TOP – QCD – brainstorming discussion

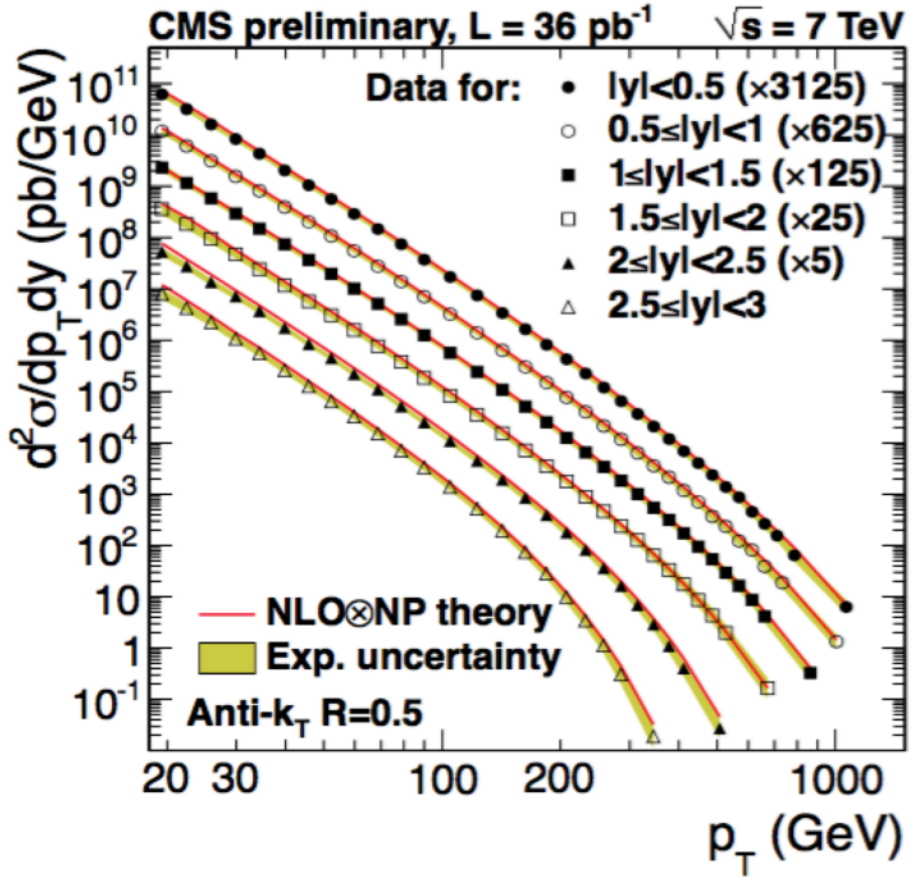
- exchange of ideas for measurements in run2
- exchange of expertise and knowledge
-

