

Precision predictions for direct gaugino and slepton production at the LHC

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3 July 2014



References

- B. Fuks, MK, D.R. Lamprea, M. Rothering
Gaugino production in pp collisions at a CMS energy of 8 TeV
JHEP 1210 (2012) 081 [1207.2159]
- B. Fuks, MK, D.R. Lamprea, M. Rothering
Revisiting slepton pair production at the Large Hadron Collider
JHEP 1401 (2014) 168 [1310.2621]
- B. Fuks, MK, D.R. Lamprea, M. Rothering
Precision predictions for electroweak superpartner production at
hadron colliders with RESUMMINO
EPJC 73 (2013) 2480 [1304.0790]

Particle content of the MSSM

FERMIONS			BOSONS		
spin	Name	Symbols	Name	Symbols	spin
1/2	leptons	e, ν_{eL} $\mu, \nu_{\mu L}$ $\tau, \nu_{\tau L}$	sleptons	$\tilde{e}_L, \tilde{e}_R, \tilde{\nu}_{eL}$ $\tilde{\mu}_L, \tilde{\mu}_R, \tilde{\nu}_{\mu L}$ $\tilde{\tau}_L, \tilde{\tau}_R, \tilde{\nu}_{\tau L}$	0
1/2	quarks	u, d c, s t, b	squarks	$\tilde{u}_L, \tilde{d}_L, \tilde{u}_R, \tilde{d}_R$ $\tilde{c}_L, \tilde{s}_L, \tilde{c}_R, \tilde{s}_R$ $\tilde{t}_L, \tilde{b}_L, \tilde{t}_R, \tilde{b}_R$	0
1/2	gluinos	\tilde{g}	gluons	g	1
1/2	charginos	$\tilde{\chi}_1^\pm, \tilde{\chi}_2^\pm$	EW bosons	γ, Z^0, W^\pm	1
1/2	neutralinos	$\tilde{\chi}_1^0, \tilde{\chi}_2^0, \tilde{\chi}_3^0, \tilde{\chi}_4^0$	higgs	h^0, H^0, A^0, H^\pm	0
SM particles (observed)		SM particles (not yet observed)		Super Partners (not yet observed)	

Experimental situation after LHC with 7 and 8 TeV

ATLAS SUSY Searches* - 95% CL Lower Limits

Status: Moriond 2014

ATLAS Preliminary

$$\int \mathcal{L} dt = (4.6 - 22.9) \text{ fb}^{-1} \quad \sqrt{s} = 7, 8 \text{ TeV}$$

