Central jet veto and parton showers in VBF

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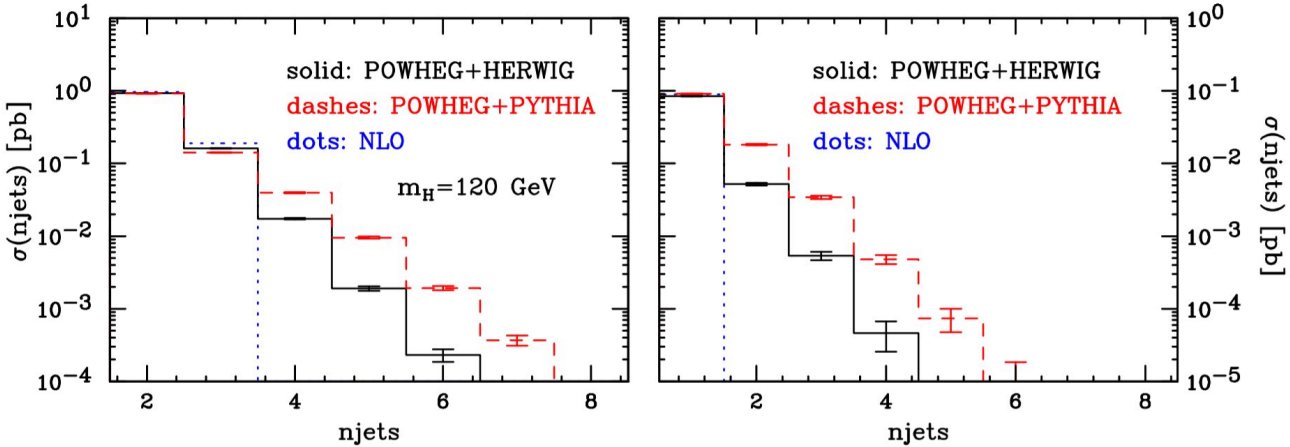
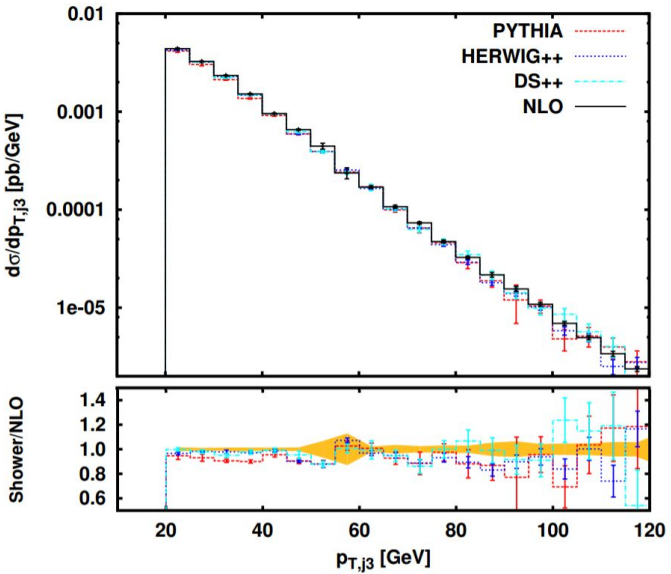
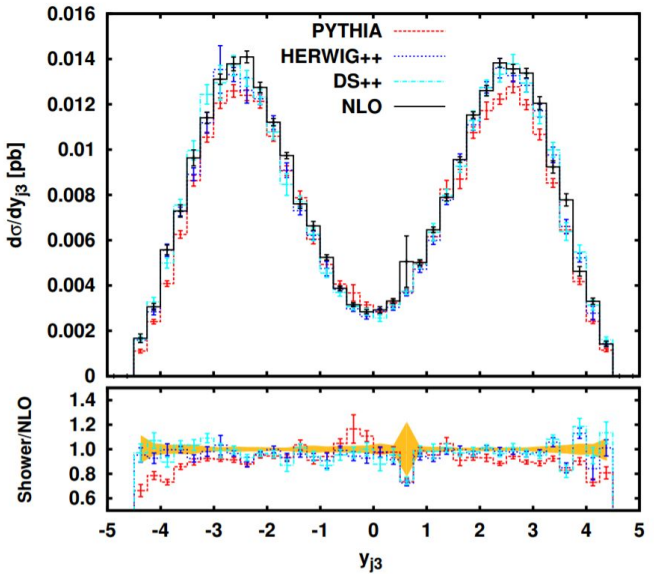
(work in progress)

Central jet veto

- Jet activity in between the two tagging jets is strongly suppressed in VBF which is not the case in QCD induced Hjj background.
- Hence, requiring no central jet activity can help significantly reduce the Hjj background without losing too much of the VBF signal.
- When matching NLO VBF to a parton shower, various showers give significantly different central jet activity and disagree widely on the Njets distribution (Nason, Oleari: 0911.5299).
- The third jet distributions stabilise when NLO VBF Hjjj is matched with a parton shower (Jäger, Schissler, Zeppenfeld: 1405.6950).