TOP – QCD – brainstorming discussion

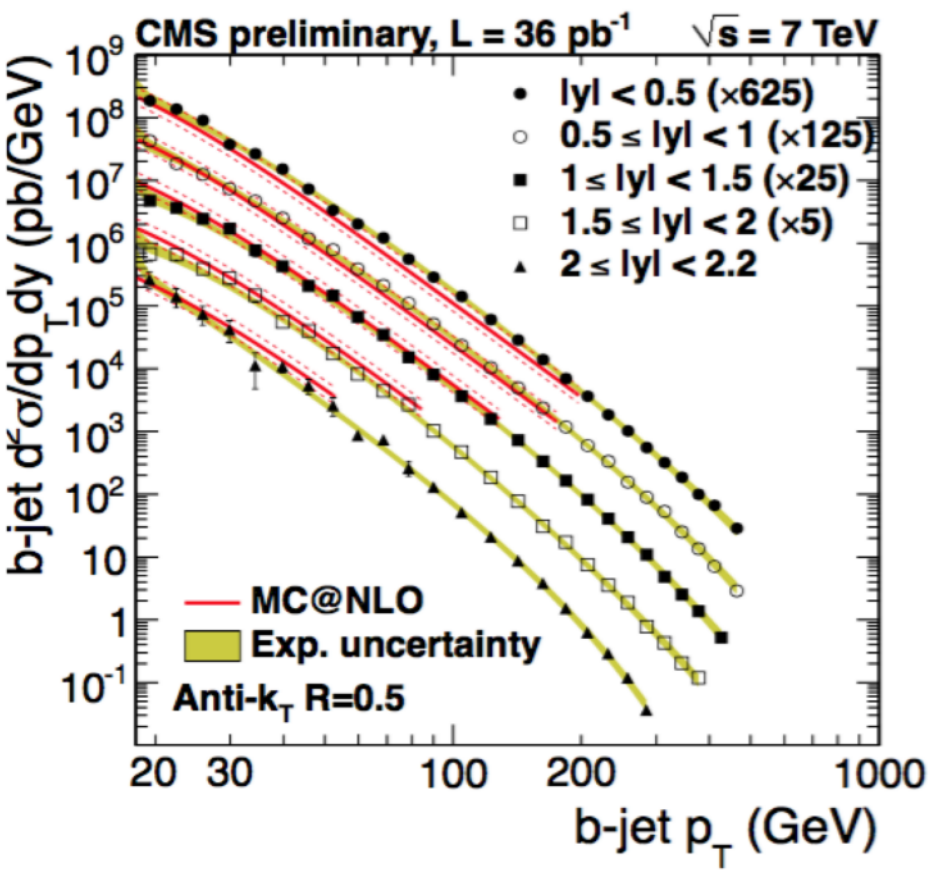
- Top is a beautiful trigger for QCD studies
  - standard analyses: collinear PDFs, α_s
  - But it can be much more:
    - with large m_{top} study multi-scale processes
      - m_{top} , m_{tt}, $p_\perp$
- study light and heavy flavor production
  - inclusive jet cross section as function of $p_\perp$ and y

