Early SUSY searches at LHC without E_T^{miss}

Andre Lessa

Homer L. Dodge Department of Physics and Astronomy
University of Oklahoma

PHENO, 2009


H. Baer, A. Lessa and H. Summy
Early SUSY discovery at LHC via sparticle cascade decays to same-sign and multimuon states.
Phys.Lett.B674:49-53, 2009.


H. Baer, V. Barger, A. Lessa and X. Tata
Discovery potential of LHC for supersymmetry at $\sqrt{s} = 10$ *TeV without and with* E_T^{miss}.
soon to appear on arXiv

Outline

Standard Search Channels

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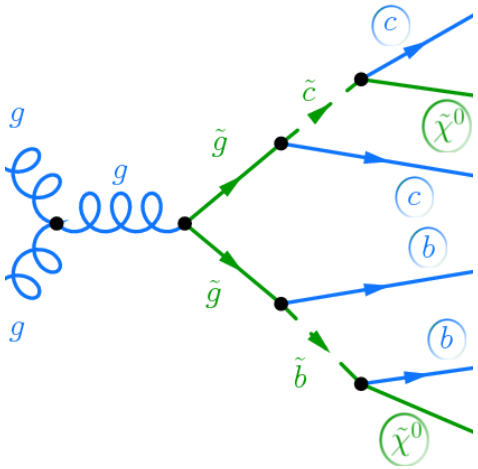

- *jets* $+ E_T^{\text{miss}}$ (no isolated leptons)

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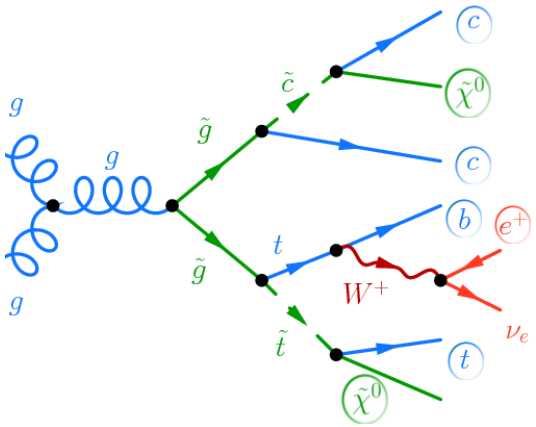

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- $1\ell + jets + E_T^{\text{miss}}$

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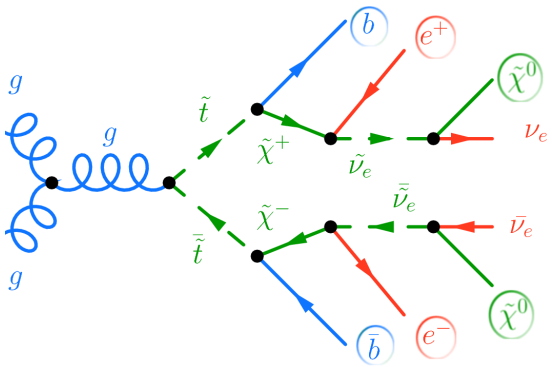

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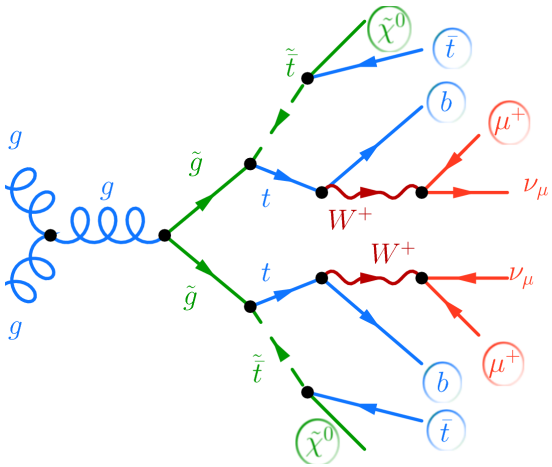

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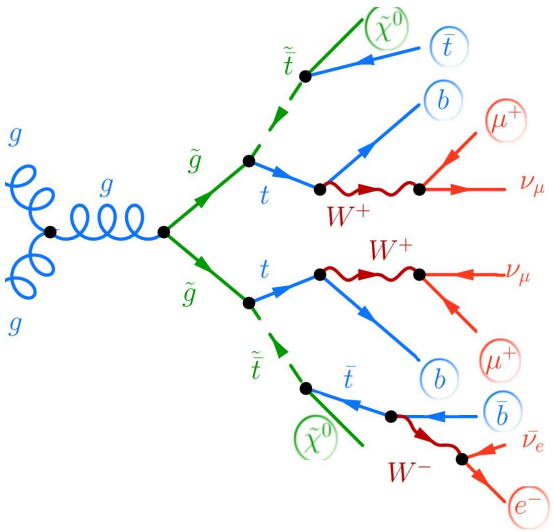

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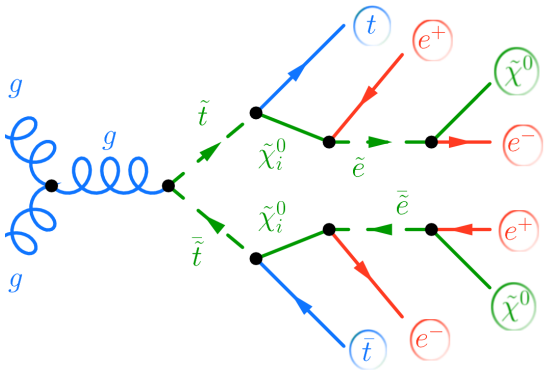

