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INCLUSIVE SEARCHES FOR SUPERSYMMETRY WITH JETS AND MISSING TRANSVERSE ENERGY WITH THE ATLAS DETECTOR

Marija Vranjes Milosavljevic* *for the ATLAS Collaboration*
*Institute of Physics Belgrade

INTRODUCTION

Supersymmetry (SUSY) is a theoretically favoured candidate for physics beyond the Standard Model. If strongly interacting supersymmetric particles are present at the TeV-scale, then such particles should be copiously produced in the 7TeV collisions at the Large Hadron Collider. With increasing integrated luminosities it is expected that the LHC experiments should soon be approaching sensitivity to SUSY particles exceeding that of the direct search experiments at the Tevatron.

A first set of measurements of supersymmetry-sensitive variables in the final states with jets, missing transverse momentum and no leptons from the √s= 7TeV proton-proton collisions at the LHC are described here. The data were collected during the period March 2010 to July 2010 and correspond to a total integrated luminosity of 70 ± 8 nb $^{-1}$.

EVENT SELECTION

Preselection:
✓Events are rejected if they contain a bad jet:
- veto noise in hadronic end cap calorimeter
- veto noise in electromagnetic calorimeter
- veto cosmic ray energy deposites (in monojet channel)

✓Events are rejected if contain no primary vertex with at least five associated tracks.
✓Events are rejected if contain any reconstructed leptons (e or μ) with pT > 10 GeV.

	MONOJET	TWO JETS	THREE JETS	FOUR JETS
Leading jet pT	> 70 GeV	> 70 GeV	> 70 GeV	> 70 GeV
jets pT	veto 2rd jet pT > 30GeV	> 30 GeV	> 30 GeV > 30 GeV	> 30 GeV > 30 GeV > 30 GeV
EtMiss	> 40 GeV	> 40 GeV	> 40 GeV	> 40 GeV
| Δφ(j,EtMiss) |	no cut	>0.2, >0.2	>0.2,>0.2, >0.2	>0.2,>0.2, >0.2
EtMiss>f*Meff	no cut	f=0.3	f=0.25	f=0.2

TRIGGER

The calorimeter jet triggers of the first trigger level (L1) were used.

The trigger is fully efficient for jets with pT above 50 GeV. The plateau efficiency is greater than 99% for the events used in this study.

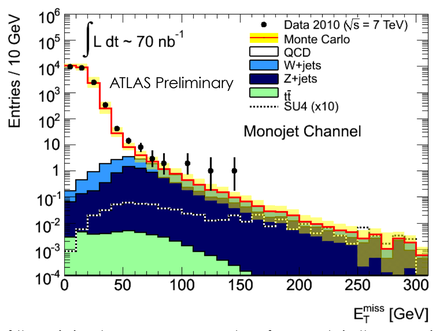
SYSTEMATIC UNCERTAINTIES

✓ The calorimeter energy scale uncertainty was estimated using a parameterisation of this scale as a function of jet pT and η. The resulting systematic uncertainty on the number of expected events was found to be >25% for the monojet analysis and 2-jet analysis, > 40% for the 3-jet analysis and > 50% for the 4-jet analysis.

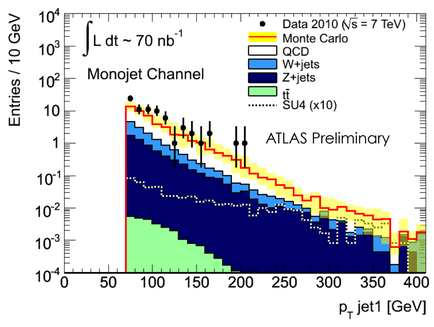
✓ The uncertainty in the integrated luminosity is estimated to result in an overall normalization error of 11% for the W± + jets, Z0 + jets and ttbar production.

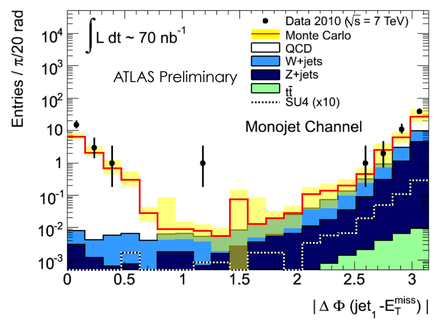
✓ The statistical uncertainty on the Monte Carlo prediction and all systematic uncertainties are added in quadrature.

