
MSSM Higgs production at NLO QCD

Hendrik Mantler
Universität Wuppertal

in collaboration with R. Harlander and F. Hofmann

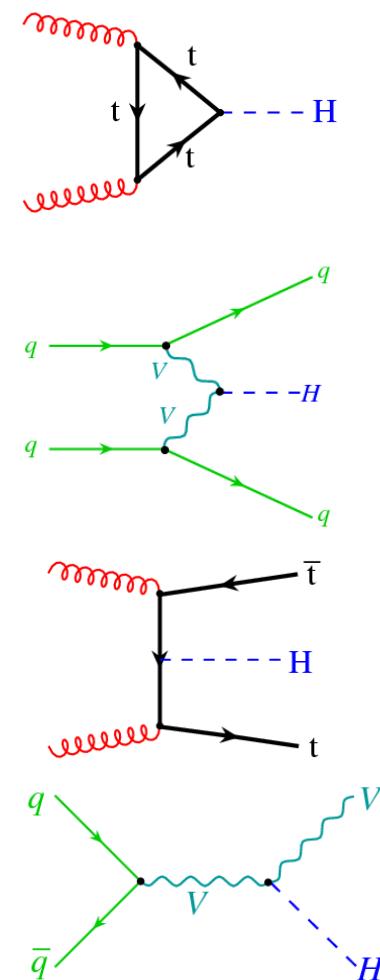
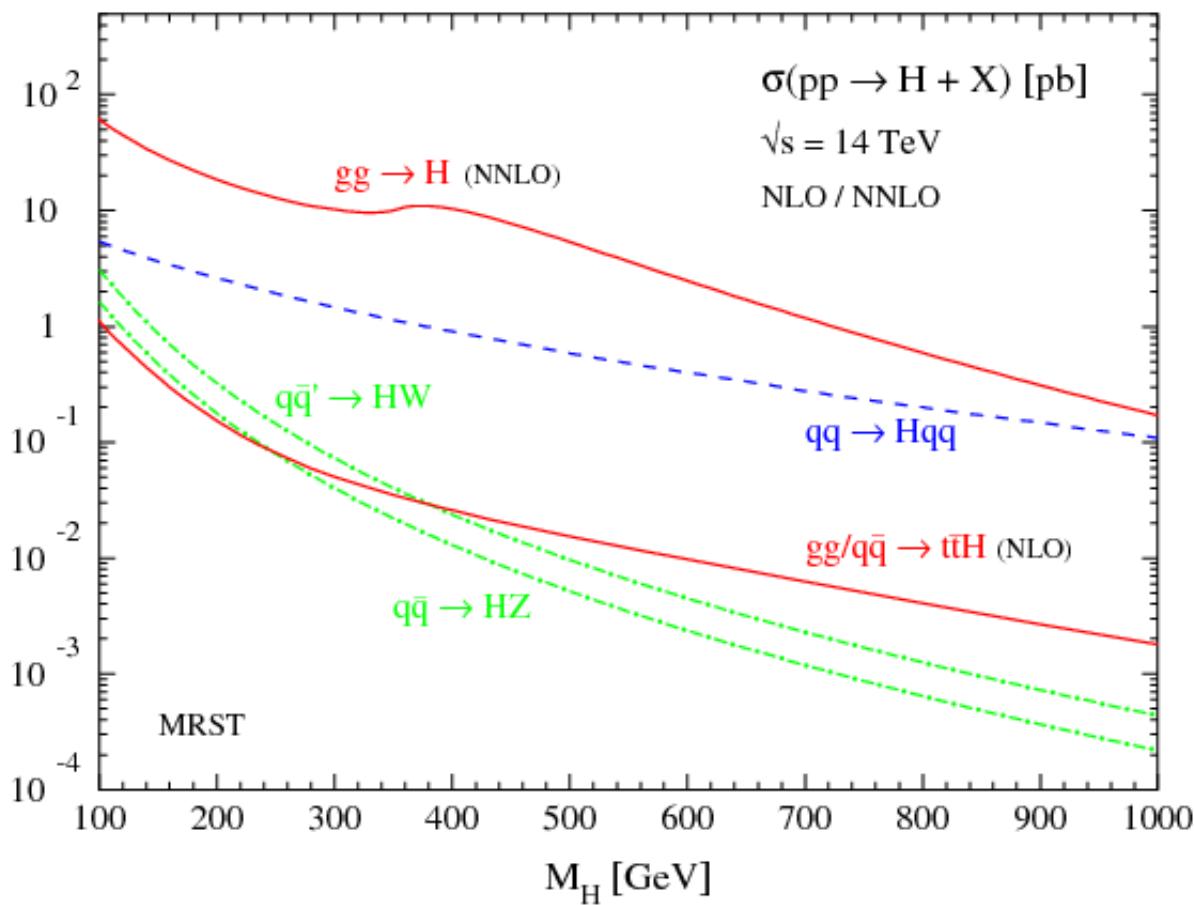
Higgs Cross Sections for the LHC
Brookhaven National Laboratory, May 4-6, 2011