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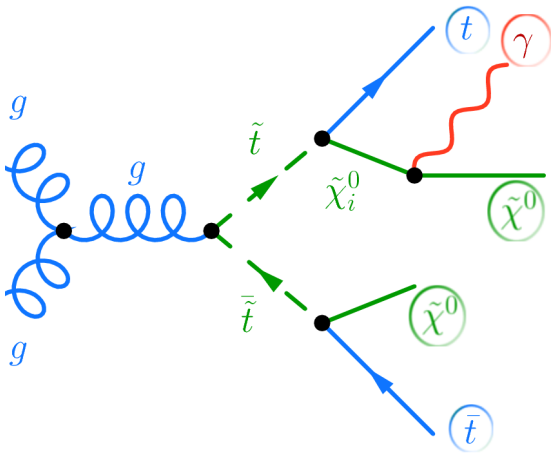

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- hard, isolated $\gamma +$ *jets* $+ E_T^{\text{miss}}$

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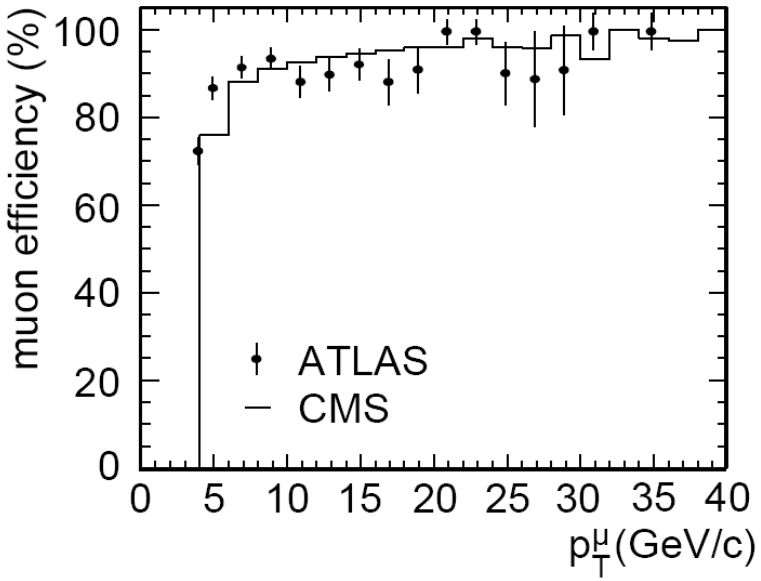

(O. Kortner, arXiv:0707.0905)

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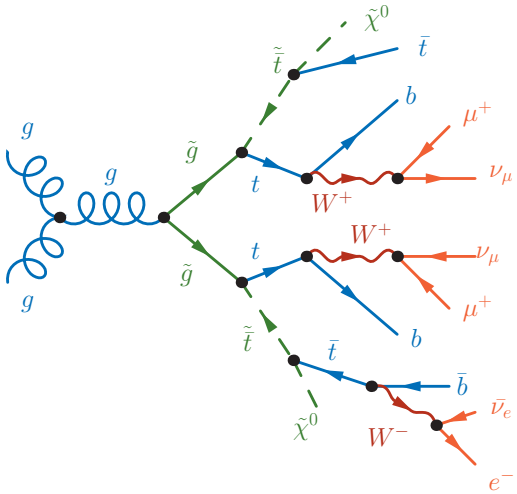

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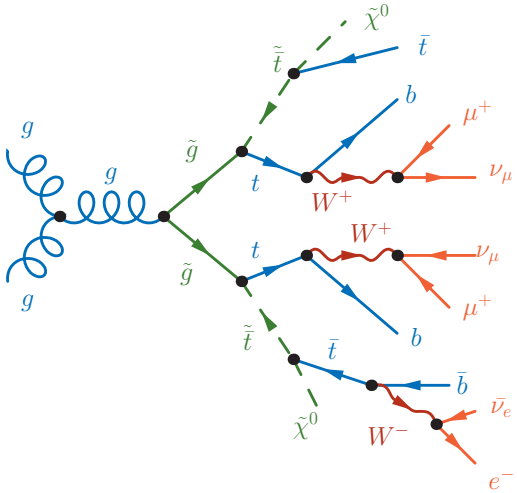

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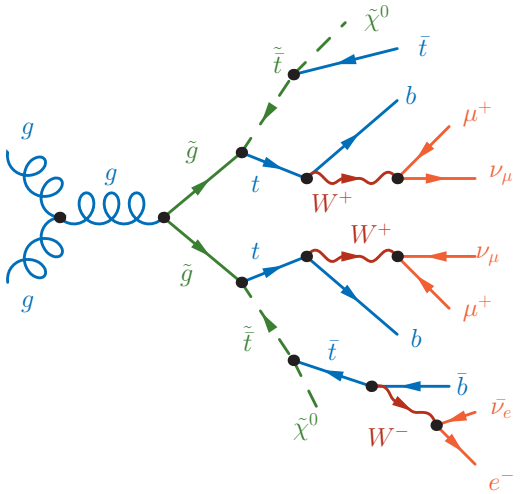

