Higgs + Bottom

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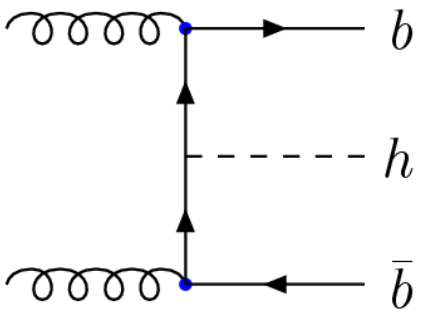
T. McElmurry, F. Maltoni, SW, hep-ph/0505014

Les Houches 2005

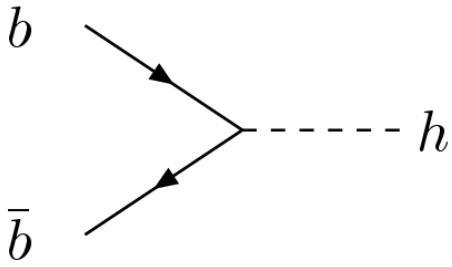
May 18, 2005

Higgs with bottom quarks

Inclusive cross section



Expansion in $\alpha_S \ln(m_h/m_b)$



Expansion in α_S

and $1/\ln(m_h/m_b)$

Aivazis, Collins, Olness, Tung;
Chuvakin, Smith, van Neerven

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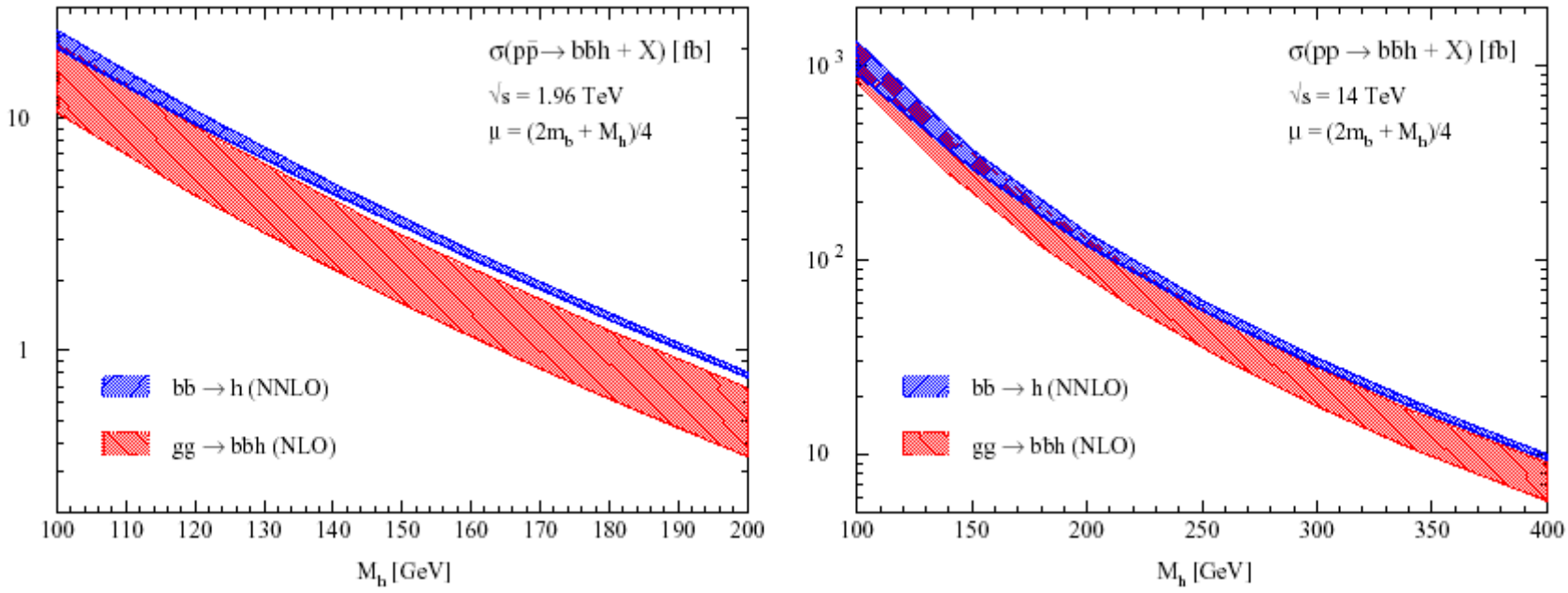


bb → h @ NNLO – Harlander and Kilgore

gg → bbh @ NLO – Dittmaier, Kramer, Spira; Campbell et al.

Dawson, Jackson, Reina, Wackeroth

Possible explanations

- ~~m_b neglected in bb→h NNLO calculation~~
  - ``phase space effects, approximate kinematics,…''
- Top loop treated differently
  - remove from four-flavor calculation
- Four-flavor calculation with five-flavor PDF
  - a goal of this workshop
- Effect of resummation
  - this talk

Quantifying the effect of resummation

- Define approximate b PDF:

$$\tilde{b}(x,\mu_F) = \frac{\alpha_s(\mu_F)}{2\pi} \ln\left(\frac{\mu_F^2}{m_b^2}\right) \int_x^1 \frac{dy}{y} P_{qg}\left(\frac{x}{y}\right) g(y,\mu_F),$$

where $P_{qg}(x) = \frac{1}{2}[x^2 + (1-x)^2]$ and μ_F is the factorization scale.

