Gluino decays in Split SUSY

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Based on:

P. Gambino, G.F. Giudice, P.S., hep-ph/0506214

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Introduction

- In Split SUSY, all the scalars but the SM Higgs are much heavier than the EW scale ($\widetilde{m} = 10^5 - 10^{13}$ GeV).

- Gluinos decay only through the exchange of the heavy virtual squarks, thus they can be extremely long–lived.

- To interpret (possible) experimental results and to determine cosmological constraints on Split SUSY we need a precise prediction of the gluino lifetime and branching ratios.

- The allowed gluino decay modes are $\tilde{g} \to \chi^0 q\bar{q}$, $\tilde{g} \to \chi^{\pm} q\bar{q}'$ and $\tilde{g} \to \chi^0 g$ (decays into $\widetilde{G}$ might also be relevant).

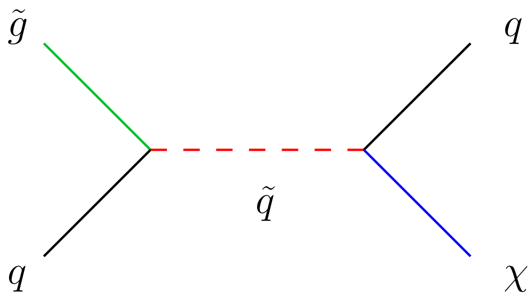
- The radiative corrections to the gluino decay processes are enhanced by powers of the potentially large $\log(\widetilde{m}/m_{\tilde{g}})$.

- For a precise determination of the gluino lifetime and branching ratios the large logarithms must be resummed to all orders with the usual renormalization group technique.

Gluino decays at lowest order

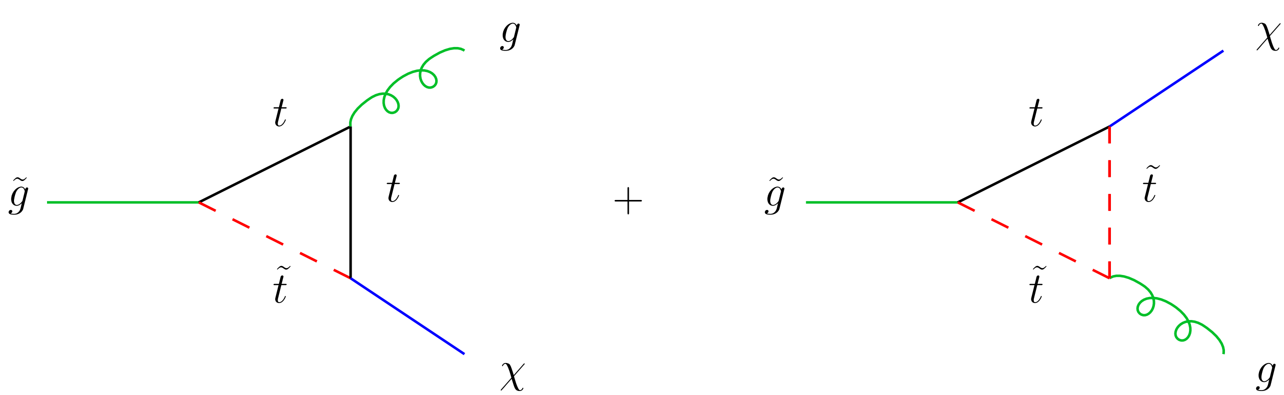
- When the decays of the gluino into squarks are kinematically closed, two different channels are available:

  – $\tilde{g} \to \chi^0 q\bar{q}, \;\; \tilde{g} \to \chi^\pm q\bar{q}'$



$$\Gamma_{\chi q q} \;\sim\; \frac{\alpha_i\, \alpha_s}{64\,\pi}\, \frac{m_{\tilde{g}}^5}{\widetilde{m}^4} \qquad (\alpha_i = \alpha_1, \alpha_2, \alpha_t)$$

  – $\tilde{g} \to \chi^0 g$

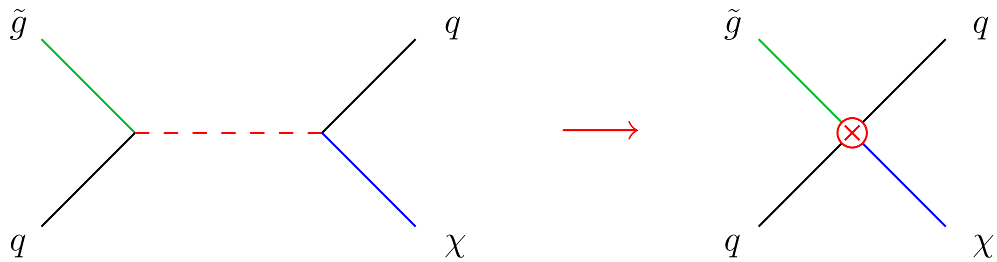


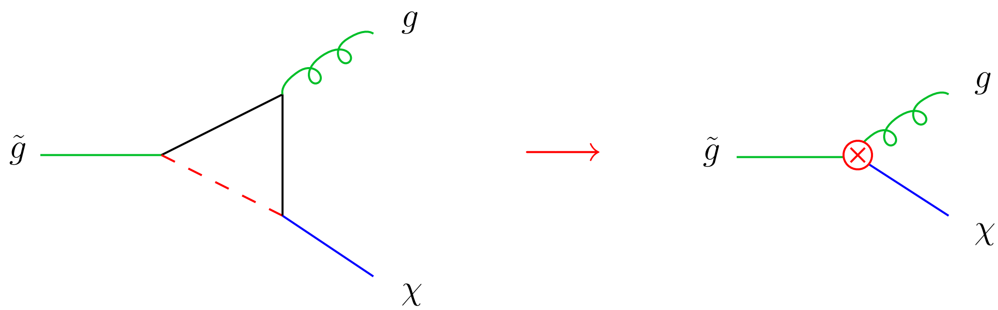
$$\Gamma_{\chi^0 g} \;\simeq\; \frac{\alpha_t\, \alpha_s^2}{32\,\pi^2}\, \frac{m_t^2\, m_{\tilde{g}}^3}{\widetilde{m}^4}\, \left(1 + \log \frac{m_t^2}{\widetilde{m}^2}\right)^2$$

- Beyond tree–level, large logarithms also appear in $\Gamma_{\chi q q}$.

Effective Lagrangian of Split SUSY

- We integrate out the squarks and get a set of four–fermion and chromomagnetic operators:





- The effective Lagrangian of Split SUSY contains:

$$\mathcal{L} \supset \frac{1}{\widetilde{m}^2} \sum_{i=1}^{7} C_i^{\widetilde{B}} Q_i^{\widetilde{B}} + \frac{1}{\widetilde{m}^2} \sum_{i=1}^{2} C_i^{\widetilde{W}} Q_i^{\widetilde{W}} + \frac{1}{\widetilde{m}^2} \left(\sum_{i=1}^{5} C_i^{\widetilde{H}} Q_i^{\widetilde{H}} + \text{h.c.} \right)$$

- Now we need to compute:
  - High–energy matching conditions: $C_i^{\chi}(\widetilde{m}) = \ldots$
  - Anomalous dimensions: $\gamma_{ij}^{\chi} = \ldots$
  - Partial decay widths: $\Gamma_{xy} = \ldots$

