

SUSY work & plans

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For the CAT SUSY group

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Outline

- Introduction
- Software
- Datasets
- Selections
- Some plots
 - Comparing SUSY points
 - Comparing AtIFast with fullAOD
 - Lepton efficiency
 - MissingEt resolution
 - Quick TMVA study
- Plans

Introduction

- Recently started effort
- Quite a few people – but all very busy with other stuff so progress so far has been slow
- Many of us are learning:
 - SUSY analysis for first time
 - ATLAS analysis for first time
 - Both (like me)
- So far just started thinking about what to work on and developing a software framework
- We are testing / exercising the Atlas Physics Analysis Tools software
 - Would be much simpler & quicker to use CBNT ntuples but we think this is the wrong way to go – for real data analysis will need the AOD etc..
- CAT SUSY group have
 - Wiki – <https://unimon.cern.ch/twiki/bin/view/Main/AtlasSusyCernLocal>
 - Weekly meeting on Tuesday at 13:15
 - Mailing list: atlas-cat-phys-susy@cern.ch
 - CVS space: `kserver:atlas-sw.cern.ch:/atlas-cvsgroups/catsusy/SFrame`

Software

- New package SUSYView based on EventView
 - Modular analysis
 - Can be easily be configured to do useful things without writing new C++
 - Pretty new so still finding/fixing bugs
 - Presented to SUSY working group by Amir:
<http://agenda.cern.ch/askArchive.php?base=agenda&categ=a062126&id=a062126s0t1/transparencies>
 - Reasonable interest from other SUSY analysts already (3 groups have contacted me about using it)
 - Wiki on how to use it at:
<https://twiki.cern.ch/twiki/bin/view/Atlas/SusyView>
 - Can run on full AOD or AtlFast AOD
 - Produces a Reco & Truth ntuple with truth matching linking the two
- Root based analysis package SFrame
 - For iterating over the SUSYView ntuple
 - Interface with TMVA, ROOFit,

Data samples we have looked at

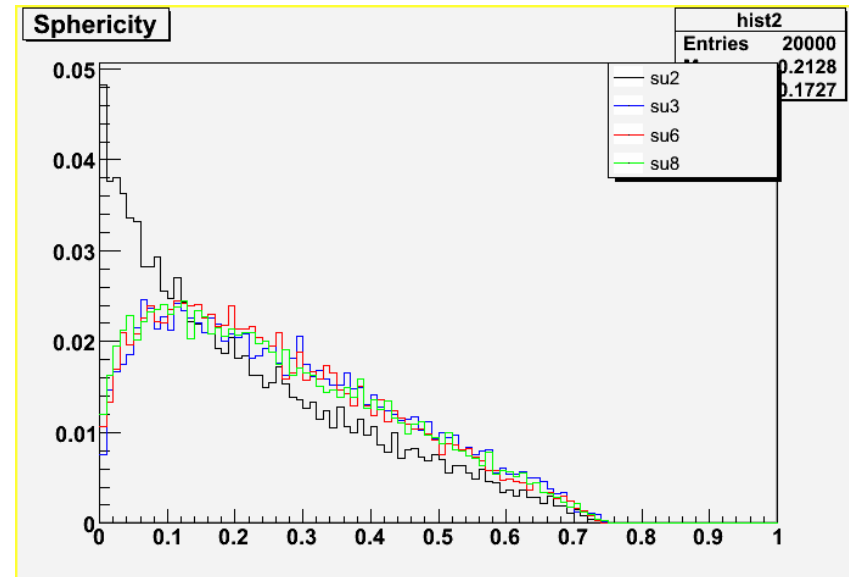
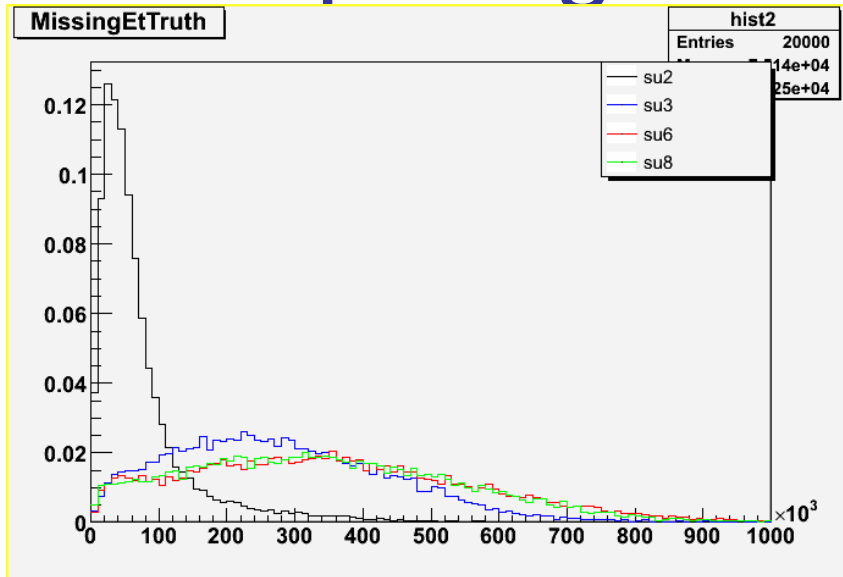
- Full AOD
 - Retrieved from many places using grid tools (quite painful to find and to get)
 - SU3 (signal 10k evts), J2 (15k evts), J3 (20k evts), J5 (10k evts), J6 (8k evts), T2 (10k evts)
 - All reconstructed with 11.0.4 or greater
- AtIFast samples
 - Produced by SUSY WG to study backgrounds
 - Zll+nJets, Znn+nJets, Wln+nJets, top+nJets (lots of stats – we have only run on a very small sub-sample)
 - SUSY signal for different points (generated by hand) – SU2, SU3, SU6, SU8
- Some samples are corrupted when we run over them

