Jet Multiplicity In ttbar Events: Discussion of MadGraph Scale Variations

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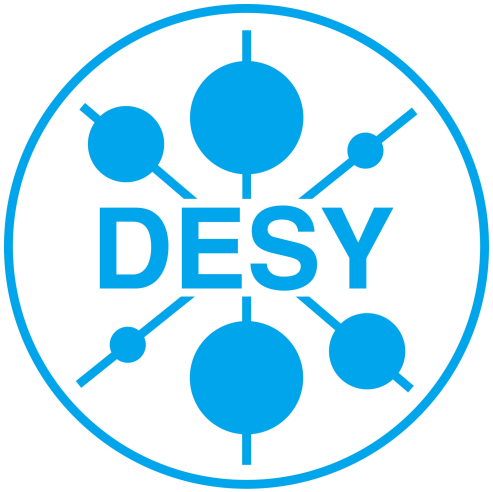
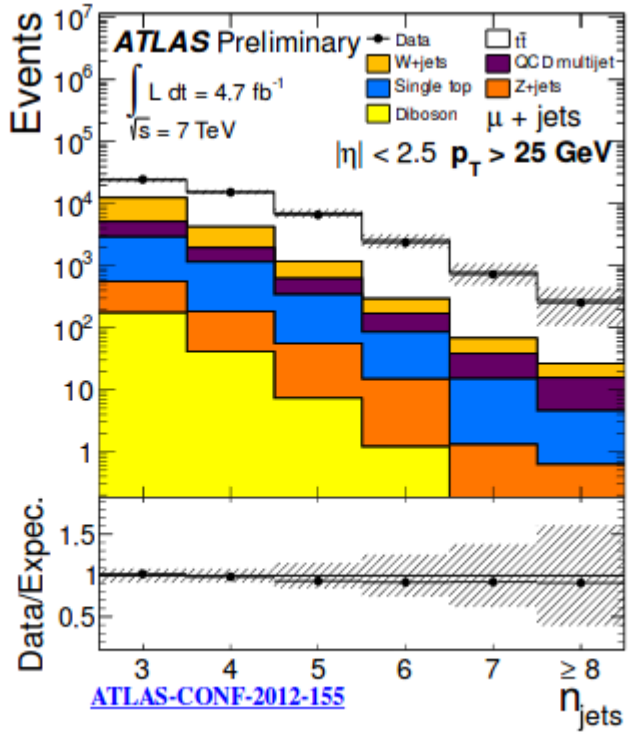


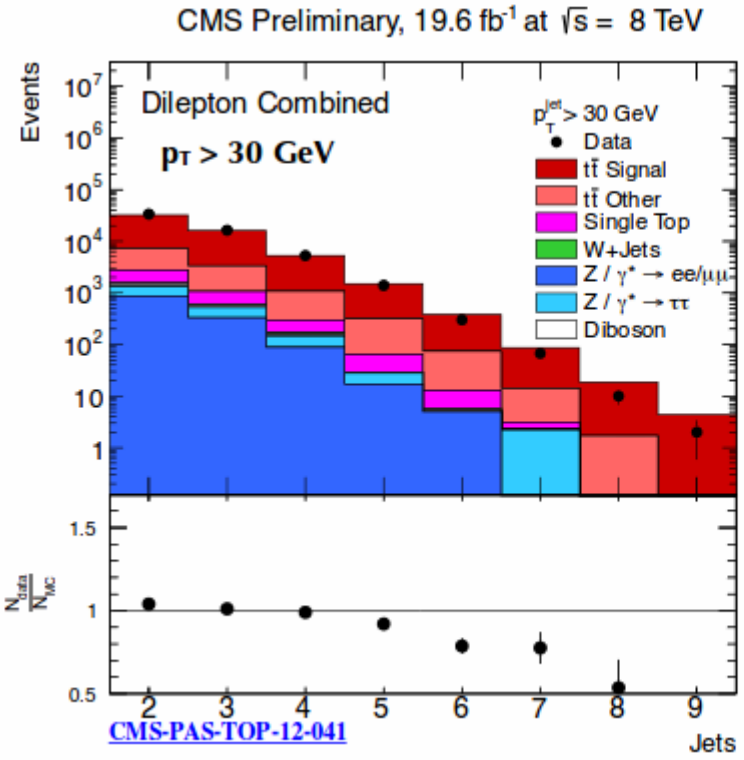
Introduction

- Discussion triggered by S. Sevilla's talk at QCD@LHC
- Description of jet multiplicity in ttbar events with different QCD predictions
- Comparison between Atlas and CMS results:
  - Atlas: Alpgen (varied α_s)
  - CMS: MadGraph (varied Q2 scale, jet-parton matching threshold)

