

The background of the slide is a light blue color with a pattern of faint, overlapping Feynman diagrams. These diagrams consist of various lines (solid and dashed) and loops, representing particle interactions in quantum field theory. The diagrams are scattered across the entire slide, with some being more prominent than others.

Ananda Landwehr
Max-Planck-Institut für Physik

Full one-loop corrections to squark decays

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Karlsruhe

Squark sector

- MSSM: L- and R-quarks get own SUSY partner
- Left- and right-handed squarks mix

$$\begin{pmatrix} \tilde{t}_1 \\ \tilde{t}_2 \end{pmatrix} = \begin{pmatrix} M_{\tilde{Q}_L}^2 + \dots & m_t(A_t - \frac{\mu}{t_\beta}) \\ m_t(A_t - \frac{\mu}{t_\beta}) & M_{\tilde{t}_R}^2 + \dots \end{pmatrix} \begin{pmatrix} \tilde{t}_L \\ \tilde{t}_R \end{pmatrix}$$

- Third generation: large mixing $m_{\tilde{t}_2} > m_{\tilde{t}_1}$
→ decay channels $\tilde{t}_2 \rightarrow \tilde{t}_1 \dots$

Squark decays

$$\tilde{t}_2 \rightarrow t \tilde{\chi}_i^0$$

$$\tilde{t}_2 \rightarrow b \tilde{\chi}_i^+$$

} Effective m_b^{eff}

$$\tilde{t}_2 \rightarrow t \tilde{g}$$

$$\tilde{t}_2 \rightarrow \tilde{t}_1 Z$$

$$\tilde{t}_2 \rightarrow \tilde{b}_i W^+$$

$$\tilde{t}_2 \rightarrow \tilde{t}_1 (h^0, H^0, A^0)$$

$$\tilde{t}_2 \rightarrow \tilde{b}_i H^+$$

} Effective m_b^{eff}

} Higgs corrections

} large mixing

UV Renormalization

- SM, squarks, gauginos: on-shell conditions
- Squarks: 1 squark mass ($m_{\tilde{q}_L}$) dependent

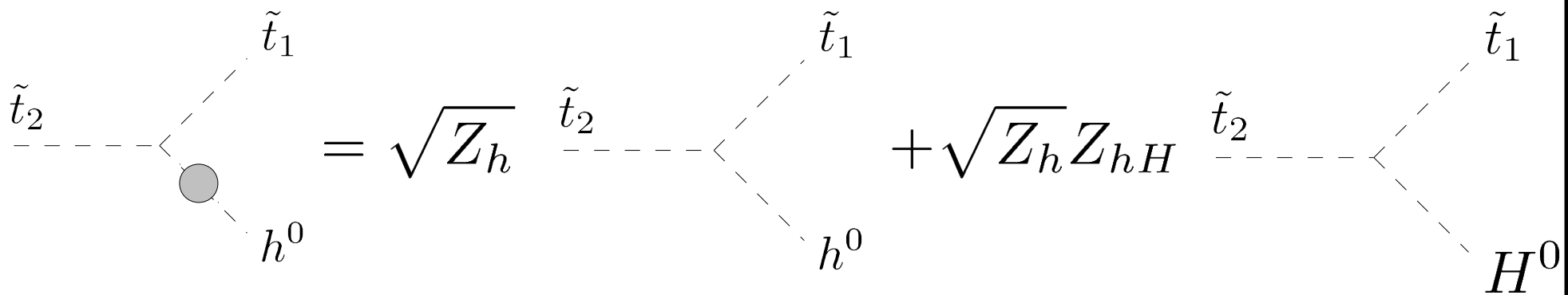
$$m_{\tilde{q}_1}^{\text{OS}^2} = m_{\tilde{q}_1}^{\text{tree}^2} + dm_{\tilde{q}_1}^{\text{fin}^2}$$

- Bottom / sbottom sector: $\overline{\text{DR}}$
- Resum large $\tan\beta$ -enhanced contributions (Δm_b)

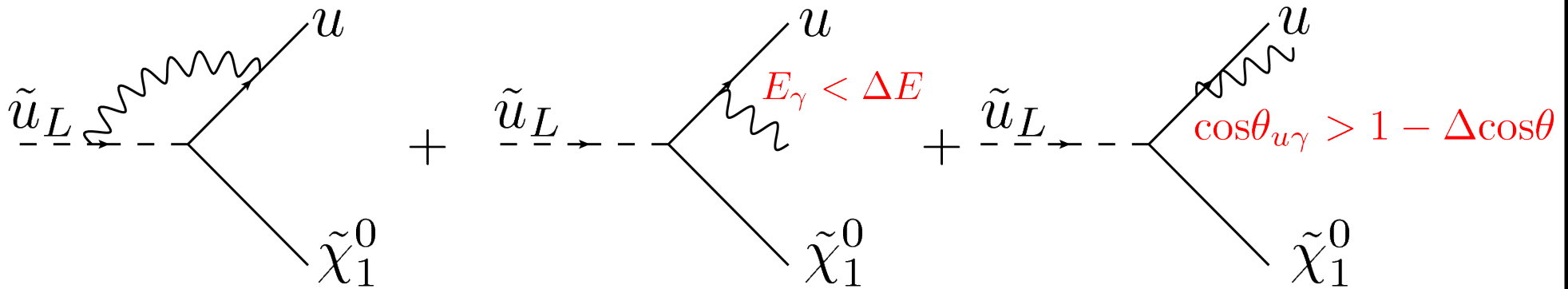
$$m_b^{\overline{\text{DR}}} = \frac{m_b^{\text{OS}} + \frac{1}{2}m_b \left(\Sigma_{b_L}^{\text{fin}} + \Sigma_{b_R}^{\text{fin}} \right) + m_b \tilde{\Sigma}_{b_S}^{\text{fin}}}{1 + \Delta m_b}$$

