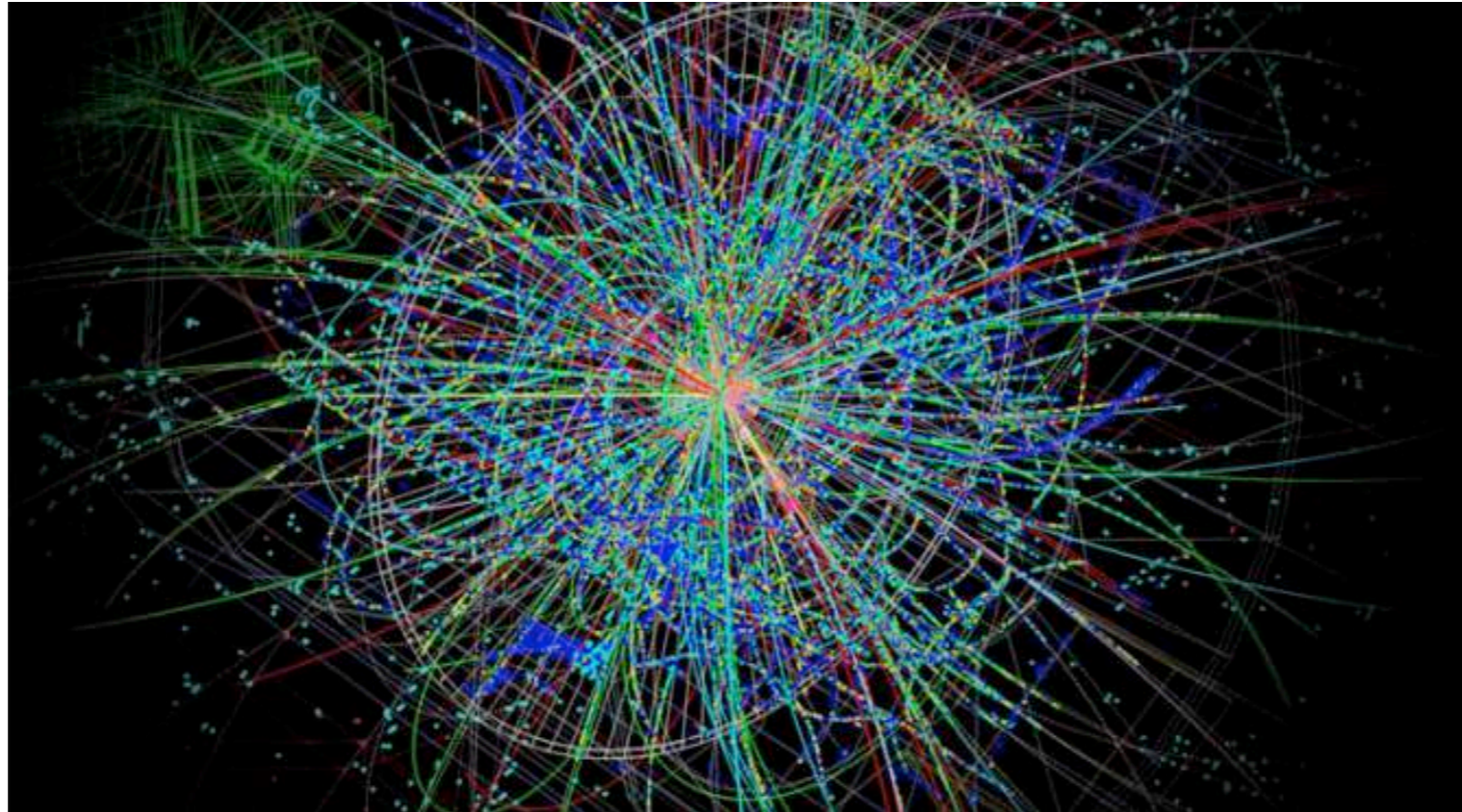


# **Vector plus Higgs boson production: Status and Open Issues**



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**Meeting of the LHC HXS WG 1 – August 2014**

# Vector plus Higgs boson (VH) production ( $V=W,Z$ )

## Outline

- \* QCD corrections
- \* EW corrections
- \* Combination of QCD and EW corrections
- \* Combination of production and decay
- \* NLO QCD matched to parton shower
- \* Other issues

