Comparison of Fast Sim and Full Sim with QCD Events

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Introduction

- I compared the FastSim and FullSim productions of the Gumbo soup (QCD)
  - /CSA07AllEvents/CMSSW_1_6_7-CSA07-Gumbo-B1-PDAllEvents-ReReco-100pb/AODSIM
  - /CSA07AllEvents/CMSSW_1_6_9-FastSim-1205437066/AODSIM
  - I separated the samples into the different QCD pthat bins
  - About 40M events used per sample (almost all that exist)
  - MET and Jets are the focus

Pass Rates for MET+Jets Selection

- The beginning of the investigation is to check the pass rates for full sim and fast sim for a MET+jets selection
- The selection is taken from CMS-AN 2006/089 by Spiropulu and Yetkin, “Inclusive missing transverse energy + multijet SUSY search at CMS”
- This is the same selection that the UCSB group is taking as a model for our background studies
  - with our code we reproduce to 10% the LM1 signal efficiency quoted in the note

Pass Rates for MET+Jets Selection

Full Sim

QCD pthat bin	cross section	selection rate	MC stat. error
300-380	6.24nb	1.8e-05	4.6e-06
380-470	1.78nb	7.3e-05	9.1e-06
470-600	683pb	0.00021	1.5e-05
600-800	204pb	0.00062	4.4e-05
800-1000	35.1pb	0.0013	0.00010
1000-1400	10.9pb	0.0023	0.00035

Fast Sim

QCD pthat bin	cross section	selection rate	MC stat. error
300-380	6.24nb	6.9e-05	8.6e-06
380-470	1.78nb	0.00022	1.5e-05
470-600	683pb	0.00051	2.3e-05
600-800	204pb	0.0012	5.8e-05
800-1000	35.1pb	0.0027	0.00014
1000-1400	10.9pb	0.0055	0.00052

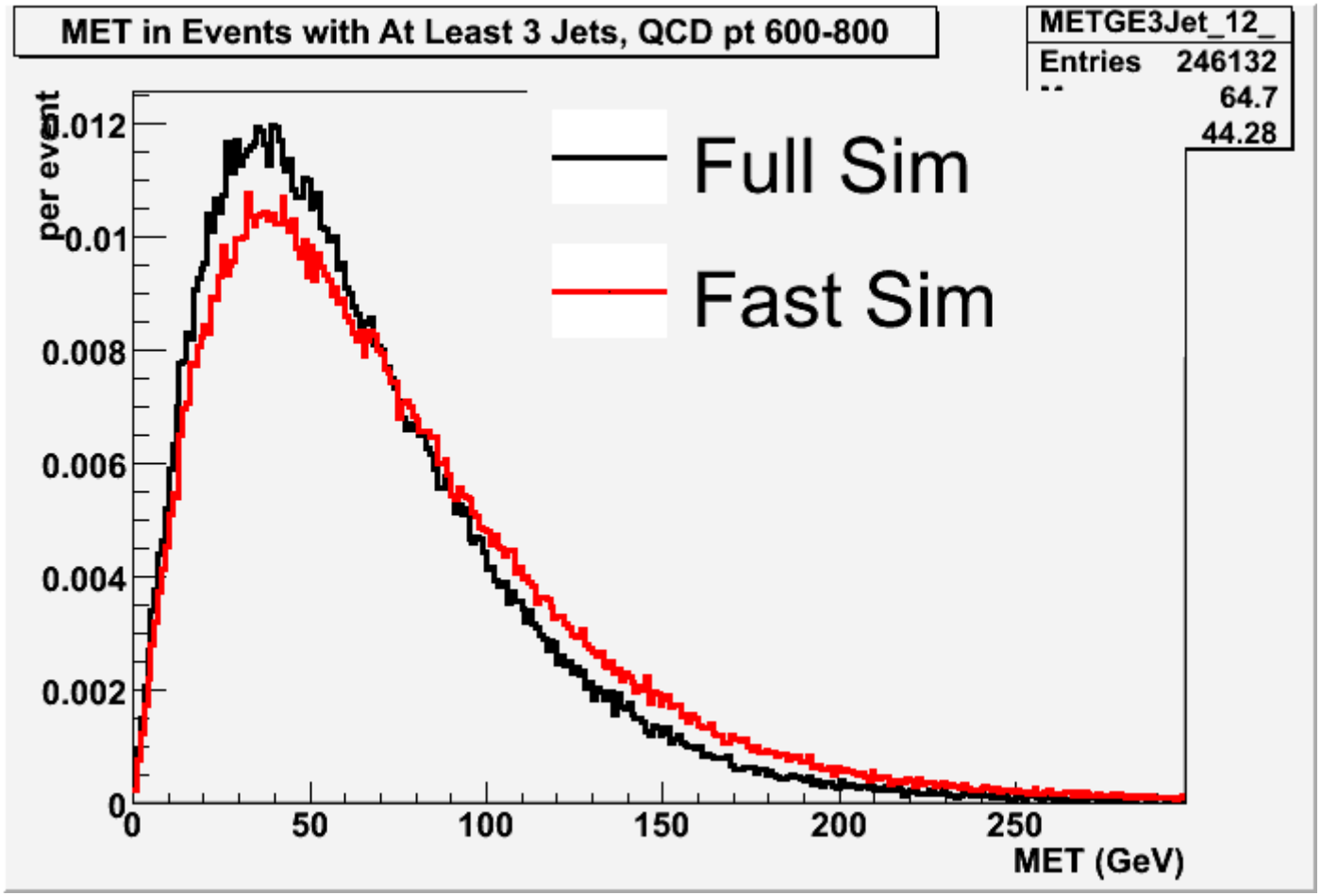
I show here the selection rates in bins high enough that stat errors are small enough and cross section high enough that the numbers are useful. Tables for all QCD Pthat bins are in the backup slides

Pass Rates for MET+Jets Selection

- This table shows the efficiencies of all cuts, relative to the previous step, for fast sim and full sim, in the pthat 600-800 bin
- Discrepancies in most steps, biggest in delta phi of MET with any jet of eT > 30 GeV uncorrected

