Unfolding in ATLAS ttbar+jets.

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DESY

Introduction

- Measure jet multiplicity in semi-leptonic ttbar events (e+jets and mu+jets) with a number of jet pT thresholds: 25, 40, 60, and 80 GeV.
- Measured up to 8 jets (inclusive).
- Motivation: Constrain radiation, test pQCD, understand background for many searches.
- Reco-level plots were compared with data in ATLAS-CONF-2011-142 (2011, 0.70 fb^{-1}).
- Present measurement fully unfolded to particle level in fiducial region using full 2011 data set (4.7 fb^{-1}).
  CONF note from last November: ATLAS-CONF-2012-155
- Paper on the way.

Reco-level event selection

- Standard top-group semi-leptonic selections, with some exceptions (marked in red below):
  - Electron (20 and 22 GeV) or muon (18 GeV) trigger.
  - Electron $|\eta| < 2.47$, excluding $1.37 < |\eta| < 1.52$
  - Muon $|\eta| < 2.5$
  - Exactly one lepton with $p_T > 25$ GeV. No other lepton with $p_T > 15$ GeV.
  - ≥ 3 jets with $p_T > 25$ (40, 60, 80) GeV (EM+JES calibration) and |JVF| > 0.75
  - $E_T^{miss} > 30$ GeV
  - $m_T(W) > 35$ GeV in both channels
  - ≥ 1 *b*-tagged jets (MV1@60%) with $p_T > 25$ GeV

Particle-level selection

- Particle level selection, used for unfolding. Closely matched to reco-level acceptance:
  - Electron
    (dressed with photons in $\Delta R < 0.1$)
    $|\eta| < 2.47$,
    excluding $1.37 < |\eta| < 1.52$
  - Muon $|\eta| < 2.5$
  - Exactly one lepton with $p_T > 25$ GeV. No other lepton with $p_T > 15$ GeV.
  - ≥ 3 jets with $p_{T,truth} > 25$ GeV
  - $E_T^{miss} > 25$ GeV
  - $m_T(W) > 35$ GeV in both channels
  - ≥ 1 jet with a $p_T > 5$ GeV *b*-hadron within $\Delta R < 0.3$
  - Electrons, muons, neutrinos matched to *W*s.

Unfolding procedure

$$f_{\text{part!reco}}\ \mathbf{M}^{\text{reco}}_{\text{part}}\ f_{\text{reco!part}}\ f_{\text{accpt}}\ (1 - f_{\text{bgnd}})\ N^{\text{reco}}(n^{\text{reco}}_{\text{jets}}).$$

Background subtraction

Unfolding matrix. Appied through iterative Bayesian method

Acceptance: All selection efficiencies except jet multiplicity, function of njets_reco

Events failing jet multiplicity requirement at reco level, but passing at particle level. Function of njets_part