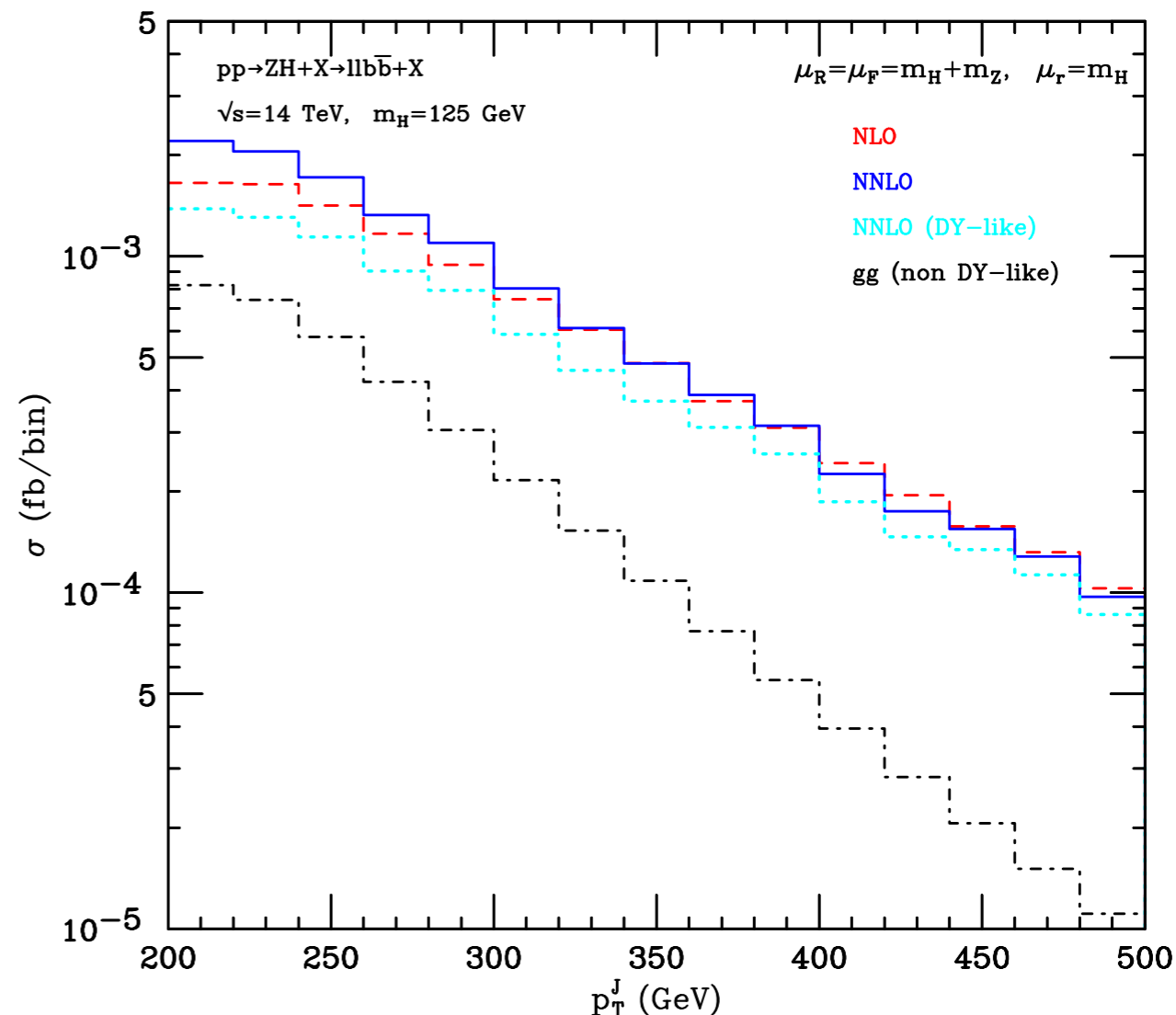
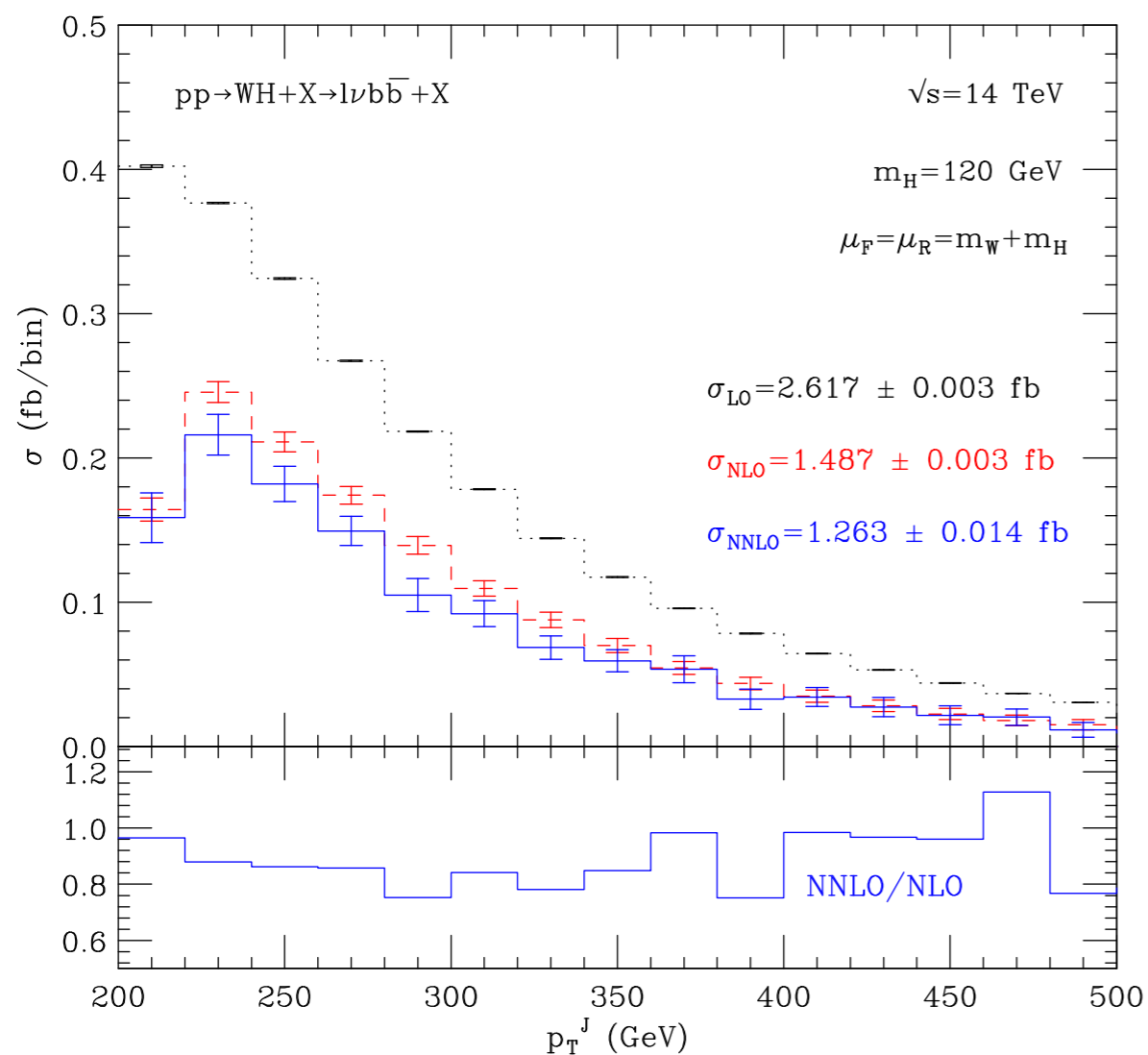
# Vector plus Higgs boson (VH) production ( $V=W,Z$ )