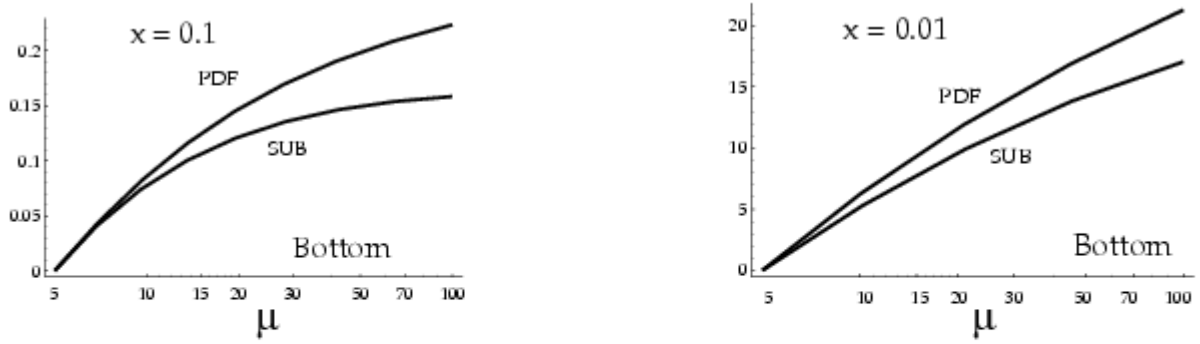
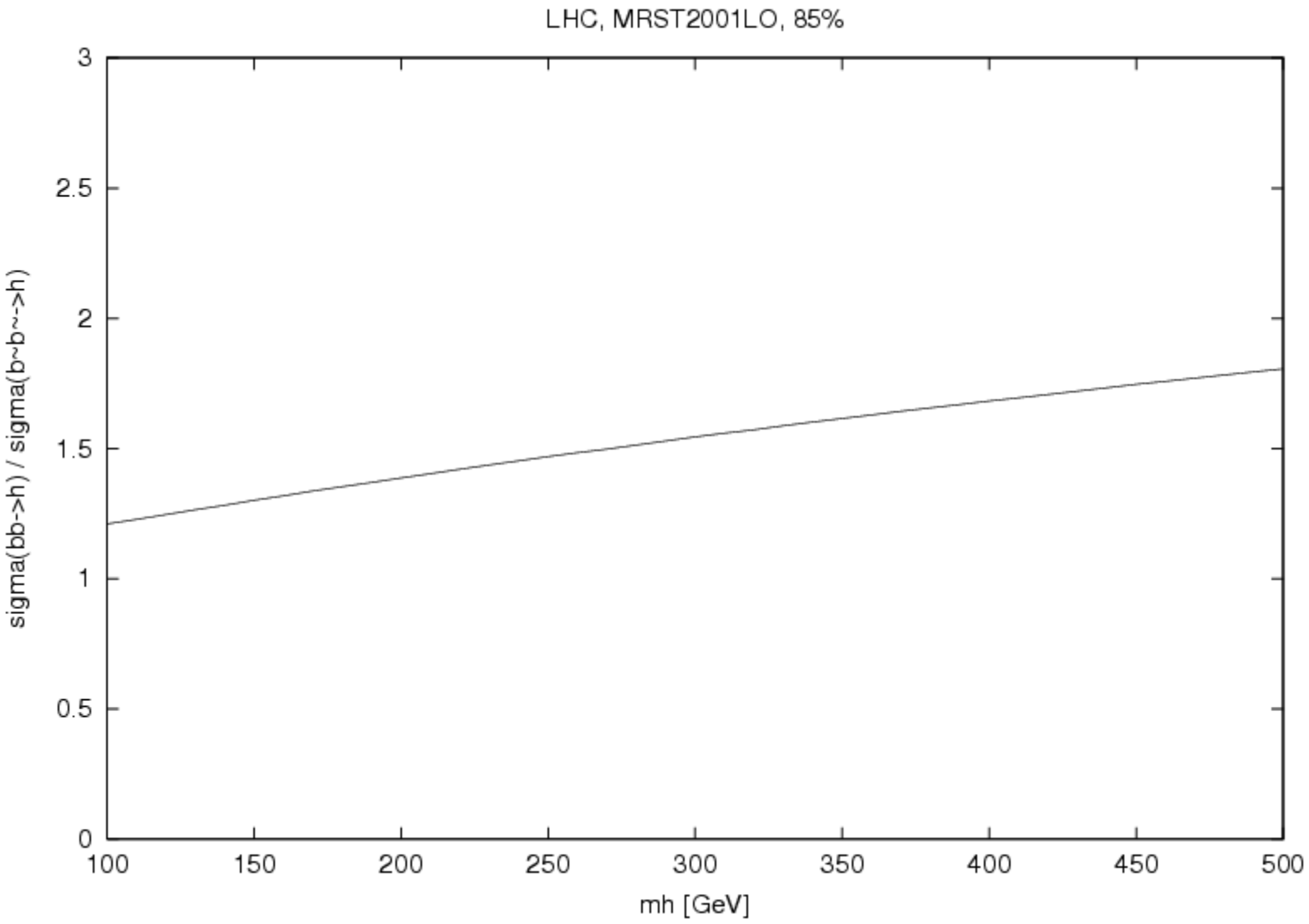