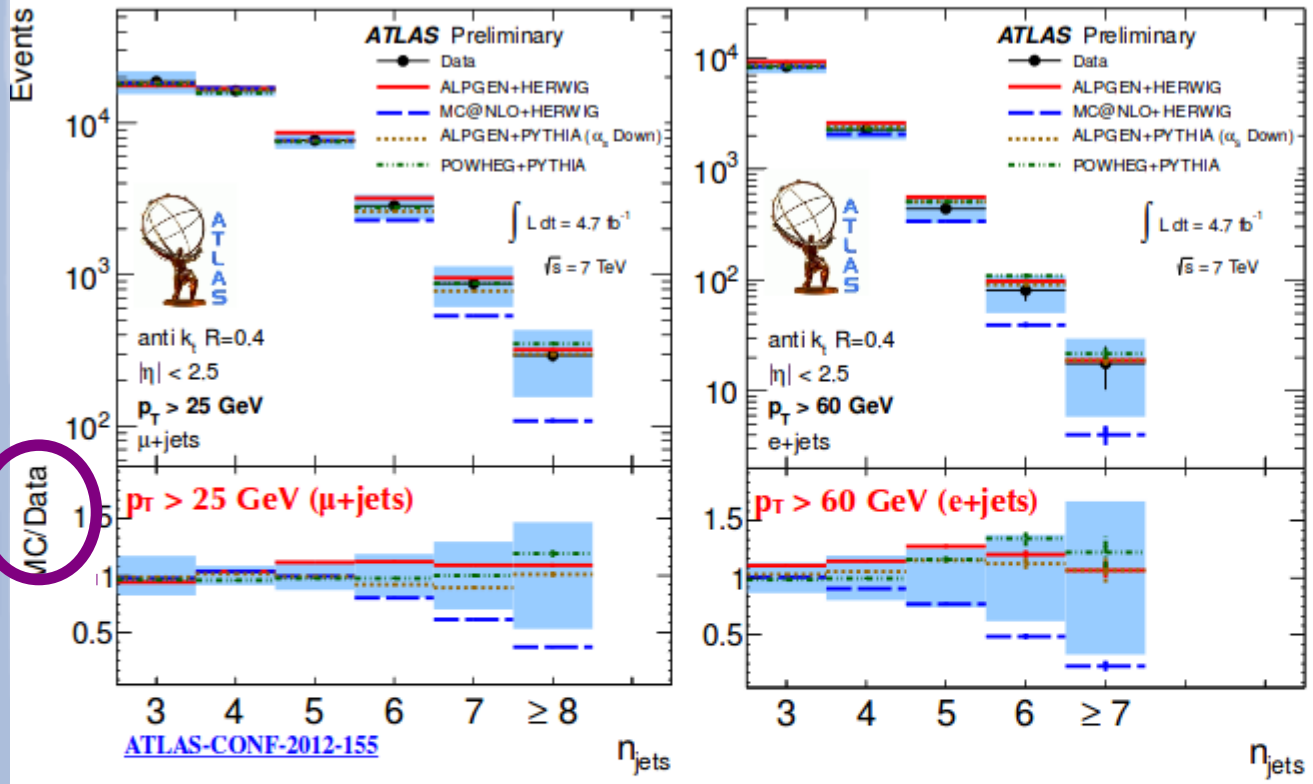
Jet multiplicity in tt events (1/2)

- Measurement of tt production with additional jets as a function of jet p_T
  - constrain ISR/FSR models at the scale of m_t
  - test of perturbative QCD in the LHC energy regime
  - multijet processes as background for many searches BSM
- LHC measurements (unfolded to particle level)
  - ATLAS: semileptonic & dilepton channels (7 TeV, 4.7fb^{-1})
  - CMS: semilep. (7 TeV, 5.0 fb^{-1}) & dilepton channels (8 TeV, 19.6 fb^{-1})





Jet multiplicity in tt events (2/2)



