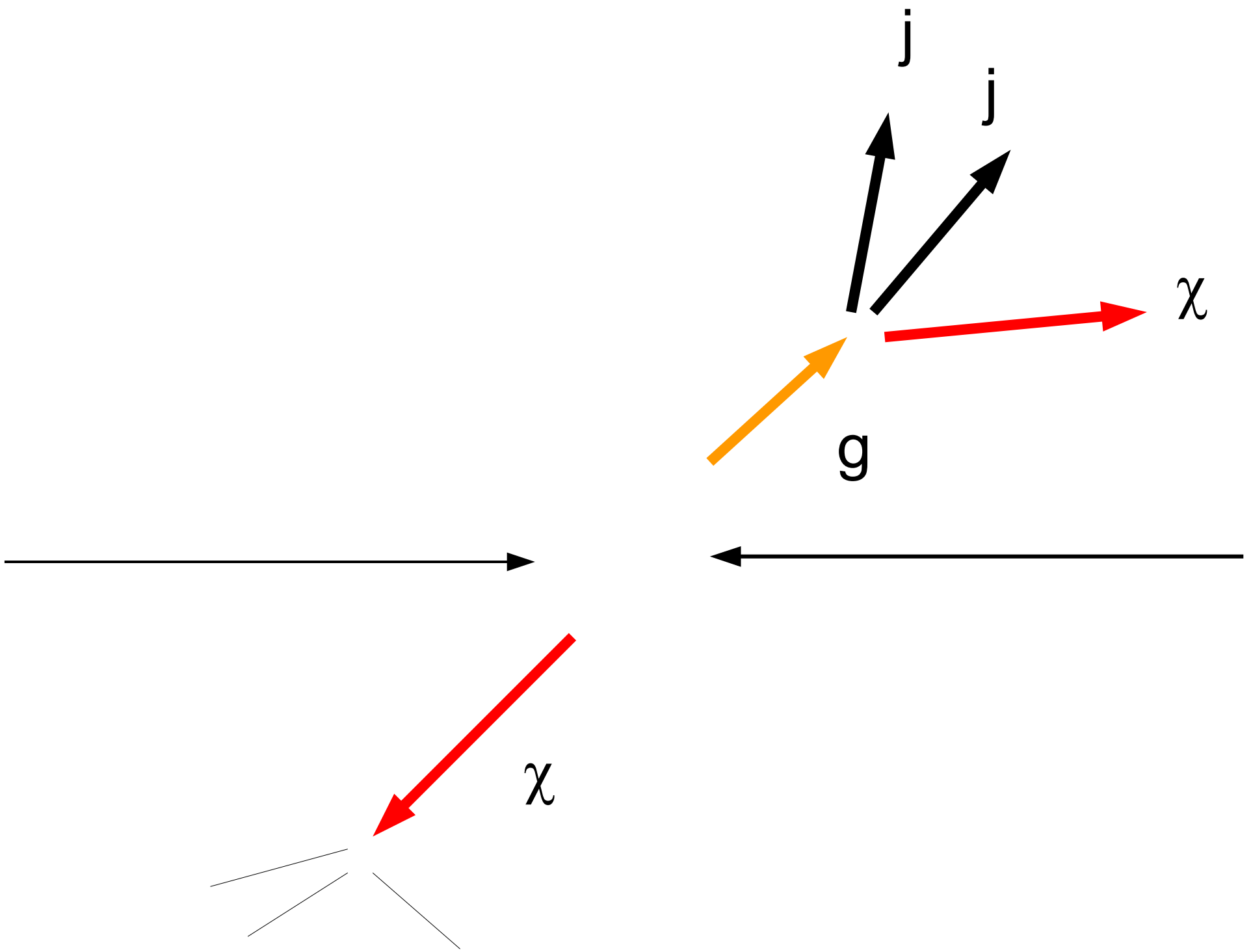
Production XSecs



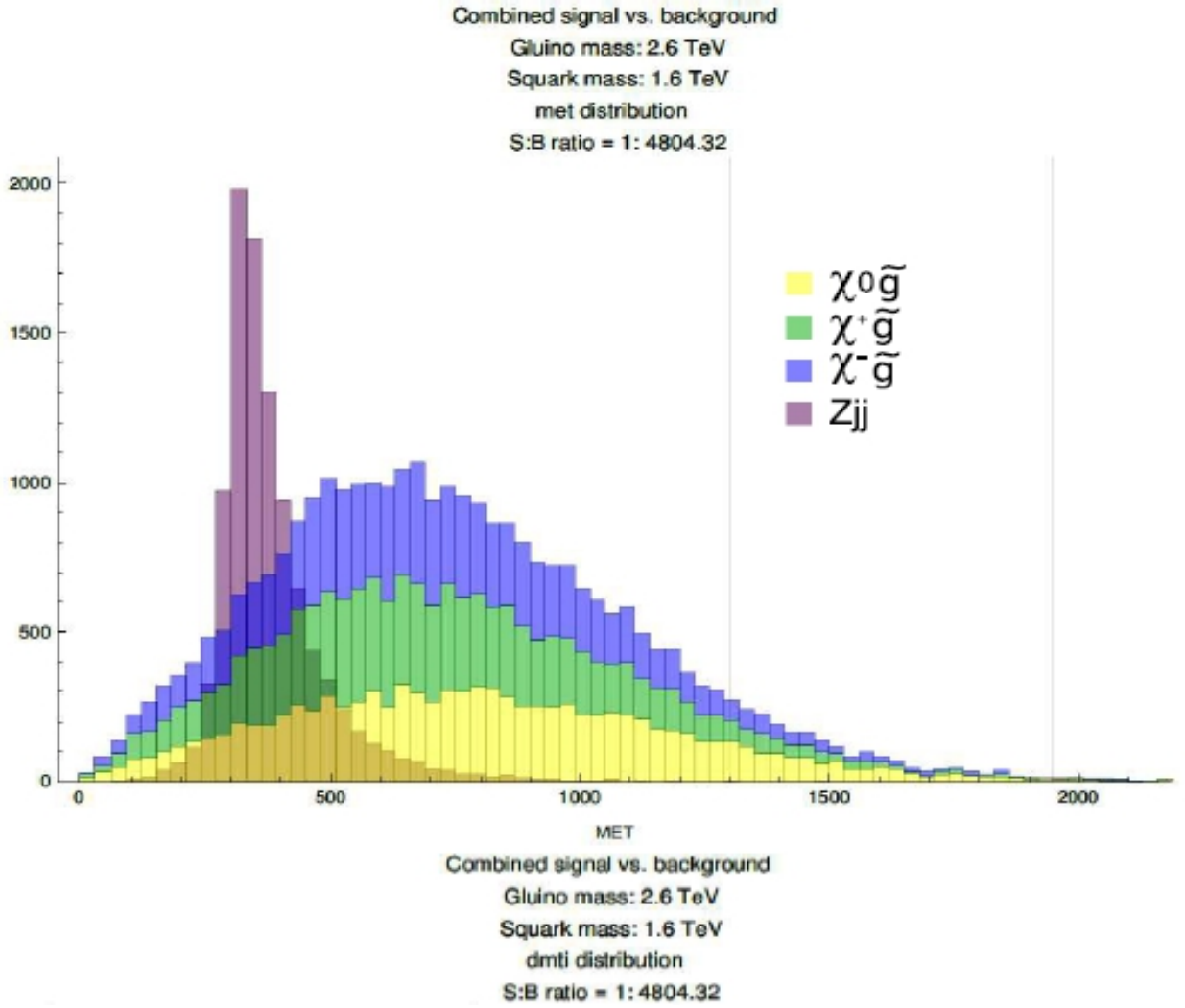
We consider the production of a gluino in conjunction with wino-like neutralinos

Evens samples were simulated in Madgraph, decayed in MadSpin, Showered in Pythia and run through detector simulation