Operators in the effective lagrangian

- B–ino ($\widetilde{B}$) operators:

$$
\begin{aligned}
Q_1^{\widetilde{B}} &= \overline{\widetilde{B}}\,\gamma^\mu\,\gamma_5\,\tilde{g}^a \otimes \sum_{k=1}^{2} \overline{q}_L^{(k)}\,\gamma_\mu\,T^a\,q_L^{(k)} \\
Q_2^{\widetilde{B}} &= \overline{\widetilde{B}}\,\gamma^\mu\,\gamma_5\,\tilde{g}^a \otimes \sum_{k=1}^{2} \overline{u}_R^{(k)}\,\gamma_\mu\,T^a\,u_R^{(k)} \\
Q_3^{\widetilde{B}} &= \overline{\widetilde{B}}\,\gamma^\mu\,\gamma_5\,\tilde{g}^a \otimes \sum_{k=1}^{2} \overline{d}_R^{(k)}\,\gamma_\mu\,T^a\,d_R^{(k)} \\
Q_4^{\widetilde{B}} &= \overline{\widetilde{B}}\,\gamma^\mu\,\gamma_5\,\tilde{g}^a \otimes \overline{q}_L^{(3)}\,\gamma_\mu\,T^a\,q_L^{(3)} \\
Q_5^{\widetilde{B}} &= \overline{\widetilde{B}}\,\gamma^\mu\,\gamma_5\,\tilde{g}^a \otimes \overline{t}_R\,\gamma_\mu\,T^a\,t_R \\
Q_6^{\widetilde{B}} &= \overline{\widetilde{B}}\,\gamma^\mu\,\gamma_5\,\tilde{g}^a \otimes \overline{b}_R\,\gamma_\mu\,T^a\,b_R \\
Q_7^{\widetilde{B}} &= \overline{\widetilde{B}}\,\sigma^{\mu\nu}\,\gamma_5\,\tilde{g}^a\,G^a_{\mu\nu}
\end{aligned}
$$

- W–ino ($\widetilde{W}$) operators:

$$
\begin{aligned}
Q_1^{\widetilde{W}} &= \overline{\widetilde{W}^A}\,\gamma^\mu\,\gamma_5\,\tilde{g}^a \otimes \sum_{k=1}^{2} \overline{q}_L^{(k)}\,\gamma^\mu\,\tau^A\,T^a\,q_L^{(k)} \\
Q_2^{\widetilde{W}} &= \overline{\widetilde{W}^A}\,\gamma^\mu\,\gamma_5\,\tilde{g}^a \otimes \overline{q}_L^{(3)}\,\gamma^\mu\,\tau^A\,T^a\,q_L^{(3)}
\end{aligned}
$$

- Higgsino ($\widetilde{H}$) operators:

$$
\begin{aligned}
Q_1^{\widetilde{H}} &= \overline{\widetilde{H}}_L\,\tilde{g}^a_R \otimes \varepsilon\,\overline{q}_L^{(3)}\,T^a\,t_R \\
Q_2^{\widetilde{H}} &= \overline{\widetilde{H}}_L\,\sigma^{\mu\nu}\,\tilde{g}^a_R \otimes \varepsilon\,\overline{q}_L^{(3)}\,\sigma_{\mu\nu}\,T^a\,t_R \\
Q_3^{\widetilde{H}} &= \overline{\widetilde{H}}_R\,\tilde{g}^a_L \otimes \overline{b}_R\,T^a\,q_L^{(3)} \\
Q_4^{\widetilde{H}} &= \overline{\widetilde{H}}_R\,\sigma^{\mu\nu}\,\tilde{g}^a_L \otimes \overline{b}_R\,\sigma_{\mu\nu}\,T^a\,q_L^{(3)} \\
Q_5^{\widetilde{H}} &= \overline{\widetilde{H}}_L\,\sigma^{\mu\nu}\,\tilde{g}^a_R\,h\,G^a_{\mu\nu}
\end{aligned}
$$

High–energy matching conditions

- B–ino operators:

$$C_1^{\widetilde{B}}(\widetilde{m}) = C_4^{\widetilde{B}}(\widetilde{m}) = -\frac{g_s\, g'}{6}\, r_{\tilde{q}_L}\,, \quad C_2^{\widetilde{B}}(\widetilde{m}) = C_5^{\widetilde{B}}(\widetilde{m}) = \frac{2\, g_s\, g'}{3}\, r_{\tilde{u}_R}$$

$$C_3^{\widetilde{B}}(\widetilde{m}) = C_6^{\widetilde{B}}(\widetilde{m}) = -\frac{g_s\, g'}{3}\, r_{\tilde{d}_R}$$

$$C_7^{\widetilde{B}}(\widetilde{m}) = \frac{g_s^2\, g'}{128\,\pi^2}\,(m_{\tilde{g}} - m_{\widetilde{B}})\,\sum_q (r_{\tilde{q}_L} - r_{\tilde{q}_R})\,Q_q$$

- W–ino operators:

$$C_1^{\widetilde{W}}(\widetilde{m}) = C_2^{\widetilde{W}}(\widetilde{m}) = -\frac{g_s\, g}{2}\, r_{\tilde{q}_L}.$$

- Higgsino operators:

$$C_1^{\widetilde{H}}(\widetilde{m}) = \frac{g_s\, h_t}{\sqrt{2}\sin\beta}\,(r_{\tilde{q}_L} - r_{\tilde{u}_R})\,, \quad C_2^{\widetilde{H}}(\widetilde{m}) = \frac{g_s\, h_t}{4\sqrt{2}\sin\beta}\,(r_{\tilde{q}_L} + r_{\tilde{u}_R})$$

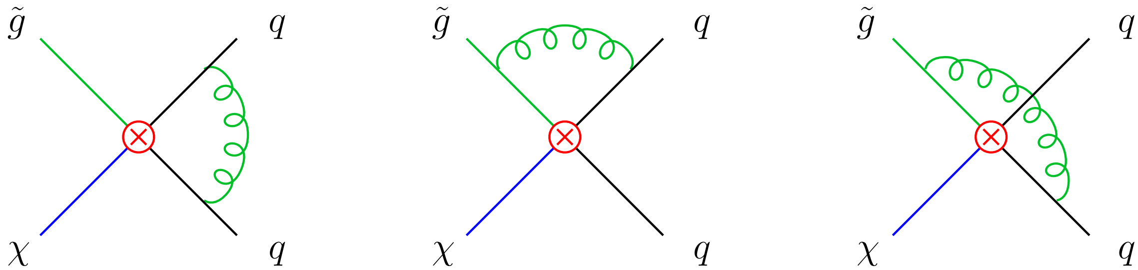
$$C_3^{\widetilde{H}}(\widetilde{m}) = \frac{g_s\, h_b}{\sqrt{2}\cos\beta}\,(r_{\tilde{q}_L} - r_{\tilde{d}_R})\,, \quad C_4^{\widetilde{H}}(\widetilde{m}) = -\frac{g_s\, h_b}{4\sqrt{2}\cos\beta}\,(r_{\tilde{q}_L} + r_{\tilde{d}_R})$$

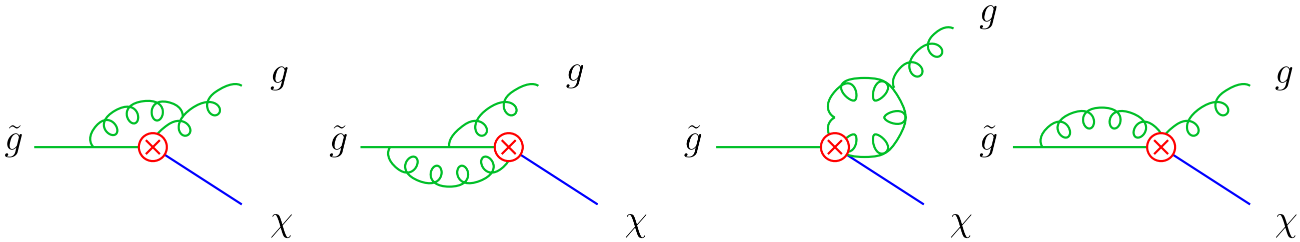
$$C_5^{\widetilde{H}}(\widetilde{m}) = \frac{g_s^2\, h_t^2}{32\sqrt{2}\,\pi^2\,\sin\beta}(r_{\tilde{q}_L} + r_{\tilde{u}_R})$$