Outline

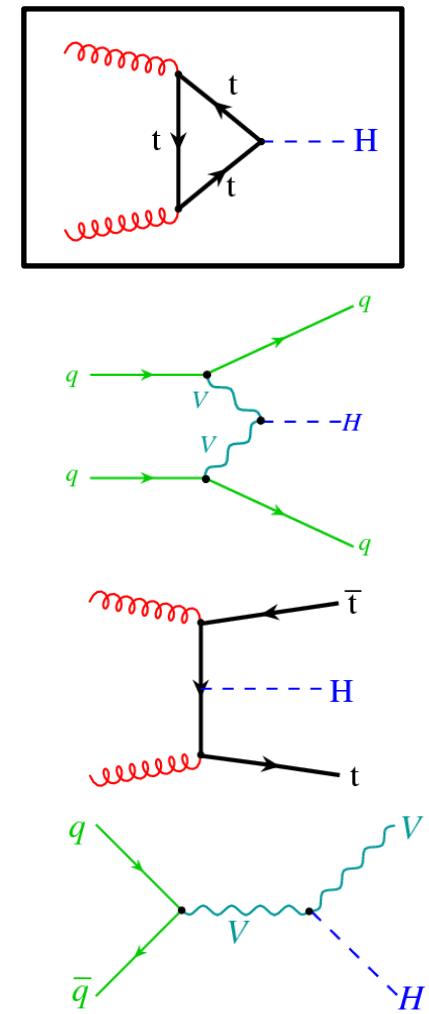
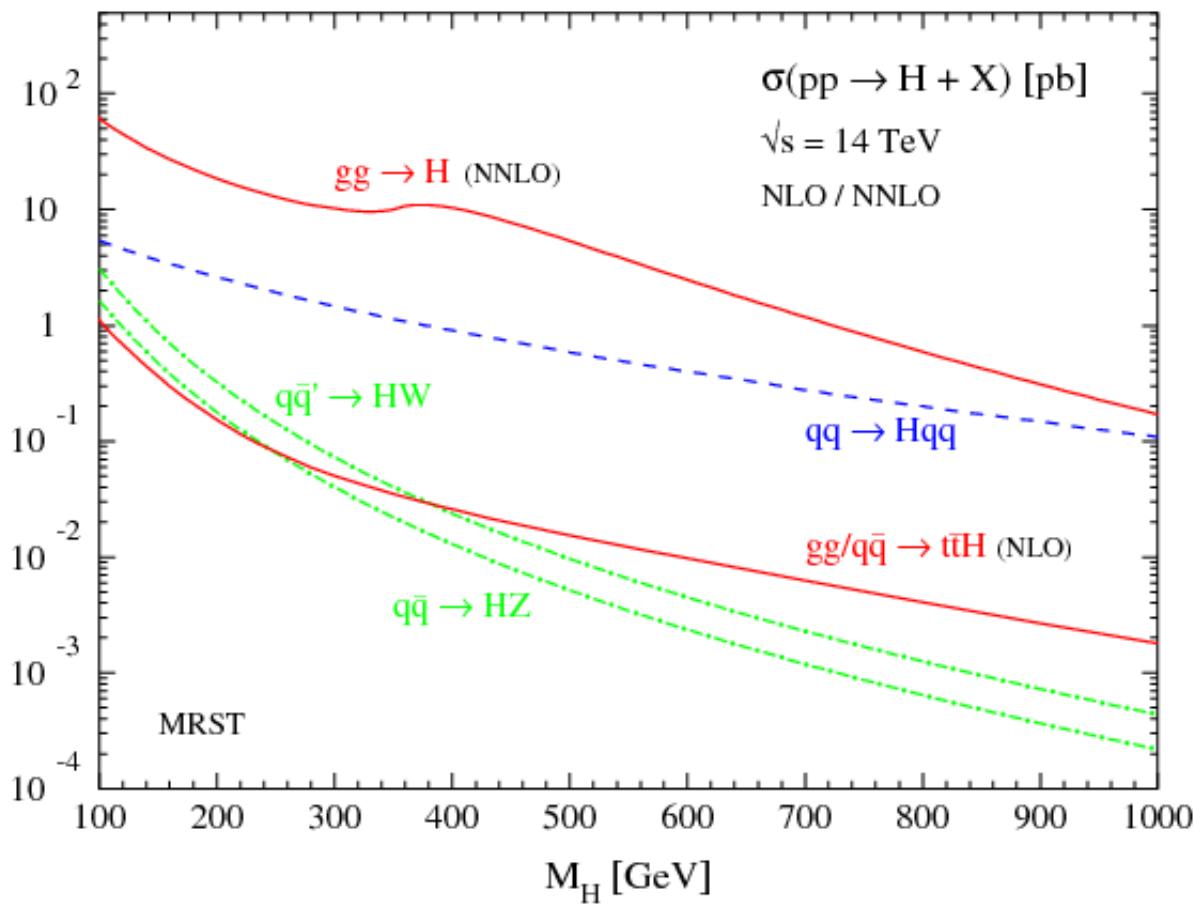
- Higgs production
 - Gluon fusion within the SM
 - Gluon fusion within the MSSM
- Results
 - Inclusive cross section
 - Distributions
 - 4th generation

Higgs production

Higgs production



Higgs production



Gluon fusion within the SM

QCD

NNLO (effective theory)

Harlander, Kilgore (2002)

Anastasiou, Melnikov (2002)

Ravindran, Smith, van Neerven (2003)

NNLO $\frac{1}{m_t}$ -terms

Harlander, HM, Marzani, Ozeren (2010)

Pak, Rogal, Steinhauser (2010)

Resummation

Catani, de Florian, Grazzini (2003)

Moch, Vogt (2005)

Idilbi, Ji, Ma, Yuan (2006)

Idilbi, Ji, Yuan (2006)

Ravindran (2006)

Ahrens, Becher, Neubert, Yang (2009)

electro-weak

NLO

Aglietti, Bonciani, Degrassi, Vincini (2004)

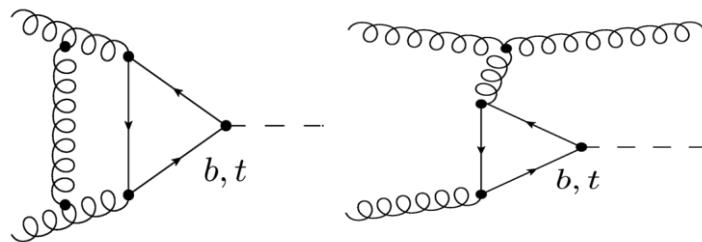
Actis, Passarino, Sturm, Uccirati (2008)

EW \otimes QCD $(m_h \ll m_W)$

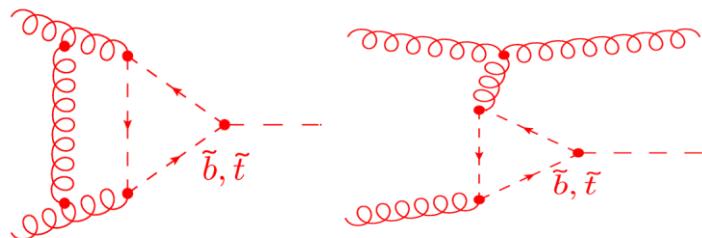
Anastasiou, Boughezal, Petriello (2009)

NLO Gluon fusion within the MSSM

QCD



scalar quarks



NLO top/stop
(effective theory)

NLO bottom/sbottom
(effective theory)

Anastasiou, Beerli,
Bucherer, Daleo, Kunszt (2007)
Aglietti, Bonciani, Degrassi, Vincini (2007)
Bonciani, Degrassi, Vincini (2007)
Mühlleitner, Spira (2008)
HIGLU

Harlander, Steinhauser (2004)
Degrassi, Slavich (2008)

Degrassi, Slavich (2010)
Harlander, HM, Hofmann (2010)

Gluon fusion within the **MSSM**

QCD

NNLO top/stop (effective theory)

Pak, Steinhauser, Zerf (2010)

p_T -distribution

Field, Dawson, Smith (2004)
Brein, Hollik (2007)