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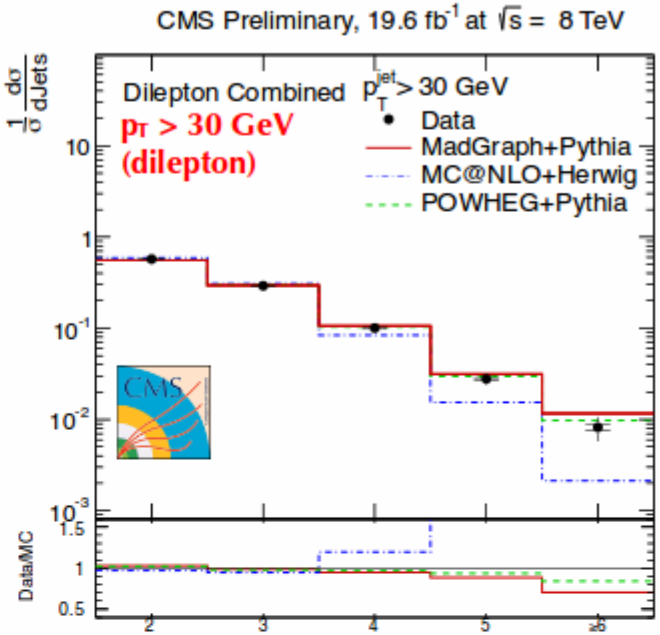
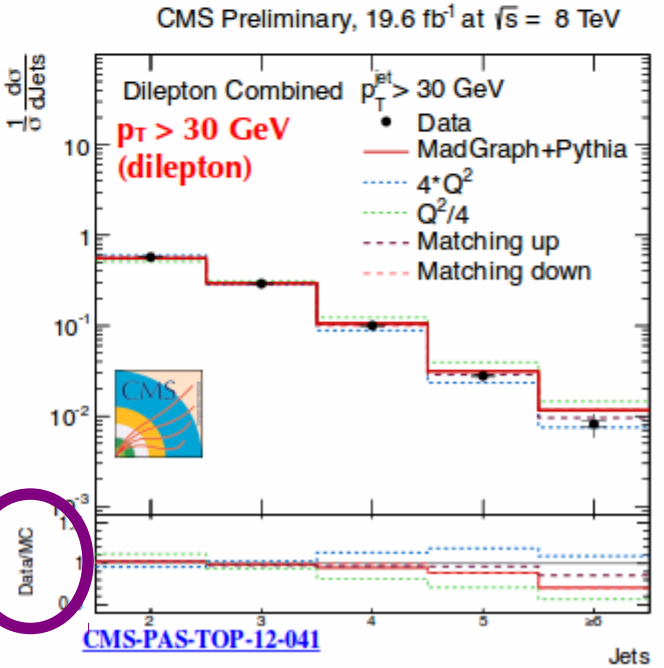
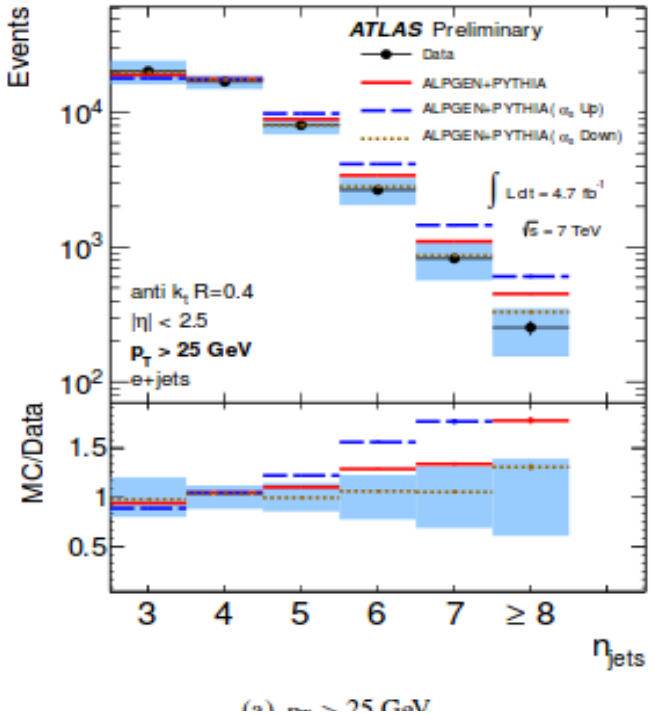


