Vector Boson Fusion @NNLO

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in collaboration with

P. Bolzoni, F. Maltoni, S.-O. Moch

arXiv:1003.4451, PRL 105 011801 2010

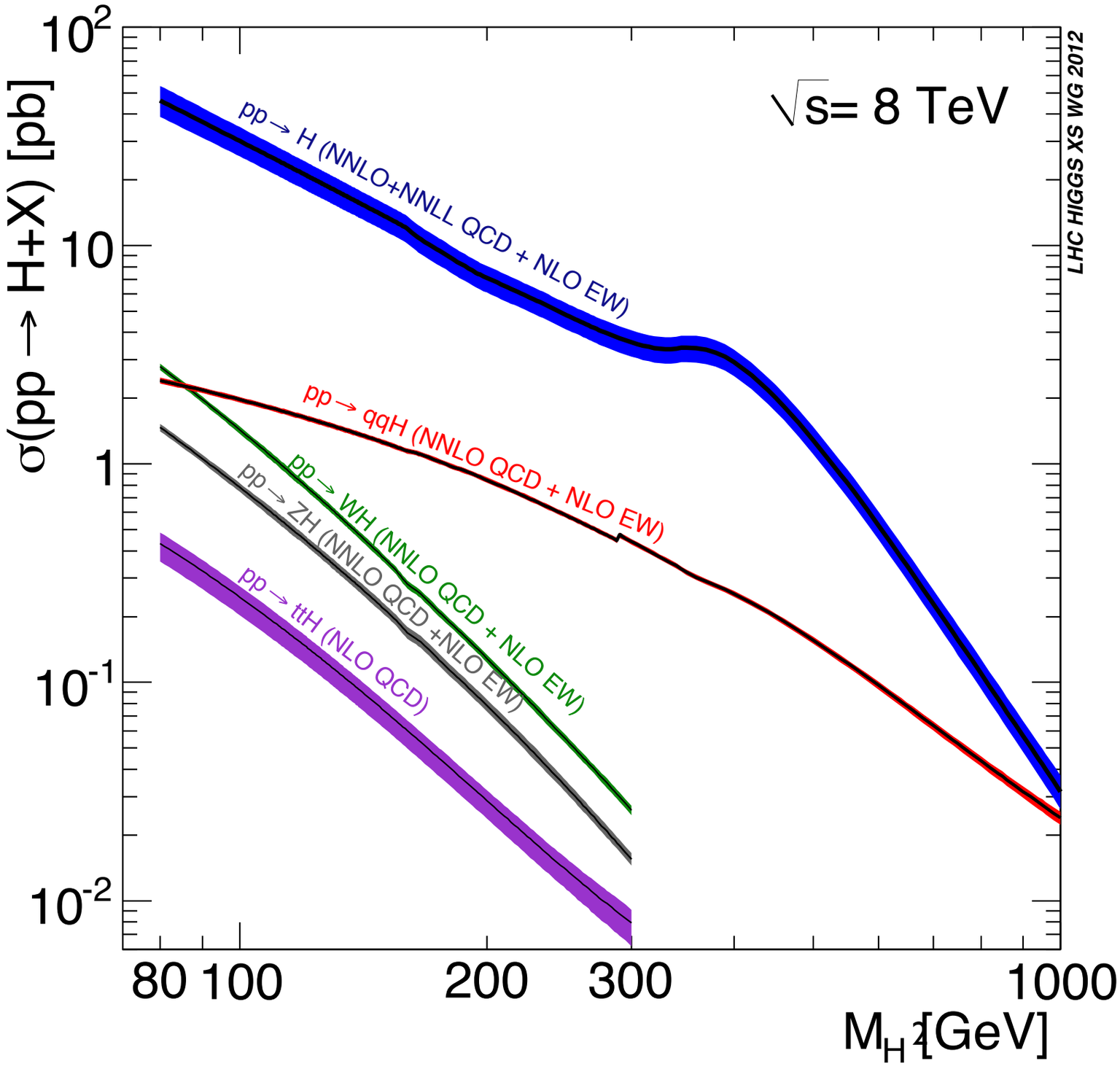
arXiv:1109.3717, PRD 85 035002 2012

and with

The Higgs Cross-Sections Working Group

https://twiki.cern.ch/twiki/bin/view/LHCPhysics/CrossSections

