

# Limits and Fits from Simplified Models

for supersymmetry and same-spin models

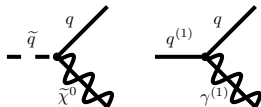
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Lisa Edelhäuser   Jan Heisig   Michael Krämer   Lennart Oymanns  
Wolfgang Waltenberger

Electroweak Interactions and Unified Theories, La Thuile, March 2015

[arXiv:1410.0965](https://arxiv.org/abs/1410.0965) *JHEP* **1412** (2014) 022  
[arXiv:1501.03942](https://arxiv.org/abs/1501.03942)

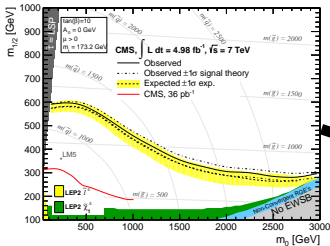
**RWTH**AACHEN  
UNIVERSITY



**DFG** Deutsche  
Forschungsgemeinschaft

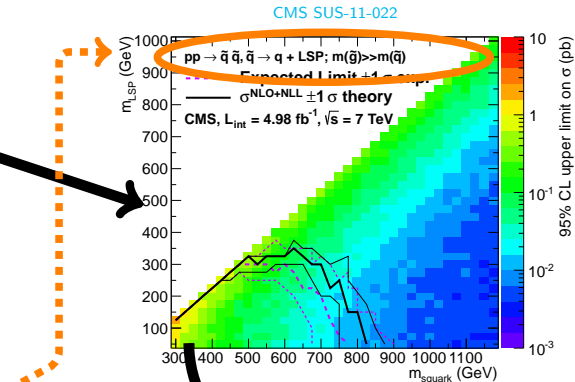
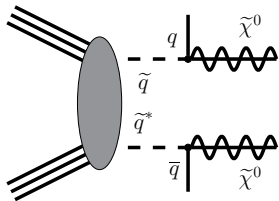
# Moving to simplified models

Full model:



From CMS: [CMS-SUS-12011](#)

Simplified model:



SModels

CHECKMATE

Fastlim

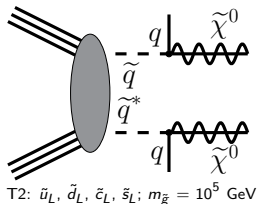


# A simplified model: T2

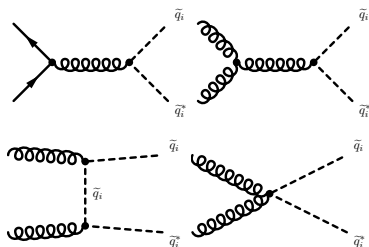
CMS SUS-11-016; arXiv:1301.2175 (CMS Simplified Models)

## CMS squark production

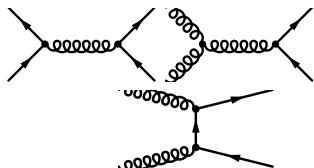
squark antiquark  $\equiv$  CMS T2



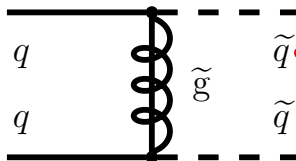
$\tilde{q}_L \tilde{q}_L^*$  production:



Change spin assumption



Add  $\tilde{g}$



# Limits for an MSSM-like model: finite $m_{\tilde{g}}$

$A\epsilon$  (events after cuts): MadGraph 5 - Pythia 6 - Delphes 3 - [analysis]