(here $r_{\tilde{q}} = \widetilde{m}^2/m_{\tilde{q}}^2$)

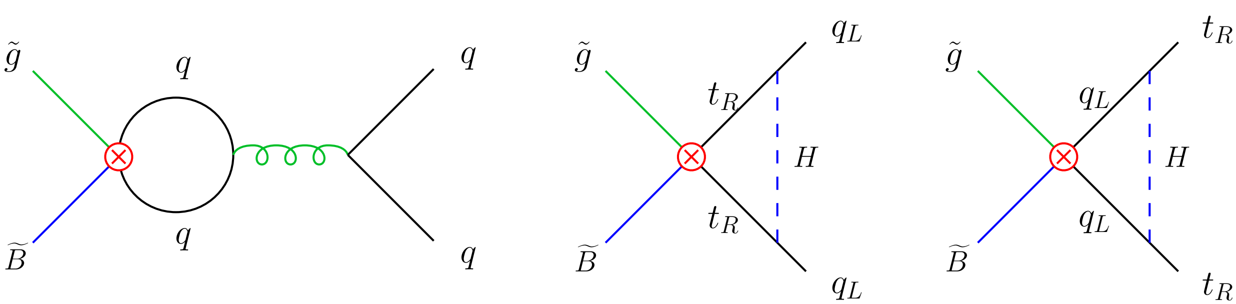
Operator renormalization

- Gluonic corrections to all operators (α_s)

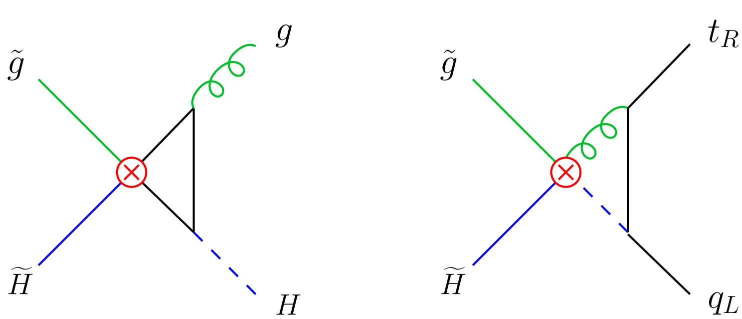




- Mixing among the B-ino operators (α_s, α_t)



- Mixing among the Higgsino operators ($\sqrt{\alpha_s \alpha_t}$)



Anomalous dimension matrices

$$\mu \frac{d\vec{C}^\chi}{d\mu} = \widehat{\gamma}^{\chi\, T}\ \vec{C}^\chi\,, \qquad \widehat{\gamma}^\chi = \frac{\alpha_s}{4\pi}\gamma_s^\chi + \frac{\alpha_t}{4\pi}\gamma_t^\chi + \frac{\sqrt{\alpha_s\alpha_t}}{4\pi}\gamma_{st}^\chi$$

$$\gamma_s^{\widetilde{B}} = \frac{1}{3}\begin{pmatrix} 8-9N_c & 8 & 8 & 8 & 8 & 8 & 0 \\ 4 & 4-9N_c & 4 & 4 & 4 & 4 & 0 \\ 4 & 4 & 4-9N_c & 4 & 4 & 4 & 0 \\ 4 & 4 & 4 & 4-9N_c & 4 & 4 & 0 \\ 2 & 2 & 2 & 2 & 2-9N_c & 2 & 0 \\ 2 & 2 & 2 & 2 & 2 & 2-9N_c & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 2N_f - 18N_c \end{pmatrix}$$

$$\gamma_t^{\widetilde{B}} = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & -2 & 0 & 0 \\ 0 & 0 & 0 & -1 & 2 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}, \qquad \gamma_{st}^{\widetilde{B}} = 0$$

$$\gamma_s^{\widetilde{W}} = \begin{pmatrix} -3N_c & 0 \\ 0 & -3N_c \end{pmatrix}, \qquad \gamma_t^{\widetilde{W}} = \begin{pmatrix} 0 & 0 \\ 0 & 1 \end{pmatrix}, \qquad \gamma_{st}^{\widetilde{W}} = 0$$

$$\gamma_s^{\widetilde{H}} = \begin{pmatrix} \frac{3}{N_c} & 0 & 0 & 0 & 0 \\ 0 & -4N_c - \frac{1}{N_c} & 0 & 0 & 0 \\ 0 & 0 & \frac{3}{N_c} & 0 & 0 \\ 0 & 0 & 0 & -4N_c - \frac{1}{N_c} & 0 \\ 0 & 0 & 0 & 0 & \frac{2}{3}N_f - 6N_c \end{pmatrix}$$

$$\gamma_t^{\widetilde{H}} = \frac{1}{2}\begin{pmatrix} 3 & 0 & 0 & 0 & 0 \\ 0 & 3 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 2N_c \end{pmatrix}, \qquad \gamma_{st}^{\widetilde{H}} = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 4 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 2 & 0 & 0 & 0 \end{pmatrix}$$

Weak scale effective Lagrangian

- After evolving the Wilson coefficients down to the low scale (e.g. $\mu = m_{\tilde{g}}$) we rotate the gaugino and Higgsino fields to the basis of mass eigenstates:

$$\overline{\widetilde{W}^+} = \overline{\chi_i^+}\,(U_{i1}\,P_L + V_{i1}\,P_R)\,, \qquad \overline{\widetilde{H}^+} = \overline{\chi_i^+}\,(U_{i2}\,P_L + V_{i2}\,P_R)$$

$$\overline{\widetilde{B}} = \overline{\chi_i^0}\,N_{i1}\,, \quad \overline{\widetilde{W}^3} = \overline{\chi_i^0}\,N_{i2}\,, \quad \overline{\widetilde{H}^0} = \overline{\chi_i^0}\,(N_{i4}\,P_R - N_{i3}\,P_L)$$

- The low–scale scale effective Lagrangian becomes

$$\mathcal{L} = \frac{1}{\widetilde{m}^2}\sum_j C_j^{\chi_i^0}\,Q_j^{\chi_i^0} \;+\; \frac{1}{\widetilde{m}^2}\left(\sum_j C_j^{\chi_i^+}\,Q_j^{\chi_i^+} + \text{h.c.}\right)$$

- For example, the chargino–quark operators and the corresponding Wilson coefficients are

$$\begin{aligned}
Q_{1\,L,R}^{\chi_i^+} &= \overline{\chi_i^+}_{L,R}\,\gamma^\mu\,\tilde{g}^a_{L,R} \,\otimes\, \sum_{k=1}^{2} \overline{d}_L^{(k)}\,\gamma_\mu\,T^a\,u_L^{(k)}\\
Q_{2\,L,R}^{\chi_i^+} &= \overline{\chi_i^+}_{L,R}\,\gamma^\mu\,\tilde{g}^a_{L,R} \,\otimes\, \overline{b}_L\,\gamma_\mu\,T^a\,t_L\\
Q_{3\,L,R}^{\chi_i^+} &= \overline{\chi_i^+}_{R,L}\,\tilde{g}^a_{L,R} \,\otimes\, \overline{b}_{R,L}\,T^a\,t_{L,R}\\
Q_{4\,L,R}^{\chi_i^+} &= \overline{\chi_i^+}_{R,L}\,\sigma^{\mu\nu}\,\tilde{g}^a_{L,R} \,\otimes\, \overline{b}_{R,L}\,\sigma_{\mu\nu}\,T^a\,t_{L,R}
\end{aligned}$$

$$C_{1\,L}^{\chi_i^+} = -\sqrt{2}\,C_1^{\widetilde{W}}\,V_{i1}\,, \qquad C_{1\,R}^{\chi_i^+} = \sqrt{2}\,C_1^{\widetilde{W}}\,U_{i1}$$

$$C_{2\,L}^{\chi_i^+} = -\sqrt{2}\,C_2^{\widetilde{W}}\,V_{i1}\,, \quad C_{3\,L}^{\chi_i^+} = C_3^{\widetilde{H}}\,U_{i2}\,, \quad C_{4\,L}^{\chi_i^+} = C_4^{\widetilde{H}}\,U_{i2}$$

$$C_{2\,R}^{\chi_i^+} = \sqrt{2}\,C_2^{\widetilde{W}}\,U_{i1}\,, \quad C_{3\,R}^{\chi_i^+} = C_1^{\widetilde{H}}\,V_{i2}\,, \quad C_{4\,R}^{\chi_i^+} = C_2^{\widetilde{H}}\,V_{i2}$$