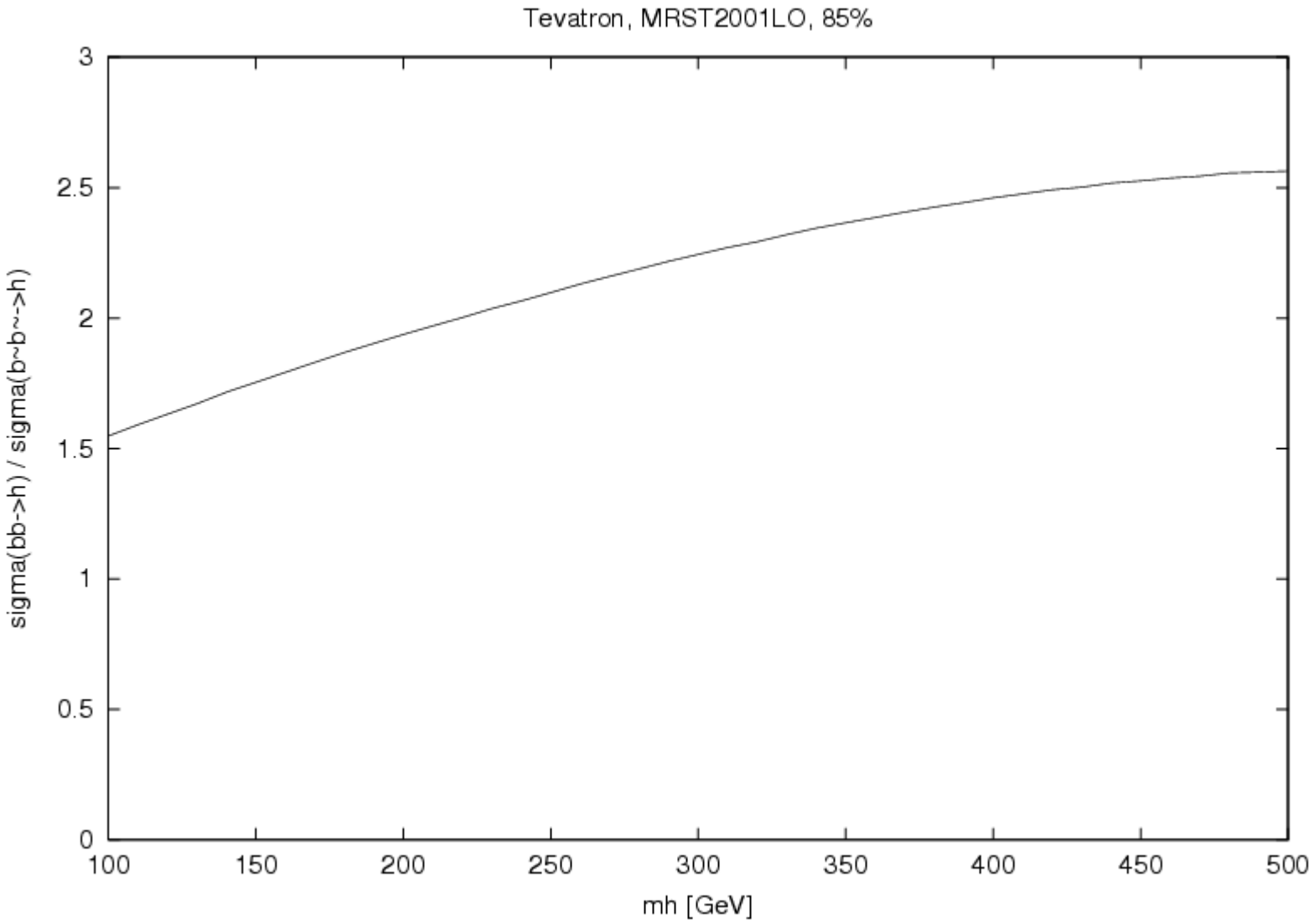
FIG. 5. Comparison of the evolved PDFs, $f^H(x,\mu)$ (labeled PDF), and perturbative PDFs, ${}^1f^H(x,\mu)$ (labeled SUB), as a function of the renormalization scale μ for charm at $x = 0.1$ (a) and $x = 0.01$ (b), and for bottom at $x = 0.1$ (c) and $x = 0.01$ (d). This shows the compensation between fully evolved heavy quark parton distribution and the first order perturbative contribution (which is the only part contained in the FFN scheme calculation).

