Report from the Squark Subgroup

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7_{+2-1} Contributions

- SUSY Higgs bosons:
  - SUSY H production and FCNC decay
  - SUSY H $\rightarrow$ bs decay and B-physics complementarity
- Squark/gaugino production and decay
  - All NMFV amplitudes, phenomenology for 3rd gen. production
- Top squark production and decay:
  - Associated light stop + chargino production
  - Gluino $\rightarrow$ light stop decay
  - Light stop detection with ATLAS
  - Stop searches with CMS (not received)
  - Stop $\rightarrow$ right-handed sneutrino LSP decay

24_{+3-3} Participants

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- B. Fuks (Grenoble)
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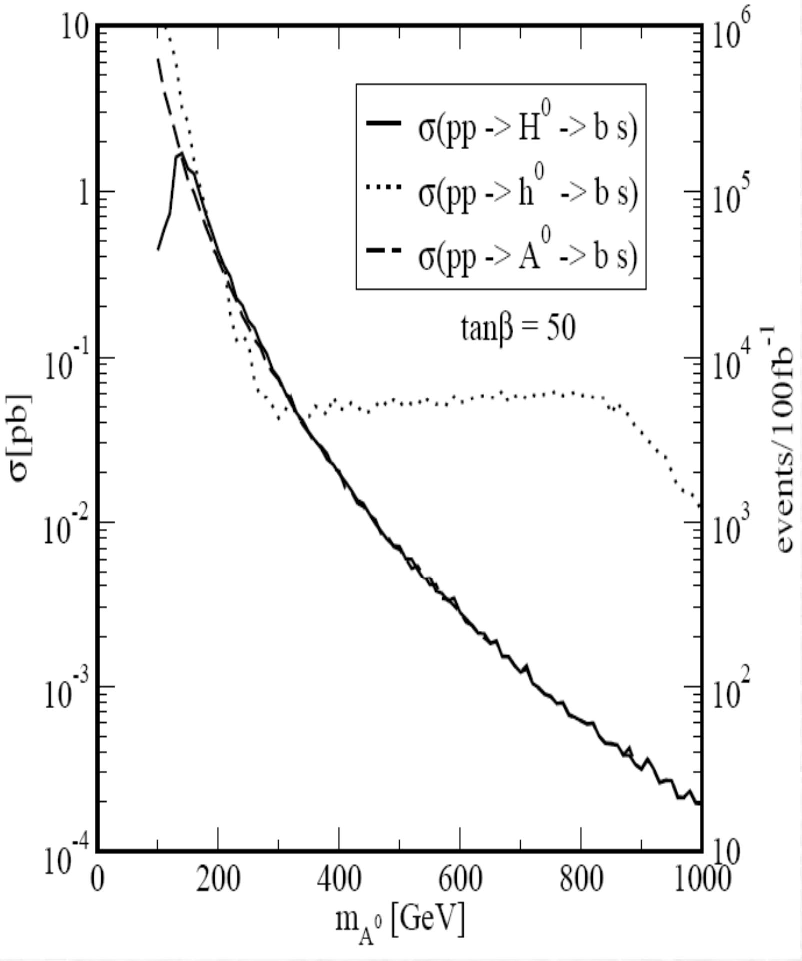
SUSY Higgs Production

Bejar, Guasch, Sola, hep-ph/0508043

- Cross section:
  - $\sigma(pp \to h \to q\,q') \equiv \sigma(pp \to hX)B(h \to q\,q')$
  - HIGLU 2.101 and PPHTT 1.1
  - Leading order only
  - Running m_q and α_s
  - Default scales
  - CTEQ4L PDFs
- Scan MSSM for σ_{max}:

h	H^0	h^0	A^0
$\sigma(pp \to h \to b\,s)$	0.45 pb	0.34 pb	0.37 pb
events/100 fb^{-1}	4.5×10^4	3.4×10^4	3.7×10^4
$B(h \to bs)$	9.3×10^{-4}	2.1×10^{-4}	8.9×10^{-4}
$\Gamma(h \to X)$	10.9 GeV	1.00 GeV	11.3 GeV
δ_{23}	$10^{-0.62}$	$10^{-1.32}$	$10^{-0.44}$
$m_{\tilde{q}}$	990 GeV	670 GeV	990 GeV
A_b	−2750 GeV	−1960 GeV	−2860 GeV
μ	−720 GeV	−990 GeV	−460 GeV
$B(b \to s\gamma)$	4.50×10^{-4}	4.47×10^{-4}	4.39×10^{-4}



SUSY Higgs Decays (1)

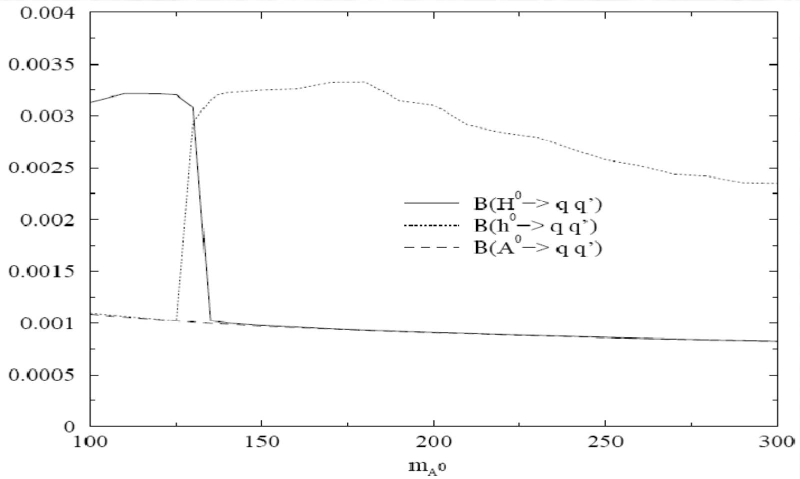
Bejar, Guasch, Sola, hep-ph/0508043

- Branching ratios ($\to$ FCHDECAY):
  - $$B(h \to q\,q') \equiv \frac{\Gamma(h \to q\,\bar{q}' + \bar{q}\,q')}{\sum_i \Gamma(h \to X_i)}$$
  - Partial decay widths: 1-loop SUSY-QCD corrections
  - FCNC Higgs couplings:
    $$g_{hq\bar{q}'} \sim \delta_{23} \frac{-\mu\, m_{\tilde{g}}}{M^2_{SUSY}} \begin{cases} \sin(\beta - \alpha_{\rm eff}) & (H^0) \\ \cos(\beta - \alpha_{\rm eff}) & (h^0) \\ 1 & (A^0) \end{cases}$$
  - Total decay width: All channels, LO only
  - Higgs mass / tan α : leading m_t, m_b tan β approximation
- Constraints on $(M^2)_{ij} = \delta_{ij}\tilde{m}_i\tilde{m}_j \; (i \neq j)$:
  - $B(b \to s\gamma) = (2.1 - 4.5)\, 10^{-4}$ (3σ), same sign as in SM
  - SUSY-QCD contribution: $A^{SQCD}(b \to s\gamma) \sim \delta_{23}\, m_b(\mu - A_b \tan\beta)/M^2_{\rm SUSY}$

SUSY Higgs Decays (2)

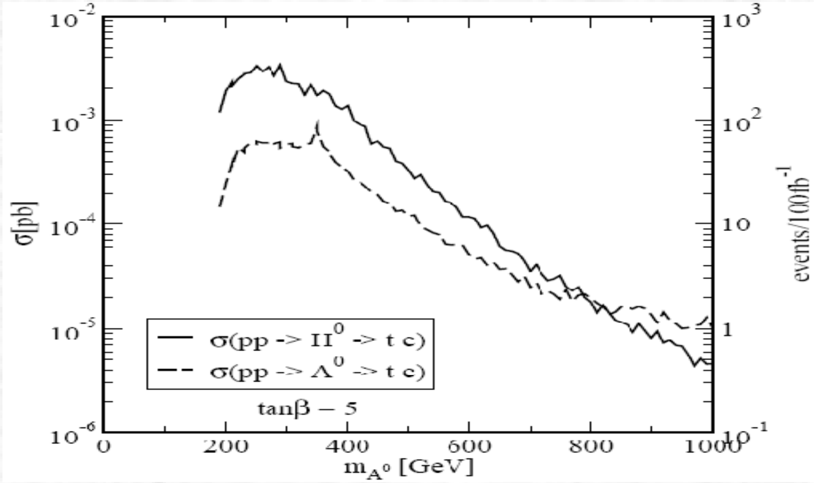
Bejar, Guasch, Sola, hep-ph/0508043

- h → bs [$\mathcal{B}(H_{SM} \to bs) \approx 4 \times 10^{-8}$]



h	H^0	h^0	A^0
$B(h \to bs)$	9.1×10^{-4}	3.1×10^{-3}	9.1×10^{-4}
$\Gamma(h \to X)$	11.2 GeV	1.4×10^{-3} GeV	11.3 GeV
δ_{23}	$10^{-0.43}$	$10^{-0.8}$	$10^{-0.43}$
M_{SUSY}	1000 GeV	975 GeV	1000 GeV
A_b	−1500 GeV	−1500 GeV	−1500 GeV
μ	−460 GeV	−1000 GeV	−460 GeV
$B(b \to s\gamma)$	4.49×10^{-4}	4.48×10^{-4}	4.49×10^{-4}