Model	$\epsilon, \mu, \tau, \gamma$	Jets	E_T^{miss}	$[\mathcal{L} dt [\text{fb}^{-1}]$	Mass limit	Reference
Inclusive Searches	MSUGRA/CMSSM	0	2-6 jets	Yes	20.3	$m(\tilde{g})=m(\tilde{t})$
	MSUGRA/CMSSM	1 ϵ, μ	3-6 jets	Yes	20.3	1.2 TeV
	MSUGRA/CMSSM	0	7-10 jets	Yes	20.3	1.1 TeV
	$\tilde{g}\tilde{g}, \tilde{g}\tilde{q}\tilde{q}^*$	0	2-6 jets	Yes	20.3	740 GeV
	$\tilde{g}\tilde{g}, \tilde{g}\tilde{q}\tilde{q}^*$	0	2-6 jets	Yes	20.3	1.3 TeV
	$\tilde{g}\tilde{g}, \tilde{g}\tilde{q}\tilde{q}^* \rightarrow \tilde{g}\tilde{g}W^+W^-$	1 ϵ, μ	3-6 jets	Yes	20.3	1.18 TeV
	$\tilde{g}\tilde{g}, \tilde{g}\tilde{q}\tilde{q}^* \rightarrow \tilde{g}\tilde{g}\tau^+\tau^-$	2 ϵ, μ	0-3 jets	-	20.3	1.12 TeV
	GMSB ($\tilde{\tau}$ NLSP)	2 ϵ, μ	2-4 jets	Yes	4.7	1.24 TeV
	GMSB ($\tilde{\nu}_\tau$ NLSP)	1, 2 τ	0-2 jets	Yes	20.7	1.24 TeV
	GGIM (bino NLSP)	2 γ	-	Yes	20.3	1.28 TeV
GGIM (wino NLSP)	1 $\epsilon, \mu + \gamma$	-	Yes	4.8	619 GeV	
GGIM (higgsino-bino NLSP)	1 \tilde{b}	Yes	4.8	900 GeV		
GGIM (higgsino NLSP)	2 ϵ, μ (Z)	0-3 jets	Yes	5.8	690 GeV	
Gravitino LSP	0	mono-jet	Yes	10.5	645 GeV	
3 σ $\tilde{g}\tilde{g}$ & $\tilde{g}\tilde{q}\tilde{q}^*$	$\tilde{g}\tilde{g} \rightarrow \tilde{g}\tilde{g}$	0	3-3 jets	Yes	20.1	$m(\tilde{g}) > 800 \text{ GeV}$
	$\tilde{g}\tilde{g} \rightarrow \tilde{g}\tilde{q}\tilde{q}^*$	0	7-10 jets	Yes	20.3	$m(\tilde{g}) > 350 \text{ GeV}$
	$\tilde{g}\tilde{g} \rightarrow \tilde{g}\tilde{t}\tilde{t}^*$	0-1 ϵ, μ	3 \tilde{b}	Yes	20.1	$m(\tilde{g}) > 400 \text{ GeV}$
3 σ $\tilde{g}\tilde{g}$ squarks direct production	$\tilde{g}\tilde{g}, \tilde{g}\tilde{q}\tilde{q}^*$	0	2 \tilde{b}	Yes	20.1	$m(\tilde{g}) > 300 \text{ GeV}$
	$\tilde{g}\tilde{g}, \tilde{g}\tilde{q}\tilde{q}^*$	0	3 jets	Yes	20.1	$m(\tilde{g}) > 90 \text{ GeV}$
	$\tilde{g}\tilde{g}, \tilde{g}\tilde{q}\tilde{q}^* \rightarrow \tilde{g}\tilde{g}$	2 ϵ, μ (SS)	0-3 \tilde{b}	Yes	20.7	$m(\tilde{g}) > 2 m(\tilde{t})$
	$\tilde{g}\tilde{g} (\text{light}), \tilde{g}\tilde{q}\tilde{q}^*$	1-2 ϵ, μ	1-2 \tilde{b}	Yes	4.7	$m(\tilde{g}) > 55 \text{ GeV}$
	$\tilde{g}\tilde{g} (\text{light}), \tilde{g}\tilde{q}\tilde{q}^* \rightarrow W\tilde{b}\tilde{t}^*$	2 ϵ, μ	0-2 jets	Yes	20.3	$m(\tilde{g}) > m(\tilde{t}), m(W) - 50 \text{ GeV}, m(\tilde{t}) < m(\tilde{t}^*)$
	$\tilde{g}\tilde{g} (\text{medium}), \tilde{g}\tilde{q}\tilde{q}^*$	2 ϵ, μ	2 jets	Yes	20.3	$m(\tilde{g}) > 1 \text{ GeV}$
	$\tilde{g}\tilde{g} (\text{medium}), \tilde{g}\tilde{q}\tilde{q}^* \rightarrow \tilde{g}\tilde{g}$	0	0 \tilde{b}	Yes	20.1	$m(\tilde{g}) > 200 \text{ GeV}, m(\tilde{t}) > 5 \text{ GeV}$
	$\tilde{g}\tilde{g} (\text{heavy}), \tilde{g}\tilde{q}\tilde{q}^* \rightarrow \tilde{g}\tilde{g}$	1 ϵ, μ	0 \tilde{b}	Yes	20.5	$m(\tilde{g}) > 0 \text{ GeV}$
	$\tilde{g}\tilde{g} (\text{heavy}), \tilde{g}\tilde{q}\tilde{q}^* \rightarrow \tilde{g}\tilde{g}$	0	2 \tilde{b}	Yes	20.7	$m(\tilde{g}) > 0 \text{ GeV}$
	$\tilde{g}\tilde{g}, \tilde{g}\tilde{q}\tilde{q}^* \rightarrow \tilde{g}\tilde{g}$	0	mono-jet+tag	Yes	20.3	$m(\tilde{g}) - m(\tilde{t}) > 85 \text{ GeV}$
EW direct	$\tilde{g}\tilde{g}, \tilde{g}\tilde{q}\tilde{q}^*, \tilde{t}\tilde{t}^* \rightarrow \tilde{t}\tilde{t}^*$	2 ϵ, μ	0	Yes	20.3	$m(\tilde{g}) > 0 \text{ GeV}$