Olness, Scalise, Tung

Effect of resummation - LHC

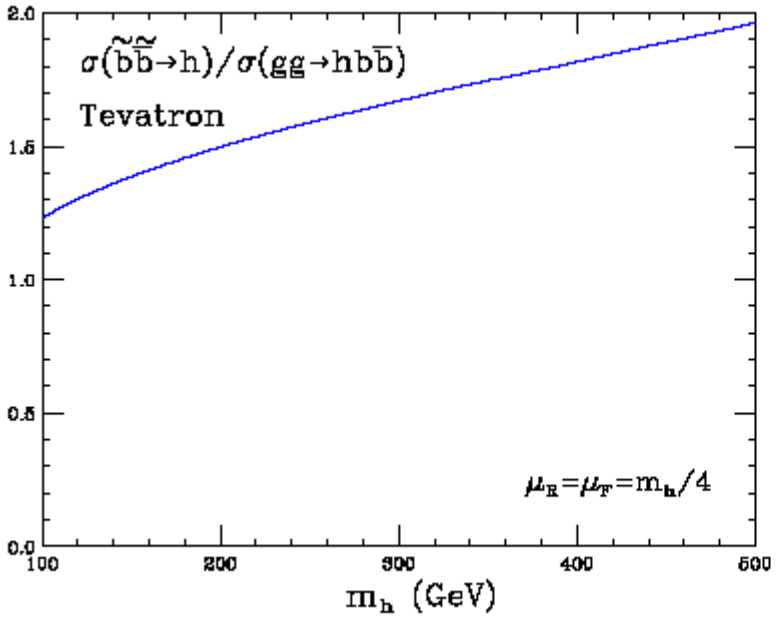


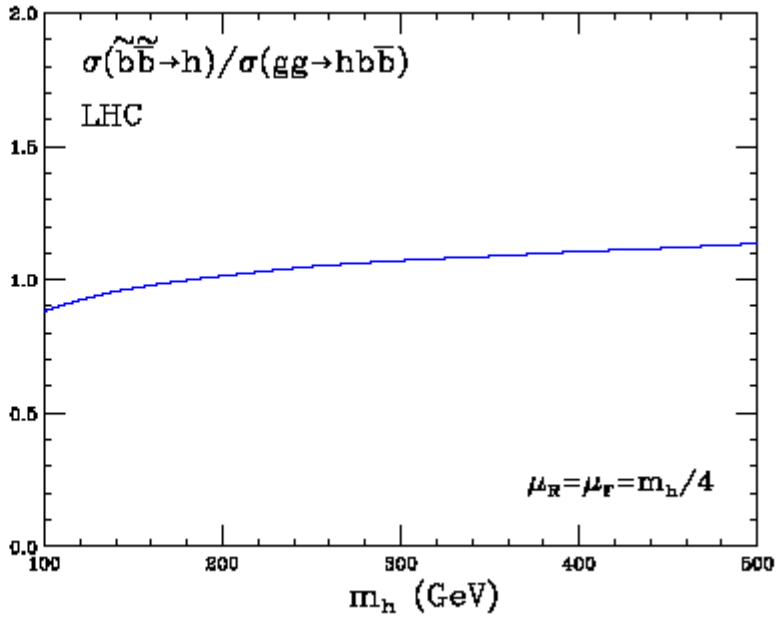
Effect of resummation - Tevatron



- Define $R = \dfrac{\sigma\left(\tilde{b}\bar{\tilde{b}} \to h\right)}{\sigma\left(gg \to hb\bar{b}\right)}$.

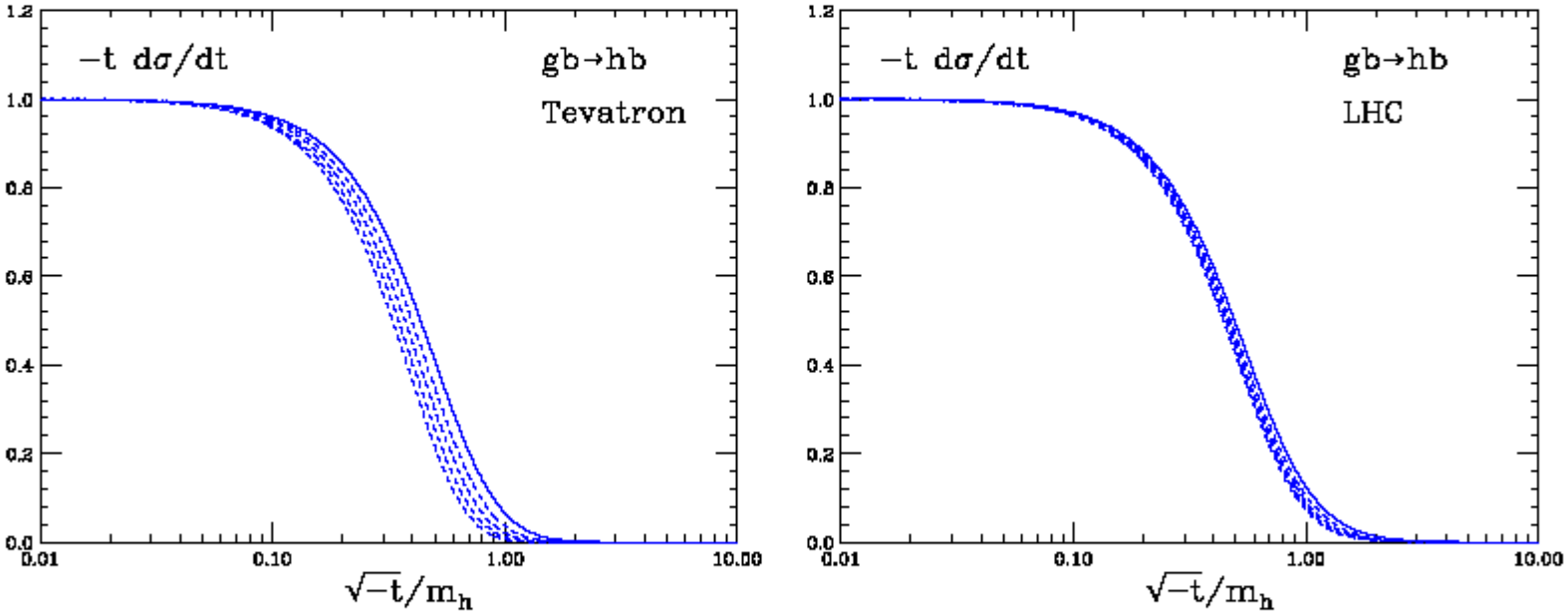
M. Krämer, hep-ph/0407080





The Edge of the Plateau

- Notice the collinear plateaux end at slightly lower scales for larger m_h.



- Choose μ_F where $-t\frac{d\sigma}{dt}$ reaches 85% of its value on the plateau.