Selections used

- EI Selection
 - Only use E/gamma electrons (cluster seeded)
 - Pass Electron PID (4 shower shape cuts, TrackHitsAO, TrackMatch and E/p cut) – don't use TRT
 - Require isolation (15 GeV of the electrons E_t in 0.45 deltaR cone)
- Photon Selection
 - Fails electron PID (ignoring TRT)
- Mu Selection
 - Cut on the combined muon track particle $\text{Chi}^2 < 20$
 - Require all muons energy to be isolated in a 0.1 delatR cone
- Tau Selection
 - Charge is +/-1 and number of tracks is ≤ 3
 - TauLikelihood >2
 - Energy (E_t) fraction in hadronic calorimeter >0.1
- Jet Selection
 - Requires 15GeV
- Overlap rejection in order shown (ie. If a candidate passes both Electron selection and Photon selection it is chosen to be an electron)
- MissingEt comes from standard Physics Analysis Tools (H1 calibration)

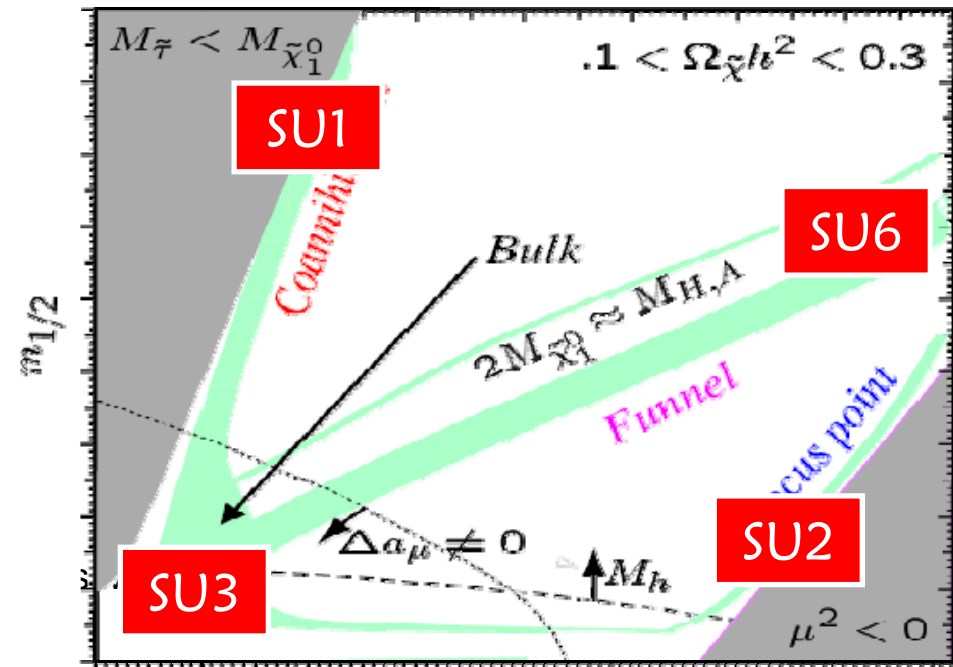
These are not optimised. This will be studied soon

