

WEAK CORRECTIONS TO TOP PRODUCTION

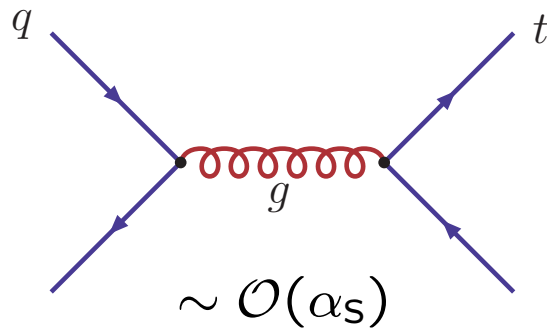
J.K., Scharf, Uwer: Eur. Phys. J. C45(2006) 139
Eur. Phys. J. C51(2007) 37

see also: Bernreuther, Fücker, Si
earlier work: Beenakker et al.

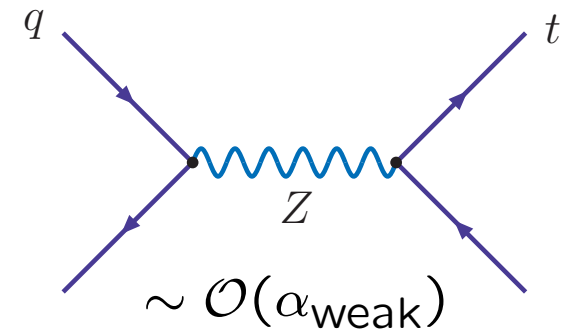
- I. Results at Partonic Level
- II. Tevatron and LHC

I. Results at Partonic Level

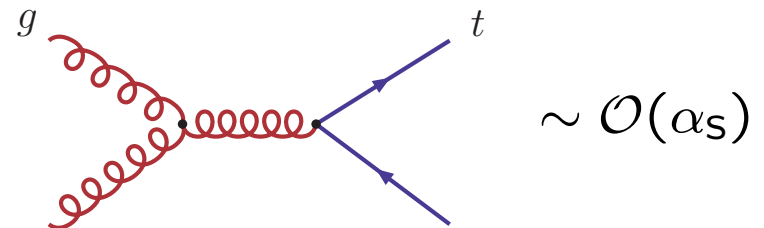
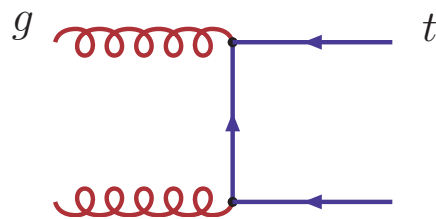
$q \bar{q} \rightarrow t \bar{t}$:



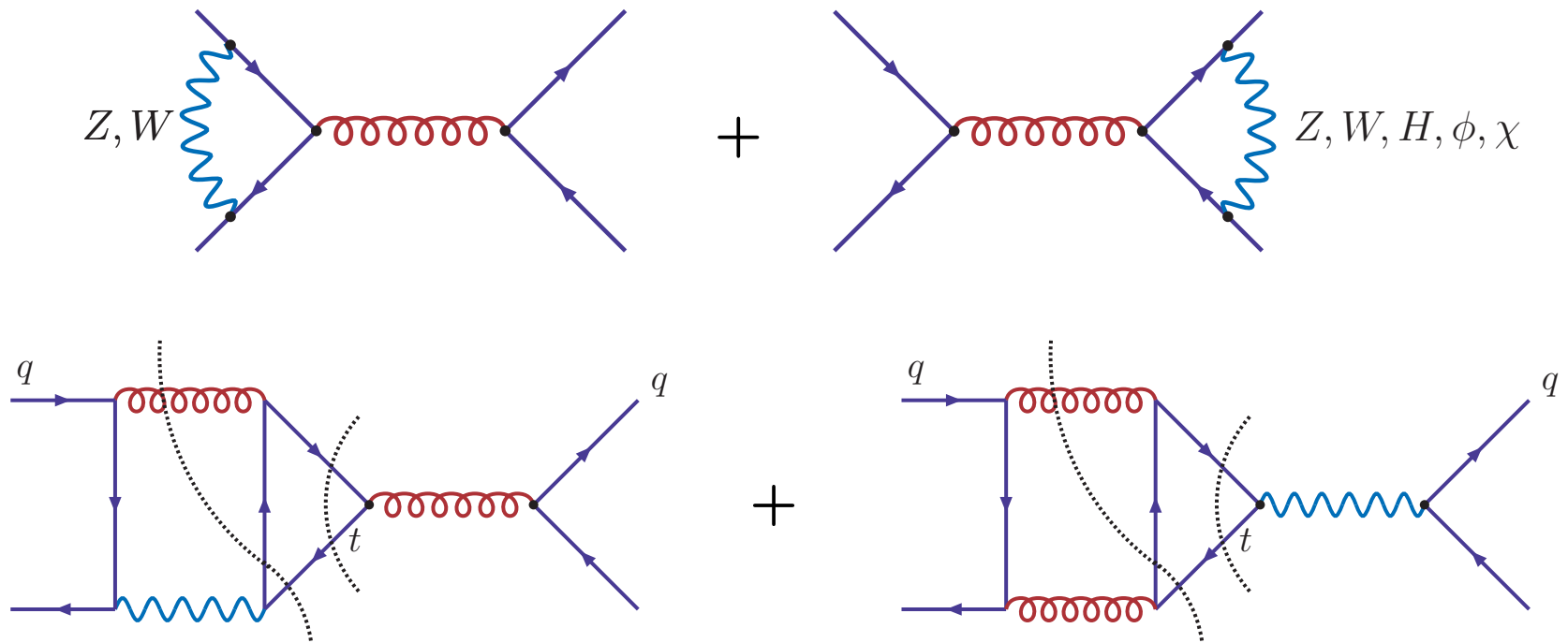
no
interference
with



$g g \rightarrow t \bar{t}$:



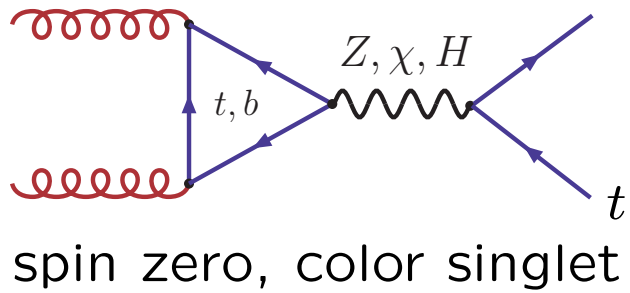
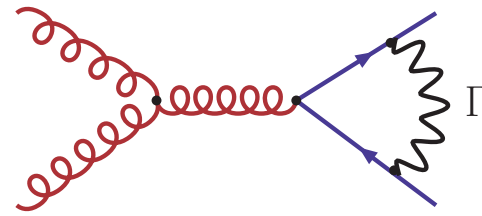
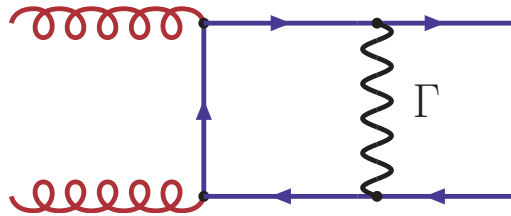
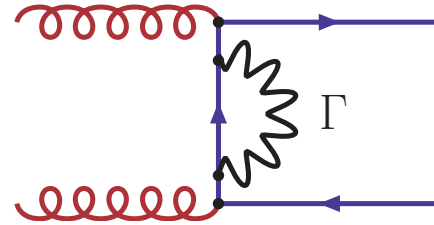
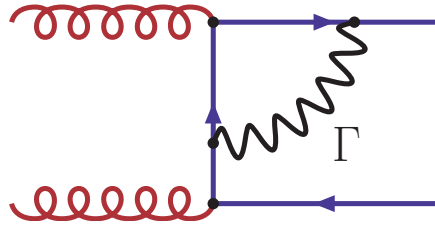
$\mathcal{O}(\alpha_S^2 \alpha_{\text{weak}})$ weak corrections ($q \bar{q} \rightarrow t \bar{t}$)



cuts of second group individually IR-divergent

electroweak and QCD corrections intertwined

$\mathcal{O}(\alpha_S^2 \alpha_{\text{weak}})$ weak corrections ($g g \rightarrow t \bar{t}$)

