Measurement of the production cross section for Z/γ^* in association with jets in pp collisions at $\sqrt{s}$ =7 TeV with the ATLAS Detector

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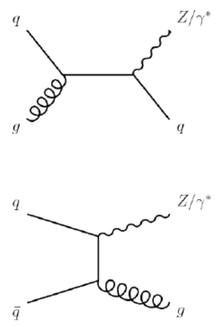
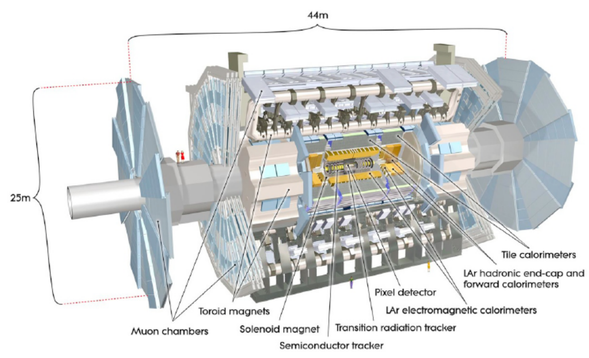
Motivation

The measurement of the Z/γ^*+jets cross section provides a stringent test of pQCD and it is a fundamental element of the ATLAS physics program, since these processes constitute backgrounds in searches for new physics. The MC predictions need to be tuned and validated at the unexplored LHC energy domain using data.



The ATLAS Detector

This poster presents measurements using 36 ± 1 pb^{-1} of data collected by ATLAS in 2010 at $\sqrt{s}$ = 7 TeV.

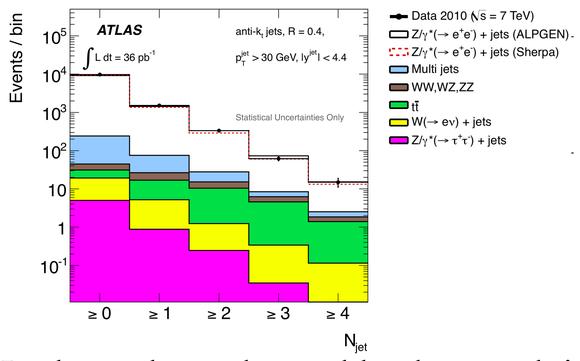


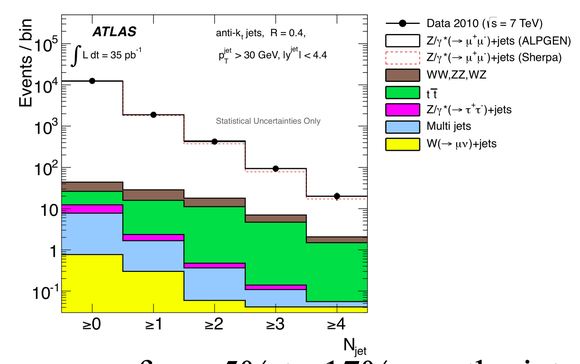
Event Selection

	Electons (*e*-channel)	Muons (μ -channel)
Trigger	Single electron	Single muon
Leptons	Electrons reconstructed as EM Clusters with a matching ID track **E_T>20 GeV $\|\eta\|$<2.47 (1.37<$\|\eta\|$<1.52 excluded)**	Muons reconstructed combining an ID track with a track in the Muon Spectrometer; an isolation criterion is applied **p_T>20 GeV, $\|\eta\|$<2.4**
Z mass	**66<M_{ll}<116 GeV**	
Jets	Anti-Kt jet algorithm with R=0.4 used to reconstruct jets from 3-D topological clusters **p_T>30 GeV, |y|<4.4, ΔR(jet,lep)>0.5**	

Background Estimation

The background is estimated using MC except for dijets: in the *e*-channel a template fit in data is used; in the μ -channel the di-muon mass vs. muon isolation plane in data is employed.





In the *e*-channel, total background increases from 5% to 17% as the jet multiplicity (N_{jet}) increases. In the μ -channel it increases from 2% to 10%.