\* QCD corrections:

- NNLO QCD fully differentially known, which should be sufficient
- > HVNNLO [Ferrera, Grazzini, FT] (already available from the authors, public soon)

NNLO computation implemented through the qT subtraction method [Catani, Grazzini]

Decay to bottom quark included up to NLO in QCD via Narrow Width Approximation (BR normalized to the precise value reported in YR1)

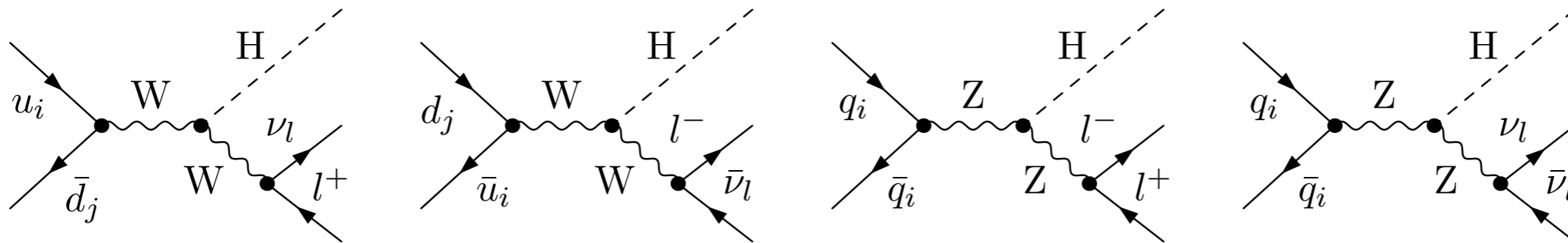


# Vector plus Higgs boson (VH) production (V=W,Z)

\* EW corrections:

NLO EW known differentially, which should be sufficient

-> HAWK [Denner, Dittmaier, Kallweit, Mück]



Fully differential 2 -> 3 NLO EW computation

Implemented through the Complex Mass Scheme@NLO [Denner, Dittmaier]

\* Combination of QCD and EW corrections:  
as done in YR2 should be ok

$$\sigma = \sigma^{\text{QCD}} \times (1 + \delta_{\text{EW}}^{\text{rec}}) + \sigma_{\gamma}$$

More can only be achieved by some NNLO QCD-EW calculation  
-> currently out of reach

# Vector plus Higgs boson (VH) production (V=W,Z)

\* Combination of production and decays:

A full (N)NLO QCD + NLO EW study of the signal

$$pp(VH) \rightarrow H(\rightarrow b\bar{b}) + V(\rightarrow l\bar{l})$$

is desirable. H->bb known to NNLO QCD differentially [Anastasiou et al]  
-> Tests impact of corrections on fiducial XS.

VH search strategy important to assess the relevance  
of the corrections to the decay process