Inclusive and B-jets in run 1

AN-2011/279

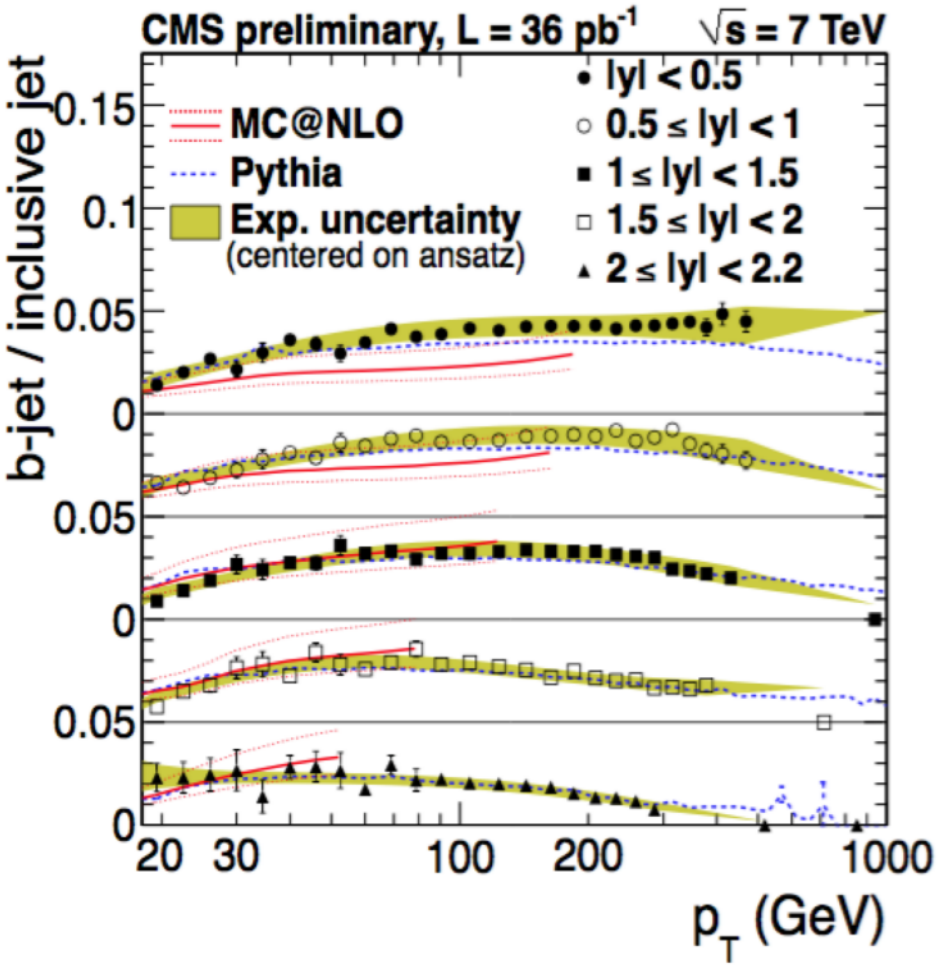


Inclusive jets



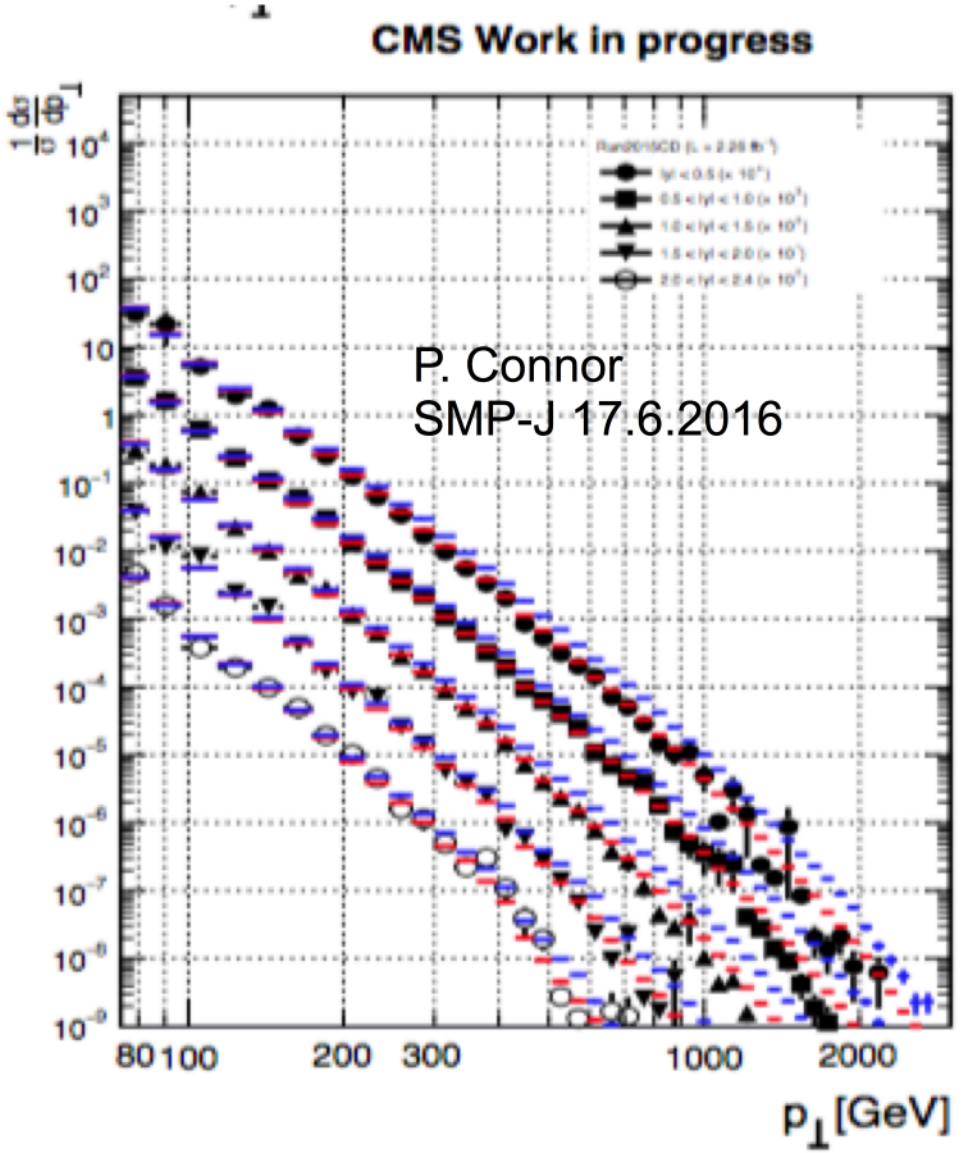
Inclusive B-jets

Inclusive and B-jets in run 1



- Bjet jet 2- 5 % of incl jets
  - simple flavor counting would give 1/6 (including gluon), but production is more complicated !
  - LO generator describes ratio pretty well

Inclusive and B-jets in run 2



- Bjet jet 2- 5 % of incl jets
  - simple flavor counting would give 1/6 (including gluon), but production is more complicated !
  - LO generator describes ratio pretty well
- B-jet measurement performed at 13 TeV up to highest pt (Patrick)
  - in same range as inclusive jets
  - reaching $p_\perp > 2$ TeV
- Do similar thing with T-jets
  - at large pt B-jet and T-jet expected to be similar
  - QCD is flavor blind !