electro-weak

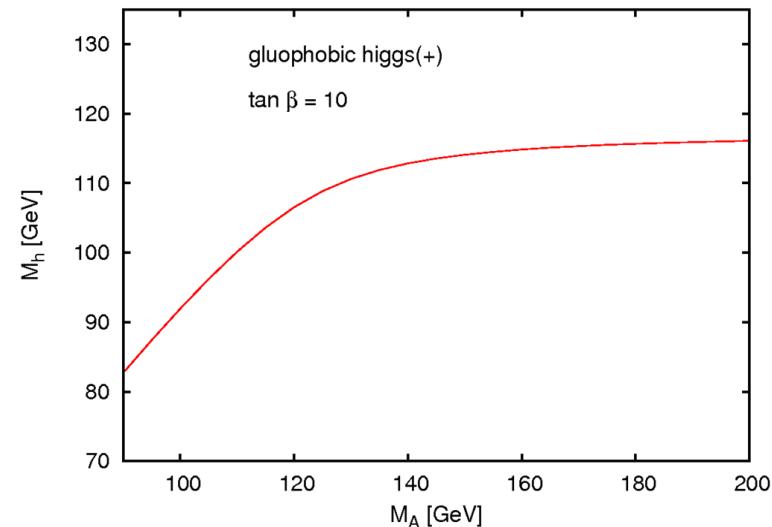
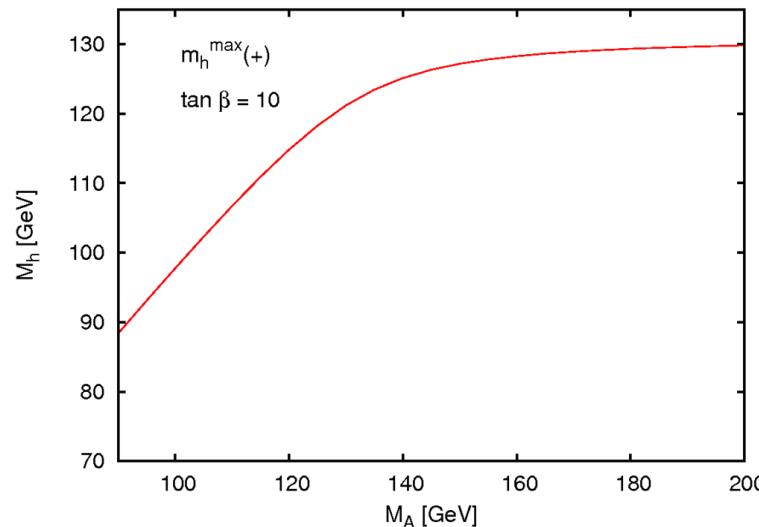
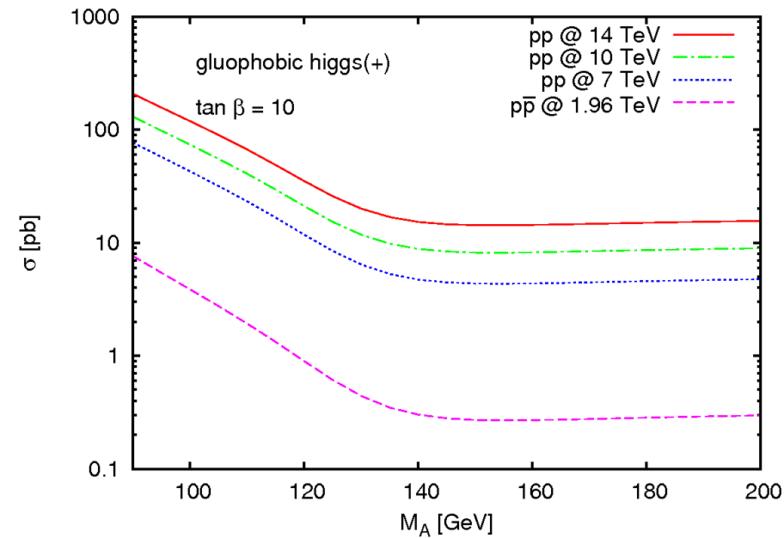
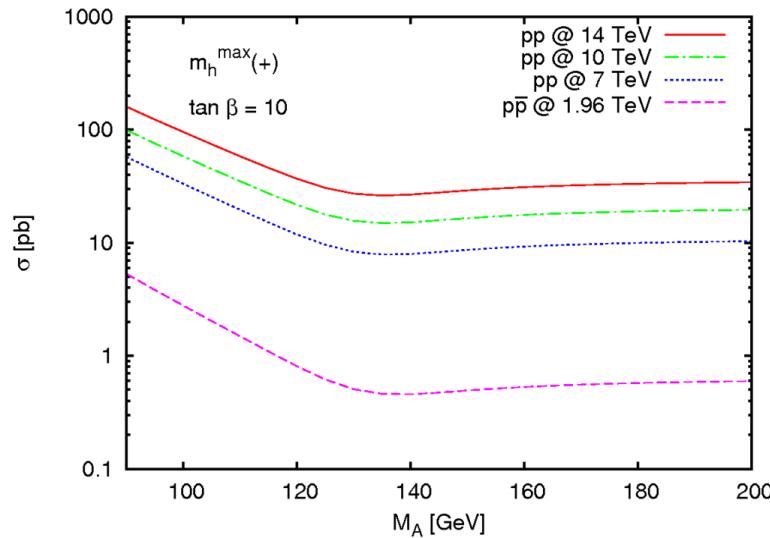
not yet known

Results

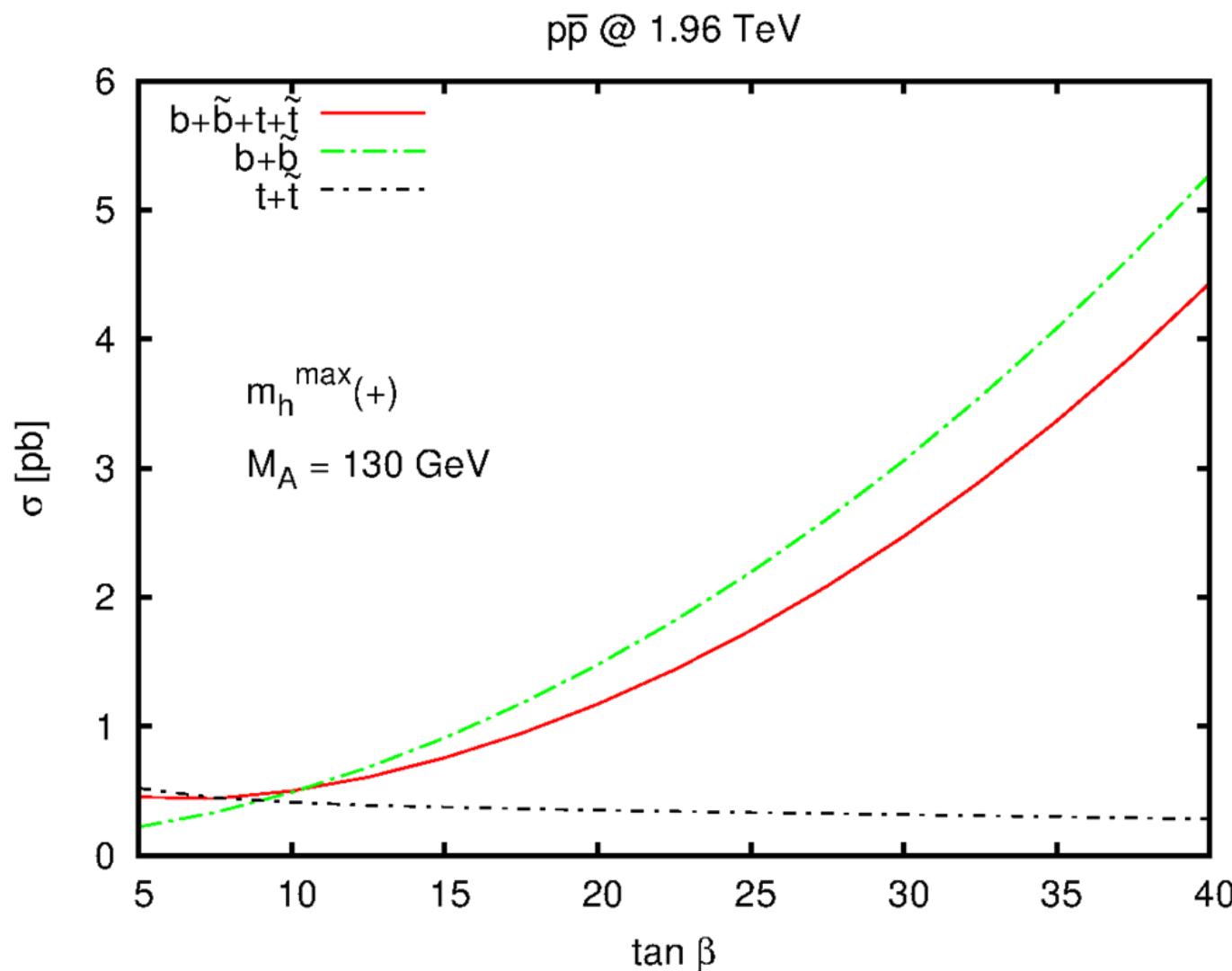
Parameters of the MSSM

- 105 additional parameters
- define parameters by choosing benchmark scenarios:
 - $m_h^{\max}(\pm)$ sign (μ)
 - no-mixing(\pm) $5 \leq \tan \beta \leq 40$
 - gluophobic higgs(\pm)
 - small $\alpha_{\text{eff}}(\pm)$ $90 \text{ GeV} \leq M_A \leq 200 \text{ GeV}$
- use FeynHiggs to calculate the parameters

