WG1 VBF:
a quick overview

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Introduction

- e-group: lhc-higgs-vbf: please subscribe!
- A twiki page is available: https://twiki.cern.ch/twiki/bin/view/LHCPhysics/LHCHXSWGVBF

- Please welcome **Stephane** and **Mathieu** as the new VBF conveners

- Roadmap for the VBF group
  - Theory inputs needed by the LHC Higgs analyses
  - Focus on major studies to be released in short/middle-long timescale (up to 1 year)
  - We tried to gather a list of topics of interest
  - Additional suggestions are welcome!

Completed Topics

- Stage 1.2 Simplified Template Cross-Sections uncertainties:
  - VBF + V(qq)H uncertainties implemented in a standalone tool [here]
  - Acceptance and uncertainties estimated with full EW H+2j calculation
  - HAWK NLO EW correction available across the stage 1.2 bins (additional studies required)
- Jet multiplicities merging and parton shower accuracy:
  - Default recoil scheme nonphysical for VBF/VBS processes. Local recoil can currently only be used with POWHEG.
  - The uncertainties are typically below 10%, and are dominated by differences in normalisation rather than shapes for most observables
  - Studies published: *Eur.Phys.J.C* 80 (2020) 8, 756
- High Higgs pT
  - First measurements of the high-pT Higgs spectrum (above 0.5 TeV) are being published
  - Dedicated calculations to account for finite quark mass effects at higher orders in QCD and with additional jets are needed to be compared to data
  - Published in the HL-HLC yellow report and in ArXiv:2005.07762

Possible Future Directions (1)

- Gluon-Gluon Fusion background:
  - Modelling
    - Best ggH background estimated using NNLOPS (2nd jet LO)
    - Recent work from HEJ suggests the xsec is overestimated under VBF cuts
  - Uncertainties:
    - Large contamination of theory uncertainties from ggHjj in VBF phase-space
    - Higher order QCD corrections to Higgs boson production in association with jets in GGF are large
    - Higher multiplicities (>2 jets) need to be considered in order to reach a reasonable theoretical accuracy (check report from Gionata's)
  - Closer collaboration with GGF and VH WG1 is required
- Higher-order corrections:
  - While NNLO QCD and NLO EWK exist at fixed order, no prescriptions are available on how to apply them to events generated after parton shower and underlying event simulation.
- Higgs Spin/CP in VBF
  - The Higgs spin can be constrained by looking at VBF tagging jets
  - Preliminary studies available from LH2019 (ArXiv:2003.01700)

Possible Future Directions (2)

- Anomalous couplings:
  - Prescription on how to re-weight existing simulations to NNLO QCD and NLO EWK without affecting the simulation precision
- Different signatures
  - VBF H + gamma (probe of W/Z exchange, EW corrections)
  - Exploring new signatures
  - VBF vs. VBS (off/on-shell, EW corrections, Higgs width)
- Higher-order corrections and uncertainties
  - NLO QCD+EW for VBH + 1j
  - NLO QCD+EW matched to PS
  - Impact of soft QCD
- Your ideas!

Any questions? Comments?

If you have ideas or suggestions,
please speak out or contact us directly!