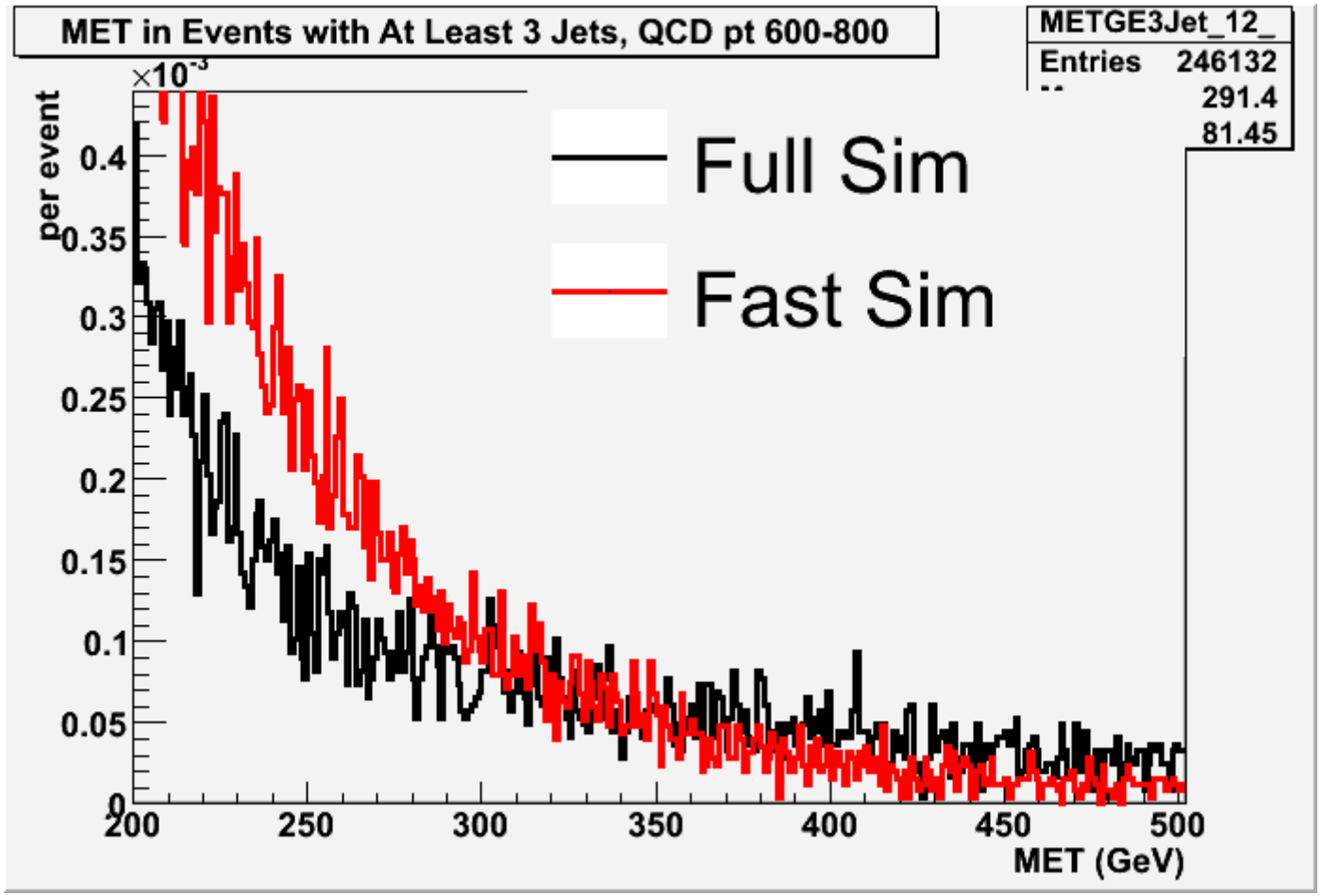
cut	**rel. eff. Full Sim**	**rel. eff. Fast Sim**
MET>200GeV	0.028	0.039
>=3 jets eT>30 GeV uncorr.	0.70	0.63
$\|eta\|$ lead jet < 1.7	0.78	0.68
dPhi met w/any jet > 0.3	0.075	0.15 ←
dPhi met 2nd jet > 0.35	0.87	0.90
R1, R2 > 0.5 (qcd angular)	0.73	0.79
lead j eT > 180, 2nd j eT > 110	0.87	0.70
HT > 500 GeV	0.99	0.94

MET in QCD Pthat 600-800



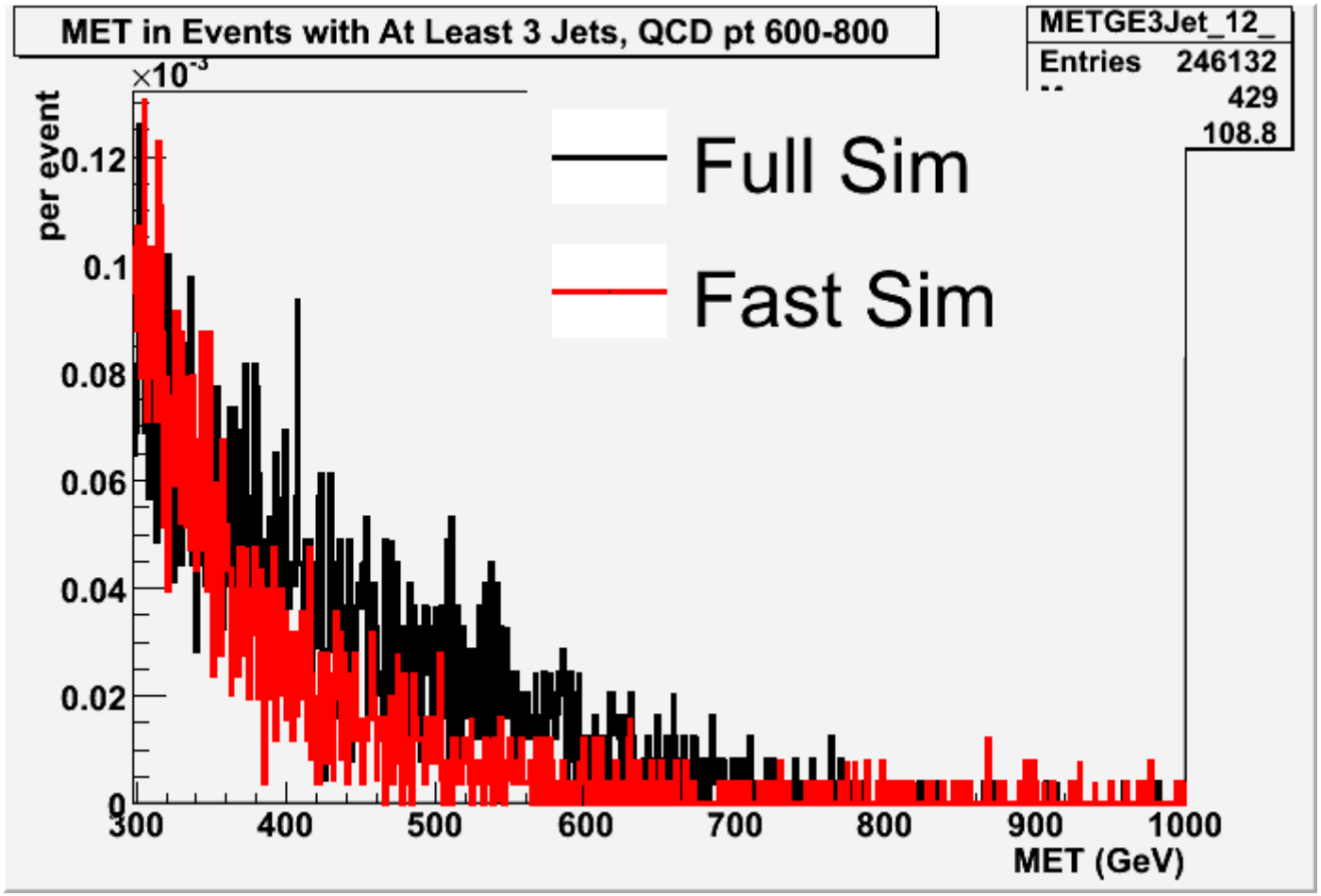
In this and the next two slides, I show MET in events with at least 3 jets with uncorrected eT>30 GeV, from QCD pthat 800-100

