Hadron Collider Physics Symposium 2011

Search for new phenomena in events with a monojet and large missing transverse momentum with the ATLAS detector

ATLAS-CONF-2011-096(*)

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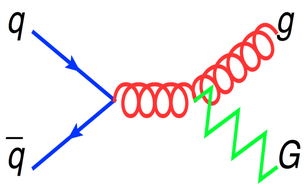
Introduction

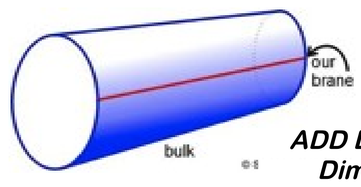
Many theoretical models beyond the Standard Model lead to final states with a monojet signature. For example, in the Arkani-Hamed, Dimopoulos, and Dvali (ADD) Large Extra Dimensions (LED) model gravitons are produced in association with a parton. The Graviton do not interact with the detector and results into a monojet signature in the final state.



Parton → high p_T jet

Graviton (undetected) → E_T^{miss}

We present results by the ATLAS experiment on a search for new phenomena in pp collision events at $\sqrt{s}$ = 7 TeV with a single hard jet plus large missing transverse momentum (E_T^{miss}) in the final state. For this analysis an integrated luminosity of 1fb^{-1} has been used.(**)



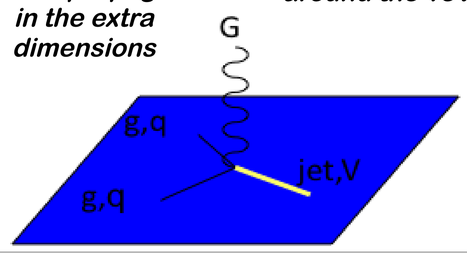
ADD Large Extra Dimensions

$(M_{Planck})^2 = (M_D)^{2+n} R^n$

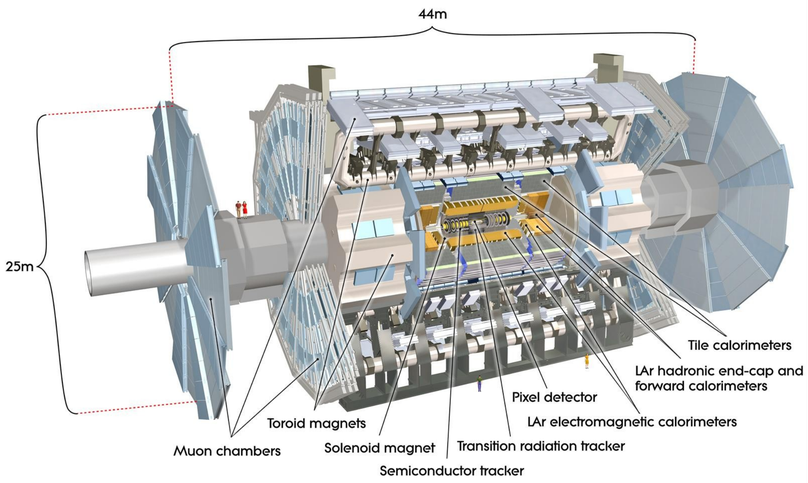
(n extra dimensions of size R)

Planck scale in 4+n dimensions (M_D) around the TeV

In ADD models the graviton propagates in the extra dimensions

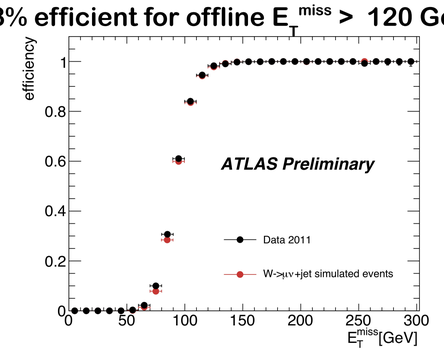


ATLAS detector



Trigger

Data collected with an E_T^{miss} based trigger (> 98% efficient for offline E_T^{miss} > 120 GeV)



