LHC SUSY/BSM cross-section working group

Michael Krämer (RWTH Aachen)

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Aim of the WG: provide state-of-the-art cross section and branching ratio predictions for SUSY and other new physics models at the LHC.

[cf. the LHC Higgs cross section working group]

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Specific tasks:

- collect SUSY/BSM cross section and branching ratio predictions, including the most advanced theory calculations (NLO, NLL resummation, electroweak corrections, bound state effects...), up-to-date SM inputs like pdf's *and a proper error estimate*;
- compare dedicated theory calculations, including higher-order corrections, with Monte Carlo predictions;
- compile a list of existing SUSY/BSM LHC tools with contact persons and test these tools for a wide region of parameter space;
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Coordination: Michelangelo Mangano & Michael Krämer
with Atlas and CMS SUSY conveners as experimental contacts

SUSY cross section calculations

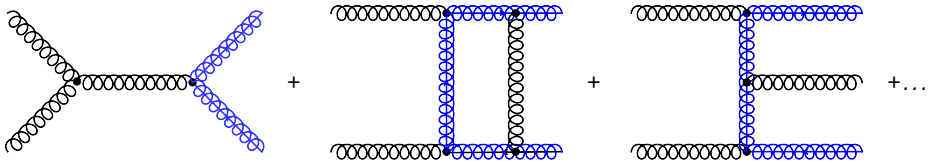
- NLO QCD: almost all in `Prospino` [Plehn]
- NLO+NLL QCD [Beenakker et al.]
- soft & Coulomb resummation ($\tilde{q}\tilde{q}^*$) [Schwinn]
- approx. NNLO ($\tilde{q}\tilde{q}^*$) [Langenfeld, Moch]
- bound state effects ($\tilde{g}\tilde{g}$)
- gluinonia production

- EWK corrections [Hollik]

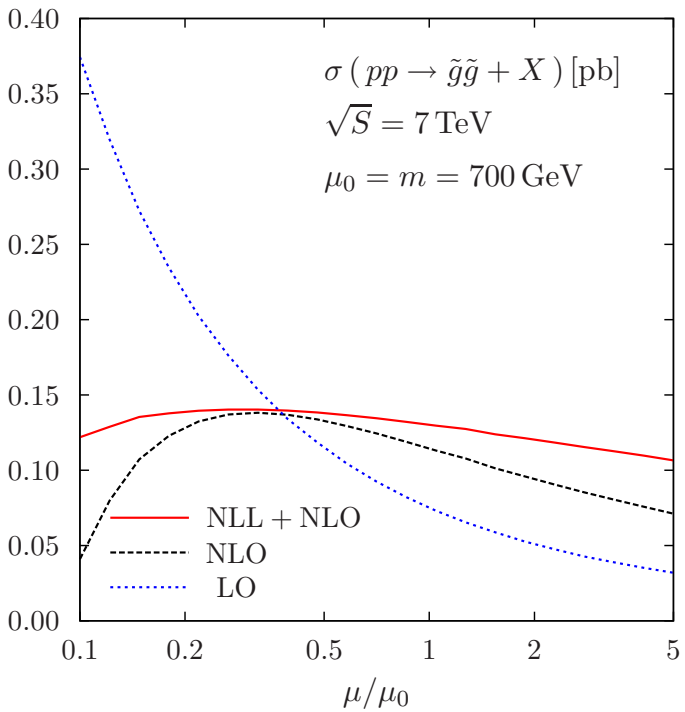
- RPV SUSY production [Dreiner]

