

Off-shell simulation tools progress summary

U. Sarica
for the off-shell subgroup conveners

Synopsis

- Gitlab repository [section](#) for different contributors to document their material:
- A number of open questions have been under consideration since the last simulations meeting on [May 19](#):
 - Documentation of SMEFT tools (thanks to Eleni!)
 - Documentation of available translation tools, progress in NLO computations and future directions as well
 - Progress in generator and reweighting method comparisons
 - Off-shell parametrization through reweighting of high mass samples NLO in QCD is outlined in detail today
- Other, open questions from May:
 - Assessment of systematics for simulation needs further studies
 - Generator comparisons need more involvement

Documentation of tools for simulation

1 Guidelines

- discuss and agree recommendations regarding specific tools and how to use them in the experimental analyses with input from Subgroup Models/EFTs
- explore to what degree compatibility/translatability between ATLAS and CMS results is feasible

2 Road map

1. survey of tools currently used by ATLAS and CMS
2. survey of existing EFT and BSM tools reviews
3. discussion of status quo and future (tools and prescriptions), discussion of reweighting techniques/K-factor application and related uncertainties

3 Effective Field Theory calculations and tools

Thanks to Eleni for putting together documentation on SMEFT and related tools

- LO predictions through SMEFTsim with different coupling bases
- SMEFT@NLO for NLO QCD predictions
- Translation and fitting

Available tools currently tabulated

Simulation/calculation tools	
General-purpose Monte Carlo event generators	
MG5_AMC OPENLOOPS+SHERPA	https://launchpad.net/mg5amcnlo https://sherpa-team.gitlab.io https://openloops.hepforge.org
Feynrules/UFO	
DIM6TOP SMEFTSIM SMEFTatNLO	https://feynrules.irmp.ucl.ac.be/wiki/dim6top https://feynrules.irmp.ucl.ac.be/wiki/SMEFT http://feynrules.irmp.ucl.ac.be/wiki/SMEFTatNLO
Other programs	
MCFM+JHUGEN POWHEG HERWIG VBFNLO MATRIX HPAIR HiGLU SUSHI AMCSUSHI EHDECAY	https://mcfm.fnal.gov https://spin.pha.jhu.edu http://powhegbox.mib.infn.it https://herwig.hepforge.org https://www.itp.kit.edu/vbfno https://matrix.hepforge.org https://arxiv.org/abs/1912.00068 http://tiger.web.psi.ch/hpair http://tiger.web.psi.ch/higlu https://sushi.hepforge.org https://cp3.irmp.ucl.ac.be/projects/madgraph/wiki/aMCSushi https://www.itp.kit.edu/~maggie/EHDECAY
Operator basis construction, translation and validation tools	
ROSETTA DEFT WCXF DSIXTOOLS WILSON	https://rosetta.hepforge.org http://web.physics.ucsb.edu/~dwsuth/DEFT https://wxcf.github.io/ https://wxcf.github.io/codes.html https://dsixtools.github.io/ https://wilson-eft.github.io/
Fitting tools to obtain constraints on EFTs	
HEPFIT	https://hepfit.roma1.infn.it/

Table 1: Simulation and conversion tools.

Reweighting studies

- Outlines a reweighting procedure using high-mass resonance samples
- Demonstration of reweighting procedure in gluon fusion
 - Also include comparisons for SM scalar ($g_1=2$) vs pseudoscalar ($g_4=5.10$)
- Demonstration of reweighting procedure in VBF
- Comparison of VBS component between LO generation and reweighted NLO sim.
 - m_{ZZ} and p_T^{ZZ} are compared today
- Thanks for the inputs given by CMS experts and JHUGen developers:
 - High-mass NLO POWHEG+JHUGen signal simulation taken from CMS @ LHE level
 - LO re-weighting applied using JHUGen/MELA framework
 - LO off-shell LHE samples produced with JHUGen+MCFM framework

See next talk by Jerry Ling for the parametrization of off-shell through reweighting of high mass samples NLO in QCD

Thank you!

Deadline to complete first version of the documentation:
October 31