Inclusive Jet p_T Analysis in RunII

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Inclusive Jet Meeting

Introduction

- Measurement of double differential inclusive jet cross section in p_T and |y| at 13 TeV
- Test of NLO pQCD
- Analysis Base 2.1.27
- Jet Algorithm: `AntiKt4LCTopoJets`
- Everything I have written is on SVN: `http://svn.cern.ch/guest/JLxAOD/JLxAOD/trunk/`
- Based on exotics dijet framework - xAODAnaHelpers: https://twiki.cern.ch/twiki/bin/viewauth/AtlasProtected/XAODAnaHelpers

MC Samples

- Datasets used:

`mc14_13TeV.14791(0..7).Pythia8_AU2CT10_jetjet_JZ(0..7)W.merge.AOD.e2743_s1982_s2008_r5787_r5853/`

Or equivalently

`mc14_13TeV.14791(0..7).Pythia8_AU2CT10_jetjet_JZ(0..7)W.merge.DAOD_JETM1.e2743_s1982_s2008_r5787_r5853_p1815/`

- JZ0W samples ignored - reasons will be shown

JZXW	pT [GeV]	XS [fb]	Filter Efficiency	# Events
JZ0W	*0 - 20*	*7.8420E+13*	*9.7193E-01*	*3498000*
JZ1W	*20 - 80*	*7.8420E+13*	*2.7903E-04*	*2998000*
JZ2W	*80 - 200*	*5.7312E+10*	*5.2261E-03*	*500000*
JZ3W	*200 - 500*	*1.4478E+09*	*1.8068E-03*	*499500*
JZ4W	*500 - 1000*	*2.3093E+07*	*1.3276E-03*	*477000*
JZ5W	*1000 - 1500*	*2.3793E+05*	*5.0449E-03*	*499000*
JZ6W	*1500 - 2000*	*5.4279E+03*	*1.3886E-02*	*493500*
JZ7W	*2000 +*	*9.4172E+02*	*6.7141E-02*	*497000*

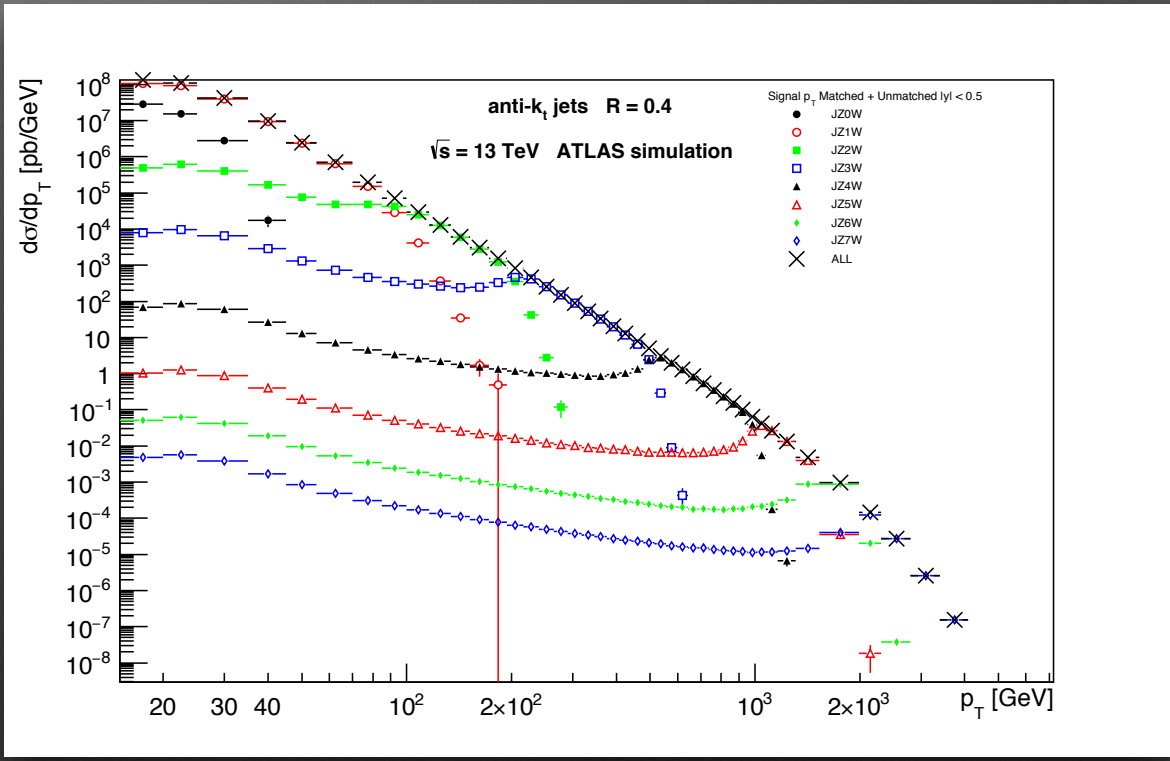
Event weight: $\frac{(\text{XS}) \cdot (\text{Filter Efficiency}) \cdot (\text{Weight})}{(\# \text{ Events})}$

Saved in `EventInfoAux` container

Binning

Analysis made in double differential binning

in p_T and |y| from 2012 analysis



p_T = 15 : 20 : 25 : 35 : 45 : 55 : 70 : 85 : 100 : 116 : 134 : 152 : 172 : 194 : 216 : 240 : 264 : 290 : 318 : 346 : 376 : 408 : 442 : 478 : 516 : 556 : 598 : 642 : 688 : 736 :786 : 838 : 894 : 952 : 1012 : 1076 : 1162 : 1310 : 1530 : 1992 : 2300 : 2800 : 3400 : 4100 : 5000 : 6000 : 7200 GeV

|y| = 0.0 : 0.5 : 1.0 : 1.5 : 2.0 : 2.5 : 3.0 : 3.5 : 4.0

Jet Calibration

- `ApplyJetCalibration-00-03-28`
- Implemented with `JetCalibrator` class from `xAODAnaHelpers`
- Configuration file: `JES_Prerecommendation2015_Feb2015.config`
- Calibration Sequence: `JetArea_Residual_EtaJES`
- Jet algorithm: `AntiKt4LCTopo`
- To be updated for 2015 recommendation