Event Selection

Veto on events with electrons or muons
Veto on events with multiple jets

Jets
AntiKt with R=0.4
MC-based calibration
pT>30GeV |η|<4.5

Muons
Matched track in the inner detector and muon system
pT>10GeV |η|<2.4

E_T^{miss}
from locally calibrated topological clusters with |η|<4.5

Electrons
Electromagnetic cluster with an associated inner detector track
pT>20GeV |η|<2.4

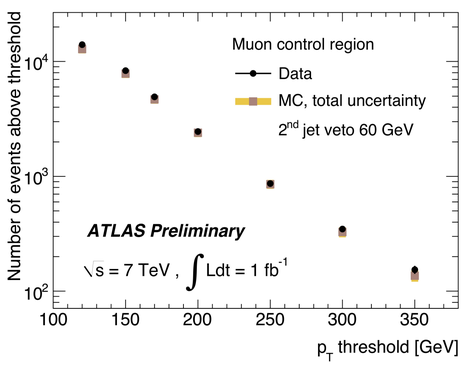
Three selection criteria considered with increasing leading-jet p_T and E_T^{miss} requirements

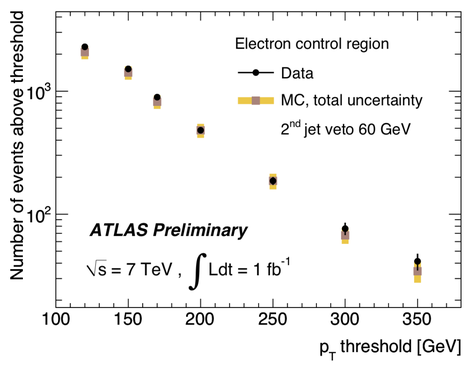
	LowPt	HighPt	*very*HighPt
E_T^{miss}	> 120 GeV	> 220 GeV	> 300 GeV
Leading jet p_T	> 120 GeV	> 250 GeV	> 350 GeV
Second jet p_T (veto)	< 30 GeV	< 60 GeV	< 60 GeV
$\Delta\phi$ (2ndjet, E_T^{miss})	-	> 0.5 rad.	> 0.5 rad.
Third jet p_T (veto)	-	< 30 GeV	< 30 GeV

W/Z + jets background

W/Z+jets production processes are the main sources of background due to the presence of misidentified leptons and high p_T neutrinos in the final state.
In particular, the Z(→νν)+jets contribution is irreducible and dominates.

Samples of ALPGEN MC simulated events are used to estimate W/Z+jets contributions. They are normalized with data-driven scale factors, as determined in data control samples with identified electrons or muons in the final state, which are orthogonal to the signal regions.