	$\tilde{g}\tilde{g}, \tilde{g}\tilde{q}\tilde{q}^*, \tilde{t}\tilde{t}^* \rightarrow \tilde{t}\tilde{t}^*$	2 ϵ, μ	0	Yes	20.3	$m(\tilde{g}) > 0 \text{ GeV}, m(\tilde{t}, \tilde{b}) > 0.5 m(\tilde{t}^*) + m(\tilde{b}^*)$
	$\tilde{g}\tilde{g}, \tilde{g}\tilde{q}\tilde{q}^*, \tilde{t}\tilde{t}^* \rightarrow \tilde{t}\tilde{t}^*$	2 τ	0	Yes	20.7	$m(\tilde{g}) > 0 \text{ GeV}, m(\tilde{t}, \tilde{b}) > 0.5 m(\tilde{t}^*) + m(\tilde{b}^*)$
Long-lived particles	$\tilde{g}\tilde{g}, \tilde{g}\tilde{q}\tilde{q}^*, \tilde{t}\tilde{t}^* \rightarrow \tilde{t}\tilde{t}^*$	3 ϵ, μ	0	Yes	20.3	$m(\tilde{g}) > 200-610 \text{ GeV}$
	$\tilde{g}\tilde{g}, \tilde{g}\tilde{q}\tilde{q}^*, \tilde{t}\tilde{t}^* \rightarrow \tilde{t}\tilde{t}^*$	2-3 ϵ, μ	0	Yes	20.3	$m(\tilde{g}) > 0 \text{ GeV}$
	$\tilde{g}\tilde{g}, \tilde{g}\tilde{q}\tilde{q}^*, \tilde{t}\tilde{t}^* \rightarrow \tilde{t}\tilde{t}^*$	1 ϵ, μ	2 \tilde{b}	Yes	20.3	$m(\tilde{g}) > 0 \text{ GeV}$
	Direct $\tilde{g}\tilde{g}, \tilde{g}\tilde{q}\tilde{q}^*$ prod., long-lived \tilde{g}	Disapp. trk	1 jet	Yes	20.3	$m(\tilde{g}) > m(\tilde{t}) - 160 \text{ MeV}, \tau(\tilde{g}) > 0.2 \text{ ns}$
	Stable, stopped \tilde{g} R-hadron	0	1-5 jets	Yes	22.9	$m(\tilde{g}) > 100 \text{ GeV}, 10 \mu\text{s} < \tau(\tilde{g}) < 1000 \text{ s}$
	GMSB, stable $\tilde{g}, \tilde{g}\tilde{q}\tilde{q}^* \rightarrow \tilde{g}\tilde{g} + \tau(\epsilon, \mu)$	1-2 μ	-	-	15.9	$10 \text{ - } \text{tag} > 50$
	GMSB, $\tilde{g}\tilde{g} \rightarrow \tilde{g}\tilde{g}$, long-lived \tilde{g}	2 γ	-	Yes	4.7	$0.4 < \tau(\tilde{g}) < 2 \text{ ns}$
	$\tilde{g}\tilde{g}, \tilde{g}\tilde{q}\tilde{q}^* \rightarrow \tilde{g}\tilde{g}$ (RPV)	1 μ , displ. vtx	-	-	20.3	$1.5 < c\tau < 156 \text{ mm}, \text{BR}(\tilde{g} \rightarrow 1), m(\tilde{g}) > 108 \text{ GeV}$
	LFV $\tilde{g}\tilde{g} \rightarrow \tilde{g}\tilde{g} + X, \tilde{g}\tilde{q}\tilde{q}^* \rightarrow \tilde{g}\tilde{q}\tilde{q}^* + X$	2 ϵ, μ	-	-	4.6	$X_{\mu\tau} > 0.10, X_{\mu\tau} > 0.05$
	LFV $\tilde{g}\tilde{g} \rightarrow \tilde{g}\tilde{g} + X, \tilde{g}\tilde{q}\tilde{q}^* \rightarrow \tilde{g}\tilde{q}\tilde{q}^* + X$	1 $\epsilon, \mu + \tau$	-	-	4.6	$X_{\mu\tau} > 0.10, X_{\mu\tau} > 0.05$
RPV	Bilinear RPV CMSSM	1 ϵ, μ	7 jets	Yes	4.7	$\tilde{g}\tilde{g}$
	$\tilde{g}\tilde{g}, \tilde{g}\tilde{q}\tilde{q}^* \rightarrow \tilde{g}\tilde{g}$	4 ϵ, μ	-	Yes	20.7	$m(\tilde{g}) > 300 \text{ GeV}, X_{121} > 0$
	$\tilde{g}\tilde{g}, \tilde{g}\tilde{q}\tilde{q}^* \rightarrow \tilde{g}\tilde{g}$	3 $\epsilon, \mu + \tau$	-	Yes	20.7	$m(\tilde{g}) > 80 \text{ GeV}, X_{121} > 0$
	$\tilde{g}\tilde{g}, \tilde{g}\tilde{q}\tilde{q}^* \rightarrow \tilde{g}\tilde{g}$	0-7 jets	-	Yes	20.3	$\text{BR}(\tilde{g} \rightarrow \text{BR}(\tilde{g}) + \text{BR}(\tilde{g})) > 0\%$
	$\tilde{g}\tilde{g}, \tilde{g}\tilde{q}\tilde{q}^* \rightarrow \tilde{g}\tilde{g}$	2 ϵ, μ (SS)	0-3 \tilde{b}	Yes	20.7	
	Scalar gluon pair, $\text{sgluon} \rightarrow \tilde{g}\tilde{g}$	4 jets	-	-	4.6	incl. limit from 1110.2693
	Scalar gluon pair, $\text{sgluon} \rightarrow \tilde{t}\tilde{t}^*$	2 ϵ, μ (SS)	2 \tilde{b}	Yes	14.3	
	WIMP interaction (DS, Dirac χ)	0	mono-jet	Yes	10.5	$m(\chi) > 80 \text{ GeV}$, limit of $\sim 687 \text{ GeV}$ for DS