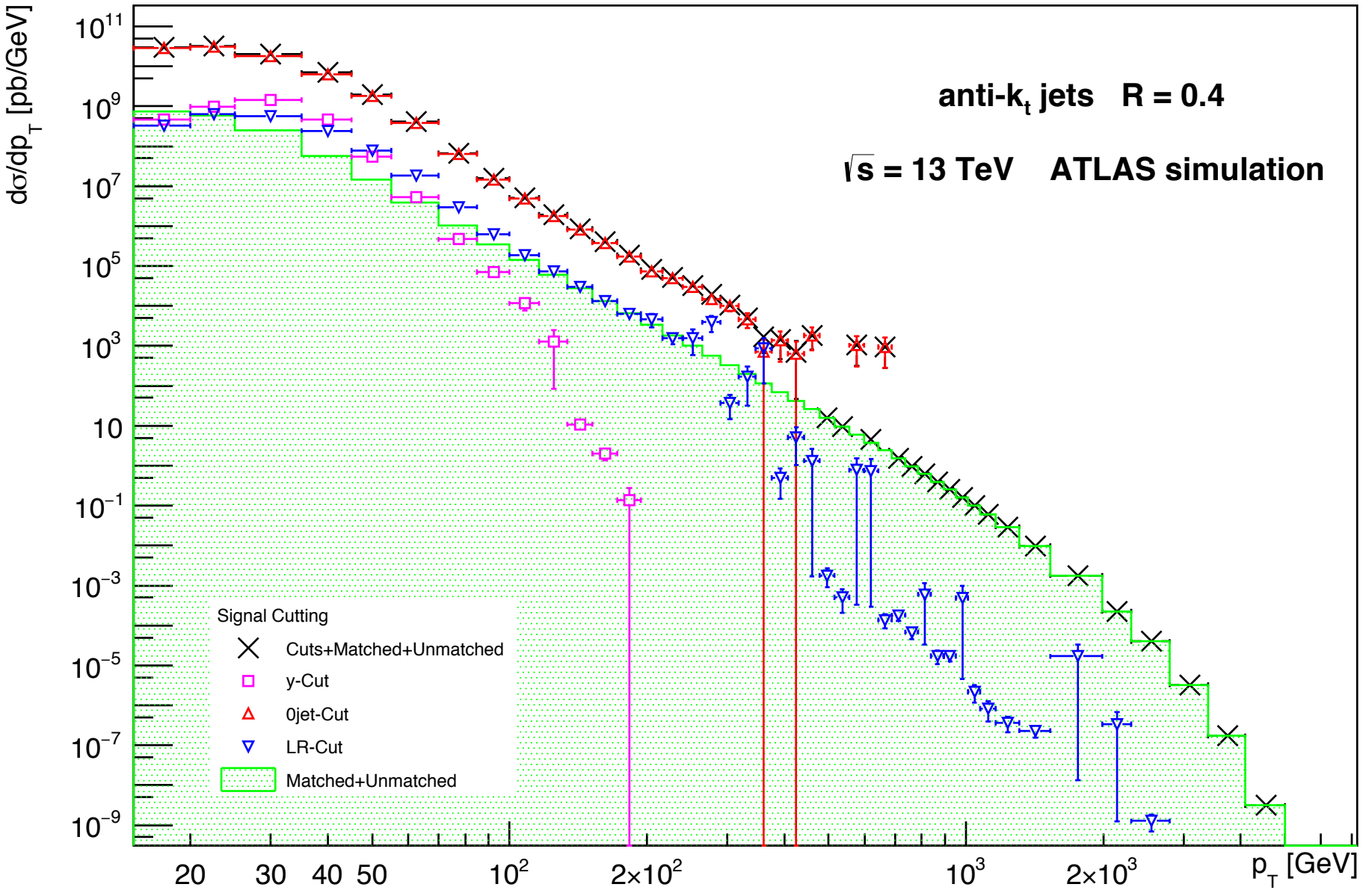
Cuts

- **p_T cut and y cut**
  removed jets with $p_T < 15$ GeV and $|y| > 4$
- **0-jet cut**
  removed events with no reco or no truth jets
- **Leading Ratio (LR) cut**
  LR = (p_T reco leading) / (p_T truth leading);
  kept events with $0.6 < LR < 1.4$
  same cut used in 2012 analysis

MOST IMPORTANT CUT
for JZ0W sample

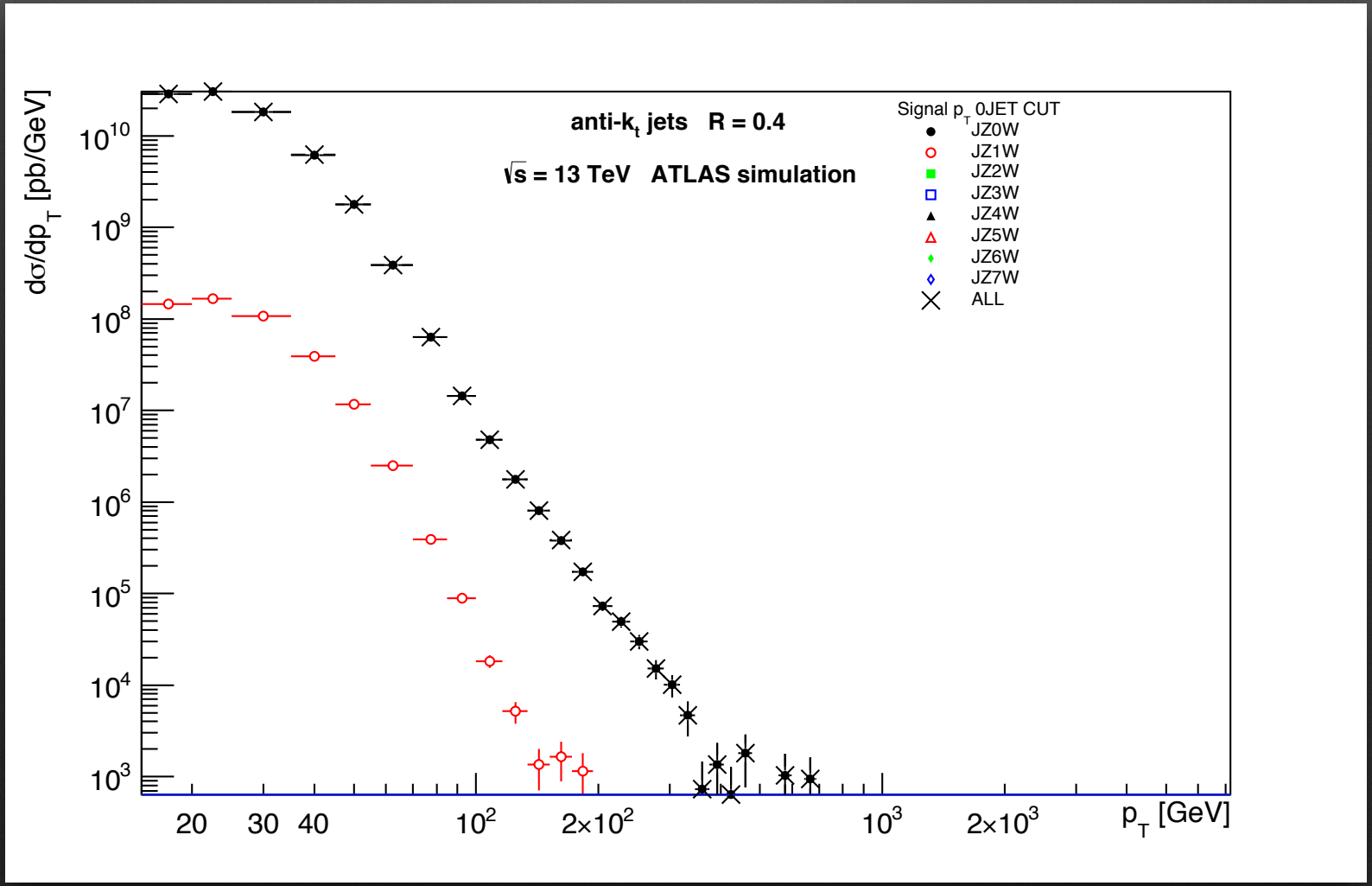
In case there are at least two reco jets, (p_T reco leading) is taken as the average of two leading reco jets p_T

Reco Jets: Cut Results, JZ0-7W



Reco Jets: 0-Jet Cut, JZ0-7W

- Contribution of reco jets which were removed by 0-jet cut, for all JZSlices
- It can be seen, there is contribution only from JZ0,1W



Reco jets: 0-jet cut

Event #4667 from JZ0W sample:

/mc14_13TeV.147910.Pythia8_AU2CT10_jetjet_JZ0W.merge.AOD.e2743_s1982_s2008_r5787_r5853_tid01598021_00/
AOD.01598021._000062.pool.root.1

Reco jets without cuts:

#1	CALIB:	pt:	125.786	y:	−2.6443	phi: 1.4586
	UNCALIB:	pt:	97.6901	y:	−2.6361	phi: 1.4586
#2	CALIB:	pt:	123.742	y:	−0.5543	phi: −1.838
	UNCALIB:	pt:	94.7108	y:	−0.5510	phi: −1.838
#3	CALIB:	pt:	57.1304	y:	−0.3061	phi: 3.0890
	UNCALIB:	pt:	26.8852	y:	−0.3038	phi: 3.0890
#4	CALIB:	pt:	45.0555	y:	−1.2838	phi: 0.4170
	UNCALIB:	pt:	13.0524	y:	−1.2685	phi: 0.4170
#5	CALIB:	pt:	44.4577	y:	1.50811	phi: 2.7526
	UNCALIB:	pt:	10.9291	y:	1.49993	phi: 2.7526
#6	CALIB:	pt:	43.3889	y:	−1.0209	phi: −0.668
	UNCALIB:	pt:	13.7215	y:	−1.0152	phi: −0.668
#7	CALIB:	pt:	42.7879	y:	−0.2844	phi: 1.2135
	UNCALIB:	pt:	12.5796	y:	−0.2830	phi: 1.2135
#8	CALIB:	pt:	42.5615	y:	−0.9339	phi: 2.9635
	UNCALIB:	pt:	16.6115	y:	−0.9289	phi: 2.9635
#9	CALIB:	pt:	41.6006	y:	1.22097	phi: 0.1975
	UNCALIB:	pt:	10.1207	y:	1.20448	phi: 0.1975

…

Truth jets without cuts:

#1	TRUTH:	pt:	9.74696	y:	−1.4113	phi: 1.0435
#2	TRUTH:	pt:	9.55277	y:	−2.8232	phi: 2.3951
#3	TRUTH:	pt:	7.21832	y:	−0.5531	phi: 0.0370
#4	TRUTH:	pt:	6.32004	y:	−3.7754	phi: −1.489