Example: squark and gluino production at NLO+NLL

Take gluino-pair production as an example



Scale dependence



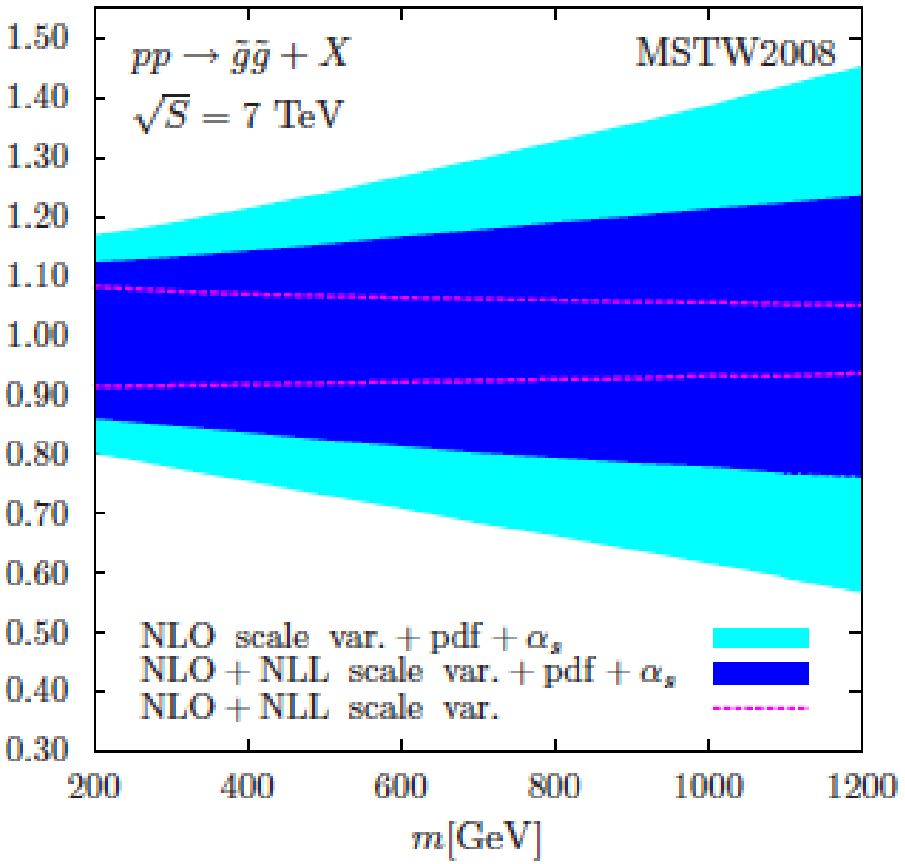
[Beenakker et al.]

$\rightarrow \Delta\sigma(\mathrm{scale}) \lesssim \pm 10\%$ at NLO+NLL

Example: squark and gluino production at NLO+NLL

Theory error: $\Delta\sigma = \Delta\mu \pm \sqrt{\Delta(\mathrm{pdf})^2 + \Delta(\alpha_\mathrm{s})^2}$

[Beenakker et al.]

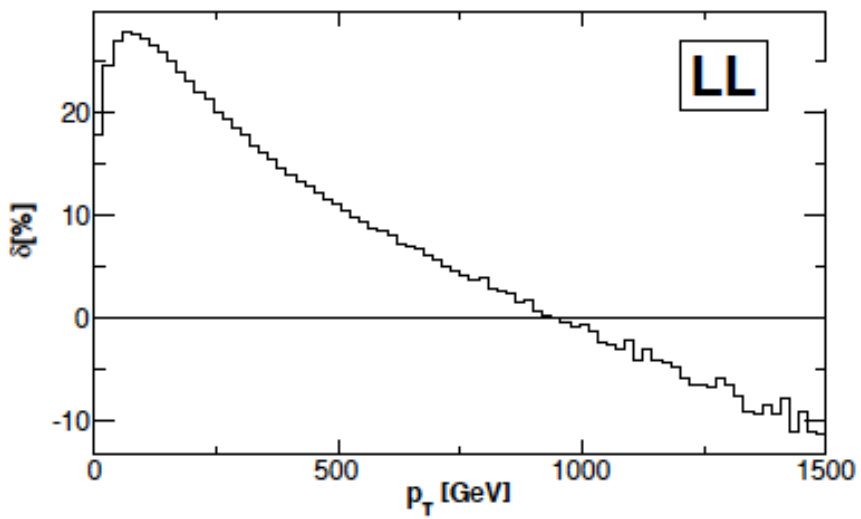


$\rightarrow \Delta\sigma \lesssim \pm 20\%$ at NLO+NLL

Example: squark pair production with EWK corrections

EWK effects include $\mathcal{O}(\alpha)$ loop corrections and QCD/EWK interference

$p_t(\tilde{q})$ distribution:



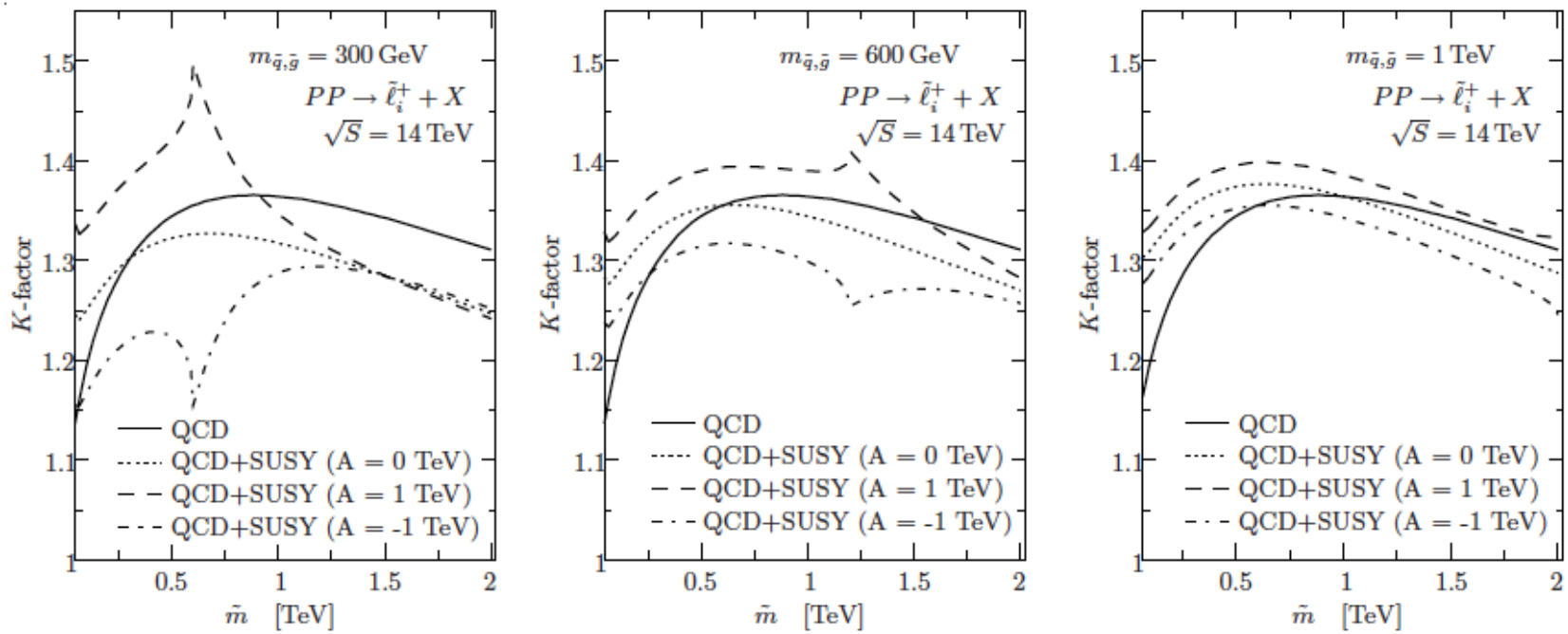
[Germer et al.]

$\longrightarrow$ potentially significant effects, depending in detail on the process and the SUSY scenario

Example: Slepton production in RPV SUSY

K-factor $K = \sigma_{\mathrm{NLO}}/\sigma_{\mathrm{LO}}$

[Dreiner et al.]



$\longrightarrow$ 30-40% enhancement through QCD corrections

$\longrightarrow$ SUSY-QCD effects model dependent

SUSY decay rate calculations

with Sven Heinemeyer & Margarete Mühlleitner

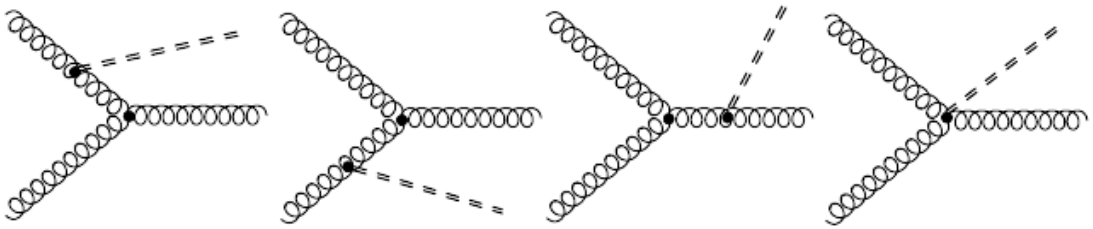
- SUSY QCD and EWK corrections available for all two-body decay processes within the real MSSM
- `SDECAY` and `SPHENO`: two-, three- and four-body decay modes, some loop-induced decays, SUSY-QCD corrections for two-body modes, leading EWK corrections.
- extension to the complex MSSM is underway

