Distributions for Higgs production in bottom quark annihilation

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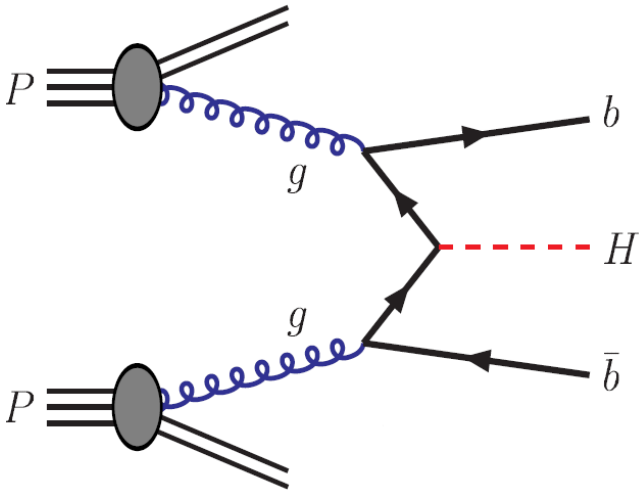
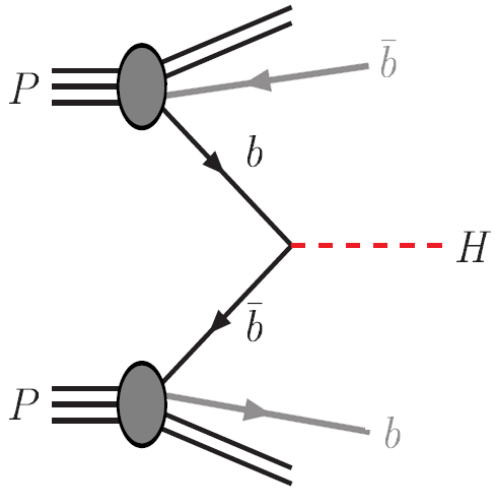
Higgs Cross Sections for the LHC
May 4-6, 2011 Brookhaven National Laboratory

4-FS vs. 5-FS

4-flavour scheme



5-flavour scheme



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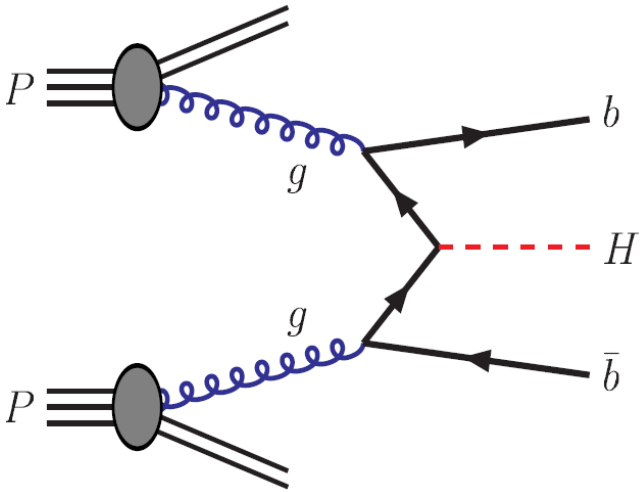

- exclusive up to NLO

  [Dittmaier, Krämer, Spira '04]

  [Dawson, Jackson, Reina, Wackeroth '04]

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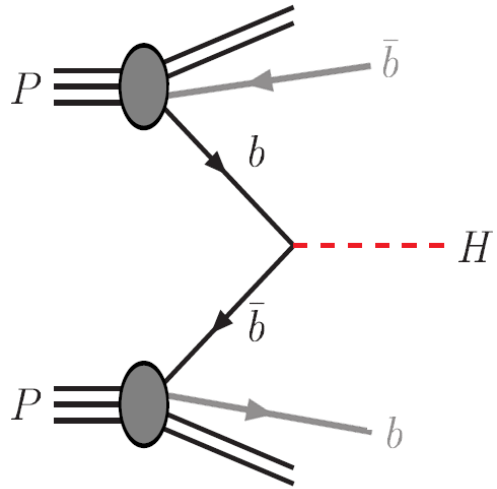

- inclusive up to NLO

  [Dicus, Willenbrock '89]

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  [Maltoni, Sullivan, Willenbrock '03]

- inclusive up to NNLO

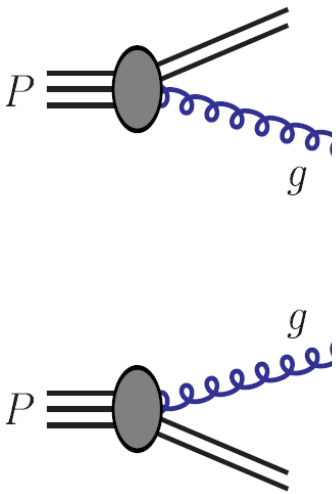
  [Harlander, Kilgore '03]

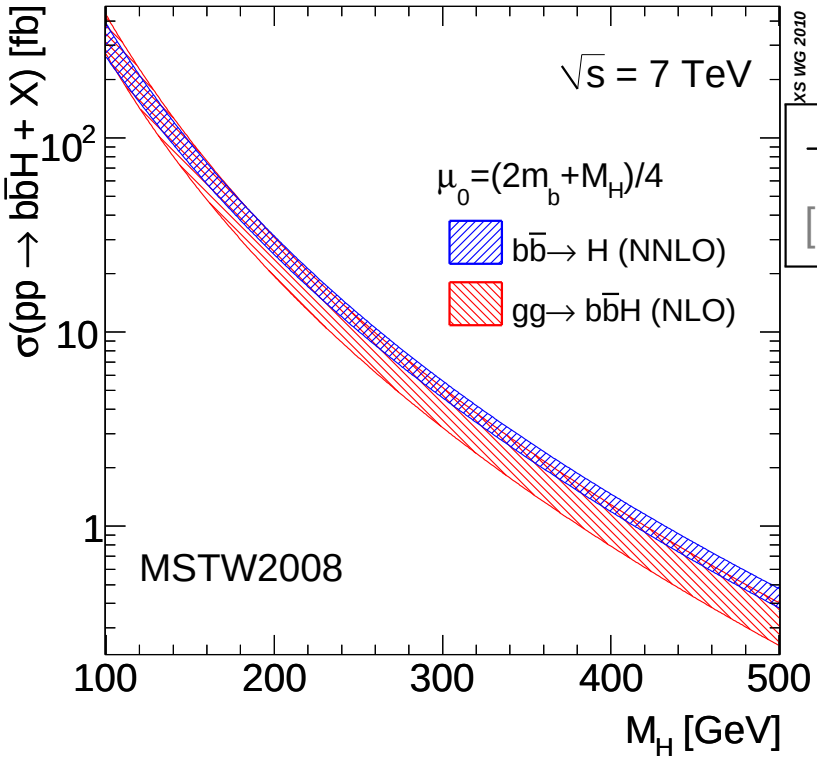
  `bbh@nnlo`

4-FS vs. 5-FS

[LHC Higgs Cross Section Working Group '11]

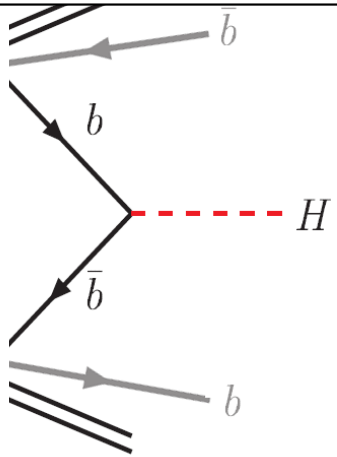
4-flavou





→ Santander-Matching

[Harlander, Krämer, Schumacher]



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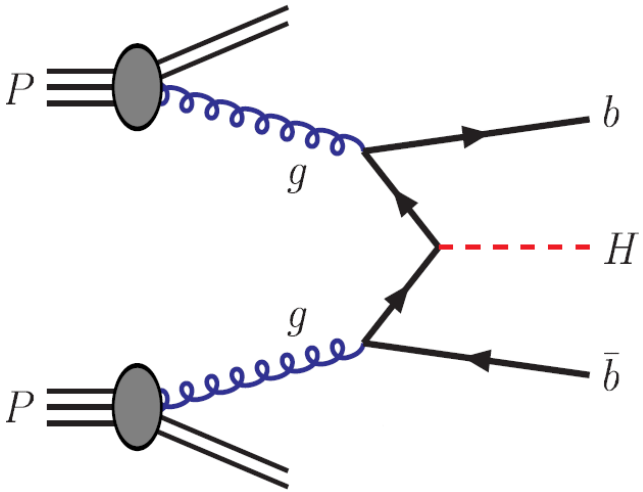

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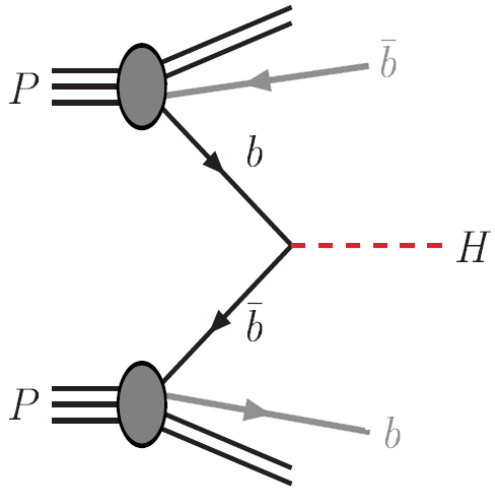


- H+bottom up to NLO

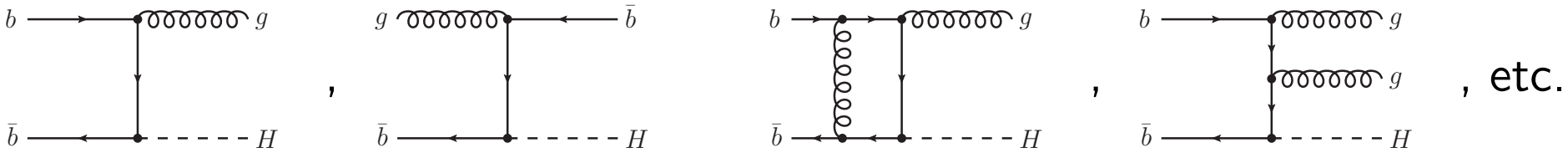
  [Campbell, Ellis, Maltoni, Willenbrock '03]

4-FS vs. 5-FS

- 5-FS advantages
  - small scale dependence (because NNLO available)
  - logs resummed
  - `bbh@nnlo` fast and publicly available
  - ...
- BUT:
  - at NNLO only inclusive!
- HERE:
  - differential results for
    - H+jet at NLO
    - H with jet veto at NNLO

Higgs+jet production in bottom quark annihilation at NLO

LO **NLO**



- fully differential Monte Carlo event generator up to NLO

  [Harlander, Ozeren, MW '10]

- dipole subtraction

  [Catani, Seymour '97]