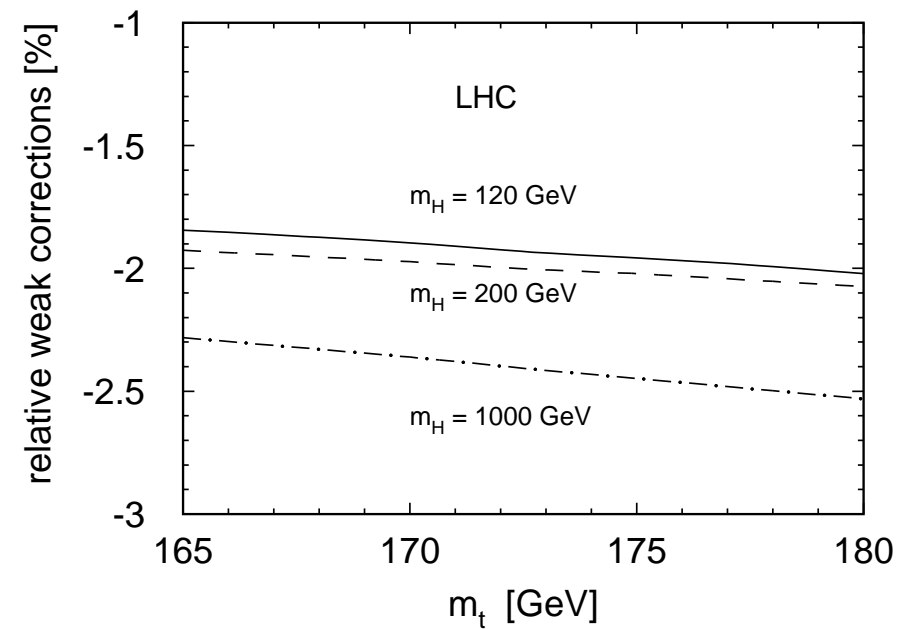
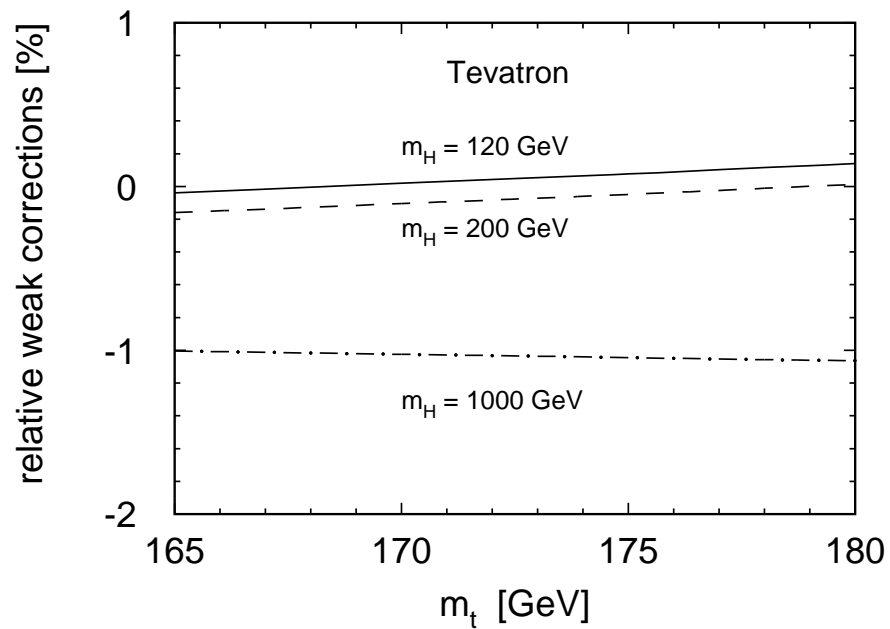