$$R_{bb} \gtrsim 2 \frac{m_H}{p_T} \quad (p_T \gg m_H)$$

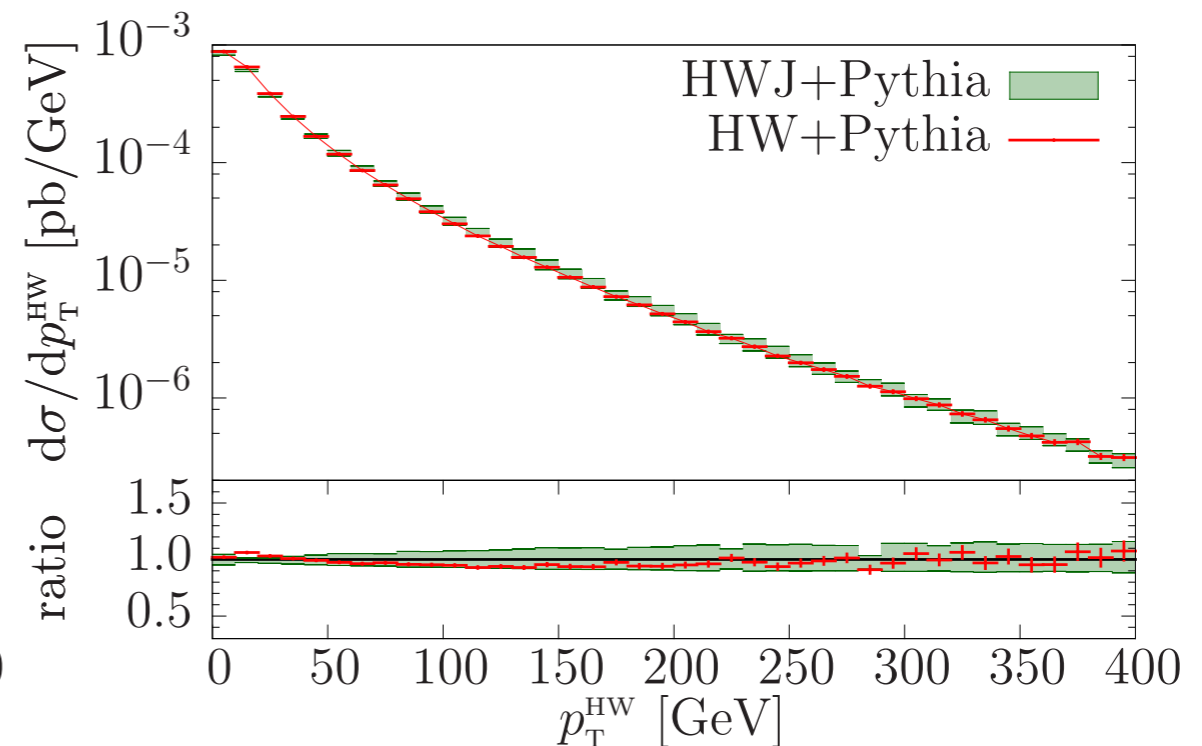
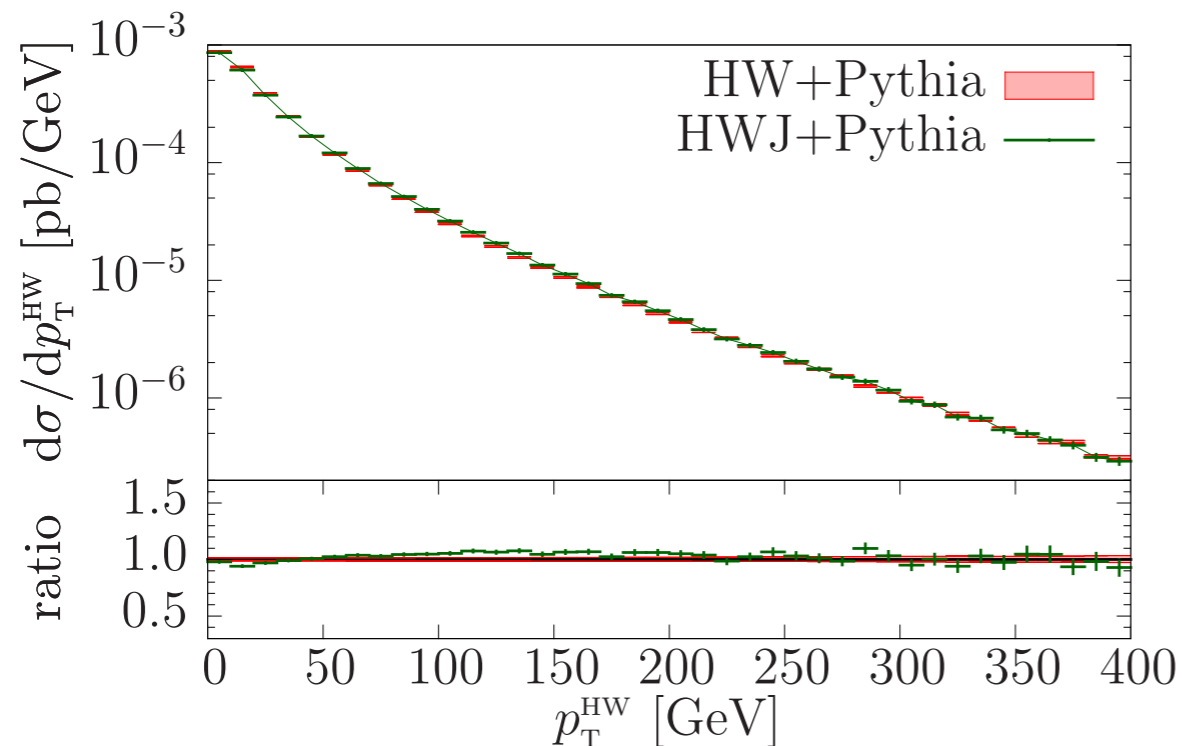
# Vector plus Higgs boson (VH) production ( $V=W,Z$ )

\* NLO QCD matched to parton shower:

merging and matching for  $pp \rightarrow VH(j)$

-> available in the POWHEG-BOX framework [Luisoni, Nason, Oleari, FT]

MINLO [Hamilton, Nason, Zanderighi] -> No error related to the merging scale



\* NNLO matching with PS possible through reweighting of HVj-MINLO with HVNNLO

reweighting procedure already worked out for:

- H production [Hamilton, Nason, Re, Zanderighi]  
reweighting with HNNLO [Grazzini]

- DY production [Karlberg, Re, Zanderighi]  
reweighting DYNNLO [Catani, Cieri, Ferrera, De Florian, Grazzini]

# Vector plus Higgs boson (VH) production ( $V=W,Z$ )

Other issues:

\* What about backgrounds?

Many of them already available

Others can be computed through automated tools  
(at least up to NLO in QCD merged with parton shower)

\* Knowledge of the search strategies for VH is the ingredient that allows to establish which corrections have to be included and eventually improved