- h → tc



h	H^0	A^0
$\sigma(pp \to h \to t\,c)$	2.4×10^{-3} pb	5.8×10^{-4} pb
events/100 fb^{-1}	240	58
$B(h \to tc)$	1.9×10^{-3}	5.7×10^{-4}
$\Gamma(h \to X)$	0.41 GeV	0.39 GeV
δ_{23}	$10^{-0.10}$	$10^{-0.13}$
$m_{\tilde{q}}$	880 GeV	850 GeV
A_t	−2590 GeV	2410 GeV
μ	−700 GeV	−930 GeV
$B(b \to s\gamma)$	4.13×10^{-4}	4.47×10^{-4}

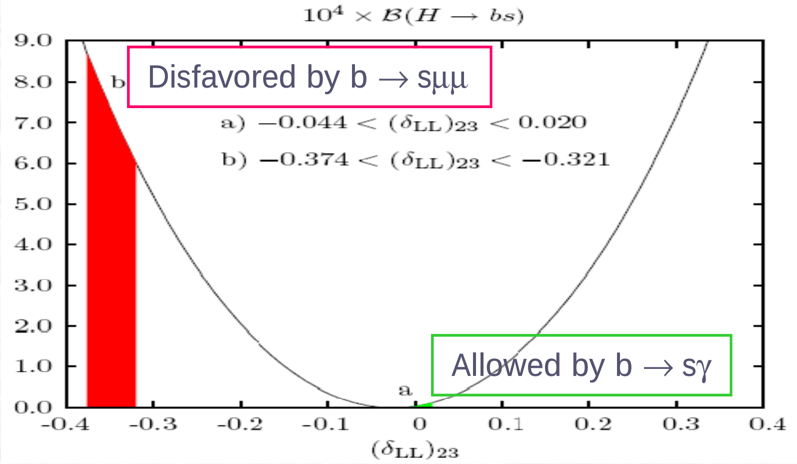
SUSY Higgs Decays (3)

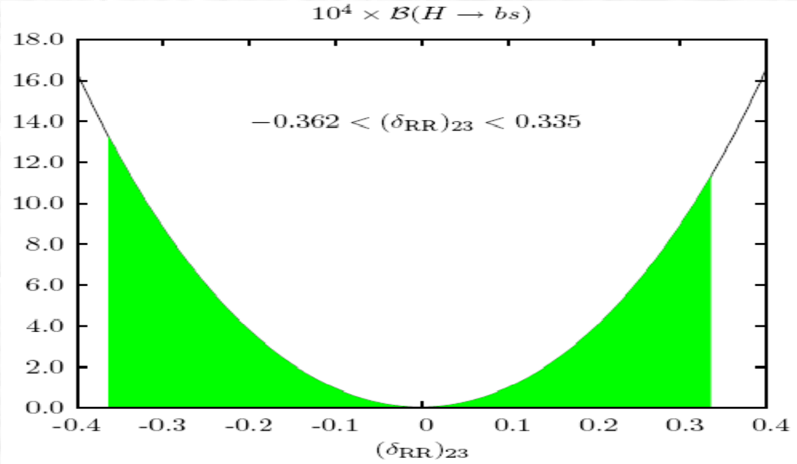
Hahn, Hollik, Illana, Penaranda, hep-ph/0512315

- B(H^0, A^0 $\to$ bs):
  - FeynArts/FormCalc/LoopTs
  - All 1-loop SM/SUSY cont.s
- B(b $\to$ sγ):
  - NMFV operators:

$$O_2 = \bar{s}_L \gamma_\mu c_L \gamma^\mu b_L,$$
$$O_7 = \frac{e}{16\pi^2} m_b \bar{s}_L \sigma_{\mu\nu} F^{\mu\nu} b_R, \qquad \tilde{O}_7 = \frac{e}{16\pi^2} m_b \bar{s}_R \sigma_{\mu\nu} F^{\mu\nu} b_L,$$
$$O_8 = \frac{g_s}{16\pi^2} m_b \bar{s}_L \sigma_{\mu\nu} G_a^{\mu\nu} t_a b_R, \qquad \tilde{O}_8 = \frac{g_s}{16\pi^2} m_b \bar{s}_R \sigma_{\mu\nu} G_a^{\mu\nu} t_a b_L.$$

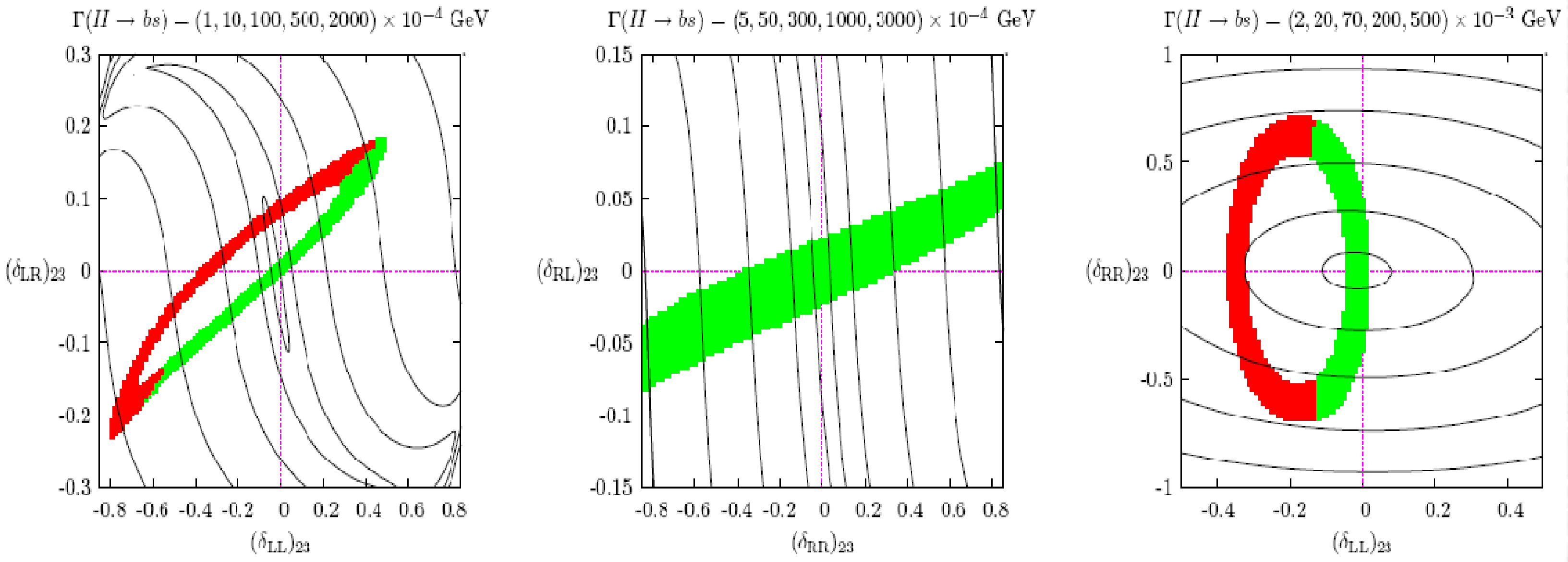
  - NLO QCD [Kagan, Neubert]
  - 1-loop SUSY contributions
- MSSM scenario:
  - $$M_{SUSY} = 800 \text{ GeV}, \quad M_2 = 300 \text{ GeV}, \quad M_1 = \frac{5}{3}\frac{s_W^2}{c_W^2} M_2,$$
    $$A = 500 \text{ GeV}, \quad m_A = 400 \text{ GeV}, \quad \tan\beta = 35, \quad \mu = -700 \text{ GeV}.$$
  - $(\delta_{ab})_{23} \equiv (\delta^u_{ab})_{23} = (\delta^d_{ab})_{23} \quad (ab = LL, LR, RL, RR)$