And another 10 reco jets with

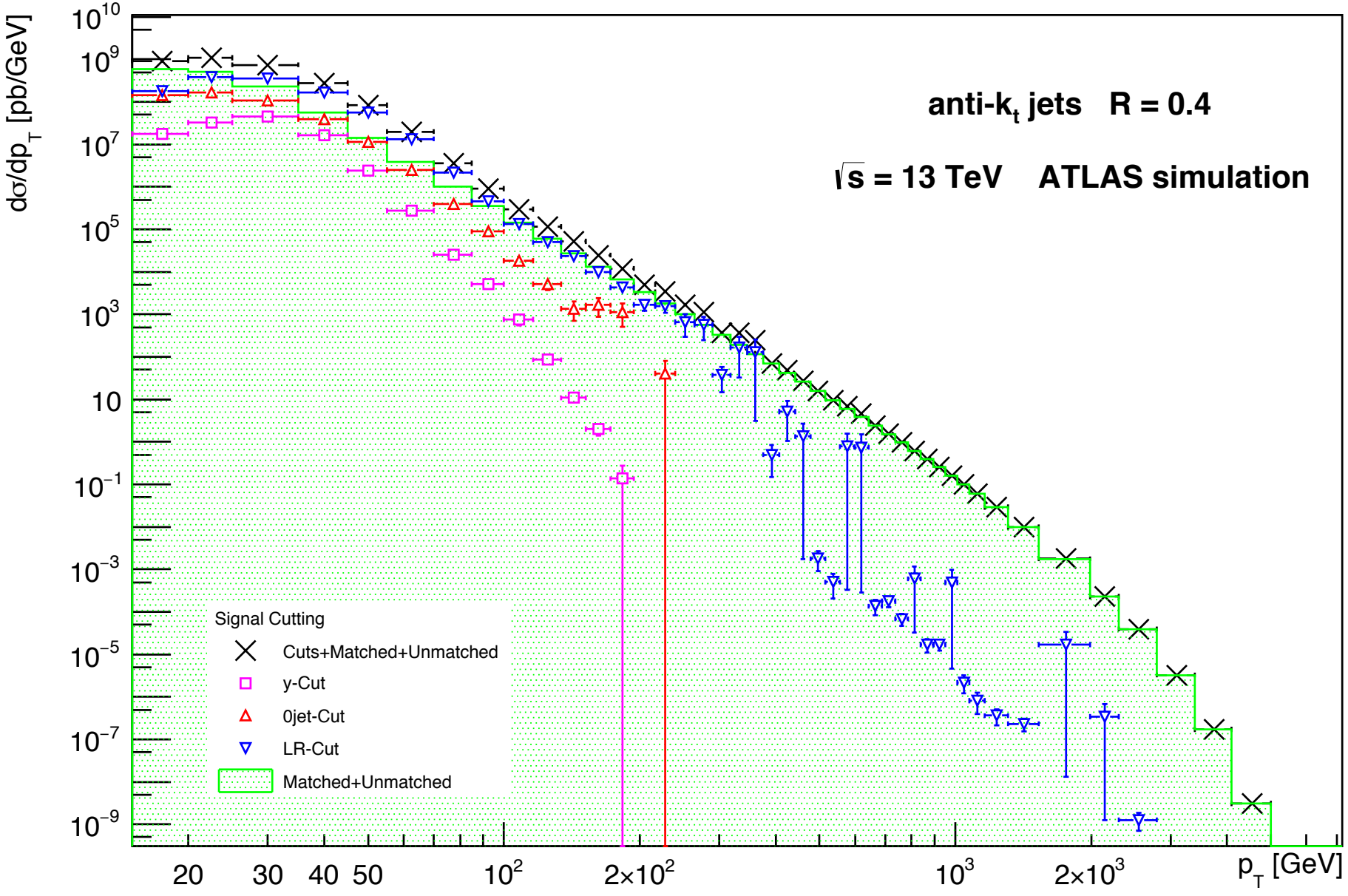
p_T(CALIB) < 40 GeV

and

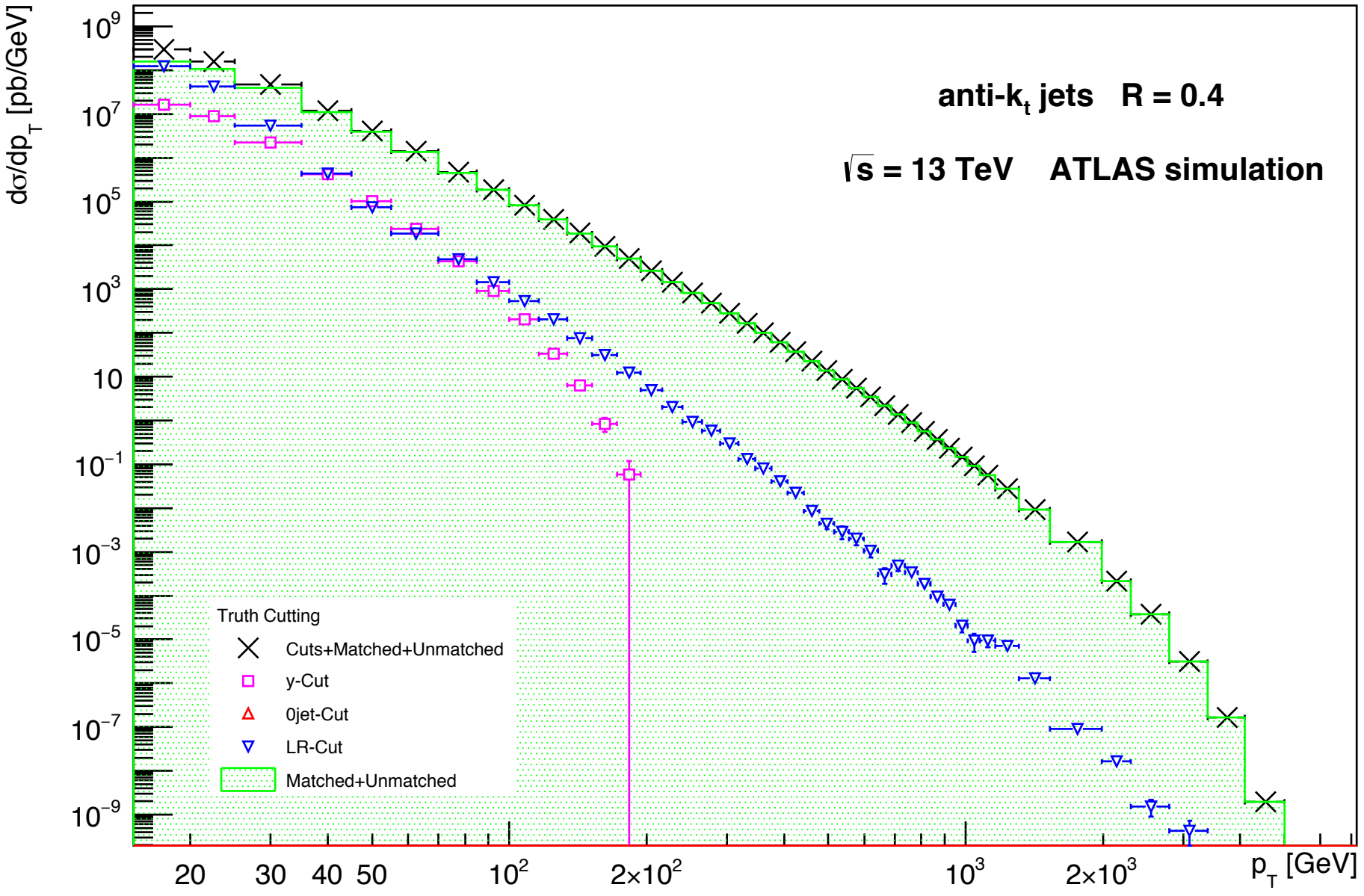
p_T(UNCALIB) < 15 GeV

in this event

Reco Jets: Cut Results, JZ1-7W



Truth Jets: Cut Results, JZ1-7W



Matching

- For each pair of reco and truth jets (i,j) was calculated

$$dR_{ij} = \sqrt{d\phi_{ij}^2 + dy_{ij}^2}$$

$d\phi_{ij}$ azimuthal angle and rapidity between i^{th} reco and j^{th} truth jet