Results: Total cross section

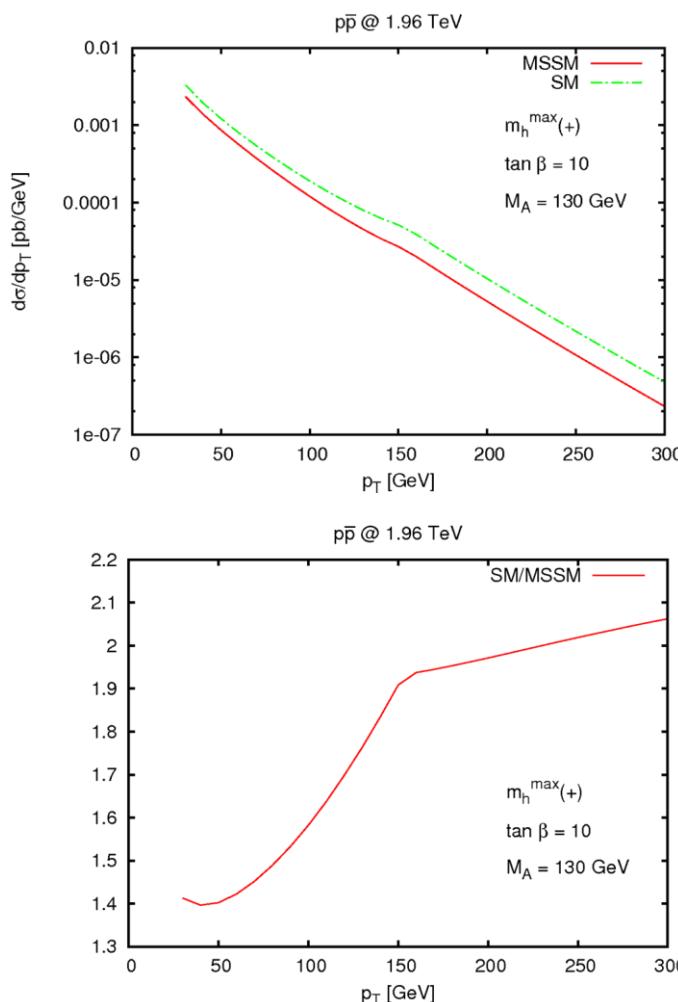


Results: $\tan \beta$ dependence

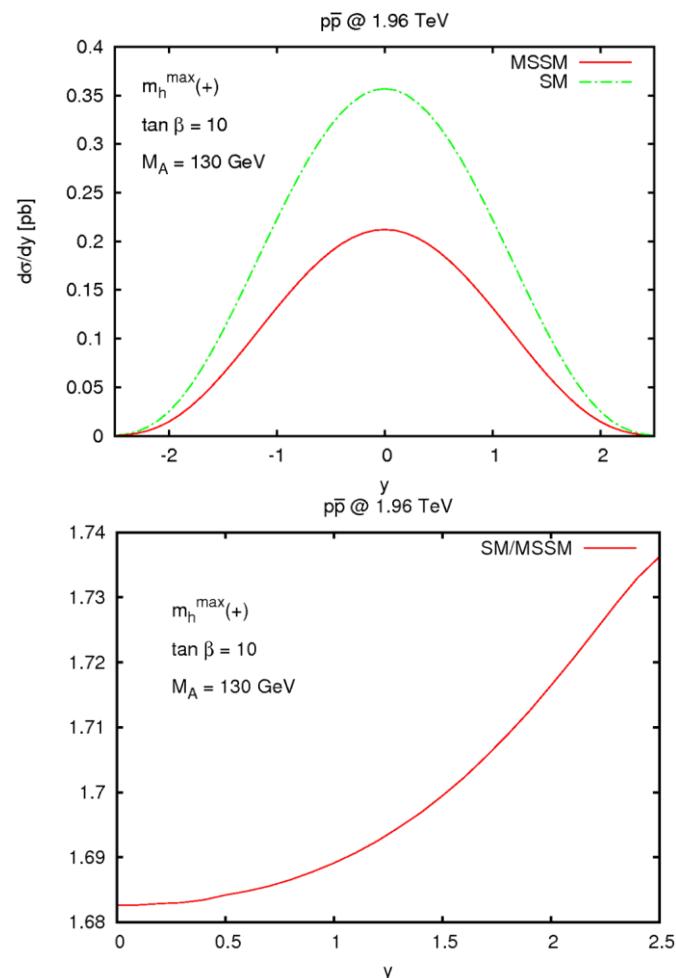


Results: Distributions

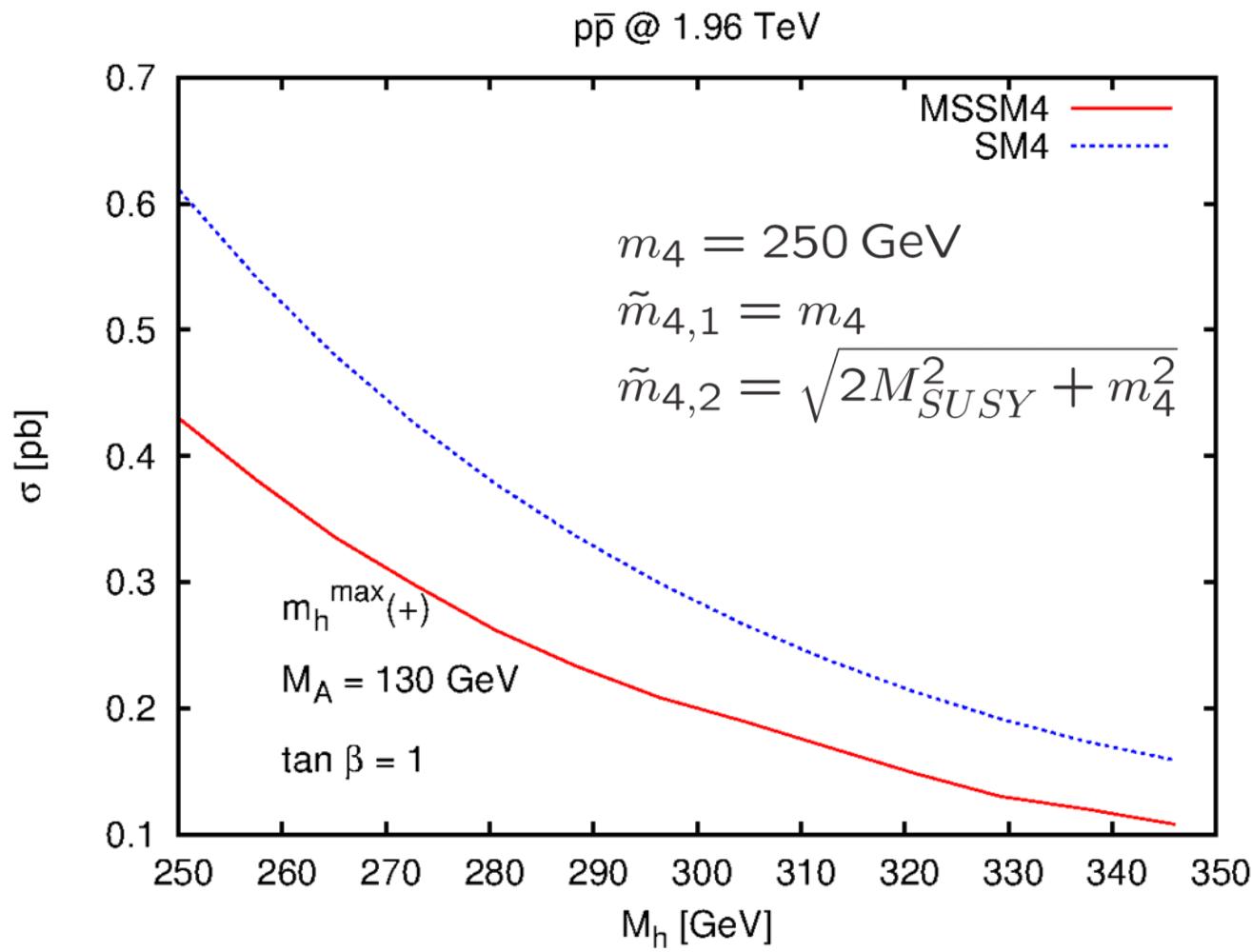
LO p_T distribution



NLO rapidity distribution



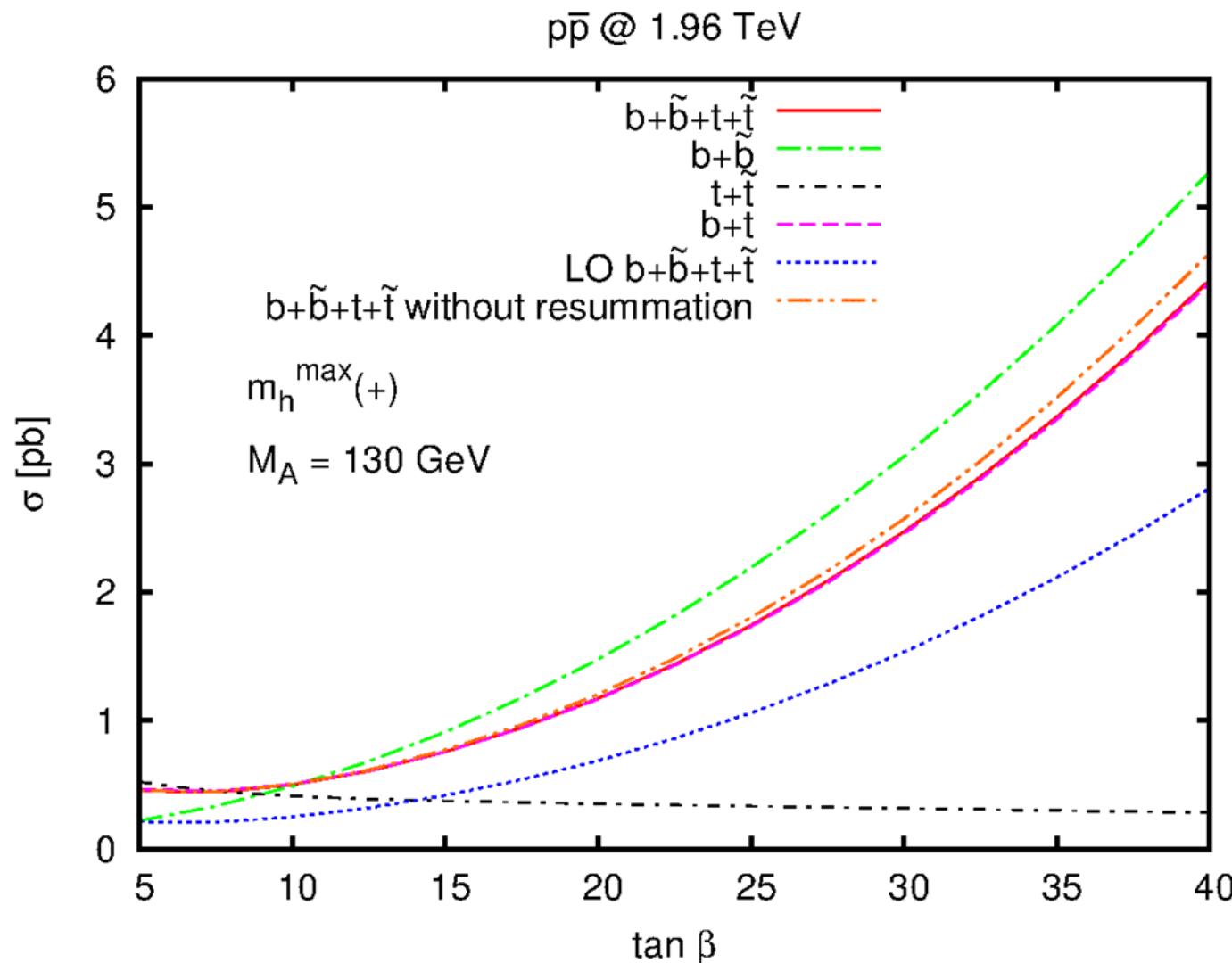