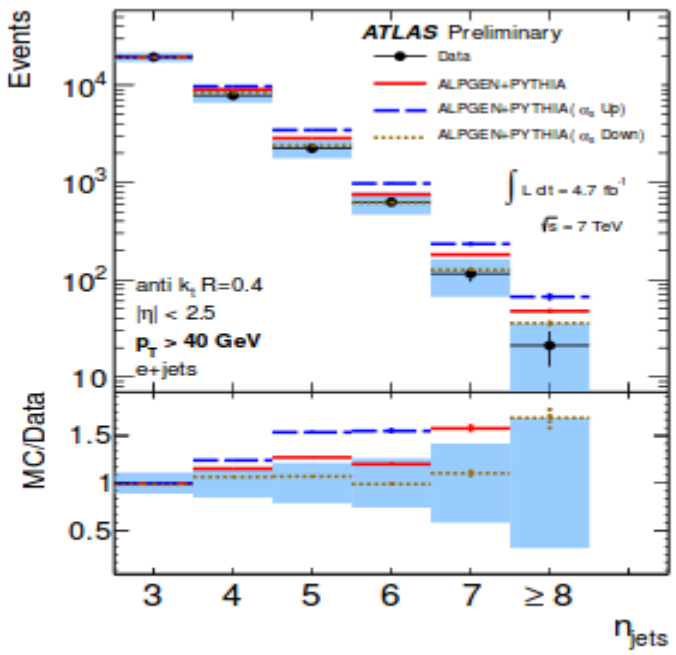


CMS-PAS-TOP-12-041

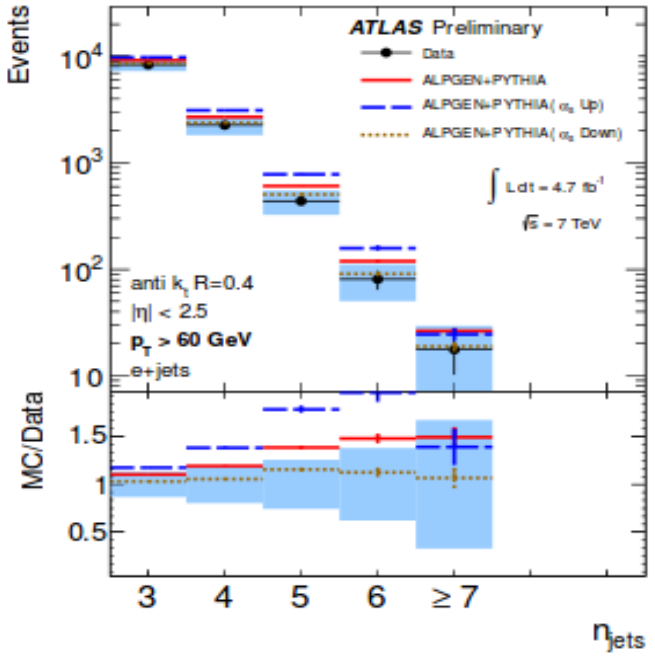
Observations	ATLAS	CMS
low jet multiplicity	• MC@NLO + HERWIG	• MC@NLO + HERWIG
data agreement (within uncertainties)	• POWHEG + PYTHIA • ALPGEN + HERWIG • ALPGEN + PYTHIA (scale down)	• POWHEG + PYTHIA • MADGRAPH + PYTHIA
worse description of data	• ALPGEN+PYTHIA (nominal, scale up)	• MADGRAPH + PYTHIA (scale down)