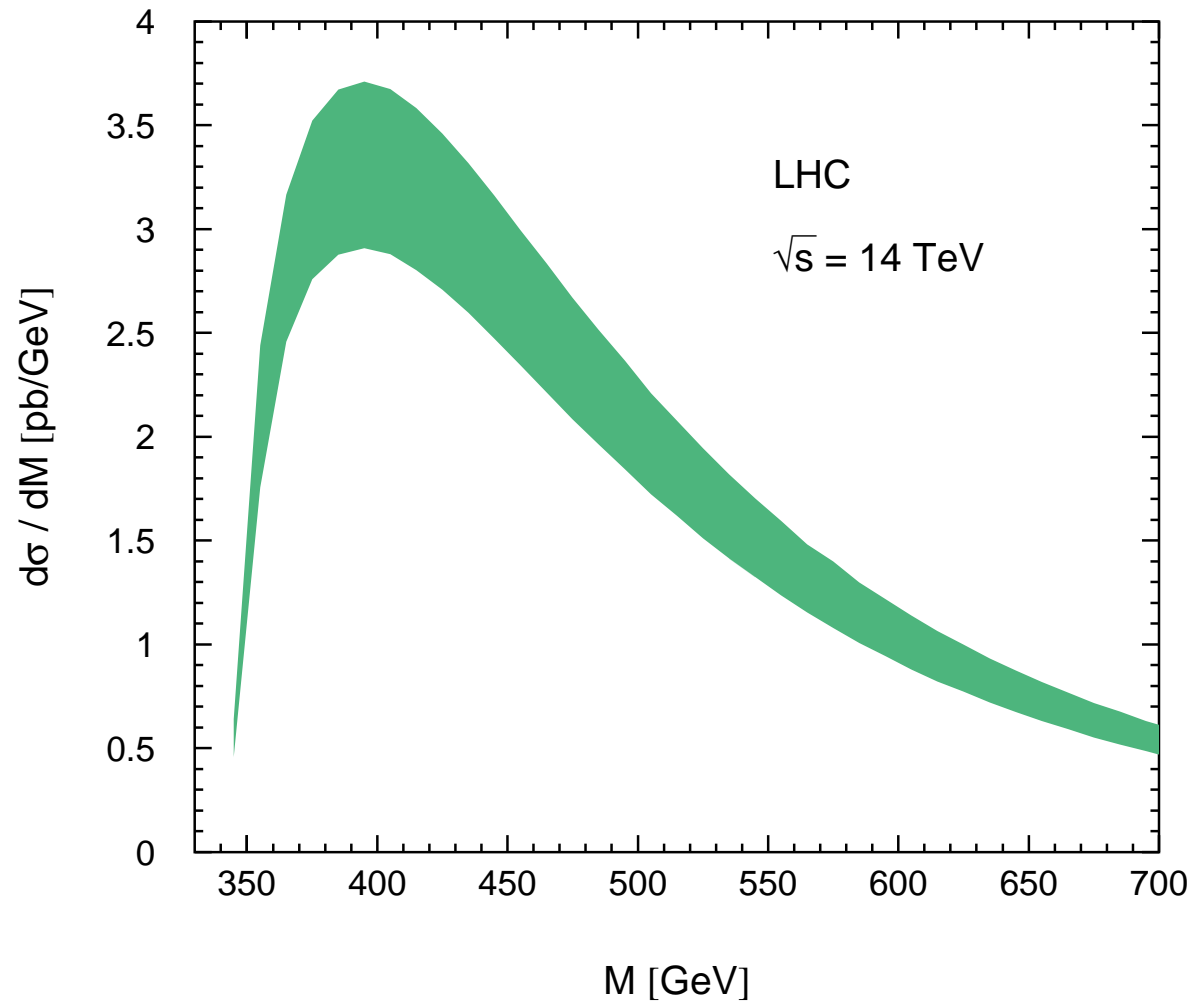
$$\Gamma = Z, W, H, \phi, \chi$$

- analytical & numerical results available
(earlier partial results by Beenakker *et al.*, some disagreements)
independent evaluation by Bernreuther & Fückler
- $(\text{box contribution})_{\text{up-quark}} = -(\text{box contribution})_{\text{down-quark}}$
 \Rightarrow suppression
- box contribution moderately \hat{s} -dependent
- strong increase of weak correction with \hat{s} (“Sudakov Logs”)
- Yukawa contributions (vertex corrections)
- sizable M_h -dependence, large effect close to threshold

II. Tevatron and LHC

Small effects for total cross section
(dominated by $\sqrt{\hat{s}} \sim 360\text{-}500$ GeV)

