

Off-shell simulation tools

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for the off-shell subgroup conveners

Off-shell simulation tools kick-off meeting
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Introduction

- Following discussions in the EFT interpretations and theory uncertainties subgroups, we would like to list a set of simulation tools available for use
 - Issues summarized in the second joint [meeting](#)
 - A key question is to assign reliable systematics on the unknowns just as much as being able to simulate the processes

- What do experimentalists use?
 - Current state-of-art corrections/tools and how they are applied (including those on the signal)
 - Do theorists have suggestions to improve these existing ingredients?

- SMEFT tools at tree and loop level for off-shell signal and background:
 - What is available now? What is needed for future studies?

- EFT fits compatibility between ATLAS and CMS:
 - Do we have tools to convert results and to validate different generators/sparameterization techniques?
 - What do we need for future studies?

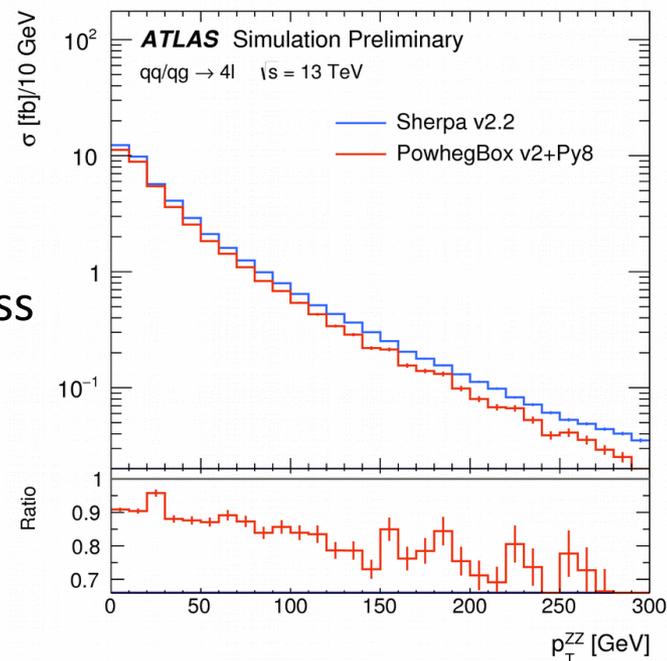
- Are tools for specific BSM extended with higher-dimensional operators needed?

- Can start listing them under the dedicated [twiki](#)
 - Also encourage active discussion on the e-group ☺

Modeling of the non-interfering backgrounds

- One of the main sources of uncertainty in the determination of off-shell signal strength is the uncertainty on the NLO EW correction on the VV backgrounds as presented in the first theory uncertainties [meeting](#)
 - It seems that the tool to use is MATRIX in this case
 - Since the experiments target 4ℓ and $2\ell 2\nu$ final states, WZ (or WW) are both as relevant as ZZ
 - Can the experiments / theorists share calculations if they already exist?

- Another aspect is QCD corrections on VV:
 - $\sim 10\%$ effects on $N_{jets} = 1$ at [NNLO](#)
 - A first comparison was shown in the theory uncertainties meeting
 - Volunteers for more studies are needed to assess systematics and corrections differentially



Modeling of the signals

- In gluon fusion, we have the usage of **SHERPA+OpenLoops** and **MCFM+JHUGen** dedicated simulations, or **POWHEG** simulation+reweighting procedures
 - A comparison of differential p_T^H, N_{jets} distributions would be useful to compare since gluon fusion is one of the key backgrounds to rarer processes like VBF
 - Need to understand differences in how K factors are applied and develop a common approach
 - How to integrate the EFT models?
- Similarly for VBF, we have the usage of **aMC@NLO**, **Phantom** and **MCFM+JHUGen** dedicated simulations, or **POWHEG** simulation+reweighting procedures
 - Need a comparison of the used techniques to understand the level of agreement between each other – and where they disagree to determine the level of systematics
 - The additional complexity in EFT models is to be able to simulate BSM couplings in two vertices vs one.
 - Comparisons between different approaches again important to understand BSM-specific systematics
- In SM, VH contribution is negligible, but in BSM, off-shell VH is enhanced to the same level as VBF [[1](#), [2](#)]
 - Note that from an experimental point of view, a categorization for VBF vs gluon fusion puts VH events most likely in a gluon fusion/untagged category. Therefore, this contribution would show up as enhancement in these categories, correlated with enhancements in the VBF category.
 - How can we include this effect reliably?

Last but not least: Reweighting tools for EFT

- The availability of reweighting tools is necessary to reinterpret existing simulation in the experiments
 - These simulations are generated with a certain set of couplings in mind, but if theorists express interest for specific couplings, we might want to apply reweighting on them.
 - Simulation usually take a lot of time to generate centrally within the experiments, so it is much easier to reweight existing ones if we know their input parameters.
- How readily available are these tools? Can we document a set of recipes to use easily?

Thank you!