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Working group for VH calculations

Role of subgroup: conduit for theorists to get information to experiments (and vice-versa).

A road-map (to be updated) of the HXSWG-VH activities within the Higgs Cross Section WG1 can be found here

General information

- Convener mailing list (lhc-higgs-vh-convener@cernNOSPAMPLEASE.ch)
- Mailing list for discussions/meetings advertisement: lhc-higgs@cernNOSPAMPLEASE.ch (whole LHCHXSWG) or lhc-higgs-xsbr@cernNOSPAMPLEASE.ch (WG1)
- Indico meetings https://indico.cern.ch/category/5847/

Guidelines for state-of-the-art VH MC+PS predictions for experimental collaborations

- currently in use: Drell-Yan VH production, QCD@MiNLO, PowhegMiNLO +Pythia8; loop-induced ggZH production, QCD@LO, Powheg+Pythia8 [Higgs decay treated by Pythia8 parton-shower] MC+PS prediction 1-D reweighting to EW@NLO as f(pTV) from HAWK VH calculation
- higher-order in QCD: NNLOPS reweighting for Drell-Yan VH production, Hbb@NLO decay implemented in Powheg
- higher-order in EW: Powheg QCD+EW@MiNLO accuracy
- loop-induced ggZH: available tools for ggZH+1jet@LO (multi-leg setup), see below

Note: Powheg QCD+EW@MiNLO not easily reweight-able to NNLOPS accuracy. Two options: 1) NNLOPS prediction with ad-hoc reweighting to EW@NLO calculation, 2) Powheg QCD+EW@MiNLO without NNLOPS reweighting
Goal: investigate the effect of each possible improvement over the currently used setup, and provide general guidelines for experimental collaboration on which tools to use and how to combine them.
Deliverables: guidelines for experiments

Loop-induced gg->ZH

Cross-section theory predictions - possible improvements

- try to improve approximation (tension between effectiveness of HEFT and boosted region where gg contribution is large);
- can we exploit similarities with (very similar) gg >HH process of G. Heinrich et al;
- is there any mileage in a direct appeal to the Goldstone equivalence theorem (perhaps applies well enough in boosted region)?

MC+PS predictions - possible short-term improvements

- available gg->ZH MC tools for 0+1jet@LO multi-leg prediction from mg5_aMC@NLO and Sherpa
- benchmark 0+1jet@LO tools against current setup (Powheg@LO)

Goal: investigate differences in modeling for the main gg->ZH variables when using 0+1jet@LO multi-leg setup, and improvement in QCD perturbative uncertainties across the typical VH phase space
Deliverables: possibly public note from HXSWG, guidelines for experiments

Background discussion: Vector boson in association with heavy flavors production

- Desire within experiments for more guidance/sharing of experience with background generation and benchmarking in boosted region.
- General agreement that, while not the focus of this subgroup, we should help to facilitate such discussions.
- Host discussion / overview ATLAS vs CMS V+hf background comparison in the context of VH(bb) analysis

VH theoretical uncertainties under simplified template cross-section approach (STXS)

QCD perturbative uncertainties

- How should the calculation of uncertainties for VH be handled under simplified template cross-section approach (STXS), c.f. YR4.
- In particular, correlated uncertainties between jet bins either using Stewart/Tackmann or other similar approaches.
- Tools under discussion: PowhegMiNLO +Pythia8 MC+PS; hv@nnlo fixed order calculation

Deliverables: guidelines for the implementation of QCD perturbative uncertainties in the STXS VH stage-1.1 binning scheme; possibly softare tool for the implementation of uncertainties

EW prediction and uncertainties

- As a first step, estimate the EW@NLO correction for each bin of STXS VH stage-1.1
- As a second step, consider how to estimate EW@NLO uncertainties for the STXS VH stage-1.1

ATLAS / CMS comparisons and points of common discussion

- HXSWG-VH often hosts ATLAS / CMS discussion for the VH(bb) experimental results, so far corresponding to main experimental publications
    - https://indico.cern.ch/event/666958/
    - https://indico.cern.ch/event/770424/

Other material

VH page for YR4

- https://twiki.cern.ch/twiki/bin/view/LHCPhysics/LHCHXSWGVHYR4

useful links

- the old page of the VH+VBF working group can be found here
- the old page of the VH working group can be found here
- 13th HXSWG General Assembly: https://indico.cern.ch/event/595100/

- 14th HXSWG General Assembly: https://indico.cern.ch/event/665524/
- 15th HXSWG General Assembly: https://indico.cern.ch/event/740110/

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