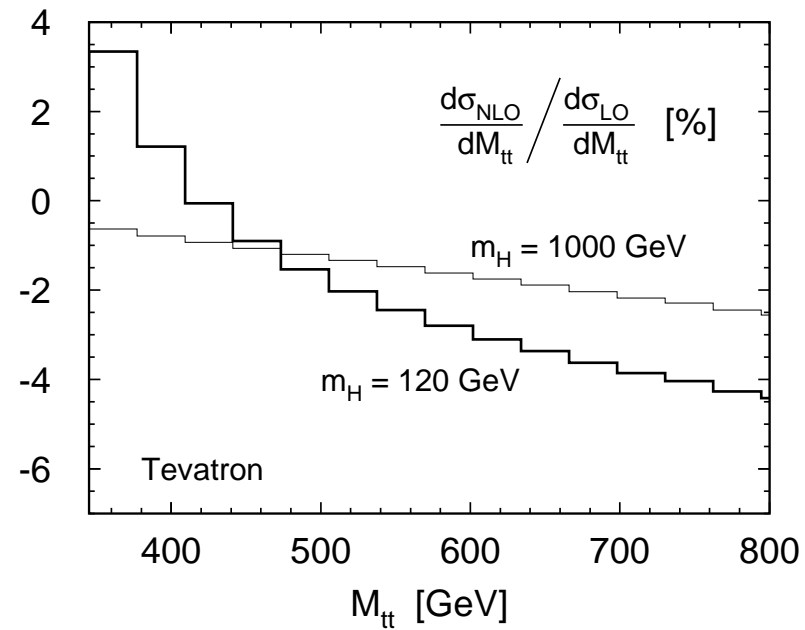
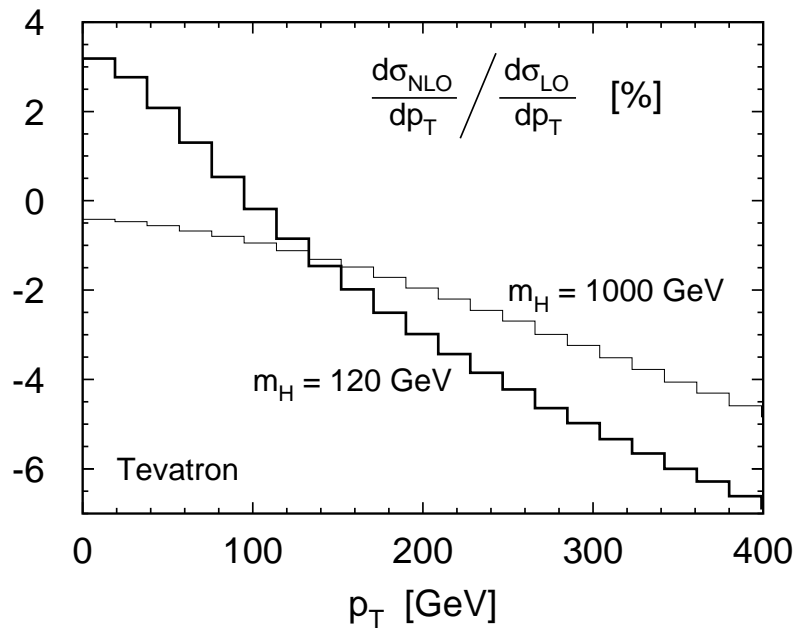