*Only a selection of the available mass limits on new states or phenomena is shown. All limits quoted are observed minus 1 σ theoretical signal cross section uncertainty.

NLO predictions for direct EW production

W. Beenakker, MK, M. Krämer, T. Plehn, M. Spira und P. Zerwas, Phys. Rev. Lett. 83 (1999) 3780

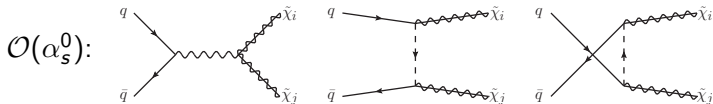
Cross section:

$$\sigma_{pp} = f_{q/p}(x, \mu) \otimes f_{\bar{q}/p}(x, \mu) \otimes \sum_{n=0}^{\infty} \alpha_s^n \sigma_{q\bar{q}}^{(n)}$$

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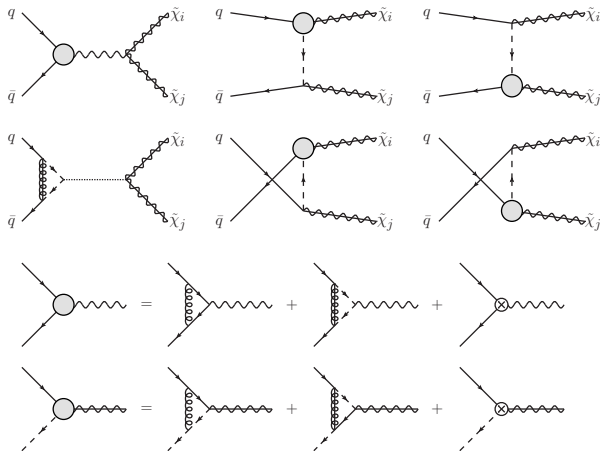


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$\mathcal{O}(\alpha_s^1)$:

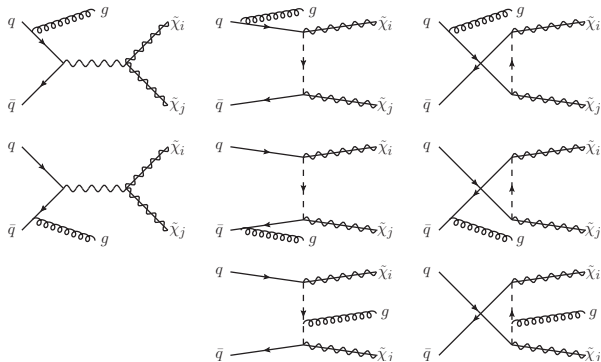


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NLL predictions for direct EW production (1)

B. Fuks, MK, D.R. Lamprea, M. Rothering, JHEP 1210 (2012) 081

Production threshold:
$$z = \frac{M^2}{s} \leq 1$$

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Resummation: $\sigma_{q\bar{q}}^{(n)}(N) = H_{q\bar{q}} \cdot \exp \left(\tilde{c}^{(1)} \ln(N) + \tilde{c}^{(2)} + \dots \right)$

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Collinear improvement: Dominant $1/N$ terms also exponentiated

NLL predictions for direct EW production (2)