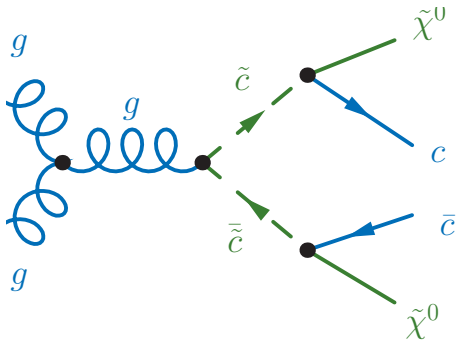

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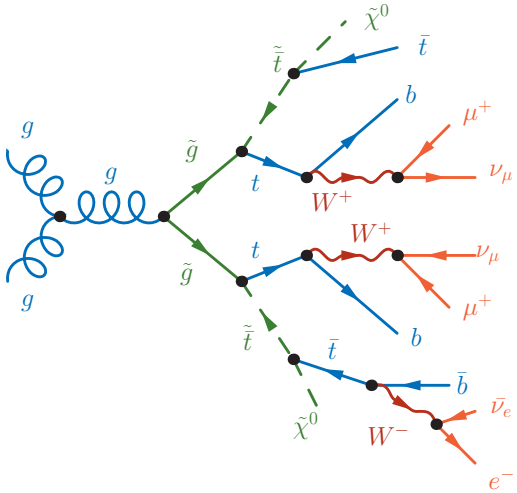

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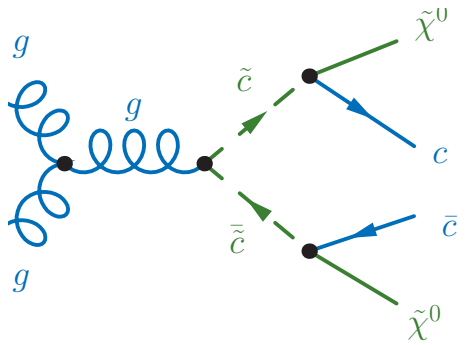

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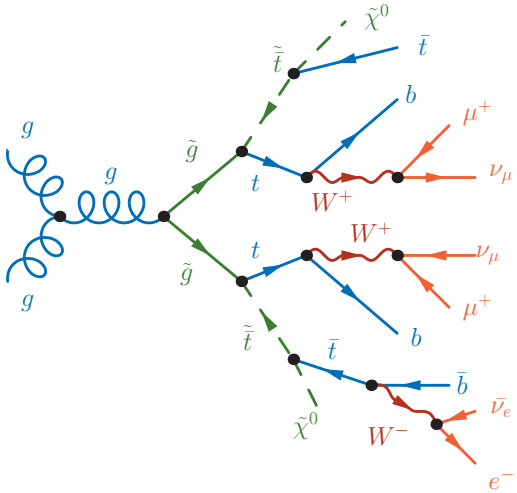

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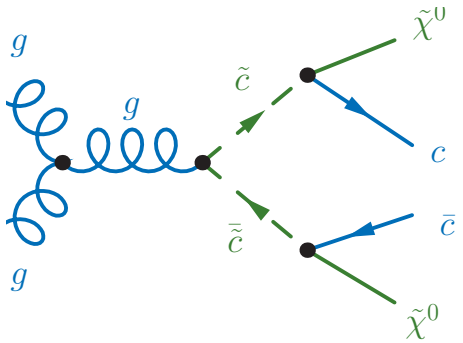

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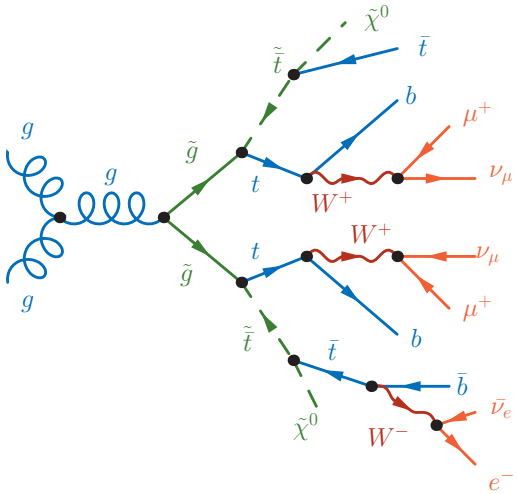

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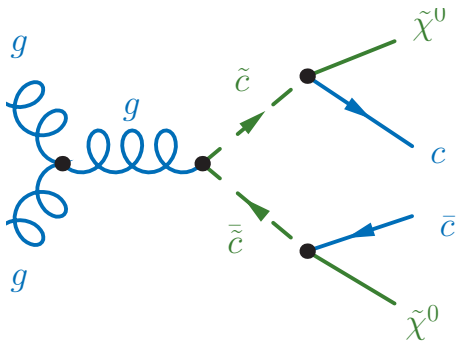

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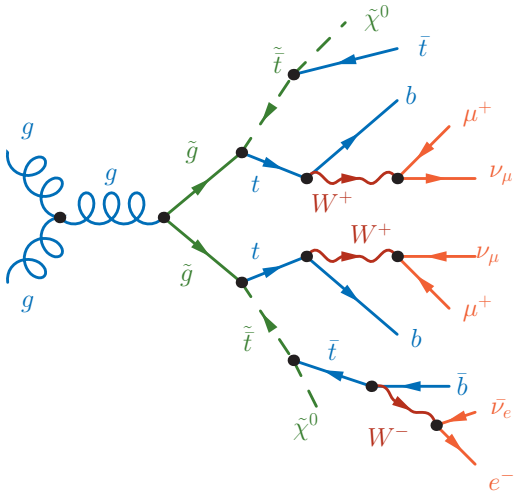

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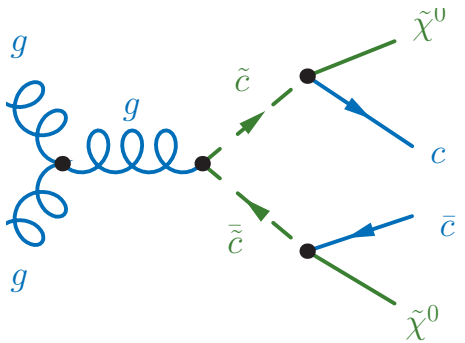


