THEORY UNCERTAINTIES UPDATE

OFFSHELL INTERPRETATIONS MEETING

LHCHXSWG OFFSHELL SUBGROUP

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Summary

- Focus of subgroup: theory uncertainty treatment for interfering and non-interfering backgrounds.

Modeling issues:
- Higher-order QCD corrections
- Jet binning
- Electroweak corrections
- Assigning theory uncertainty

“Higgs signal”

“Interfering background”

“Non-Interfering background”

(Interference at NLO.)
Meeting 19/04/2020

- First meeting on 19 April
- Presentations of current treatment of non-interfering background by ATLAS and CMS.

From ATLAS presentation.
Ongoing Work

• Careful study of event generation:
  – **Merging** using SHERPA and MEPS@NLO [ATLAS]
  – **Matching** PS+NLO using POWHEG [CMS]
• Building on preliminary study by ATLAS.
• Extending this to further understand generation and associated uncertainties:
  – *Merge with fewer jets?*
  – *Don’t reweight with NNLO?*
  – ...
• Still in **preliminary stages**, no results as yet.
Treatment of EW corrections

- **ATLAS**: NLO EW corrections as function of $m_{ZZ}$.
  [Biedermann, Denner, Dittmaier, Hofer, Jäger 1601.07787]

- **CMS**: virtual EW corrections as function of $\hat{s}$ and $t$.
  [Bierweiler, Kasprzik, Kühn 1305.5402; Gieseke, Kasprzik, Kühn 1401.3964]

**How to combine with QCD corrections?**

- Mixed NLO QCD-EW corrections very challenging theoretically.

- Combine (separate) QCD and EW corrections assuming that these factorize.

- How good is this assumption?

- How to estimate its associated uncertainty?
Treatment of EW corrections

Define parameter \( \rho = \left| \sum_i \vec{p}_{T,i} \right| / \sum_i |\vec{p}_{T,i}| \) \( i \): lepton from VV decay

[Bierweiler, Kasprzik, Kühn 1305.5402; Gieseke, Kasprzik, Kühn 1401.3964]

- \( \rho < 0.3 \): Factorization is well motivated.
  - ATLAS: No additional uncertainty
  - CMS: Uncertainty \( \delta_{EW} \times \delta_{NLOQCD} \)

- \( \rho > 0.3 \): Factorization is poorly motivated.
  - ATLAS: 100% systematic uncertainty
  - CMS: 100% of EW corrections as systematic uncertainty

Summary

- Ongoing work focusing on non-interfering background.
- Welcome more ideas and/or contributions.
- Latest updates on [Twiki link]
- Deadline for complete first version of documentation is 31 Oct 2020.

THANK YOU FOR YOUR ATTENTION!