Further BSM models

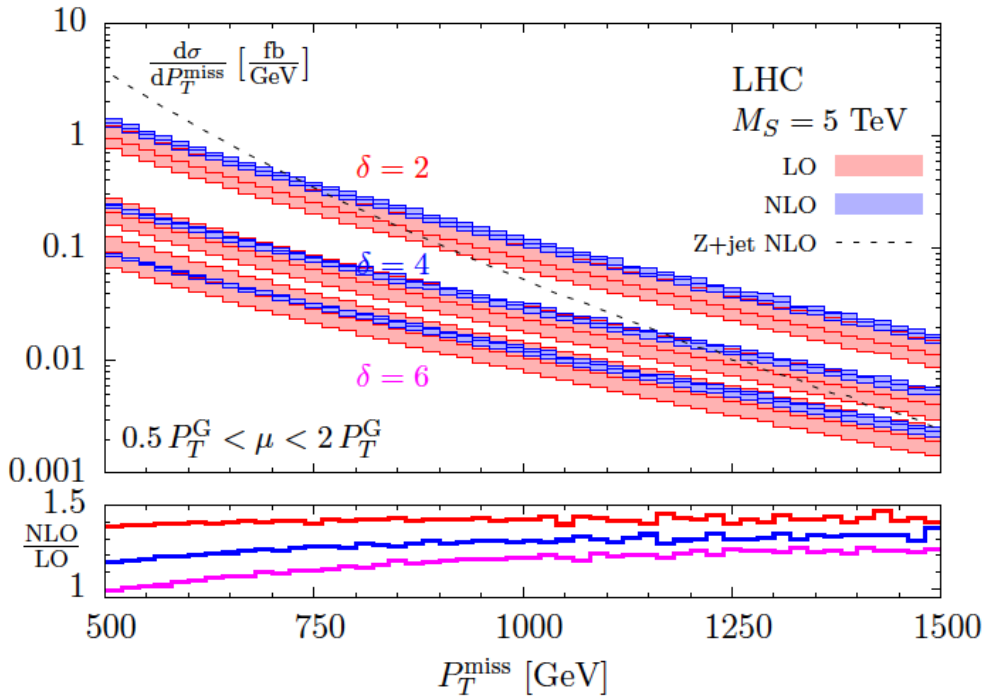
with JoAnne Hewett & Tom Rizzo

- Leptoquarks (very similar to squark production. . .)
- Extra Dimensions
- Little Higgs models
- Excited Fermions
- Technicolor
- . . .

Example: ADD graviton plus jet production at NLO



$p_t(G)$ distribution:



[Karg et al.]

$\longrightarrow$ significant reduction of scale dependence

$\longrightarrow$ sensitivity to truncation scheme?

Outlook: differential distributions

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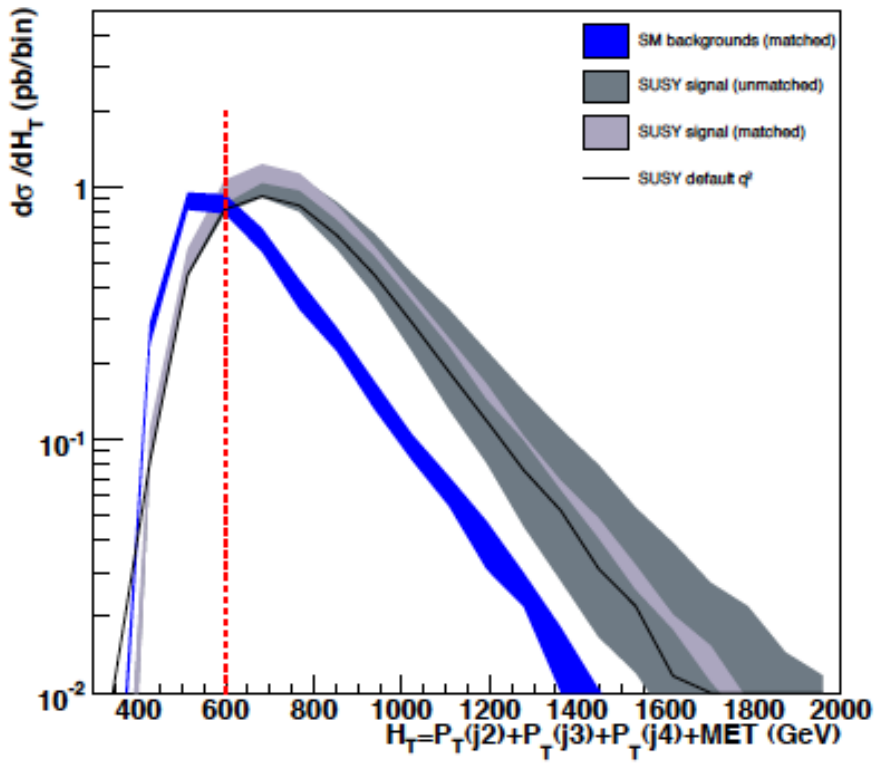
Higher-order effects are important to describe differential distributions:



[Alwall et al.]

$\longrightarrow$ more systematic theoretical studies needed

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We are starting now, please join in...