- calculation for SM H, applicable to MSSM h, H and A by reweighting

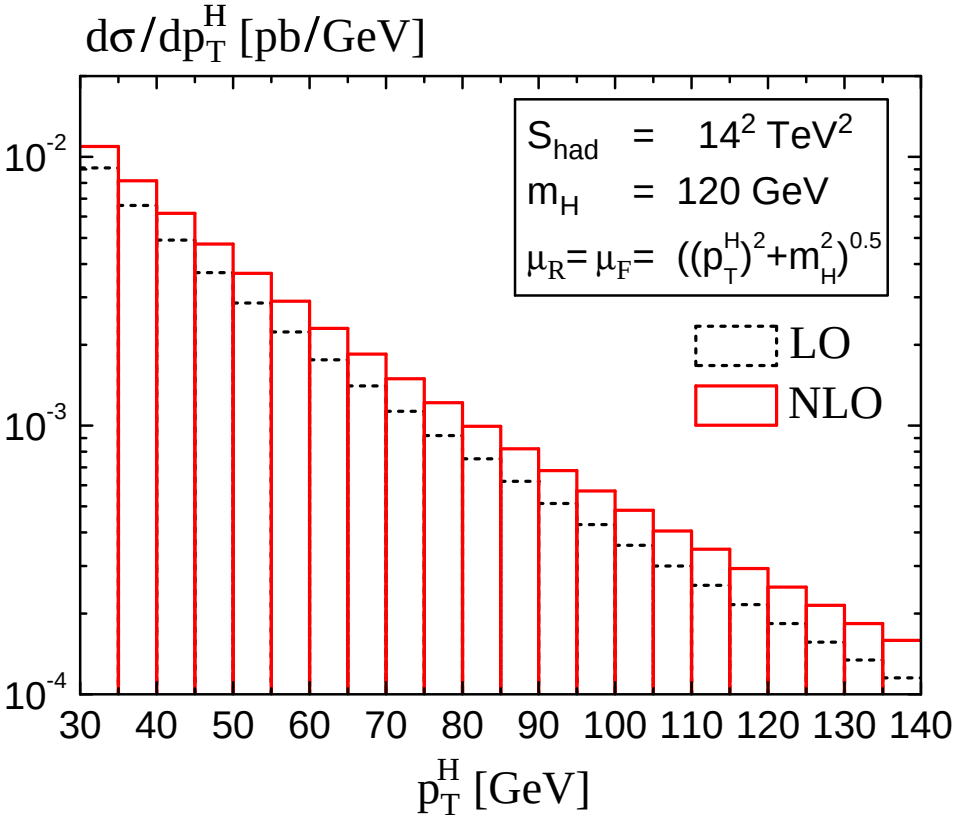
  [Dittmaier, Krämer, Mück, Schlüter '07], [Dawson, Jackson, Jaiswal '11]

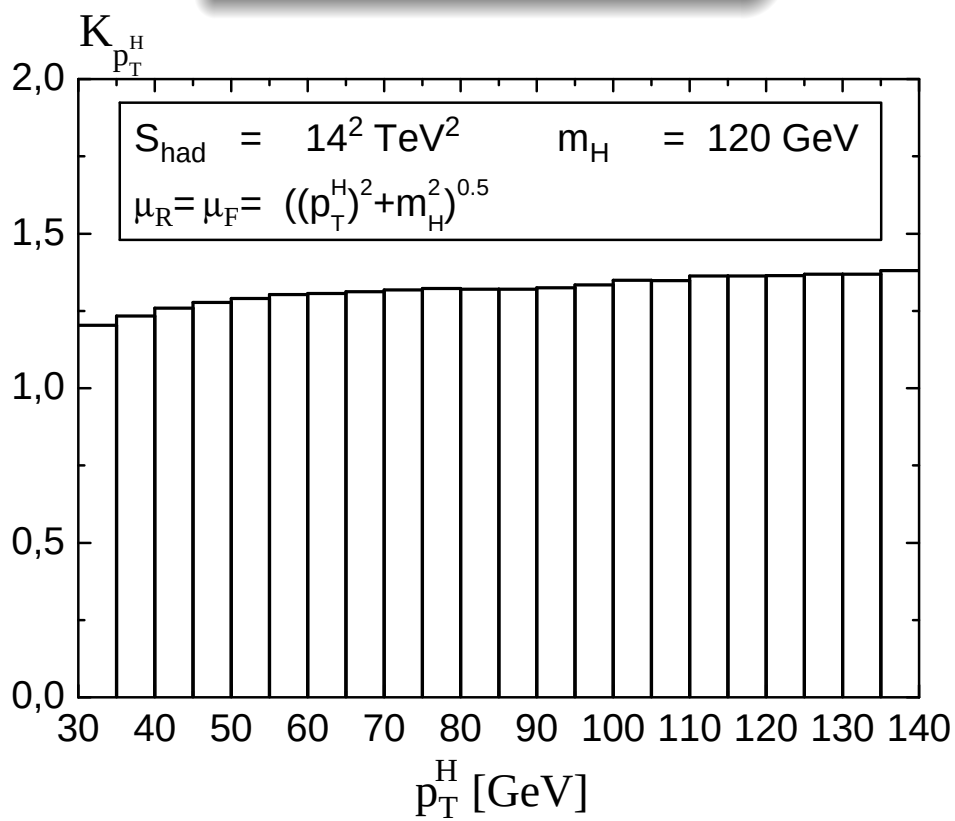
Higgs+jet production in bottom quark annihilation at NLO

Transverse momentum distribution:

[Harlander, Ozeren, MW '10]

$$K_{p_T^H} \equiv \frac{\left(d\sigma/dp_T^H\right)_{NLO}}{\left(d\sigma/dp_T^H\right)_{LO}}$$





Higgs production with jet veto

- so far: H+jet through NLO
- we can use this for jet veto through NNLO cf. [Catani, de Florian, Grazzini '01]

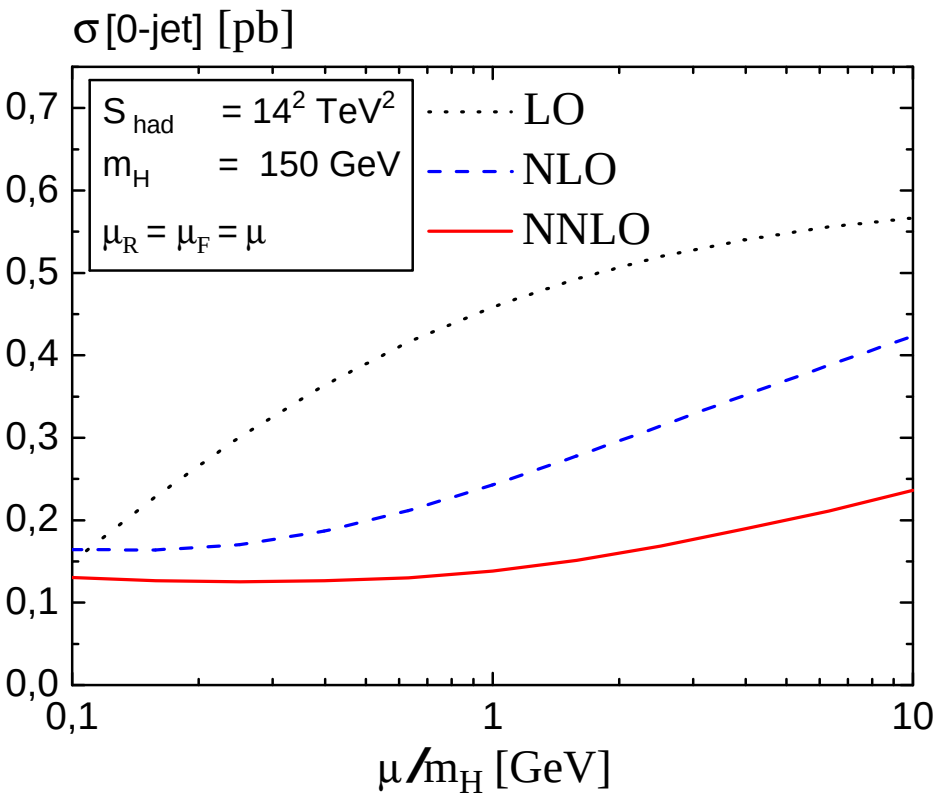
$$\sigma^{\text{veto}} = \sigma^{\text{tot}} - \sigma[\text{1-jet}] - \sigma[\text{2-jet}]$$

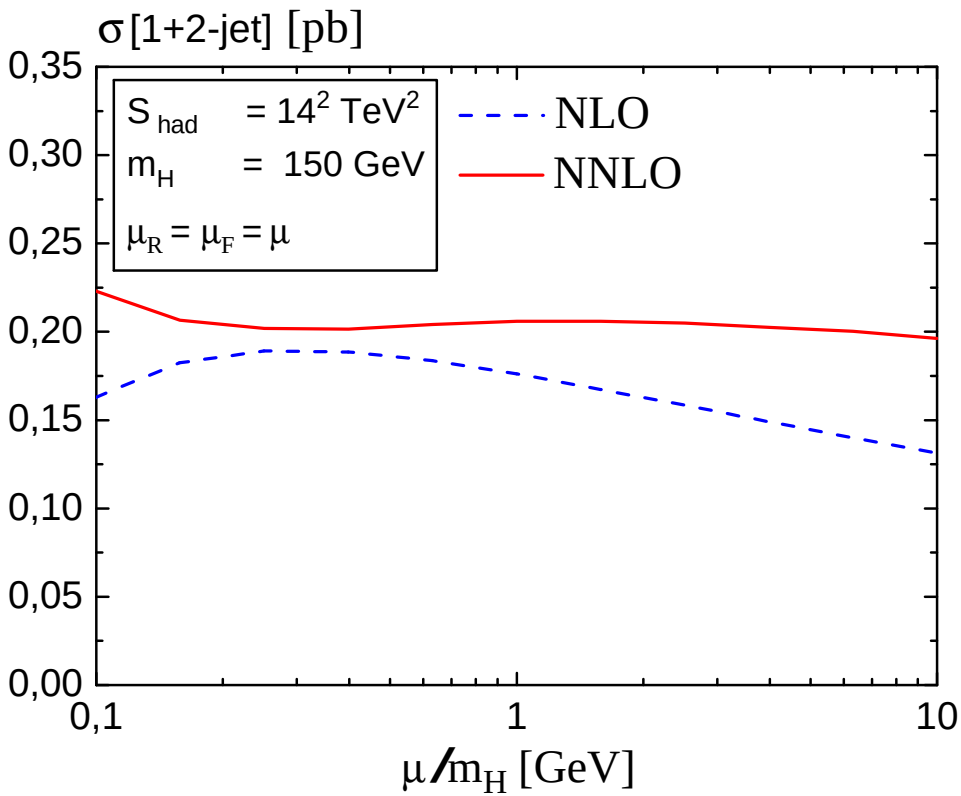
- take σ^{tot} from `bbh@nnlo` and $\sigma[n\text{-jet}]$ from calculation above
- use NNLO PDFs and couplings
- jet definition: anti-k_T, $p_{T,\text{min}}^{\text{jet}} = 20\,\text{GeV}$, $y^{\text{jet}} < 2.5,\ 4.8$

Associated $(b\bar{b})H$ jet cross sections at NNLO

Scale dependence: $m_H = 150$ GeV, $p_{T,\text{min}}^{\text{jet}} = 20\,\text{GeV}$, $y^{\text{jet}} < 4.8$

