



# VBF Higgs Production at the HL-/HE-LHC

Alexander Karlberg

In collaboration with Juan M. Cruz-Martinez and Michael Rauch  
WG1 VBF meeting  
CERN

# This talk

- Status on ongoing work
  - First inclusive results at 27 TeV
  - Differential results under “typical” tight/loose VBF cuts at LO and NLO
  - Initial study of tag jet rapidities
- Setup
  - PDG values for EW parameters ( $M_W, M_Z, G_F$ )
  - PDF: PDF4LHC\_nnlo (LUXQED for  $\gamma$ )
  - $\sqrt{s} = 27$  TeV
  - Pure VBF approximation as implemented in PROVBFH and NNLOJET
  - Electroweak corrections from HAWK<sup>1</sup>

Still preliminary!

---

<sup>1</sup>Thanks to Alexander Mueck et al. for EW results



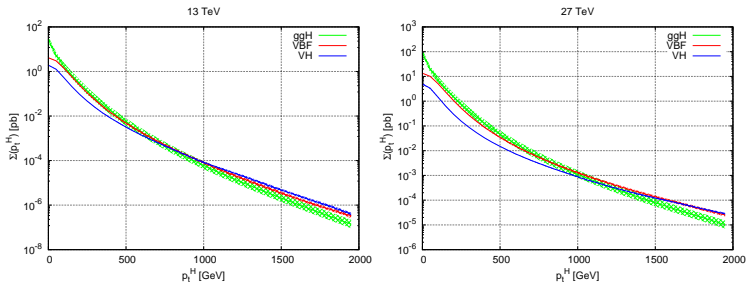
## Inclusive results

$\sqrt{s}$	$\sigma_{\text{DIS}}^{(\text{incl})}$ [pb]	$\delta_{\text{EW}}$ [%]	$\sigma_{\gamma}$ [fb]	$\sigma_{\text{s-channel}}$ [fb]
13 TeV	3.928	-5.3	35.3	1412
14 TeV	4.461	-5.4	40.7	1555
<b>27 TeV</b>	12.41	-6.2	129	3495

- Growth of electroweak corrections with energy as expected.
- $\gamma$  contribution at 1% at all energies. Reduction compare to YR4.
- s-channel contribution relatively smaller at 27 TeV



# Inclusive $p_t^H$ spectrum



- Comparison with ggH and  $VH^2$
- At 27 TeV VBF is dominant between 1 – 1.5 TeV
- Important to study this spectrum for boosted analyses

<sup>2</sup>Thanks Pier Monni and Emanuele Re



## Fiducial setup

Define two anti- $k_t$  tag jets with  $p_t > 30$  GeV and  $R = 0.4$  and always require

$$y_{j_1} y_{j_2} < 0.$$

We define a “loose” set of VBF cuts (upper frame in the following)

$$M_{jj} > 500 \text{ GeV}, \quad |\Delta y_{jj}| > 3,$$

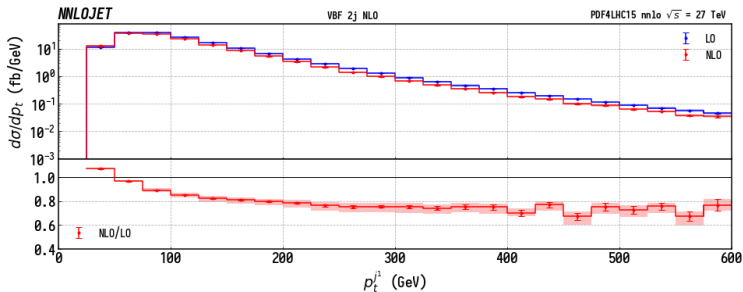
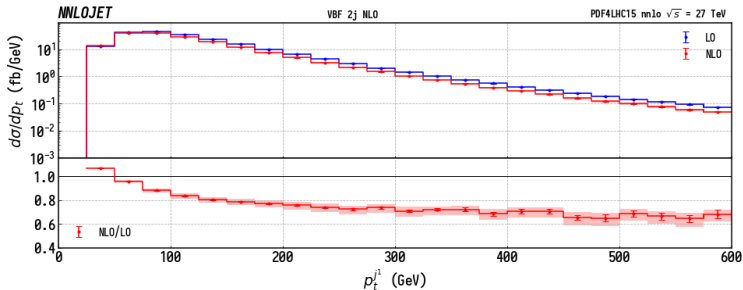
and a “tight” set with (lower frame in the following)

$$M_{jj} > 600 \text{ GeV}, \quad |\Delta y_{jj}| > 4.5.$$

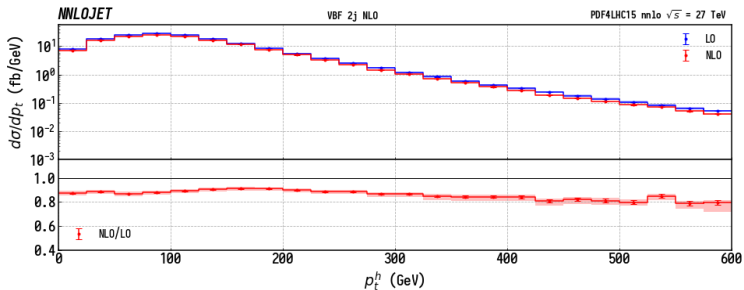
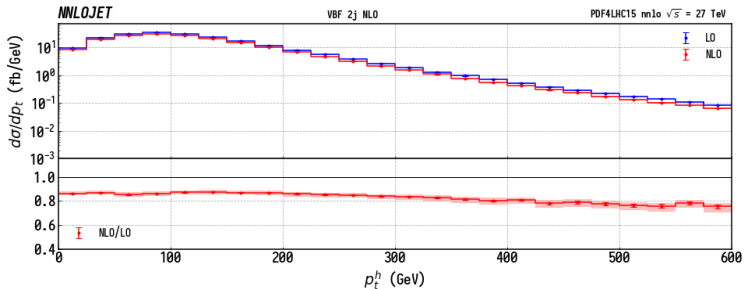
These cuts will we updated and changed after we perform a scan in  $M_{jj}$  and  $|\Delta y_{jj}|$ .