MSSM Higgs Sector

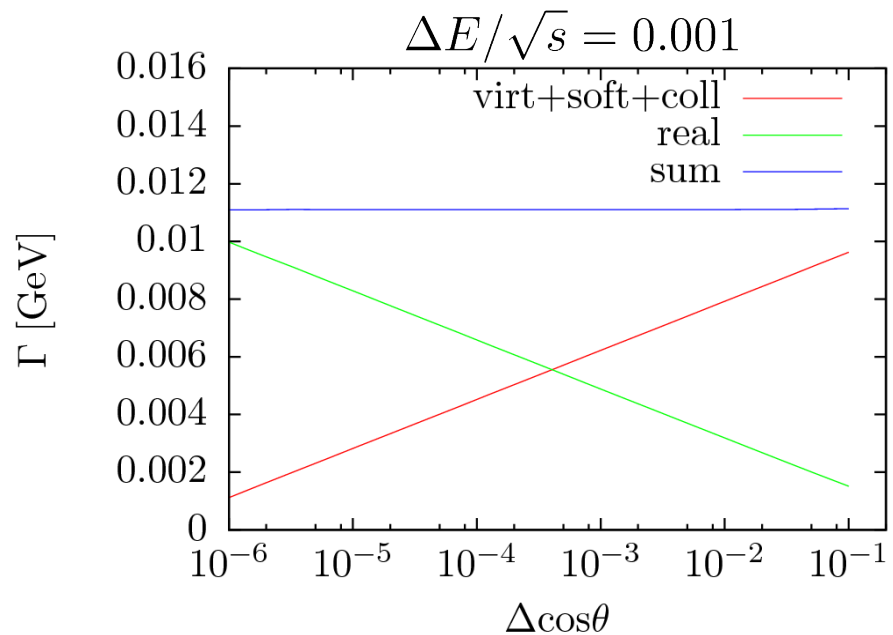
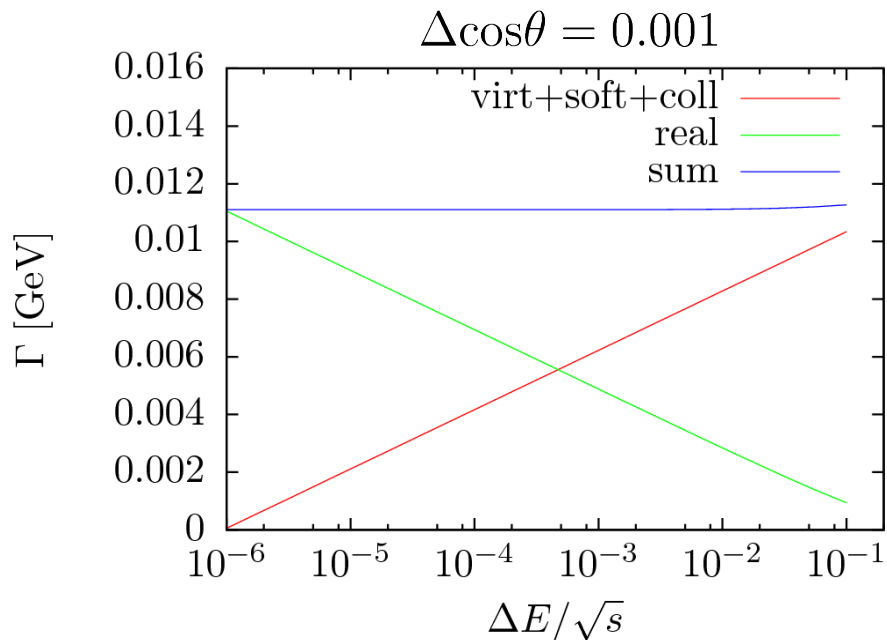
- Input parameters: $m_Z, m_{A^0}, \tan\beta = \frac{v_u}{v_d}$
- Lightest higgs mass (tree-level) $m_{h^0} \leq m_Z$
- 2-loop corrections (FeynHiggs): $m_{h^0} \lesssim 140 \text{ GeV}$
- Hybrid on-shell / $\overline{\text{DR}}$ renormalization scheme