Without E_T^{miss} cuts other SM processes may become relevant

Multimuon Channel

Cuts:

- $N(j) \geq 4$, $p_T(j_1) > 100$ GeV, $p_T(j) > 50$ GeV
- $p_T(\mu) > 10$ GeV

Event Simulation:

- BG: AlpGen (+ MLM matching), MadGraph + Pythia
- Signal: Isajet

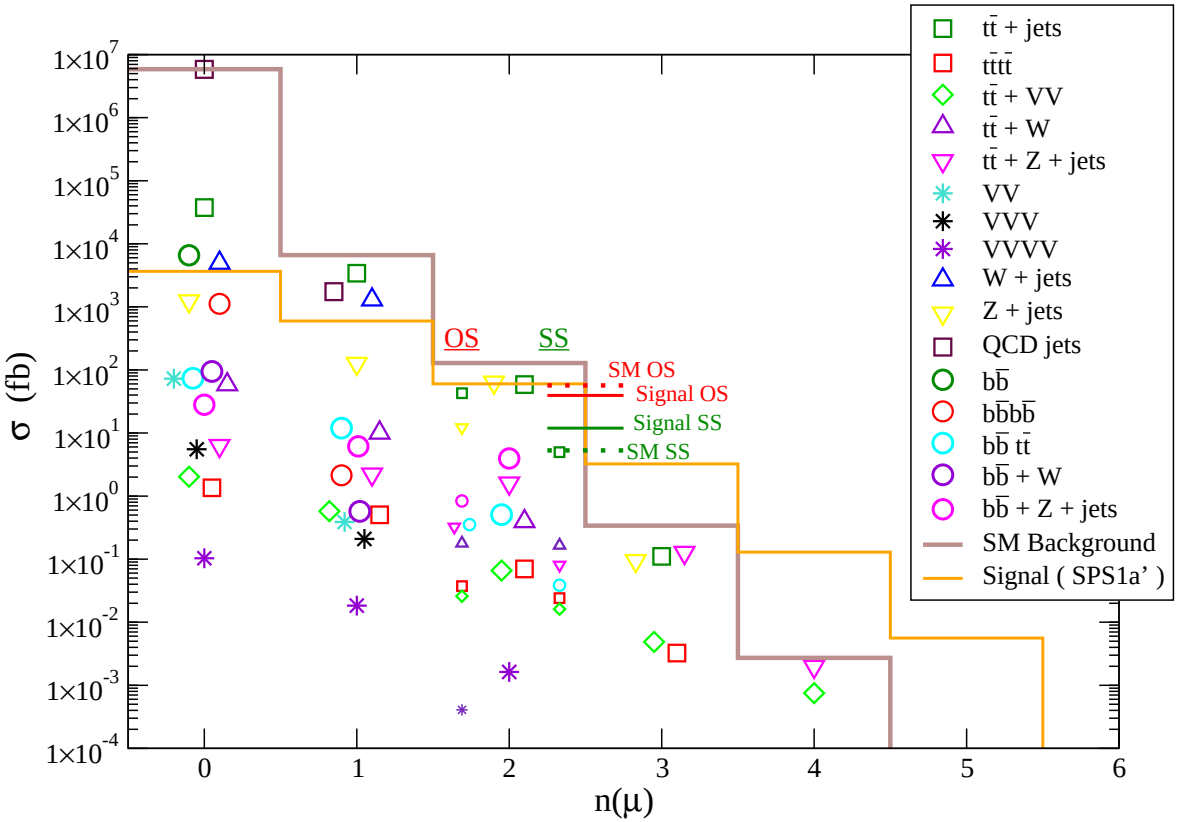
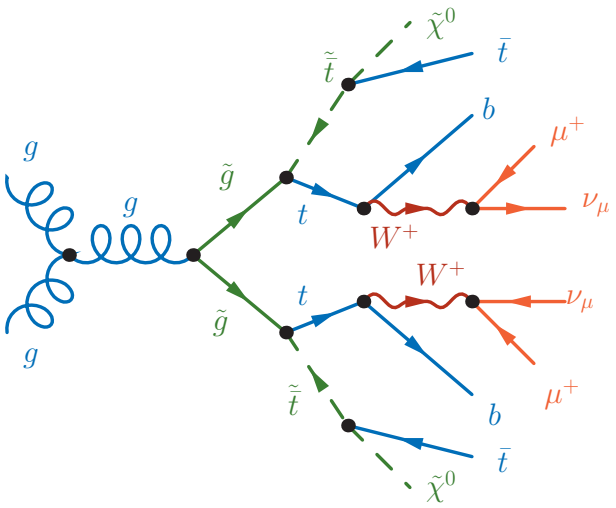


Figure: *Muon multiplicity cross sections expected from the SPS1a' mSUGRA point, along with SM background at LHC with* $\sqrt{s} = 10$ *TeV.*

