Common ATLAS/CMS ttbar Monte Carlo

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LHC Top Working Group Open Session - May 2018

Introduction

- Produce common ttbar Monte Carlo sample(s) with identical events that can be used between the two experiments
- Understand correlations in different phase-spaces and between systematics
- In case of tension in experimental results this mechanism allows us to understand in better detail the modelling inputs and their differences between experiments. (e.g. if we find tension in the top mass measurement)
- Start by comparing existing samples

Implementation

Sharing events can be done at various levels:

- Share settings only - Each experiment runs generation independently
  - Most susceptible to mistakes, small differences in setups/implementations may go unnoticed and cause hidden differences between samples
  - Most computationally intensive (everything done twice)
  - Statistically independent sets for each experiment
- Share LHE events - Each experiment runs showering separately
  - Still room for unnoticed differences in ME matching, showering and hadronization
  - Events are statistically correlated but not identical
- Share HepMC events - Identical events are used for detector simulation by both experiments
  - Can be assured of identical events both from settings and statistical perspectives

The Ideal Situation

Ideally all three implementations are in place and could be run from either experiment:

   I.e. Common settings could be run by either experiment independently,

   Experiments could shower common LHE files

   Experiments could simulate common events stored as HepMC data files

This allows the most flexibility for different scenarios. For example for many analyses using 'standard' MC setups the common events could be used directly, easing comparison between results and combinations. But for an analysis requiring non-standard settings (perhaps testing hadronization models or EFT couplings) common starting points could be used that would still facilitate future comparisons.

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The Road So Far

Before producing common samples we are working on comparing existing samples between the two experiments:

- Probably a useful exercise in its own right for understanding any differences between the two experiments
- Involves sharing and reproducing samples across the experiments - I.e. working out technical glitches in the comparison, and putting necessary infrastructure in place
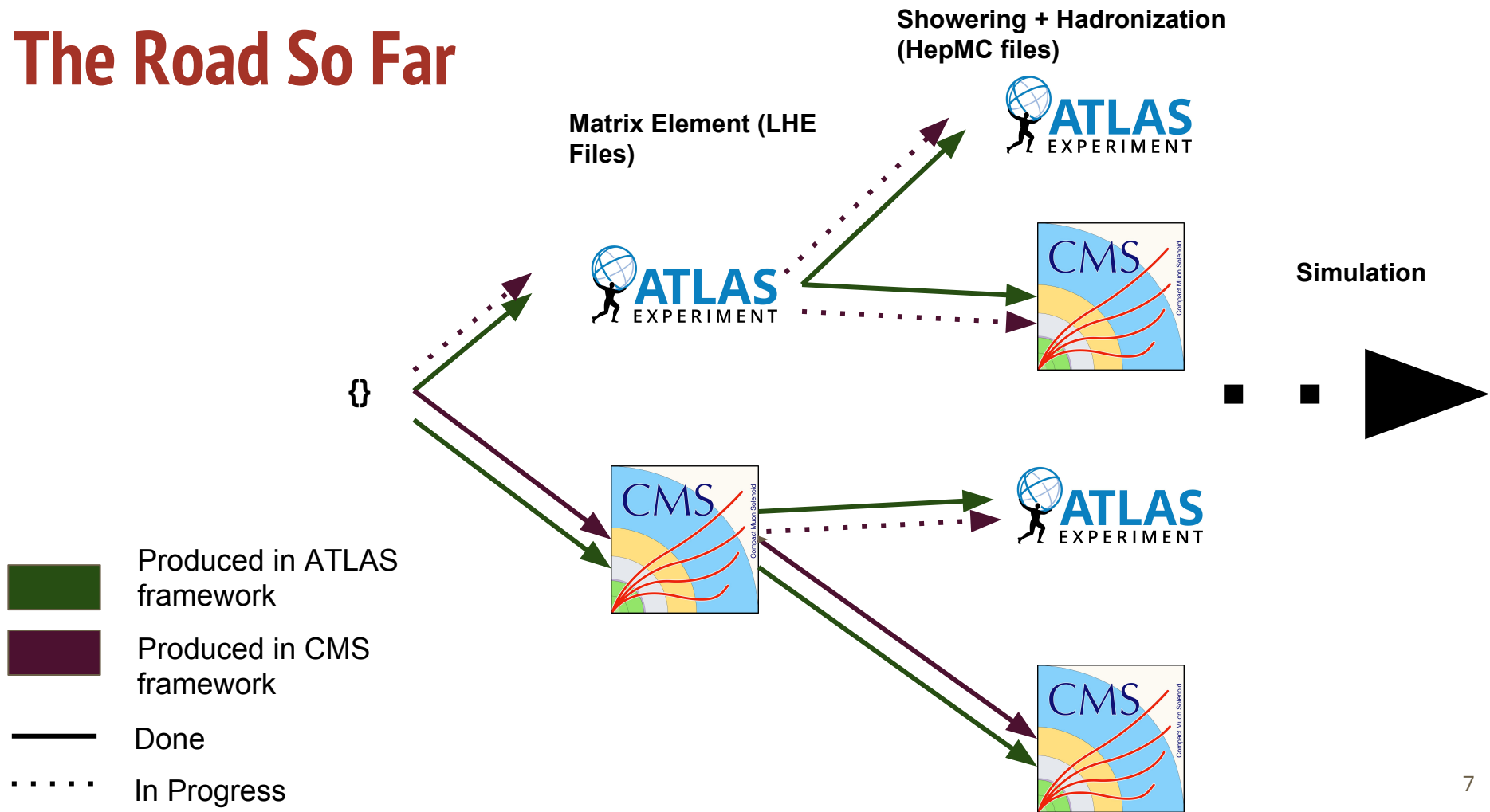- Initial focus on 'nominal' Powheg+Pythia8 setups,

The Road So Far

A number of similarities and differences between the experimental MC setups
were already known:

Powheg Settings	ATLAS	CMS
Top Mass [GeV]	172.5	172.5
Top Width [GeV]	1.31	1.32
W mass [GeV]	80.3999	80.4
W width [GeV]	2.085	2.141
h_{damp} [GeV]	258.75	237.875
Pythia Settings		
α_s (shower)	0.127	0.118
α_s (multi-parton interactions)	0.126	0.118

The Road So Far

Showering + Hadronization
(HepMC files)

Matrix Element (LHE
Files)

Simulation

Produced in ATLAS
framework

Produced in CMS
framework

Done

In Progress

The Road So Far

Successes in sharing LHE files and reproducing CMS results within ATLAS framework.

- Validatied CMS Powheg Settings within ATLAS using same random seeds and checking event by event agreement
- Validation of full CMS Powheg+Pythia setups run in ATLAS using rivet - shows agreement within statistical uncertainties for samples of 10M events
- Currently comparing ATLAS and CMS default settings as well as 'mix and match' settings using CMS Powheg + ATLAS Pythia and vice-versa.

The Road Ahead

Working on preparing a note to document the work and make results public

Analysis of differences in default setups on going, well underway

Event-by-Event validation of CMS Pythia settings in ATLAS using HepMC files

Validation of running ATLAS settings within CMS framework

Comparing systematic variations and alternative generator setups used by the experiments

Summary

Understanding differences in existing Monte Carlo samples between ATLAS and CMS and developing common samples shared between the experiments can help maximize our physics reach by understanding experimental results together and facilitating combinations.

Work is underway one performing the first sharing between samples and comparing ATLAS and CMS settings run between the two experiments. Plots and settings for these comparisons to be made public. Next time you can look forward to less text and more plots!