Comparing SUSY points (AtI Fast)

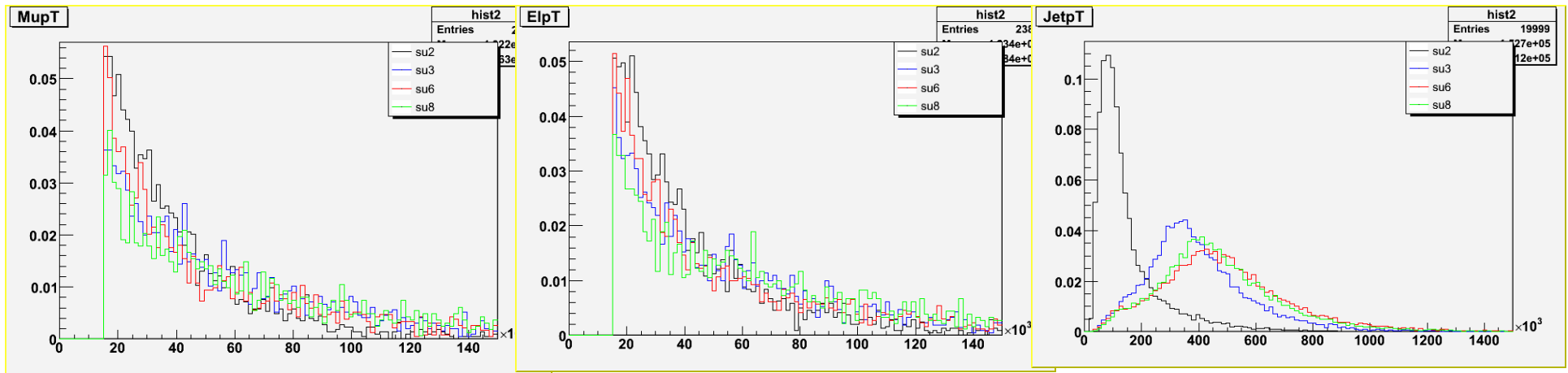
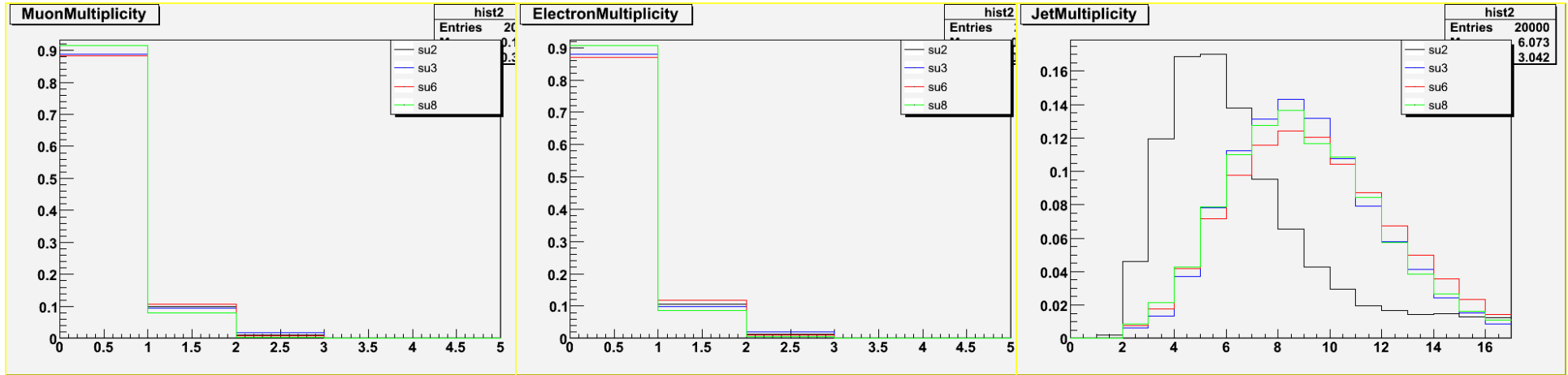


SU2 seems to have much softer distributions from other points.