Now consider kinematic distributions

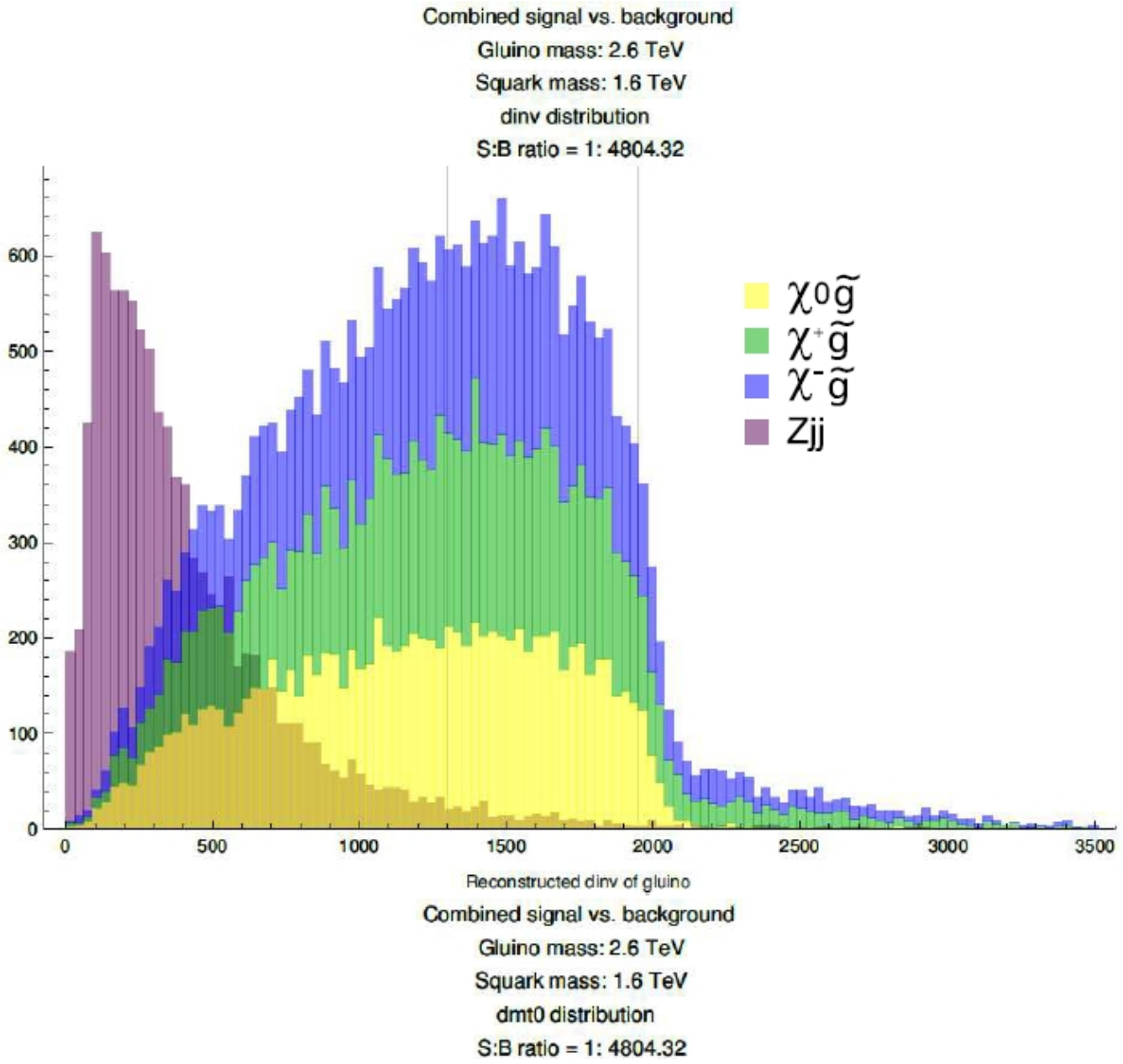

j
j
χ
g
χ

Missing ET Distribution

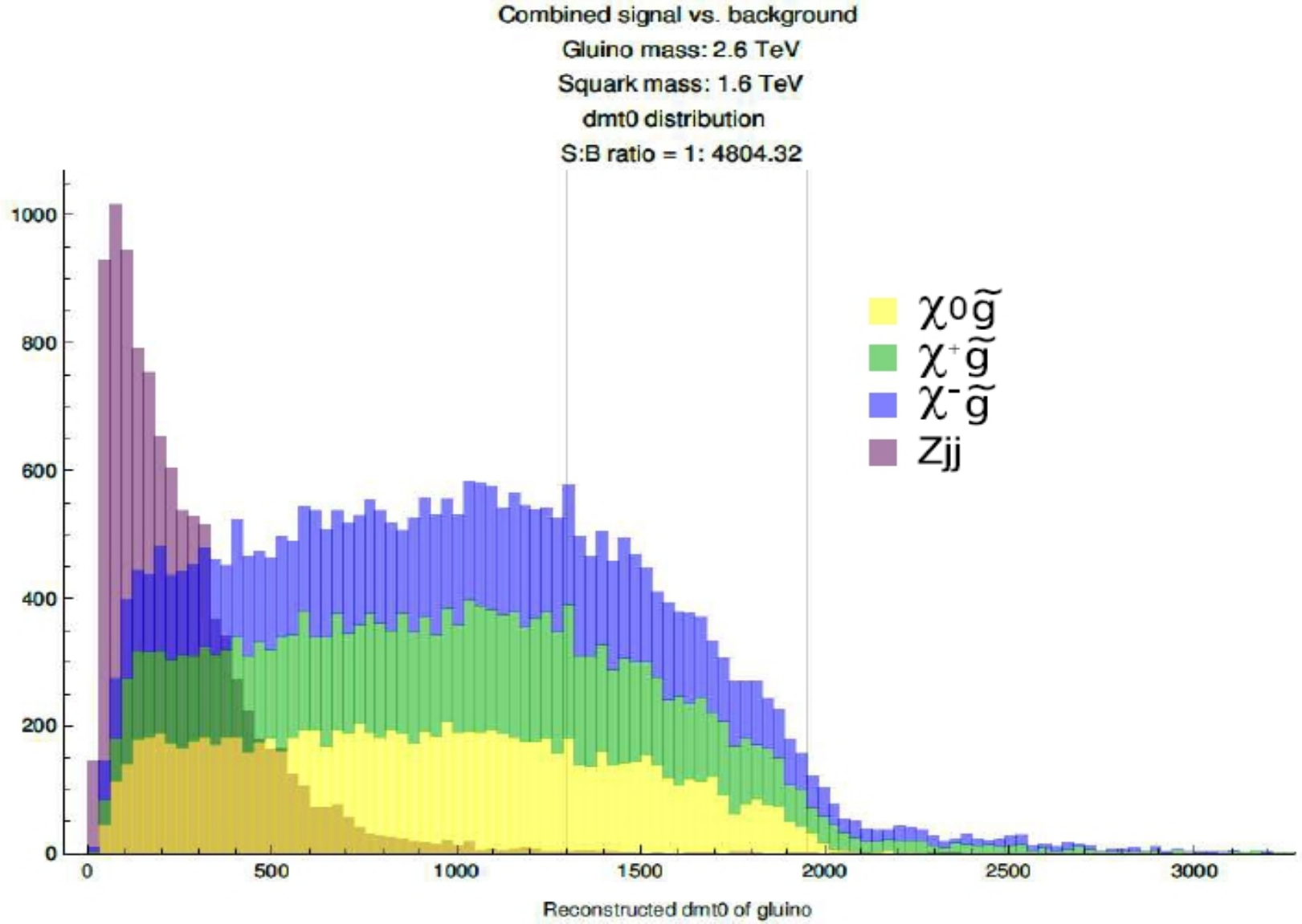


$$E_{\mathrm{T}}^{\mathrm{miss}} = -\Sigma\overline{p_T}$$

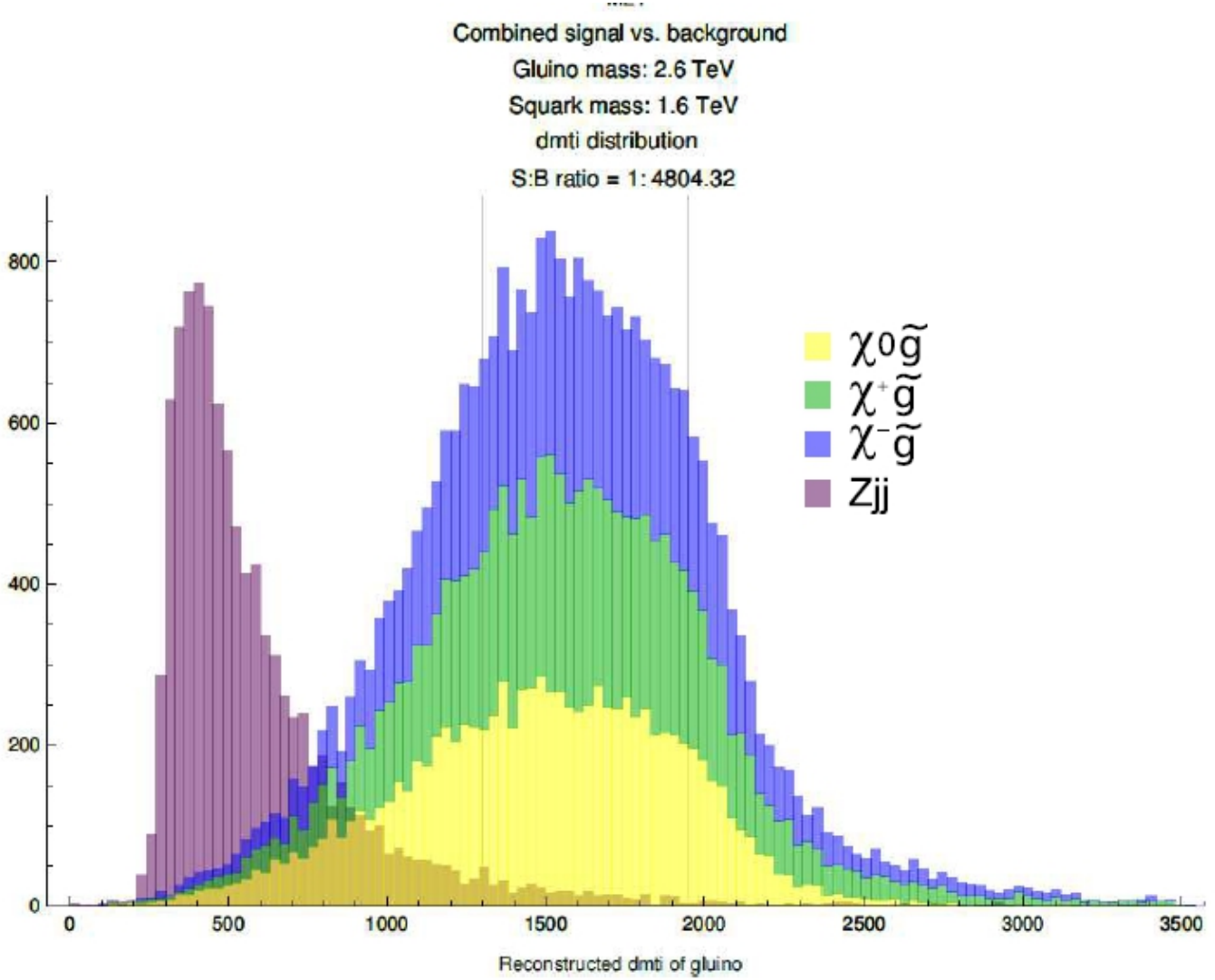
Di-jet invariant mass



Transverse Mass Distribution