solid: POWHEG+HERWIG
dashes: POWHEG+PYTHIA
dots: NLO
m_H=120 GeV
σ(njets) [pb]
njets
solid: POWHEG+HERWIG
dashes: POWHEG+PYTHIA
dots: NLO
σ(njets) [pb]
njets


PYTHIA
HERWIG++
DS++
NLO
$d\sigma/dp_{T,j3}$ [pb/GeV]
Shower/NLO
$p_{T,j3}$ [GeV]


PYTHIA
HERWIG++
DS++
NLO
$d\sigma/dy_{j3}$ [pb]
Shower/NLO
y_{j3}

NNLO results

- The recent NNLO results for VBF can be used to estimate the CJV cross section.
- Such an estimate can help with assigning uncertainties to the NLOPS computation and say something about how well the various showers capture the true CJV behaviour.
- Results are fairly preliminary.
- We are also studying various ordering of the tagging jets (transverse momentum, energy and rapidity) but for now only discuss pt-ordering.

Analysis

- Typical VBF cuts:

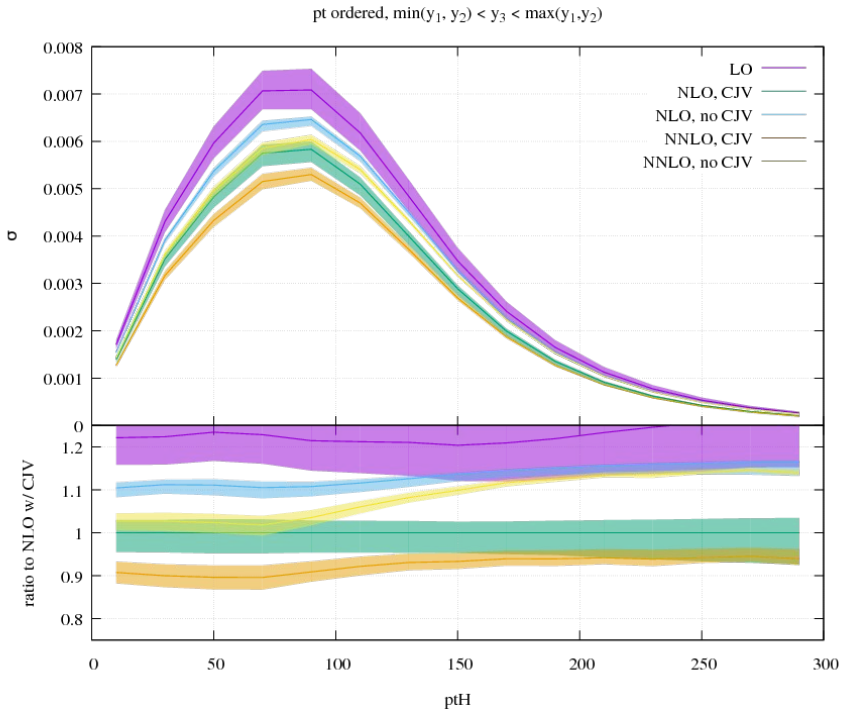
$$p_{t,\mathrm{tag}} > 25\ \mathrm{GeV}, \quad M_{jj} > 600\ \mathrm{GeV}, \quad \Delta y_{jj} > 4.5, \quad y_{j1} y_{j2} < 0, \quad y_j < 4.5$$

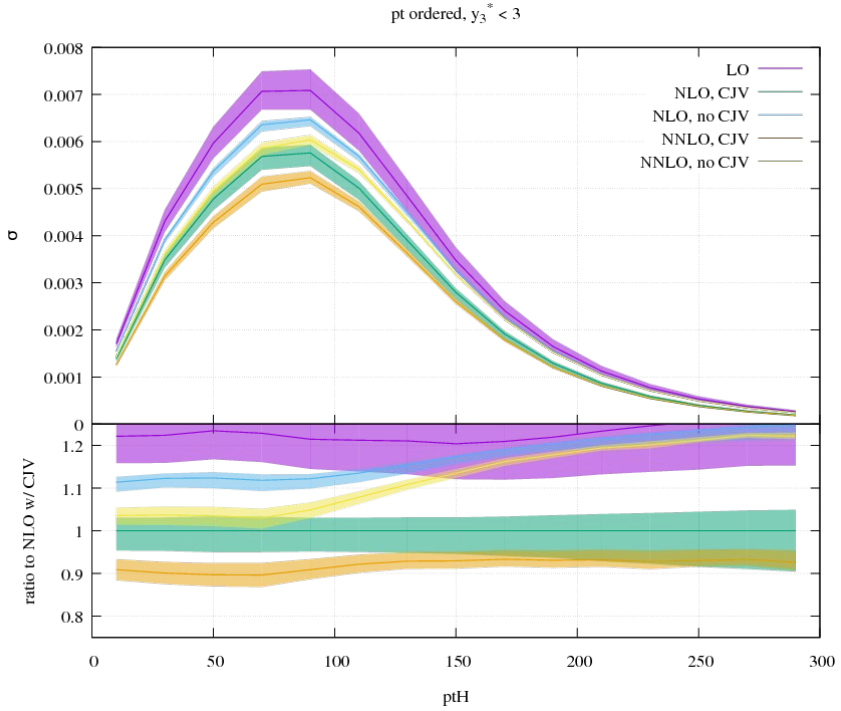
- Define the central jet by $p_{t,j3} > 20\ \mathrm{GeV}$ and either