24/05/2006

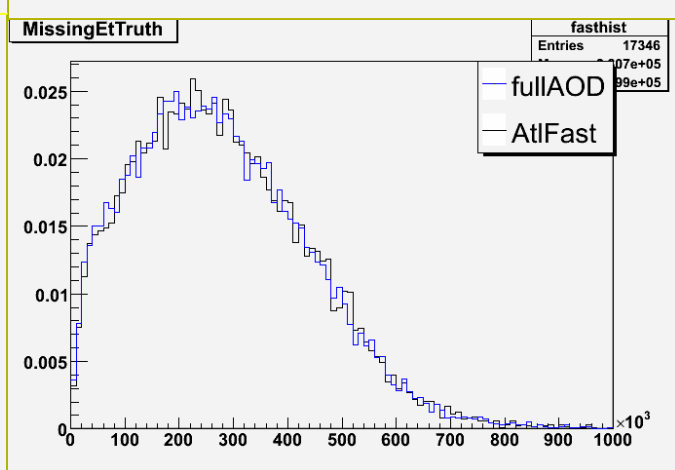
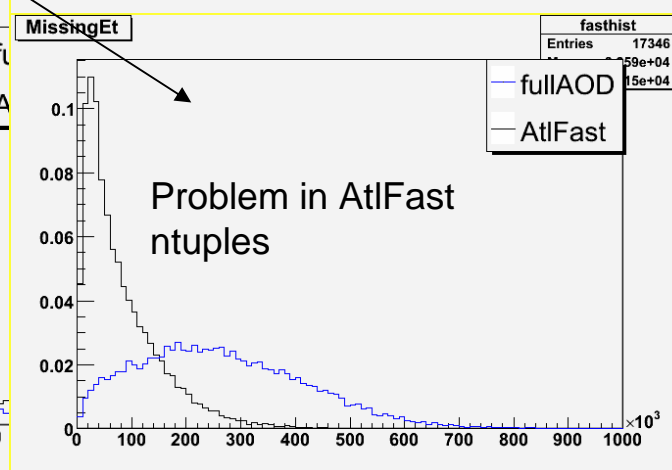
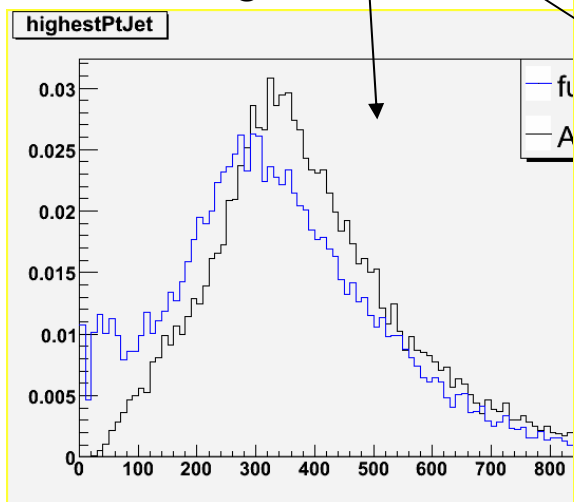