SUSY Higgs Decays (4)

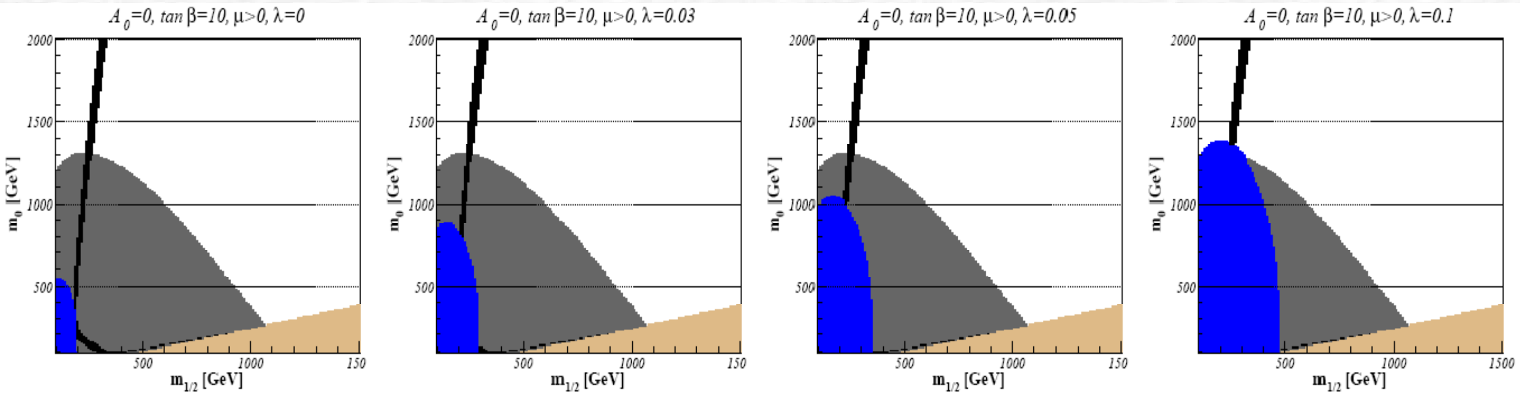
Hahn, Hollik, Illana, Penaranda, hep-ph/0512315



Scans of NMFV Parameter Space

Bozzi, Fuks, Herrmann, MK, LPSC 07-023

- Theoretical constraints:
  - $\Delta_{LL} \gg \Delta_{LR,RL} \gg \Delta_{RR}$, $\lambda_{LL}^{ct} = \lambda_{LL}^{tc*} \equiv \lambda$ and $\lambda_{LL}^{bs*} = \lambda_{LL}^{sb} \equiv \lambda$
- Experimental constraints (2σ):
  - Low energy (FeynHiggs): $\Delta\rho = -\alpha T = 0.00102 \pm 0.00086$
    $\mathrm{BR}(b \to s\gamma) = (3.55 \pm 0.26) \times 10^{-4}$ $\Delta a_\mu = (22 \pm 10) \times 10^{-10}$ [$\to \mu>0$]
  - Dark matter (DarkSUSY): $0.094 < \Omega_{CDM} h^2 < 0.136$
- mSUGRA plane ($m_{1/2}$ vs. m_0): tan β = 10, 30, 50



Proposal of 4 NMFV Benchmark Points

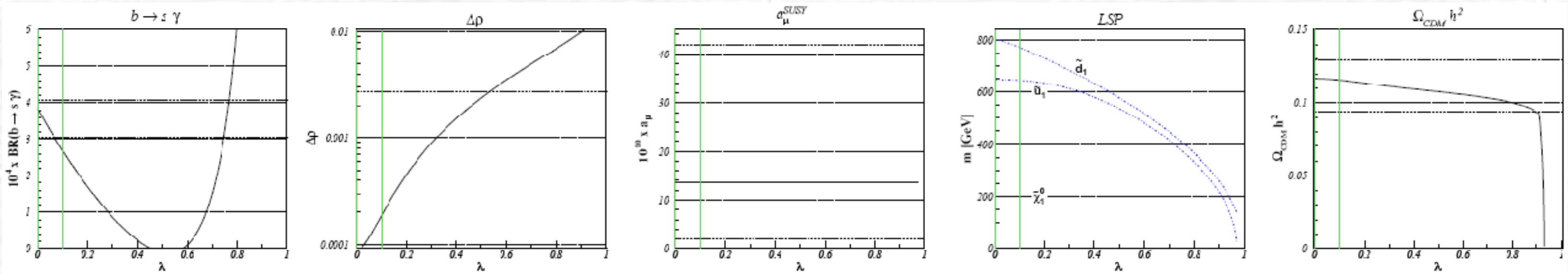
Bozzi, Fuks, Herrmann, MK, LPSC 07-023

- 4 collider-friendly NMFV benchmark points:

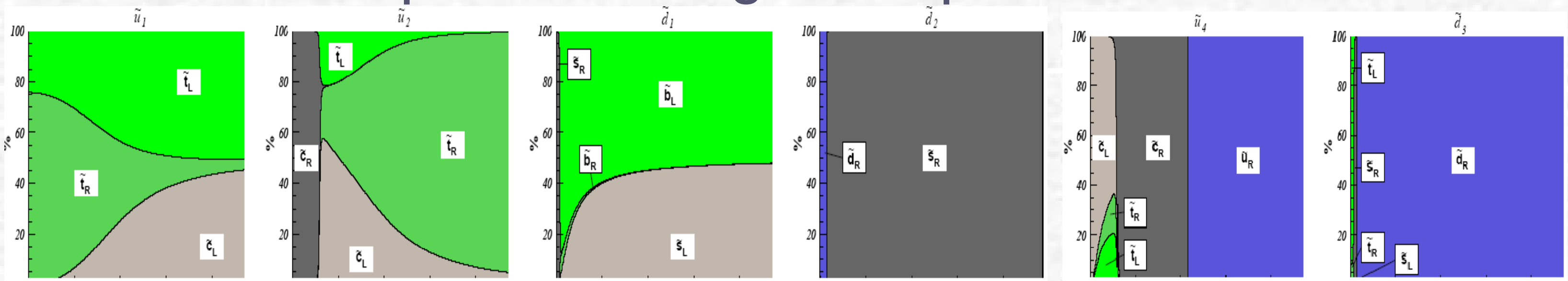
	m_0 [GeV]	$m_{1/2}$ [GeV]	A_0 [GeV]	$\tan\beta$	$sign(\mu)$
A	700	200	0	10	1
B	100	400	0	10	1

	m_0 [GeV]	$m_{1/2}$ [GeV]	A_0 [GeV]	$\tan\beta$	$sign(\mu)$
C	230	590	0	30	1
D	600	700	0	50	1

- λ-dependence of exp. constraints (point B):



- Flavour-decomposition of lighter squarks:



Squark/Gaugino Production (1)

Bozzi, Fuks, Herrmann, MK, LPSC 07-023

Squark mass matrix:

$$M^2_{\tilde U} = \left(\begin{array}{ccc|ccc} M^2_{LL,u} & \Delta^{uc}_{LL} & \Delta^{ut}_{LL} & m_u\, m_{LR,u} & \Delta^{uc}_{LR} & \Delta^{ut}_{LR} \\ \Delta^{cu}_{LL} & M^2_{LL,c} & \Delta^{ct}_{LL} & \Delta^{cu}_{RL} & m_c\, m_{LR,c} & \Delta^{ct}_{LR} \\ \Delta^{tu}_{LL} & \Delta^{tc}_{LL} & M^2_{LL,t} & \Delta^{tu}_{RL} & \Delta^{tc}_{RL} & m_t\, m_{LR,t} \\ \hline m_u\, m_{RL,u} & \Delta^{uc}_{RL} & \Delta^{ut}_{RL} & M^2_{RR,u} & \Delta^{uc}_{RR} & \Delta^{ut}_{RR} \\ \Delta^{cu}_{LR} & m_c\, m_{RL,c} & \Delta^{ct}_{RL} & \Delta^{cu}_{RR} & M^2_{RR,c} & \Delta^{ct}_{RR} \\ \Delta^{tu}_{LR} & \Delta^{tc}_{LR} & m_t\, m_{RL,t} & \Delta^{tu}_{RR} & \Delta^{tc}_{RR} & M^2_{RR,t} \end{array}\right)$$

$$\mathrm{diag}(m^2_{\tilde u_1}, \ldots, m^2_{\tilde u_6}) = R^u\, M^2_{\tilde U}\, R^{u\dagger}$$

