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Questions and requests for theorists

This page collects questions and requests to the theory community from the top groups of CMS and ATLAS. The questions are arranged according to the topic. This page is outdated as of January 2019 and some of these questions have already been addressed. The current treatment of generator setups and modeling uncertainties is documented in recent ATLAS and CMS papers.

- ♦ Contributors: many....

Generator setup and modelling systematic

- **POWHEG**: how can we evaluate intrinsic uncertainties associated with Powheg model? In particular:
  - ♦ scale variations up/down? Seems to be very small
  - ♦ choice of different functional form for the scale?
  - ♦ parameter suggested 14/12/11 - ratio of S to F events: is it available in the latest version as an external parameter? If not how to access it?
  - ♦ related to the latter point: studies mentioned above show effect on ttbar pT. Do we expect any effect from this variation for top pt?

- **MadGraph**: What is more correct: one variation of all scales (option 1) or three variations (opt 2)?
  - ♦ Option 1: one coherent variation used by CMS
    - ◊ scale up (4*Q^2)
    - ◊ scalefact = 2
    - ◊ alpsfact = 2
    - ◊ PARP(64) = 4.
    - ◊ PARP(72) = 0.125
    - ◊ scale down (Q^2/4)
    - ◊ scalefact = 0.5
    - ◊ alpsfact = 0.5
    - ◊ PARP(64) = 0.25
    - ◊ PARP(72) = 0.5
  - ♦ Option 2: 3 independent variations (used in ttV analysis in Atlas)
    - ◊ scalefact up/down (scalefact = 2/scalefact = 0.5)
    - ◊ alpsfact: (effectively varies ISR)
    - ◊ Up:
    - ◊ alpsfact = 2
    - ◊ PARP(64) = 4.
    - ◊ Down:
    - ◊ alpsfact = 0.5
    - ◊ PARP(64) = 0.25
    - ◊ FSR
    - ◊ More:
    - ◊ PARP(72)=0.7905, PARJ(82)=0.5
    - ◊ Less:
    - ◊ PARP(72)=0.2635", "PARJ(82)=1.66

- **NLO MCs**: What are the prospects for getting an improved understanding of the uncertainty in the treatment of ME-PS matching? What are the prospects at NLO for ttbar+jet and in the top decay?
    - aMC@NLO : since there is not yet possibility for extra parton generation "a la MadGraph" in aMC@NLO, is there any difference w.r.t. the MC@NLO generator ?
    - Why do Powheg+PYTHIA and MC@NLO+HERWIG give so much different results in describing the jet multiplicity?
    - What is the TH uncertainty that we test when comparing Powheg+PYTHIA and MC@NLO+HERWIG? Can we disentangle the PS part in this comparison?
    - Why are Powheg and MC@NLO not predicting same spin correlations ?

- **aMC@NLO**: What is the status of scale uncertainties via weights in aMC@NLO ? Is this ready to be used by the collaborations ?

- * When looking at initial states at parton level, the fractions of q-qbar, g-g and q(bar)-g depend on the order of the calculation. At NLO, the contribution from q(bar)-g to the total cross section is very small and even negative. How are NLO generators dealing with the negative fraction of q(bar)-g (which are obviously not physical) and what are the meaning of the initial states in generated events ? Is it meaningful to look at the origin of ttbar events in NLO generators? Related to this, how are negative fractions handled when interfaced to NLO PDFs?

Top mass

- **Color-reconnection effects** : Is it possible to develop a Model(s) or define a region in parameter space that would allow us to quantify our sensitivity to these effects more precisely than with switching them on and off?

- **Fragmentation**: We need a method for thorough validation and the potential re-adjustment of the b-fragmentation functions for the LHC phase space and with the latest MC.

- **Mass definitions**: Relation between pole and MSbar mass at 4-loop, to prove convergence and reduce ambiguity on pole mass
    - Further clarifications on the effect of EW corrections to the relation between pole and MSbar masses
    - Improved understanding of the relationship between the pole and MC mass, as used in current mass analyses and quantification of the associated uncertainty.

Differential distributions

- **NNLO**: We would like predictions to full NNLO of pT(top), m(l,b)
- Among all MC generators tested so far (including Powheg+Pythia and MC@NLO+Herwig), Powheg+Herwig gives the best decription of the ttbar differential cross section data. In particular, it describes the shape of the pt(top) distribution well over the whole measured

range. This is true for both CMS and ATLAS. What is the relevant difference to other generators where the pt(top) distribution is different? Can we adjust other generators, in particular Madgraph, such that a similarly good description is achieved ?

Top pair cross section

Single top

- Shall we marginalize or not the theory uncertainties? In some analyses the variation of simulation shapes/rates due to some theory uncertainties significantly different from data, indicating a possible overestimate of those uncertainties. This occurs mainly with renormalization and factorization scale varied between 0.5x and 2x the nominal value. One way to treat this in data is to constrain these scale from data, which would result in significantly smaller uncertainties than the usual 0.5x/2x recipe. This practice, however, is sometimes consider too aggressive. Is there any recommendation from the theory side on how to take into account properly the scale variation uncertainty, in cases when data show that the usual 0.5x/2x range corresponds to more than a 68% coverage? This question holds for the constraining of TH uncertainties on signal and background (typically ttbar)

- Connected to the previous one: how could we constrain PS for single-top event using data (as was done for ttbar in the gap fraction analysis) ? Is there a relevant observable that could be probed ?

- How well can we trust the ALPGEN heavy flavor in the 1 jet bin? As we use the 4 flavor scheme we have a separate Wc sample, but no separate Wb sample. In principle our Wbb sample should take care of (some) Wb production. How good is this prediction - or - can they propose a procedure to estimate this uncertainty?

- Recommendation for generator uncertainties when using aMC@NLO, 4FS. Which uncertainties should be considered within the generator, for ISR/FSR and comparing to matched 2->2/2->3 generators

- When should/can we give up the separation of Wt and ttbar? In other words, what is the status of inclusive WWbb calculation and MC?

- **t-channel signal modeling**:
  - We do know that the 4FS is supposed to reduce the fact./renormalization scales dependence on the 2nd b-jet kinematic observables, besides giving us the effect of adding a mass for the b-quark. Is this the case for other objects distributions in our high-momentum regimes? In other words : can we have the distributions of top/light jet pt and eta with the envelope of fact./renormalization scales and pdfs, preferably in a regime that is similar to the one of our analyses (e.g. 2-3 jets with pt > 40)?
  - In general: is it sufficient/correct to quote fact./renorm.

scales and pdf as theoretical uncertainties on the 4FS t-channel?
- aMC@NLO: What are the prospects to have t-channel + jets? Will there be special recommendations to generate this process, also in the light of tH, predictions for t-channel+b (bbar)?
- TopFit: it would be important to extend this program towards taking correlations between measurements properly into account
- Would be nice to have a similar program for FCNC anomalous couplings as for Wtb anomalous couplings
- What are the suggested differential TH calculations (with acceptance definitions) that experimentalists should superimpose to unfolded differential distributions from data?

- **tW-channel signal modeling**:
  - What is the status of tW in aMC@NLO/other NLO generators? Is it possible to implement the DR/DS scheme?

draft update after May 2014 TOP LHC WG ws

-- RobertoChierici - 07 Nov 2013

This topic: LHCPhysics > QuestionsToTheorists
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