MONOJET CHANNEL



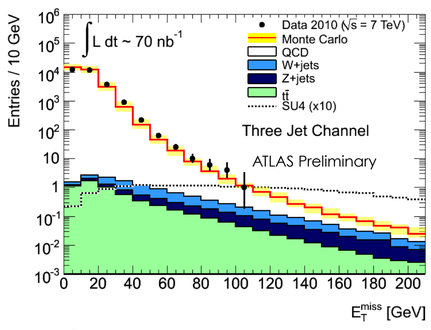
Distribution of the missing transverse momentum for events in the monojet channel. Only the jet selection cuts have been applied.

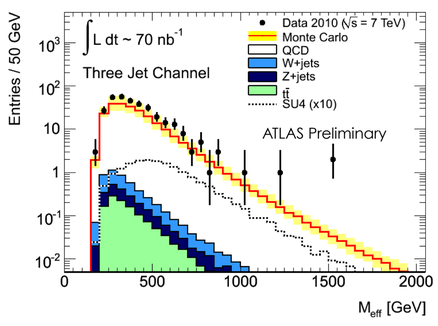




Distributions of the leading jet transverse momentum (left) and the difference in azimuthal angle between the jet and the missing transverse momentum vector for events in the monojet channel after the cut requiring EtMiss > 40 GeV is applied.

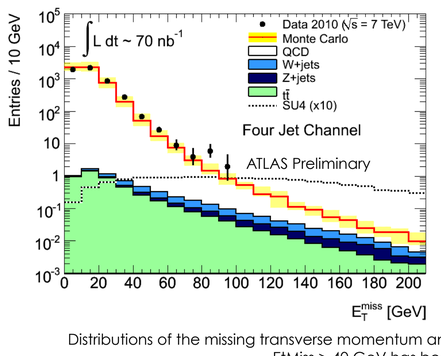
THREE-JET CHANNEL

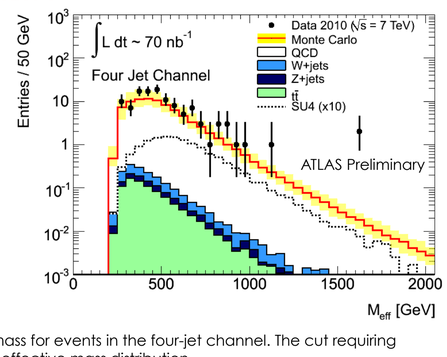




Distributions of the missing transverse momentum and the effective mass for events in the three-jet channel. The cut requiring EtMiss > 40 GeV has been applied in the effective mass distribution.

FOUR-JET CHANNEL

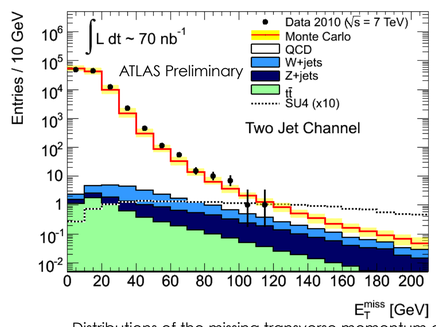


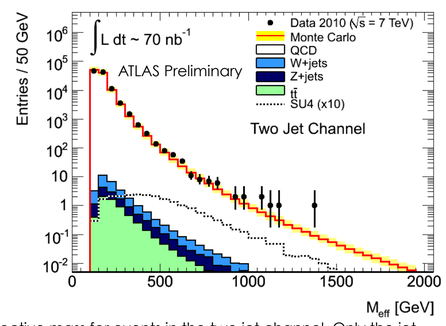


Distributions of the missing transverse momentum and the effective mass for events in the four-jet channel. The cut requiring EtMiss > 40 GeV has been applied in the effective mass distribution.

TWO-JET CHANNEL

$$M_{Eff} = \sum_{i=1}^{n} |\mathbf{p}_T^{(i)}| + E_T^{miss}$$

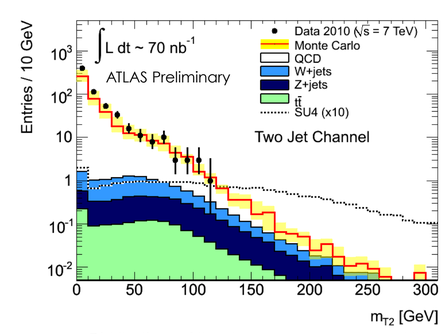


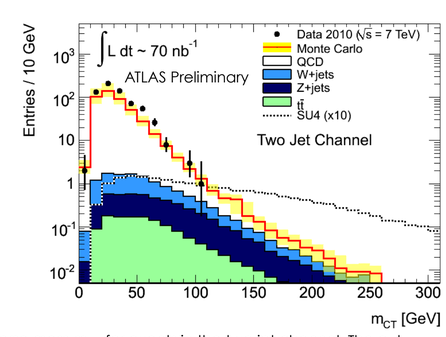


Distributions of the missing transverse momentum and the effective mass for events in the two jet channel. Only the jet selection cuts have been applied.