Multimuon Channel



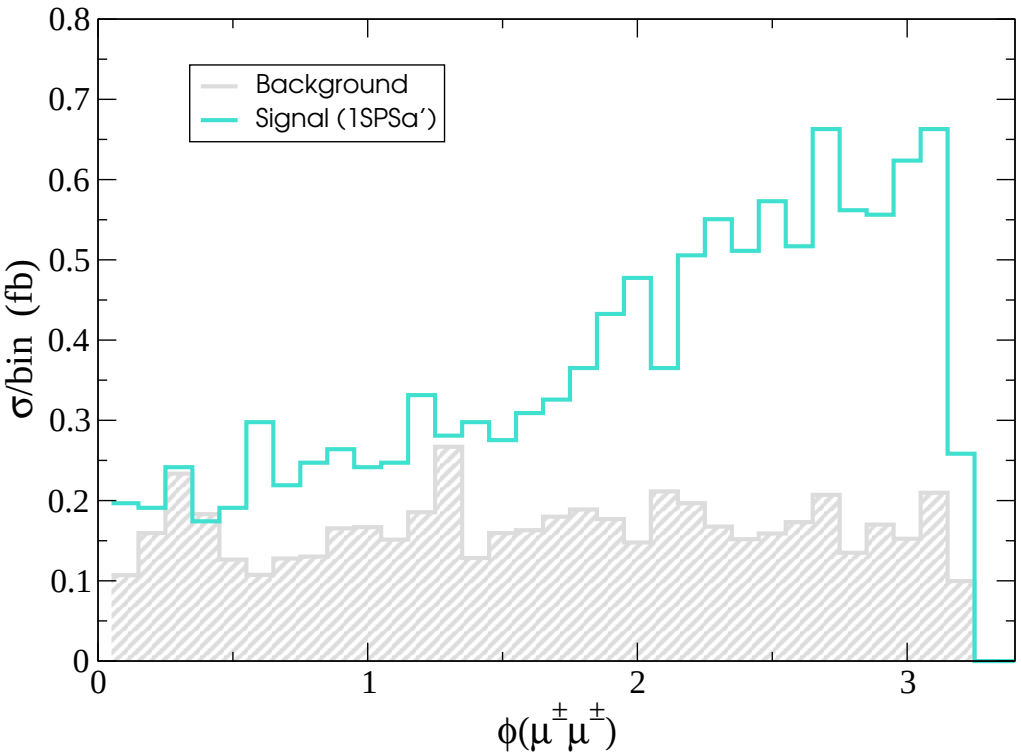


Figure: *SS dimuon $\Delta\phi$ distribution from SPS1a', along with SM backgrounds at LHC with $\sqrt{s} = 10$ TeV.*

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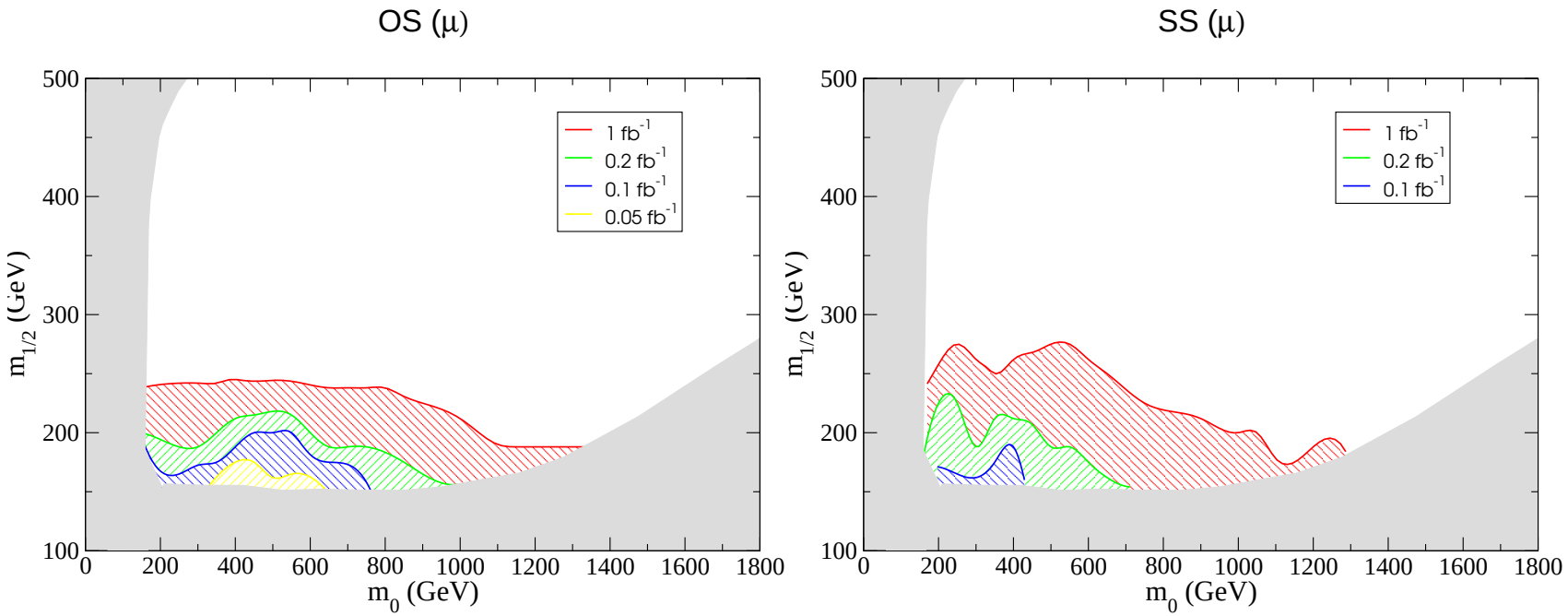


Figure: *Reach of the $\sqrt{s} = 10$ TeV LHC for mSUGRA models with $A_0 = 0$, $\tan\beta = 45$ and $\mu > 0$ via OS and SS dimuon $+ \geq 4$ jet events in the m_0 vs. $m_{1/2}$ plane, for various integrated luminosity values.*