Squared helicity amplitudes:

$$a_{h_a}(p_a)\, b_{h_b}(p_b) \;\to\; \begin{cases} \tilde q_i^{(*)}(p_1)\, \tilde q_j'^{(*)}(p_2), \\ \tilde\chi_j^{\pm}(p_1)\, \tilde q_i^{(*)}(p_2), \\ \tilde\chi_i^{\pm(0)}(p_1)\, \tilde\chi_j^{\pm(0)}(p_2), \end{cases}$$

Gauge boson couplings:

$$\{L_{\tilde q_i \tilde q_j Z}, R_{\tilde q_i \tilde q_j Z}\} = (2\,T^3_{\tilde q} - 2\,e_{\tilde q}\, x_W) \times \sum_{k=1}^{3} \{R^u_{ik}\, R^{u*}_{jk}, R^u_{i(3+k)}\, R^{u*}_{j(3+k)}\}$$

$$\{L_{\tilde u_i \tilde d_j W}, R_{\tilde u_i \tilde d_j W}\} = \sum_{k,l=1}^{3} \{\sqrt{2}\, c_W\, V_{u_k d_l}\, R^u_{ik}\, R^{d*}_{jl},\, 0\}$$

Gluino coupling:

$$\{L_{\tilde q_j q_k \tilde g}, R_{\tilde q_j q_k \tilde g}\} = \left\{R^q_{jk}, -R^q_{j(k+3)}\right\}$$

Gaugino couplings:

$$L_{\tilde d_j d_k \tilde\chi^0_i} = \left[(e_q - T^3_q)\, s_W\, N_{i1} + T^3_q\, c_W\, N_{i2}\right] R^{d*}_{jk} + \frac{m_{d_k}\, c_W\, N_{i3}\, R^{d*}_{j(k+3)}}{2\, m_W\, \cos\beta}$$

$$-R^*_{\tilde d_j d_k \tilde\chi^0_i} = e_q\, s_W\, N_{i1}\, R^d_{j(k+3)} - \frac{m_{d_k}\, c_W\, N_{i3}\, R^d_{jk}}{2\, m_W\, \cos\beta},$$

$$L_{\tilde u_j u_k \tilde\chi^0_i} = \left[(e_q - T^3_q)\, s_W\, N_{i1} + T^3_q\, c_W\, N_{i2}\right] R^{u*}_{jk} + \frac{m_{u_k}\, c_W\, N_{i4}\, R^{u*}_{j(k+3)}}{2\, m_W\, \sin\beta}$$

$$-R^*_{\tilde u_j u_k \tilde\chi^0_i} = e_q\, s_W\, N_{i1}\, R^u_{j(k+3)} - \frac{m_{u_k}\, c_W\, N_{i4}\, R^u_{jk}}{2\, m_W\, \sin\beta},$$

$$L_{\tilde d_j u_l \tilde\chi^\pm_i} = \sum_{k=1}^{3} \left[U_{i1}\, R^{d*}_{jk} - \frac{m_{d_k}\, U_{i2}\, R^{d*}_{j(k+3)}}{\sqrt{2}\, m_W\, \cos\beta}\right] V_{u_l d_k},$$

$$-R^*_{\tilde d_j u_l \tilde\chi^\pm_i} = \sum_{k=1}^{3} \frac{m_{u_l}\, V_{i2}\, V^*_{u_l d_k}\, R^d_{jk}}{\sqrt{2}\, m_W\, \sin\beta},$$

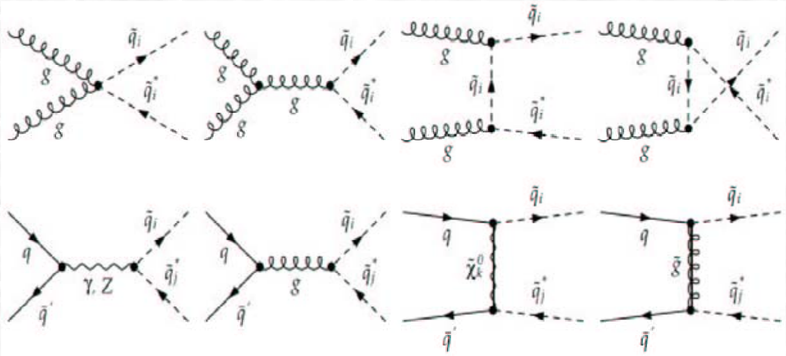
$$L_{\tilde u_j d_l \tilde\chi^\pm_i} = \sum_{k=1}^{3} \left[V^*_{i1}\, R^u_{jk} - \frac{m_{u_k}\, V^*_{i2}\, R^u_{j(k+3)}}{\sqrt{2}\, m_W\, \sin\beta}\right] V_{u_k d_l},$$

$$-R^*_{\tilde u_j d_l \tilde\chi^\pm_i} = \sum_{k=1}^{3} \frac{m_{d_l}\, U^*_{i2}\, V^*_{u_k d_l}\, R^{u*}_{jk}}{\sqrt{2}\, m_W\, \cos\beta},$$

Squark/Gaugino Production (2)

Bozzi, Fuks, Herrmann, MK, LPSC 07-023

Ex.: (Anti-)squark production



(Anti-)quark cross section:

