Suggestions for further measurements and combinations of theoretical interest

LHC Top WG mtg
July 19 2012

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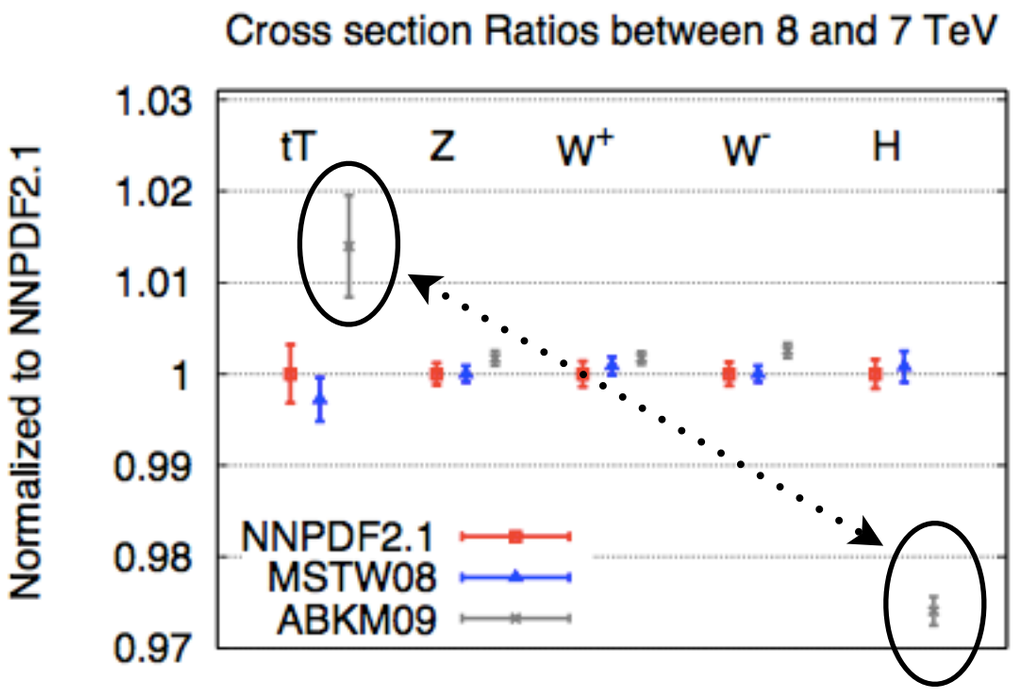
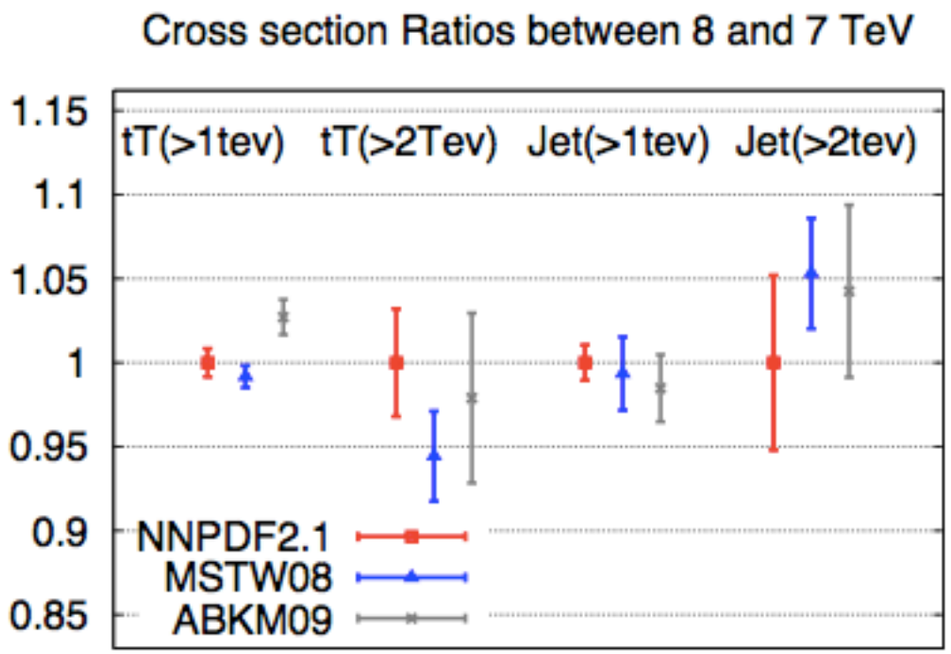
7 TeV/ 8 TeV cross section ratios

MLM & Rojo, arXiv:1206.3557

- Strongly reduced theoretical systematics from scale dependence and higher orders
- Typically strongly reduced PDF dependence, but opportunity to add strong constraints to fits
- Fully correlated theory uncertainties in the exptl measurement (ISR/FSR, hadronization, scale, etc)
- N.B.: can use ratios of double ratios ($\sigma(tt)/\sigma(Z)[8\,TeV] / \sigma(tt)/\sigma(Z)[7\,TeV]$) to remove $\delta_{syst}(Lum)$





More extensive characterization of the more detailed properties of t-tbar final states

- Validate in more detail the MC description of top decay and hadronization. E.g. study:
  - b-jet fragmentation properties (e.g B and light hadron frag functions, track multiplicities, etc.). Compare t-tbar and single-t results (should be the same, up to CR-related effects)
  - out-of-cone radiation:
    - jet shapes,
    - jet properties vs jet-cone size
    - track multiplicities in the intra-jet and beam-jet regions
  - see other remarks in the morning mtop discussion session
- Validation of "ISR":
  - more studies along the lines of ATLAS "no-jet-fraction" measurement
  - pt(t-tbar)
  - eta(Jet_1), and a function of pt(Jet_1), (Jet_1 = leading jet not-from-top) => major difference observed between MCs
  - cross section measurements for tt + N-jets

Further obvious distributions

- M(tt)
- Asymmetry
- pt(top)
- Production correlations
- ΔΦ(tt), ΔΦ(ll), M(ll), ...