Higgs production @LHC



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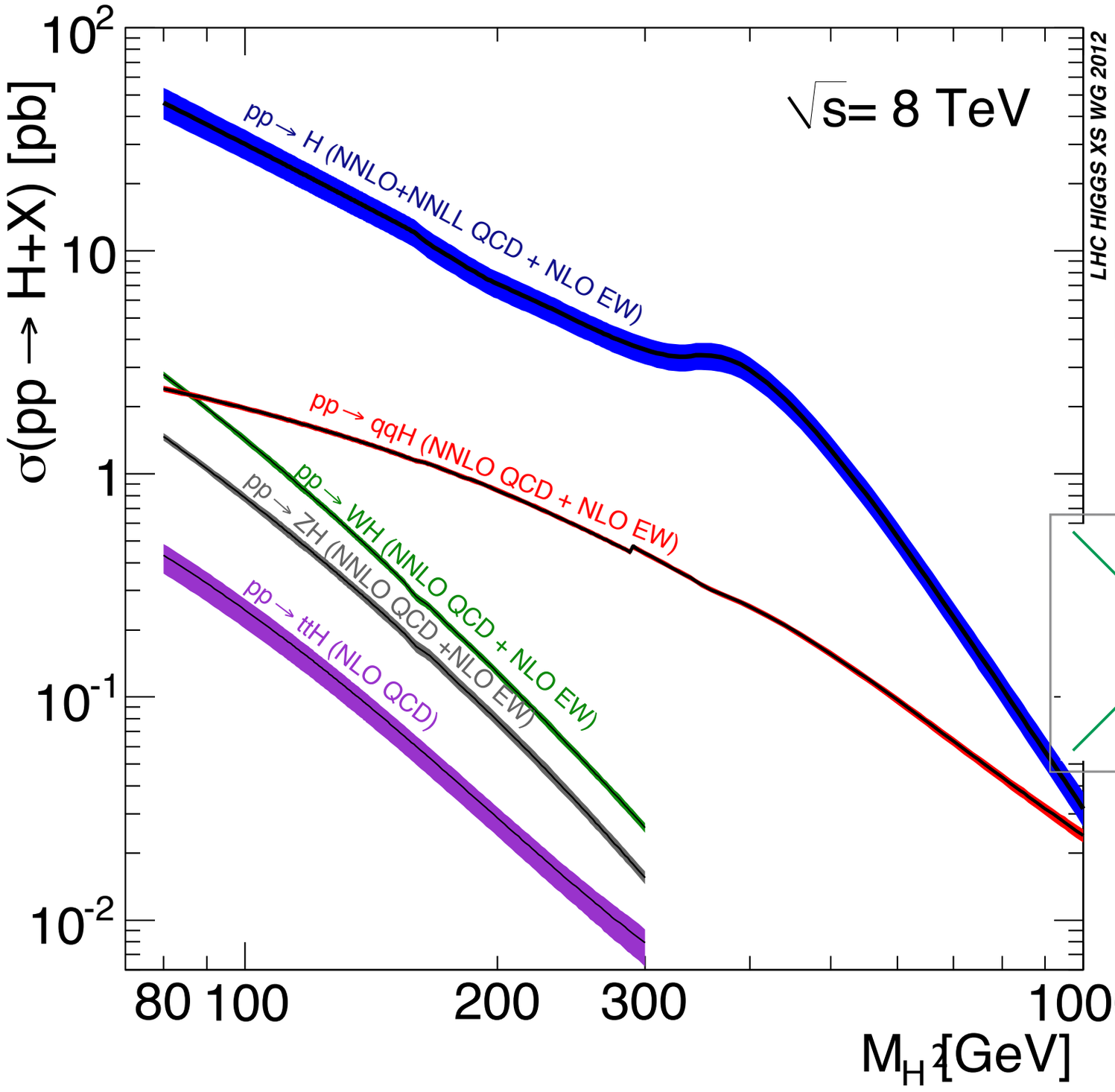
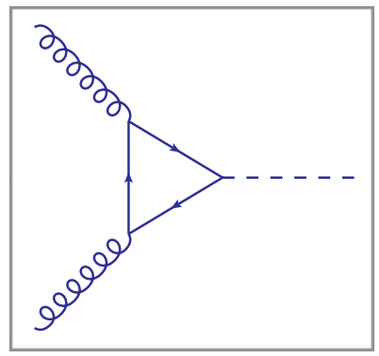
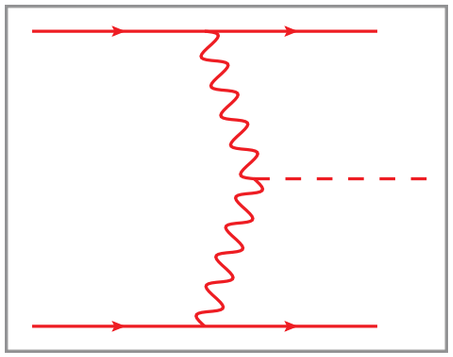
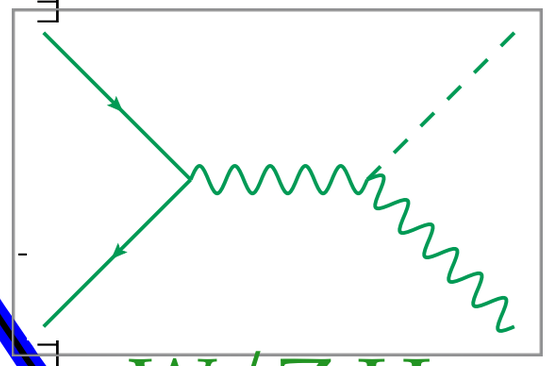




ggH

VBF





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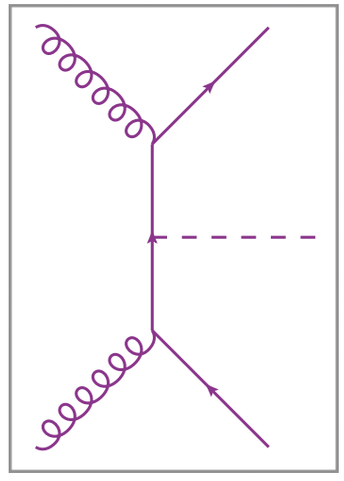