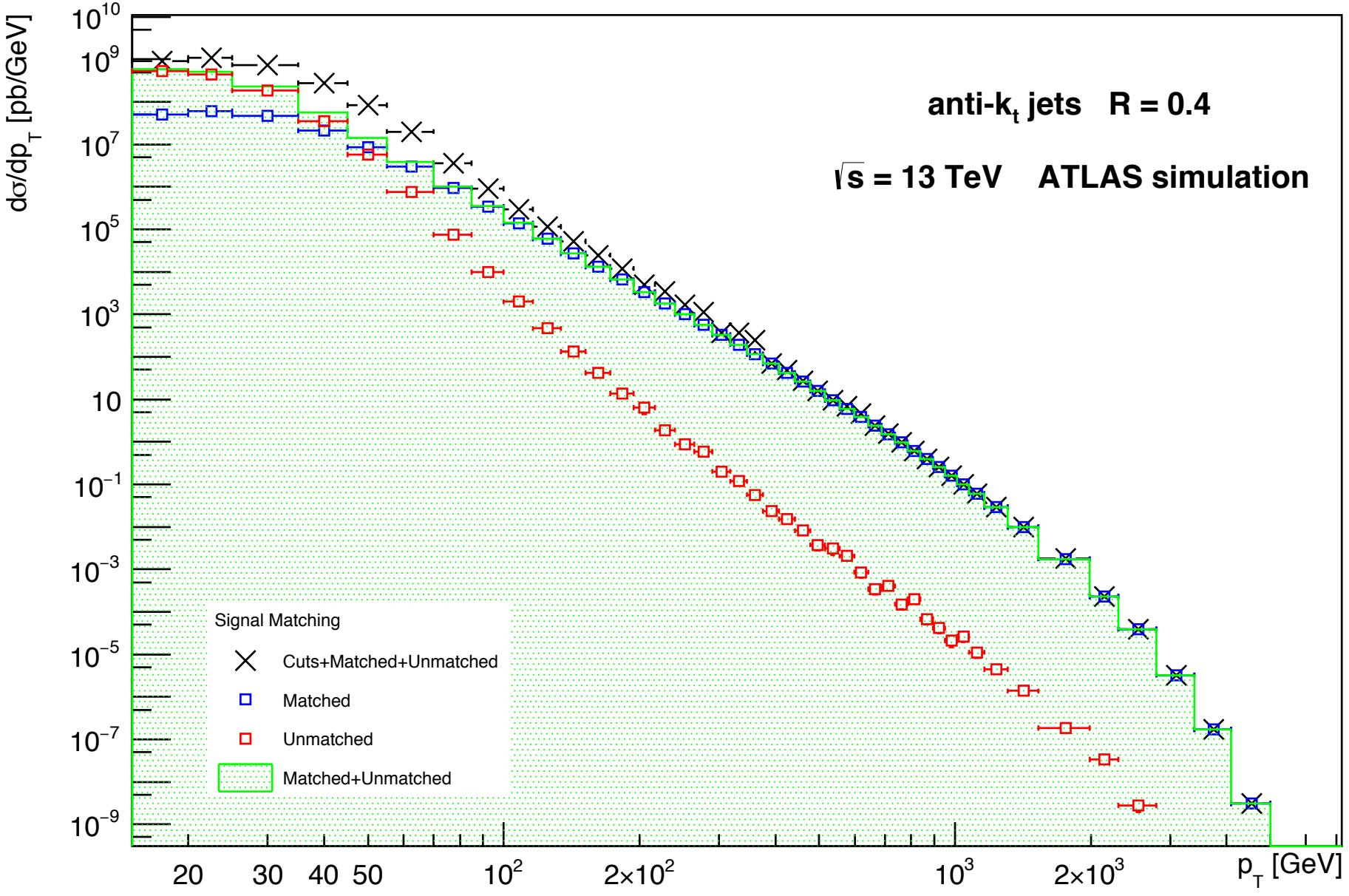
dy_{ij}

- If the minimum between all dR_{ij}'s fulfilled

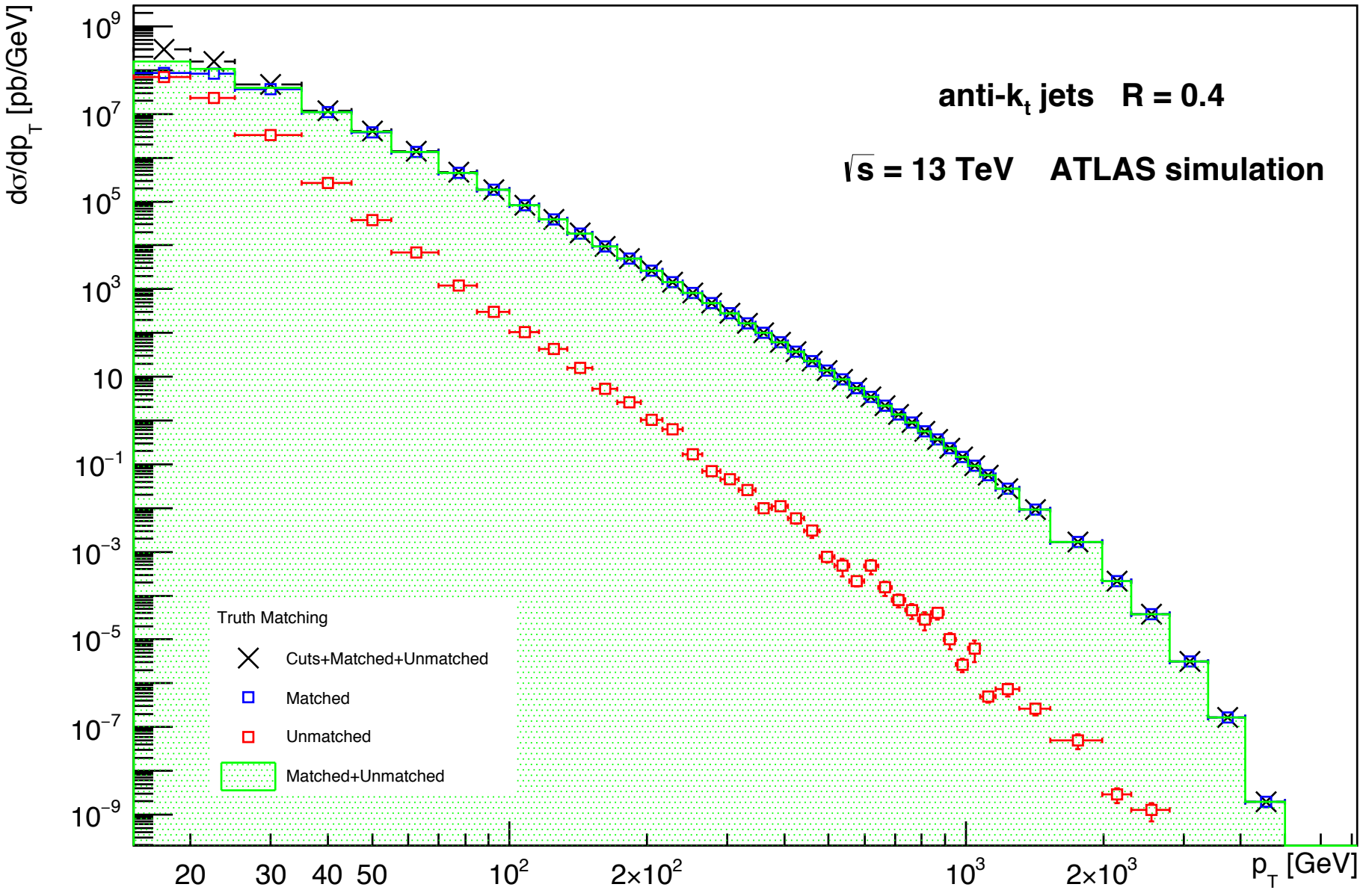
$$\min\left(dR_{ij}\right) = dR_{pq} < 0.2$$