[Harlander, Ozeren, MW '10]

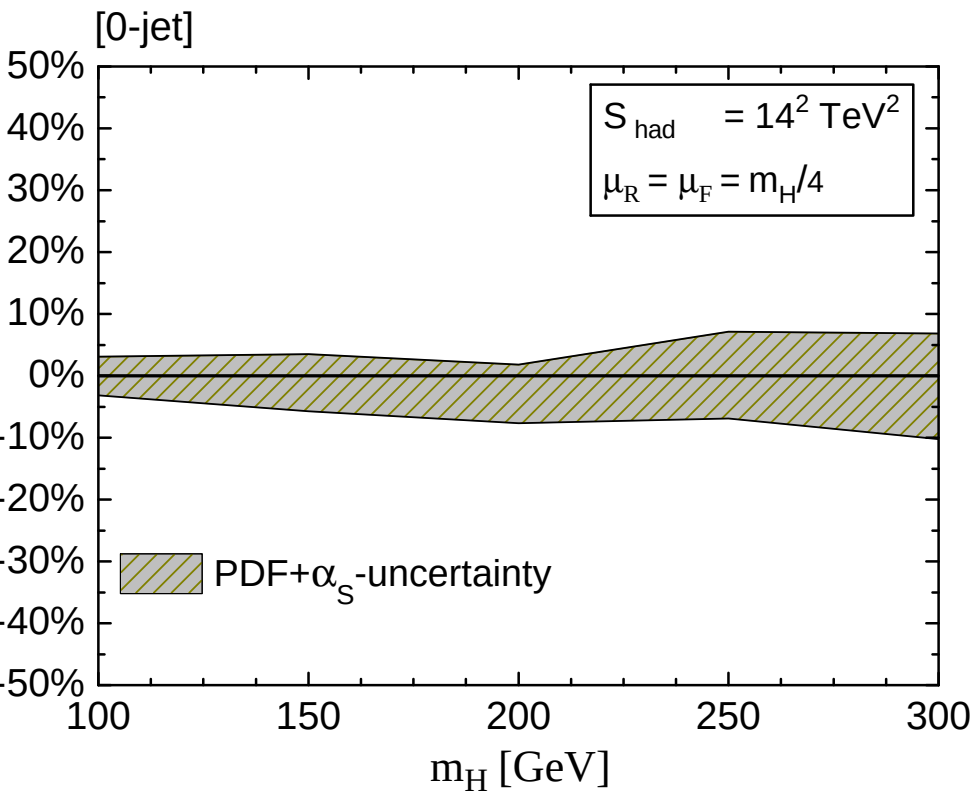


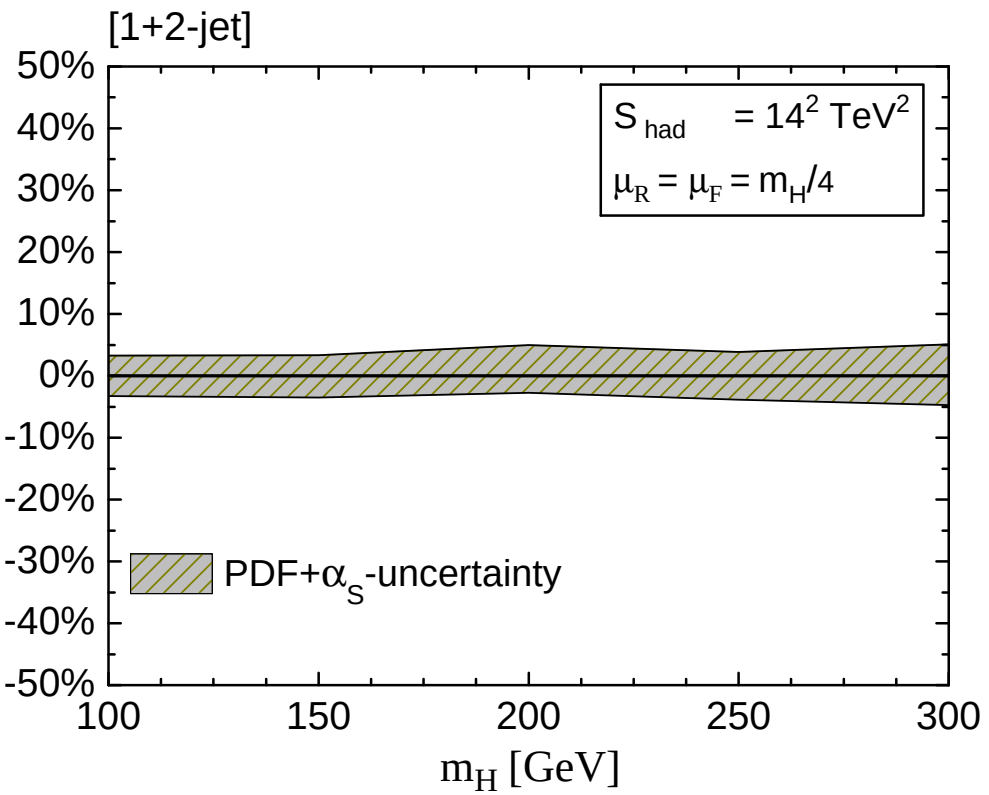


Associated $(b\bar{b})H$ jet cross sections at NNLO

PDF+α_S-uncertainty: $p_{T,\text{min}}^{\text{jet}} = 20\,\text{GeV},\ y^{\text{jet}} < 4.8$

[Harlander, Ozeren, MW '10]





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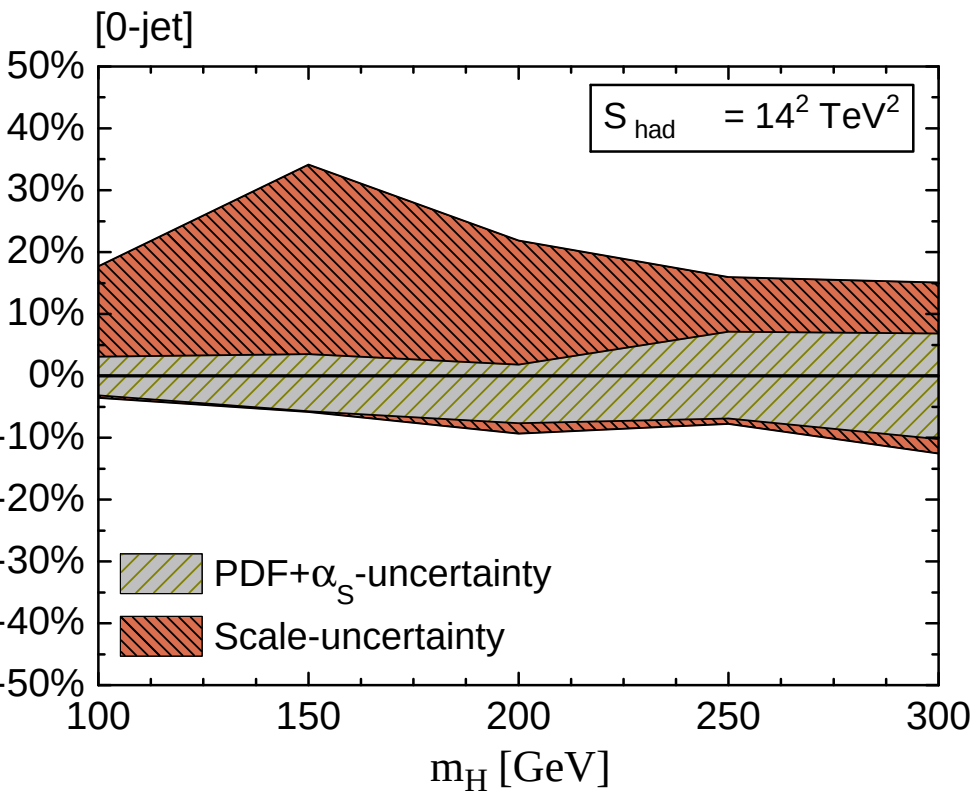
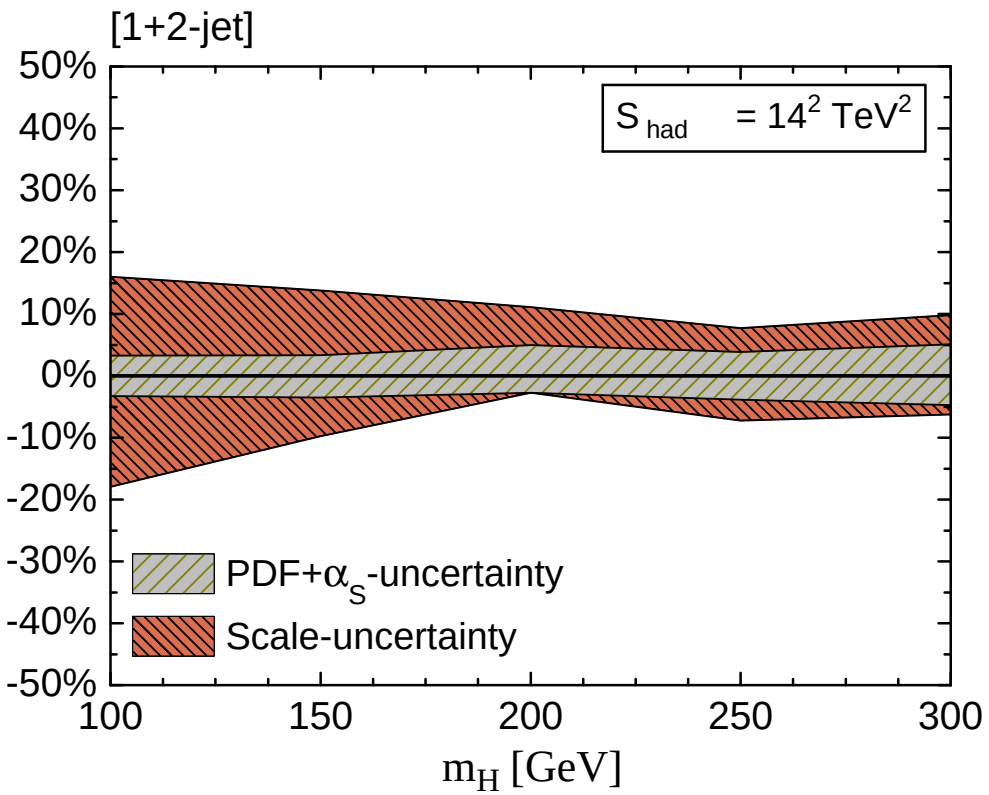
[Harlander, Ozeren, MW '10]