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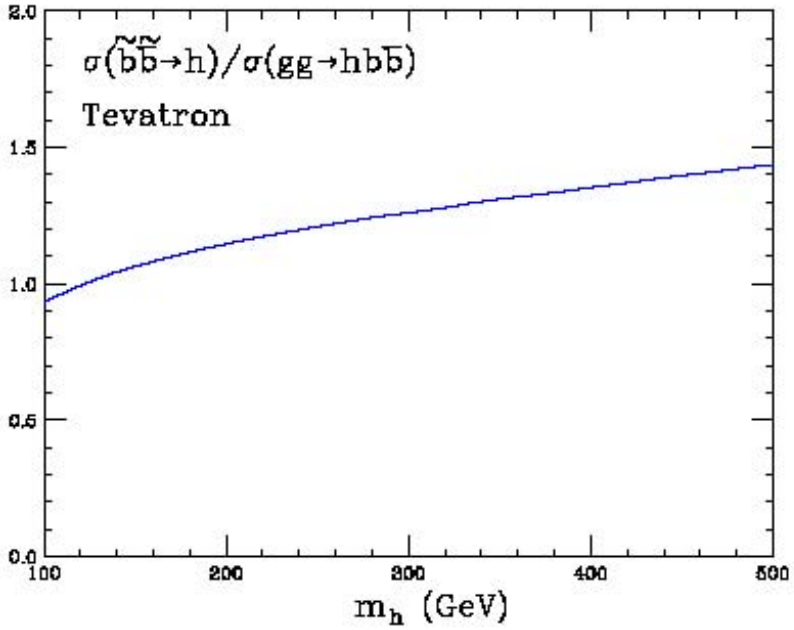
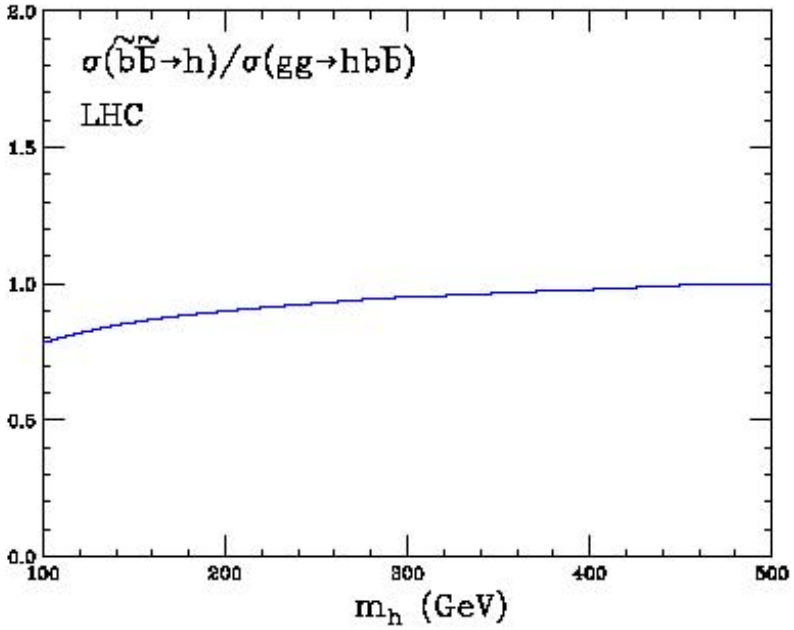