MET in QCD Pthat 600-800



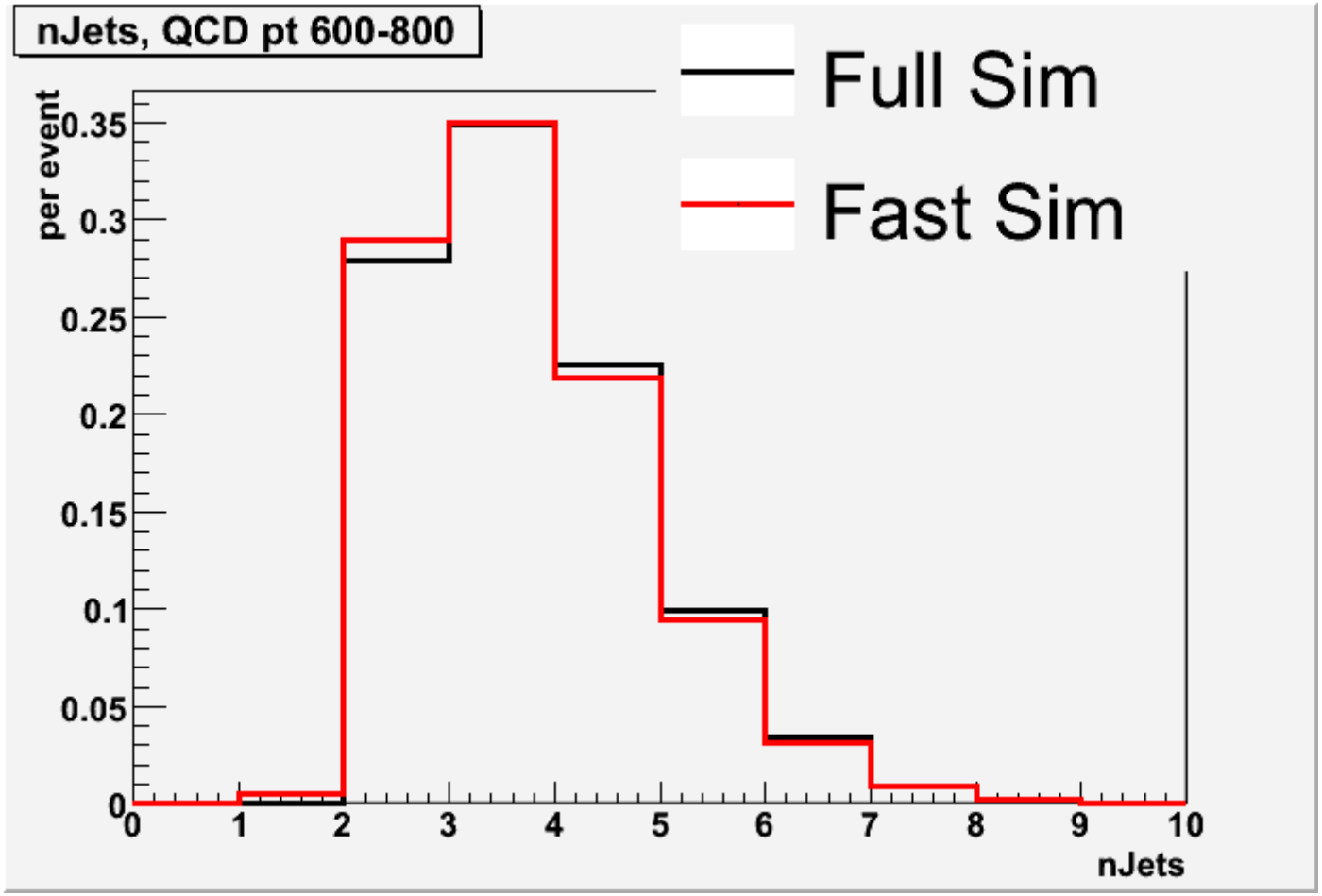
same histogram as previous slide, different x axis range