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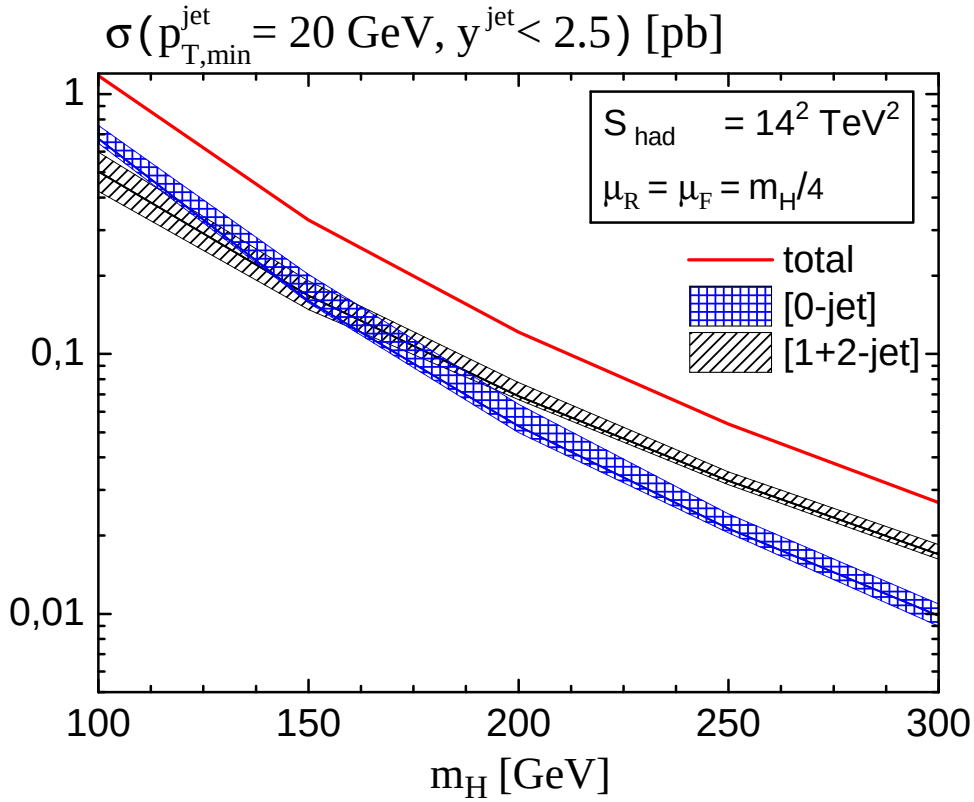
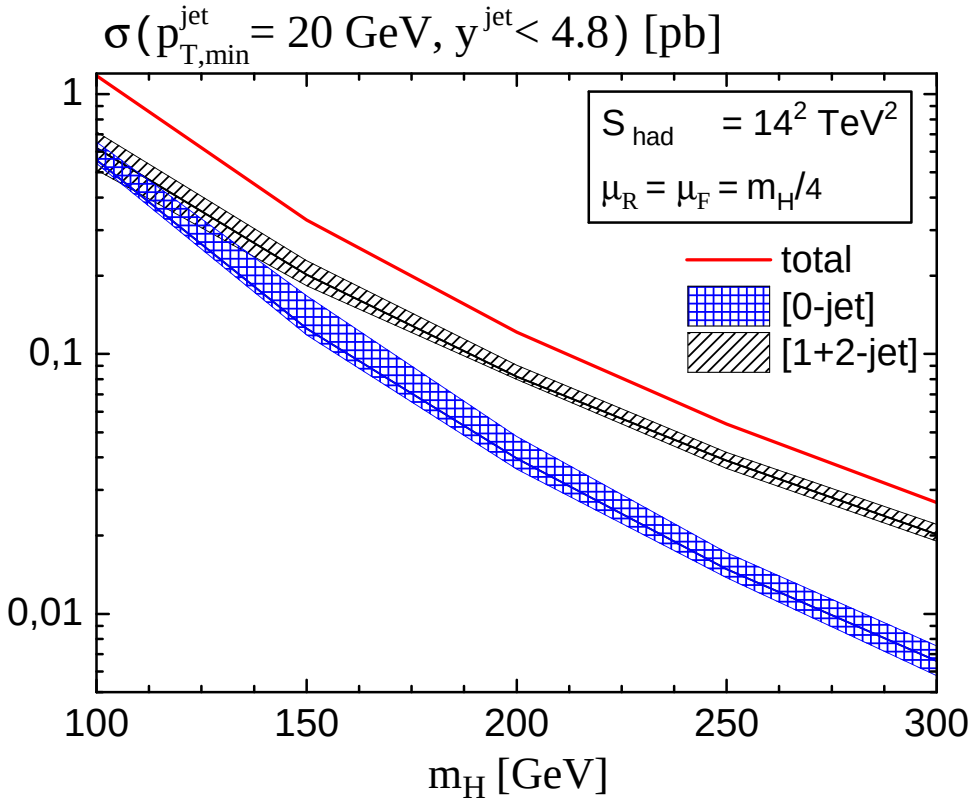
Higgs mass dependence:

[Harlander, Ozeren, MW '10]





Conclusions and Outlook

Conclusions:

- step forward from fully inclusive 5-FS prediction
- $b\bar{b}H + jet$ production up to NLO (fully differential)
- NNLO jet vetoed cross section calculated
- K-factors rather flat, but different from inclusive ones
- exclusive 0-, 1- and 2-jet cross section calculated
- flat μ_F-dependence for 0-jet cross section and 1-jet inclusive cross section

Outlook:

- b-tag
- full NNLO Monte Carlo
- parton shower
- combination with Higgs+jet in gluon fusion – interference terms

BackUp

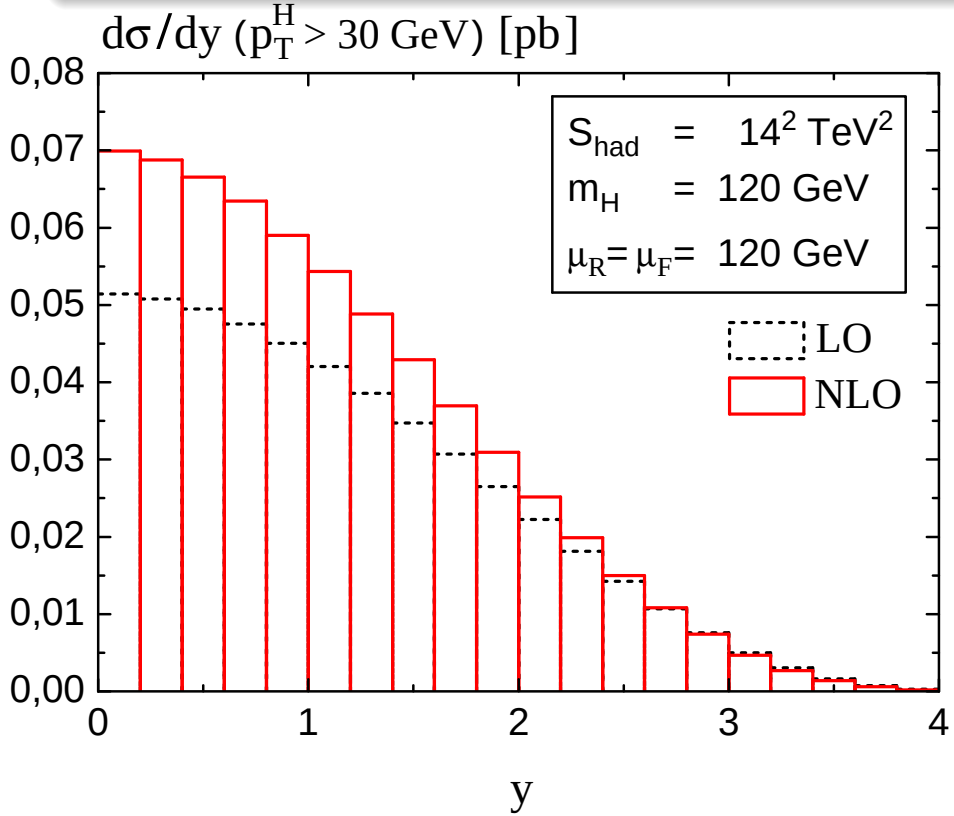
Higgs+jet production in bottom quark annihilation at NLO

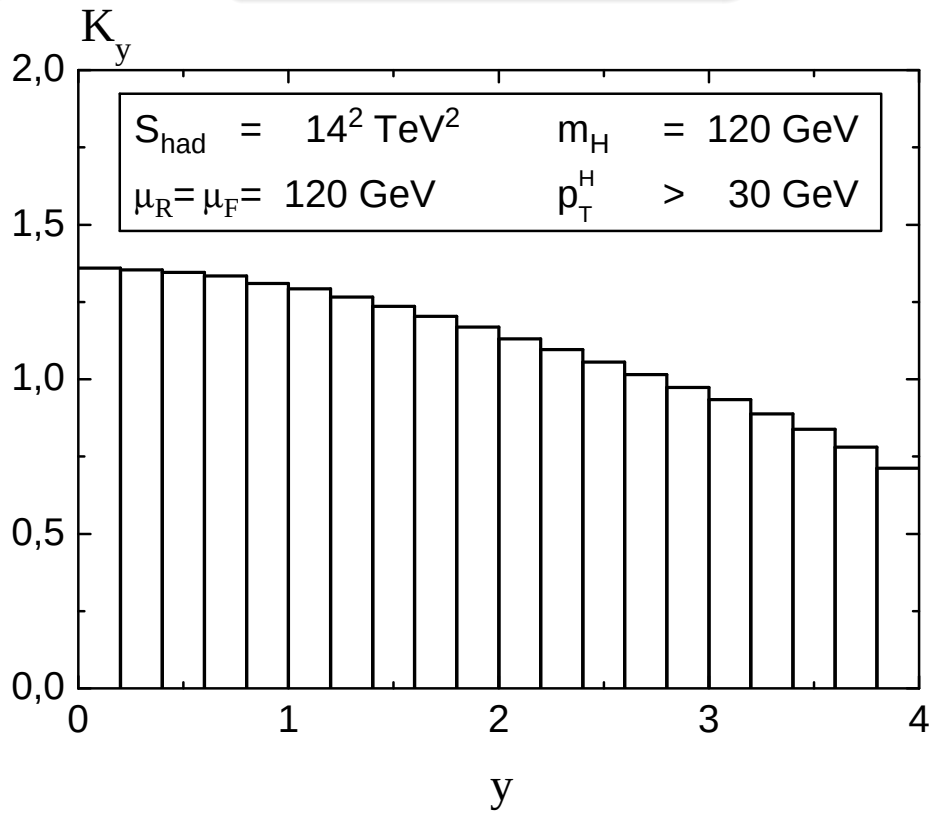
Rapidity distribution:

[Harlander, Ozeren, MW '10]

$$\sigma(p_T^H > p_{T,\text{cut}}) = \int_{p_T^H > p_{T,\text{cut}}} \frac{d\sigma}{dp_T^H}\, dp_T^H$$

$$K_y \equiv \frac{(d\sigma/dy)_{NLO}}{(d\sigma/dy)_{LO}}$$





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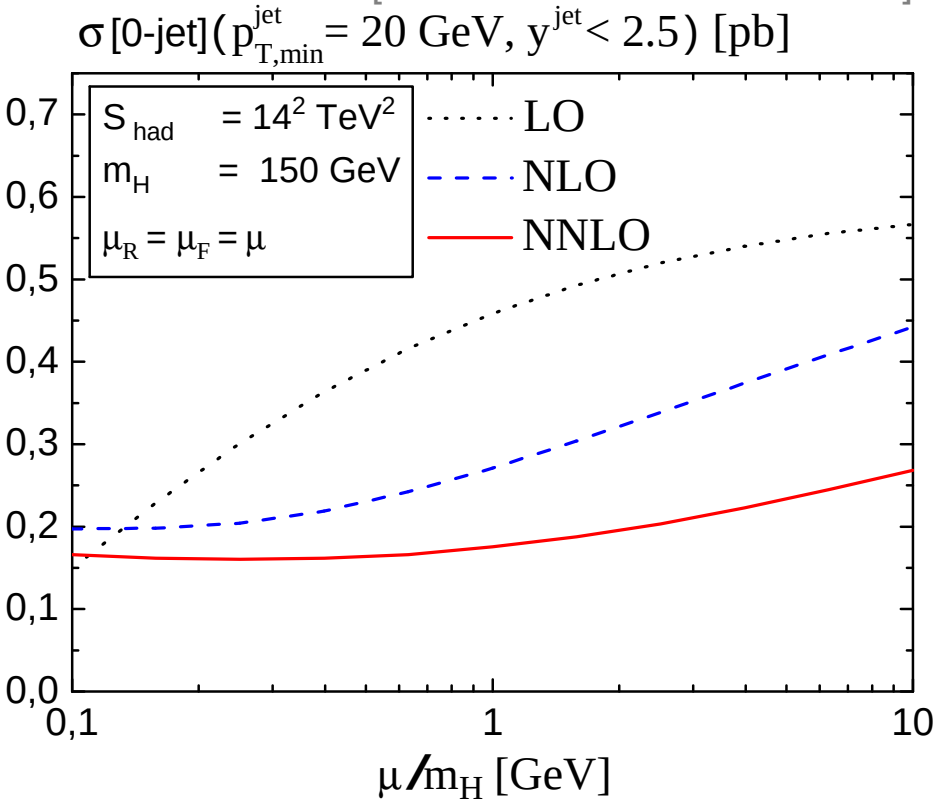
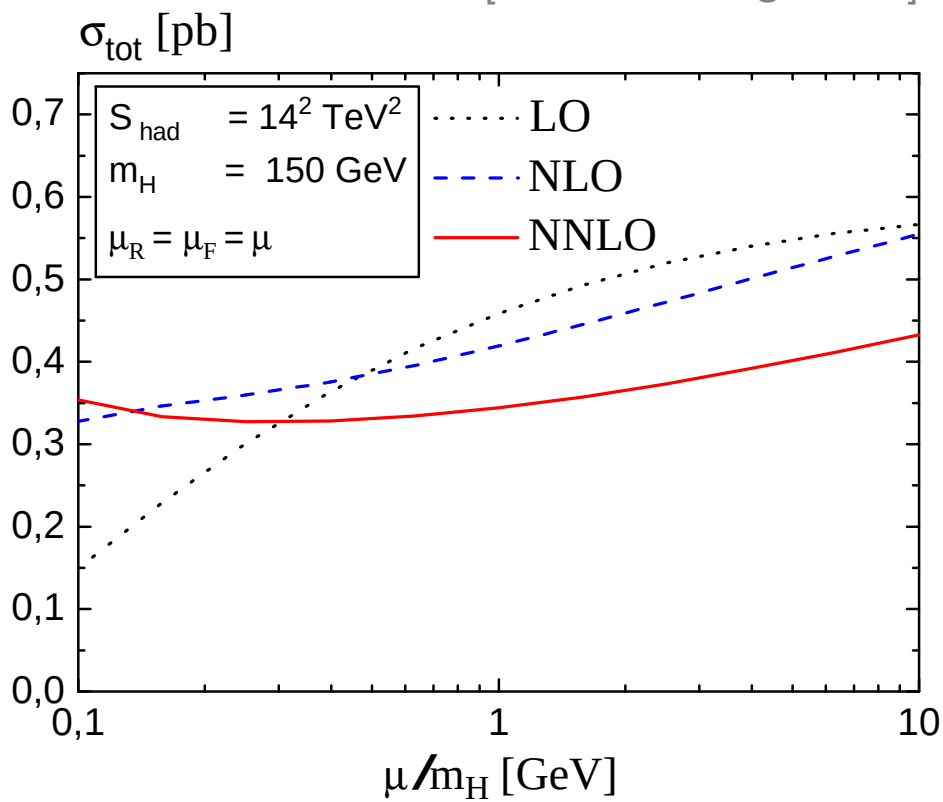


[Harlander, Kilgore '03]



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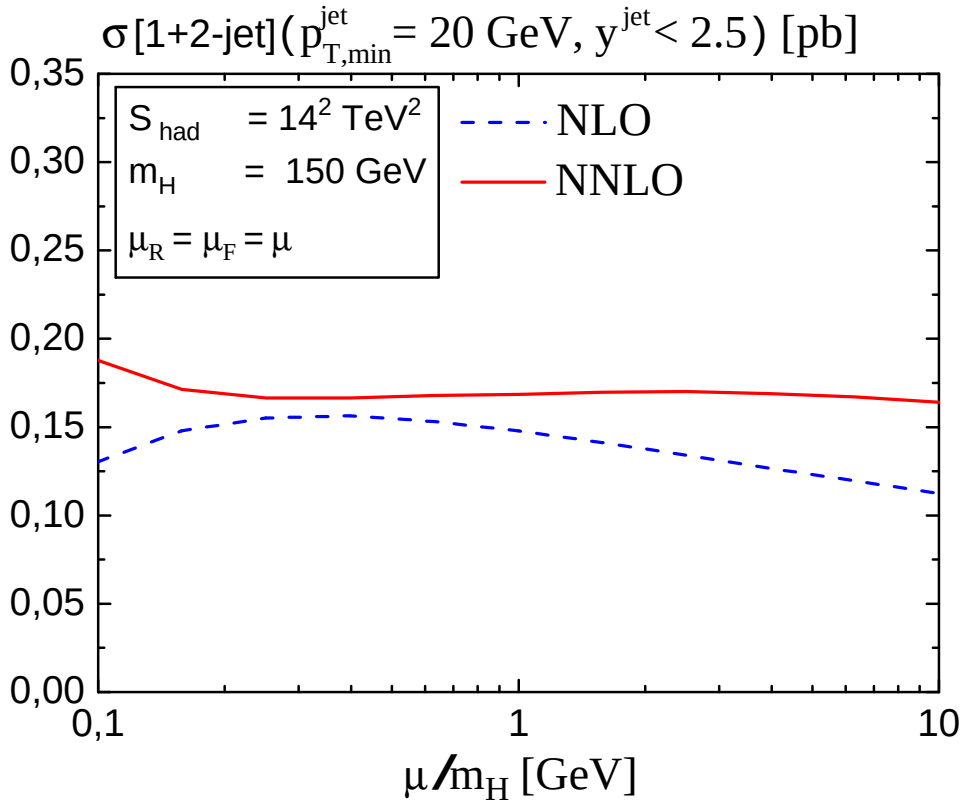

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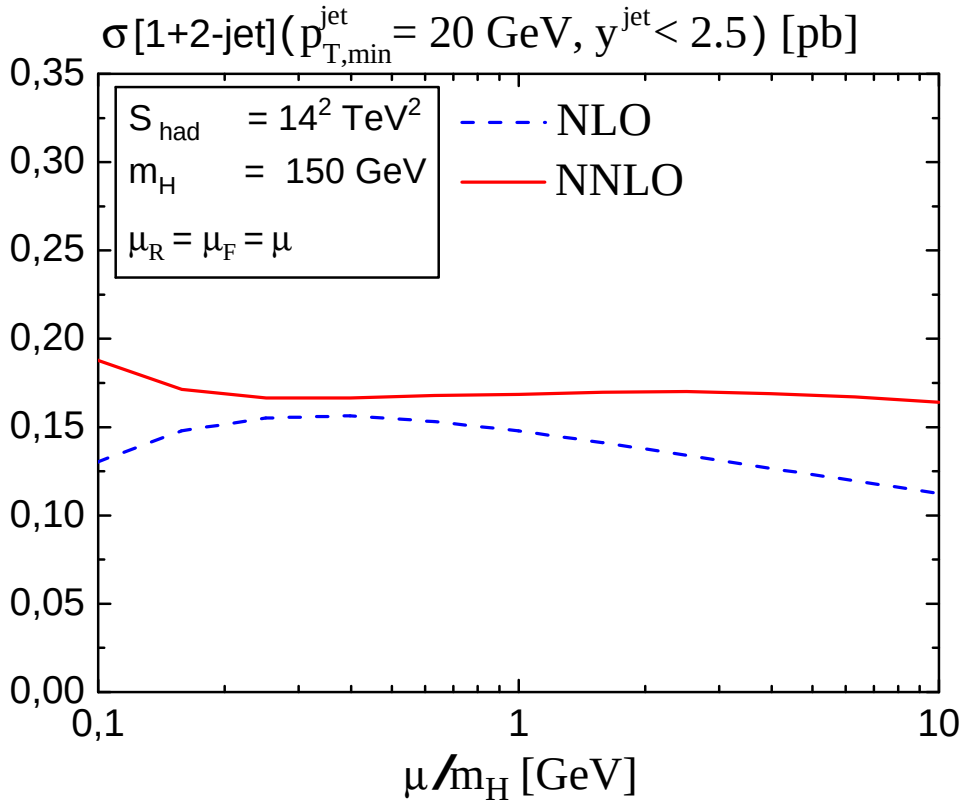
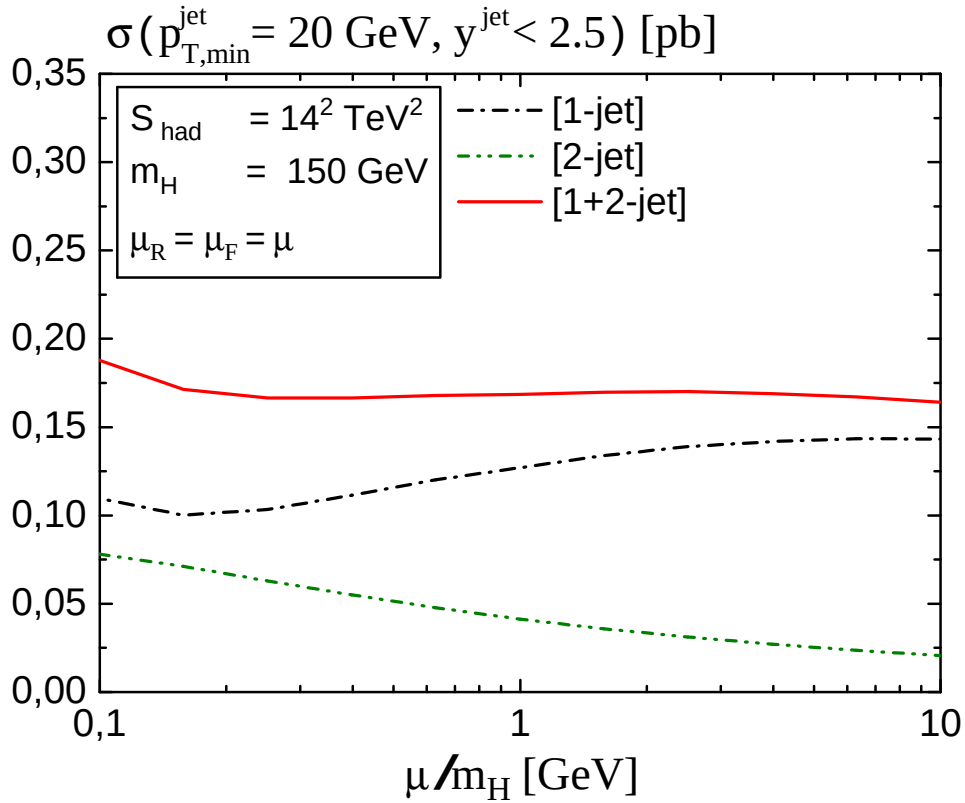
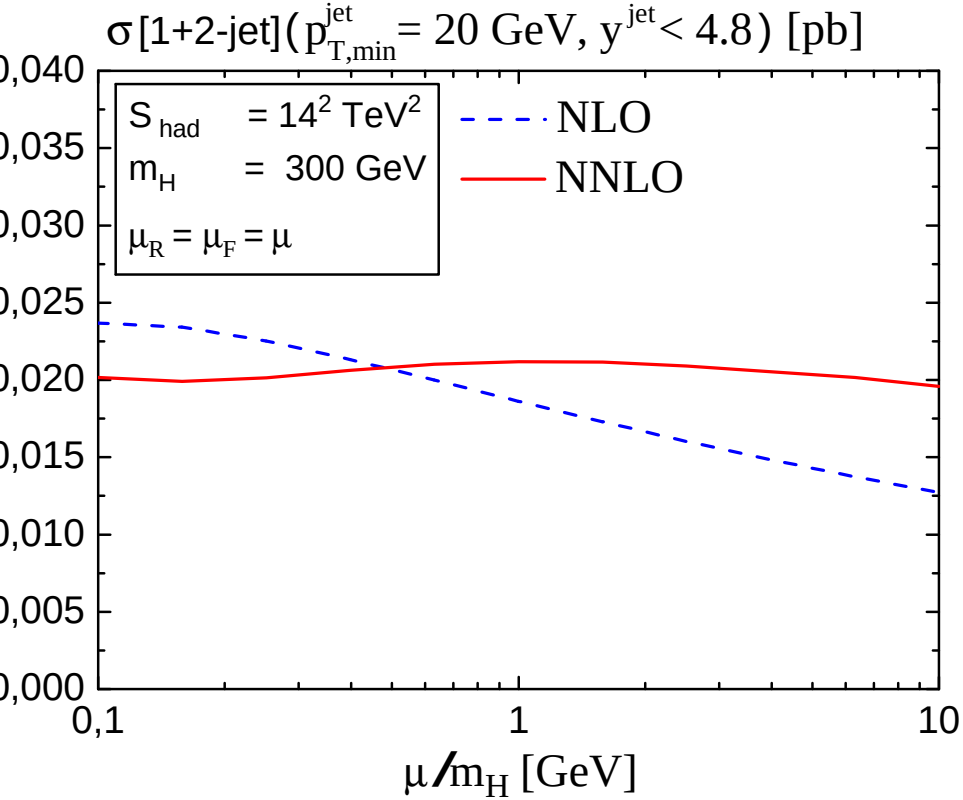