$$y^*_{j3} = y_{j3} - \frac{1}{2}(y_{j1} + y_{j2}) < 3$$

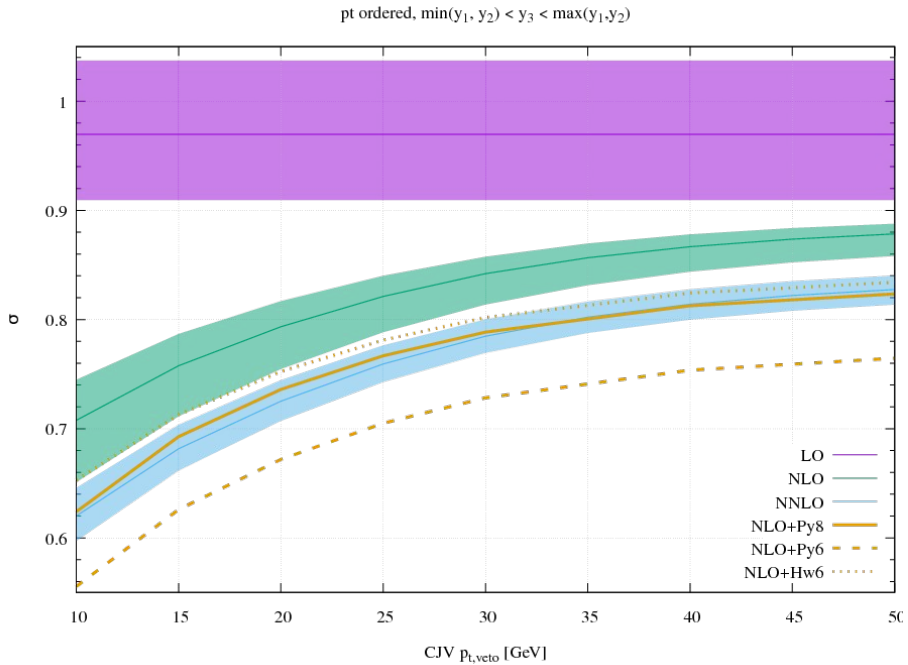
- or

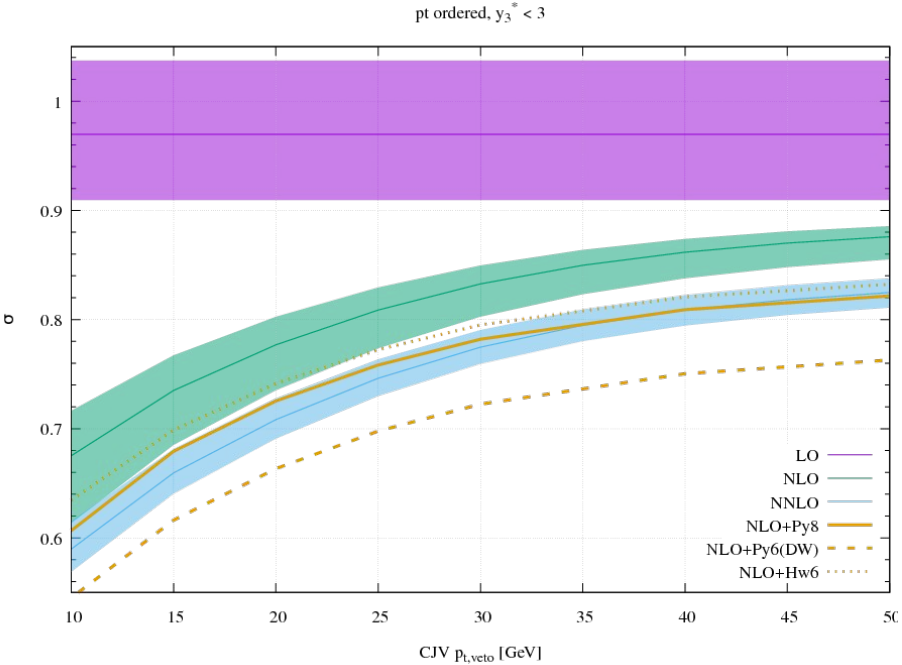
$$\min(y_{j1}, y_{j2}) < y_{j3} < \max(y_{j1}, y_{j2})$$