MET in QCD Pthat 600-800

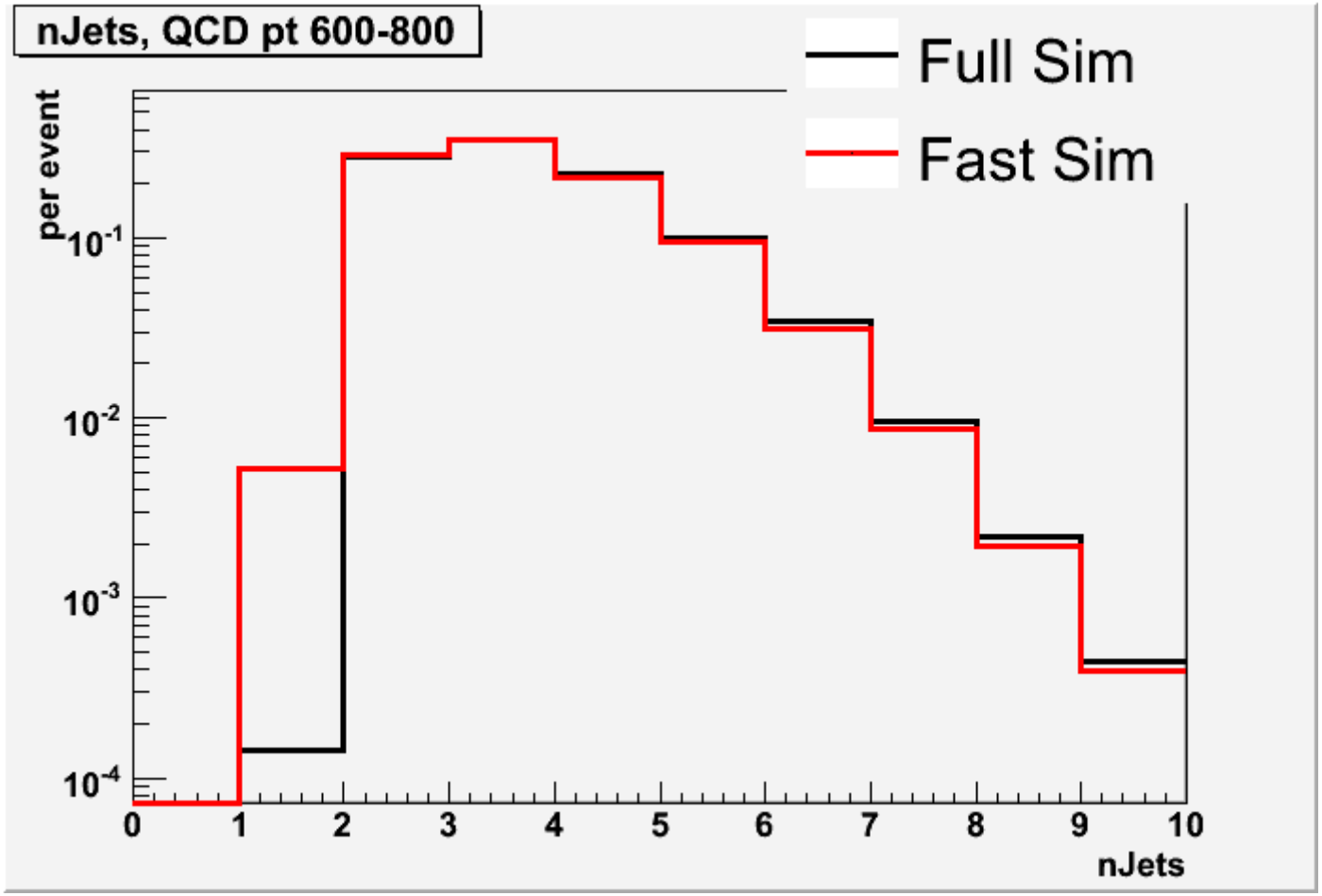


same histogram as previous slides, different x axis range

N Jets in QCD Pthat 600-800

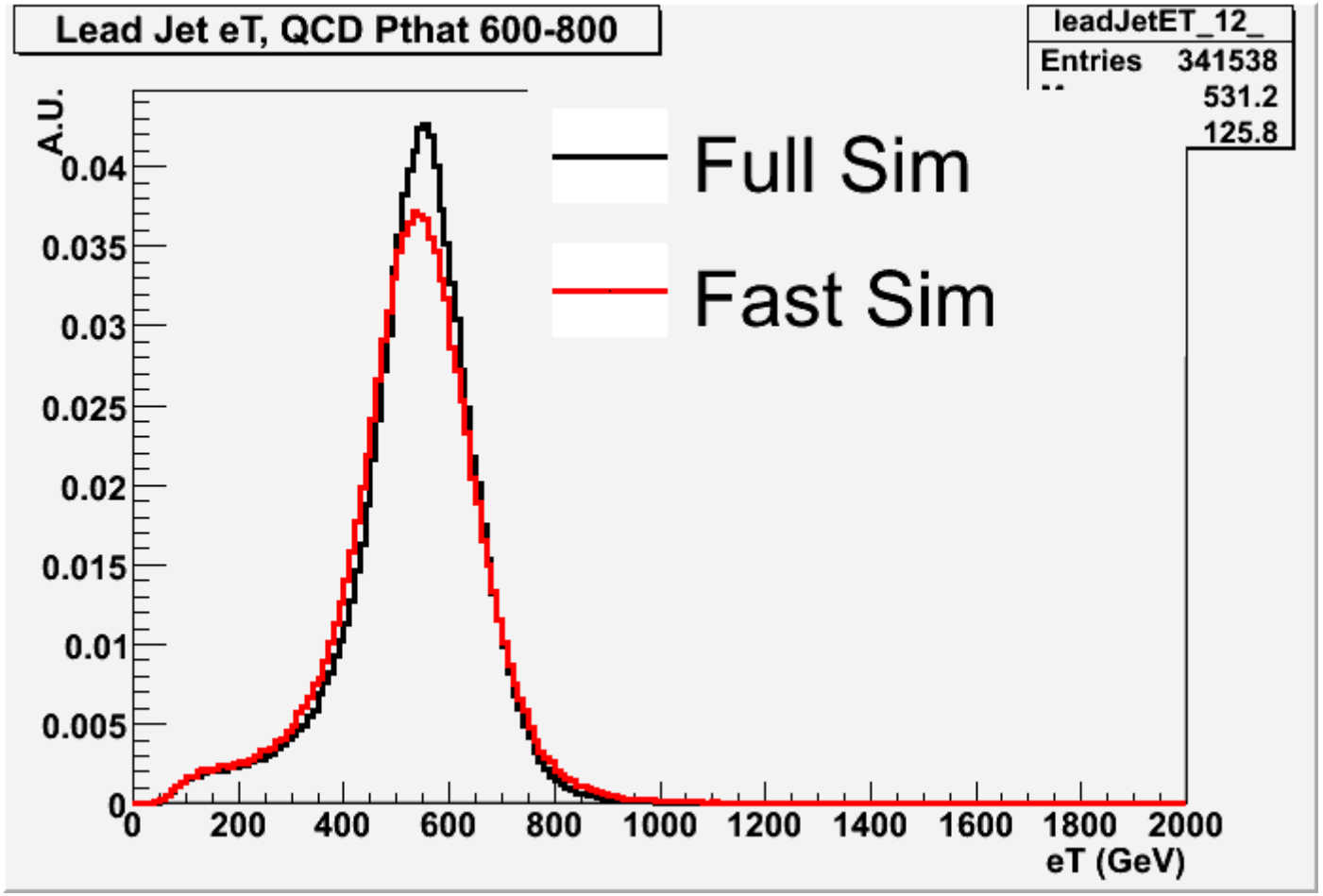


N Jets in QCD Pthat 600-800

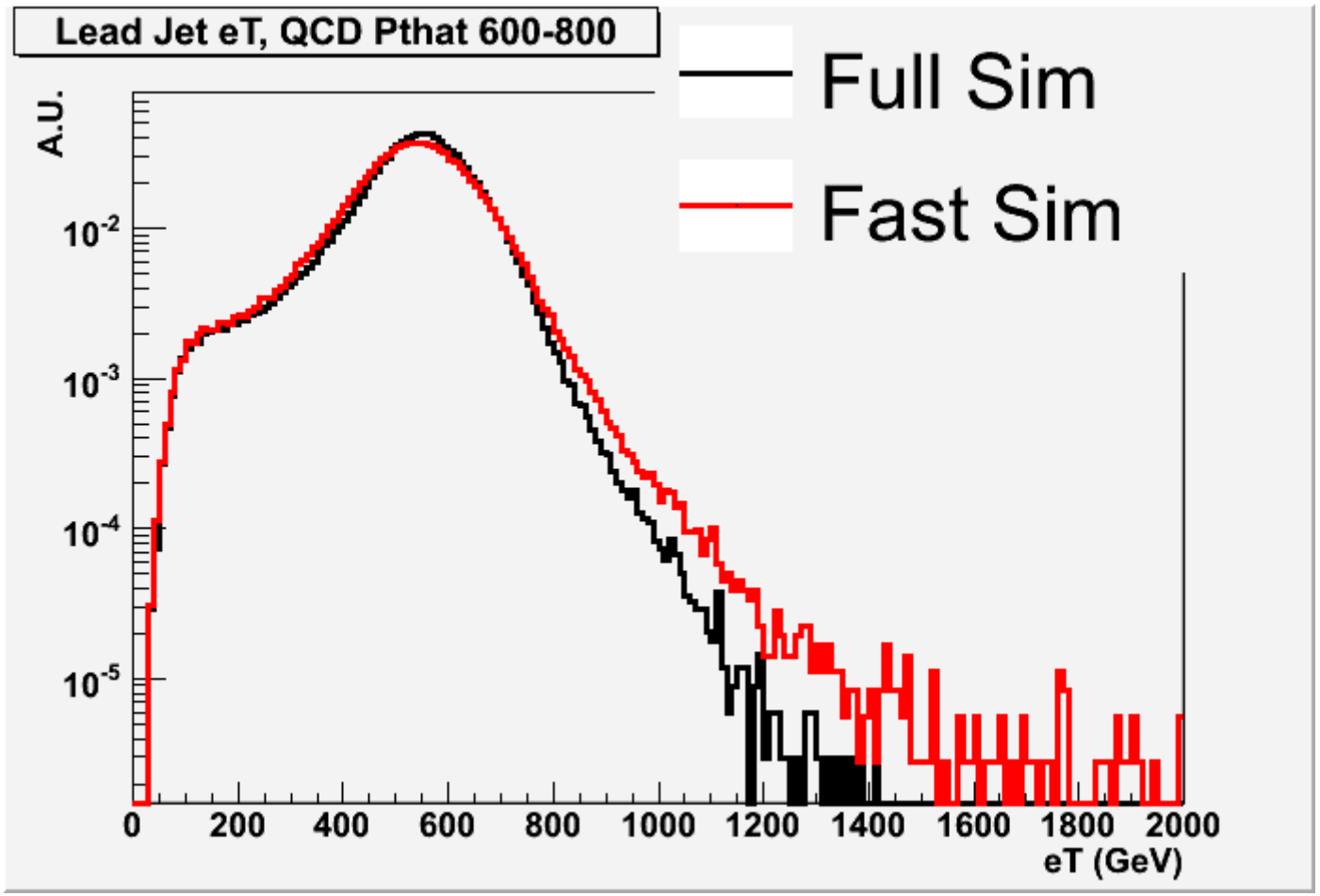


Disagreement in the 1-jet bin

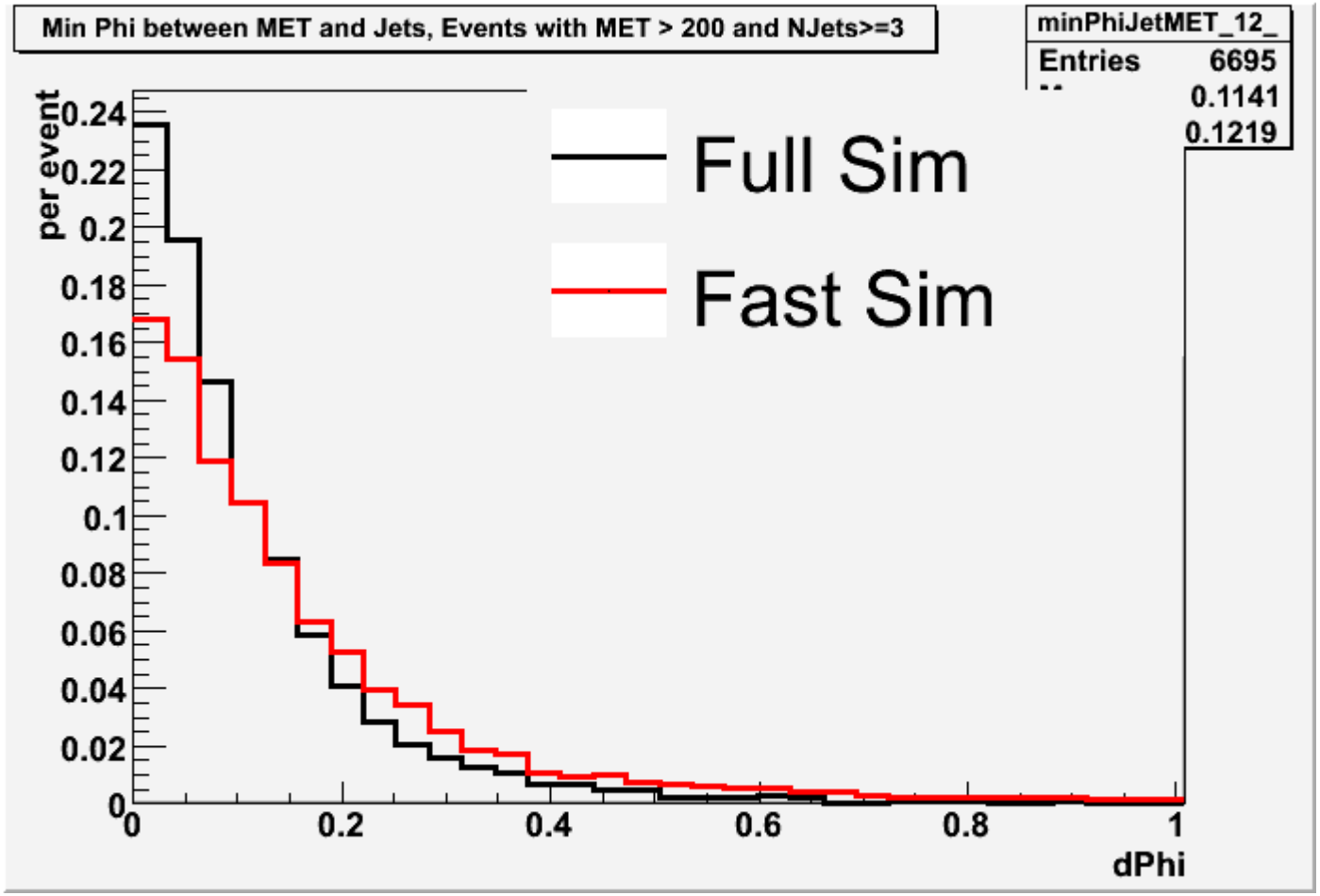
Lead Jet eT in QCD Pthat 600-800



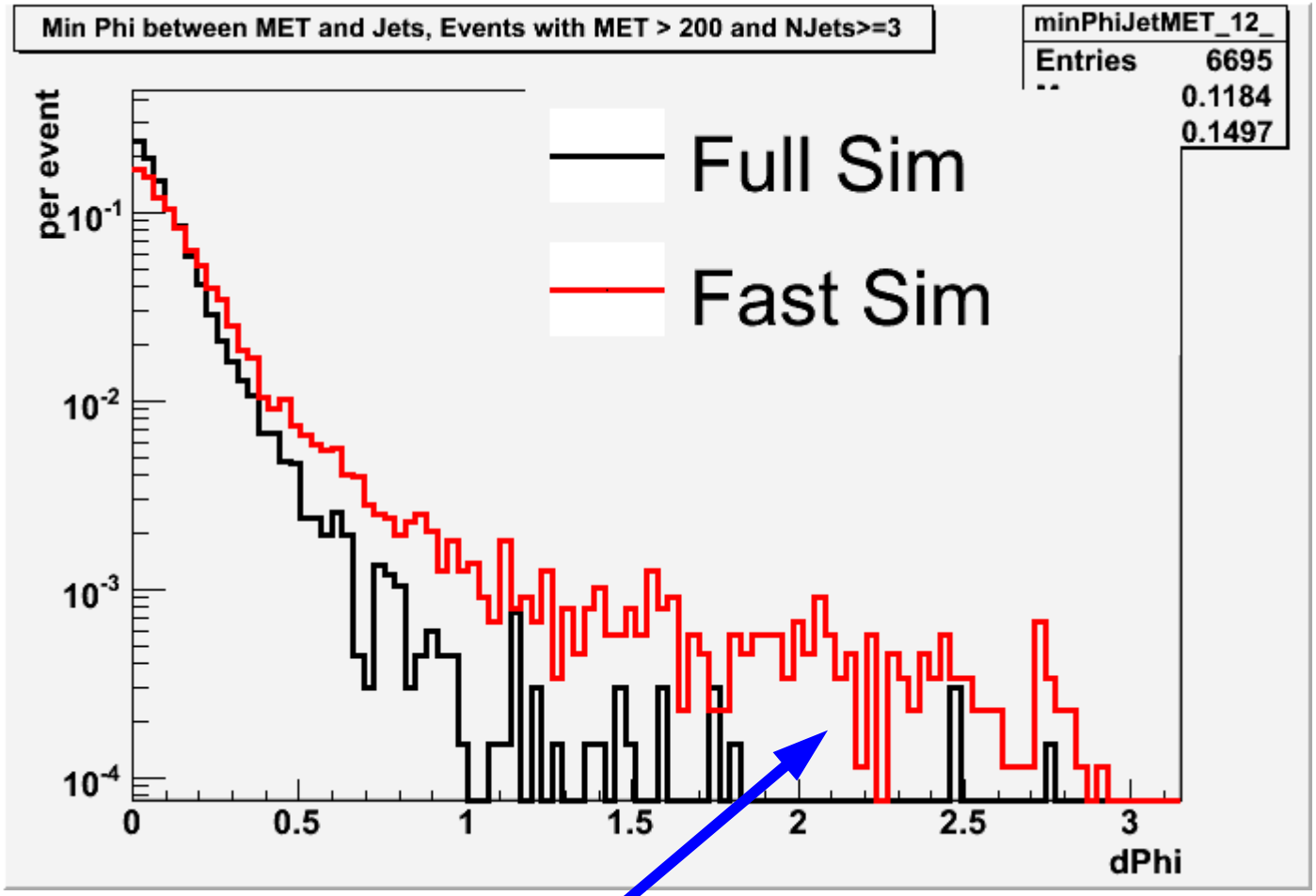