Cross Section Measurement

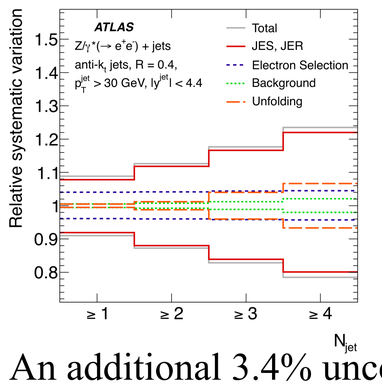
The differential cross section for a given jet observable (ξ):

$$\frac{d\sigma}{d\xi} = \frac{1}{\mathcal{L}} \frac{1}{\Delta\xi}(N_{\mathrm{data}} - N_{\mathrm{backg}}) \times U(\xi)$$

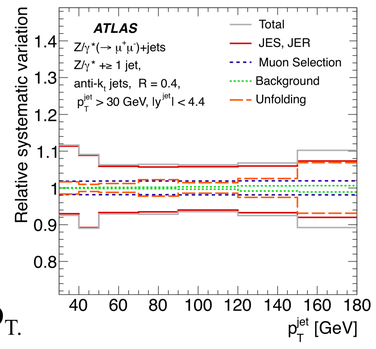
N_{data}= number of entered events (or jets) in data; N_{backg}= background prediction; $\Delta\xi$=bin width; L = total integrated luminosity; $U(\xi)$ = detector to particle level correction factors (ALPGEN). Cross sections defined fiducial in jet and lepton kinematics.

Systematic Uncertainties

The main systematic source is the Jet Energy Scale that increases from 7% to 22% as N_{jet} increases and from 8% to 12% as p_T increases.



The total systematic uncertainty increases from 9% to 23% as N_{jet} increases; and from 10% at low p_T to 13% at very high p_T.



An additional 3.4% uncertainty on the total integrated luminosity is also taken into account.

NLO pQCD Predictions

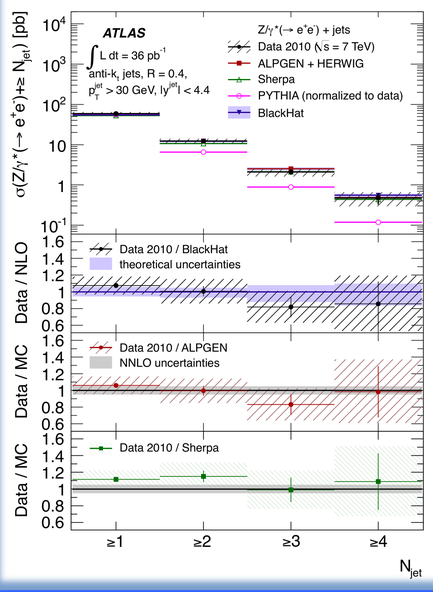
Predictions are computed with BlackHat.

CTEQ6.6 PDFs are employed and renormalization and factorization scales are set to $\mu = H_T/2$ (H_T = scalar sum of the p_T of all particle and partons in the final state).

The corrections for QED radiation effects and for non perturbative effects are applied.

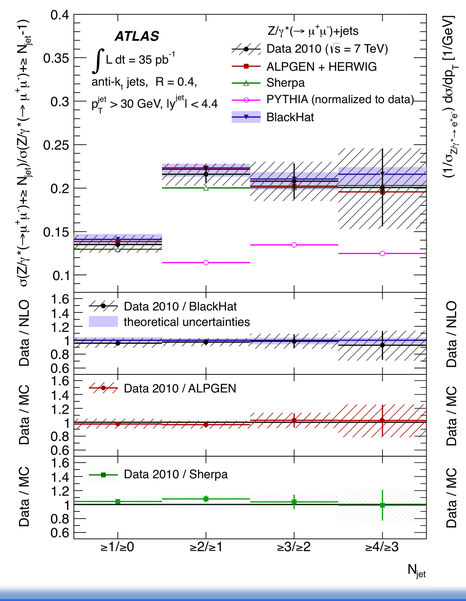
Selected Results

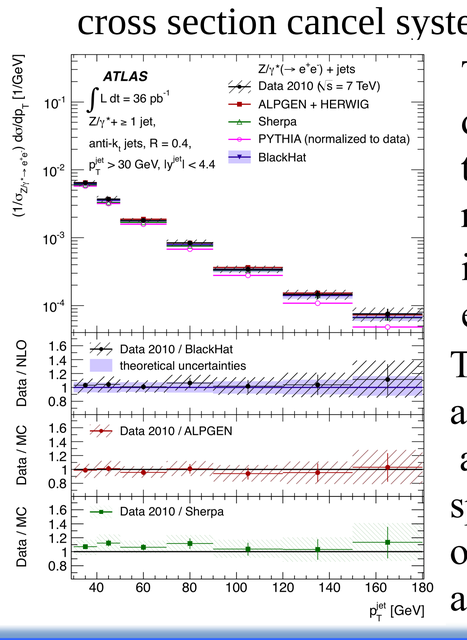
The inclusive differential cross sections divided by the total inclusive Z/γ^* cross section cancel systematic related to lepton and luminosity.