Comparison Alpgen/Madgraph varied scales

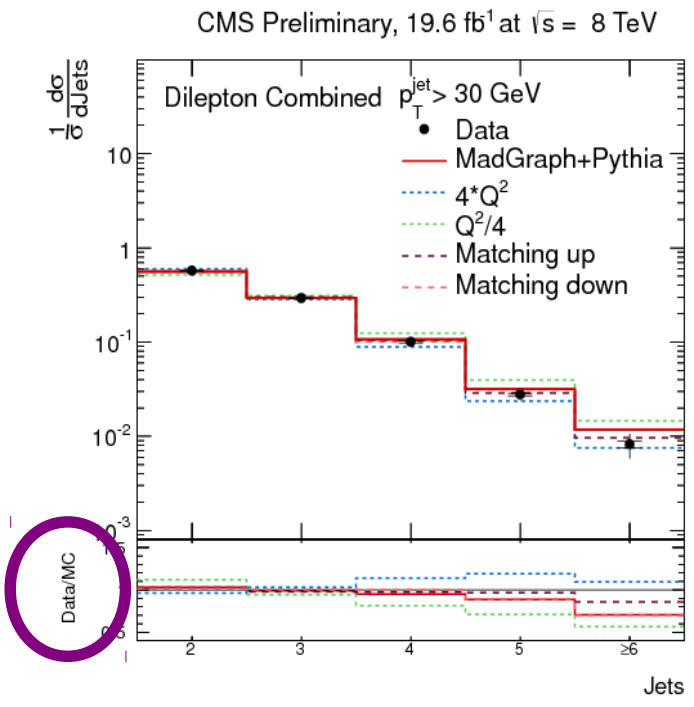


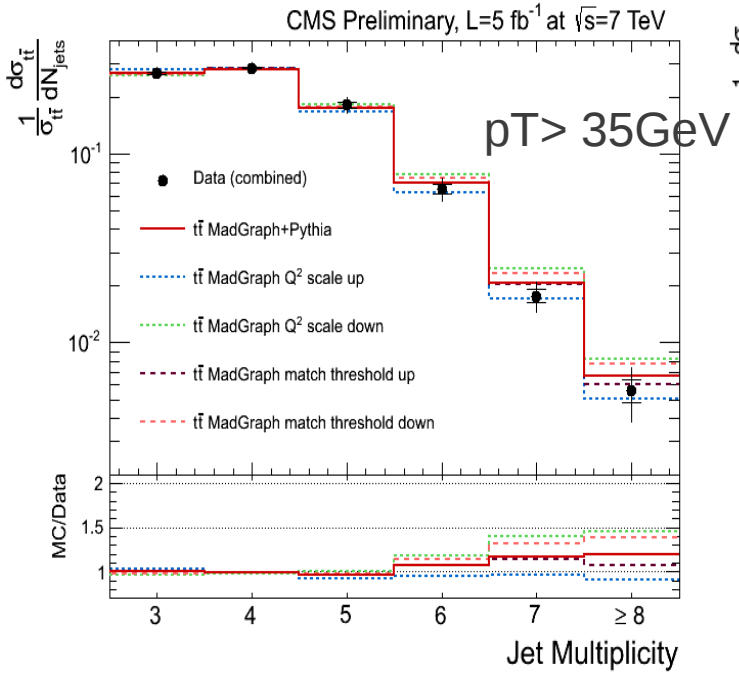


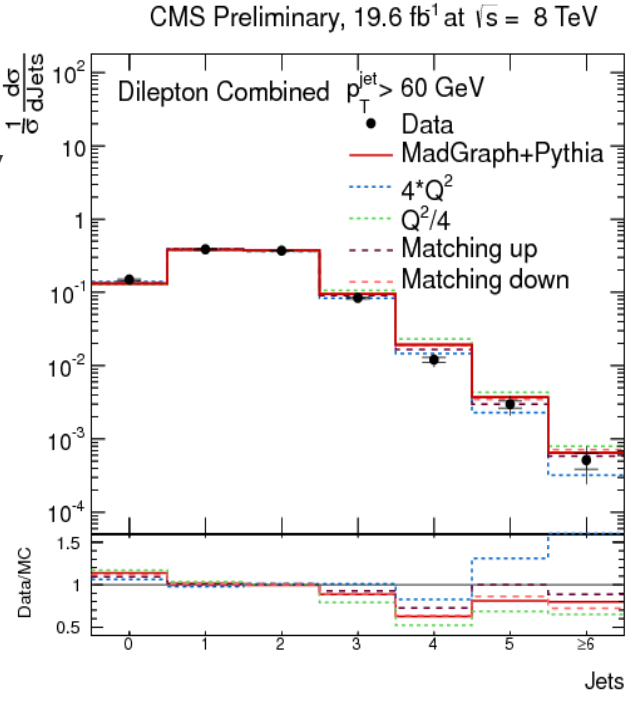
(b) $p_T > 40$ GeV



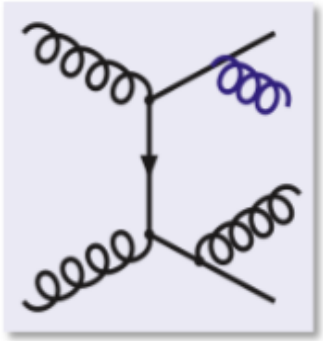
(c) $p_T > 60$ GeV







Radiative corrections



- The 'Q^2 scale' variation addresses 2 aspects:
  - renormalisation and factorisation scale (ME)
  - amount of initial and final state radiation (ISR/FSR)

- For each event, Q^2 is defined as:

$$Q^2 = m_t^2 + \sum p_T^2 \text{ (MadGraph)}$$

$$Q^2 = m_t^2 \text{ (POWHEG/MC@NLO)}$$

  - Q^2 varied up (down) by a factor 4.0 (0.25)

- Parton showering:
  - p_T-ordered evolution scale of ISR/FSR
  - shares Q^2 factor α_S scale with ME
  - implicitly: starting scale changes with ΔQ^2

- MadGraph uses:
  - tree-level diagrams for hard radiation and interferences (up to 3 final-state partons for ttbar)
  - parton showering for soft and collinear region (with Pythia 6.42X)
  - matching via ktMLM, thresholds varied by factor 0.5 to 2.0 (nominal = 20 GeV)