Results: 4th generation



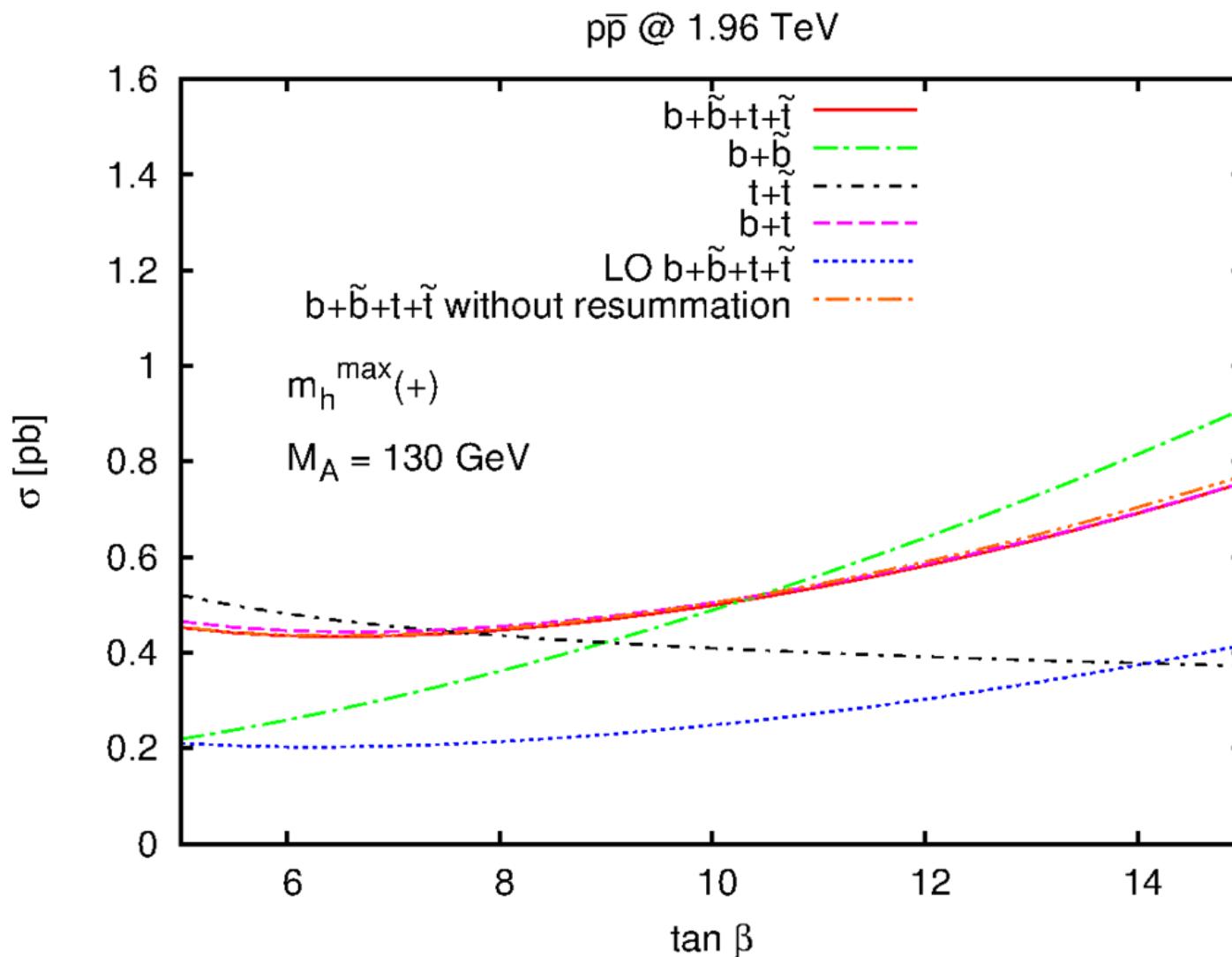
Conclusion

- complete calculation within the MSSM including the top- and bottom-sector
 - p_T and rapidity distributions
 - jet veto
 - renormalization scheme dependence
-
- fortran program available upon request