Lead Jet eT in QCD Pthat 600-800



Angle Between Jets and MET in QCD Pthat 600-800



Angle Between Jets and MET in QCD Pthat 600-800

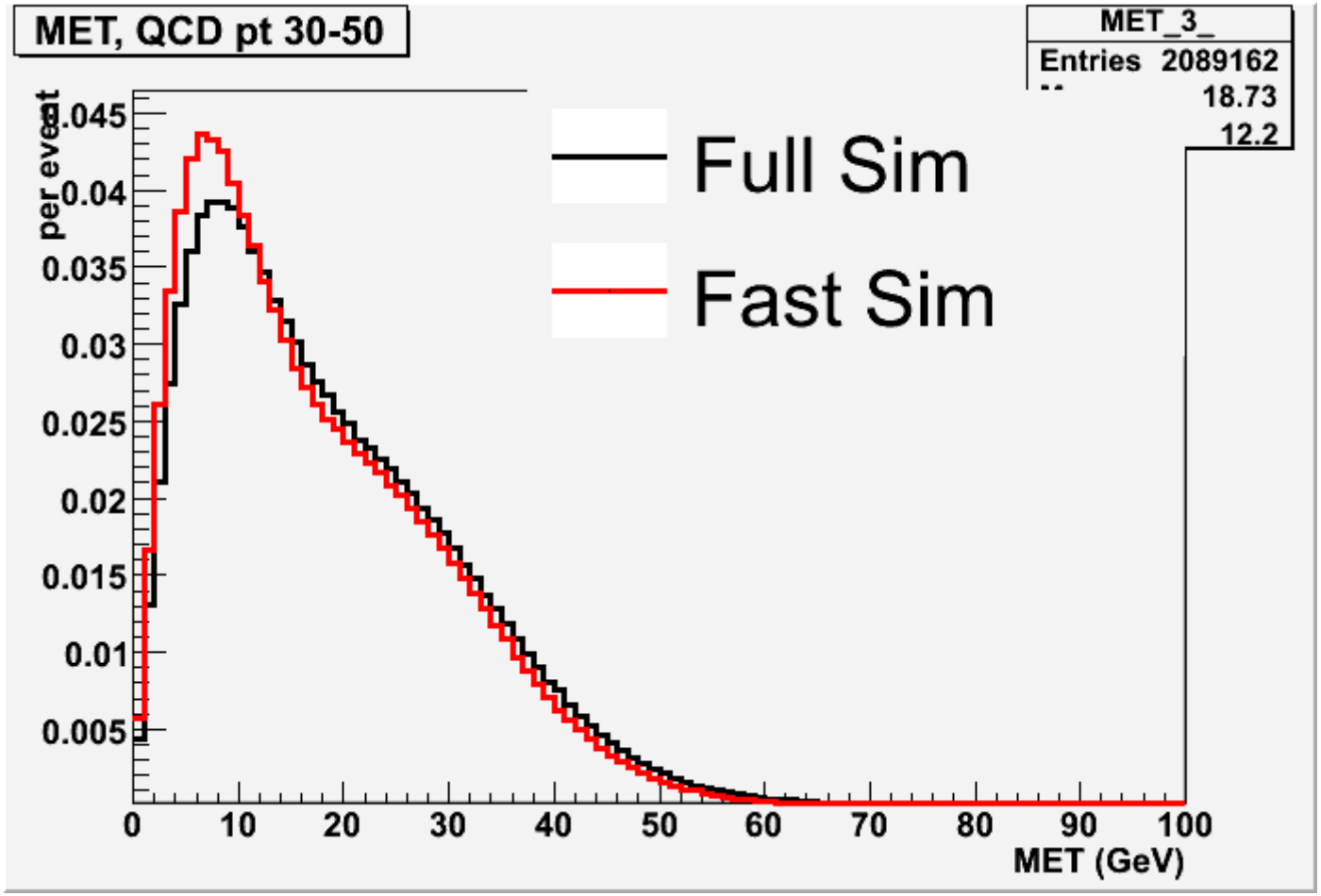


this tail is very strange given that >= 3 jets are required

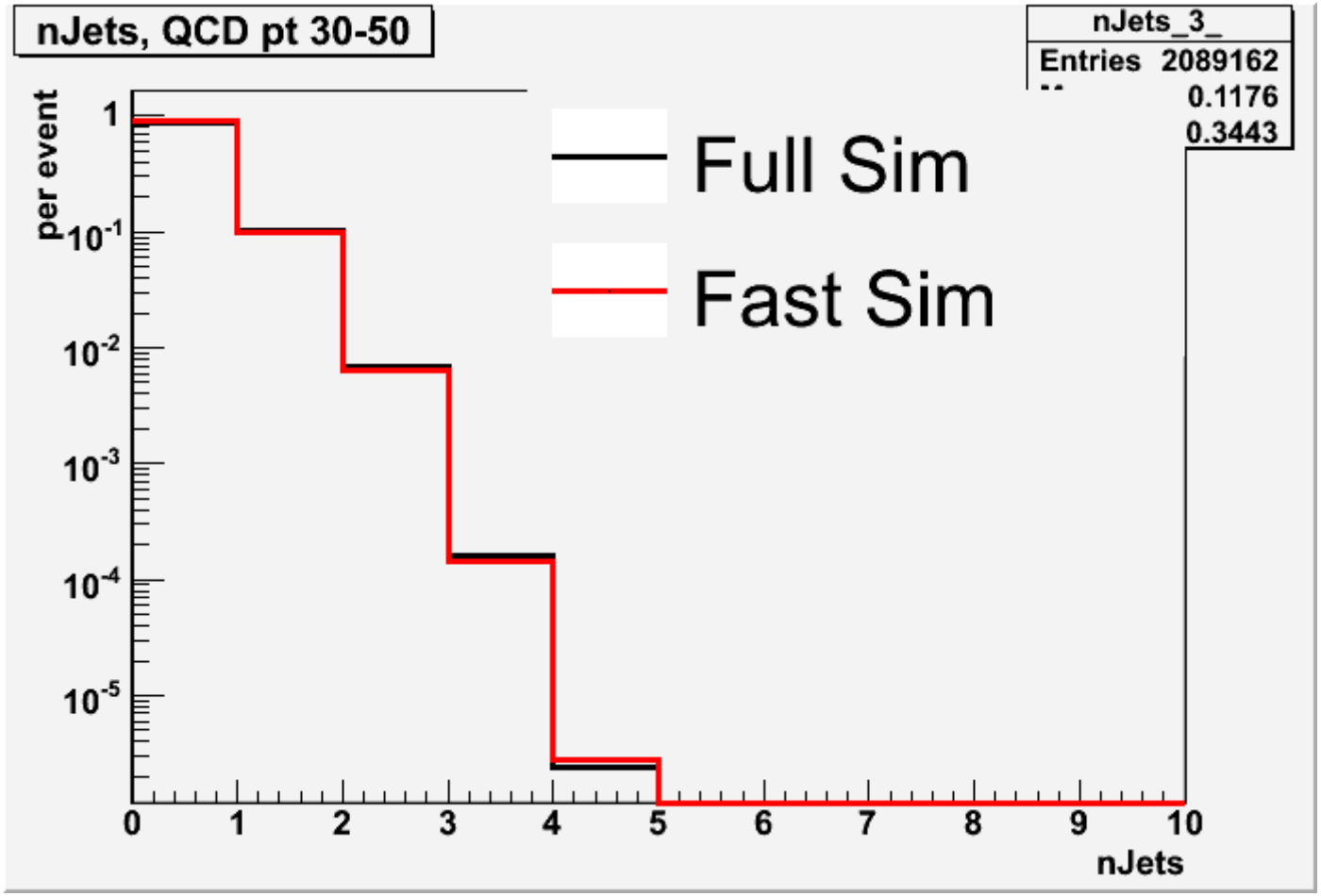
Other Pthat bins

- So far I have taken the QCD pthat bin 600-800 as an example
  - it is sufficiently energetic to pass MET+Jets selections
  - it has sufficient cross section (204pb from pythia) that we expect to see some events
  - It is typical of the high pthat bins (everything above 300)
- What about much lower bins?
  - In the pthat 30-50 bin:
    - better agreement in the MET distribution
    - better agreement in number of jets with eT > 30 GeV uncorrected
    - but there are different discrepancies
    - this bin is much less relevant for SUSY searches