Multimuon Channel

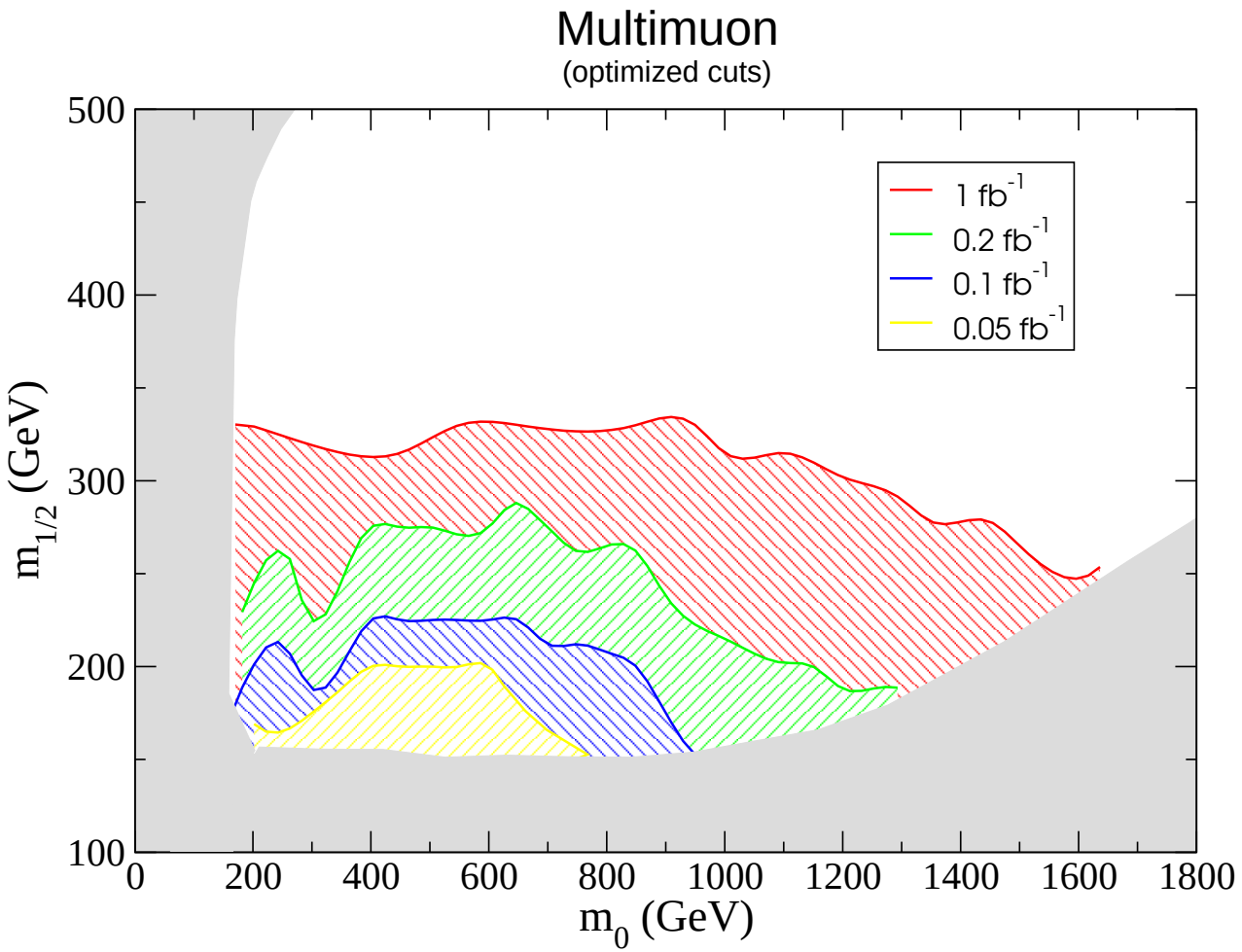
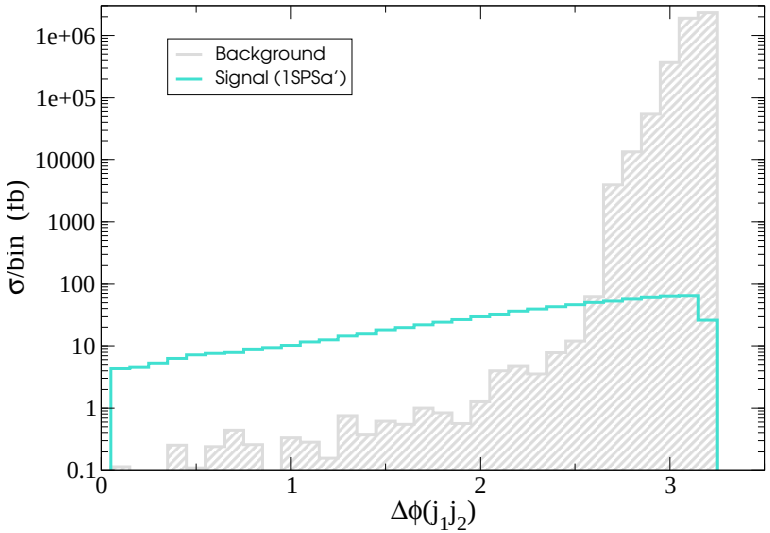


Figure: *Reach of the $\sqrt{s} = 10$ TeV LHC for mSUGRA models with $A_0 = 0$, $\tan\beta = 45$ and $\mu > 0$ in the multimuon channel with $+ \geq 2$ jets and optimized cuts for $n(\mu)$, $p_T(jet)$ and $N(jet)$ in the m_0 vs. $m_{1/2}$ plane.*

Dijet Channel

Cuts:

- $N(j) = 2, N(lep) = 0, p_T(j_1) + p_T(j_2) > 500$ GeV



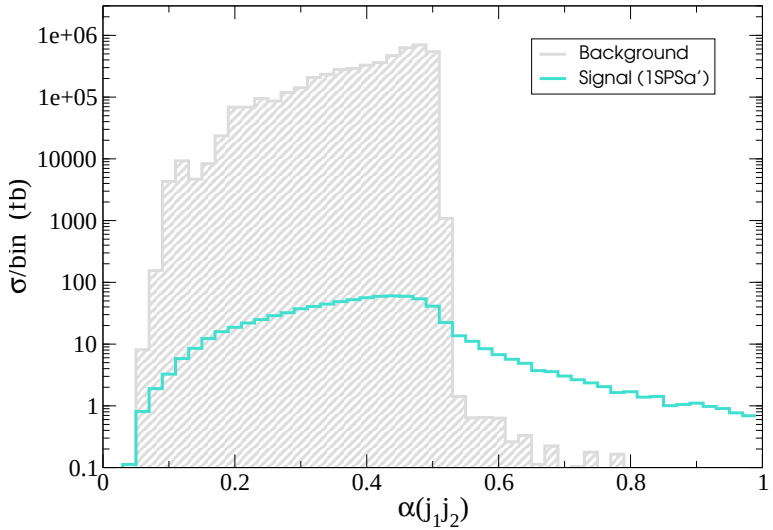


Figure: *$\Delta\phi$ and α distributions for the mSUGRa point SPS1a' and the SM background (QCD dijets, $Z(\rightarrow \nu\bar{\nu}) + 2$ jets and $W(\rightarrow \nu l) + 2$ jets)*

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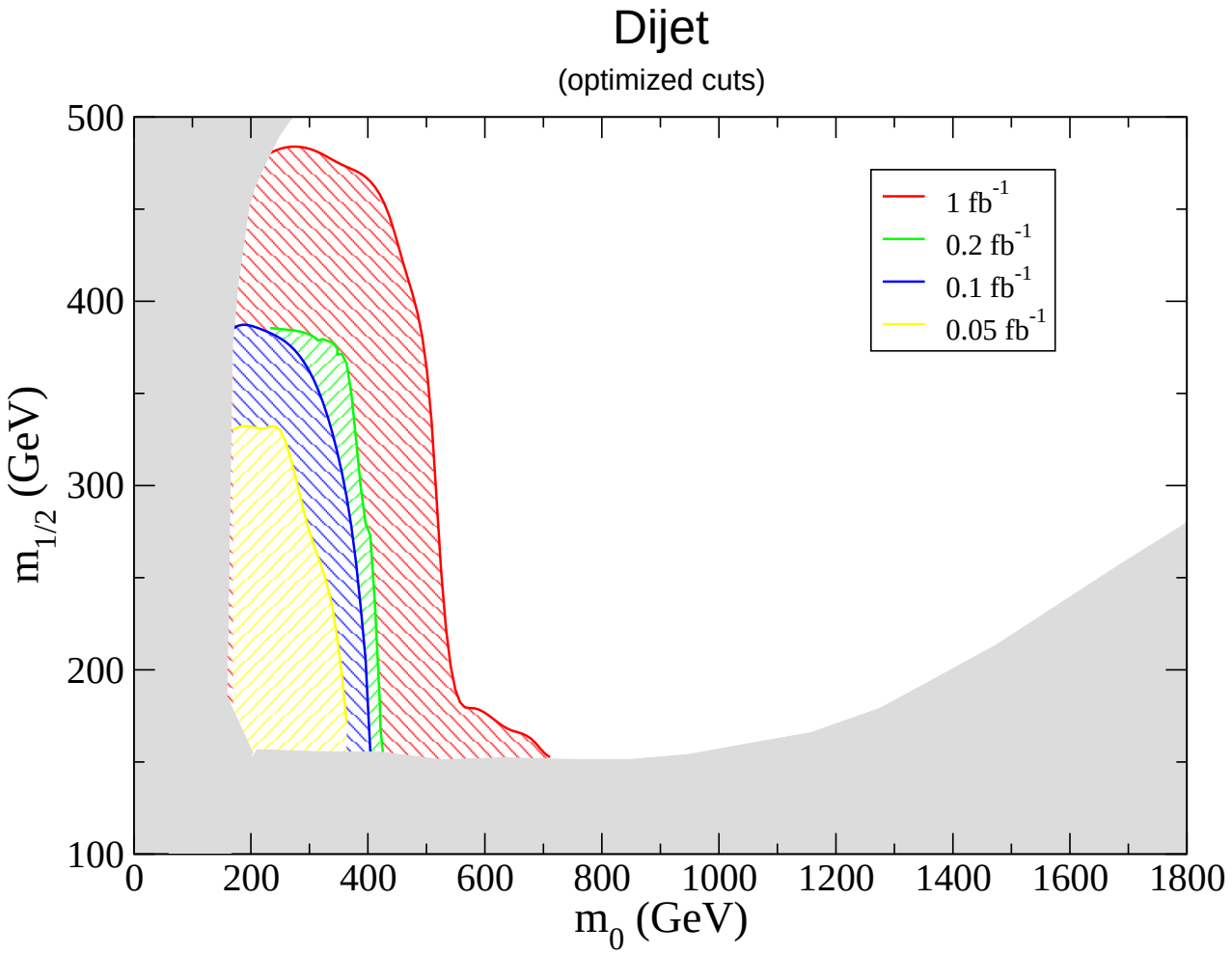