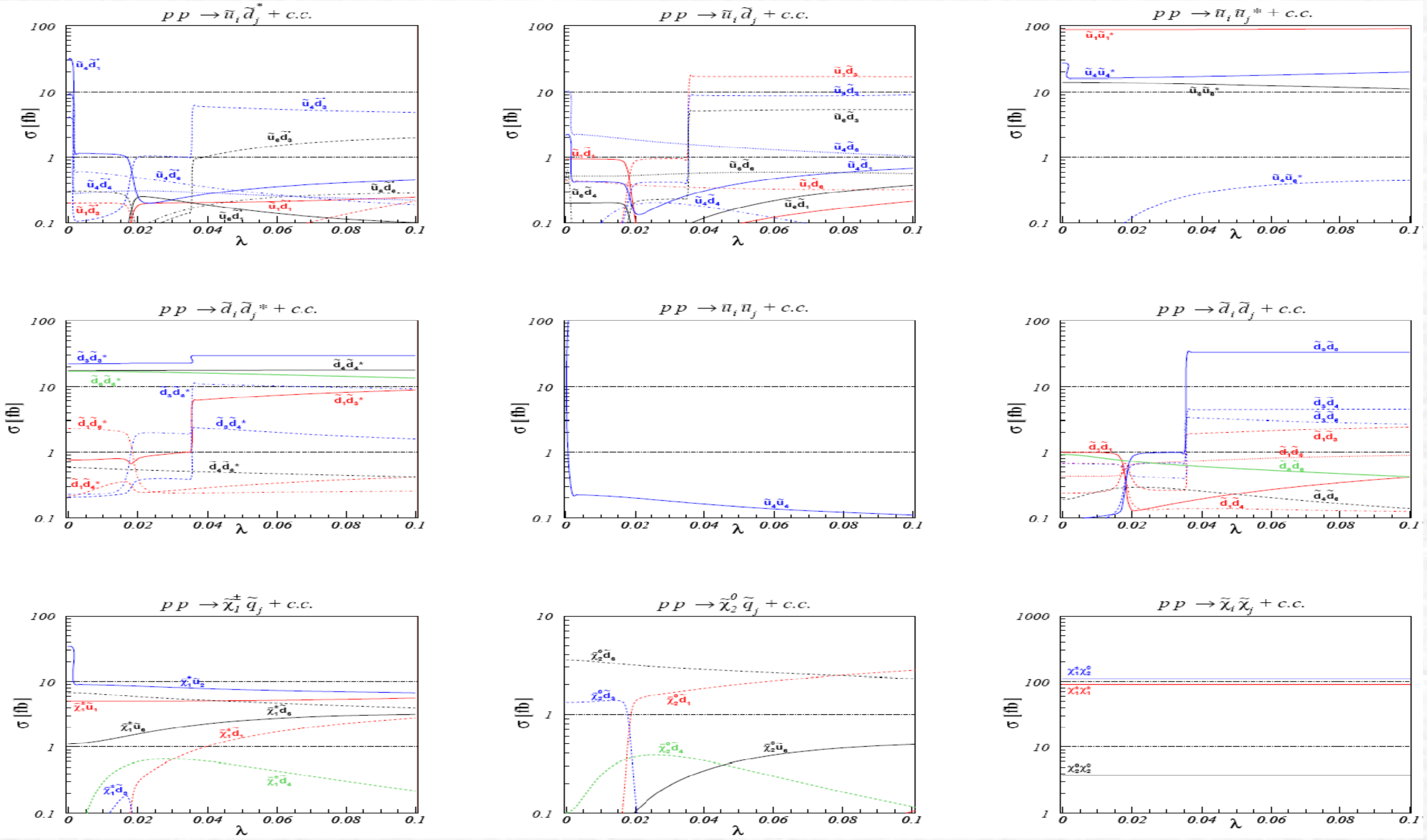
$$\begin{aligned}
\frac{d\hat{\sigma}^{q\bar{q}}_{h_a,h_b}}{dt} =\ & (1-h_a)(1+h_b)\Bigg[\frac{\mathcal{Y}}{s^2}+\frac{\mathcal{Z}_1}{s_z^2}+\frac{\mathcal{G}}{s^2}+\frac{\tilde{\mathcal{G}}_{11}}{t_{\tilde{g}}^2}+\frac{[\mathcal{YZ}]_1}{s\,s_z}+\frac{[\tilde{\mathcal{G}}\mathcal{Y}]_1}{t_{\tilde{g}}\,s}+\frac{[\tilde{\mathcal{G}}\mathcal{Z}]_1}{t_{\tilde{g}}\,s_z}+\frac{[\tilde{\mathcal{G}}\mathcal{G}]_1}{t_{\tilde{g}}\,s}\\
&+\sum_{k,l=1,\dots,4}\left(\frac{\mathcal{N}^{kl}_{11}}{t_{\tilde{\chi}^0_k}\,t_{\tilde{\chi}^0_l}}\right)+\sum_{k=1,\dots,4}\left(\frac{[\mathcal{NY}]^k_1}{t_{\tilde{\chi}^0_k}\,s}+\frac{[\mathcal{NZ}]^k_1}{t_{\tilde{\chi}^0_k}\,s_z}+\frac{[\mathcal{NG}]^k_1}{t_{\tilde{\chi}^0_k}\,s}\right)\Bigg]\\
&+(1+h_a)(1-h_b)\Bigg[\frac{\mathcal{Y}}{s^2}+\frac{\mathcal{Z}_2}{s_z^2}+\frac{\mathcal{G}}{s^2}+\frac{\tilde{\mathcal{G}}_{22}}{t_{\tilde{g}}^2}+\frac{[\mathcal{YZ}]_2}{s\,s_z}+\frac{[\tilde{\mathcal{G}}\mathcal{Y}]_2}{t_{\tilde{g}}\,s}+\frac{[\tilde{\mathcal{G}}\mathcal{Z}]_2}{t_{\tilde{g}}\,s_z}+\frac{[\tilde{\mathcal{G}}\mathcal{G}]_2}{t_{\tilde{g}}\,s}\\
&+\sum_{k,l=1,\dots,4}\left(\frac{\mathcal{N}^{kl}_{22}}{t_{\tilde{\chi}^0_k}\,t_{\tilde{\chi}^0_l}}\right)+\sum_{k=1,\dots,4}\left(\frac{[\mathcal{NY}]^k_2}{t_{\tilde{\chi}^0_k}\,s}+\frac{[\mathcal{NZ}]^k_2}{t_{\tilde{\chi}^0_k}\,s_z}+\frac{[\mathcal{NG}]^k_2}{t_{\tilde{\chi}^0_k}\,s}\right)\Bigg]\\
&+(1-h_a)(1-h_b)\left[\frac{\tilde{\mathcal{G}}_{12}}{t_{\tilde{g}}^2}+\sum_{k,l=1,\dots,4}\left(\frac{\mathcal{N}^{kl}_{12}}{t_{\tilde{\chi}^0_k}\,t_{\tilde{\chi}^0_l}}\right)\right]+(1+h_a)(1+h_b)\left[\frac{\tilde{\mathcal{G}}_{21}}{t_{\tilde{g}}^2}+\sum_{k,l=1,\dots,4}\left(\frac{\mathcal{N}^{kl}_{21}}{t_{\tilde{\chi}^0_k}\,t_{\tilde{\chi}^0_l}}\right)\right]
\end{aligned}$$

Form factors:

$$\begin{aligned}
\mathcal{Y} &= \frac{\pi\,\alpha^2\,e_q^2\,e_{\tilde{q}}^2\,\delta_{ij}\,\delta_{qq'}}{s^2}\left(u\,t-m^2_{\tilde{q}_i}\,m^2_{\tilde{q}'_j}\right),\\
\mathcal{Z}_m &= \frac{\pi\,\alpha^2}{16\,s^2\,x_W^2(1-x_W)^2}\left|L_{\tilde{q}_i\tilde{q}_jZ}+R_{\tilde{q}_i\tilde{q}_jZ}\right|^2\left(C^m_{qq'Z}\right)^2\left(u\,t-m^2_{\tilde{q}_i}\,m^2_{\tilde{q}'_j}\right),\\
\mathcal{G} &= \frac{2\,\pi\,\alpha_s^2\,\delta_{ij}\,\delta_{qq'}}{9\,s^2}\left(u\,t-m^2_{\tilde{q}_i}\,m^2_{\tilde{q}'_j}\right),\\
\mathcal{N}^{kl}_{mn} &= \frac{\pi\,\alpha^2}{x_W^2\,(1-x_W)^2\,s^2}\,\mathcal{C}^{m*}_{\tilde{q}_iq\tilde{\chi}^0_k}\,\mathcal{C}^{m}_{\tilde{q}_iq\tilde{\chi}^0_l}\,\mathcal{C}^{n}_{\tilde{q}_jq'\tilde{\chi}^0_k}\,\mathcal{C}^{n*}_{\tilde{q}_jq'\tilde{\chi}^0_l}\left[\left(u\,t-m^2_{\tilde{q}_i}\,m^2_{\tilde{q}_j}\right)\delta_{mn}+\left(m_{\tilde{\chi}^0_k}\,m_{\tilde{\chi}^0_l}\,s\right)(1-\delta_{mn})\right]\\
\tilde{\mathcal{G}}_{mn} &= \frac{2\,\pi\,\alpha_s^2}{9\,s^2}\left|\mathcal{C}^{m}_{\tilde{q}_iq\tilde{g}}\,\mathcal{C}^{n*}_{\tilde{q}_jq'\tilde{g}}\right|^2\left[\left(u\,t-m^2_{\tilde{q}_i}\,m^2_{\tilde{q}_j}\right)\delta_{mn}+\left(m^2_{\tilde{g}}\,s\right)(1-\delta_{mn})\right],\\
[\mathcal{YZ}]_m &= \frac{\pi\,\alpha^2\,e_q\,e_{\tilde{q}}\,\delta_{ij}\,\delta_{qq'}}{2\,s^2\,x_W(1-x_W)}\,\mathrm{Re}\left[L_{\tilde{q}_i\tilde{q}_jZ}+R_{\tilde{q}_i\tilde{q}_jZ}\right]C^m_{qq'Z}\left(u\,t-m^2_{\tilde{q}_i}\,m^2_{\tilde{q}'_j}\right),\\
[\mathcal{NY}]^k_m &= \frac{2\,\pi\,\alpha^2\,e_q\,e_{\tilde{q}}\,\delta_{ij}\,\delta_{qq'}}{3\,x_W\,(1-x_W)\,s^2}\,\mathrm{Re}\left[\mathcal{C}^{m}_{\tilde{q}_iq\tilde{\chi}^0_k}\,\mathcal{C}^{m*}_{\tilde{q}_jq'\tilde{\chi}^0_k}\right]\left(u\,t-m^2_{\tilde{q}_i}\,m^2_{\tilde{q}_j}\right),\\
[\mathcal{NZ}]^k_m &= \frac{\pi\,\alpha^2}{6\,x_W^2\,(1-x_W)^2\,s^2}\,\mathrm{Re}\left[\mathcal{C}^{m}_{\tilde{q}_iq\tilde{\chi}^0_k}\,\mathcal{C}^{m*}_{\tilde{q}_jq'\tilde{\chi}^0_k}\left(L_{\tilde{q}_i\tilde{q}_jZ}+R_{\tilde{q}_i\tilde{q}_jZ}\right)\right]C^m_{qq'Z}\left(u\,t-m^2_{\tilde{q}_i}\,m^2_{\tilde{q}_j}\right),\\
[\mathcal{NG}]^k_m &= \frac{8\,\pi\,\alpha\,\alpha_s\,\delta_{ij}\,\delta_{qq'}}{9\,x_W\,(1-x_W)\,s^2}\,\mathrm{Re}\left[\mathcal{C}^{m}_{\tilde{q}_iq\tilde{\chi}^0_k}\,\mathcal{C}^{m*}_{\tilde{q}_jq'\tilde{\chi}^0_k}\right]\left(u\,t-m^2_{\tilde{q}_i}\,m^2_{\tilde{q}_j}\right),\\
[\tilde{\mathcal{G}}\mathcal{G}]_m &= -\frac{4\,\pi\,\alpha_s^2\,\delta_{ij}\,\delta_{qq'}}{27\,s^2}\,\mathrm{Re}\left[\mathcal{C}^{m*}_{\tilde{q}_iq\tilde{g}}\,\mathcal{C}^{m}_{\tilde{q}_jq'\tilde{g}}\right]\left(u\,t-m^2_{\tilde{q}_i}\,m^2_{\tilde{q}_j}\right),\\
[\tilde{\mathcal{G}}\mathcal{Y}]_m &= \frac{8\,\pi\,\alpha\,\alpha_s\,e_q\,e_{\tilde{q}}\,\delta_{ij}\,\delta_{qq'}}{9\,s^2}\,\mathrm{Re}\left[\mathcal{C}^{m*}_{\tilde{q}_iq\tilde{g}}\,\mathcal{C}^{m}_{\tilde{q}_jq'\tilde{g}}\right]\left(u\,t-m^2_{\tilde{q}_i}\,m^2_{\tilde{q}_j}\right),\\
[\tilde{\mathcal{G}}\mathcal{Z}]_m &= \frac{2\,\pi\,\alpha\,\alpha_s}{9\,x_W\,(1-x_W)\,s^2}\,\mathrm{Re}\left[\mathcal{C}^{m*}_{\tilde{q}_iq\tilde{g}}\,\mathcal{C}^{m}_{\tilde{q}_jq'\tilde{g}}\left(L_{\tilde{q}_i\tilde{q}_jZ}+R_{\tilde{q}_i\tilde{q}_jZ}\right)\right]C^m_{qq'Z}\left(u\,t-m^2_{\tilde{q}_i}\,m^2_{\tilde{q}_j}\right).
\end{aligned}$$