Top x-section

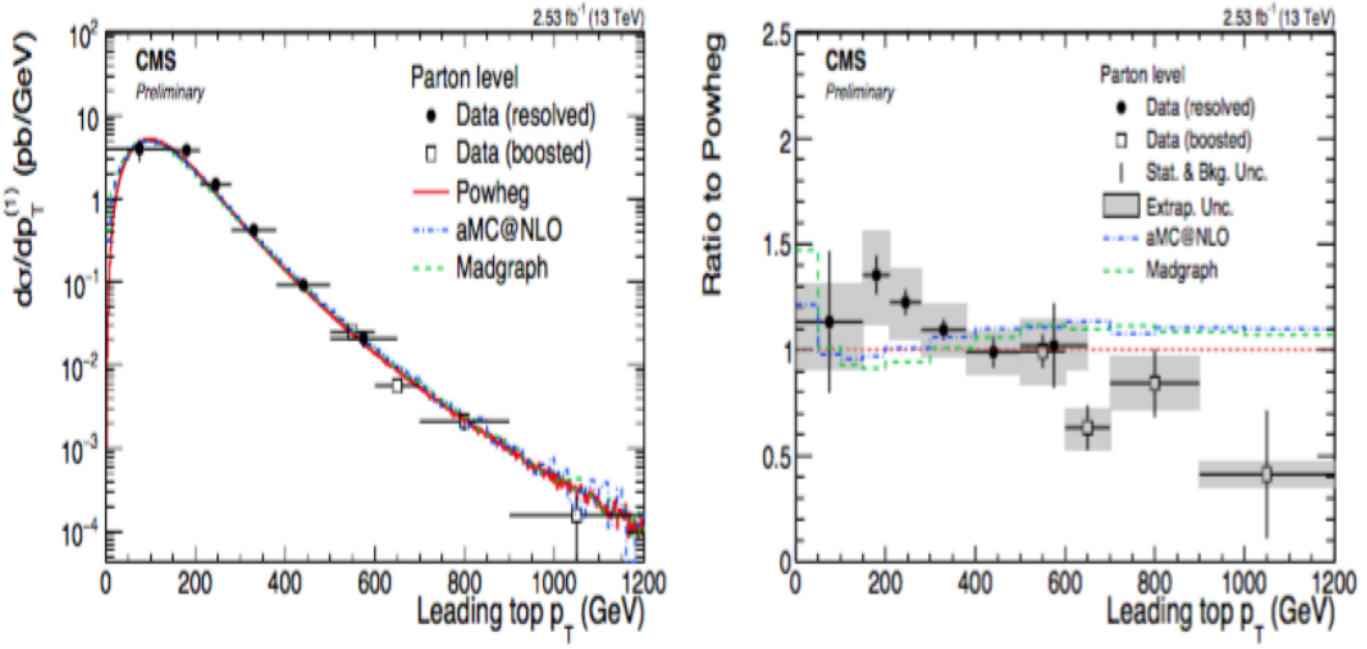


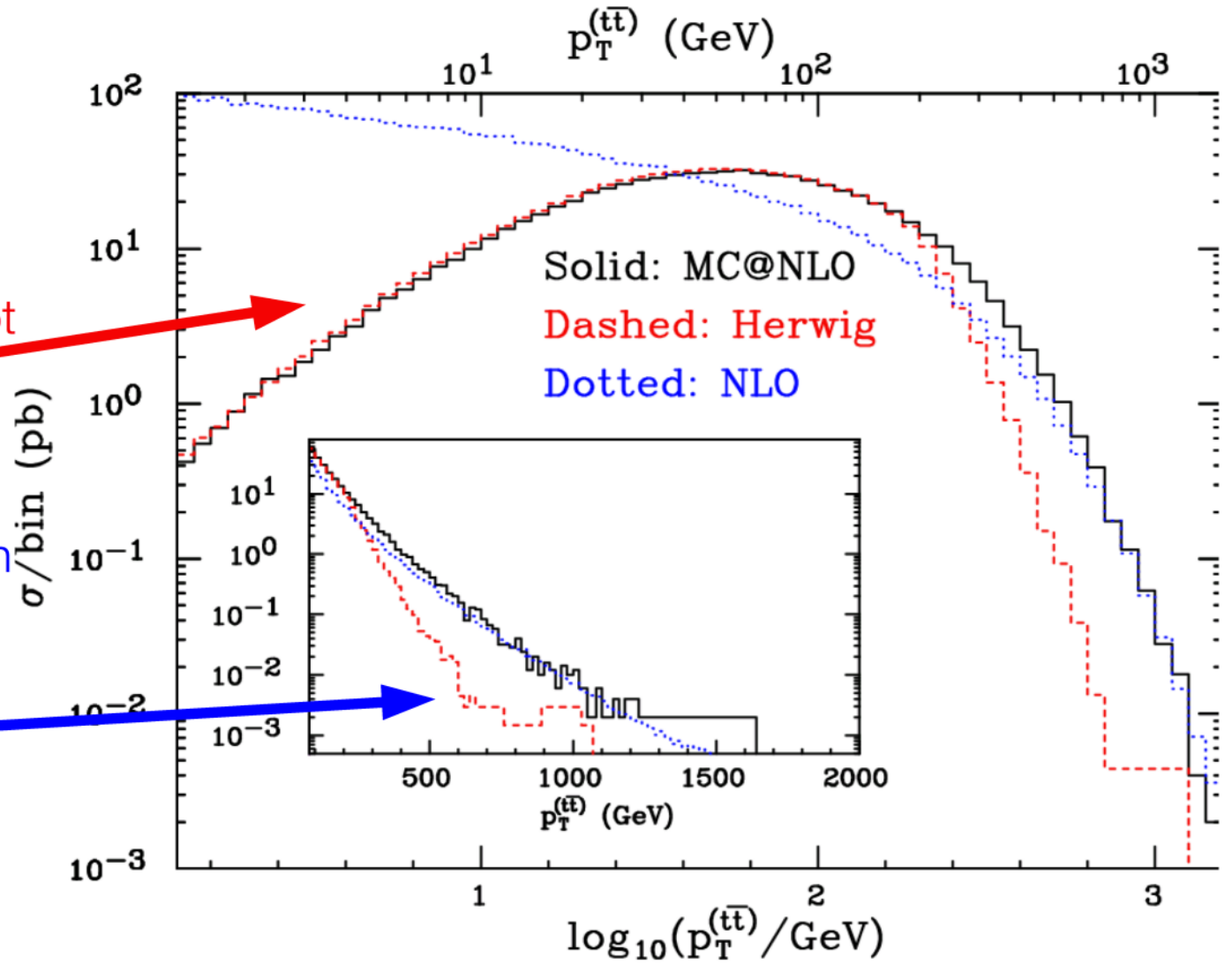
Figure 9: Left: Unfolded differential cross section, extrapolated to the full phase space, as a function of the leading top quark p_T. Right: Ratio of the unfolded differential cross section, extrapolated to the full phase space, over the POWHEG + PYTHIA8 prediction.

- Interesting to have top x-section up to 1 TeV in pt
  - inclusive top-jet x-section, like inclusive jets, B-jets, T-jets ?
  - in same binning as inclusive jets

Small pt in top-anti-top production

Frixione et al, hep-ph/035252

- Compare fixed NLO calculation of top production with resummed calculation from Monte Carlo
- Similar effects at small pt are observed: Suppression of xsection at small pt
- At large pt, resummation is too small, NLO is better



Special interest in high $p_\perp$ -jet production

- Issues in factorization in $pp \to j_1 + j_2 + X$ in back-to-back region J. Collins, J.W. Qiu h
  - very interesting: highest $p_\perp$
  -