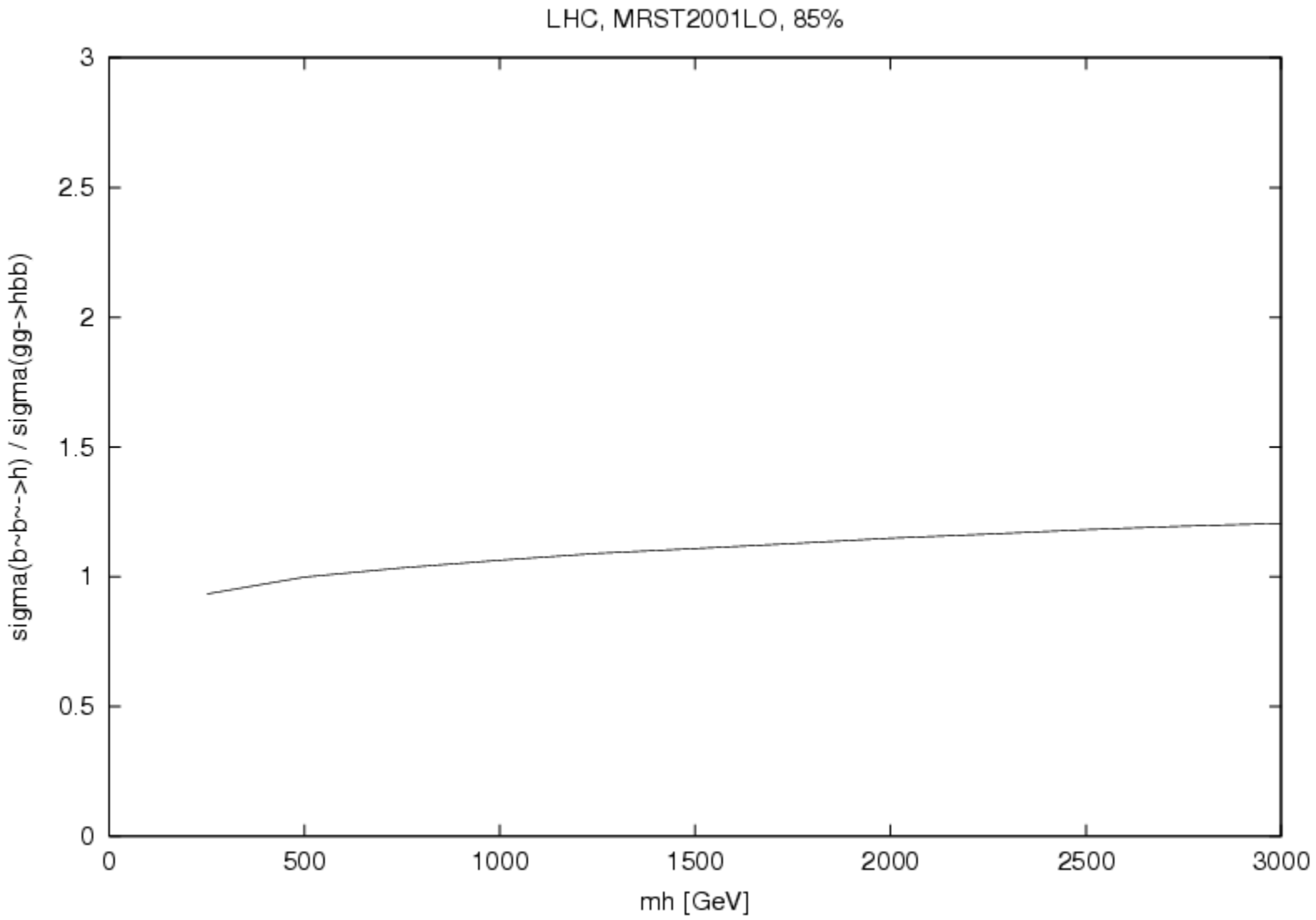
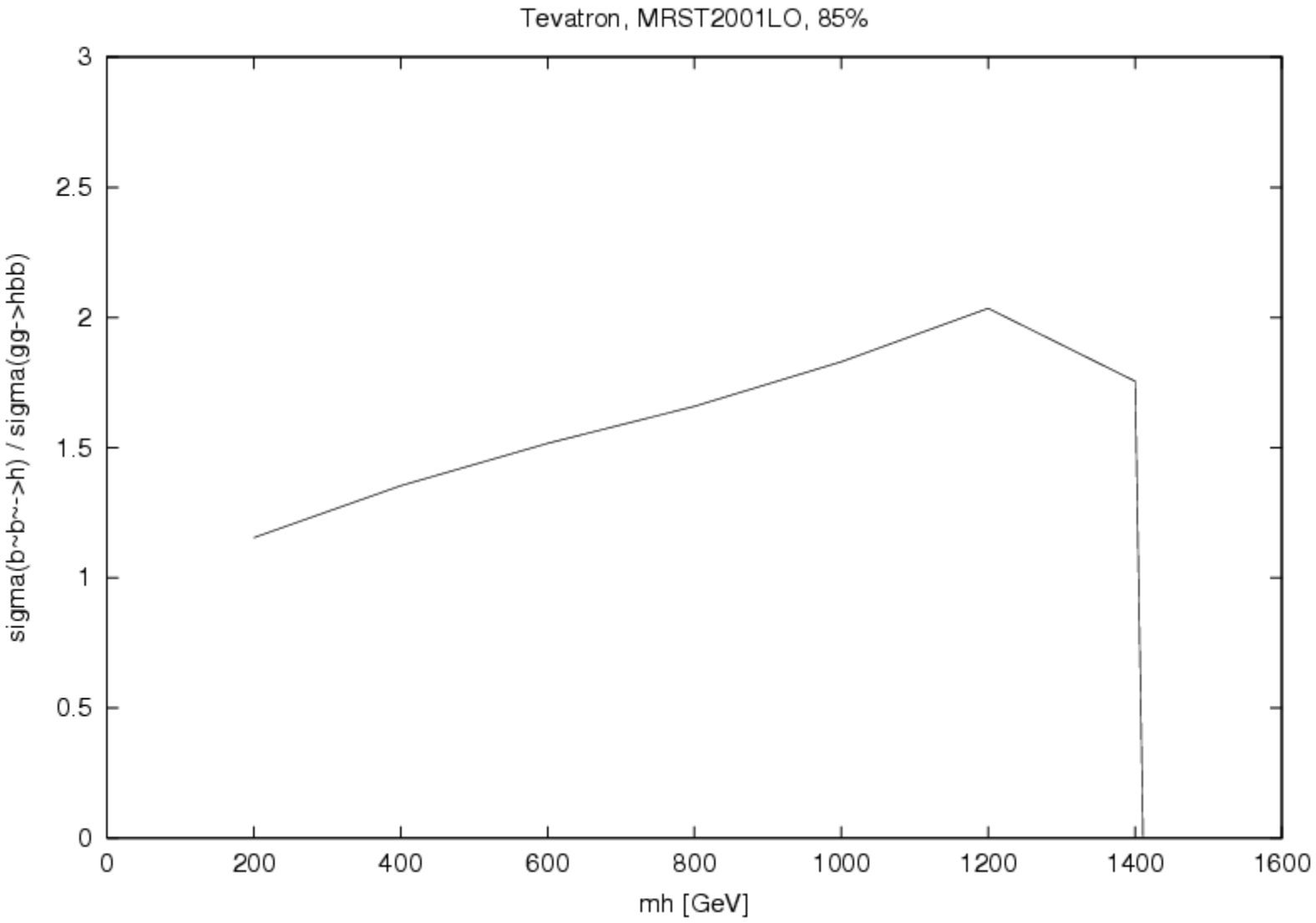
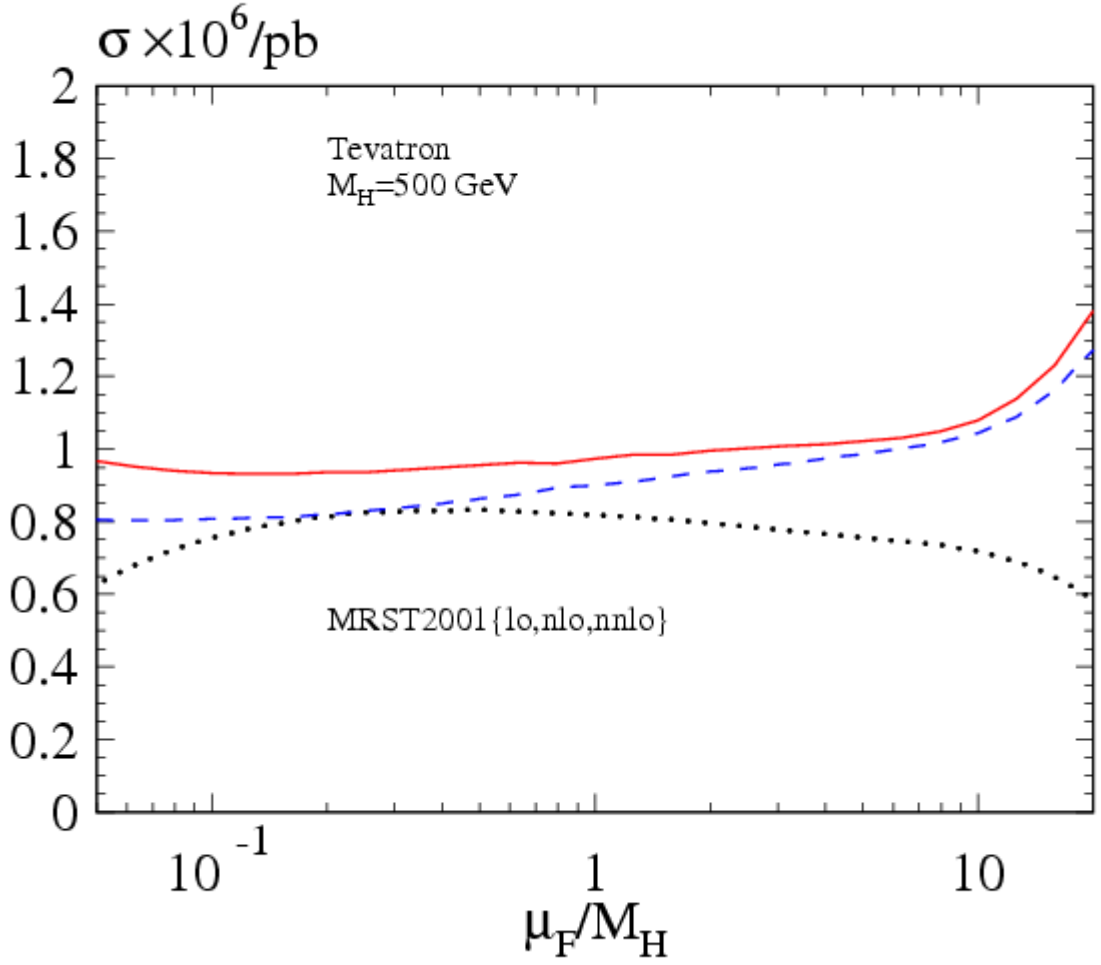