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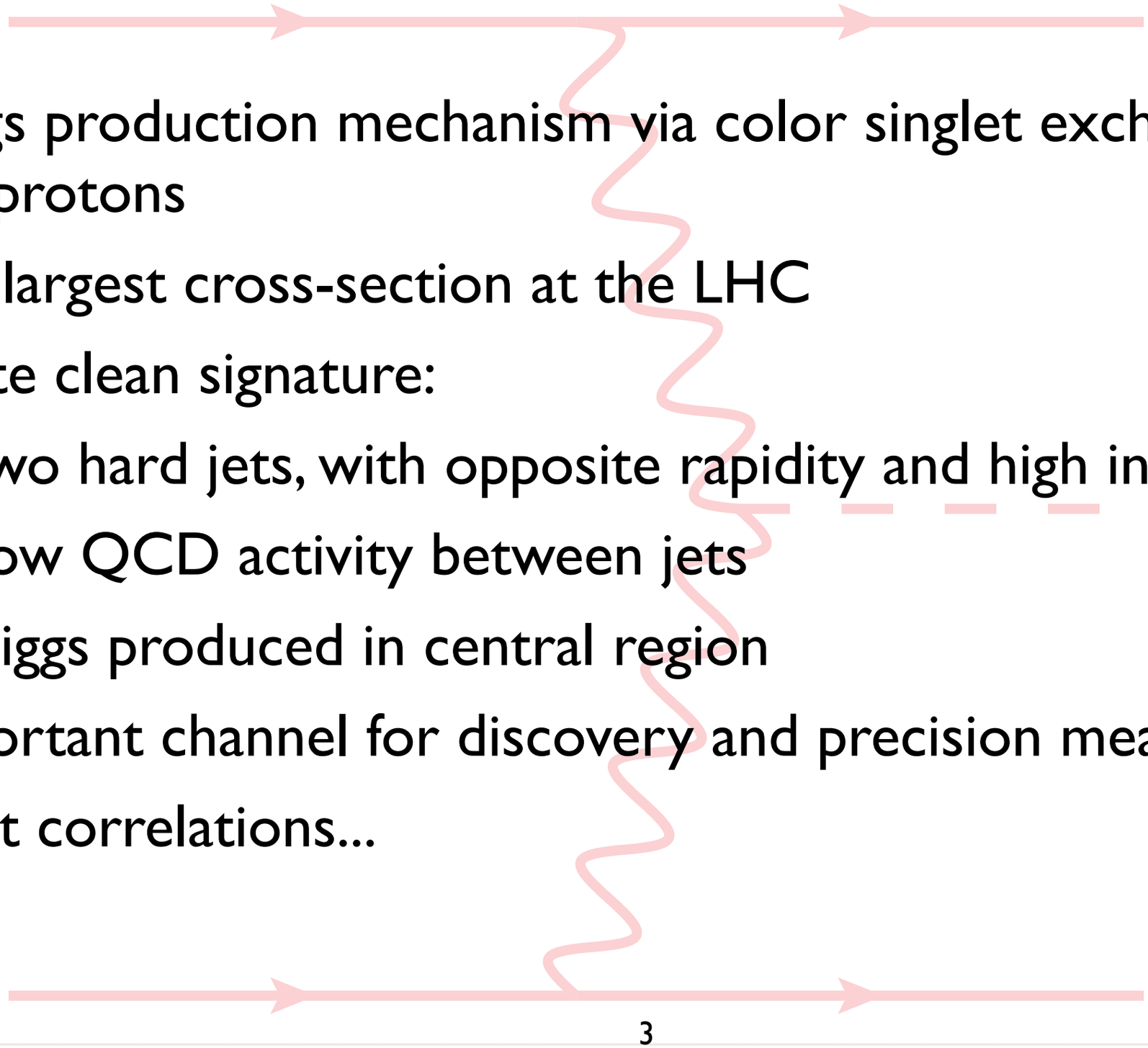
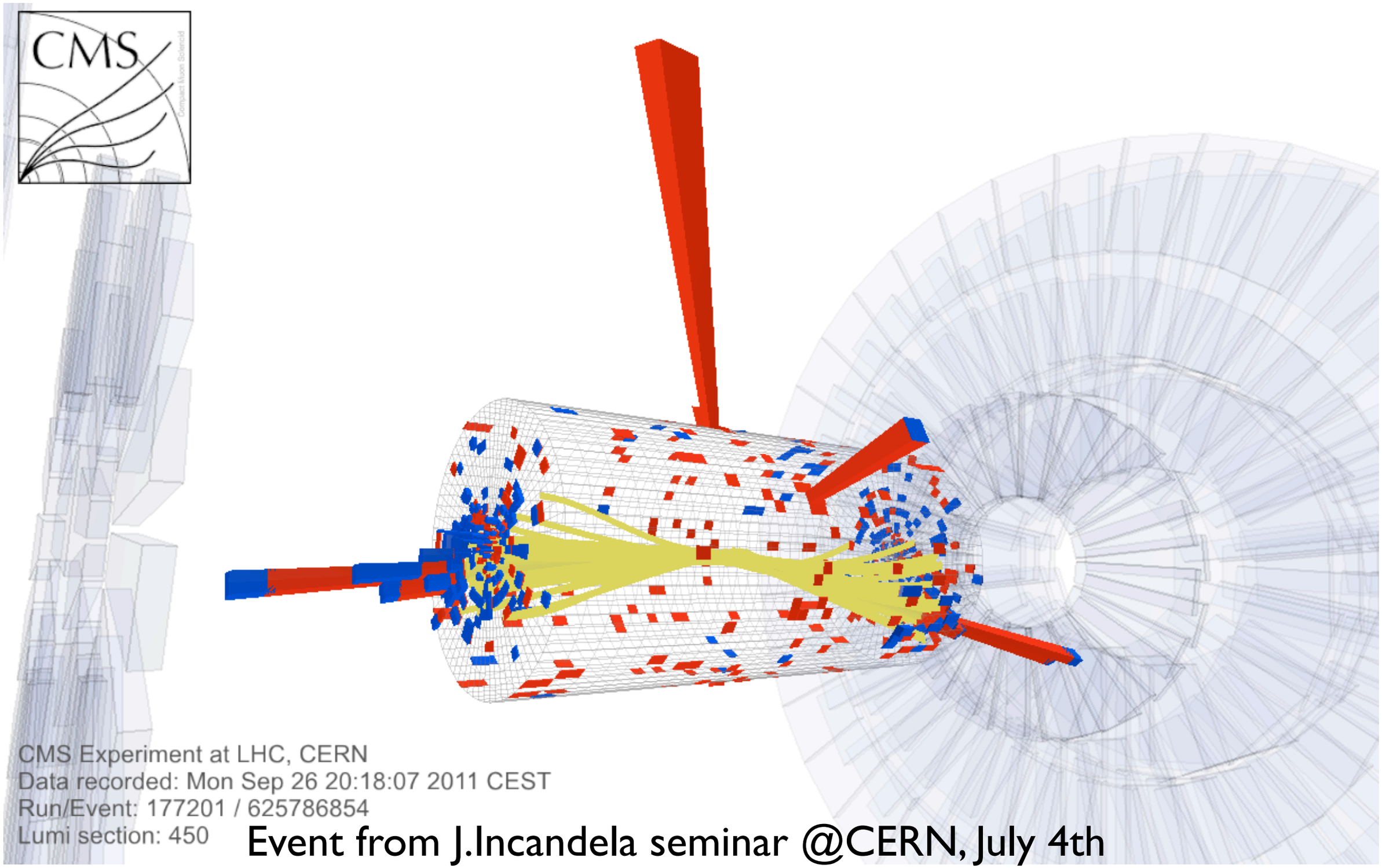
Vector Boson Fusion