$$m_{T0}^2 = (\Sigma E_T)^2 - (\Sigma \overline{p_T})^2$$



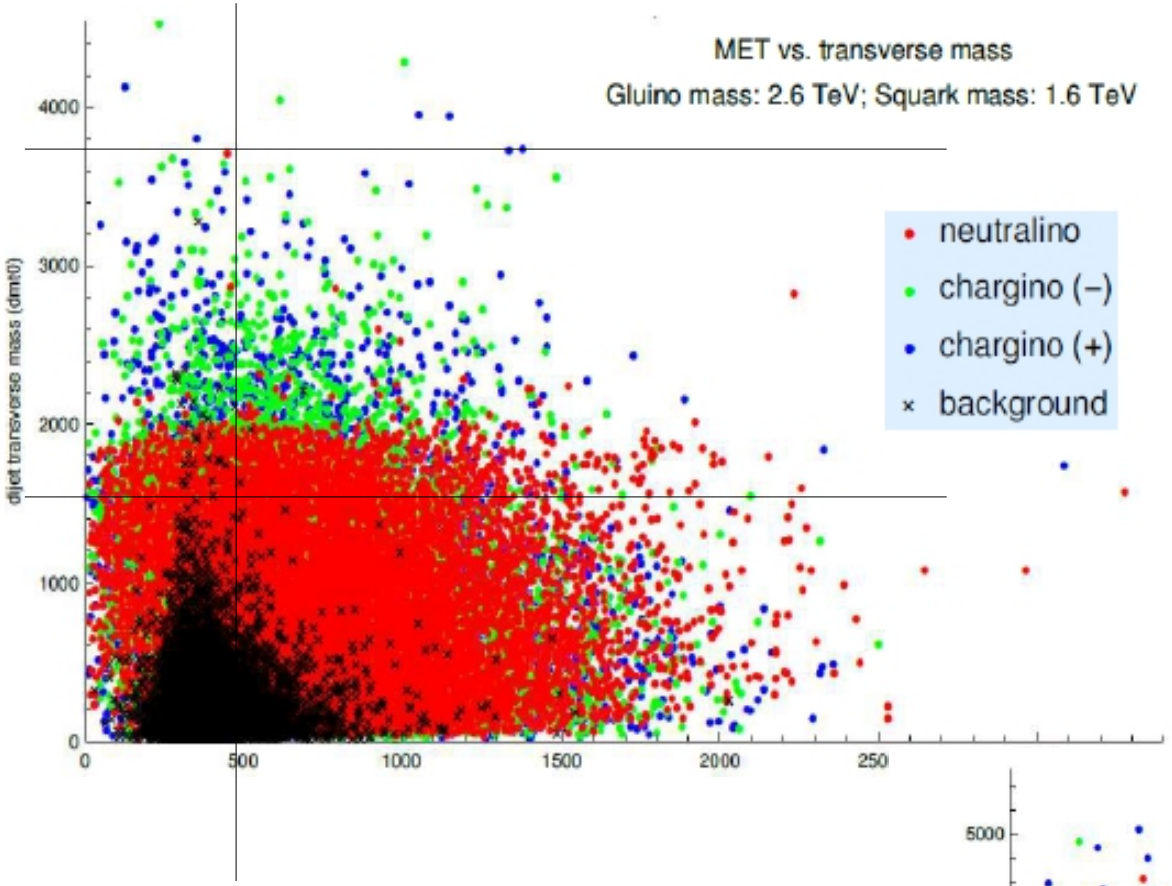
$$m_{Ti}^2 = (m_{iv}^2 + (\Sigma \overline{p_T})^2)$$

Cut Based Analysis

- Events must contain at least 2 jets in the central region of the detector $\eta < 2.5$
- Jets must have $p_T > 20GeV$
- Events must have $E_{\mathrm{T}}^{\mathrm{miss}} \geq 500$ GeV
- A dijet transverse mass discriminant $m_T = m_{T0}$ or m_{Ti} is constructed using only the two leading jets in the event
- the chosen m_T must fall in a kinematic window which varies with hypothesized gluino mass $M_g - \Delta < m_T < M_g + \Delta$ where Δ is $.5M_g$

