Precision predictions for direct gaugino and slepton production at the LHC

Michael Klasen

Institute for Theoretical Physics, University of Münster

3 July 2014

DFG

HELMHOLTZ | GEMEINSCHAFT

Allianz für Astroteilchenphysik

GEFÖRDERT VOM

Bundesministerium für Bildung und Forschung

References

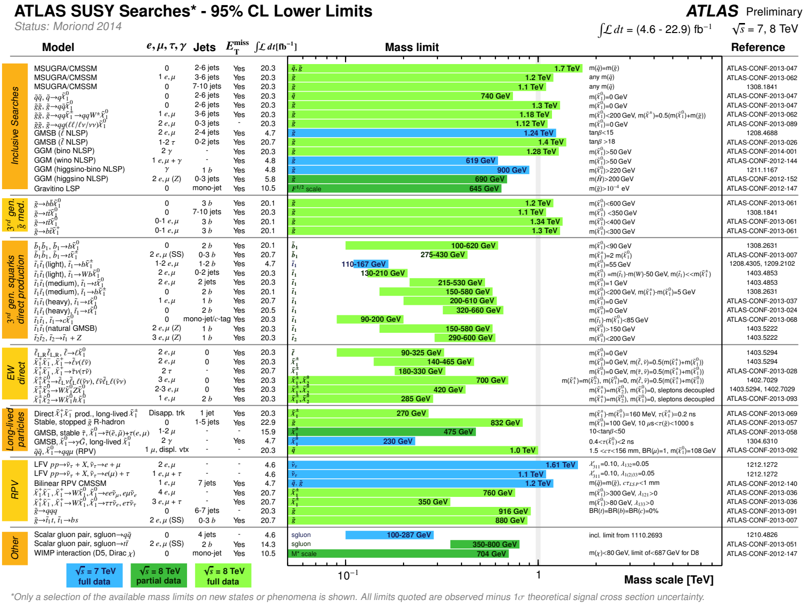
- B. Fuks, MK, D.R. Lamprea, M. Rothering
  Gaugino production in *pp* collisions at a CMS energy of 8 TeV
  JHEP 1210 (2012) 081 [1207.2159]
- B. Fuks, MK, D.R. Lamprea, M. Rothering
  Revisiting slepton pair production at the Large Hadron Collider
  JHEP 1401 (2014) 168 [1310.2621]
- B. Fuks, MK, D.R. 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
½	leptons	e, ν_{eL}	sleptons	$\tilde{e}_L, \tilde{e}_R, \tilde{\nu}_{eL}$	0
		$\mu, \nu_{\mu L}$		$\tilde{\mu}_L, \tilde{\mu}_R, \tilde{\nu}_{\mu L}$	
		$\tau, \nu_{\tau L}$		$\tilde{\tau}_L, \tilde{\tau}_R, \tilde{\nu}_{\tau L}$	
½	quarks	u, d	squarks	$\tilde{u}_L, \tilde{d}_L, \tilde{u}_R, \tilde{d}_R$	0
		c, s		$\tilde{c}_L, \tilde{s}_L, \tilde{c}_R, \tilde{s}_R$	
		t, b		$\tilde{t}_L, \tilde{b}_L, \tilde{t}_R, \tilde{b}_R$	
½	gluinos	$\tilde{g}$	gluons	g	1
½	charginos	$\tilde{\chi}_1^\pm, \tilde{\chi}_2^\pm$	EW bosons	$\gamma, Z^0, W^\pm$	1
½	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



NLO predictions for direct EW production

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

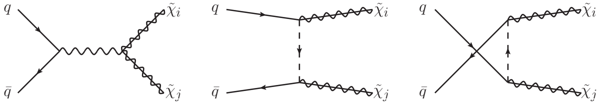
Cross section: $$\boxed{\sigma_{pp} = f_{q/p}(x,\mu) \otimes f_{\bar{q}/p}(x,\mu) \otimes \sum_{n=0}^{\infty} \alpha_s^n \sigma_{q\bar{q}}^{(n)}}$$

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

$\mathcal{O}(\alpha_s^0)$:

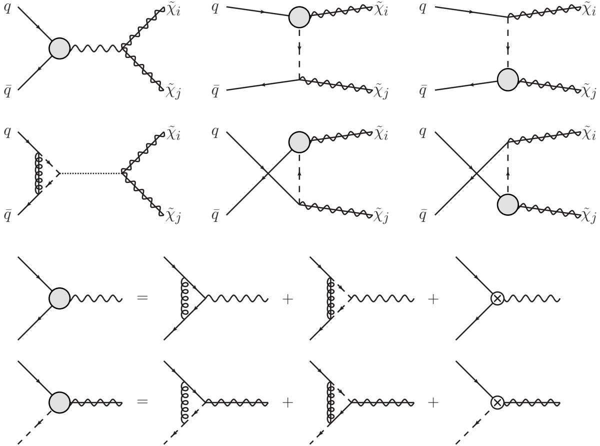


NLO predictions for direct EW production

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

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

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

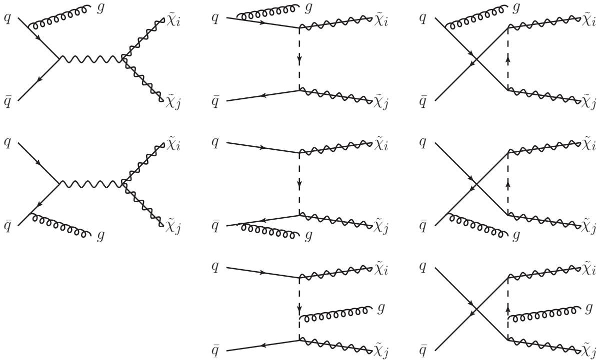


NLO predictions for direct EW production

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

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

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



NLL predictions for direct EW production (1)

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

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

NLL predictions for direct EW production (1)

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

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

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

NLL predictions for direct EW production (1)

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

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

Cross section: $\sigma^{(n)}_{q\bar{q}}(z) = \sum_{m=0}^{2n-1} c^{(m)} \left[\frac{\ln^m(1-z)}{(1-z)}\right]_+$

Mellin transform: $\left[\frac{\ln^m(1-z)}{(1-z)}\right]_+ \to \ln^{m+1}(N)$

NLL predictions for direct EW production (1)

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

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

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

Mellin transform: $\left[\frac{\ln^m(1-z)}{(1-z)}\right]_+ \to \ln^{m+1}(N)$

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

NLL predictions for direct EW production (1)

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

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

Cross section: $\sigma^{(n)}_{q\bar{q}}(z) = \sum_{m=0}^{2n-1} c^{(m)} \left[\frac{\ln^m(1-z)}{(1-z)}\right]_+$

Mellin transform: $\left[\frac{\ln^m(1-z)}{(1-z)}\right]_+ \to \ln^{m+1}(N)$

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

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: $p_T \to 0$

NLL predictions for direct EW production (2)

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

Other critical region: $p_T \to 0$

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

NLL predictions for direct EW production (2)

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

Other critical region: $p_T \to 0$

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

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

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

NLL predictions for direct EW production (2)

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

Other critical region: $p_T \to 0$

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

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

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

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

NLL predictions for direct EW production (2)

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

Other critical region: $p_T \to 0$

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

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

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

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

Same kinematic origin: Soft gluon radiation → 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: $\sigma_{ab} = \sigma_{ab}^{\rm f.o.} + \sigma_{ab}^{\rm res.} - \sigma_{ab}^{\rm exp.}$