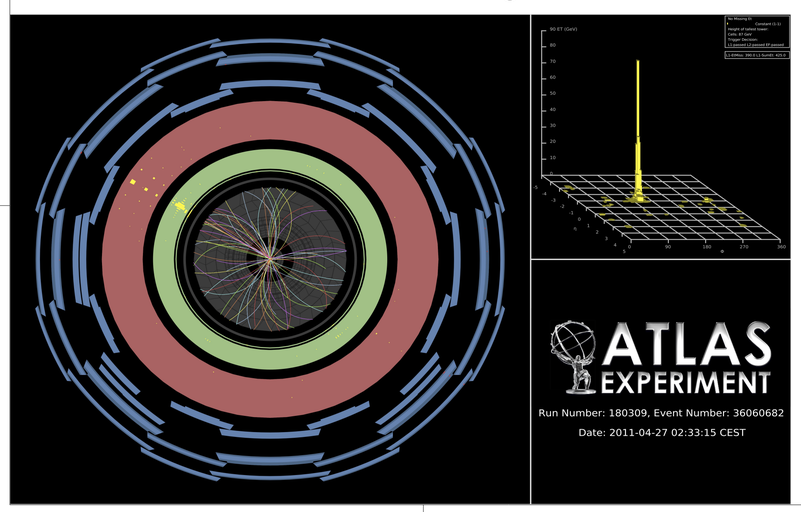


Non collision background

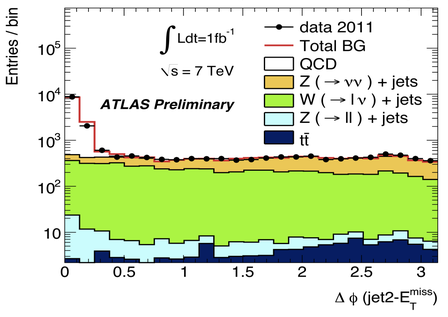
Non-collision backgrounds originate from cosmic rays, overlaps between background events and genuine proton-proton collisions, and beam-halo muons traversing the detector parallel to the beam direction. The contributions to the selected sample are estimated in the data using events registered in empty and unpaired proton bunches in the collider, and a beam-hallo tagger.
This constitutes a 1% to 2% of the total background.

QCD-jets background

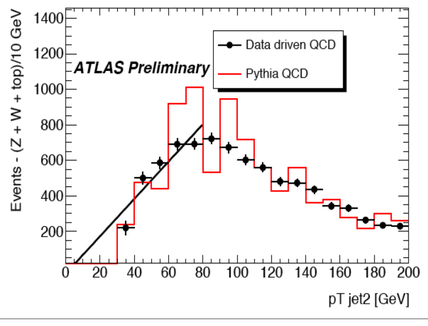
The background contribution from QCD-jets events is estimated from data extrapolating the second-leading jet p_T distribution below the threshold, as determined in events with $\Delta\phi$ (jet2-E_T^{miss}) < 0.5 (see Figures).
This constitutes a 2% of the total background.



QCD-jets control sample



QCD-jets background extrapolation



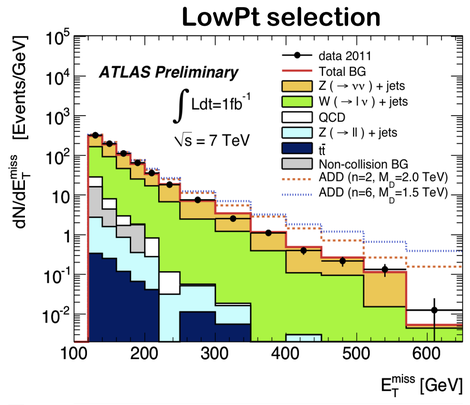
Results

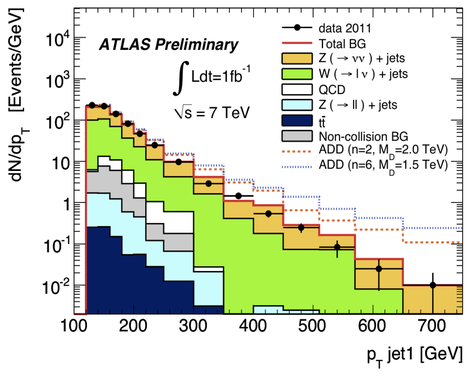
Counting experiment: good agreement observed between data and the background predictions.

	LowPt	HighPt	veryHighPt
Total Background	15100±170±680	1010±37±65	193±15±20
Events in data (1fb^{-1})	15740	965	167

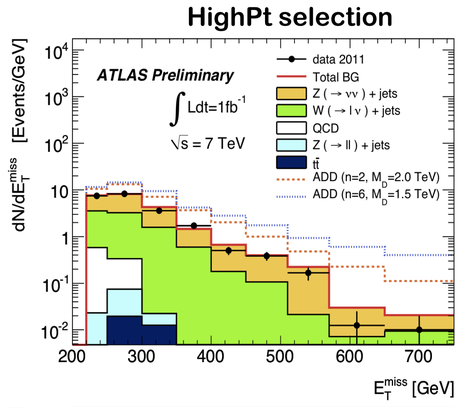
Measured uncorrected E_T^{miss} and leading-jet p_T in the different regions

