

How to include EFT dependence in unfolding/background?

Laura Barranco Navarro (Stockholm University)

Peter Berta (DESY, Hamburg)

Kirill Skovpen (Ghent University)

- **Reinterpretation** of an inclusive measurement
- **Reinterpretation** of unfolded differential measurements
- **Measurement** at detector level with generator-based reweighting (“hybrid”)
- **Measurement** at detector level with full event simulation (“direct”)

- Reinterpretation → **No EFT effects** are considered within an experimental study, **neither for signal nor background**

- Measurement → Sensitivity of an experimental analysis is optimized (to some degree) as a function of potential EFT contributions → Possible to **include EFT effect in both signal and background**

- In the following slides:
 - recall what are these main experimental approaches
 - see what are the limitations and advantages when applied to an EFT study

Present

- Measured observables are **unfolded to parton or particle levels**
- Relevant backgrounds subtracted from observed distributions
- EFT sensitivity can be probed in the unfolded observables assuming **no EFT effects on background or unfolding**
- 👍 No re-analysis is needed to interpret results in any other theoretical model/framework
- 👍 Well-established procedure for preservation and combination of results among experiments (also beyond LHC)
- 👎 Sensitivity of an experimental study is not optimized for EFT
- 👎 Assume SM acceptance for EFT
- 👎 No simultaneous treatment of signal and background

ATLAS: [Phys. Lett. B 800 \(2019\) 135082](#), [ATLAS-CONF-2019-026](#)
CMS: [JHEP 08 \(2018\) 011](#), [JHEP 11 \(2019\) 082](#), [Phys. Rev. D 100 \(2019\) 072002](#)

Ideas for background/unfolding?

- Need to think about EFT before subtracting background and unfolding procedure!
 - Simulation of background events with EFT effects needed
 - Simulation of acceptance/migration matrix with EFT effects
 - Report the EFT effects on background in the publication
 - Do not subtract background - report fiducial measurements for several physics processes (e.g. measure $ttZ+tWZ+ttW+tZ$ diff cross section)

[Talk from Andy Buckley at the LHC EFT WG meeting](#)

Present

- Detector-level study of EFT effects based on EFT/SM **event reweighting** or **yield parameterisation** via inclusive cross sections at generator level
- 👍 Only needs event simulation at generator-level
- 👎 Assume SM acceptance for EFT
- 👎 Translation to detector level with additional acceptance corrections and associated uncertainties are needed
- 👎 Limited simultaneous treatment of signal and background
- 👎 **The preservation format needs to be defined**

ATLAS: [PRD 99 \(2019\) 072009](#)

CMS: [JHEP 03 \(2020\) 056](#), [Eur. Phys. J. C 79 \(2019\) 886](#)

Ideas for background/unfolding?

- EFT effects can be fully included in background processes, but only at generator level
- Need to properly assess all relevant correction factors when translating to detector-level predictions → Possible use of Fast Simulation?
- EFT-related systematics should be assessed for both signal and background (e.g. scale variations, dim-8, NLO/LO - possibly can be checked at the SM point)
- Preservation format needs to be worked out

Present

- A dedicated EFT **full event simulation** for both signal and background processes at detector level
- 👍 **Most complete experimental analysis** with a comprehensive treatment of EFT effects in signal and background processes
 - 👍 No SM assumption involved
 - 👍 Simultaneous EFT treatment of signal and background
 - 👍 Account for SM-EFT and EFT-EFT interference effects
 - 👍 Include correlations and interferences among different processes and final states
 - 👍 No unfolding involved
 - 👎 Extensive resources are needed for event generation of EFT samples (even if fully relying on MG reweighting)
 - 👎 **The preservation format needs to be defined**

Ideas for background/unfolding?

- Goes in the same spirit as EFT: include all relevant processes and final states in a fully optimized experimental study for EFT at detector level
- Comprehensive treatment of systematic uncertainties, interferences, etc.
- Need to carefully define the preservation format for such a complex analysis: statistical model, treatment of uncertainties, correlation matrix, etc. - No value of performing a complicated study if can't be used later in combination with other results!