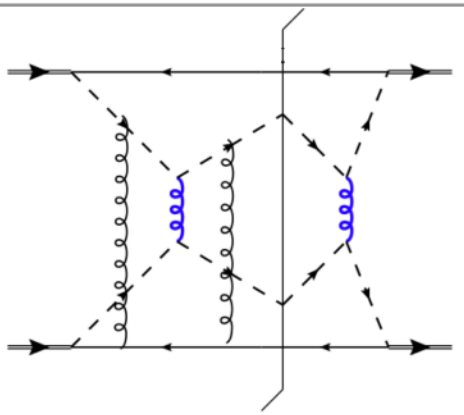
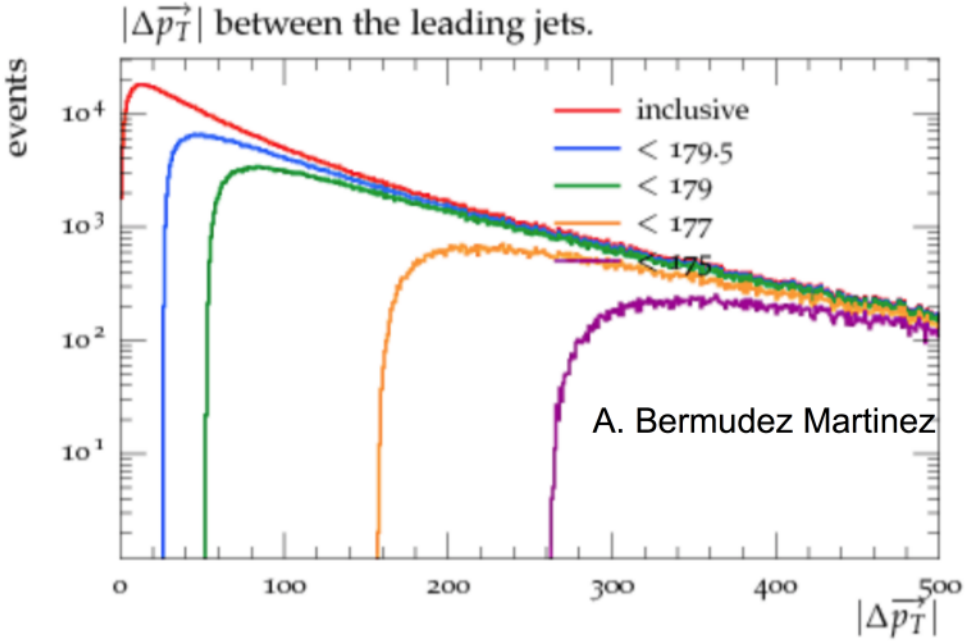
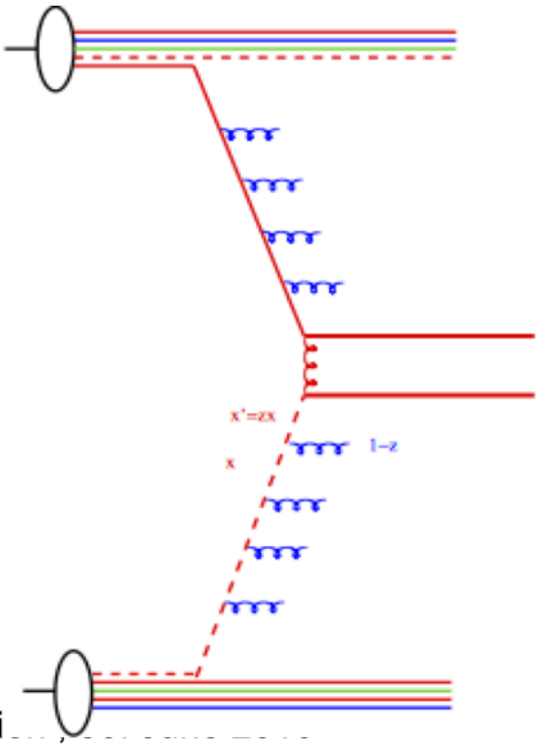


FIG. 8 (color online). The exchange of two extra gluons, as in this graph, will tend to give nonfactorization in unpolarized cross sections.