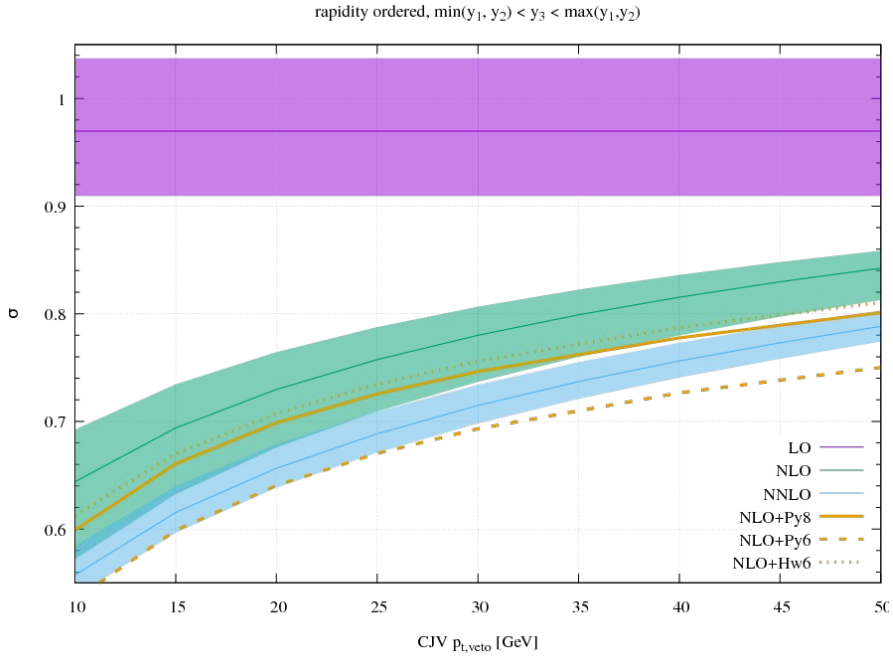


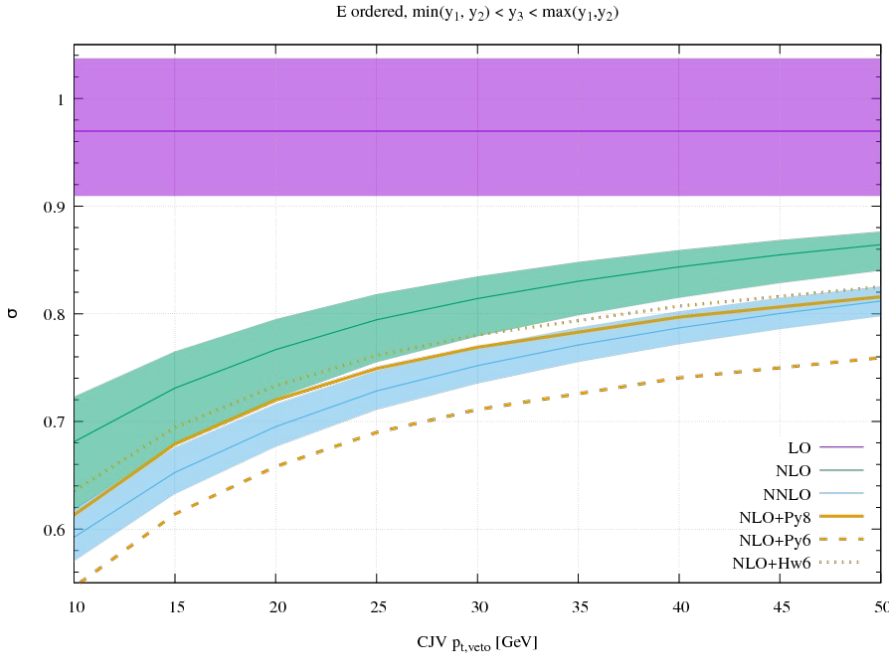
- The NNLO corrections tend to follow the same pattern as without the CJV - lower fiducial cross sections due to softer tagging jets.
- Corrections are in general of the same size as without the CJV (5-6% for fiducial xsec and up to 10-15% in certain kinematic regions)





- NLO result doesn't favour any of the three showers, but NNLO result seems to favour the pt-ordered shower over an angular or virtual ordering.





- When considering energy ordered and rapidity ordered jets, the story changes a bit, and the pt-ordered shower is no longer favoured

Discussion