The total cross section decreases by a factor of five with any additional jet.

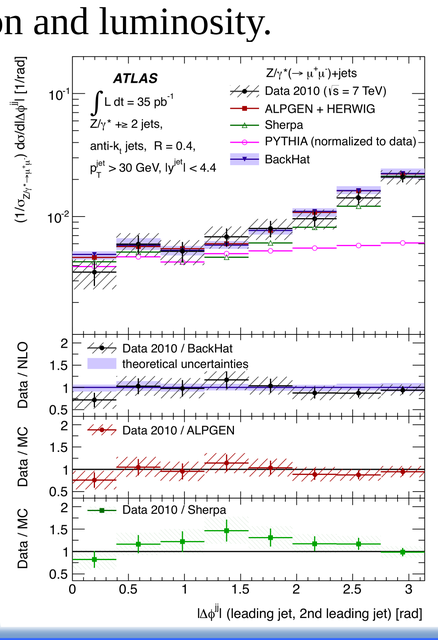
The ratio of cross sections cancels part of the systematic uncertainty and constitutes an improved test of the SM.





The cross sections decrease by more than two orders of magnitude as p_T increases in the explored range.

The dijet cross section are also measured as a function of the spatial separation of the two leading jets and of the dijet mass.

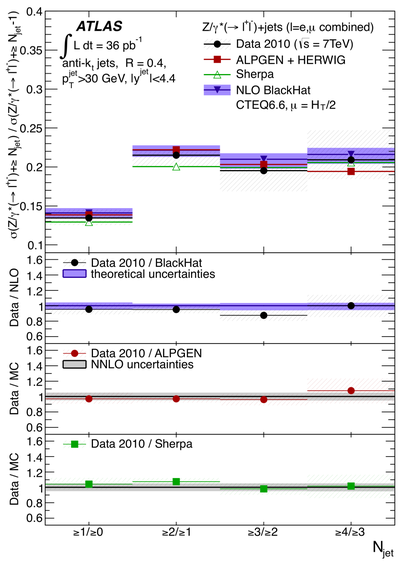


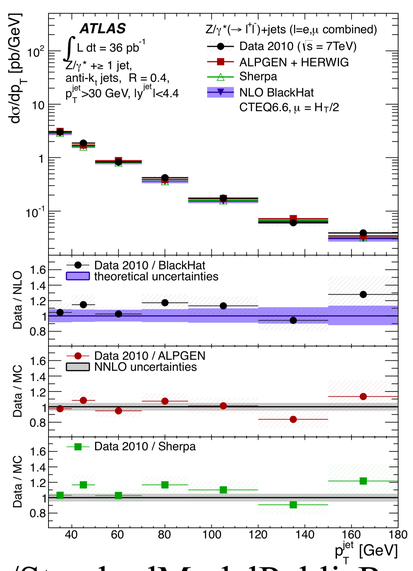
Combination

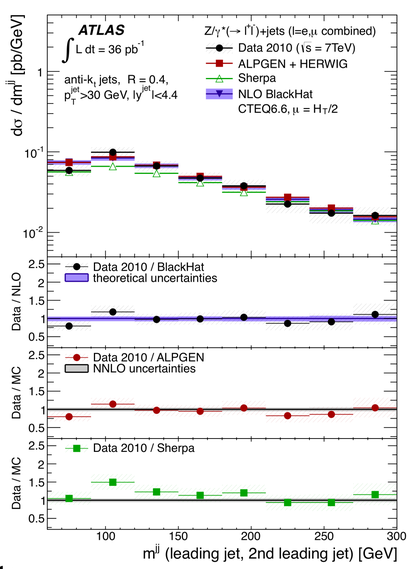
Combination of electron and muon results extrapolated to a common lepton kinematical region : p_T > 20 GeV and $|\eta|$ < 2.5 as defined at the Z vertex (correction factors from MC).

The results are combined using the BLUE (Best Linear Unbiased Estimate) method.

Three examples shown here; complete set at: https://twiki.cern.ch/twiki/bin/view/AtlasPublic/StandardModelPublicResults







Conclusions

The measured Z/γ^*+jets cross sections are well described by NLO pQCD predictions including non-perturbative corrections, as well as by predictions of LO matrix elements of up to 2 →5 parton scatters, supplemented by parton showers, as implemented in the ALPGEN and Sherpa MC generators. PYTHIA underestimates the measured cross sections.