General remarks

- Complete documentation on impact of theory systematics: which observables gets **directly** affected by which parameter change?
- Use measured mtop as reference value to quote cross section measurements
- Measure fiducial cross sections, in addition to cross sections corrected to the whole phase-space (e.g. total cross section)

Proposals for the definition of top quark in differential distributions

Discussed at the March 12 top WG mtg

- Result of discussions among
  - K.Hamilton, M.Mangano, A.Mitov, P.Nason, G.Perez, G.Salam, P.Skands, J.Winter

General remarks

- We tried to define a general "framework" for the reconstruction of a top at the particle level, which should apply to a large class of differential measurements
    - Specific analyses may require different prescriptions, or will benefit from optimized versions of the prescription
- We assume that each top analysis starts from an event selection defined by conditions on a set of **objects**, namely: leptons, neutrinos, jets, b-jets
- We assume that these objets are reconstructed and corrected at the particle level (detector corrected)
- We assume that the determination of the background, and its subtraction, is part of the experimental analysis (namely the results will be distributions for top final states).

Event selection. E.g.:

- ≧4 jets with $|\eta| < \eta_{max}$ and $E_T < E_{Tmin}$
- 2 of these jets are b-tagged
- lepton and MET passing some cuts

"Event objects"

Definition of *pseudo*-top (t_P):

- Introduce a function of the event objects, ***F(j,l,b,ν)***, whose result is a mapping of those objects into the top and tbar pair. E.g.

$$t_P = W_{jj} + b_1$$
$$\overline{t_P} = W_{l\nu} + b_2 + jet_5$$

F(j,l,b,ν) *should be formulable as a "RIVET" routine, to act on MC-generated final states. Its defintion could include "fiducial-like" requirements, such as:*

- a cut on $m(t_P)$
- cuts on $y(t_P)$, $p_T(t_P)$, etc
- cuts on global "top-likelihood", to optimize the relation between truth-level top and pseudo-top

Definition of *parton-level*-top (t_{PL}):

The distributions of t_{PL} are used to compare against parton-level top spectra calculated in fixed-order perturbation theory ((N)NLO).

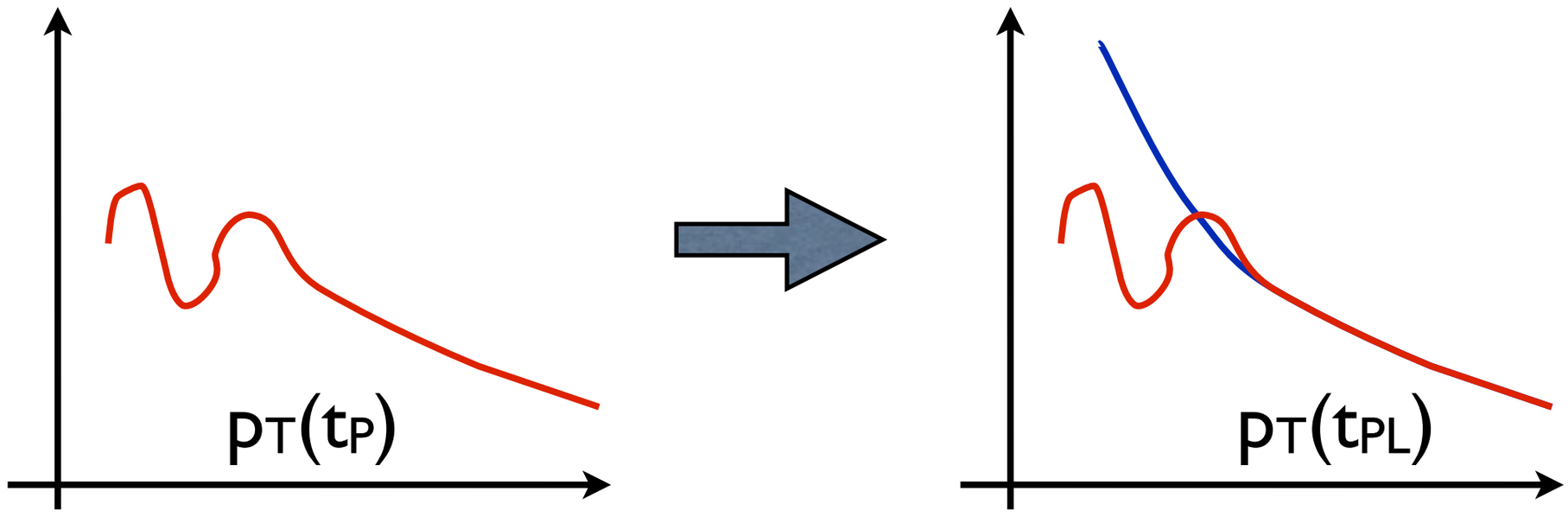
- a MC should be used to correct the distributions from t_P to t_{PL}

- t_{PL} is the MC top, at the end of the perturbative shower, and before its decay (the shower cutoff should be defined)

- the definition of t_P (namely the function *F(j,l,b,ν))*, may be optimized so as to:

  - minimize the MC systematics for the correction $\sigma(t_P) \rightarrow \sigma(t_{PL})$

  - minimize the effect of unfolding of the cuts that defined the *event object*



- The transition *event objects* → t_{PL} can be done as a convolution *(event objects)* → t_P → t_{PL} , or as a single step *(event objects)* → t_{PL}