- Jets (p,q) were matched

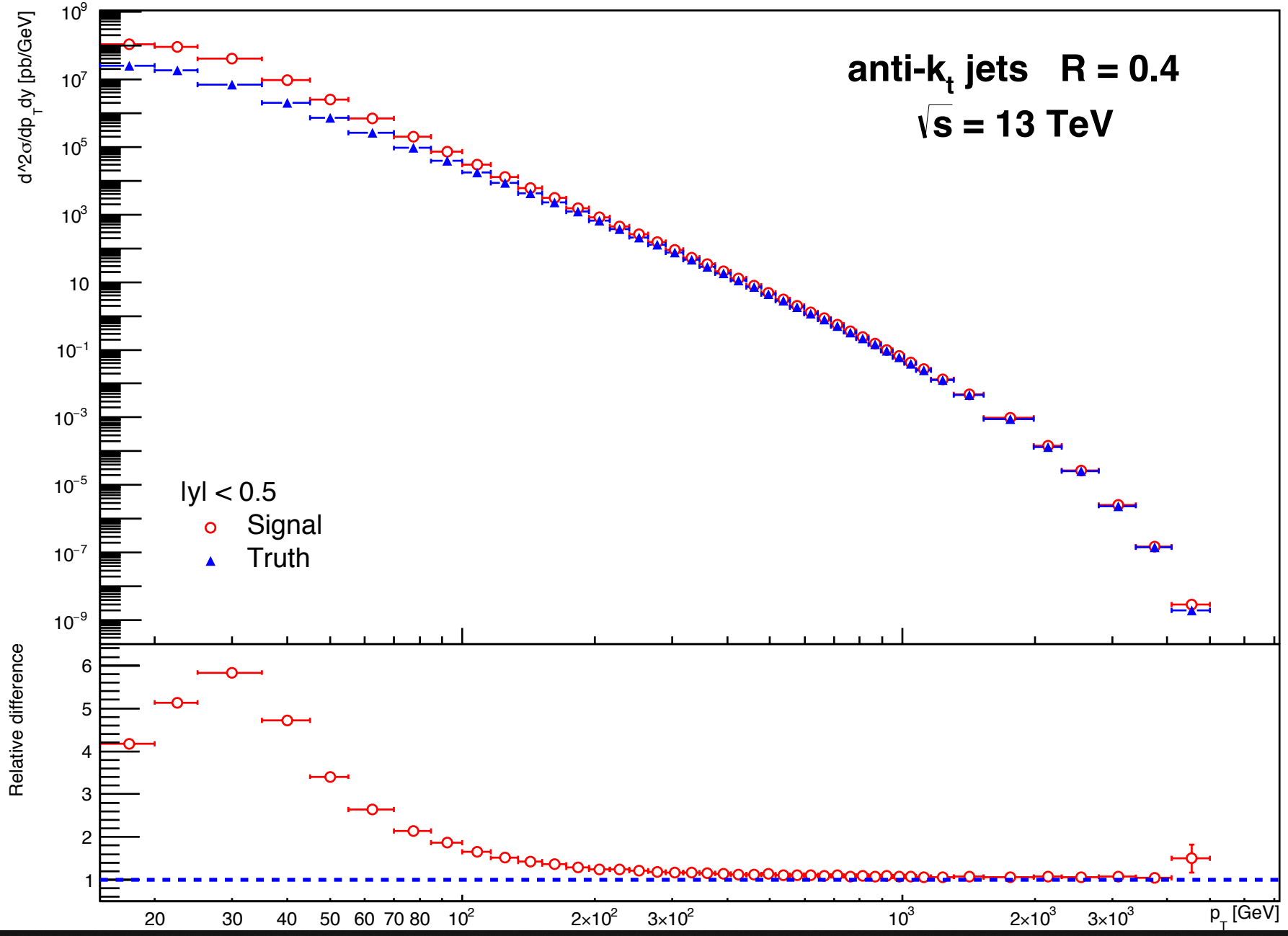
Reco Jets: Match Results, JZ1-7W



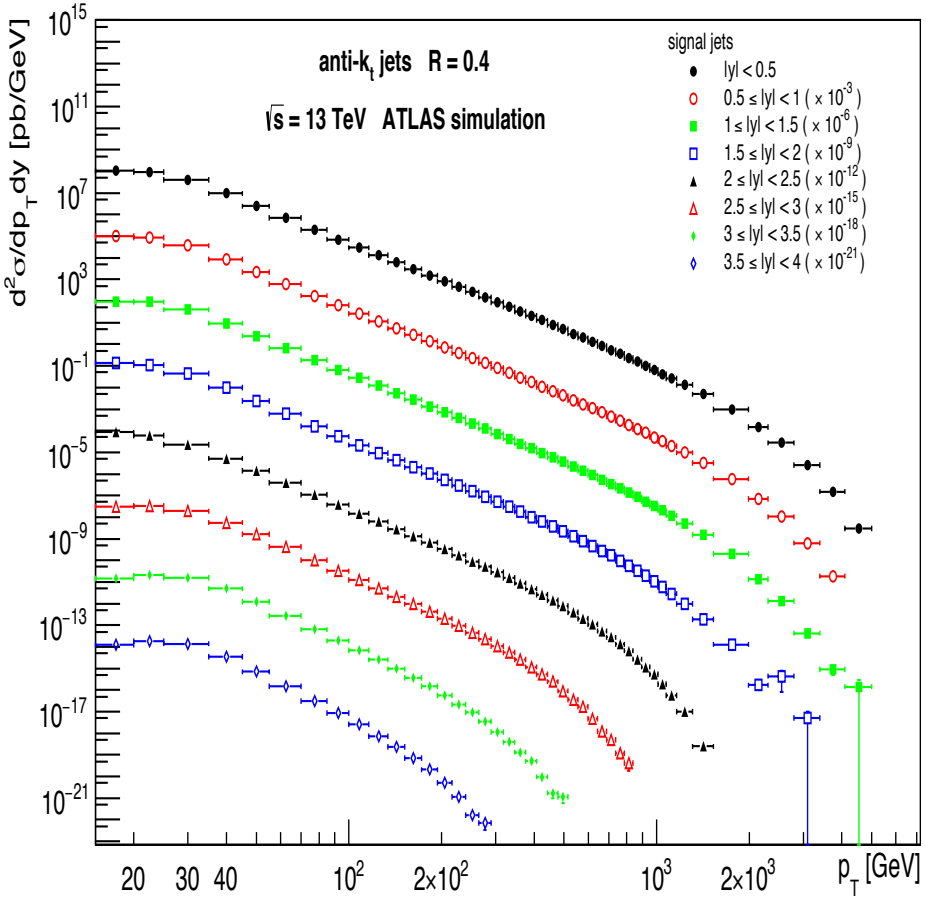
Truth Jets: Match Results, JZ1-7W

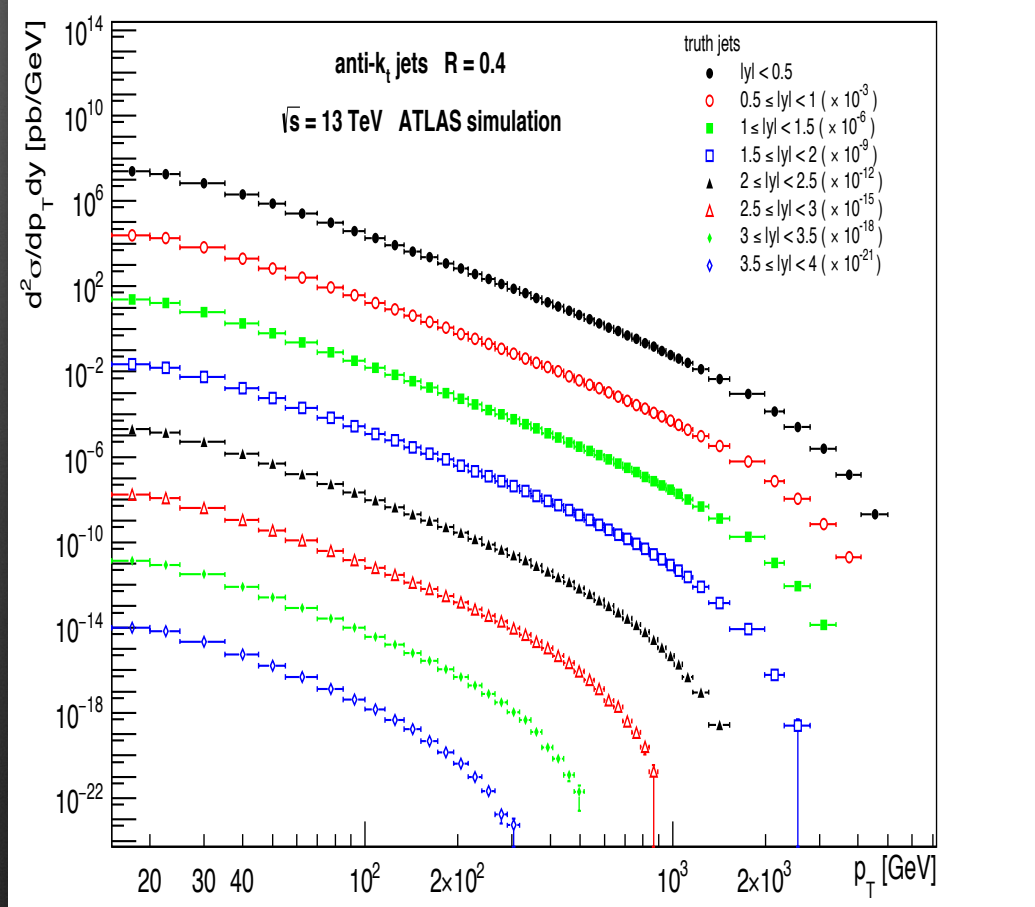


Reco & Truth: Matched+Unmatched, JZ1-7W



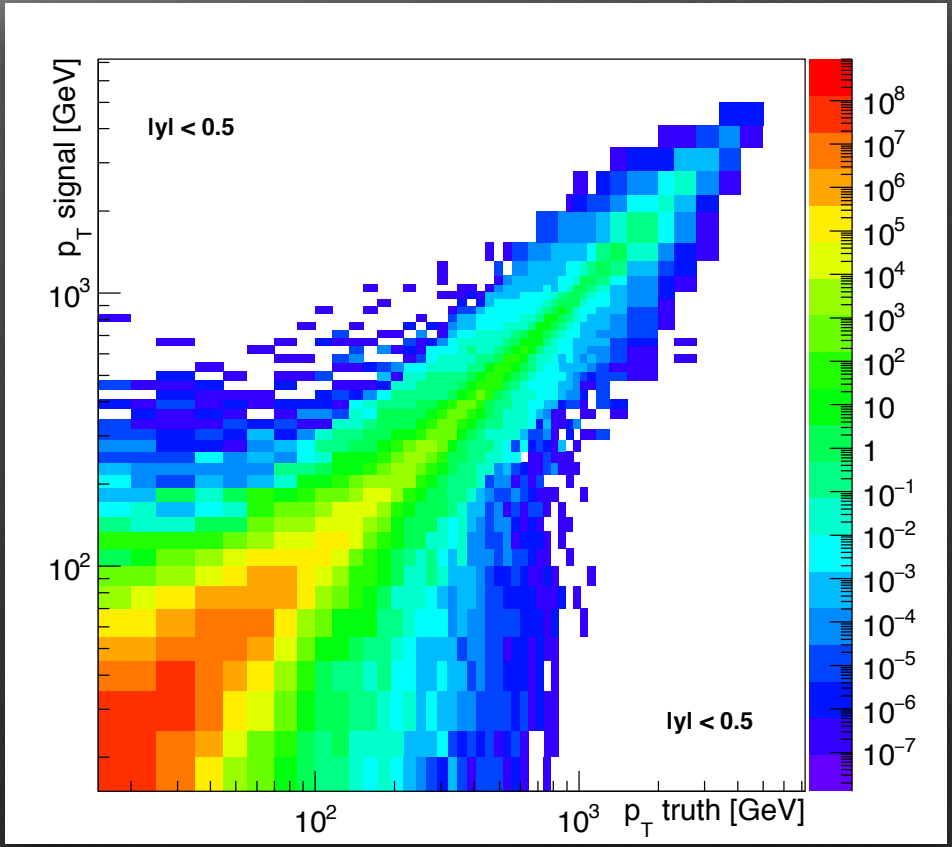
Reco & Truth Jets: All Rapidity Bins, JZ1-7W