Example: decay width for $\tilde{g} \to \chi_i^+ b \bar{t}$

$$\Gamma_{\chi^+ b\bar{t}} = \frac{1}{256\,\pi^3\, m_{\tilde{g}}^3\; \widetilde{m}^4} \int \overline{|\mathcal{M}|^2}\, ds_{13}\, ds_{23} \qquad \left[s_{ij} = (p_i + p_j)^2\right]$$

$$\begin{aligned}
\overline{|\mathcal{M}|^2} \;=\;& C_{2\,L}^{\chi_i^+\,2}\; (m_{\tilde{g}}^2 + m_t^2 - s_{13})\,(s_{13} - m_{\chi_i^+}^2 - m_b^2) \\
+\;& C_{2\,R}^{\chi_i^+\,2}\; (m_{\tilde{g}}^2 + m_b^2 - s_{23})\,(s_{23} - m_{\chi_i^+}^2 - m_t^2) \\
+\;& \frac{1}{4}\left(C_{3\,L}^{\chi_i^+\,2} + C_{3\,R}^{\chi_i^+\,2}\right)\Big[(m_{\chi_i^+}^2 + m_{\tilde{g}}^2 - s_{13} - s_{23}) \\
& \qquad\qquad (s_{13} + s_{23} - m_t^2 - m_b^2)\Big] \\
+\;& 4\left(C_{4\,L}^{\chi_i^+\,2} + C_{4\,R}^{\chi_i^+\,2}\right)\Big[4\,(s_{13} - m_{\chi_i^+}^2)\,(s_{23} - m_{\chi_i^+}^2) - 4\,m_t^2\,m_b^2 \\
& +(m_{\chi_i^+}^2 + m_{\tilde{g}}^2 - s_{13} - s_{23})\,(s_{13} + s_{23} - m_t^2 - m_b^2 - 4\,m_{\chi_i^+}^2)\Big] \\
+\;& 2\,C_{2\,L}^{\chi_i^+}\,C_{2\,R}^{\chi_i^+}\,m_{\tilde{g}}\,m_{\chi_i^+}\,(s_{13} + s_{23} - m_{\chi_i^+}^2 - m_{\tilde{g}}^2) \\
+\;& \left(C_{2\,R}^{\chi_i^+}\,C_{3\,R}^{\chi_i^+} + 12\,C_{2\,R}^{\chi_i^+}\,C_{4\,R}^{\chi_i^+}\right) m_{\chi_i^+}\,m_t\,(s_{23} - m_b^2 - m_{\tilde{g}}^2) \\
+\;& \left(C_{2\,R}^{\chi_i^+}\,C_{3\,L}^{\chi_i^+} + 12\,C_{2\,R}^{\chi_i^+}\,C_{4\,L}^{\chi_i^+}\right) m_{\tilde{g}}\,m_b\,(s_{23} - m_t^2 - m_{\chi_i^+}^2) \\
-\;& \left(C_{2\,L}^{\chi_i^+}\,C_{3\,R}^{\chi_i^+} - 12\,C_{2\,L}^{\chi_i^+}\,C_{4\,R}^{\chi_i^+}\right) m_{\tilde{g}}\,m_t\,(s_{13} - m_b^2 - m_{\chi_i^+}^2) \\
-\;& \left(C_{2\,L}^{\chi_i^+}\,C_{3\,L}^{\chi_i^+} - 12\,C_{2\,L}^{\chi_i^+}\,C_{4\,L}^{\chi_i^+}\right) m_{\chi_i^+}\,m_b\,(s_{13} - m_t^2 - m_{\tilde{g}}^2) \\
+\;& 2\left(C_{3\,L}^{\chi_i^+}\,C_{4\,L}^{\chi_i^+} + C_{3\,R}^{\chi_i^+}\,C_{4\,R}^{\chi_i^+}\right)\Big[2\,m_b^2\,(s_{23} - m_t^2 - m_{\chi_i^+}^2) \\
& +(m_{\tilde{g}}^2 + m_{\chi_i^+}^2 - s_{13} - s_{23})\,(s_{23} - s_{13} + m_b^2 - m_t^2) \\
& \qquad\qquad -2\,m_t^2\,(s_{13} - m_b^2 - m_{\chi_i^+}^2)\Big] \\
-\;& 2\left(C_{3\,L}^{\chi_i^+}\,C_{3\,R}^{\chi_i^+} + 48\,C_{4\,L}^{\chi_i^+}\,C_{4\,R}^{\chi_i^+}\right) m_{\tilde{g}}\,m_{\chi_i^+}\,m_t\,m_b
\end{aligned}$$

Input parameters for the numerical analysis

- Gauge and Yukawa couplings are extracted from the SM inputs:

$$M_Z = 91.187\,\text{GeV}, \;\; M_W = 80.41\,\text{GeV}, \;\; G_F = 1.166{\times}10^{-5}\text{GeV}^{-2}$$

$$m_t = 178\,\text{GeV}, \quad m_b(m_t) = 2.75\,\text{GeV}, \quad \alpha_s(m_t) = 0.106$$

- For simplicity, we take the squark masses to be degenerate:

$$m_{\tilde{q}^i_L} = m_{\tilde{u}^i_R} = m_{\tilde{d}^i_R} \equiv \widetilde{m}$$