B. Fuks, MK, D.R. Lamprea, M. Rothering, JHEP 1210 (2012) 081

Other critical region: $p_T \rightarrow 0$

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$$\sigma_{q\bar{q}}^{(n)}(p_T) = \sum_{m=0}^{2n-1} c^{(m)} \left[\frac{1}{p_T^2} \ln^m \left(\frac{M^2}{p_T^2} \right) \right]_+$$

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Fourier transform:
$$\left[\frac{1}{p_T^2} \ln^m \left(\frac{M^2}{p_T^2} \right) \right]_+ \rightarrow \ln^{m+1} \left(\frac{M^2 b_0^2}{b_0^2} + 1 \right)$$

with $b_0 = 2e^{-\gamma_E}$

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Same kinematic origin: Soft gluon radiation \rightarrow **joint resummation** (N, b)

NLO+NLL matching and inverse transforms

B. Fuks, MK, D.R. Lamprea, M. Rothering, JHEP 1210 (2012) 081

Matching of NLO+NLL:
$$\sigma_{ab} = \sigma_{ab}^{\text{f.o.}} + \sigma_{ab}^{\text{res.}} - \sigma_{ab}^{\text{exp.}}$$

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Inverse Mellin transform: $M^2 \frac{d\sigma_{AB}(\tau)}{dM^2} = \frac{1}{2\pi i} \int_{\mathcal{C}_N} dN \tau^{-N} M^2 \frac{d\sigma_{AB}(N)}{dM^2}$

with **minimal prescription** $\mathcal{C}_N : N = C + ze^{\pm i\phi}$ and $z \in [0; \infty[$.

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Inverse Fourier transform: $\frac{d\sigma}{dp_T^2} = \frac{M^2}{s} \int_0^\infty db \frac{b}{2} J_0(bp_T) d\sigma(b)$

with **deformed contour** $b = (\cos \phi + i \sin \phi)t$ and $t \in [0; \infty[$.

Example: LPCC benchmark point 18

B. Fuks, MK, D.R. Lamprea, M. Rothering, JHEP 1210 (2012) 081

cMSSM: $m_{1/2} = 600 \text{ GeV}$, $m_0 = 400 \text{ GeV}$; $\tan \beta = 10$, $A_0 = 0$, $\mu > 0$

$\rightarrow m_{\tilde{g}} = 1370 \text{ GeV}$, $m_{\tilde{q}} = 1275 \text{ GeV}$; $\text{BR}(\chi_2^0 \rightarrow \chi_1^0 h^0) = 92\%$

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Total cross sections:

Process	m_1 [GeV]	m_2 [GeV]	LO [fb]	NLO [fb]	NLO+NLL [fb]
$pp \rightarrow \chi_1^0 \chi_1^0$	249.6	249.6	0.13 ^{+8.6%} -7.5%	0.16 ^{+3.5%} -3.4% ^{+3.3%} -2.3%	0.16 ^{+0.2%} -0.3% ^{+3.5%} -2.4%
$pp \rightarrow \chi_2^0 \chi_1^-$	471.9	471.8	1.63 ^{+10.0%} -8.6%	1.88 ^{+1.8%} -2.4% ^{+4.1%} -3.1%	1.86 ^{+0.6%} -1.2% ^{+4.1%} -3.1%
$pp \rightarrow \chi_1^+ \chi_2^0$	471.8	471.9	4.73 ^{+9.8%} -8.4%	5.28 ^{+1.8%} -2.4% ^{+3.9%} -2.5%	5.22 ^{+0.3%} -0.6% ^{+4.0%} -2.5%
$pp \rightarrow \chi_1^+ \chi_1^-$	471.8	471.8	3.13 ^{+9.8%} -8.4%	3.57 ^{+1.9%} -2.5% ^{+3.5%} -2.2%	3.52 ^{+0.4%} -0.7% ^{+3.7%} -2.3%
$pp \rightarrow \chi_2^+ \chi_3^0$	766.3	754.0	0.16 ^{+14.2%} -11.6%	0.17 ^{+3.5%} -4.2% ^{+6.1%} -3.8%	0.17 ^{+1.0%} -1.8% ^{+6.1%} -3.8%
$pp \rightarrow \chi_2^+ \chi_4^0$	766.3	766.6	0.15 ^{+14.3%} -11.7%	0.16 ^{+3.4%} -4.2% ^{+6.1%} -3.9%	0.16 ^{+1.1%} -1.8% ^{+6.1%} -4.0%
$pp \rightarrow \chi_2^+ \chi_2^-$	766.3	766.3	0.11 ^{+13.6%} -11.2%	0.12 ^{+3.1%} -3.9% ^{+6.0%} -3.5%	0.12 ^{+1.0%} -1.8% ^{+6.0%} -3.6%