Figure: *Reach of the $\sqrt{s} = 10$ TeV LHC for mSUGRA models with $A_0 = 0$, $\tan\beta = 45$ and $\mu > 0$ in the dijet channel with optimized cuts for $\alpha(j_1 j_2)$, $\Delta\phi$ and $p_T(j_1) + p_T(j_2)$ in the m_0 vs. $m_{1/2}$ plane.*

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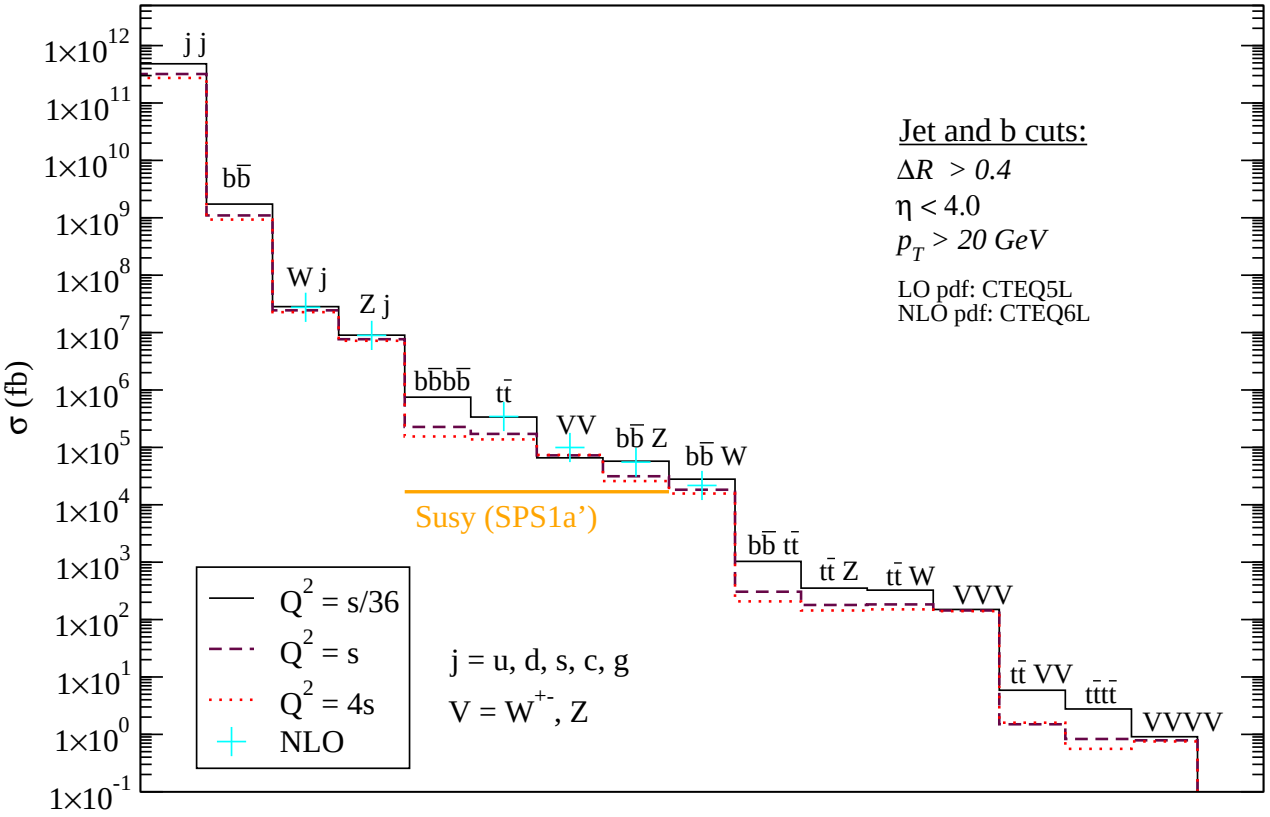
- Excesses in the multimuon or dijet channel may give hints on where to start looking for SUSY...


σ (fb)
1×10^12
1×10^11
1×10^10
1×10^9
1×10^8
1×10^7
1×10^6
1×10^5
1×10^4
1×10^3
1×10^2
1×10^1
1×10^0
1×10^-1
j j
bb̄
W j
Z j
bb̄bb̄
tt̄
VV
bb̄ Z
bb̄ W
Susy (SPS1a')
bb̄ tt̄
tt̄ Z
tt̄ W
VVV
tt̄ VV
tttt̄
VVVV
Jet and b cuts:
ΔR > 0.4
η < 4.0
p_T > 20 GeV
LO pdf: CTEQ5L
NLO pdf: CTEQ6L
Q^2 = s/36
Q^2 = s
Q^2 = 4s
NLO
j = u, d, s, c, g
V = W^+-, Z

Detector:

- $\Delta\eta \times \Delta\phi = 0.05 \times 0.05$ and $-5 < \eta < 5$
- Hadronic calorimetry: $80\%/\sqrt{E} + 3\%$ for $|\eta| < 2.6$ and $100\%/\sqrt{E} + 5\%$ for $|\eta| > 2.6$
- Electromagnetic calorimetry: $3\%/\sqrt{E} + 0.5\%$

Cuts:

- Jets: $R \equiv \sqrt{\Delta\eta^2 + \Delta\phi^2} = 0.4$, $E_T(jet) > 25$ GeV, $|\eta| \geq 3.0$
- Isolated leptons: $p_T(l) > 5$ GeV with visible activity within a cone of $\Delta R < 0.2$ of $\Sigma E_T^{cells} < 5$ GeV
- Muons: $p_T(l) > 10$ GeV, $|\eta| \geq 2.0$