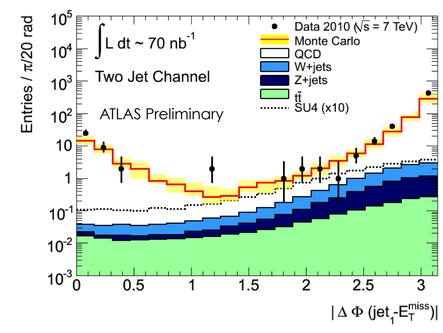
$$m_{T2}\left(j^{(1)}, j^{(2)}, \not\mathbf{p}_T\right) \equiv \min_{\not\mathbf{q}_T^{(1)}+\not\mathbf{q}_T^{(2)}=\not\mathbf{p}_T} \left\{\max\left(m_T\left(j^{(1)}, \not\mathbf{q}_T^{(1)}\right), m_T\left(j^{(2)}, \not\mathbf{q}_T^{(2)}\right)\right)\right\}$$

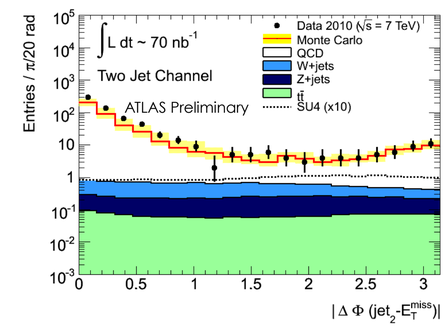
$$m_{CT}^2\left(j^{(1)}, j^{(2)}\right) \equiv 2E_T^{(1)}E_T^{(2)} + 2\mathbf{p}_T^{(1)} \cdot \mathbf{p}_T^{(2)}.$$



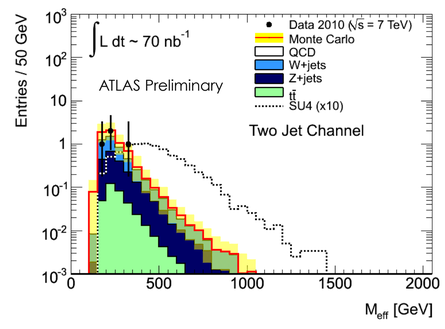


Distributions of the stransverse mass m_{T2} and the contransverse mass m_{CT} for events in the two jet channel. The cut requiring EtMiss > 40 GeV has been applied.





Distributions of the difference in azimuthal angle between the jet and the missing transverse momentum vector for events in the two-jet channel. The cut requiring EtMiss > 40 GeV has been applied.



Distribution of the effective mass for events in the two-jet channel. The cuts on EtMiss , the azimuthal difference Δφ(jet, EtMiss) and on the ratio of the missing transverse momentum over the effective mass have been applied.

The number of data and events predicted from the Monte Carlo simulation (QCD, W/Z+jets, ttbar) passing the selection for each jet multiplicity

	MONOJET		≥ 2 JETS		≥ 3 JETS		≥ 4 JETS	
	Data	MC	Data	MC	Data	MC	Data	MC
JET CUTS	21227	+7000 23000 -6000	108239	+31000 108000 -25000	28697	+10000 31000 -8000	5329	+2300 5600 -1600
ETMISS CUT	73	+22 46 -14	650	+190 450 -120	325	+100 230 -70	116	+45 84 -30
ETMISS/MEFF and Δφ CUTS	-	-	4	6.6 ± 3	0	1.9 ± 0.9	1	1.0 ± 0.6

CONCLUSION

Measured distributions of jet momenta, missing transverse momentum, effective mass, azimuthal angles, stransverse mass, contransverse mass and event shape variables show good agreement with the Standard Model up to values of EtMiss~100GeV, Meff~1500GeV, m_{T2}~m_{CT}~100GeV.

The good agreement between the ATLAS measurements and the standard model predictions shows that the ATLAS detector is performing well and that the Monte Carlo simulations describe both the underlying physics, and the detector response to jets and EtMiss within the systematic uncertainties achievable thus far.