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B. Fuks, MK, D.R. Lamprea, M. Rothering, JHEP 1210 (2012) 081

cMSSM: $m_{1/2} = 600$ GeV, $m_0 = 400$ GeV; $\tan \beta = 10, A_0 = 0, \mu > 0$

$\rightarrow m_{\tilde{g}} = 1370$ GeV, $m_{\tilde{q}} = 1275$ GeV; $BR(\chi_2^0 \rightarrow \chi_1^0 h^0) = 92\%$

Total cross sections:

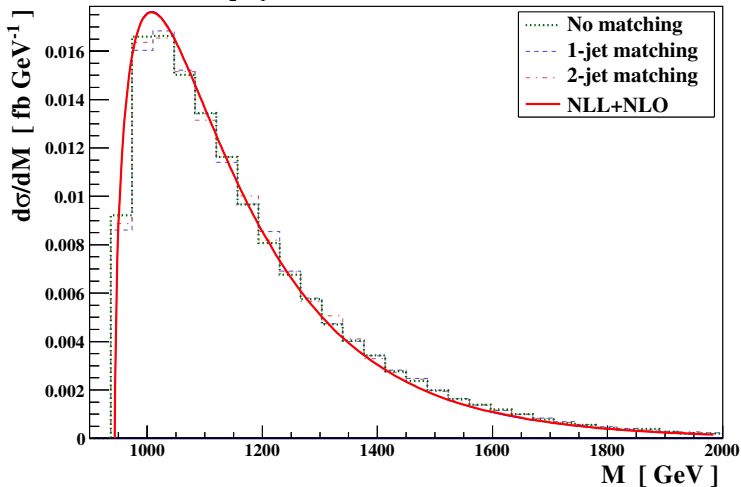
Process	m_1 [GeV]	m_2 [GeV]	LO [fb]	NLO [fb]	NLO+NLL [fb]
$pp \rightarrow \chi_1^0 \chi_1^0$	249.6	249.6	0.13 ^{+8.6%} -7.5%	0.16 ^{+3.5%} -3.4% ^{+3.3%} -2.3%	0.16 ^{+0.2%} -0.3% ^{+3.5%} -2.4%
$pp \rightarrow \chi_2^0 \chi_1^-$	471.9	471.8	1.63 ^{+10.0%} -8.6%	1.88 ^{+1.8%} -2.4% ^{+4.1%} -3.1%	1.86 ^{+0.6%} -1.2% ^{+4.1%} -3.1%
$pp \rightarrow \chi_1^+ \chi_2^0$	471.8	471.9	4.73 ^{+9.8%} -8.4%	5.28 ^{+1.8%} -2.4% ^{+3.9%} -2.5%	5.22 ^{+0.3%} -0.6% ^{+4.0%} -2.5%
$pp \rightarrow \chi_1^+ \chi_1^-$	471.8	471.8	3.13 ^{+9.8%} -8.4%	3.57 ^{+1.9%} -2.5% ^{+3.5%} -2.2%	3.52 ^{+0.4%} -0.7% ^{+3.7%} -2.3%
$pp \rightarrow \chi_2^+ \chi_3^0$	766.3	754.0	0.16 ^{+14.2%} -11.6%	0.17 ^{+3.5%} -4.2% ^{+6.1%} -3.8%	0.17 ^{+1.0%} -1.8% ^{+6.1%} -3.8%
$pp \rightarrow \chi_2^+ \chi_4^0$	766.3	766.6	0.15 ^{+14.3%} -11.7%	0.16 ^{+3.4%} -4.2% ^{+6.1%} -3.9%	0.16 ^{+1.1%} -1.8% ^{+6.1%} -4.0%
$pp \rightarrow \chi_2^+ \chi_2^-$	766.3	766.3	0.11 ^{+13.6%} -11.2%	0.12 ^{+3.1%} -3.9% ^{+6.0%} -3.5%	0.12 ^{+1.0%} -1.8% ^{+6.0%} -3.6%

Often increased, always considerably stabilized.