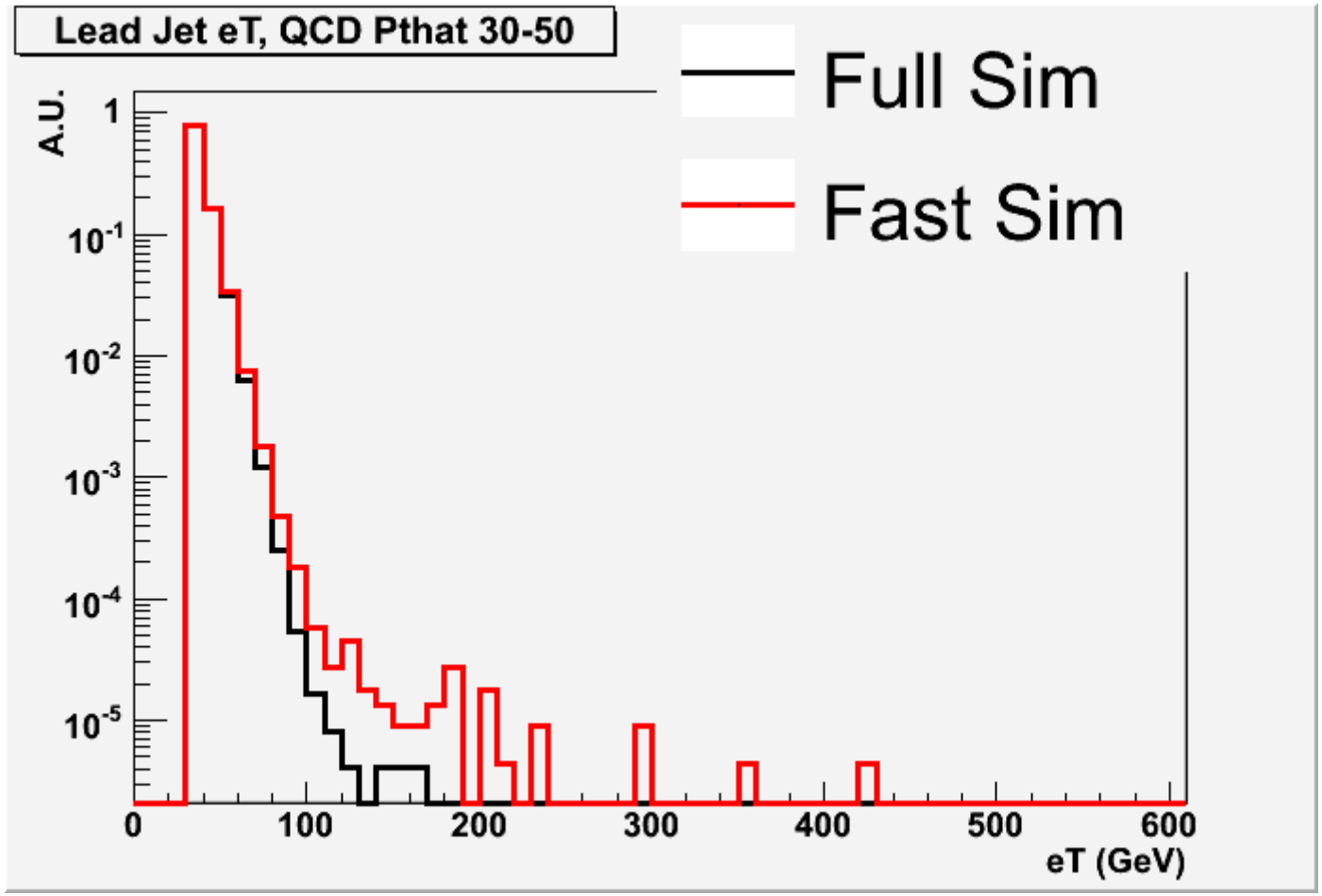
MET in QCD Pthat 30-50



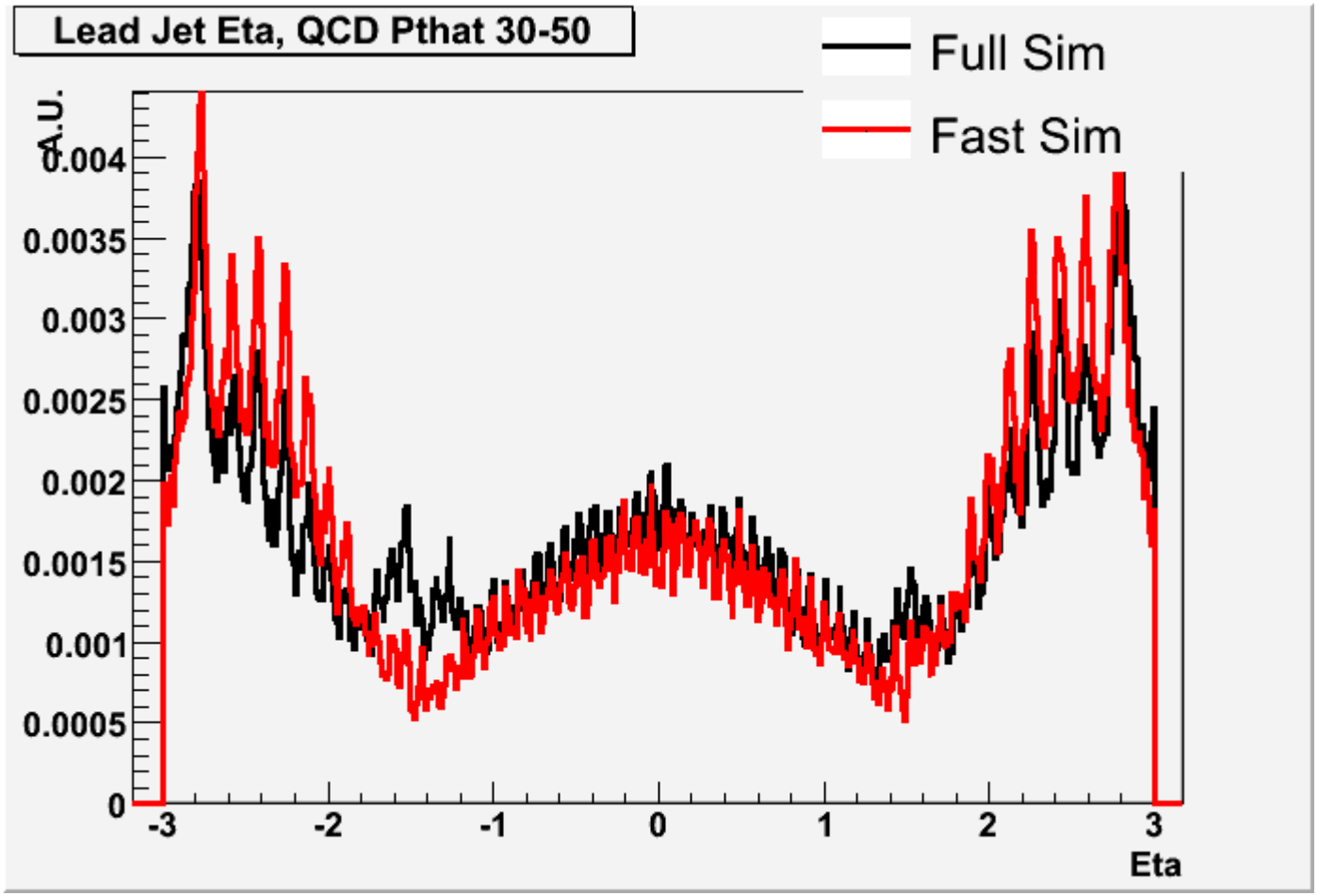
N Jets in QCD Pthat 30-50



Lead Jet eT in QCD Pthat 30-50

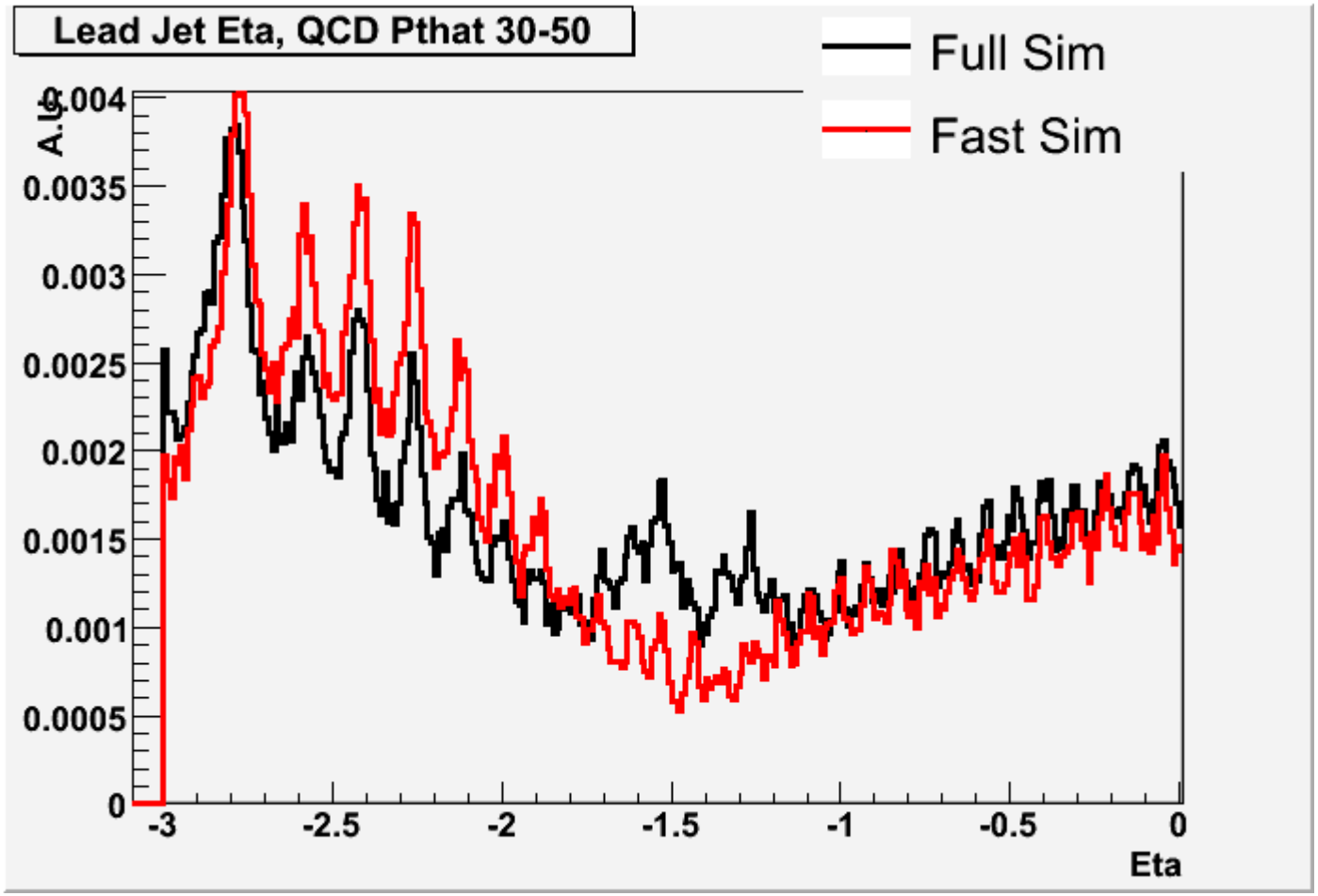


Lead Jet Eta in QCD Pthat 30-50



- **something strange in the jet eta distributions in low pthat bins**
- **discrepancy doesn't show up in higher pthat bins**

Lead Jet Eta in QCD Pthat 30-50



- **something strange in the jet eta distributions in low pthat bins**
- **discrepancy doesn't show up in higher pthat bins**

Summary

- FastSim QCD events in the pthat range 300-1400 are selected at about twice the rate by a model MET+jets selection
- Largest discrepancy seems to be angles between MET and jets.
  - High MET and jets in general are not perfectly reproduced by FastSim
- If you use FastSim QCD in your analysis, be aware that the tails of the MET and jets distributions aren't well reproduced
  - There are probably others in corners of phase space I haven't probed
  - Don't trust Full Simulation all the way either....
- I have many more plots than can fit in this presentation and I do not know what particular corner of phase space interests you. I'm happy to share whatever other comparisons I have offline

Backup

Complete table for MET+Jets Selection, Full Sim

QCD pthat bin	cross section	selection rate	MC stat. error