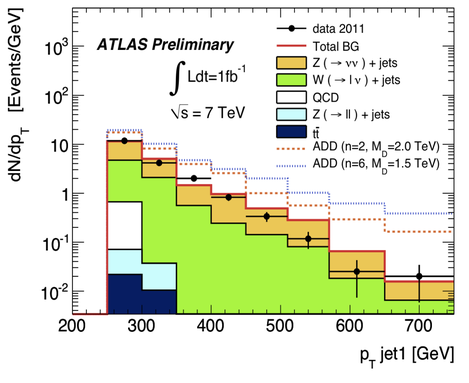
LowPt selection



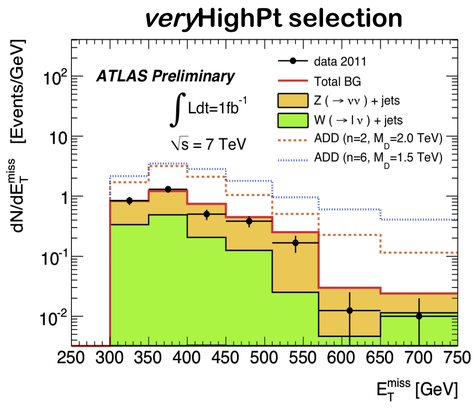


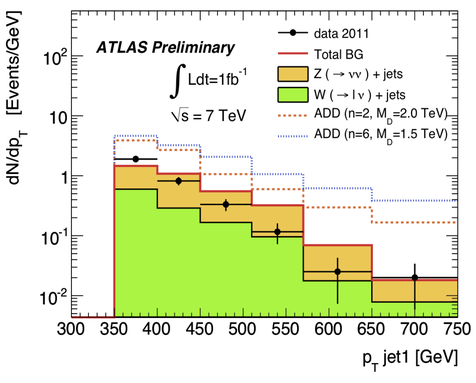
HighPt selection





*very*HighPt selection





Exclusion limits

The observed number of events in data in each region are translated into model independent limits on σ x Acceptance (at the detector level)

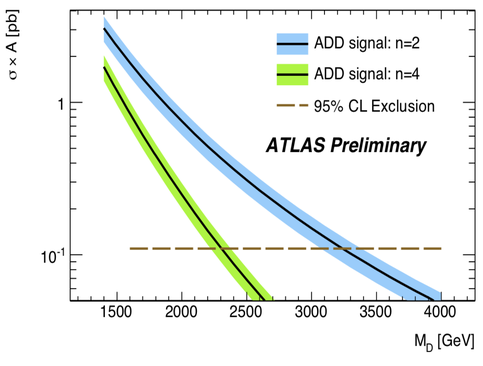
LowPt: 1.7 pb
HighPt: 0.11 pb
*very*HighPt: 0.035 pb

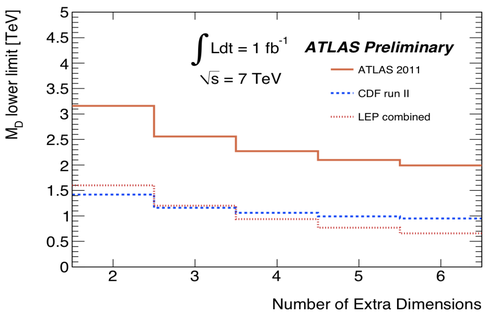
(according to the simulation, detector effects reduced the signal yields by a factor 0.8)

95% confidence level upper limits for ADD scale M_D vs n

3.2 TeV (n=2)
2.3 TeV (n=4)
2.0 TeV (n=6)

Well beyond Tevatron reach





(*) For more details see http://cdsweb.cern.ch/record/1369187

(**) Previous results with 33 pb^{-1} are published as Phys. Lett. B 705, 294 (2011)