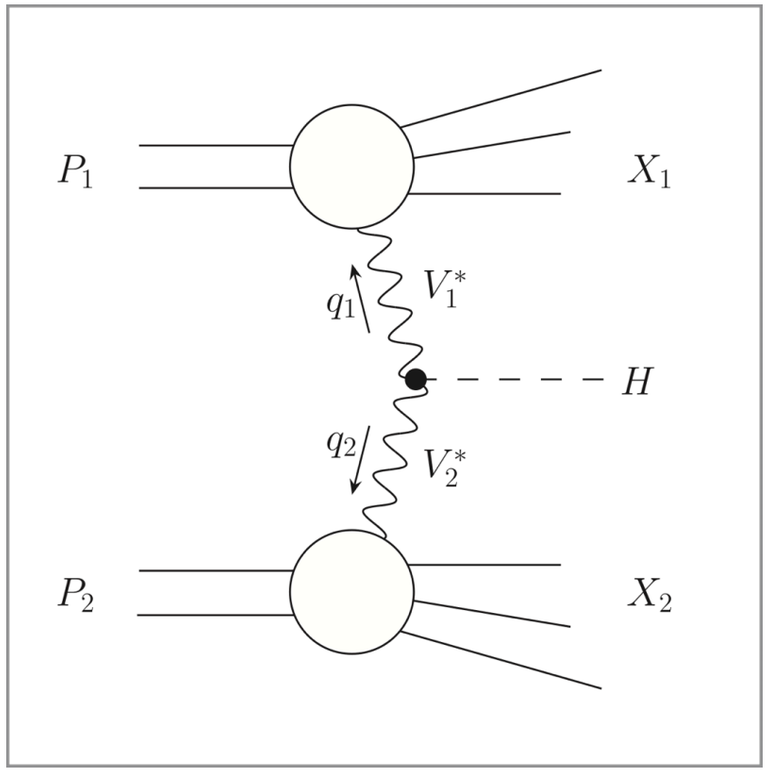
- Higgs production mechanism via color singlet exchange between the protons
- 2nd largest cross-section at the LHC
- Quite clean signature:
  - Two hard jets, with opposite rapidity and high invariant mass
  - Low QCD activity between jets
  - Higgs produced in central region
- Important channel for discovery and precision measurements
  - Jet correlations...



Event from J.Incandela seminar @CERN, July 4th

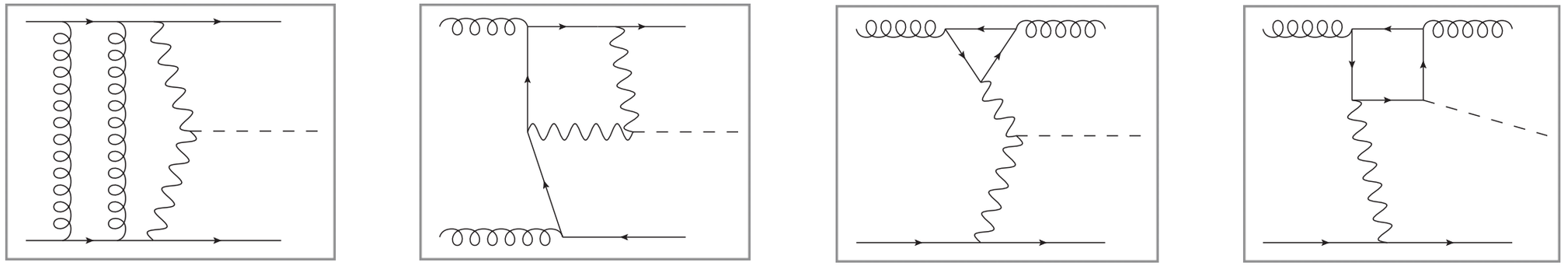
QCD corrections to VBF

- NLO QCD corrections are mild (~5-10%) and factorize because of color conservation
  - First NLO computation of VBF x-sec done in the **structure function approach** (Han, Valencia, Willenbrock, 1992)



NNLO QCD corrections

- At NNLO, things are (in principle) more complicated:
  - many extra contributions need to be considered