NLO+NLL matching and inverse transforms

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

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

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

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

NLO+NLL matching and inverse transforms

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

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

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

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

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

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

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

Example: LPCC benchmark point 18

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

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

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

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

Example: LPCC benchmark point 18

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

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

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

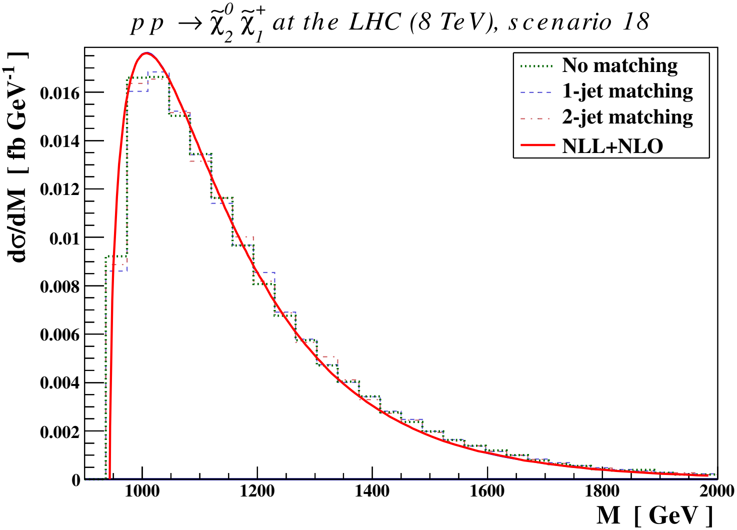
Total cross sections:

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

Often increased, always considerably stabilized.

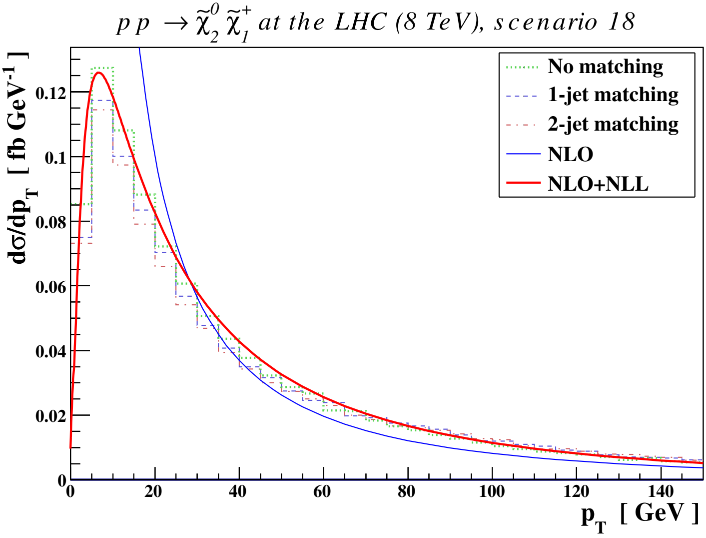
NLL threshold resummation vs. MadGraph+PYTHIA

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



NLL p_T-resummation vs. MadGraph+PYTHIA

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



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 + $\not{E}_T$

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 + $\not{E}_T$

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 ($\tilde{\tau}$):

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

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 ($\tilde{\tau}$):

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

Slepton couplings:

$$\mathcal{C}_Z^{(\tau)} = \Big[-\frac{1}{2} + s_W^2\Big]\cos^2\theta_{\tilde{\tau}} + \Big[s_W^2\Big]\sin^2\theta_{\tilde{\tau}}$$

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

$$\mathcal{C}_N^{(\tau,R)} = \Big[-2\sqrt{2}e s_W N_1\Big]\sin\theta_{\tilde{\tau}} - \Big[2c_W s_W N_3 y_\tau\Big]\cos\theta_{\tilde{\tau}}$$

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 ($\tilde{\tau}$):

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

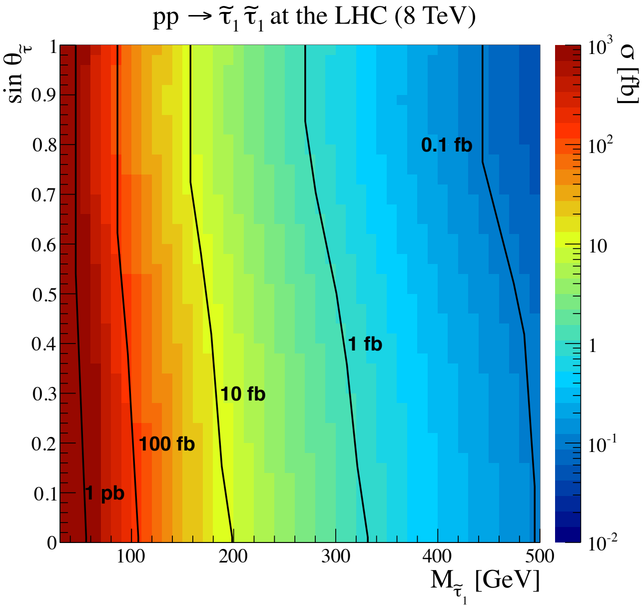
Slepton couplings:

$$\begin{aligned}
\mathcal{C}_Z^{(\tau)} &= \left[-\frac{1}{2} + s_W^2\right] \cos^2\theta_{\tilde{\tau}} + \left[s_W^2\right] \sin^2\theta_{\tilde{\tau}} \\
\mathcal{C}_N^{(\tau,L)} &= \sqrt{2}e\left[s_W N_1^* + c_W N_2^*\right] \cos\theta_{\tilde{\tau}} - \left[2 c_W s_W N_3^* y_\tau\right] \sin\theta_{\tilde{\tau}} \\
\mathcal{C}_N^{(\tau,R)} &= \left[-2\sqrt{2} e s_W N_1\right] \sin\theta_{\tilde{\tau}} - \left[2 c_W s_W N_3 y_\tau\right] \cos\theta_{\tilde{\tau}}
\end{aligned}$$

Unitarity constraint:

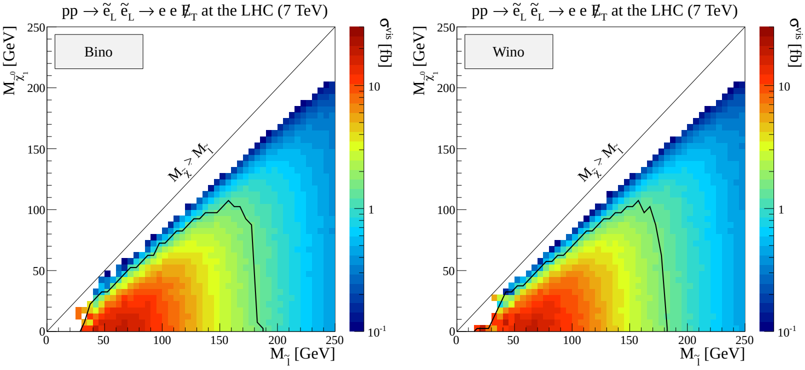
$$|N_1|^2 + |N_2|^2 + |N_3|^2 + |N_4|^2 = 1$$

Stau mass and mixing angle dependence



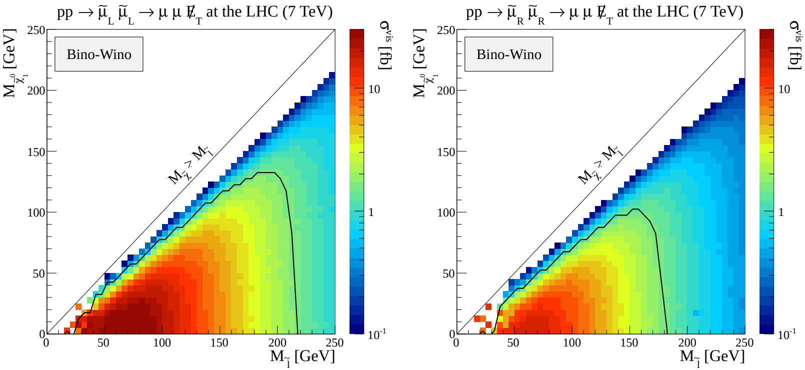
Bino/wino nature of the lightest neutralino

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



Left/right couplings of the smuon

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



Do it yourself with http://www.resummino.org/

WESTFÄLISCHE
WILHELMS-UNIVERSITÄT
MÜNSTER

Resummino | Home | Quick Start

Resummino Resummation for BSM particles

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.

Download Resummino 1.0.0rc2

Documentation:
Quick Start

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.

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.

Download

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].