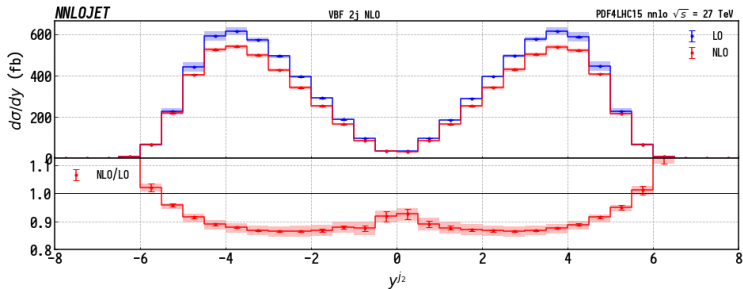
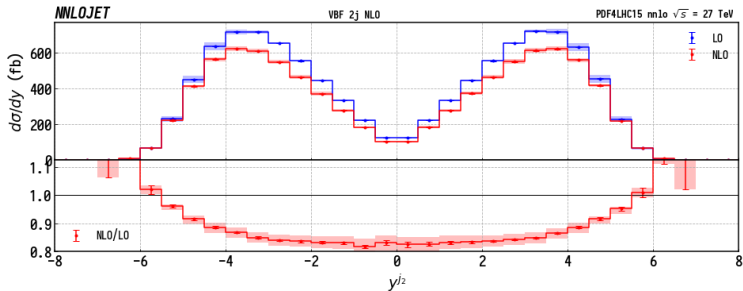
# Distributions - $p_{t,j_1}$



# Distributions - $p_{t,H}$

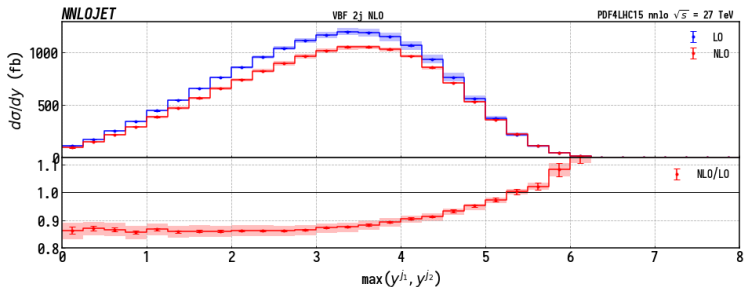
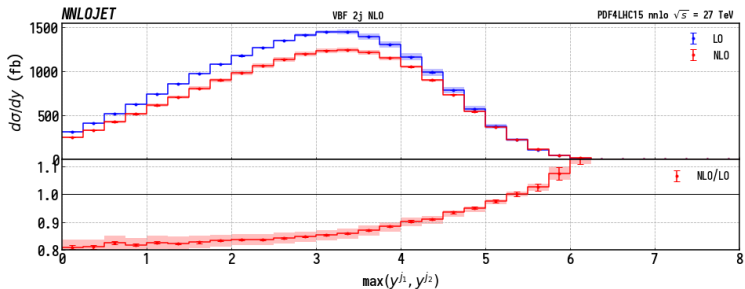


# Distributions - $y_{j_2}$

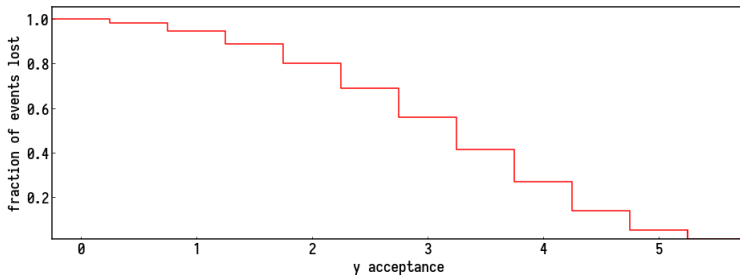
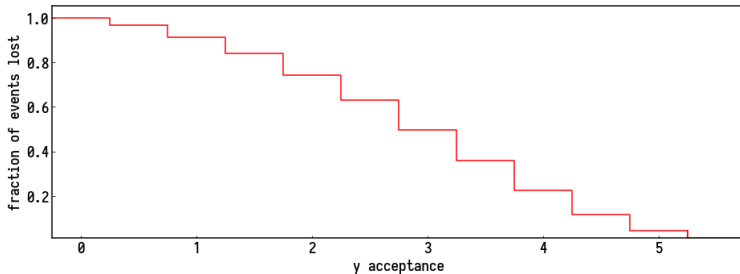




# Distributions - $\max(|y_{j_1}|, |y_{j_2}|)$



# Detector acceptance



# Things to be done

- 2D-scan of  $M_{jj}$  and  $\Delta y_{jj}$  to establish VBF cuts
  - A study of  $ggH_{jj}$  background would be valuable as well
- VBF approximation - how well does it work at 27 TeV?
- Detector reach
  - Need some input from experimentalists...
- Report at set of fiducial/inclusive cross sections based on the above
- Study  $M_{jj}$  and  $p_{t,H}$  reach with full integrated luminosity