Hannes Jung, Paolo Gunnellini, Benoit Roland TOP-QCD brain storming discussi

Special interest in top production

- Similar features in $pp \to t + t + X$

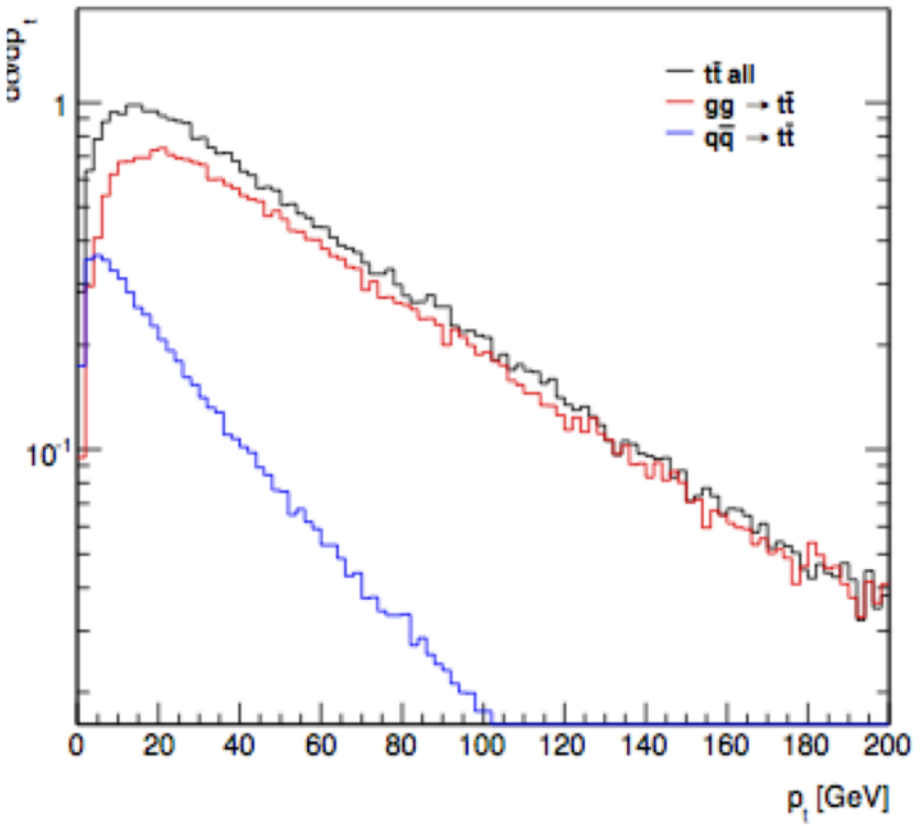
  S. Catani, M. Grazzini, and A. Torre. T ransverse-momentum resummation for heavy-quark hadroproduction. arXiv 1408.4564

  - how well can ttbar $p_\perp$ measured ?
  - how well can ttbar $\Delta\,\phi$ measured ?
- of special interest is:
  - $\Delta\, p_\perp / M_{tt} \ll 1$

    a region, where resummation to all orders is needed, because of the very different scales involved.

    And:
  - $\Delta\, p_\perp / M_{tt} \sim 1$

    a region where fixed order calc is appropriate.



Special interest in top production

From S. Catani

The wording "factorisation breaking" is used with many different meanings in the current literature, so I prefer not to use it.
I prefer to think of the Delta pt region where one can look for interesting effects (effects that go beyond the expectation of a customary NLO or NNLO computation).

As for top jets, the interesting region (from my viewpoint)
is small "Delta pt/pt_hard"
(actually I would say small "Delta pt/M_{t tbar}"), which is the region that you can investigate with high pt top jets and small Delta phi.
In that region, relevant observables to look at are: Delta pt, Delta phi, and even more interesting the difference between the azimuthal angle of the top and the azimuthal angle of ttbar pair (i.e. the azimuthal angle difference between pt_hard and Delta pt).
Of course, if one is really interested in effects of non-pertubative origin the region Delta pt \sim Lambda_QCD is certainly much more sensitive.

Issues for discussion

- Hadron level definition of Top-jet ?
  - avoid all complications with m_{top}
  - avoid all corrections to parton level
  - using of Top-Jet tagger (similar to B-tag) ?

- Which channel gives best resolution ?

- Interest from TOP in QCD studies ?
  - common activity of QCD-TOP ?

Issues for discussion

- Technical issues: ntuples etc