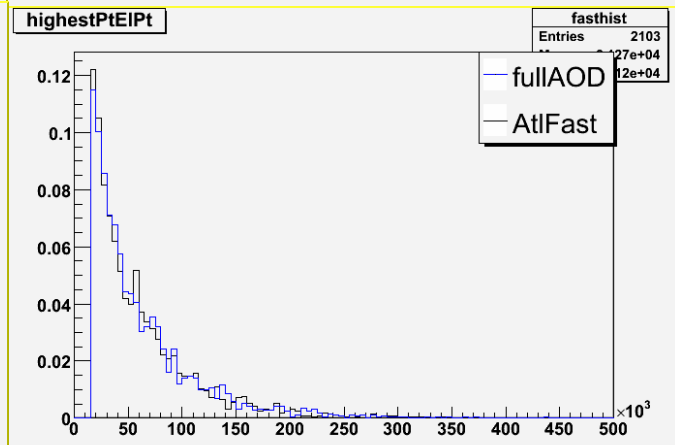
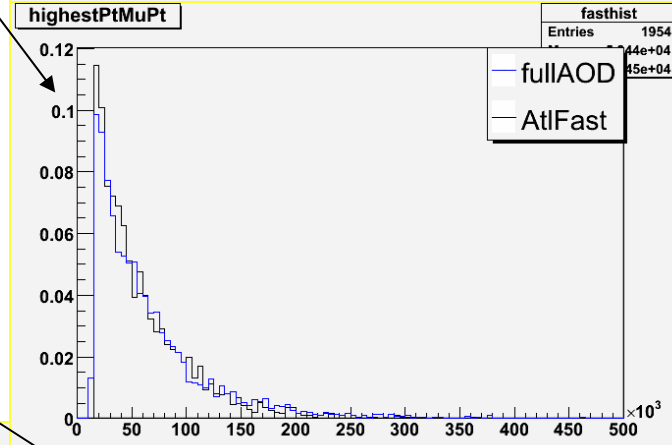
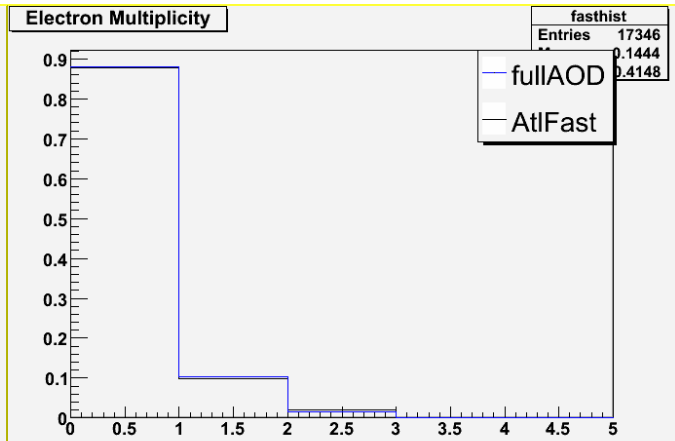
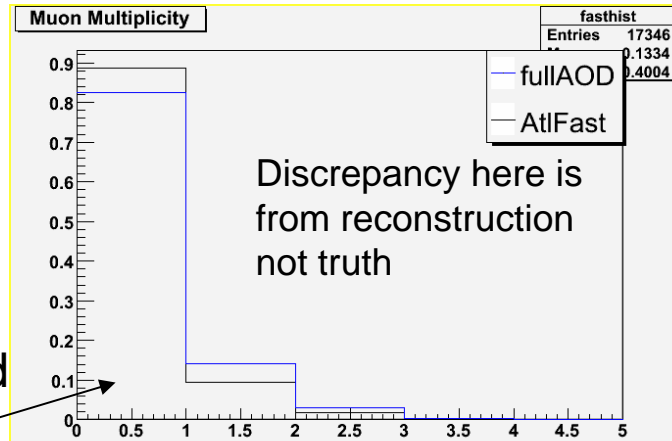