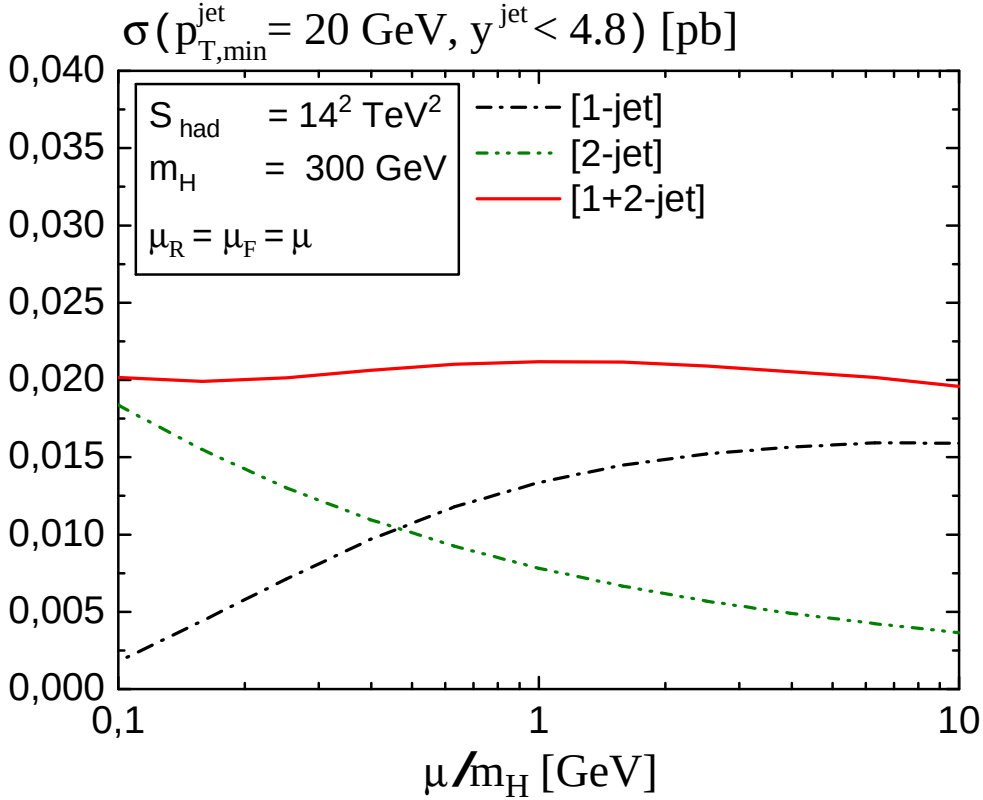


Associated $(b\bar{b})H$ jet cross sections at NNLO

Scale dependence: $m_H = 300,\ y^{\text{jet}} < 4.8$

[Harlander, Ozeren, MW '10]

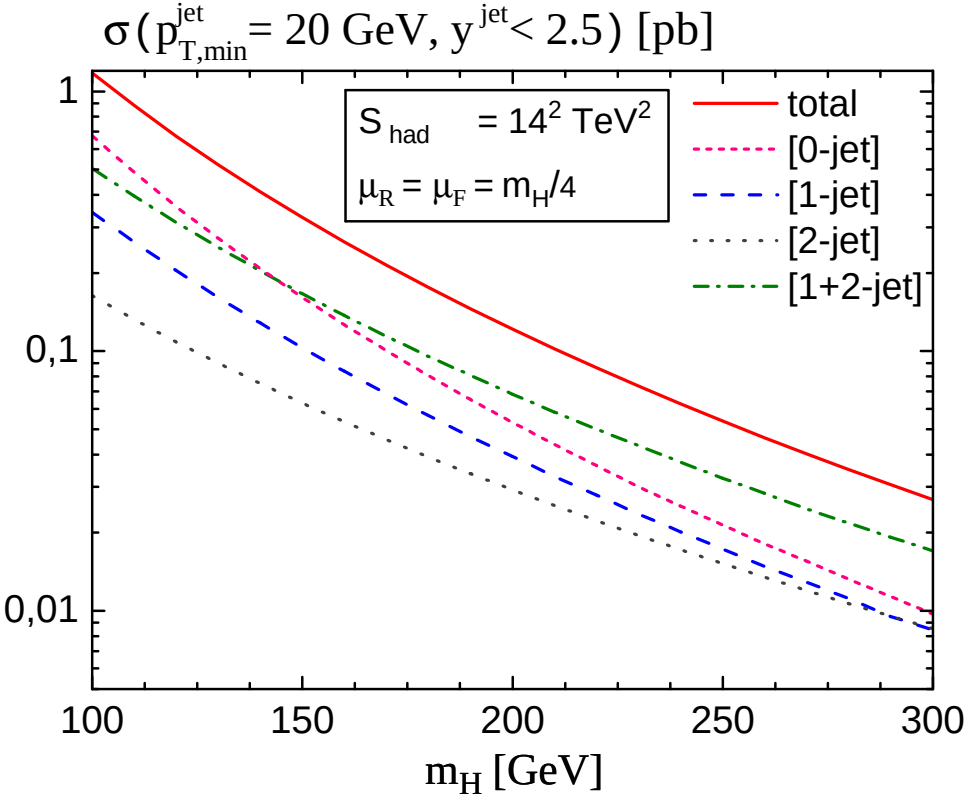




Associated $(b\bar{b})H$ production with jet veto at NNLO

Higgs mass dependence:

[Harlander, Ozeren, MW '10]



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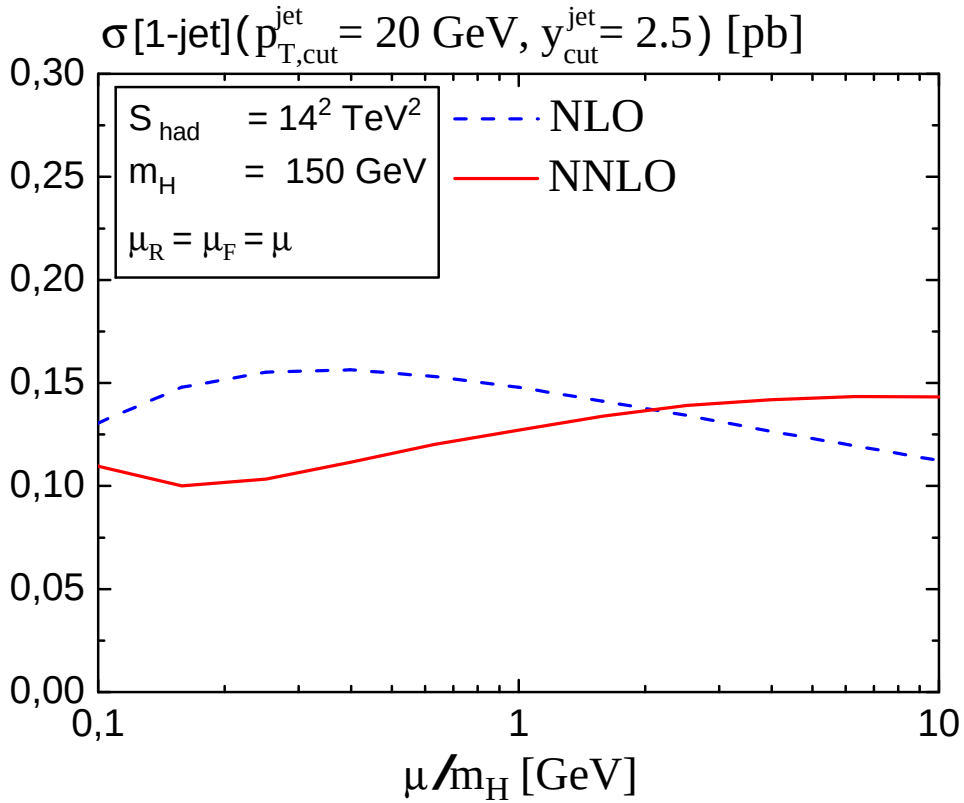