Invariant mass distribution $d\sigma/dM$ from NLO calculation

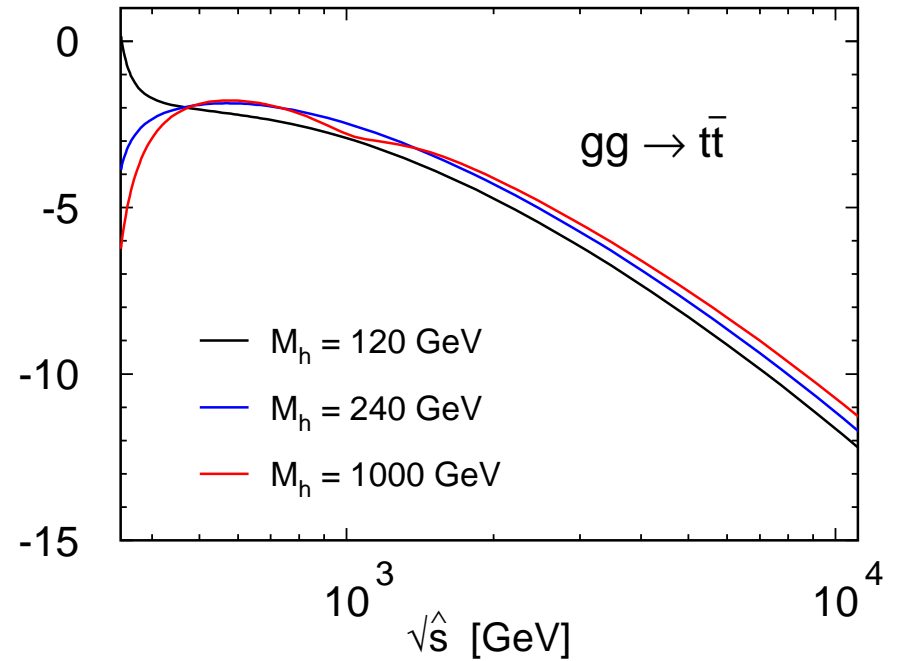
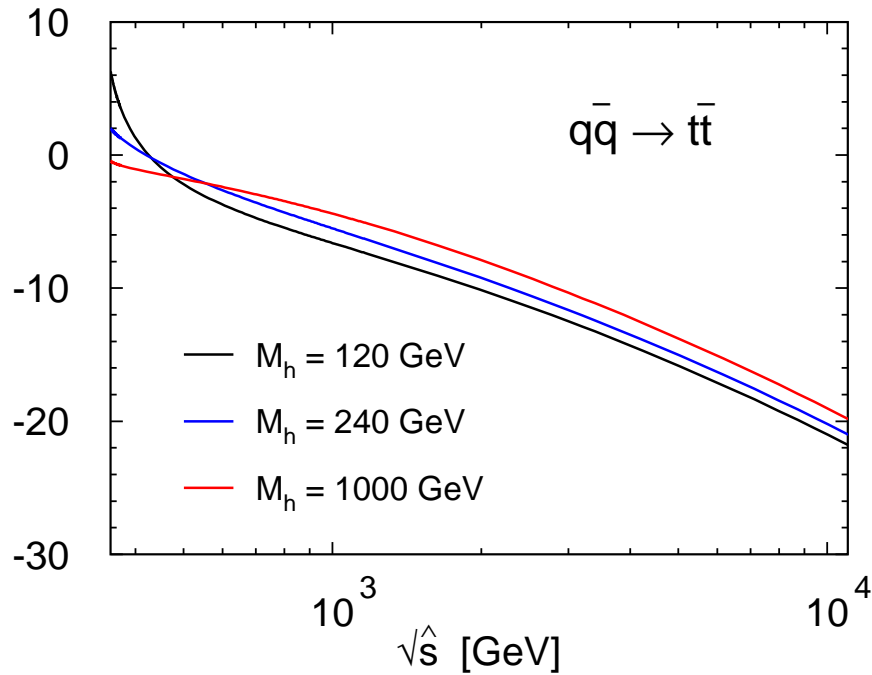
Based on HVQMNR (Mangano, Nason, Ridolfi)