Comparing SUSY points (AtI Fast)

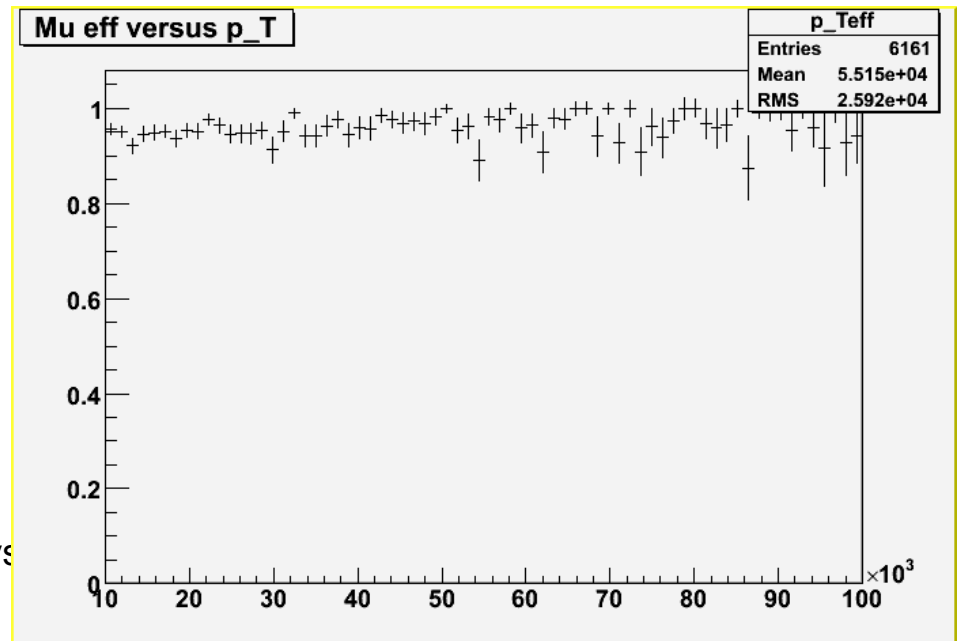
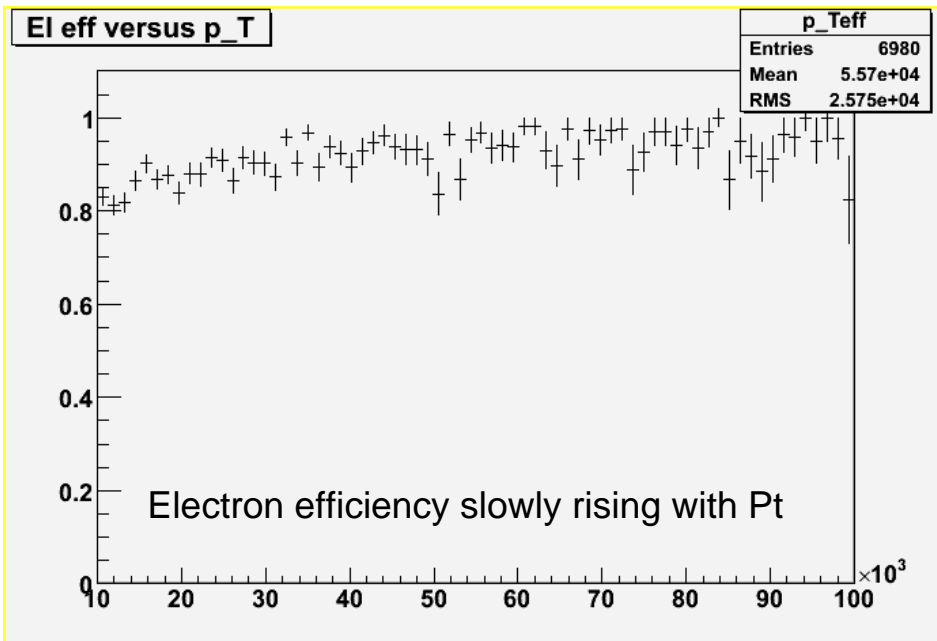