NLL threshold resummation vs. MadGraph+PYTHIA

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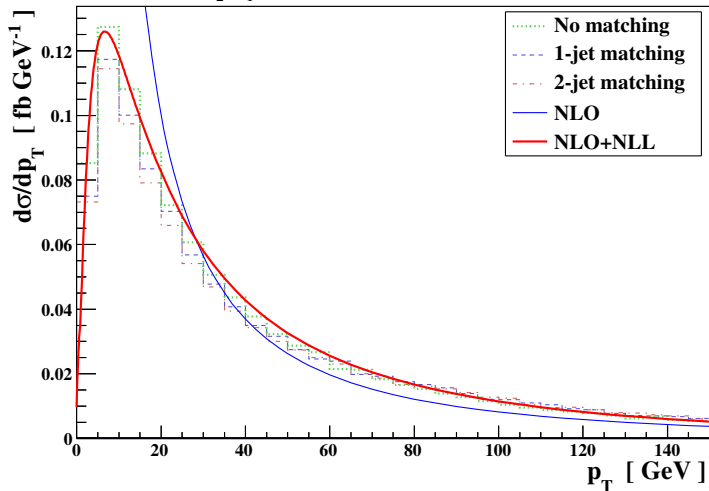
$pp \rightarrow \tilde{\chi}_2^0 \tilde{\chi}_1^+$ at the LHC (8 TeV), scenario 18



NLL p_T -resummation vs. MadGraph+PYTHIA

B. Fuks, MK, D.R. Lamprea, M. Rothering, JHEP 1210 (2012) 081

$pp \rightarrow \tilde{\chi}_2^0 \tilde{\chi}_1^+$ at the LHC (8 TeV), scenario 18



Simplified models in LHC slepton analyses

B. Fuks, MK, D.R. Lamprea, M. Rothering, JHEP 1401 (2014) 168

ATLAS/CMS light slepton (\tilde{l}) searches prior to 2014:

- Flavor-conserving decay into SM lepton l and LSP ($\tilde{\chi}_1^0$)
- Other SUSY particles (in particular \tilde{q} , \tilde{g}) decoupled
- Experimental signature: Same-flavor lepton pairs + \cancel{E}_T

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Our reanalysis:

- Different slepton flavors (also $\tilde{\tau}$)
- Left- and right-handed sleptons (incl. mixing)
- Gaugino or higgsino nature of lightest neutralino

Slepton decomposition, mixing and couplings

B. Fuks, MK, D.R. Lamprea, M. Rothering, JHEP 1401 (2014) 168

Slepton decomposition ($\tilde{e}_{L,R}$, $\tilde{\mu}_{L,R}$) and mixing ($\tilde{\tau}$):

$$\begin{pmatrix} \tilde{\tau}_1 \\ \tilde{\tau}_2 \end{pmatrix} = \begin{pmatrix} \cos \theta_{\tilde{\tau}} & \sin \theta_{\tilde{\tau}} \\ -\sin \theta_{\tilde{\tau}} & \cos \theta_{\tilde{\tau}} \end{pmatrix} \begin{pmatrix} \tilde{\tau}_L \\ \tilde{\tau}_R \end{pmatrix}$$

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Slepton couplings:

$$C_Z^{(\tau)} = \left[-\frac{1}{2} + s_W^2 \right] \cos^2 \theta_{\tilde{\tau}} + \left[s_W^2 \right] \sin^2 \theta_{\tilde{\tau}}$$

$$C_N^{(\tau,L)} = \sqrt{2}e \left[s_W N_1^* + c_W N_2^* \right] \cos \theta_{\tilde{\tau}} - \left[2c_W s_W N_3^* y_\tau \right] \sin \theta_{\tilde{\tau}}$$

$$C_N^{(\tau,R)} = \left[-2\sqrt{2}e s_W N_1 \right] \sin \theta_{\tilde{\tau}} - \left[2c_W s_W N_3 y_\tau \right] \cos \theta_{\tilde{\tau}}$$

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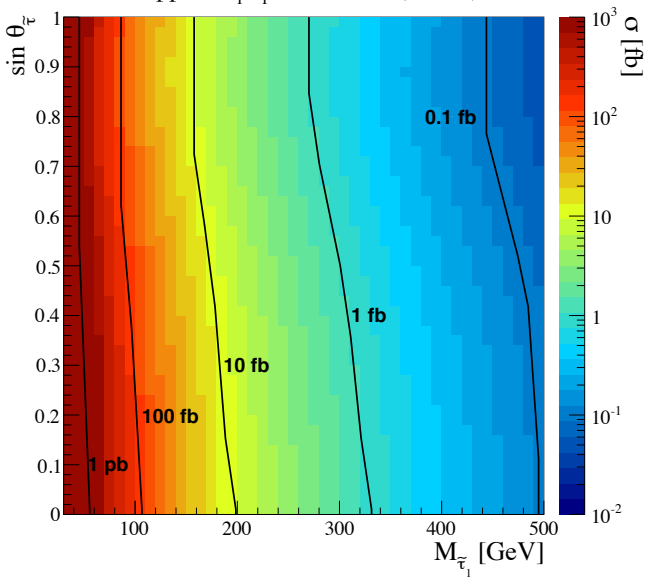
$$C_N^{(\tau,R)} = \left[-2\sqrt{2}e s_W N_1 \right] \sin \theta_{\tilde{\tau}} - \left[2c_W s_W N_3 y_\tau \right] \cos \theta_{\tilde{\tau}}$$