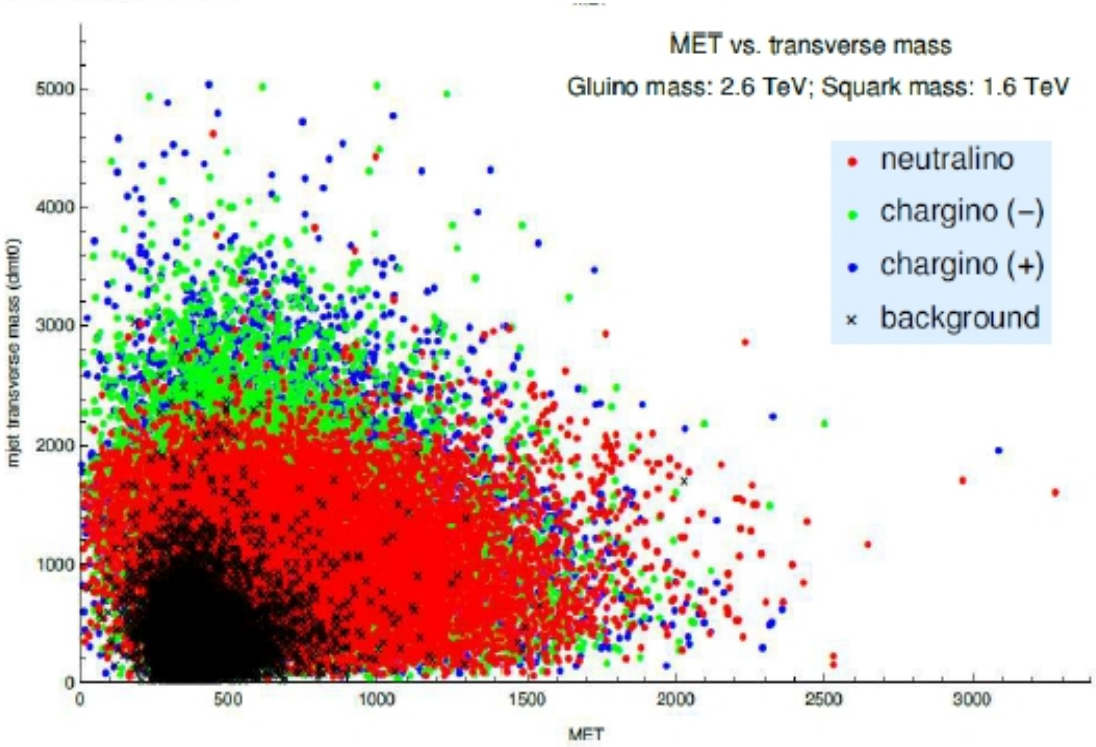
$m_{\tilde{g}}$ 2.2 TeV				
cut	$\tilde{g}\chi_0$	$\tilde{g}\chi^-$	$\tilde{g}\chi^+$	Z j j
none	10000	10000	10000	10000
inclusive m_{T0}	1511	2417	2509	94
500 GeV $E_{\mathrm{T}}^{\mathrm{miss}}$	1048	1592	1645	11
$m_{\tilde{g}}$ 1.0 TeV				
cut	$\tilde{g}\chi_0$	$\tilde{g}\chi^-$	$\tilde{g}\chi^+$	Z j j
none	10000	10000	10000	10000
inclusive m_{T0}	2269	4091	4259	1091
500 GeV $E_{\mathrm{T}}^{\mathrm{miss}}$	796	583	532	124