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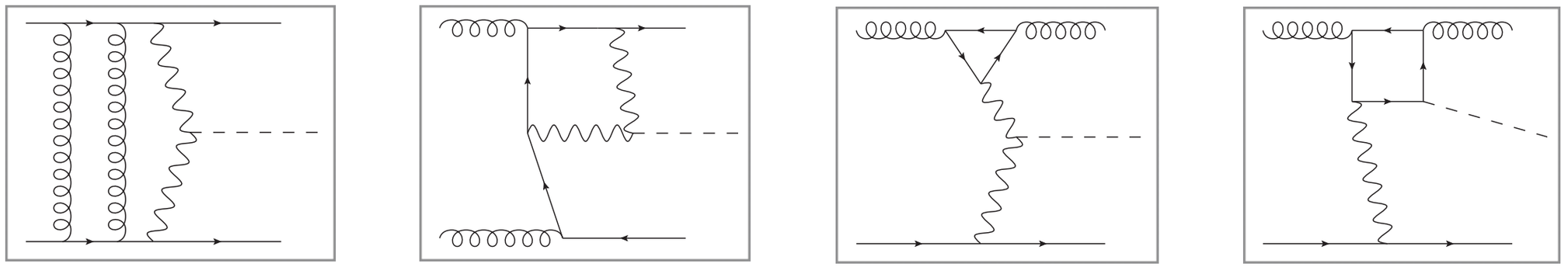

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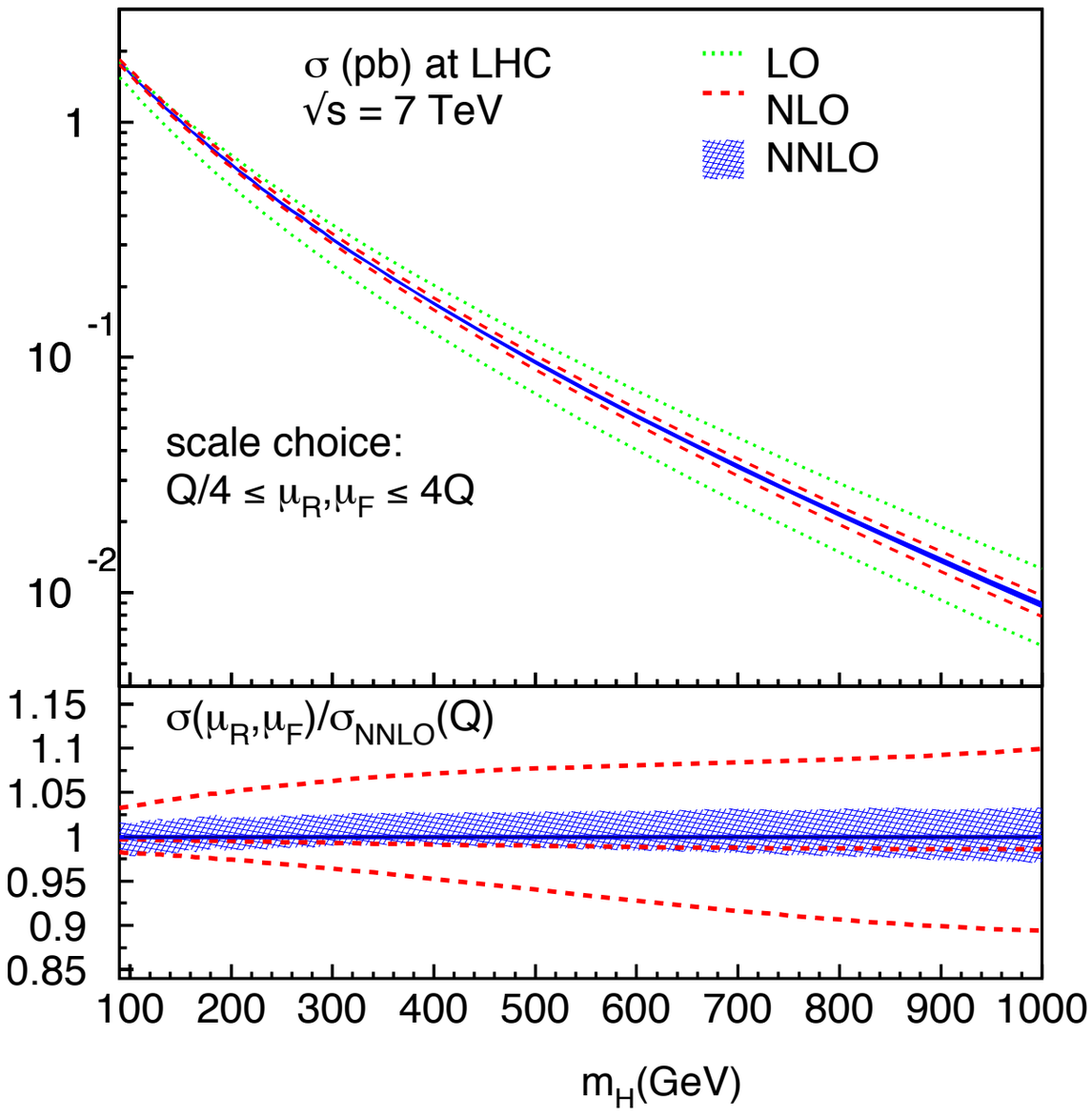
Bottom line:

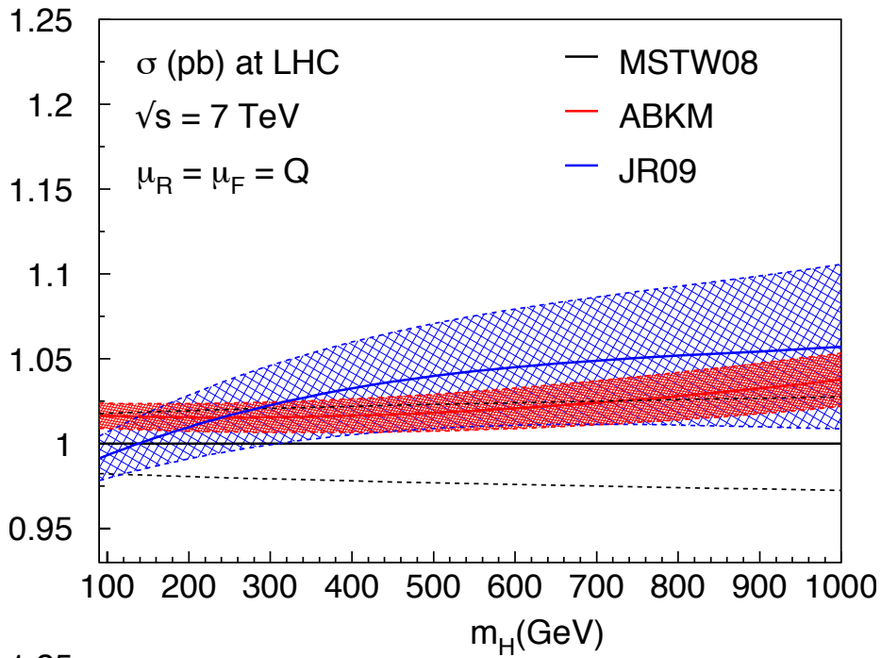
non factorizable contributions are < 10% of the NNLO correction
(which is 1% of total x-sec)