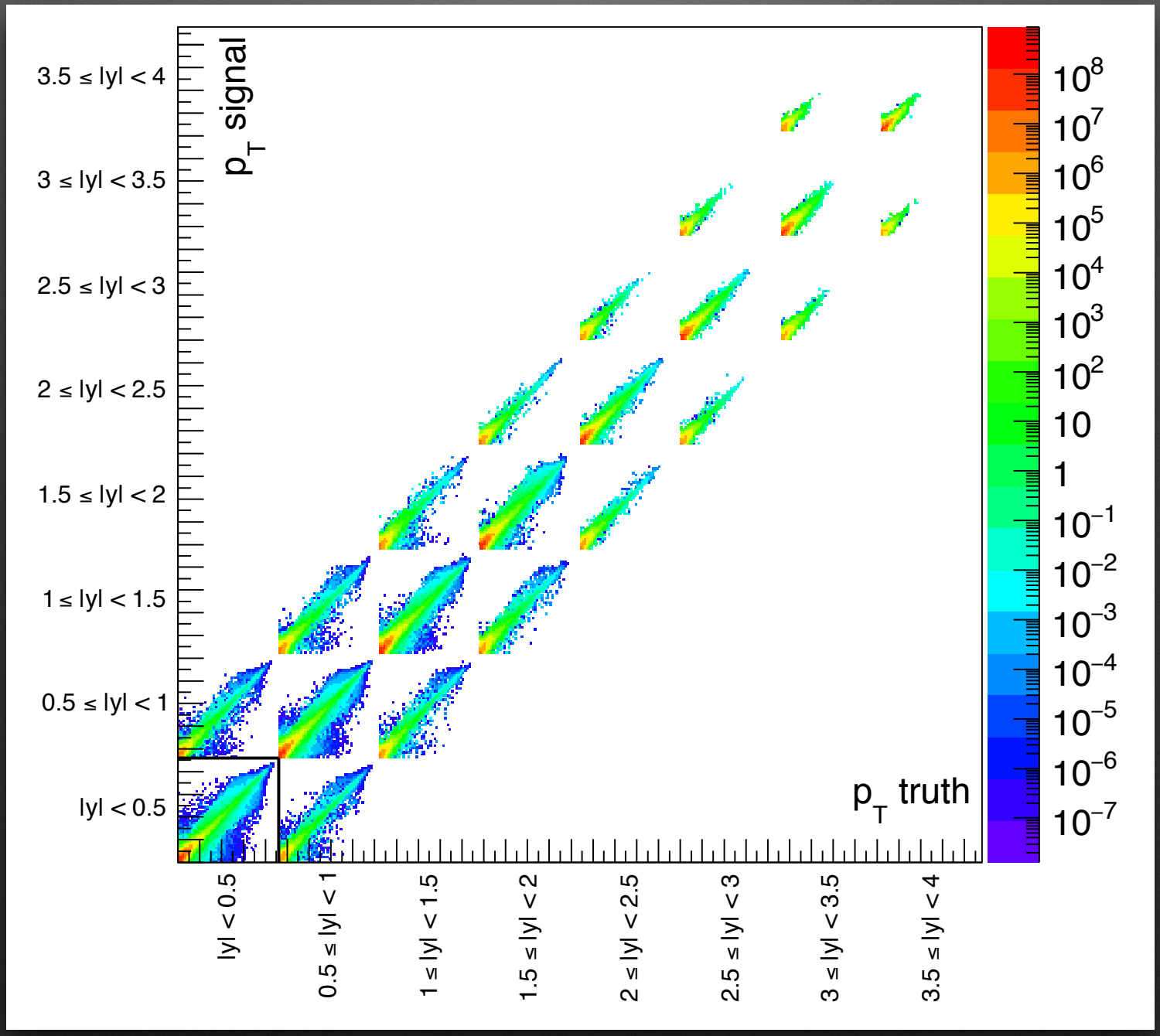
Unfolding

- Used Iterative Dynamical Stabilized unfolding method with one iteration
- Unfolding was done as
  1. SIMPLE UNFOLDING: matching truth and reco jets within the same rapidity bin.
     8 transfer matrices 46x46
  2. 2D UNFOLDING: migration between rapidity bins in matching procedure allowed.
     1 transfer matrix 368x368
- In the figure shown transfer matrix in |y|<0.5 region