Unitarity constraint:

$$|N_1|^2 + |N_2|^2 + |N_3|^2 + |N_4|^2 = 1$$

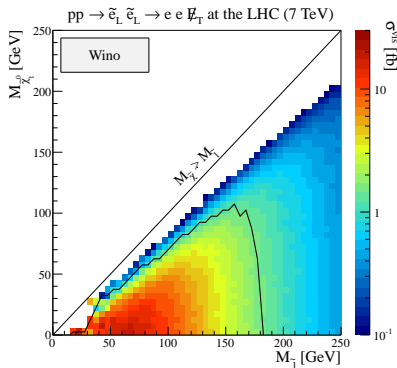
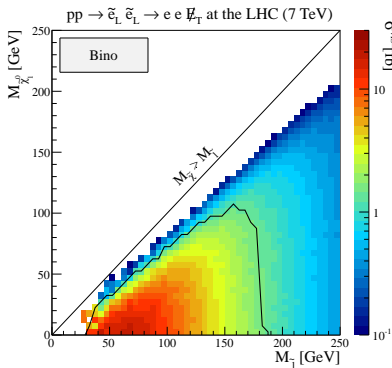
Stau mass and mixing angle dependence

$pp \rightarrow \tilde{\tau}_1 \tilde{\tau}_1$ at the LHC (8 TeV)



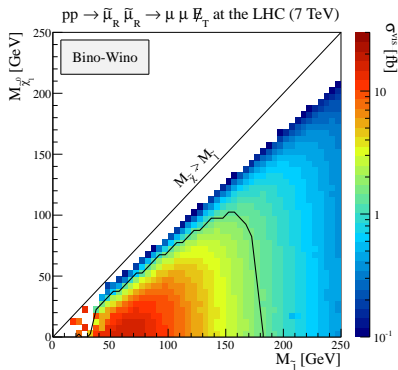
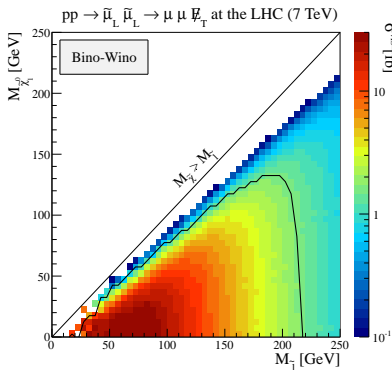
Bino/wino nature of the lightest neutralino

B. Fuks, MK, D.R. Lamprea, M. Rothering, JHEP 1401 (2014) 168



Left/right couplings of the smuon

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Resummino computes resummation predictions for Beyond the Standard Model (BSM) particle production at hadron colliders up to the NLO+NLL level. Currently the processes implemented include **gaugino**-pair production and **slepton**-pair production. It is able to compute total cross sections as well as invariant-mass and transverse-momentum distributions.

This is open-source software under the terms of the European Union Public Licence, version 1.1 or later, and is actively developed at Institut für Theoretische Physik, Universität Münster, Germany, by David Lamprea and Marcel Rothering at the Research Group of Prof. Dr. Michael Klasen.

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Documentation

A simple [Quick Start](#) is available. Further instructions to compile and run the code are available in the [README.md](#) file of the tarball.

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The latest version is **1.0.0rc2** (2013-03-12):

- [resummino-1.0.0rc2.tar.bz2](#) - Source code tarball

All versions are available on the [download server](#).

Publications

1. B. Fuks, J. Debove and M. Klasen, Phys. Lett. B **688**, 208 (2010).
2. B. Fuks, J. Debove and M. Klasen, Nucl. Phys. B **842**, 51 (2011).
3. B. Fuks, J. Debove and M. Klasen, Nucl. Phys. B **849**, 64 (2011).
4. B. Fuks, M. Klasen, D. R. Lamprea and M. Rothering, JHEP **10**, 081 (2012), [arXiv:1207.2159 \[hep-ph\]](#).