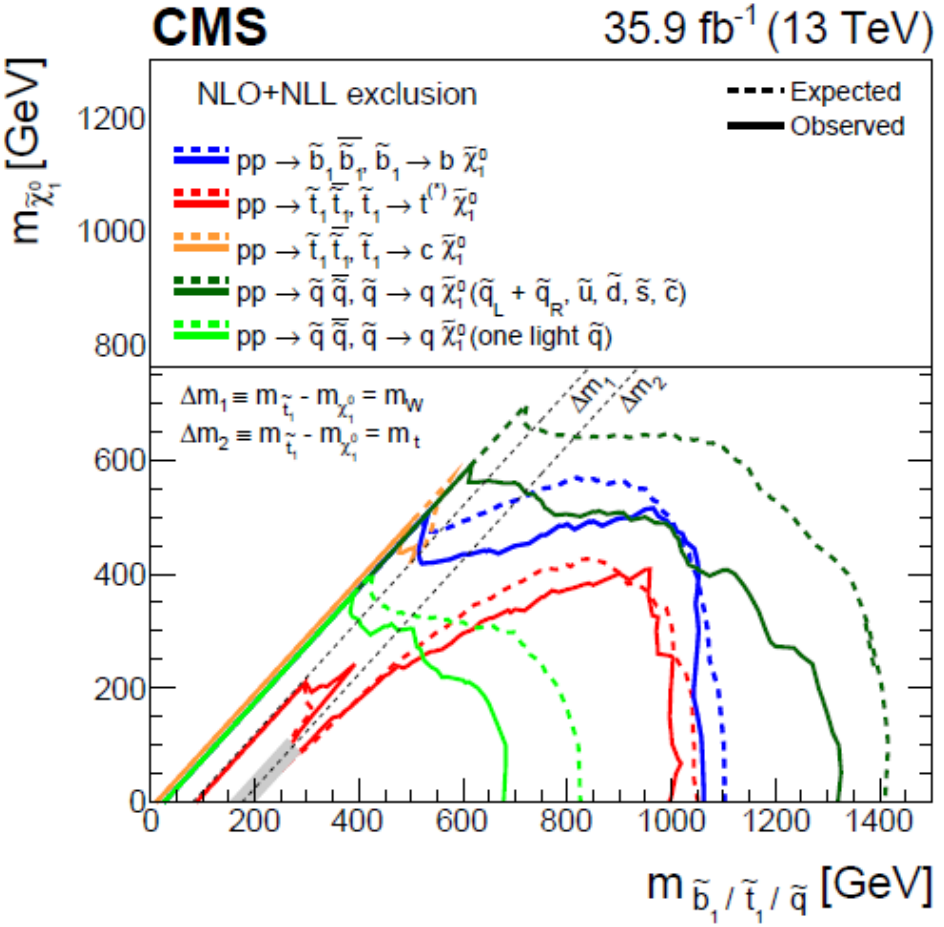
Cut-Flow



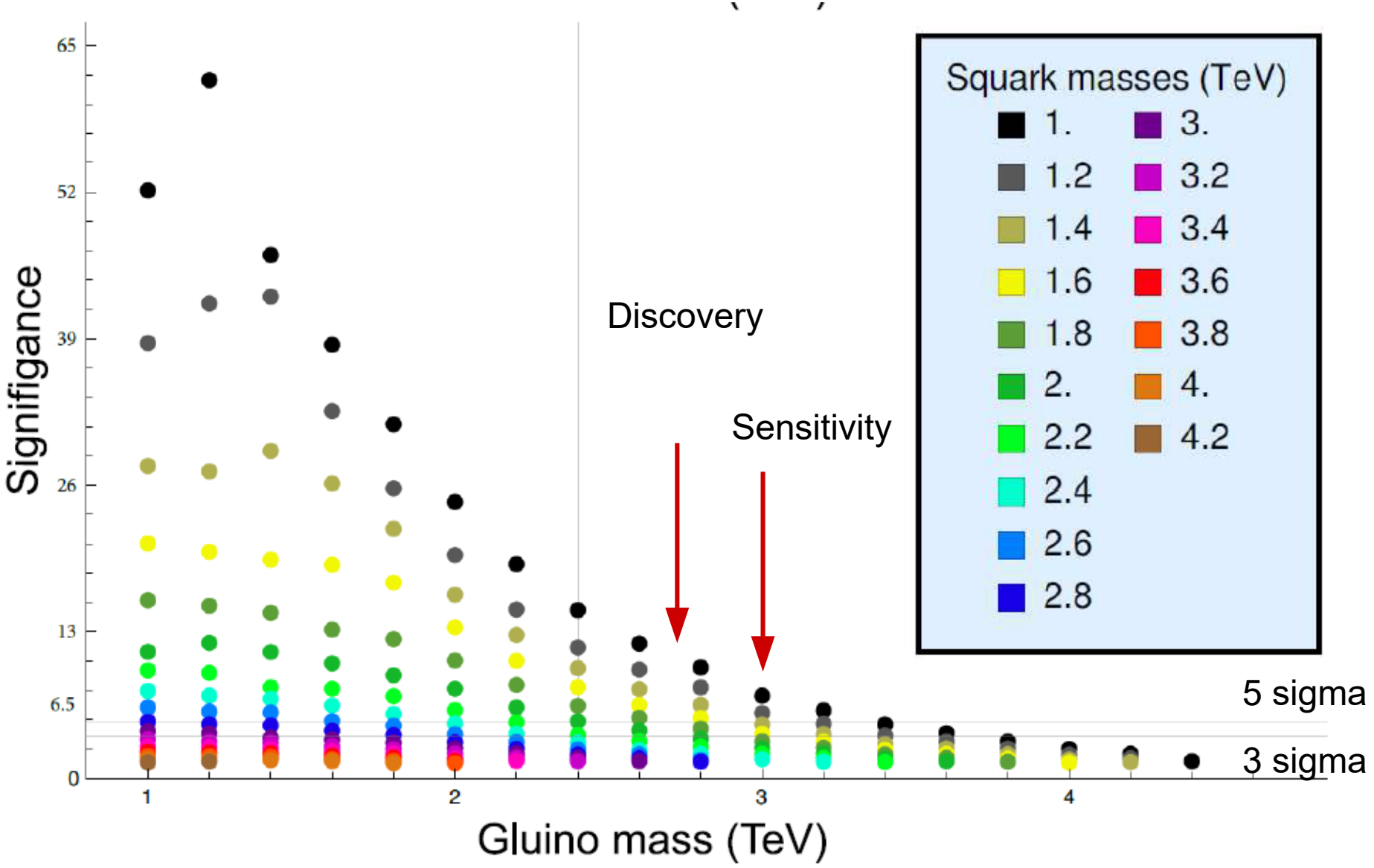
Exclusive transverse variable using 2 leading jets