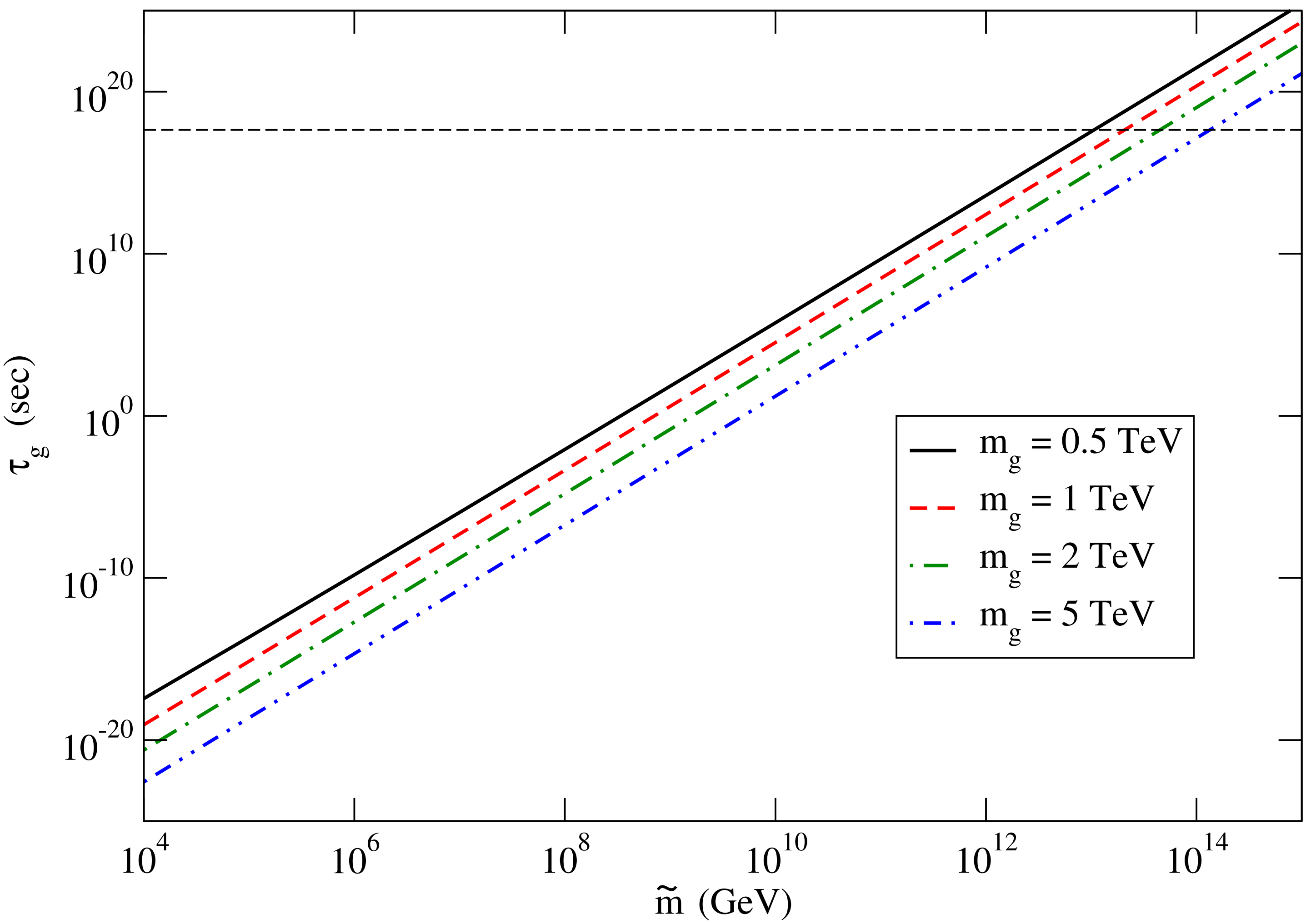
- The left–right squark mixing is $\mathcal{O}(\mu,\, M_i)$ in Split SUSY, thus we can safely neglect it with respect to $\widetilde{m}$.

- Taking $m_{\tilde{g}}$ as input, we extract M_3 including radiative corrs, and compute M_1 and M_2 assuming GUT scale unification.

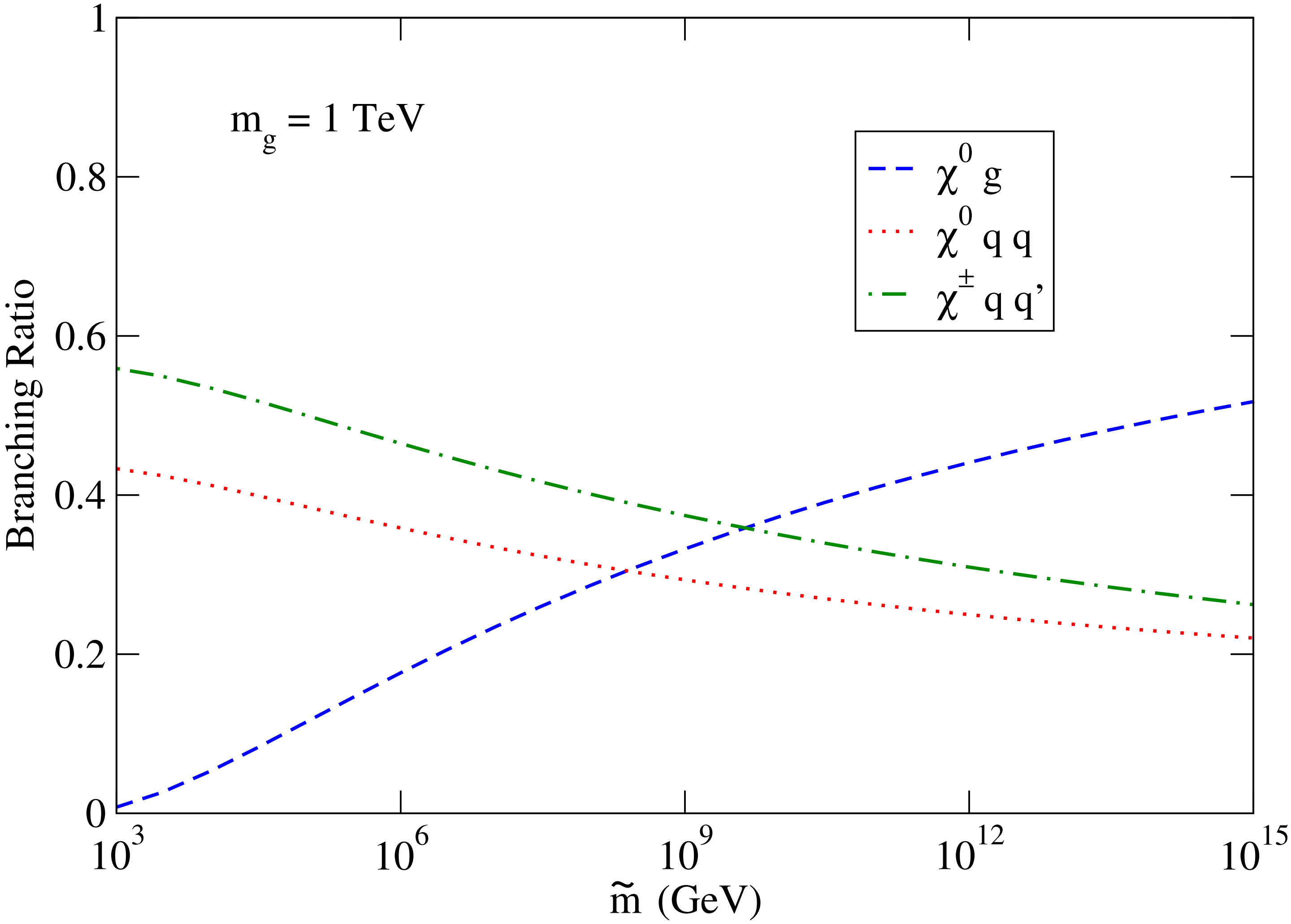
- We determine μ as a function of M_2 by requiring that the neutralino relic abundance is consistent with the WMAP data.

$\longrightarrow$ The SUSY inputs relevant to the analysis are $\widetilde{m}$, $m_{\tilde{g}}$ and $\tan\beta$ (but our results for $\Gamma_{\tilde{g}}$ are valid for general SUSY parameters)