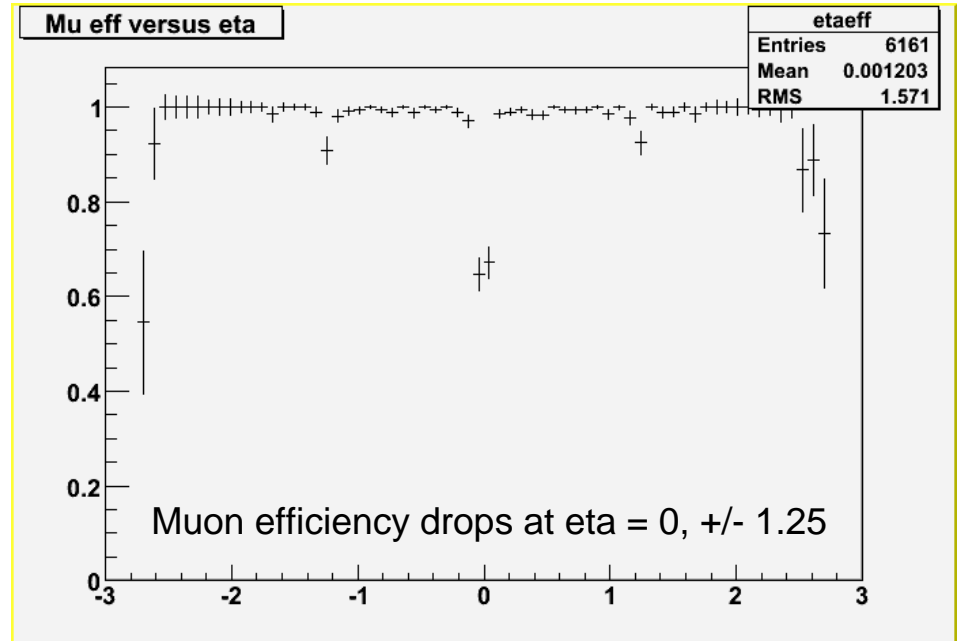
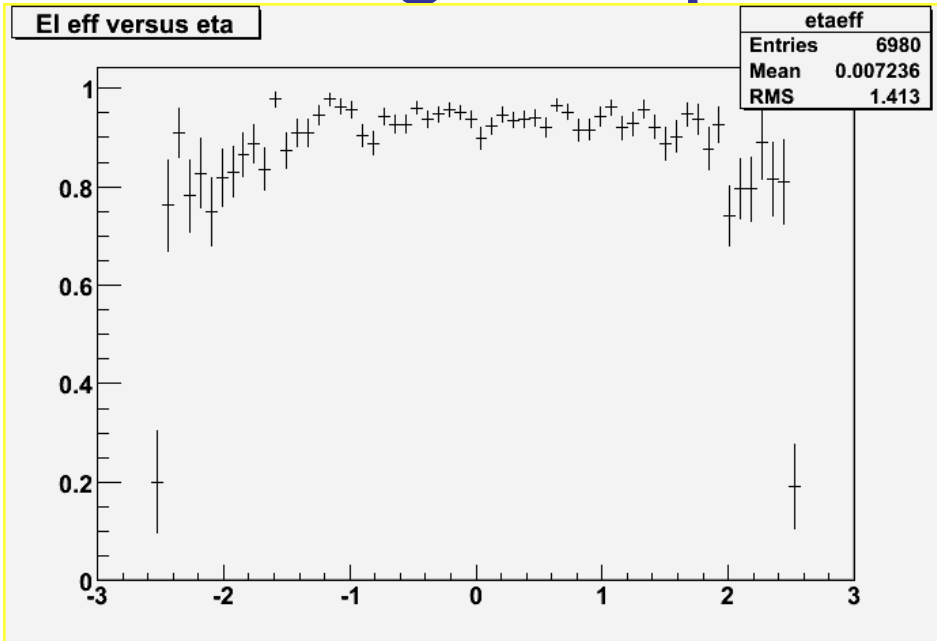