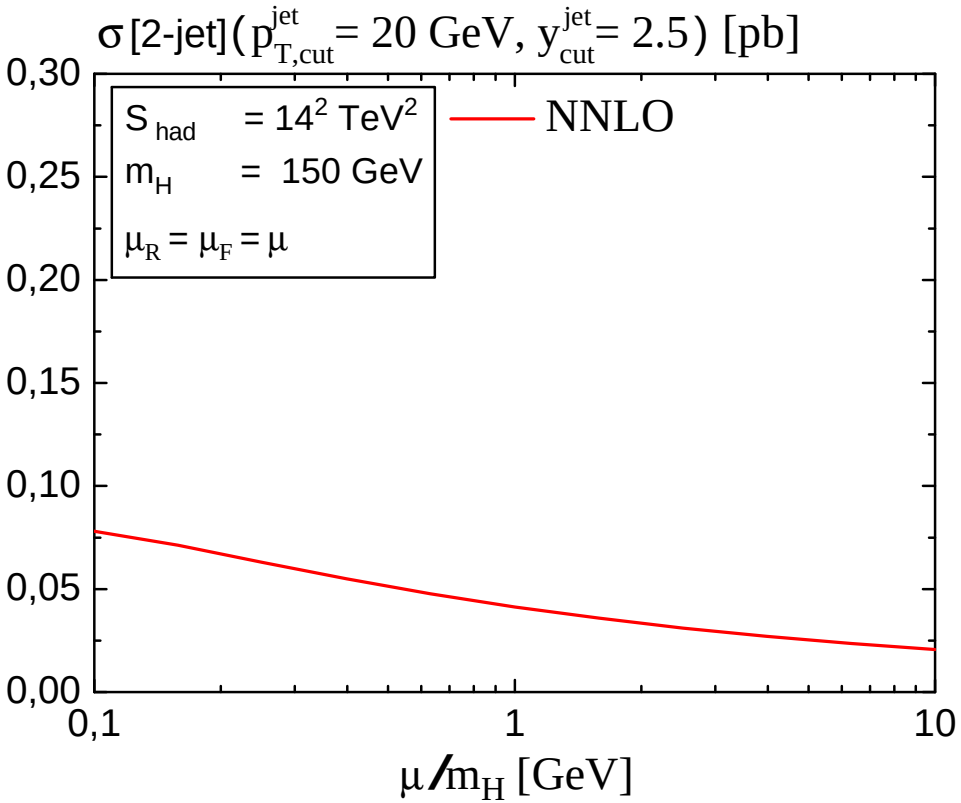

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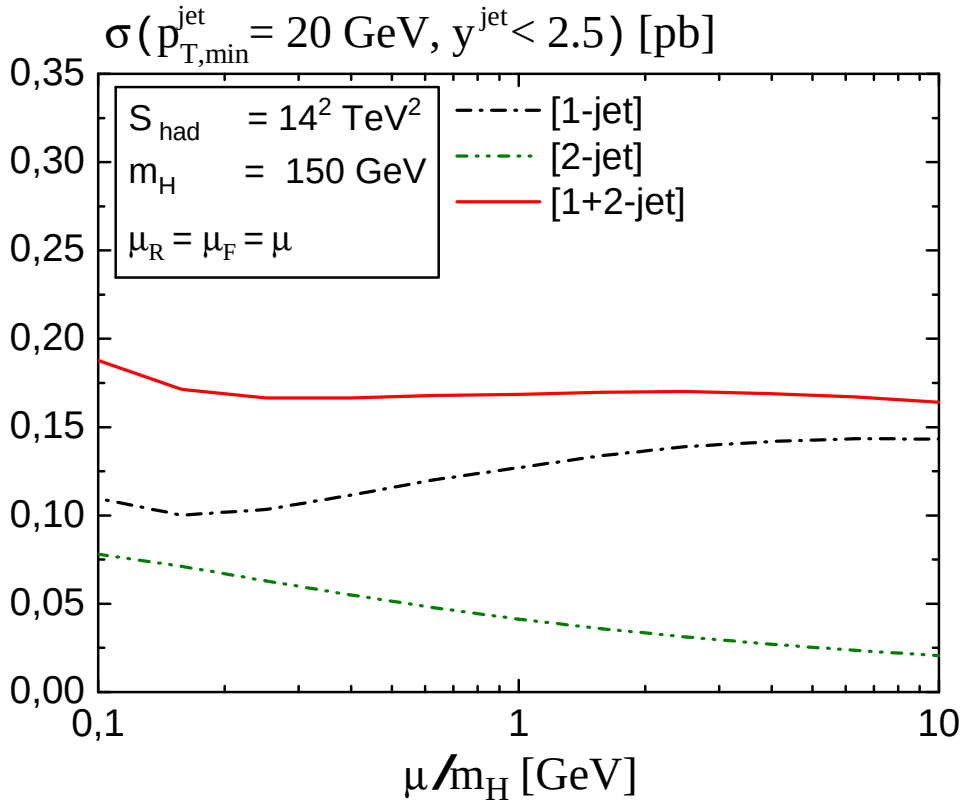

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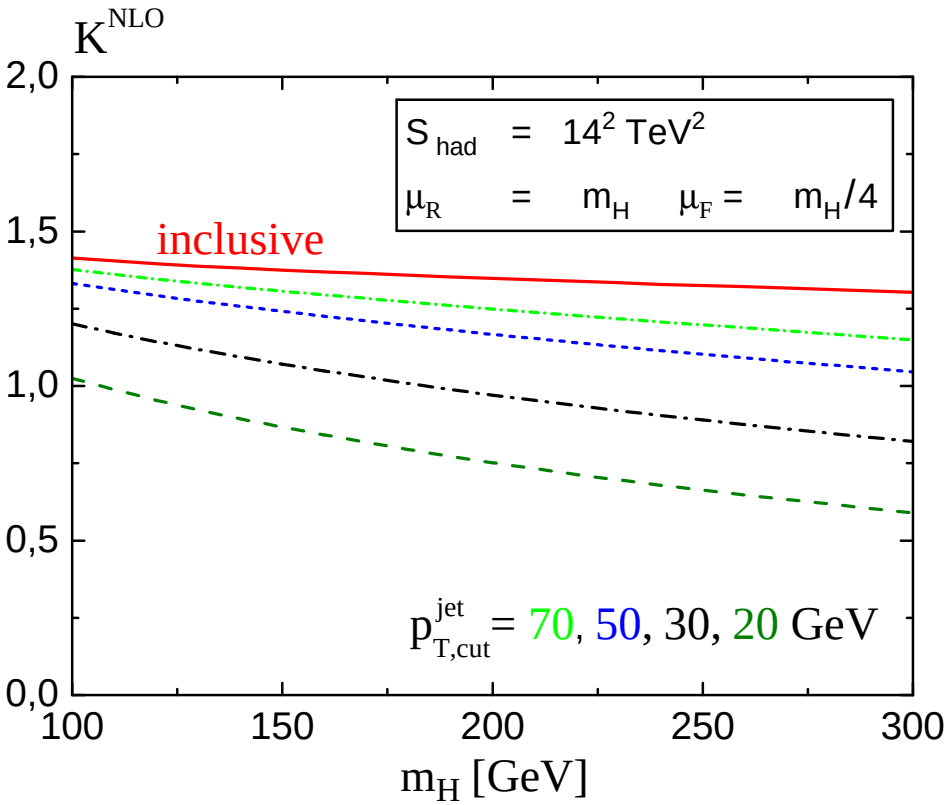

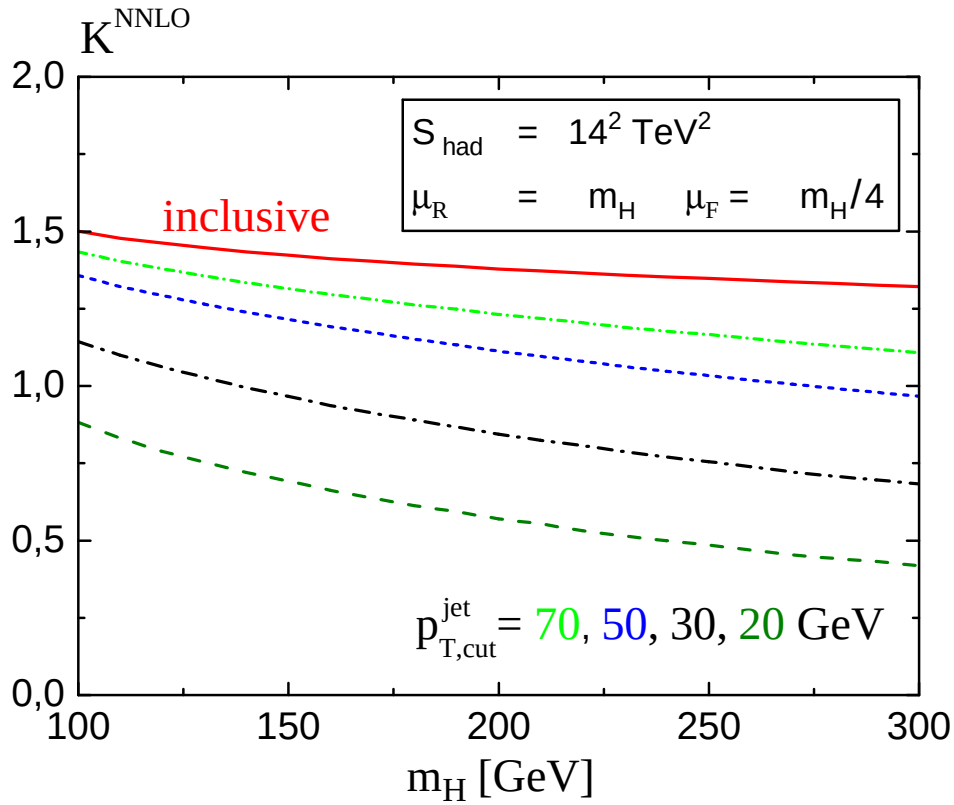

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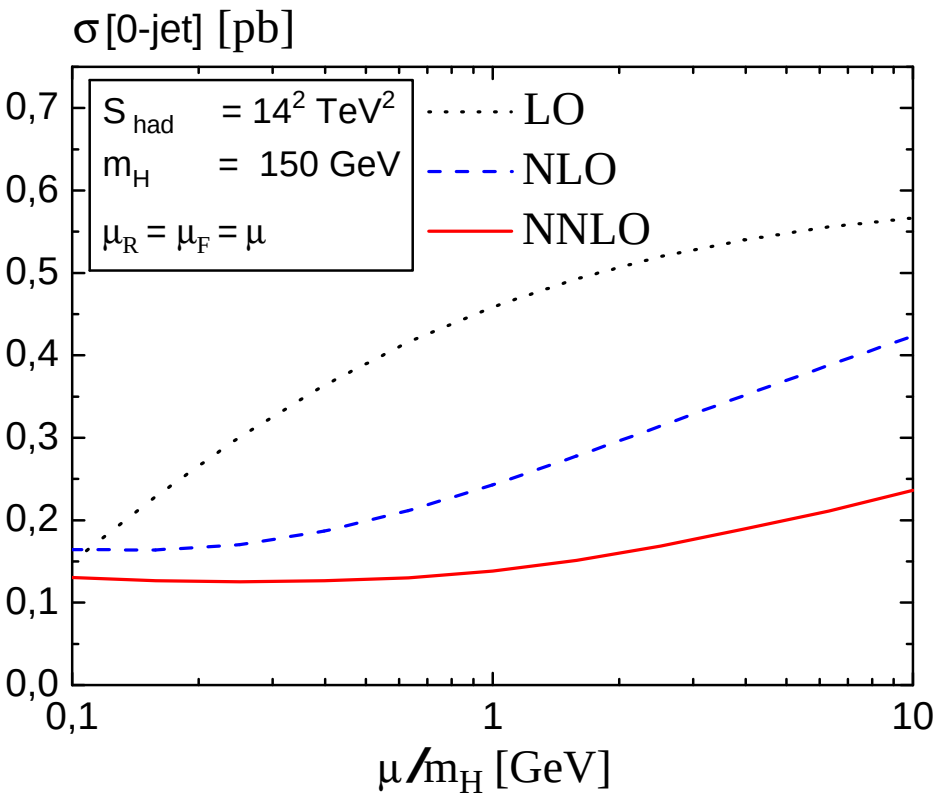