Infrared Singularities

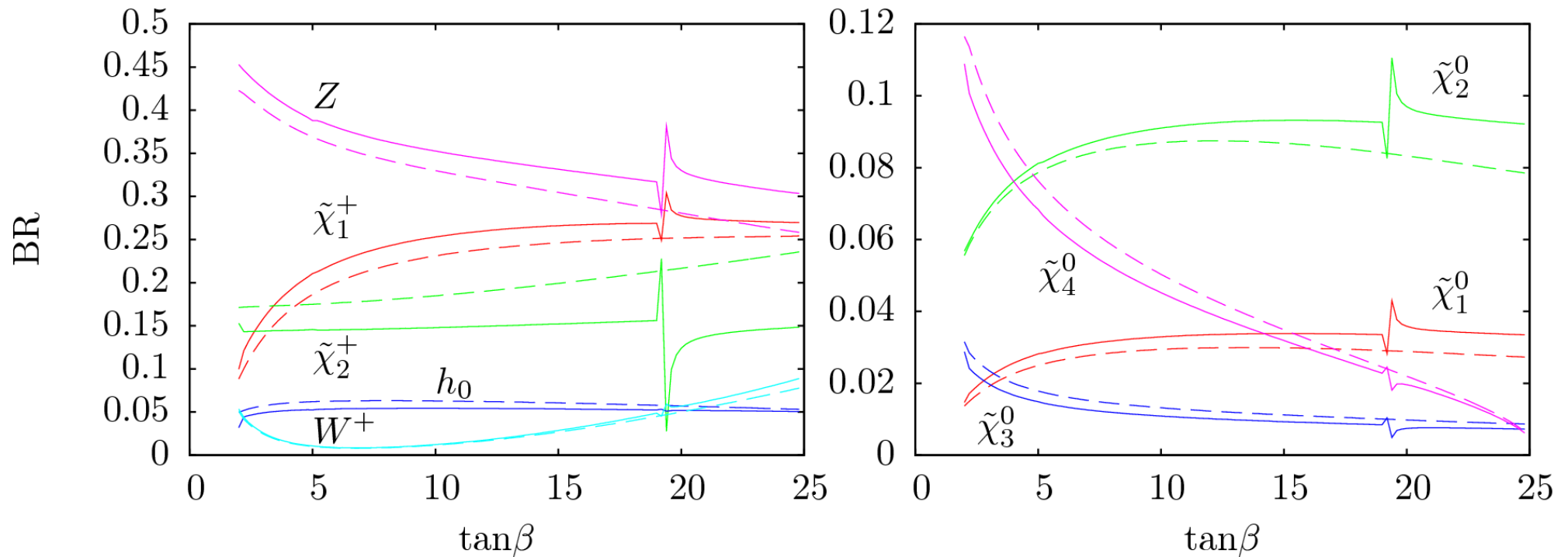


$$\Gamma_{\text{soft / coll}} = \Gamma_0 \delta_{\text{soft / coll}}$$



Numerical evaluation

•SPS1a' $\tilde{t}_2 \rightarrow (s)\text{quark} + \dots$



•Pole: Threshold $m_{\tilde{t}_2} = m_t + m_{\tilde{\chi}_4^0}$

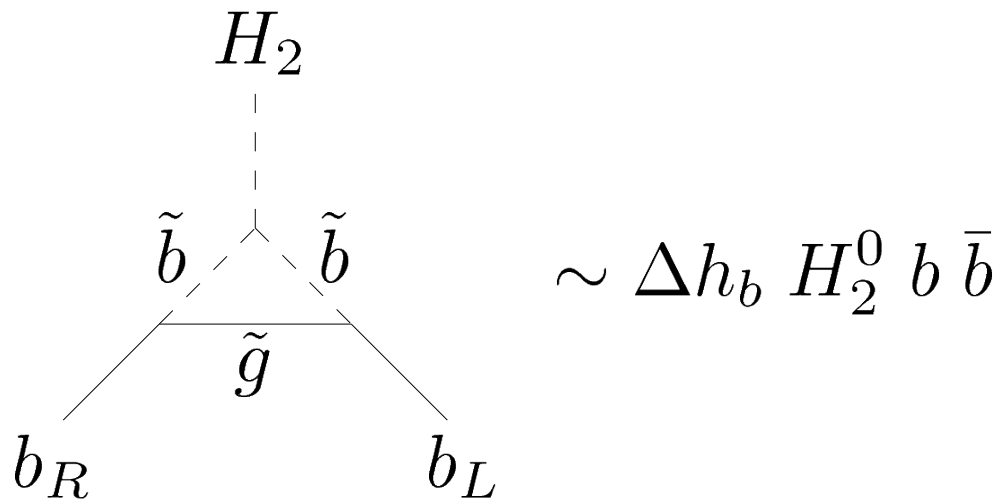
• $\tilde{\chi}_2^+$: Higgsino-like: strong dependence on m_b

Conclusions & Outlook

- More decay channels for 3rd generation squarks
- Collected QCD and EW corrections to all decay channels
- Outlook:
 - Make code publicly available

Effective bottom mass m_b^{eff}

- 1-loop: Coupling of up-type Higgs with bottom quark



- Resum terms $\sim \alpha_s \log \frac{m_b}{m_t}$

$$m_b \rightarrow m_b^{\text{eff}} = \frac{m_b}{1 + \tan\beta \Delta h_b}$$