Limits and Fits from Simplified Models
for supersymmetry and same-spin models

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arXiv:1501.03942
Moving to simplified models

Full model:

![Graph showing the full model with mass spectra and cross-sections.]

From CMS: CMS-SUS-12011

Simplified model:

![Simplified model diagram with squarks and LSPs.]

CMS SUS-11-022

Limits and Fits from Simplified Models
A simplified model: T2


squark antisquark $\equiv$ CMS T2

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

$\tilde{q}_L$, $\tilde{d}_L$, $\tilde{c}_L$, $\tilde{s}_L$; $m_{\tilde{g}} = 10^5$ GeV

Change spin assumption

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

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

- **MSSM-like**: Limits using (correct) $\sigma \equiv A_\varepsilon \times$ 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) $A_\varepsilon$ from simplified model T2

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

arXiv:1410.0965
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

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arXiv:1501.03942

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MHT, \( q^{(1)} \in \{u^{(1)}, d^{(1)}, c^{(1)}, s^{(1)}\} \)

UED-like \( q^{(1)} \) production

--- SUSY-T2 (T2 \( A_\epsilon \))

\( m_B^{(1)} \) vs. \( m_{q^{(1)}} \) [GeV]

--- correct \( A_\epsilon \)

CMS SUS-13-012

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\( \alpha_T, q^{(1)} \in \{u^{(1)}, d^{(1)}, c^{(1)}, s^{(1)}\} \)

UED-like \( q^{(1)} \) production

--- SUSY-T2 (T2 \( A_\epsilon \))

\( m_B^{(1)} \) vs. \( m_{q^{(1)}} \) [GeV]

--- correct \( A_\epsilon \)

CMS SUS-12-028
Conclusion We found simplified models are a good approximation
- for limits on more general SUSY models; 
- for limits on same-spin models.

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.