0-15	55mb	0	1.6e-07
15-20	1.46mb	0	7.0e-07
20-30	0.63mb	0	4.3e-07
30-50	0.163mb	0	4.8e-07
50-80	21.6ub	0	4.9e-07
80-120	3.08ub	0	1.0e-06
120-170	494nb	0	1.0e-06
170-230	101nb	0	1.1e-06
230-300	24.5nb	2.4e-06	1.7e-06
300-380	6.24nb	1.8e-05	4.6e-06
380-470	1.78nb	7.3e-05	9.1e-06
470-600	683pb	0.00021	1.5e-05
600-800	204pb	0.00062	4.4e-05
800-1000	35.1pb	0.0013	0.00010
1000-1400	10.9pb	0.0023	0.00035
1400-1800	1.6pb	0.0055	0.00052
1800-2200	145fb	0.0083	0.00089
2200-2600	23.8fb	0.011	0.0014
2600-3000	4.29fb	0.020	0.0020
3000-3500	0.844fb	0.026	0.0020
3500-inf	0.108fb	0.030	0.0026

n

Complete table for MET+Jets Selection, Fast Sim

QCD pthat bin	cross section	selection rate	MC stat. error
0-15	55mb	0	1.6e-07
15-20	1.46mb	0	7.1e-07
20-30	0.63mb	0	4.3e-07
30-50	0.163mb	0	4.7e-07
50-80	21.6ub	0	4.7e-07
80-120	3.08ub	0	9.6e-07
120-170	494nb	1.0e-06	1.0e-06
170-230	101nb	2.1e-06	1.5e-06
230-300	24.5nb	1.4e-05	4.0e-06
300-380	6.24nb	6.9e-05	8.6e-06
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800-1000	35.1pb	0.0027	0.00014
1000-1400	10.9pb	0.0055	0.00052
1400-1800	1.6pb	0.0090	0.00061
1800-2200	145fb	0.013	0.0011
2200-2600	23.8fb	0.016	0.0016
2600-3000	4.29fb	0.023	0.0020
3000-3500	0.844fb	0.030	0.0020
3500-inf	0.108fb	0.040	0.0026

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