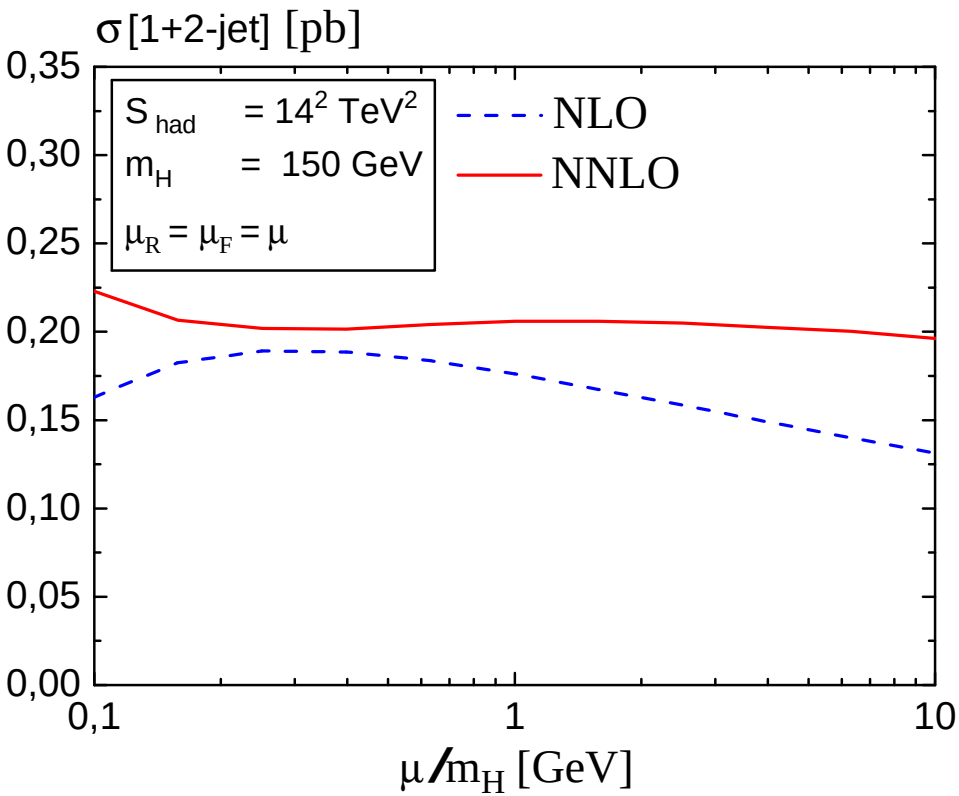

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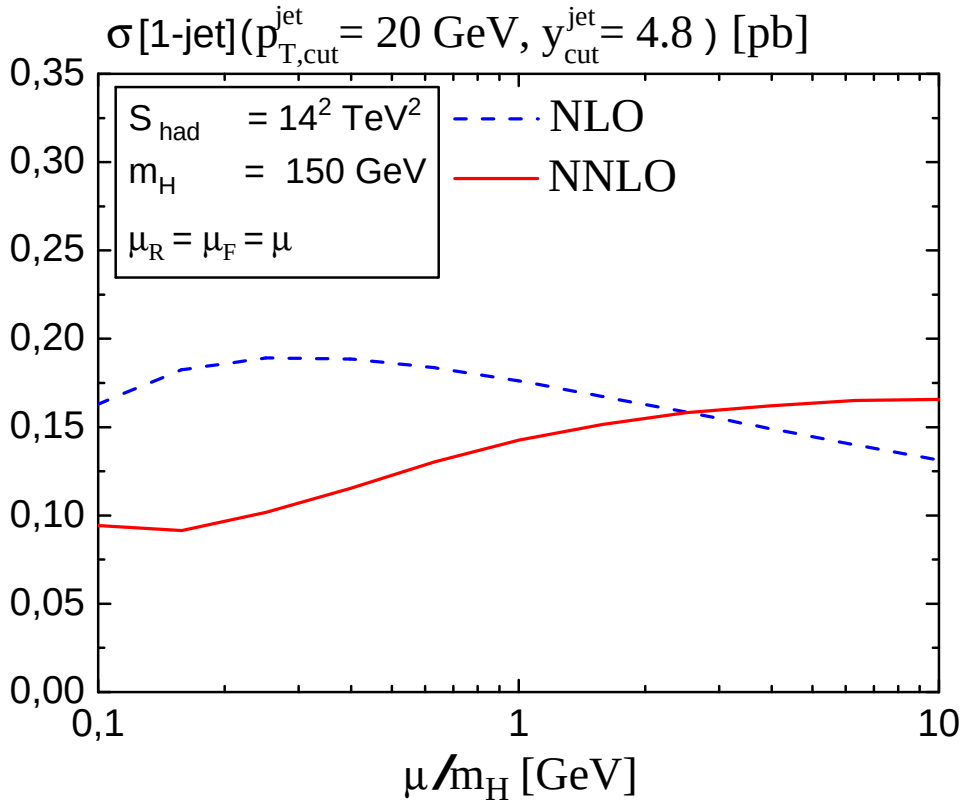

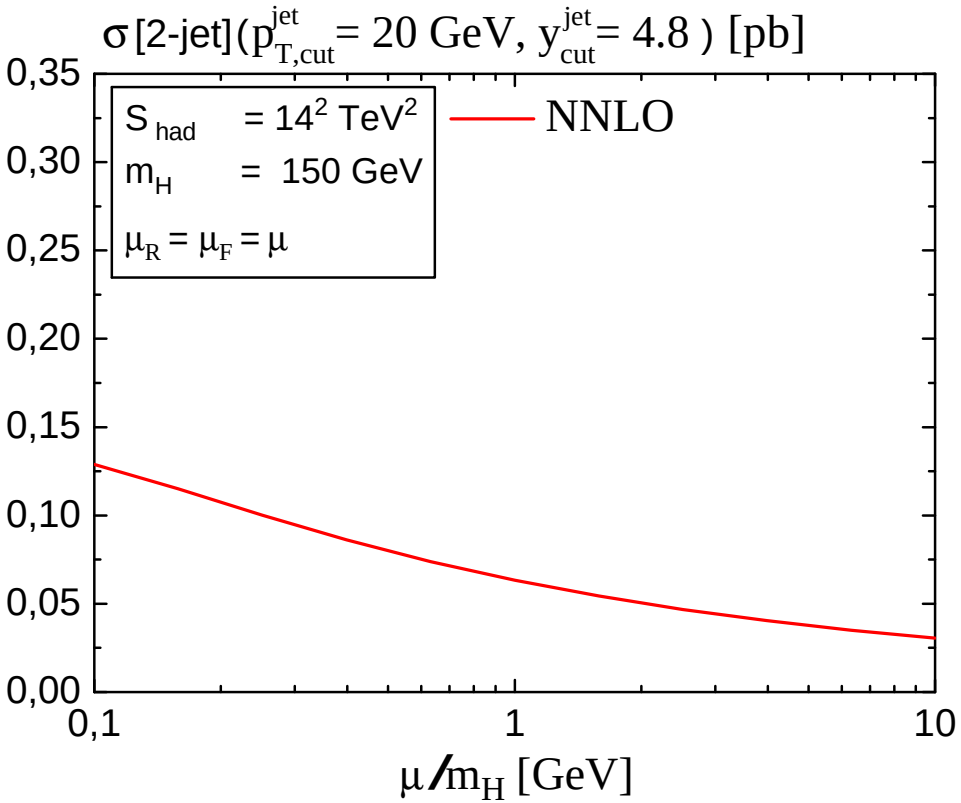

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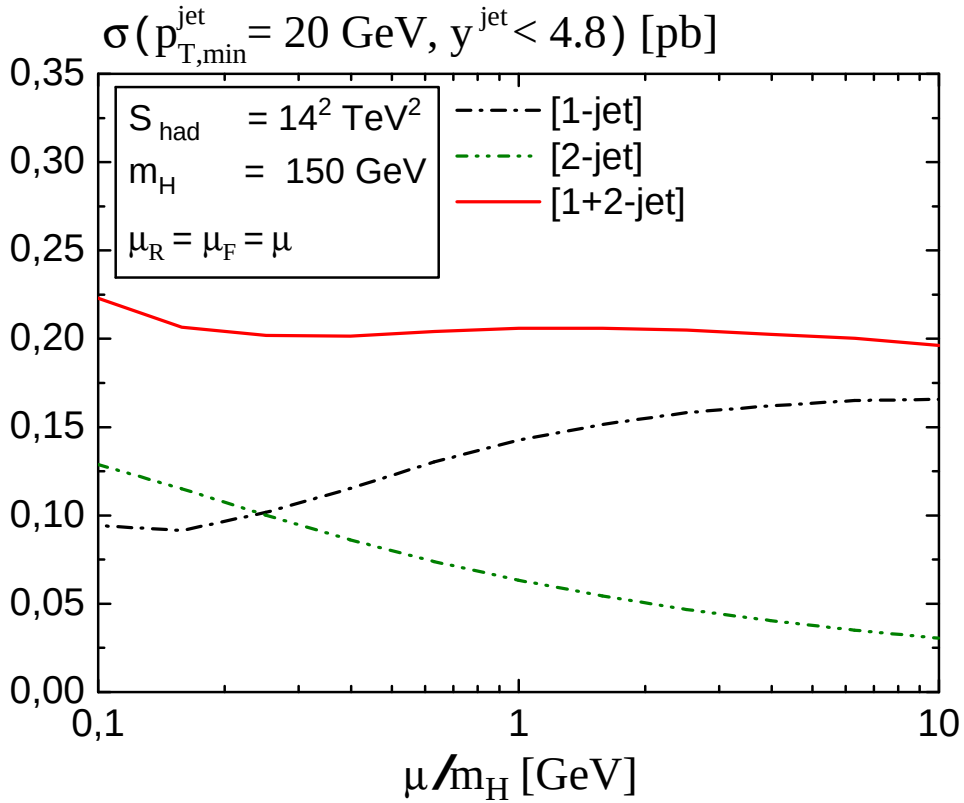

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