Warmup: gluino lifetime vs squark mass

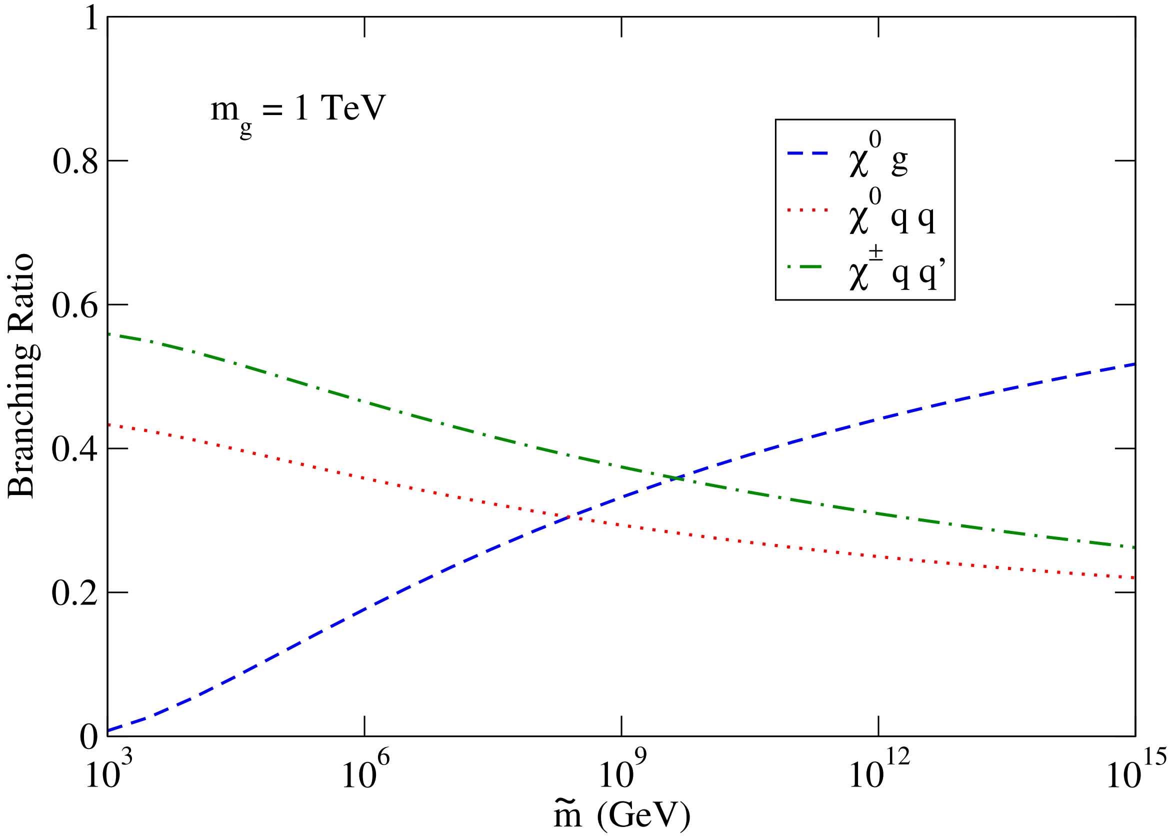


Branching ratios for the gluino decays

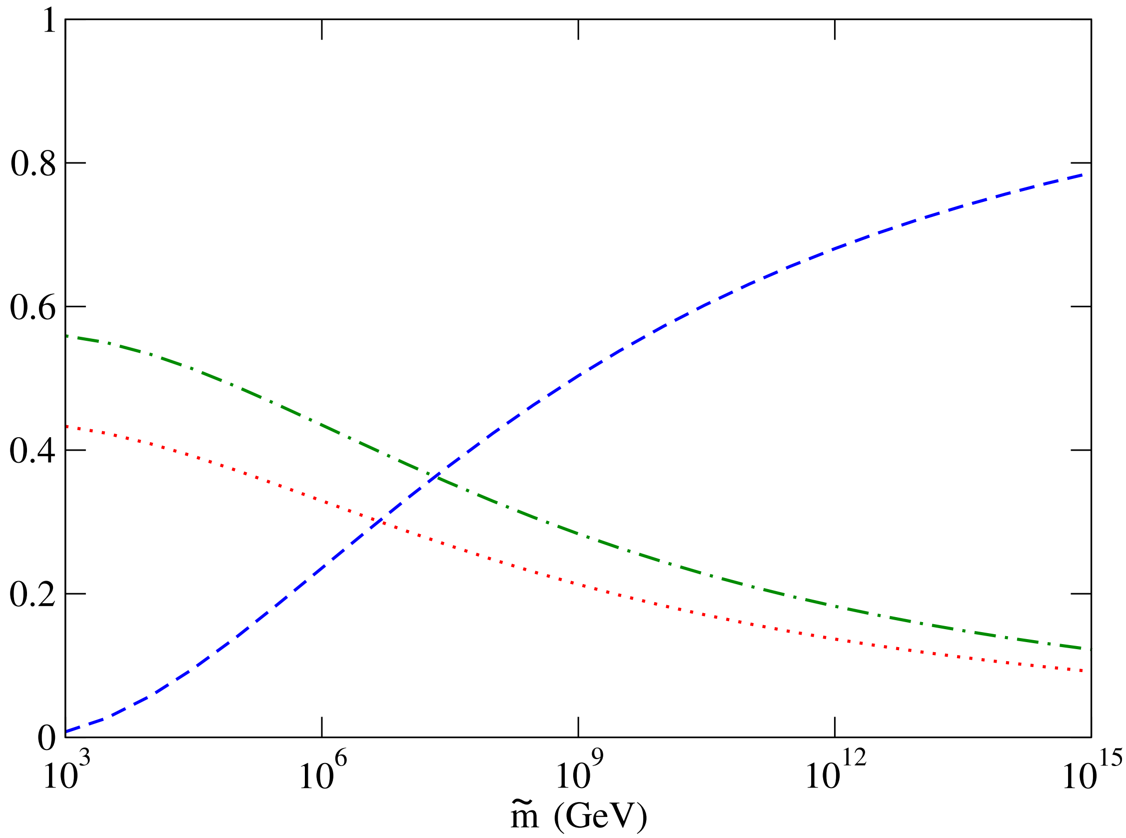


Effect of resummation on the branching ratios

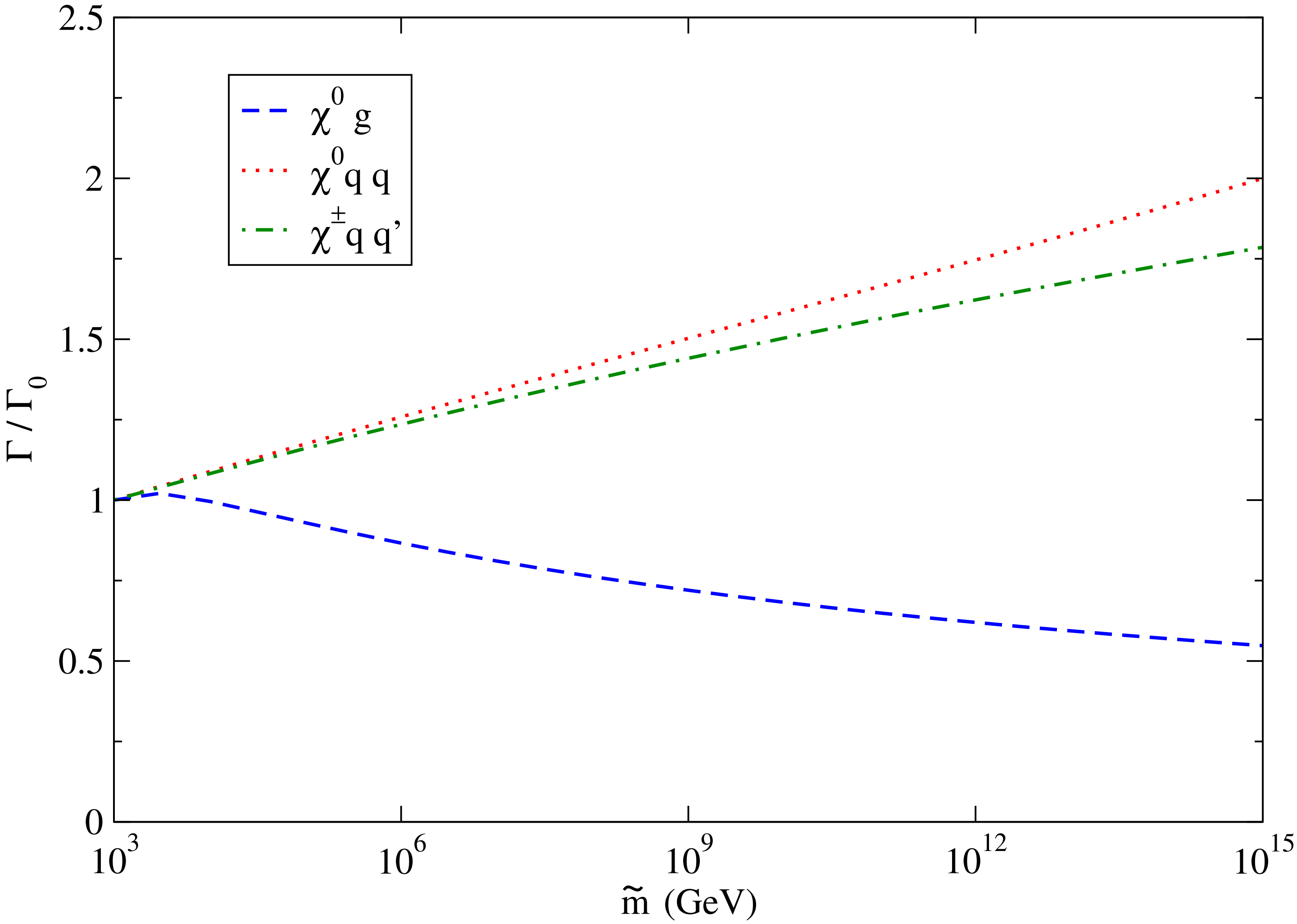
with resummation



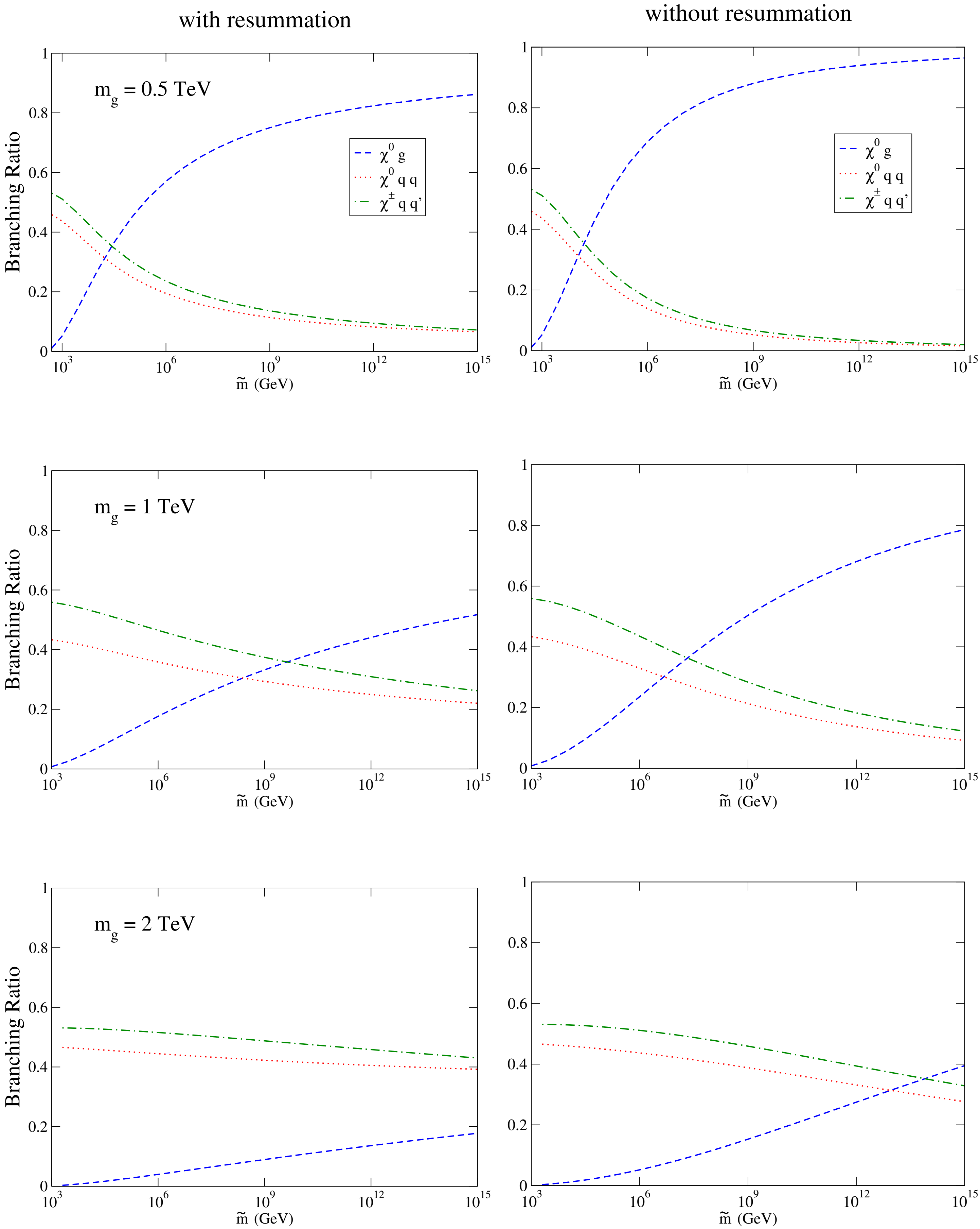
without resummation



Effect of resummation on the partial decay widths

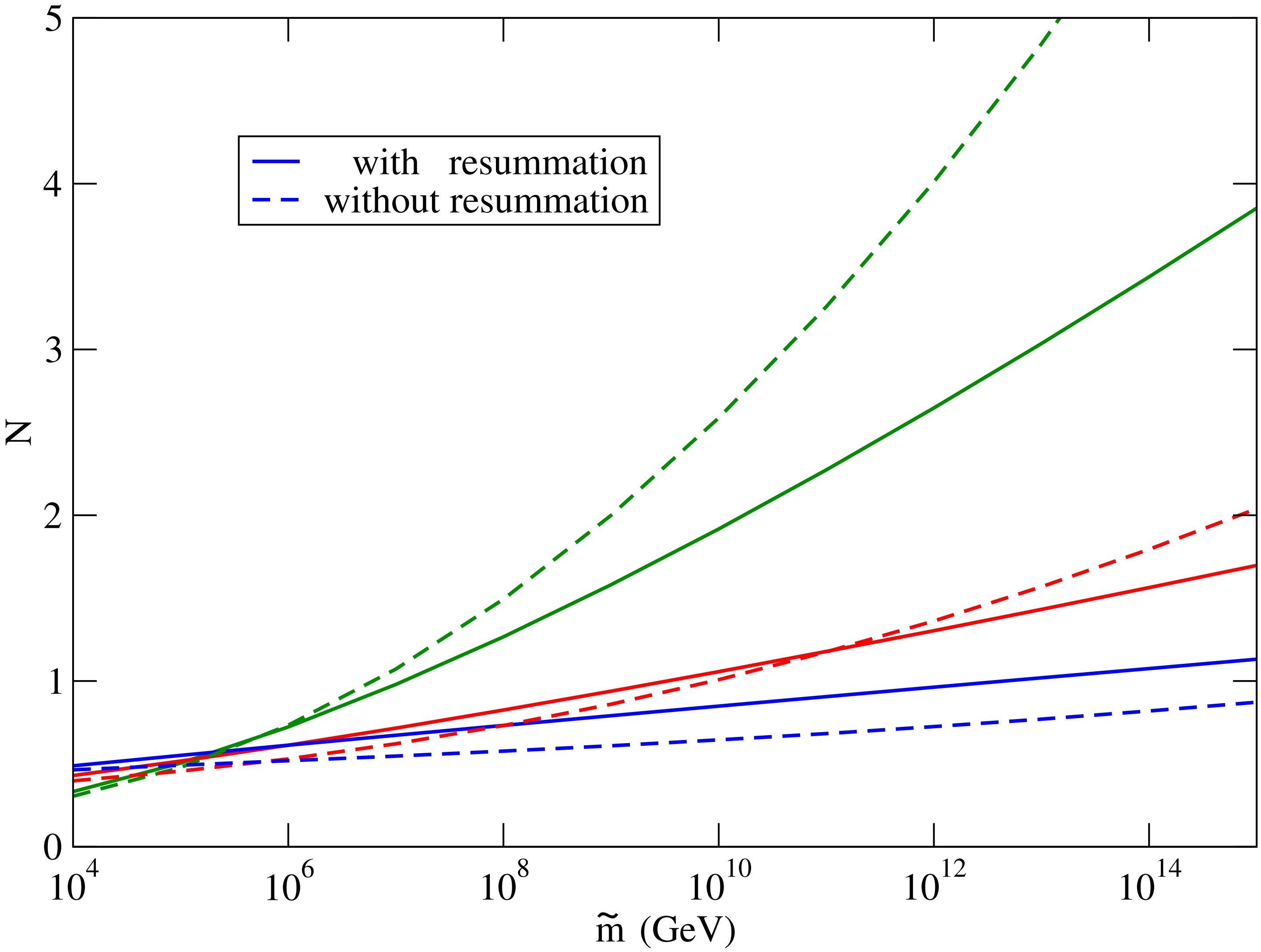


Branching ratios for the gluino decays (II)



A closer look on the gluino lifetime

$$\tau_{\tilde{g}} = \frac{4\,\text{sec}}{N} \times \left(\frac{\widetilde{m}}{10^9\,\text{GeV}}\right)^4 \times \left(\frac{1\,\text{TeV}}{m_{\tilde{g}}}\right)^5$$



$m_{\tilde{g}} = (500,\ 1000,\ 2000)$ GeV

Gluino decay into gravitinos