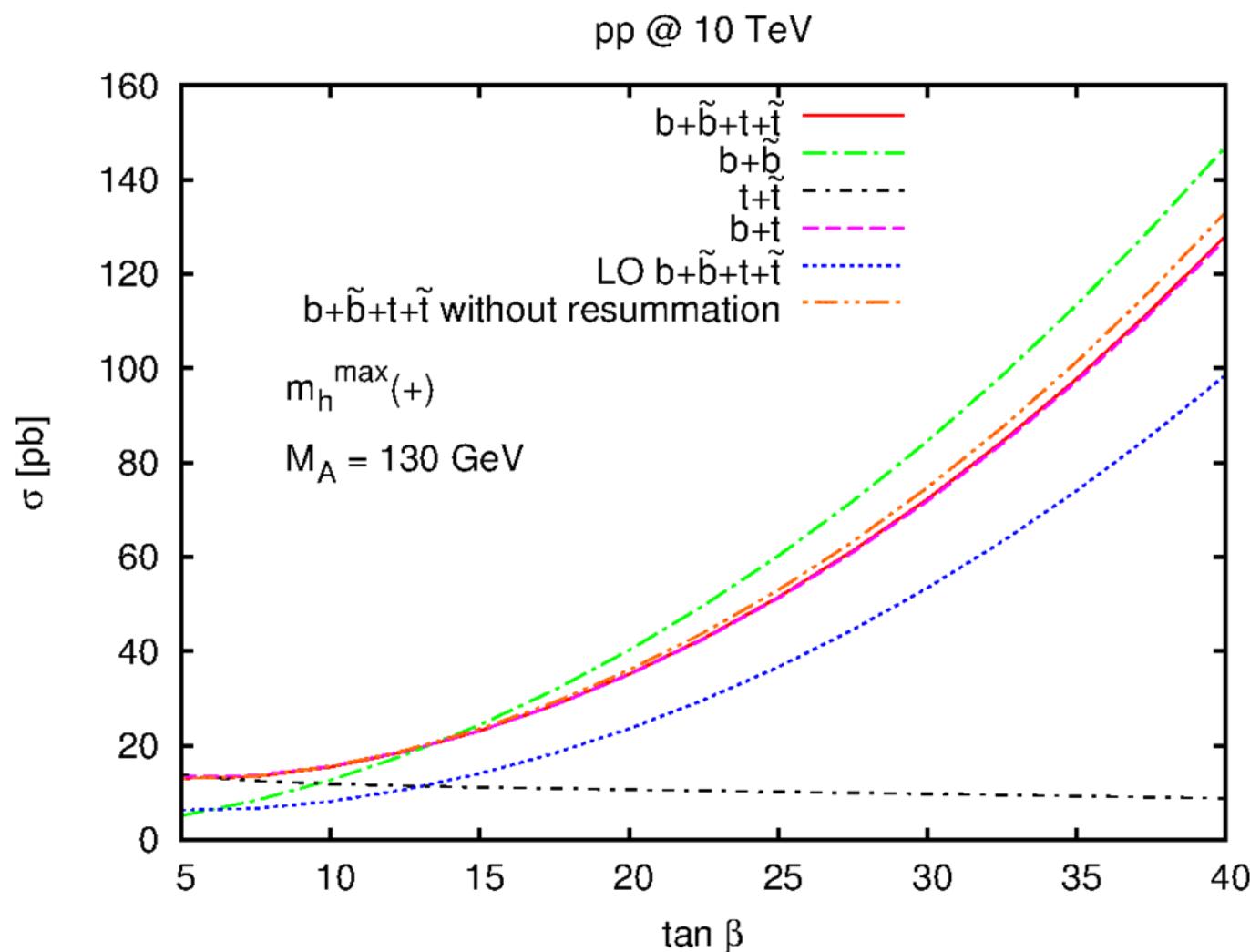
Results



Results

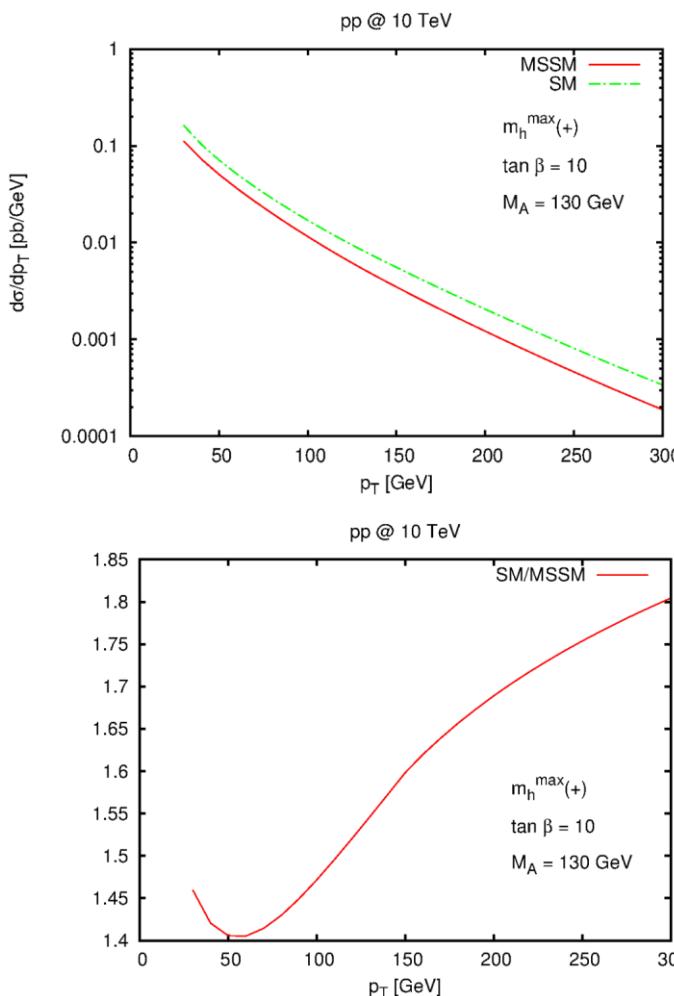


Results

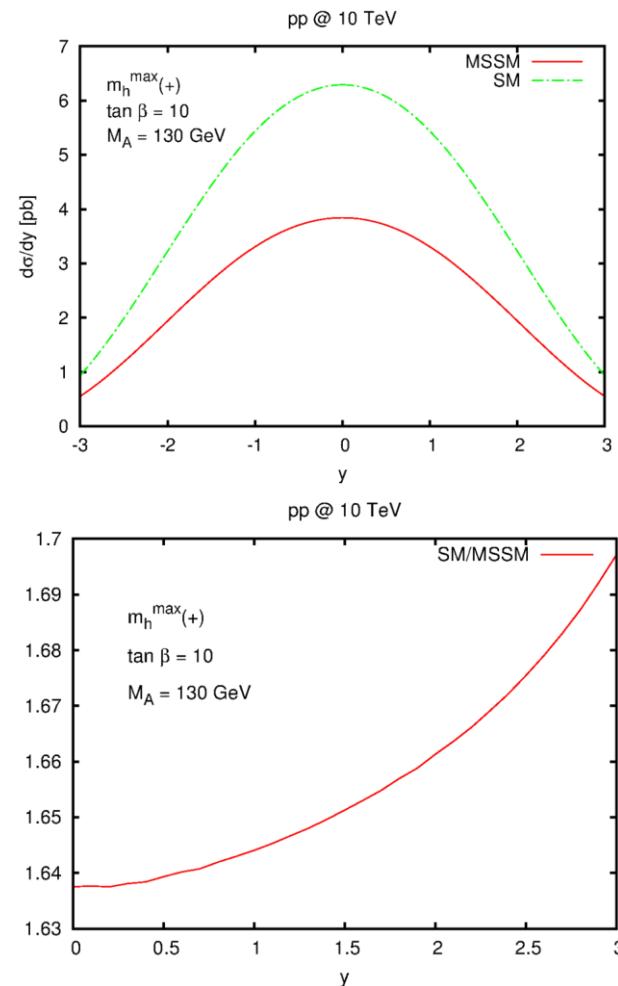


Results

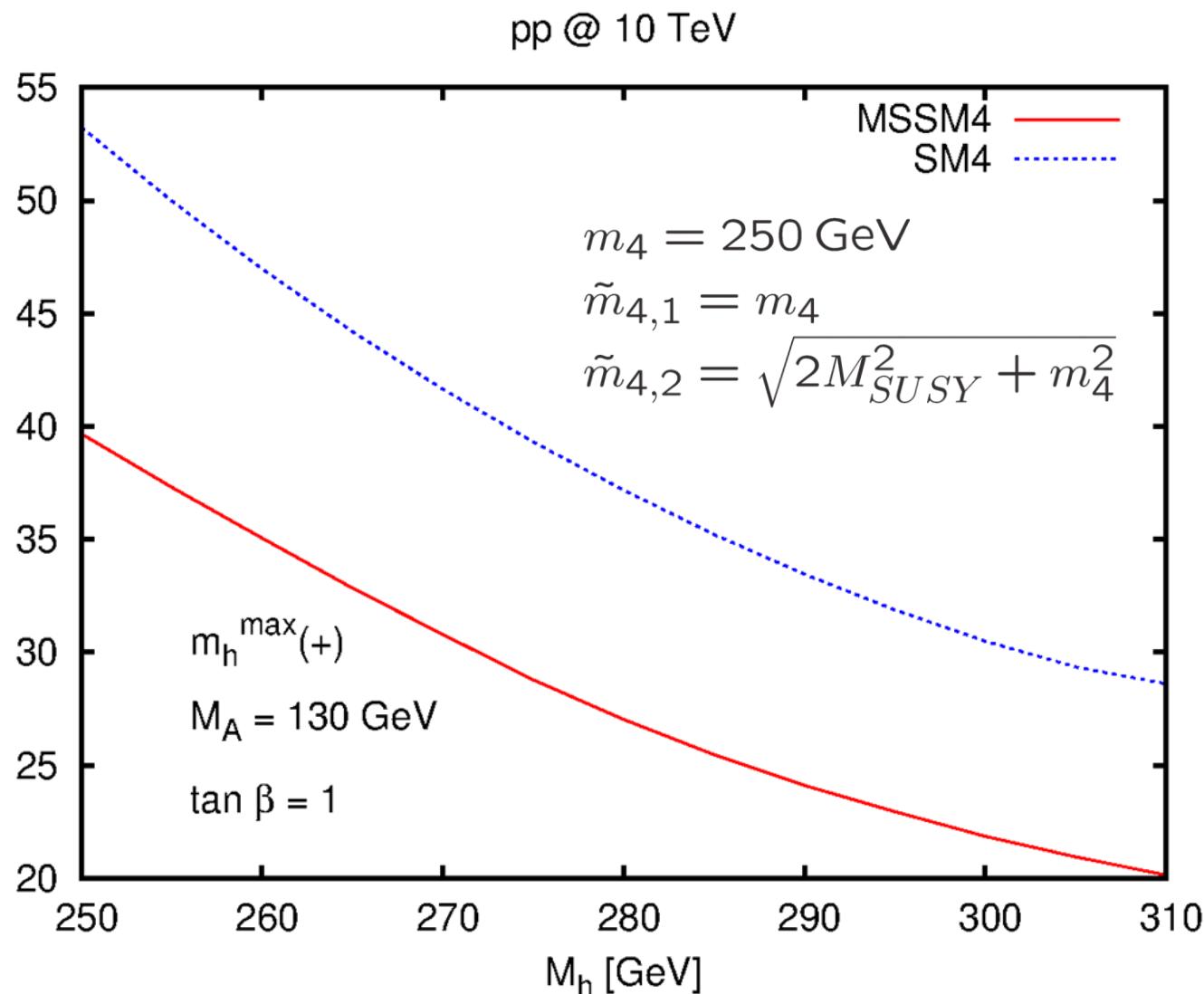