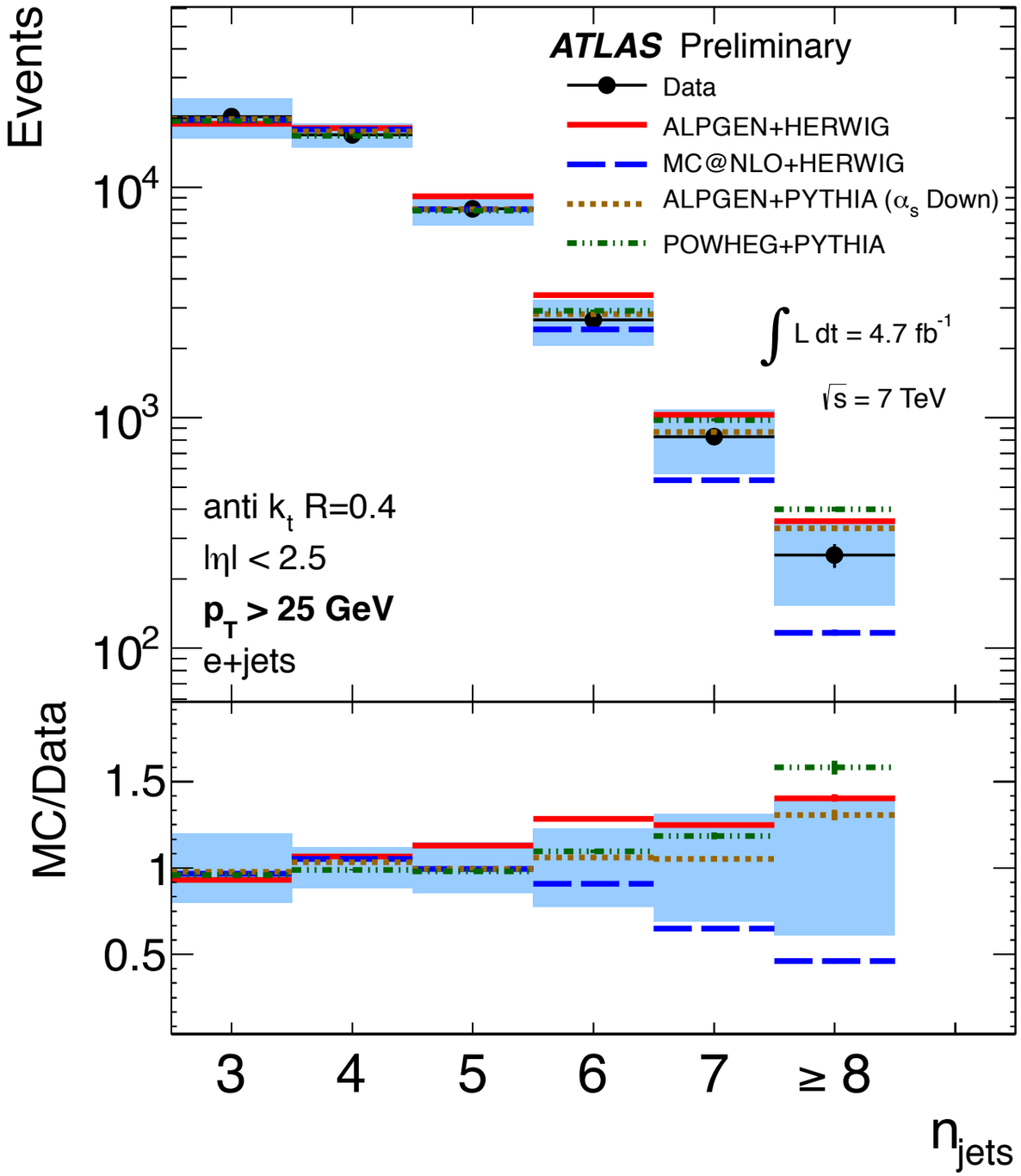
Events failing jet multiplicity requirement at particle level, but passing at reco level. Function of njets_reco