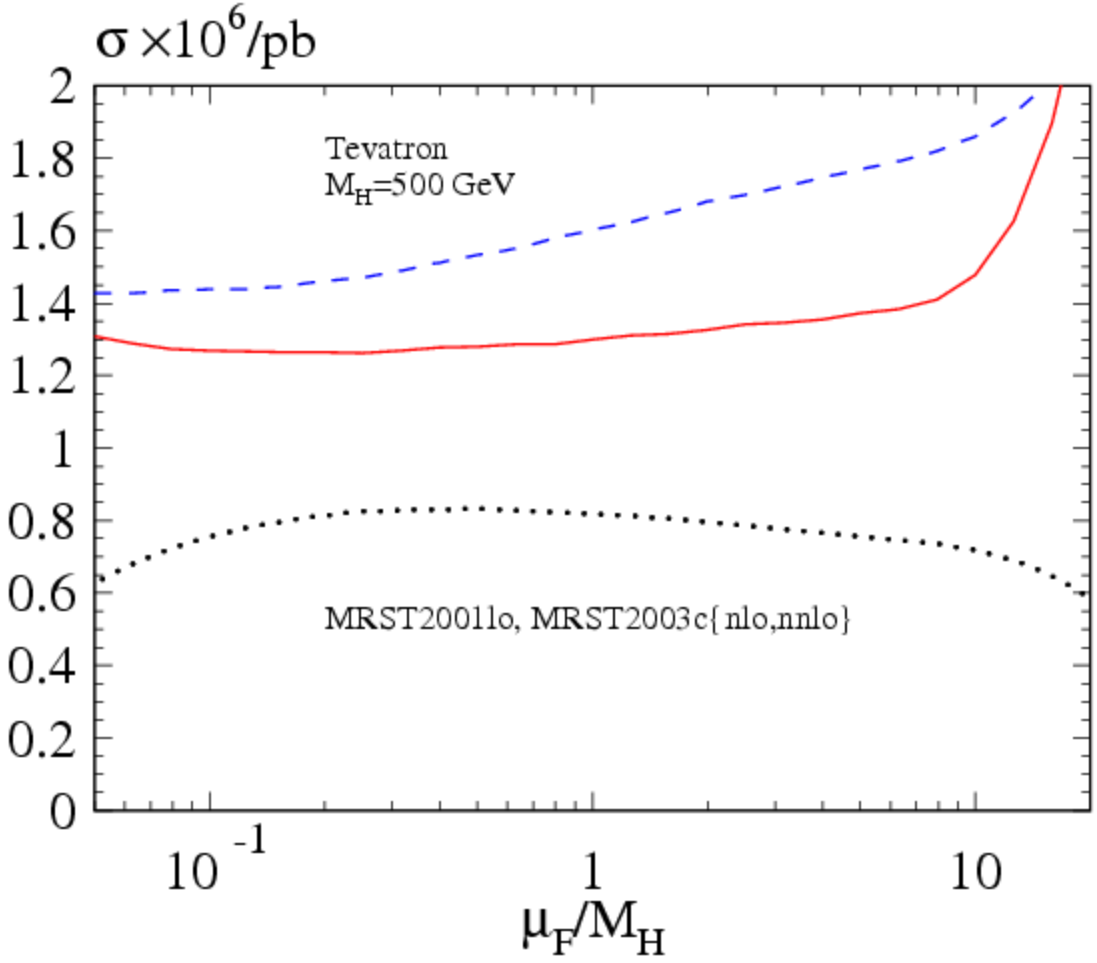



LHC, MRST2001LO, 85%
sigma(b~b~->h) / sigma(gg->hbb)
mh [GeV]
0
0.5
1
1.5
2
2.5
3
0
500
1000
1500
2000
2500
3000


Tevatron, MRST2001LO, 85%
sigma(b~b~->h) / sigma(gg->hbb)
mh [GeV]
0
0.5
1
1.5
2
2.5
3
0
200
400
600
800
1000
1200
1400
1600