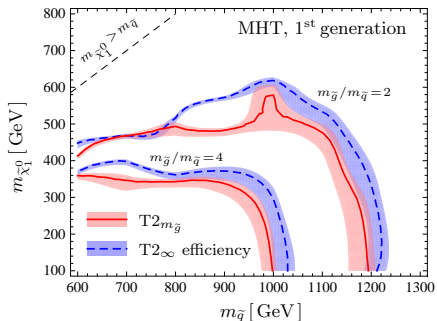
- **MSSM-like:** Limits using (correct)  $\sigma \equiv A\epsilon \times$  cross section:

$$2\sigma_{\tilde{q}_L\tilde{q}_L} + 2\sigma_{\tilde{q}_L\tilde{q}_L^*} + \sigma_{\tilde{q}_L\tilde{q}_R} + 2\sigma_{\tilde{q}_L\tilde{q}_R^*}$$

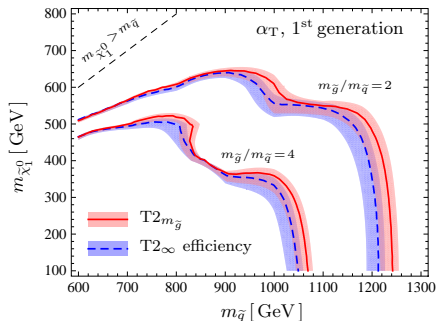
- **T2:** Limits using (incomplete)  $A\epsilon$  from simplified model T2

Limits from one bin only (vs. CMS combined limit)

[arXiv:1410.0965](https://arxiv.org/abs/1410.0965)



CMS SUS-13-012



CMS SUS-12-028

# Limits for a UED-like model: same-spin partners

$A_\epsilon$  (events after cuts): MadGraph 5 - Pythia 6 - Delphes 3 - [analysis]

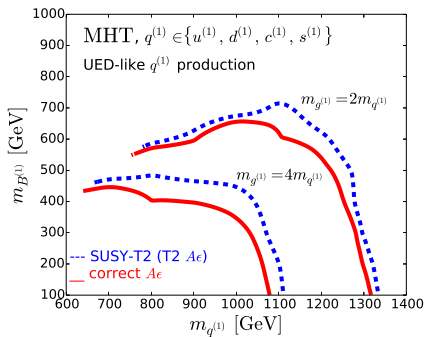
- UED-like:

$$2(q_D q_D + q_D \bar{q}_D + q_D \bar{q}_S) + q_D q_S.$$

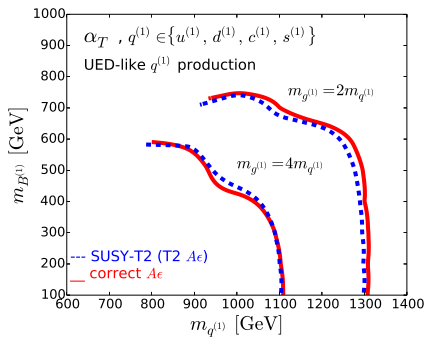
- T2: Limits using (incomplete)  $A_\epsilon$  from simplified model T2

$q_{D(S)}$ : first KK mode SU(2) doublet (singlet) quark

arXiv:1501.03942



CMS SUS-13-012



CMS SUS-12-028

# Summary and Application

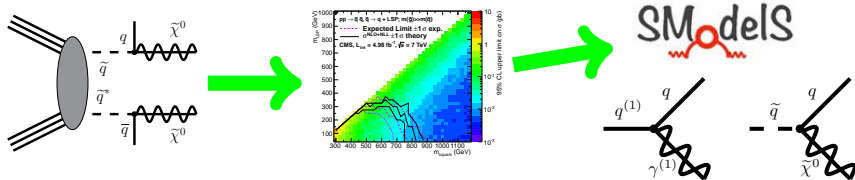
## Conclusion We found simplified models are a good approximation

- for limits on more general SUSY models;
- for limits on same-spin models.

[arXiv:1410.0965](https://arxiv.org/abs/1410.0965)

[arXiv:1501.03942](https://arxiv.org/abs/1501.03942)

Accuracy is analysis dependent, but can indicate interesting search regions.



## Future application: Global Fits with SModels and Fittino

Use simplified model results to obtain likelihoods for fast fits of  
*Your Favorite (SUSY) model.*