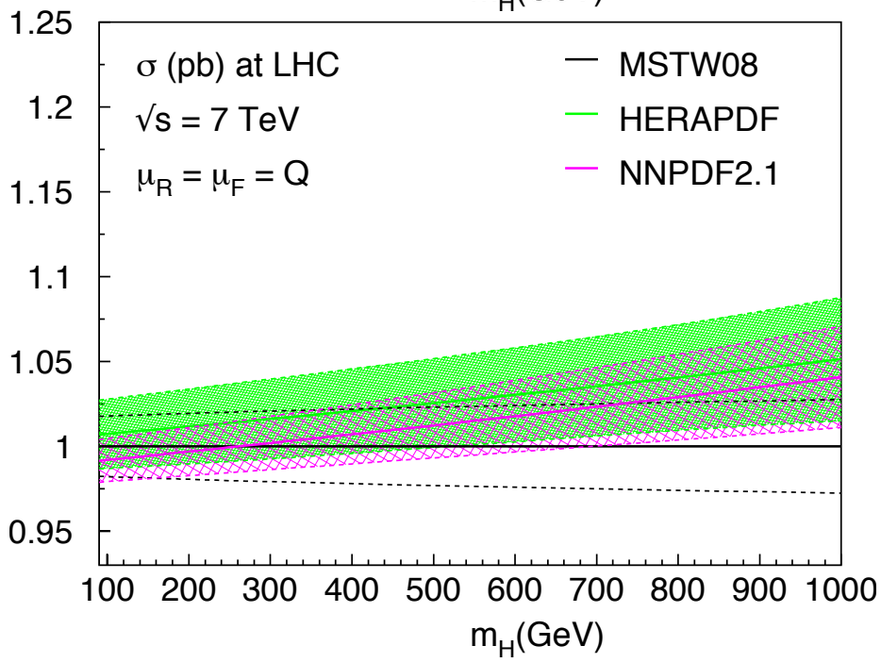
Structure function approach holds also at NNLO

Results

from 1109.3717







NLO EW corrections

in collaboration with the Higgs cross-section working group

- NLO ElectroWeak corrections to VBF are known and sizable
  (Ciccolini, Denner, Dittmaier, arXiv:0710.4749)
- Publicly available in the HAWK/VBFNLO code
- Can be combined with NNLO QCD corrections
  - Multiplicative scheme (formally includes higher orders):

$$\sigma = \sigma_{\mathrm{NNLO}} \times \left(1 + \frac{\Delta\sigma_{\mathrm{EW}}}{\sigma_{\mathrm{LO}}}\right)$$

  - Additive scheme

$$\sigma = \sigma_{\mathrm{NNLO}} + \Delta\sigma_{\mathrm{EW}}|_{\mathrm{NNLO\ PDFs}}$$

  - For the total cross-section, both schemes are equivalent

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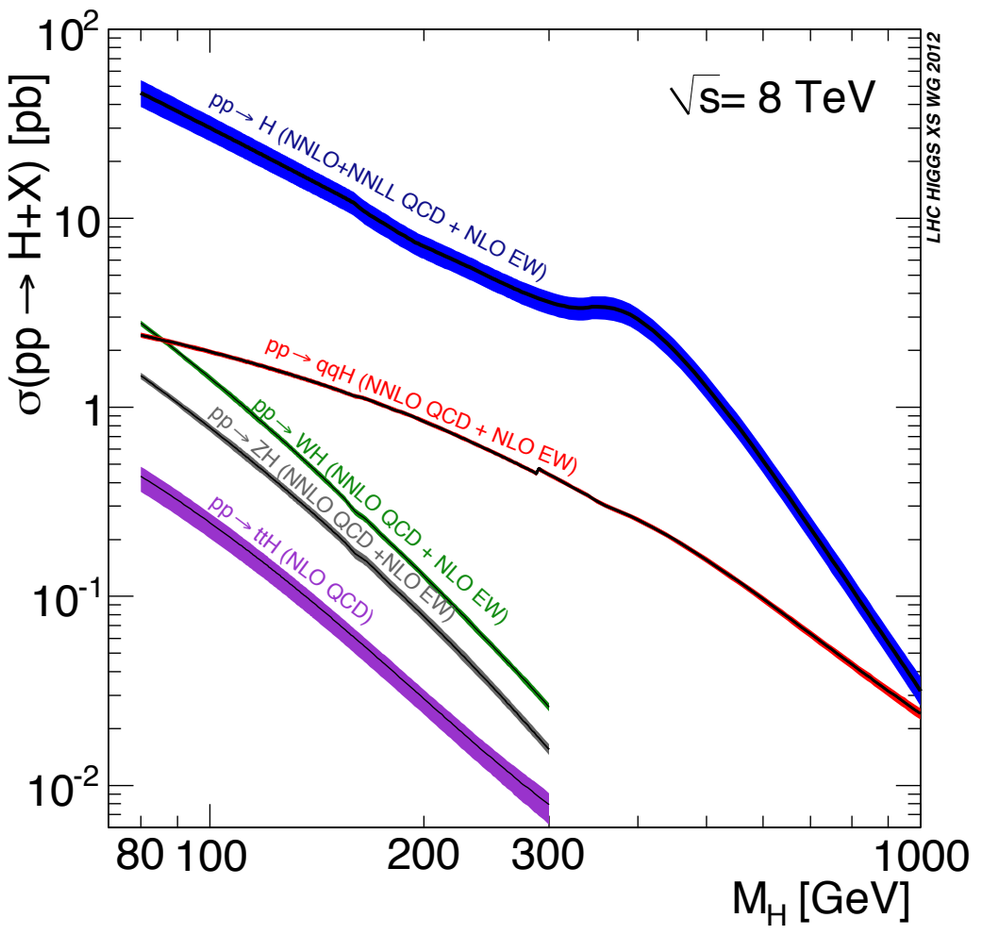