Sizeable effects for differential distribution



large corrections for large $\sqrt{\hat{s}}$

sizable M_h -dependence

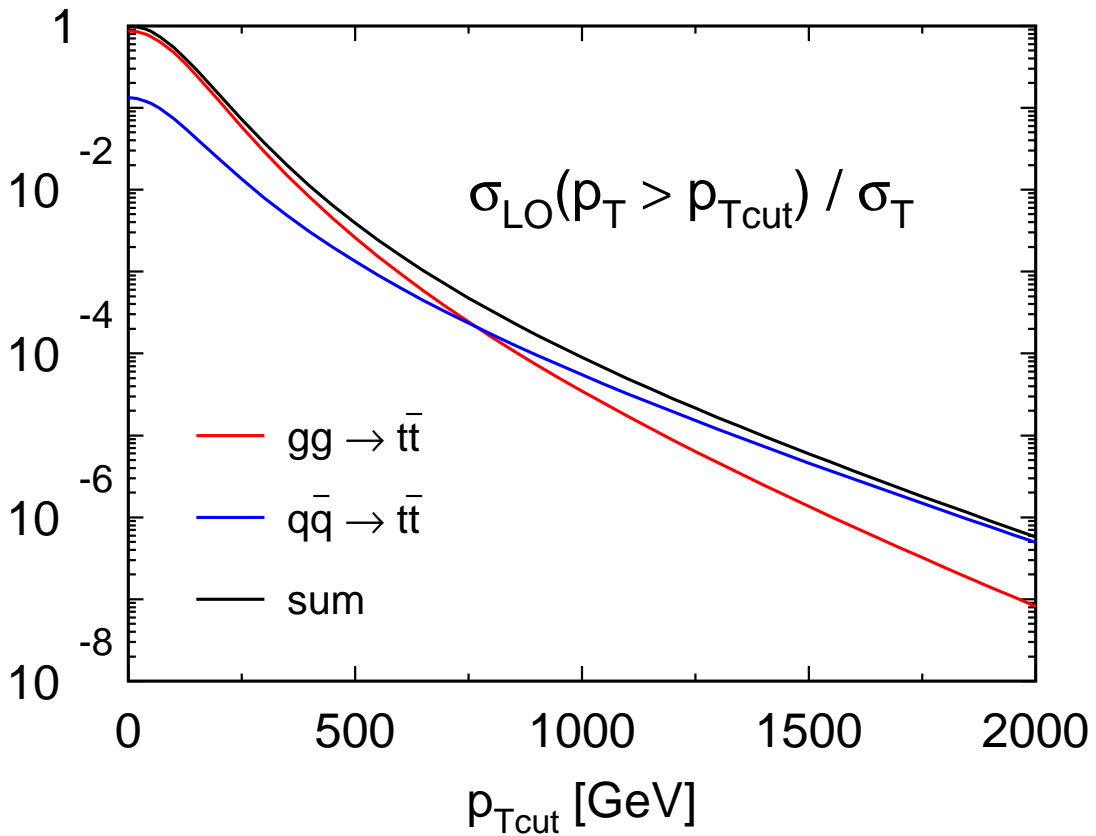


(relative weak corrections [%])

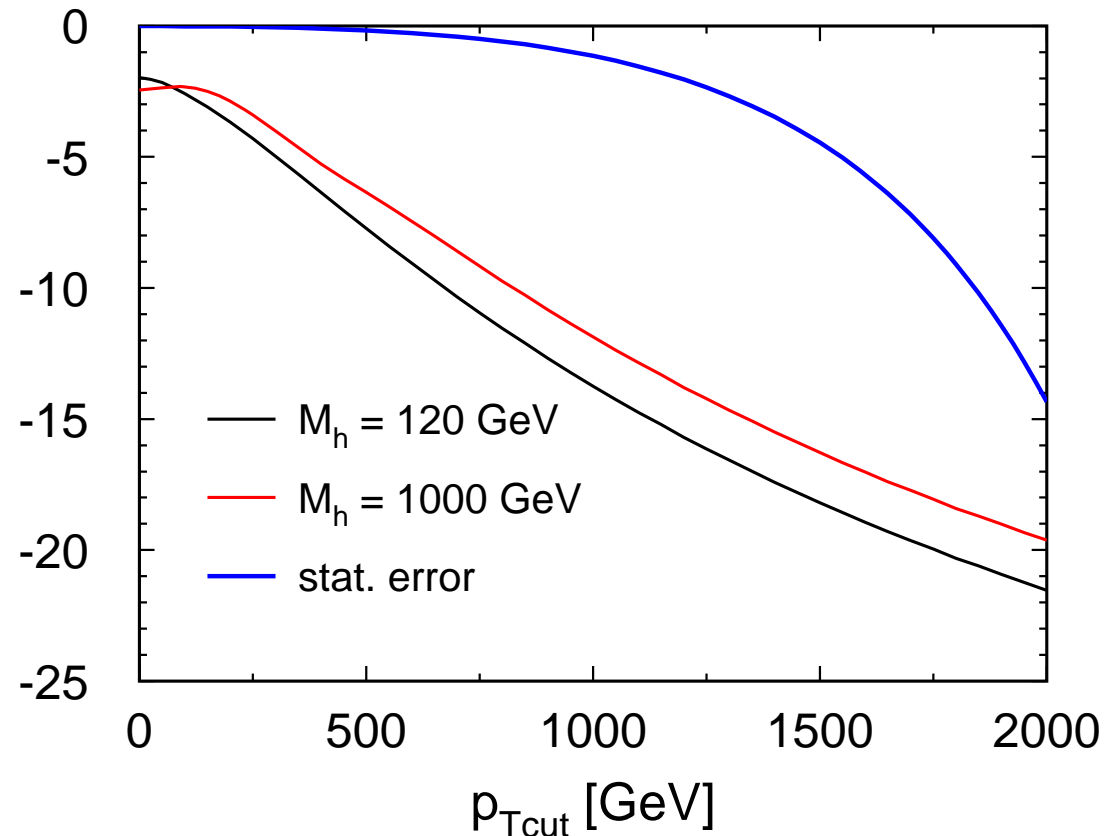
enhanced dependence on Yukawa coupling for light Higgs boson.