- Split SUSY opens up the possibility of direct mediation of (D–term) supersymmetry breaking: $\widetilde{m} = \sqrt{F}$, where F is the original SUSY–breaking scale ($m_{3/2} = \sqrt{8\,\pi/3}\,F/M_{\rm P}$).

- In that case the gluino interactions with the goldstino ($\widetilde{G}$) component of the gravitino, suppressed by $1/F$, are as strong as those with charginos and neutralinos, suppressed by $1/\widetilde{m}^2$.

- At lowest order, the gluino decay widths into goldstino and quarks and into goldstino and gluon are:

$$\Gamma_{\widetilde{G}\,q\bar{q}} \simeq \frac{\alpha_s\, m_{\tilde{g}}^5}{96\,\pi^2\,F^2}\,, \qquad \Gamma_{\widetilde{G}\,g} = \frac{m_{\tilde{g}}^5}{16\,\pi\,F^2}$$

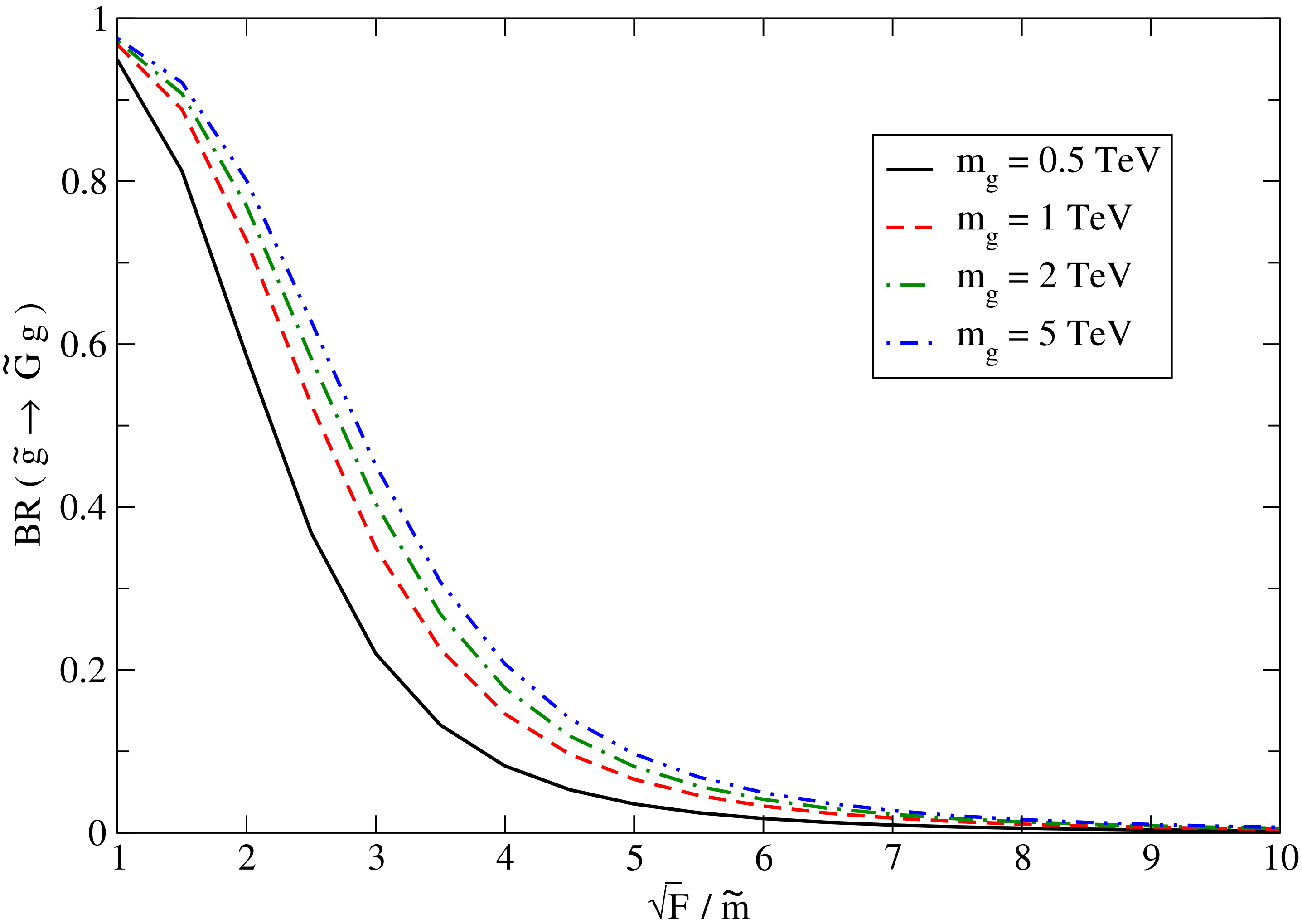
(the decay into goldstino and gluon dominates)

- We defined an effective lagrangian for the gluino–goldstino interactions:

$$\mathcal{L} = \frac{1}{F}\sum_{i=1}^{5} C_i^{\widetilde{G}}\, Q_i^{\widetilde{G}}$$

- Then we performed the same renormalization procedure as for the gluino–chargino and gluino–neutralino interactions *(details omitted!)*.

Branching ratio for $\tilde{g} \to \tilde{G}\, g$



- The branching ratio for the decay into goldstino may dominate, but it falls off when we depart from the condition $\widetilde{m} = \sqrt{F}$.

Summary

- Long–lived gluinos are a trademark of Split SUSY.

- We provided a precise determination of the gluino lifetime and branching ratios, resumming the leading logarithmic corrections controlled by α_s and α_t.

- The radiative corrections enhance the three-body gluino decays into quarks and suppress the two–body radiative decay. They can affect sizeably the gluino lifetime and branching ratios.

- In models with direct mediation of SUSY breaking, the gluino decays into gravitinos might dominate over the other modes.