Squark/Gaugino Production (3)

Bozzi, Fuks, Herrmann, MK, LPSC 07-023

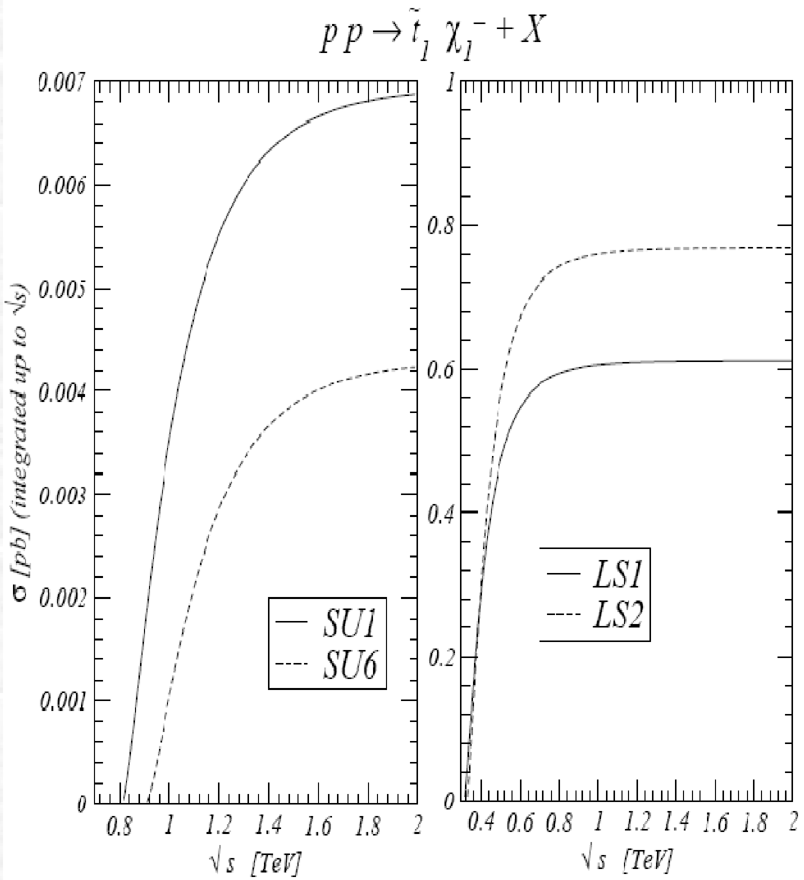


Associated Light Stop + Chargino Production

Beccaria, Macorini, Panizzi, Renard, Verzegnassi, hep-ph/0610075

- Motivation for light stop:
  - Electroweak baryogenesis
  - $m_{stop} < m_{top}$
- LO calculation:
  - $bg \to t_1\chi_1$
  - Minimal Flavour Violation
  - CTEQ6 HQ PDFs
- "Experimental" cut:
  - $p_T > 10$ GeV
- 4 benchmark points:
  - ATLAS data challenge: SU1 (tanβ = 10), SU6 (50)
  - BMRV light SUSY: LS1 (tan β = 10), LS2 (50)

- Cross section at threshold:



Gluino $\rightarrow$ Light Stop Decay (1)