Transverse momentum dependence (LHC) 14 TeV

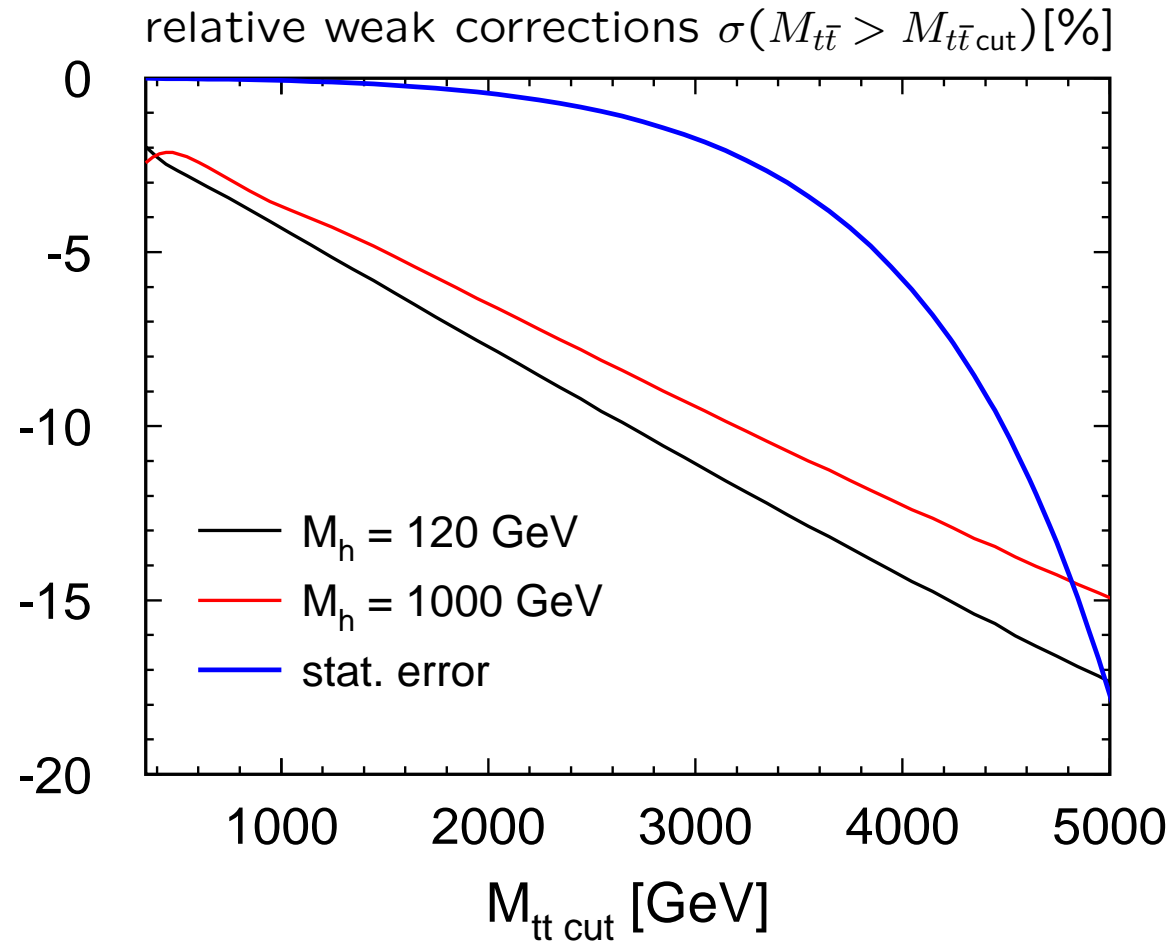
relative composition



relative weak corrections $\sigma(p_T > p_{T\text{cut}})$ [%]



$M_{t\bar{t}}$ -dependence (LHC)



relativ corrections for $2p_{T\text{ cut}}$ larger than for $M_{t\bar{t}\text{ cut}}$.
(Sudakov logs require large \hat{s} and \hat{t} !)

Conclusions on weak corrections

- LHC will explore the TeV-region: $\hat{s}/M_W^2 \gg 1$
- electroweak corrections amount to $\mathcal{O}(10\% - 20\%)$ in the interesting kinematic region $p_T \gtrsim 1$ TeV
- top-quark distributions at large \hat{s} are strongly modified
- sizable M_h -dependence for small p_T
- how to combine QCD and weak corrections?