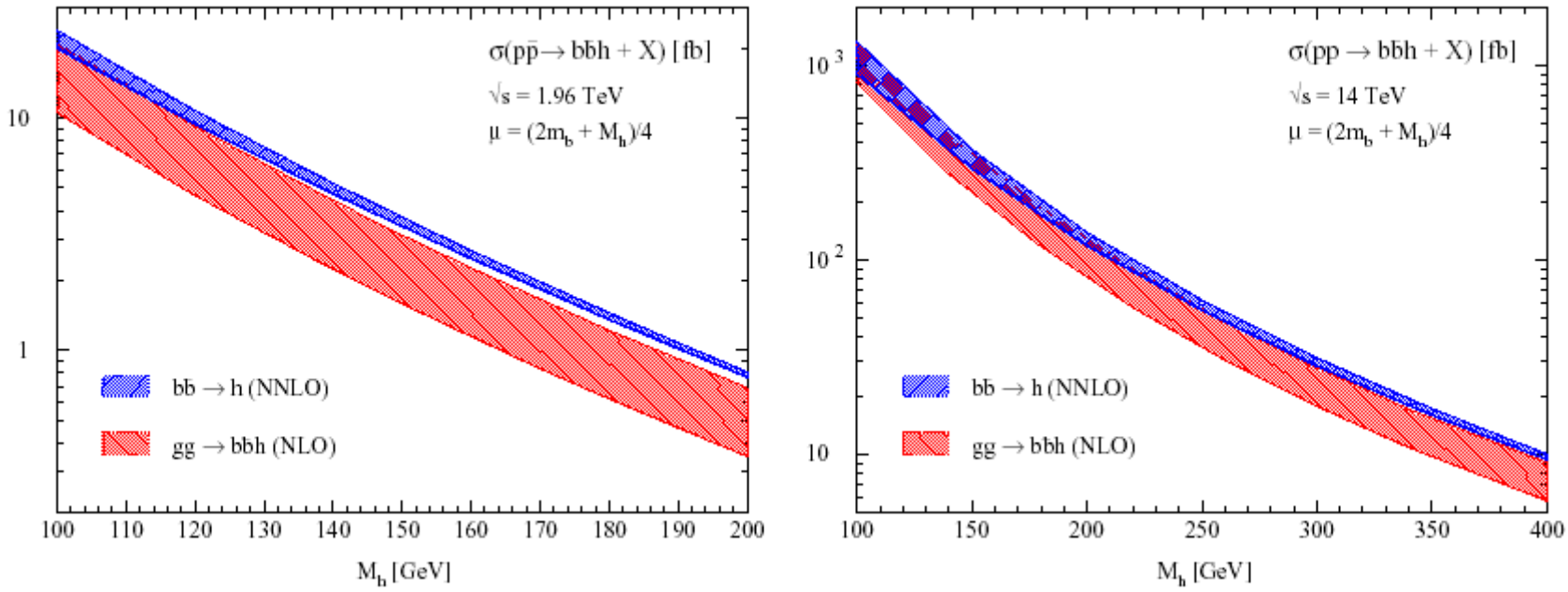


Harlander and Kilgore



Harlander and Kilgore

Les Houches 2003



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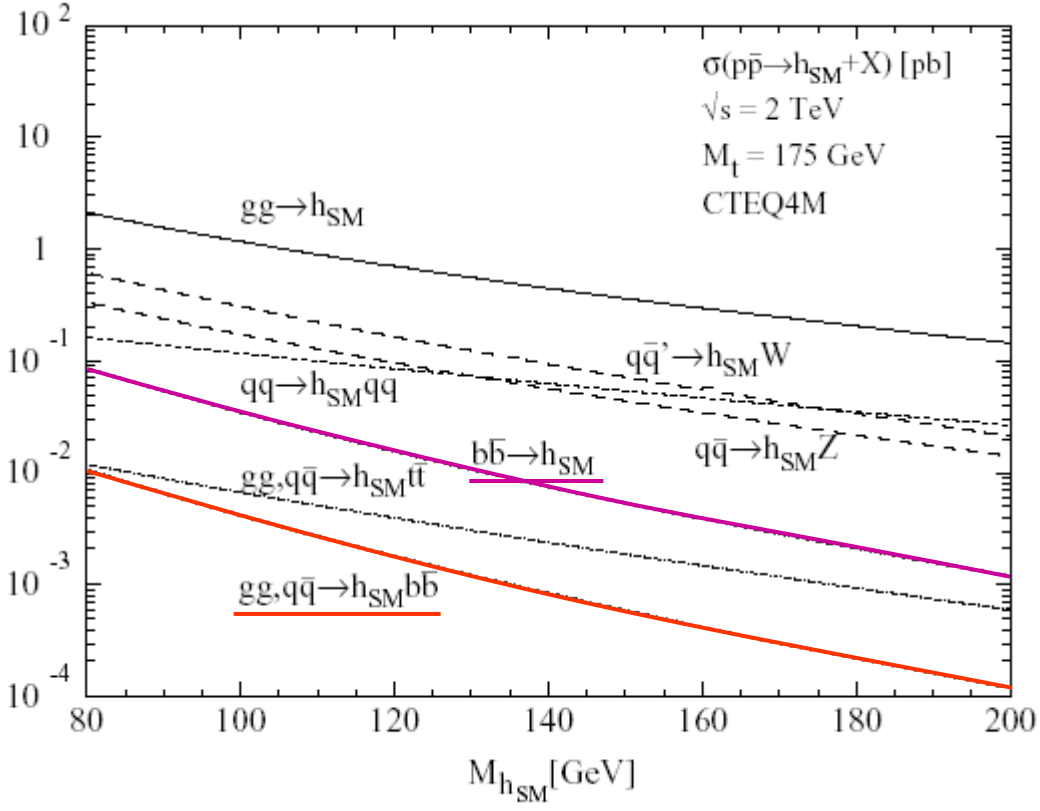
Run II SUSY/Higgs Workshop (1998)



Spira