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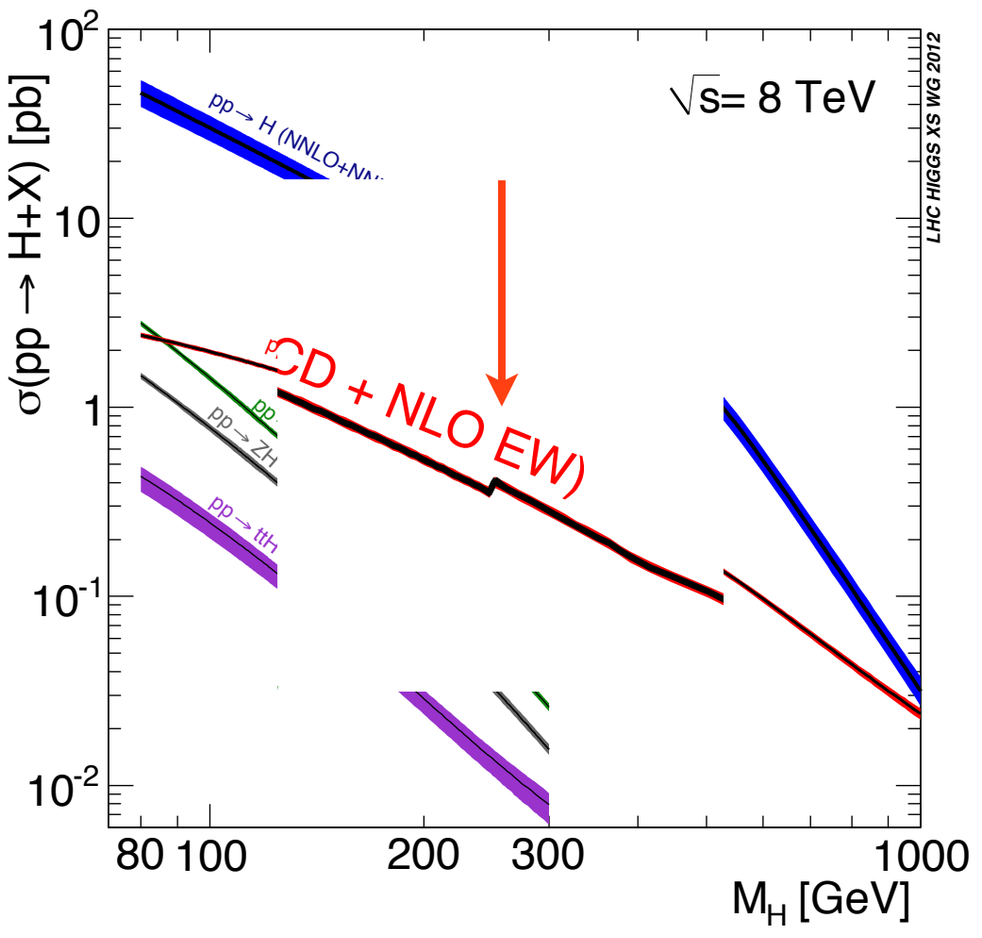

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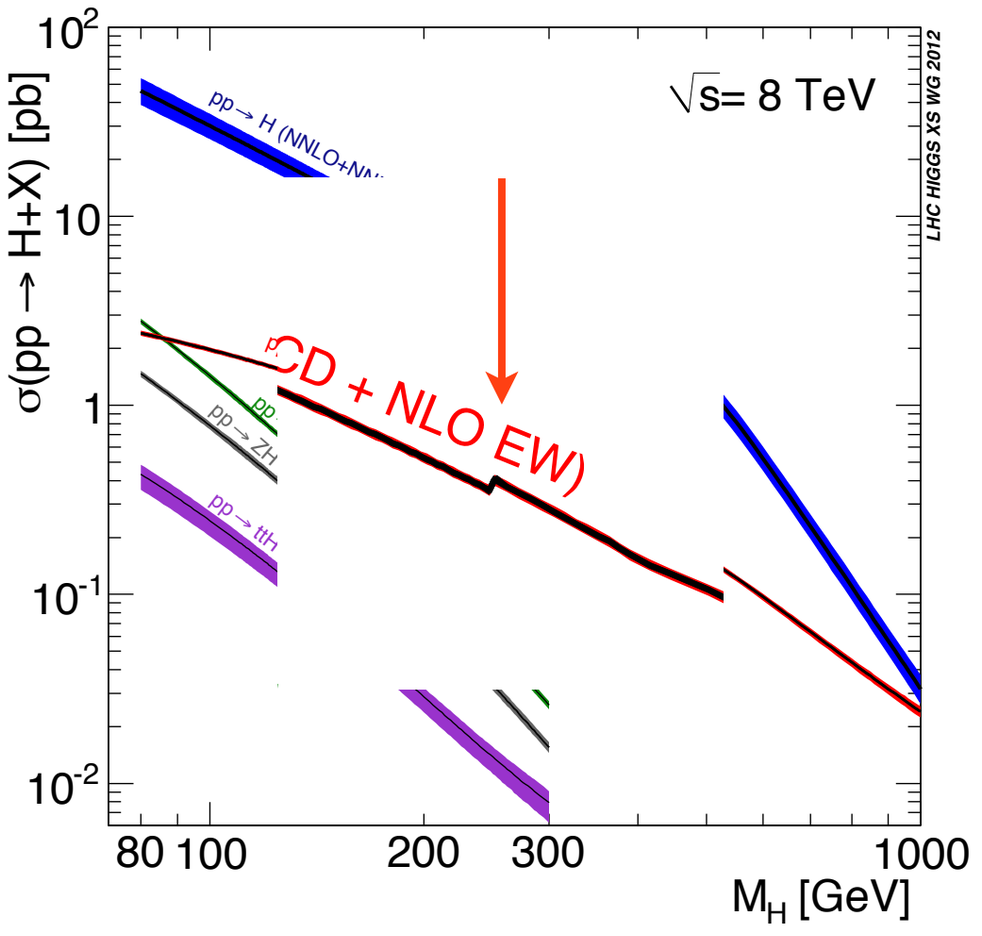