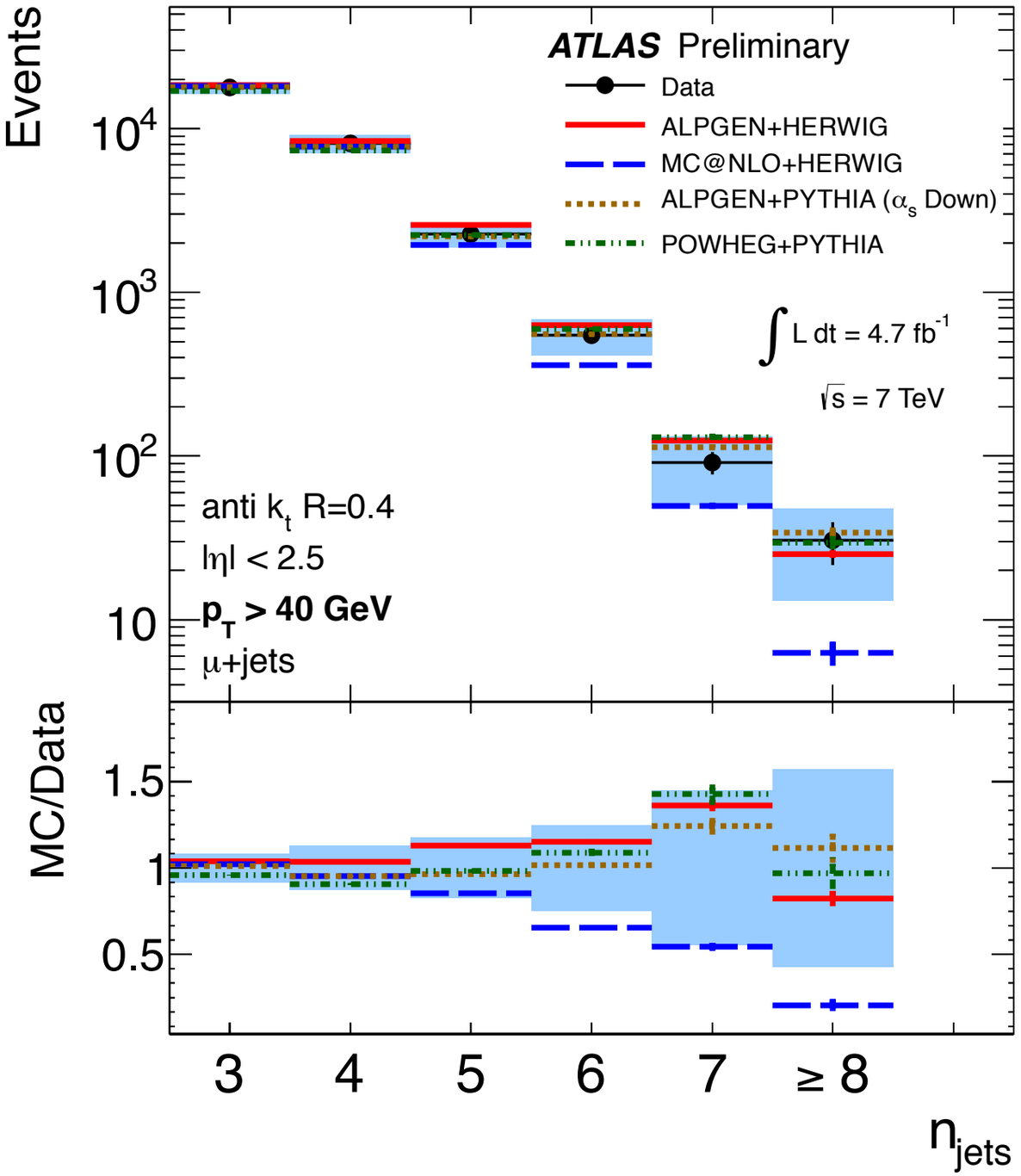
- Uncertainties propagated through unfolding using pseudo-experiments:
  - Statistical uncertainty on unfolding factors
  - Background estimation
  - Reconstruction efficiencies
  - Generator bias
  - ISR/FSR from ALPGEN+PYTHIA alpha_s variations.

Derivation of correction factors

- f_bgnd
  - QCD data-driven
  - W+jets semi-data-driven
  - Z+jets, single top, di-bosons from Monte Carlo
- f_accpt
  - from Monte Carlo
  - Various selection efficiencies measured in data (b-tagging, lepton id, trigger...). MC re-scaled to match data.
  - 1.8-1.9 for electron channel and 1.4-1.5 for muon channel.
- f_rnp : from Monte Carlo
- M: From Monte Carlo.
- f_pnr
  - from Monte Carlo
  - extrapolating from probability of measuring 3 jets at reco level, given 4 particle jets.

Unfolded distributions, example





Unfolding ansatz for pT of jet #n

$$f_{\mathrm{p!r}} \cdot M \cdot f_{\mathrm{misassign}} \cdot f_{\mathrm{r!p}} \cdot f_{\mathrm{accpt}} \cdot f_{\mathrm{bkg}}$$

truth jet #n is not matched to any reco jet

actual pT resolution unfolding, using reco jet matched to truth jet considered

reco jet #n is not matched to any truth jet

bin-by-bin correction for effect of measuring wrong jet truth jet at reco level

non-jet-resolution related acceptance efficiencies

non-ttbar bg

> Under study.

BACKUP