LO p_T distribution



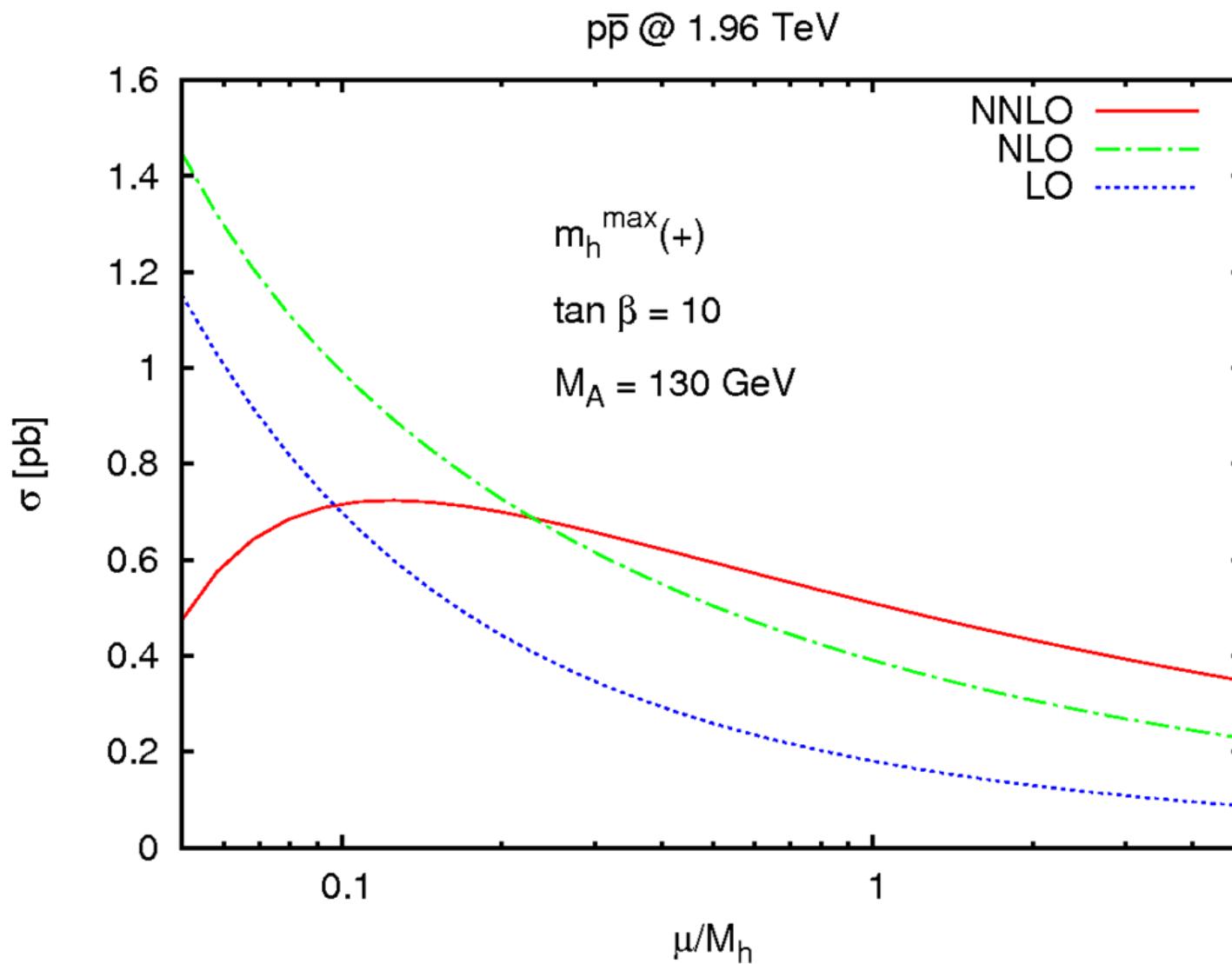
NLO rapidity distribution



Results

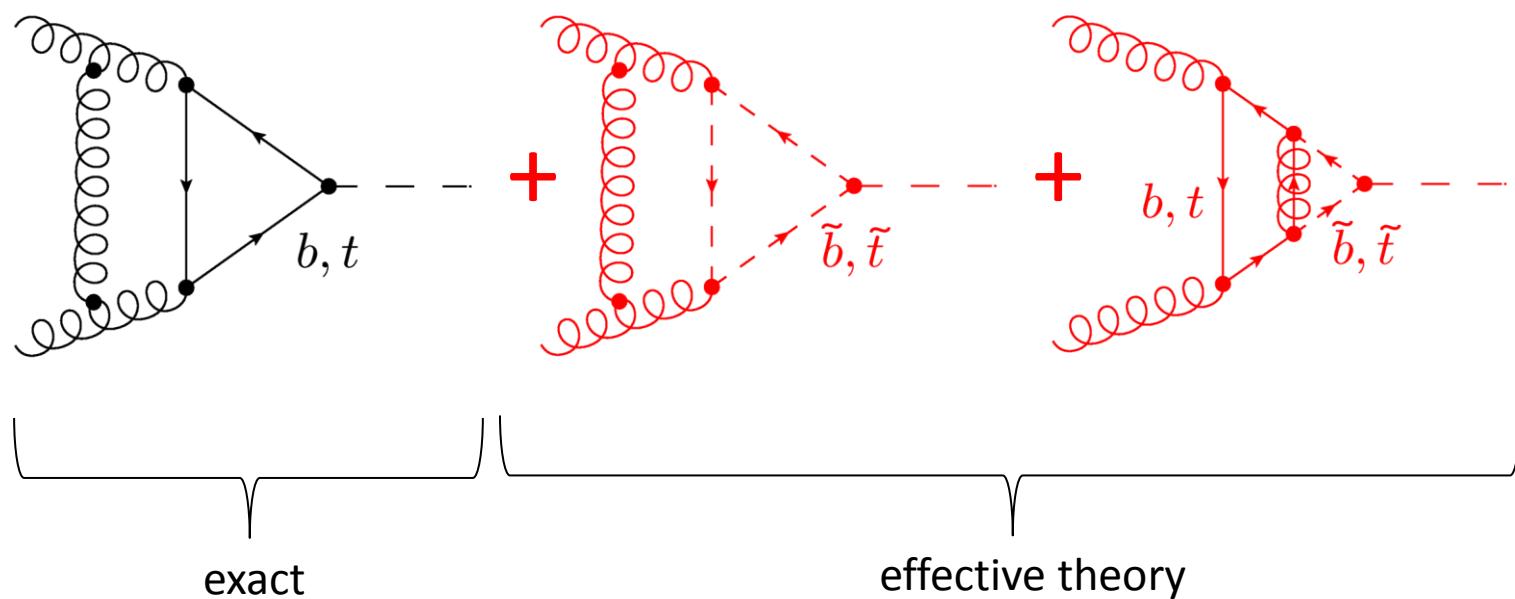


Results



Gluon fusion

NLO virtual corrections



top-sector: $m_t, m_{\tilde{t}_1}, m_{\tilde{t}_2}, m_{\tilde{g}} \gg m_h$

bottom-sector: $m_{\tilde{b}_1} = m_{\tilde{b}_2} = m_{\tilde{g}} = \tilde{M} \gg m_h, m_b$