Inclusive transverse variable using all jets

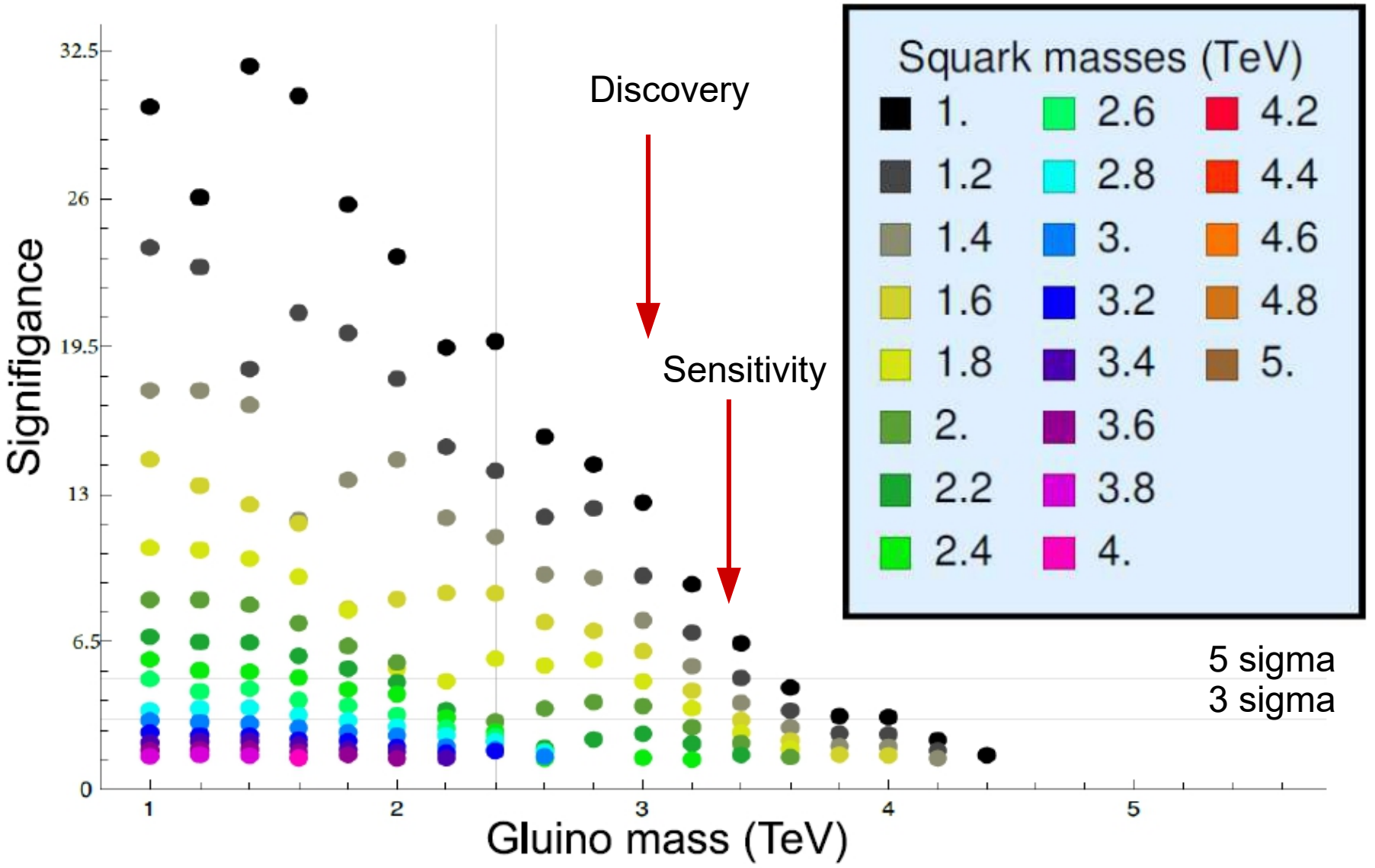



CMS
35.9 fb-1 (13 TeV)
NLO+NLL exclusion
Expected
Observed
pp → b̃1 b̃1*, b̃1 → b χ̃10
pp → t̃1 t̃1*, t̃1 → t(*) χ̃10
pp → t̃1 t̃1*, t̃1 → c χ̃10
pp → q̃ q̃*, q̃ → q χ̃10 (q̃L + q̃R, ũ, d̃, s̃, c̃)
pp → q̃ q̃*, q̃ → q χ̃10 (one light q̃)
Δm1 ≡ mt̃1 - mχ̃10 = mW
Δm2 ≡ mt̃1 - mχ̃10 = mt
Δm1
Δm2
mχ̃10 [GeV]
mb̃1 / t̃1 / q̃ [GeV]
0
200
400
600
800
1000
1200
1400

mTi Variable



mT0 variable



Conclusion

- Gluino-Weakino is a clean signal with outstanding kinematic features large MET and transverse variables
- Conservative analysis shows discovery potential in this channel can be competitive or e with di-gluino production, and may exceed it for light squarks
- More sophisticated cuts in the MET- transverse mass plane, or fitting of edges may improve analysis more