- Library used:
  https://svnweb.cern.ch/trac/atlasusr/browser/cjmeyer/Unfolding

Transfer Matrix for 2D Unfolding



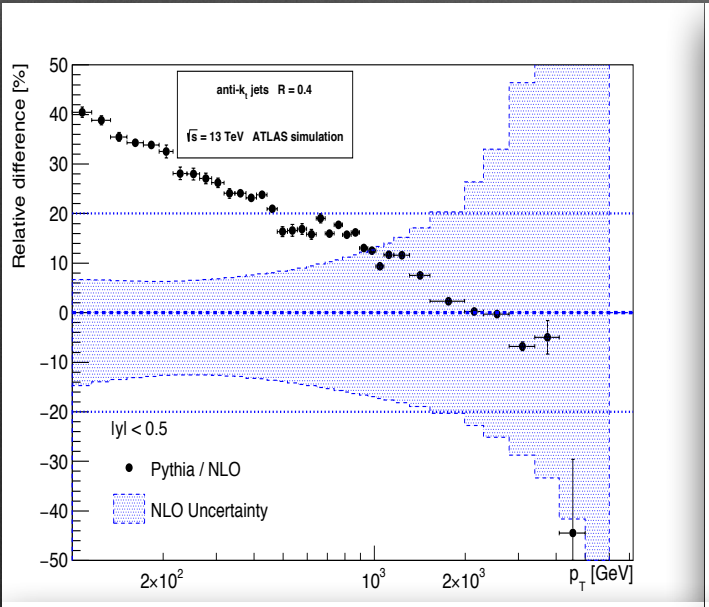
NLO pQCD Prediction

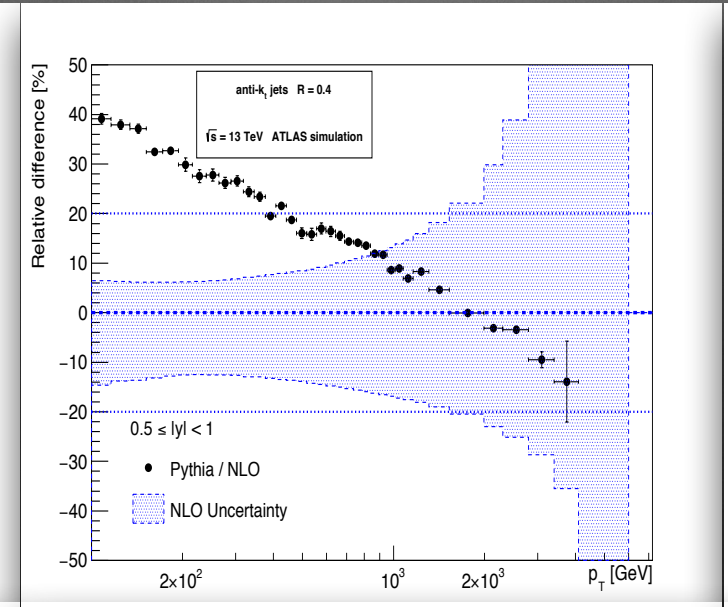
- Used Zdenek's calculations from SM Workshop
- CT10 NLO PDFs, μ_R & $\mu_F = p_T^{max}$
- Uncertainty calculated as the sum of α_S, PDF and Scale uncertainties

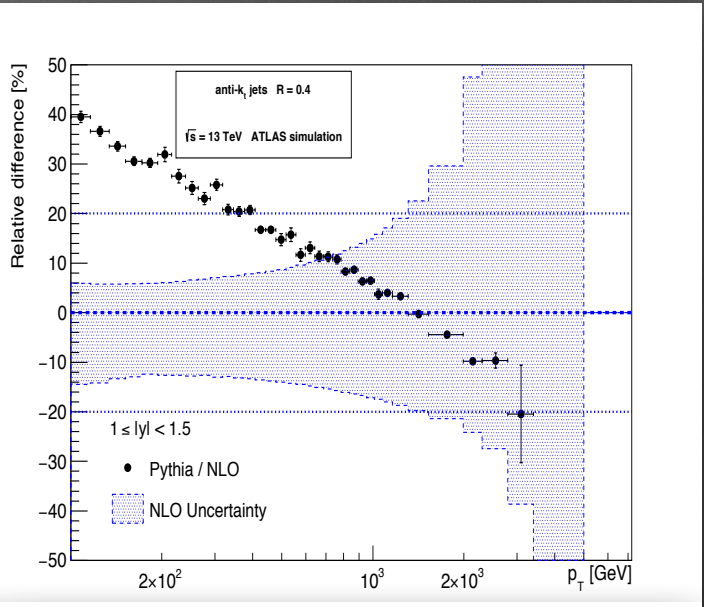
Path to NLO prediction:
`/afs/cern.ch/user/z/zhubacek/public/ForPavel/13TeV_260115/stand`

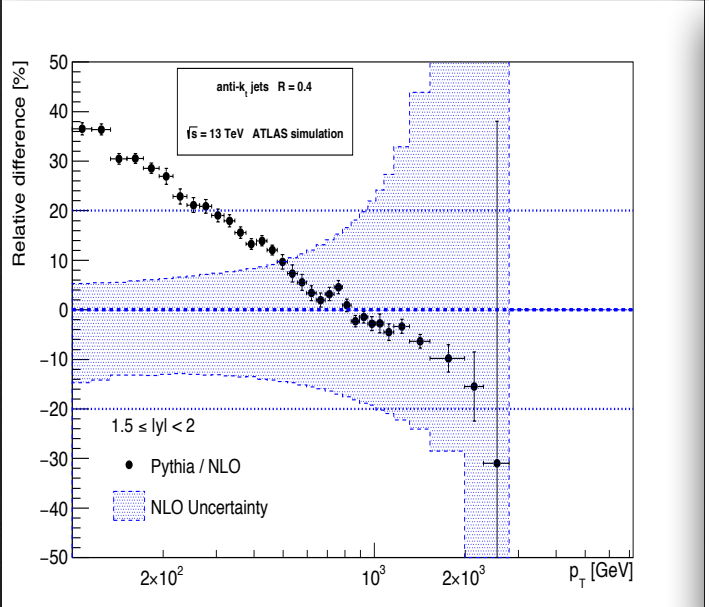
Histograms used: `CT10nlo/pdfs/xsec_pdf_0`
and from remaining histograms determined α_S, PDF and Scale uncertainty:

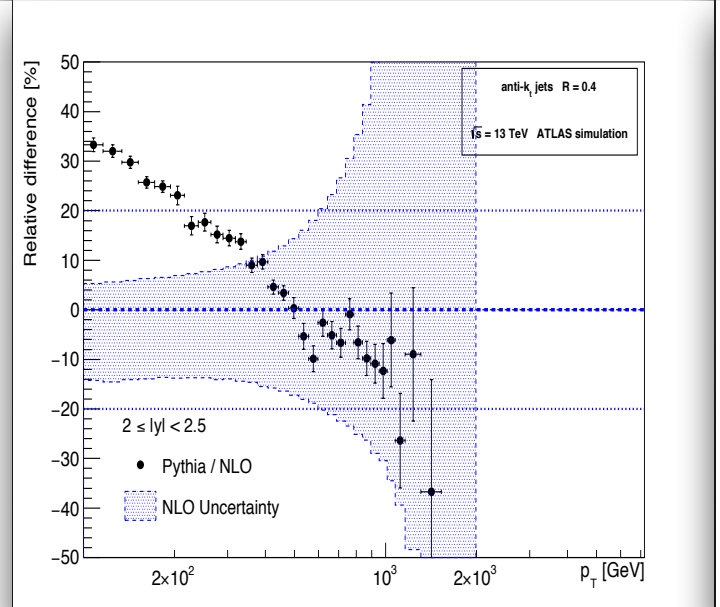
Comparison with CT10 NLO Prediction

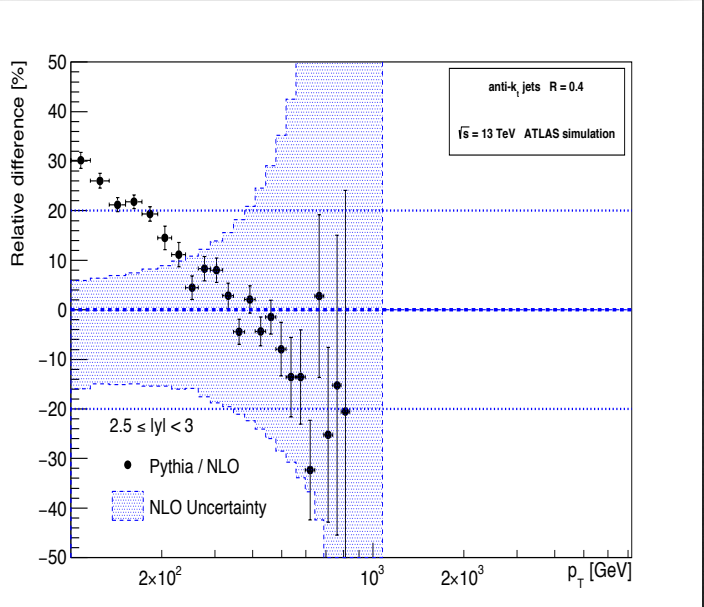












Conclusion

- Preliminary study of the double differential cross section in p_T na |y| from mc14_13TeV Pythia simulation
- Between Pythia (LO) and NLO pQCD there is difference < 40 % - in low pT region LO overwhelms the NLO whereas in high pT region the situation is reversed