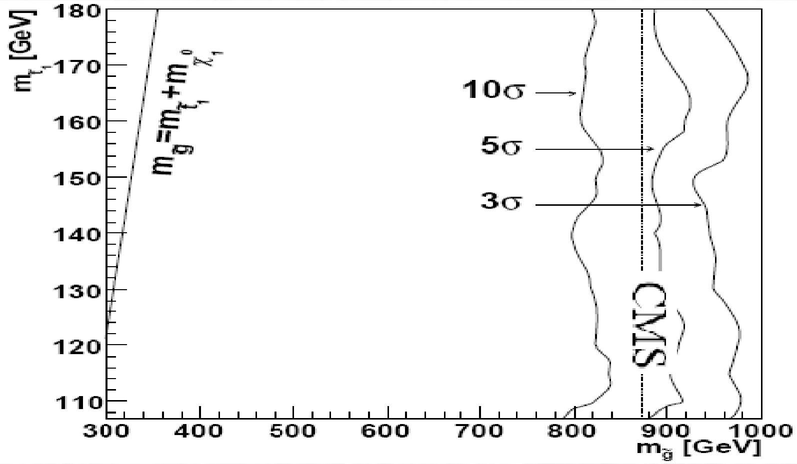
Kraml, Raklev, hep-ph/0609293

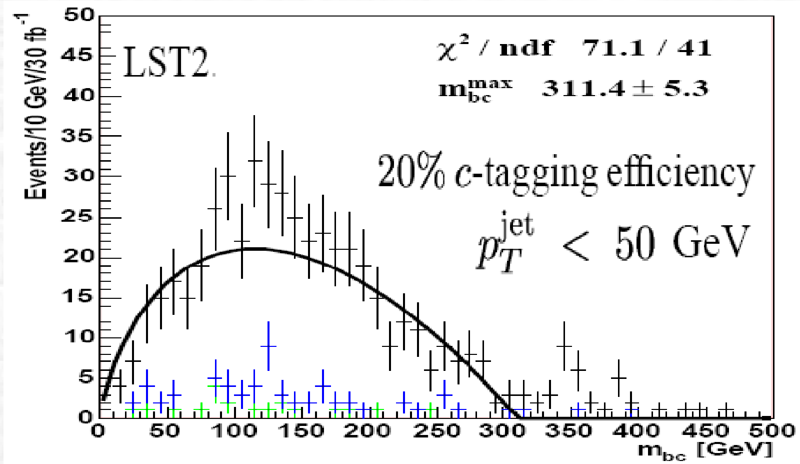
- Majorana gluino, light stop scenario:
  - $B(g \rightarrow tt_1) \sim 100$ % with $t \rightarrow bW \rightarrow bl\nu$ and $t_1 \rightarrow c\chi_1$
  - LHC signature: $pp \to \tilde{g}\tilde{g} \to bb\,l^+l^+ \ (\text{or } \bar{b}\bar{b}\,l^-l^-) + \text{jets} + \not{E}_T$
- Benchmark points:
  - LST1: $m_{\tilde{\chi}_1^0} = 105$ GeV, $m_{\tilde{t}_1} = 150$ GeV, $m_{\tilde{g}} = 660$ GeV
  - LST2: $m_{\tilde{\chi}_1^0} = 105$ GeV, $m_{\tilde{t}_1} = 125$ GeV, $m_{\tilde{g}} = 660$ GeV
- Fast generic LHC-detector simulation: 30 fb^{-1}
- Experimental cuts:
  - require two same-sign leptons (e or μ) with $p_T^{\text{lep}} > 20$ GeV;
  - require two b-tagged jets with $p_T^{\text{jet}} > 50$ GeV;
  - missing transverse energy $\not{E}_T > 100$ GeV;
  - demand two combinations of the two hardest leptons and b-jets that give invariant masses $m_{bl} < 160$ GeV, consistent with a top quark.

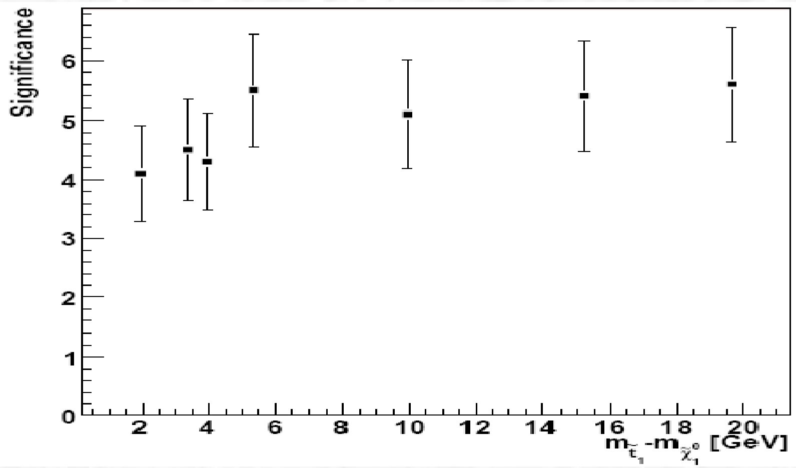
Cut		2lep, 2b	$\not{E}_T$	2t	SS
Signal:	$\tilde{g}\tilde{g}$	1091	949	831	413
Background:	SM	34224	8558	8164	53
	SUSY	255	209	174	85

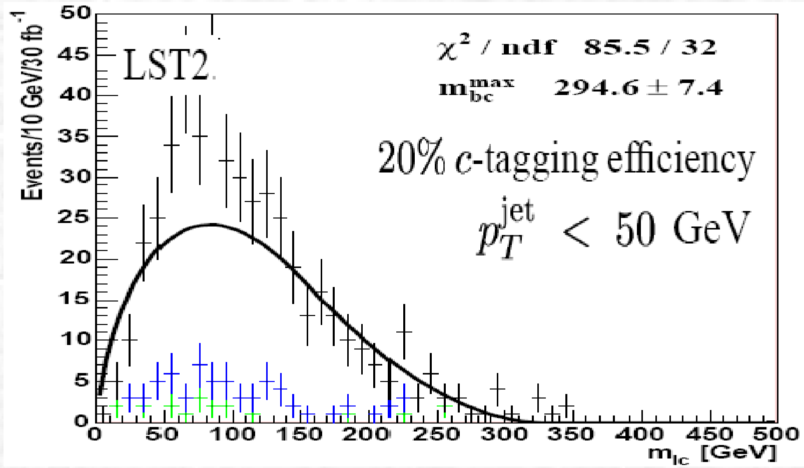
Gluino → Light Stop Decay (2)

Kraml, Raklev, hep-ph/0609293









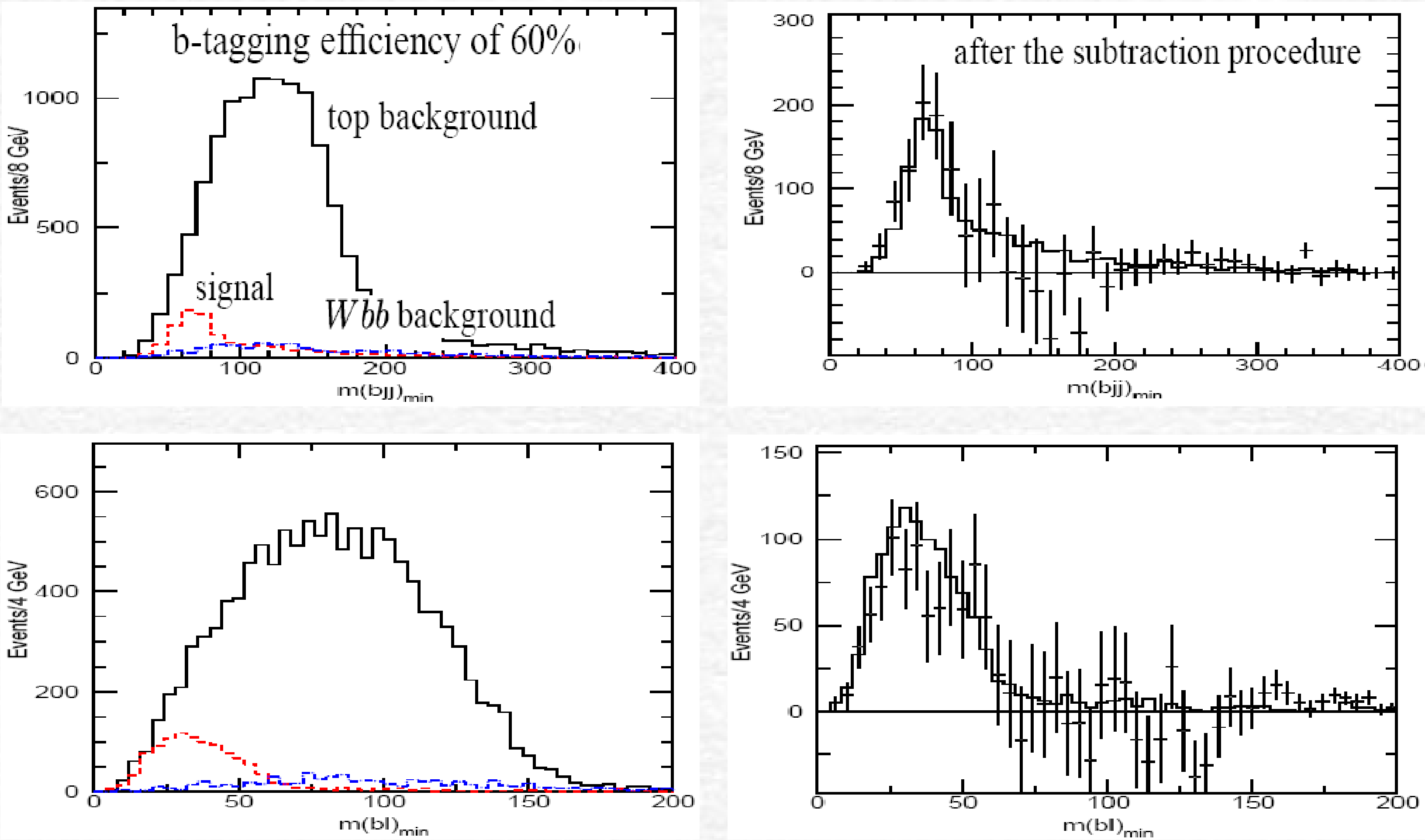
Light Stop Detection with ATLAS (1)

Lari, Polesello, ATL-PHYS-CONF-2006-014

- Benchmark point:
  - $M_1 = 60.5$ GeV $\mu = 400$ GeV $\tan\beta = 7$ $M_3 = 950$ GeV
  - $m(Q_3) = 1500$ GeV $m(\tilde{t}_R) = 0$ GeV $m(\tilde{b}_R) = 1000$ GeV $A_t = -642.8$ GeV
  - $m(\tilde{t}_1) = 137$ GeV, $m(\tilde{\chi}_1^\pm) = 111$ GeV, $m(\tilde{\chi}_1^0) = 58$ GeV.
- Signature:
  - $t_1 \to b\chi_1 \to bW\ \chi_1^0$
  - $B(tt \to bb+ll+E_T) = 4.9\%$, $B(tt \to bb+l+2jets+E_T) = 29\ \%$
- HERWIG(t_1t_1)/PYTHIA(tt)/ALPGEN(Wbb)/ATLFAST
- Experimental cuts:
  - One and only one isolated lepton (e, μ), $p_T^l > 20$ GeV.
  - $E_T^{miss} > 20$ GeV.
  - At least four jets $P_T(J_1, J_2) > 35$ GeV, $P_T(J_3, J_4) > 25$ GeV.
  - Exactly two jets in the events must be tagged as b-jets, and they both must have $p_T > 20$ GeV.