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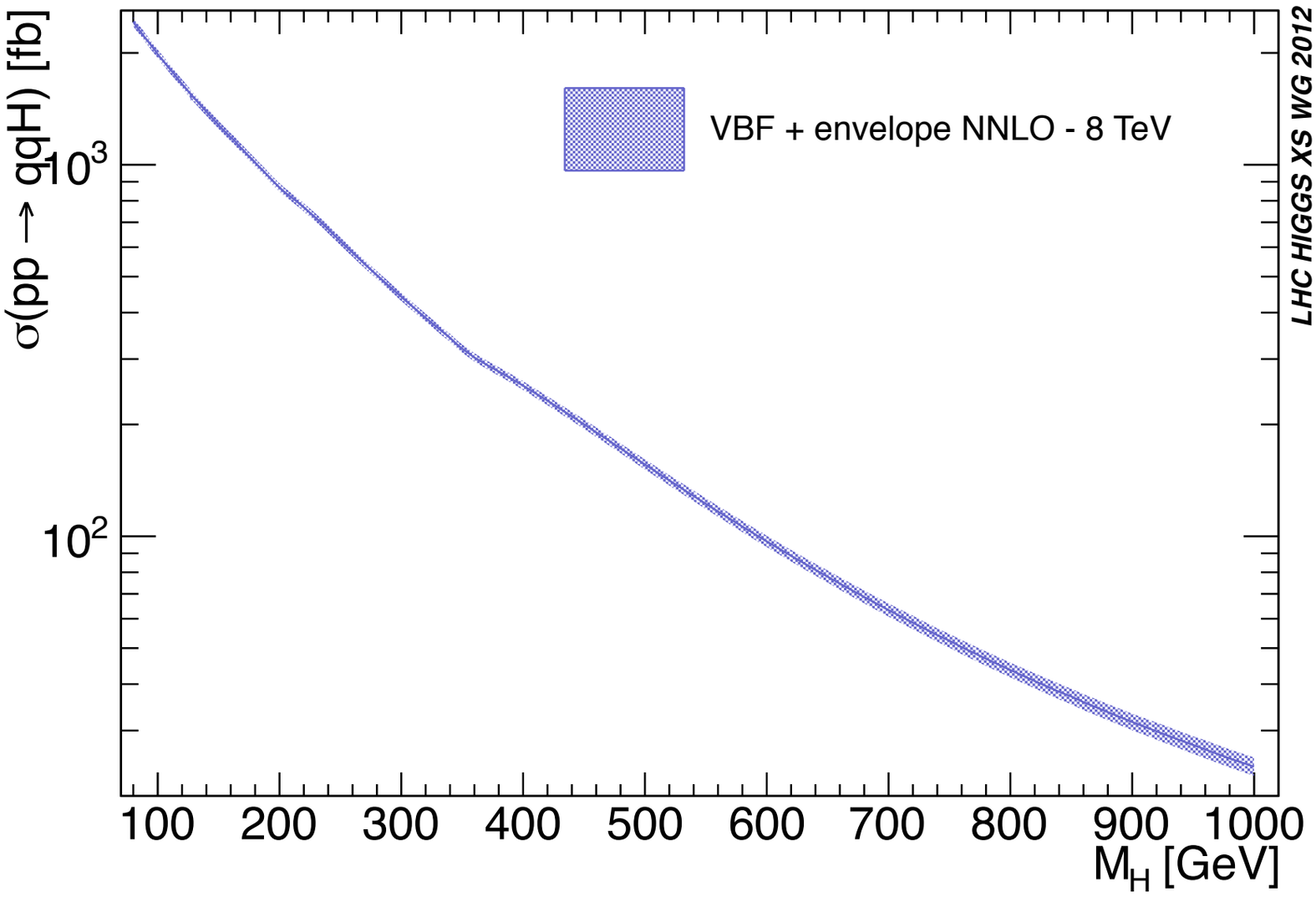

Plot from Daniela Rebuzzi

Conclusions

- VBF is a crucial process for LHC Higgs physics
- NNLO corrections (to the total x-sec) can be computed within the structure function approach
  - Corrections are small
  - Residual uncertainity ~ 2%
  - Differential (parton level) MC?
- Combined with NLO EW corrections
- Off-shell effects included
  - Interference with the background?
- Possible BSM applications (see in 1109.3717)
- Web interface http://vbf-nnlo.phys.ucl.ac.be/vbf.html


Thank you!