Light Stop Detection with ATLAS (2)

Lari, Polesello, ATL-PHYS-CONF-2006-014



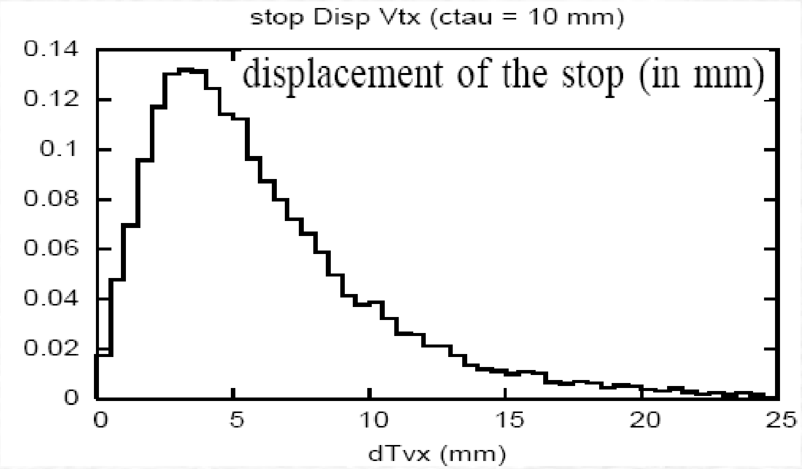
Stop $\rightarrow$ Right-Handed Sneutrino LSP Decay (1)

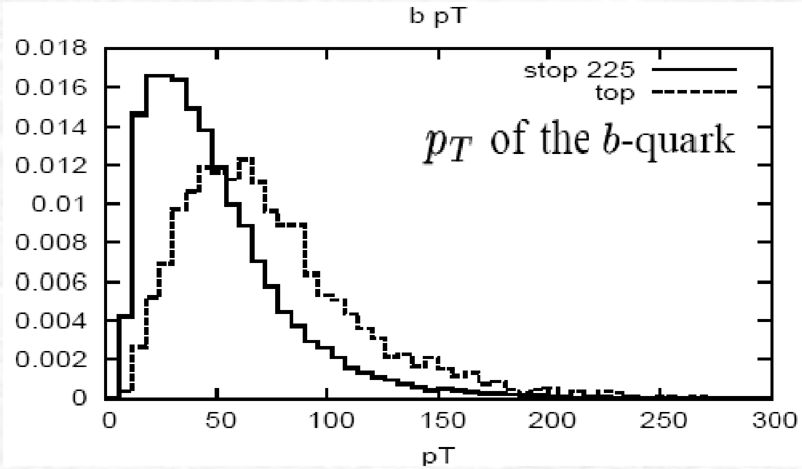
de Gouvea, Gopalakrishna, Porod, hep-ph/0606296

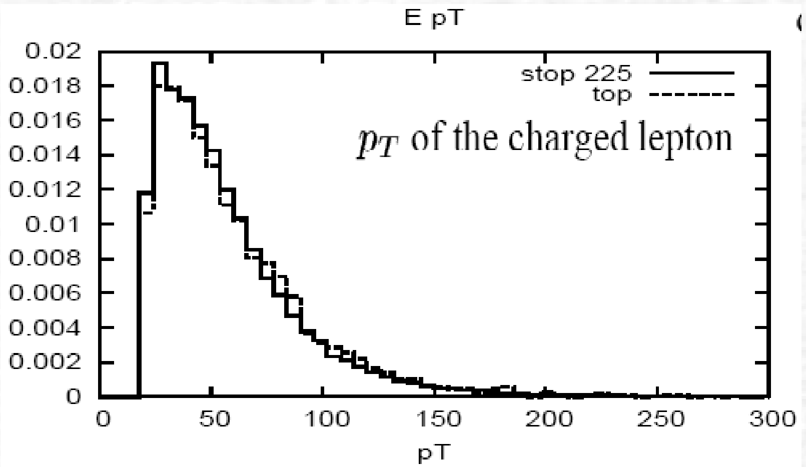
- Right-handed sneutrino LSP:
  - Massive ν's $\rightarrow$ right-handed ν's (see-saw, m_R~100 GeV)
  - SUSY: right-handed sneutrinos; small Y_N $\rightarrow$ small mixing
  - NLSP decay into right-handed sneutrino extremly slow
- Stop NLSP: t_1 ~ t_R, no chargino mixing, $\tilde{t}_1 \to b\,\ell^+\,\tilde{N}_R$
  - $$|T_{fi}|^2 \sim \frac{4|Y_t|^2|Y_N|^2 M^2_{\tilde{t}_R} E_b E_l}{\left((p_{\tilde{t}_R} - k_b)^2 - M^2_{\tilde{H}}\right)^2} \frac{(1+\cos\theta_{b\ell})}{2}$$
- Benchmark point:
  - $M_{\tilde{t}_R} = 225$ GeV, $M_{\tilde{N}_R} = 100$ GeV, $M_{\tilde{H}} = 250$ GeV $Y_N = 4 \cdot 10^{-6}$
- Signal (PYTHIA): $pp(\bar{p}) \to \tilde{t}_R \tilde{t}^*_R \to b\ell^+ \bar{b}\ell^- + E_T^{\rm miss}$
- Background (PYTHIA): $pp(\bar{p}) \to t\bar{t} \to bW^+\bar{b}W^- \to b\ell^+\bar{b}\ell^- + E_T^{\rm miss}$

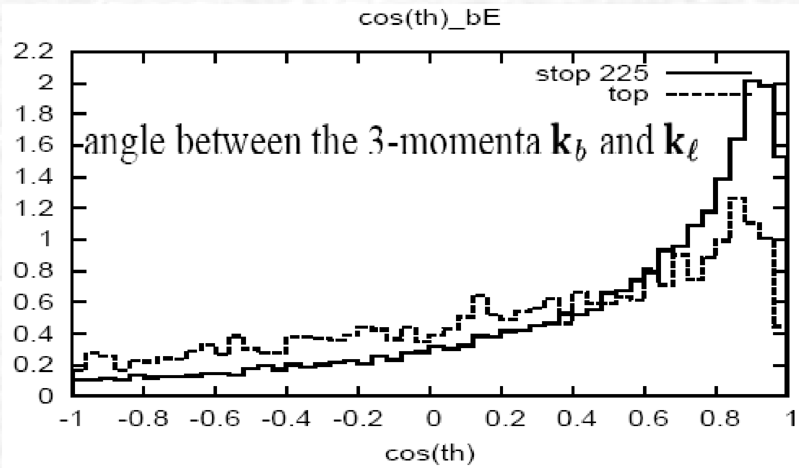
Stop → Right-Handed Sneutrino LSP Decay (2)

de Gouvea, Gopalakrishna, Porod, hep-ph/0606296









Summary

- FCNC Higgs decays:
  - Squark contributions → may be much larger than in SM
  - Put constraints on NMFV
  - Complementary to low-energy observables ($b \to s\gamma$)
- Extensive study of squarks/gauginos in NMFV:
  - All squared helicity amplitudes for production and decay known
  - Allowed regions of NMFV parameter space → 4 benchmark points
  - Level reordering → flavour changes → big cross section variations
- (Light) stops:
  - Motivated by cosmology
  - Large production cross sections
  - Good identification (SS leptons, b-tagging, displaced vertices)
  - Can involve FCNC ($t_1 \to c\chi_1$) → sensitive to NMFV