Comparing AtFast and fullAOD

- SU3 signal for both
- Lepton multiplicity and Pt spectra compare OK (Mu Eff wrong in AtFast??)
- Known bug in Jets for full AOD (now fixed) shows up here
- Something wrong in MissingEt in AtFast

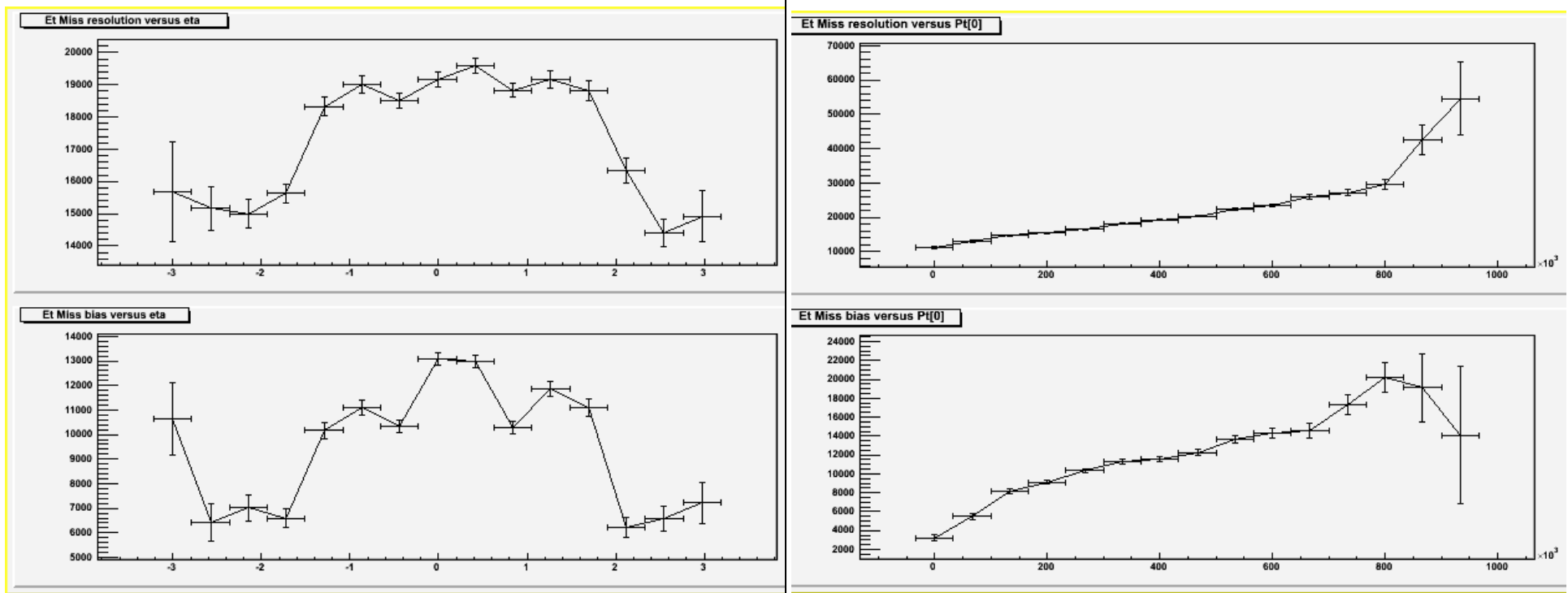


Looking at lepton efficiencies (full AOD)

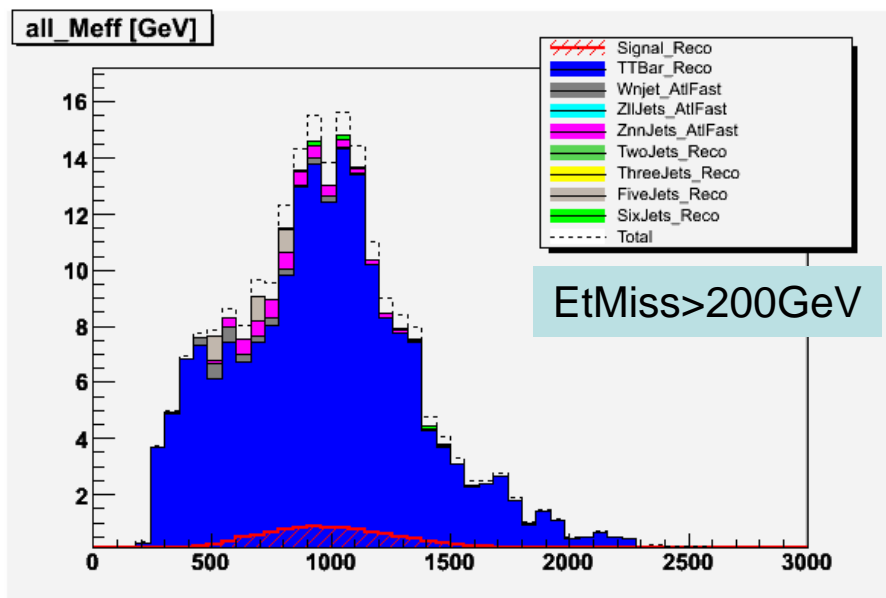
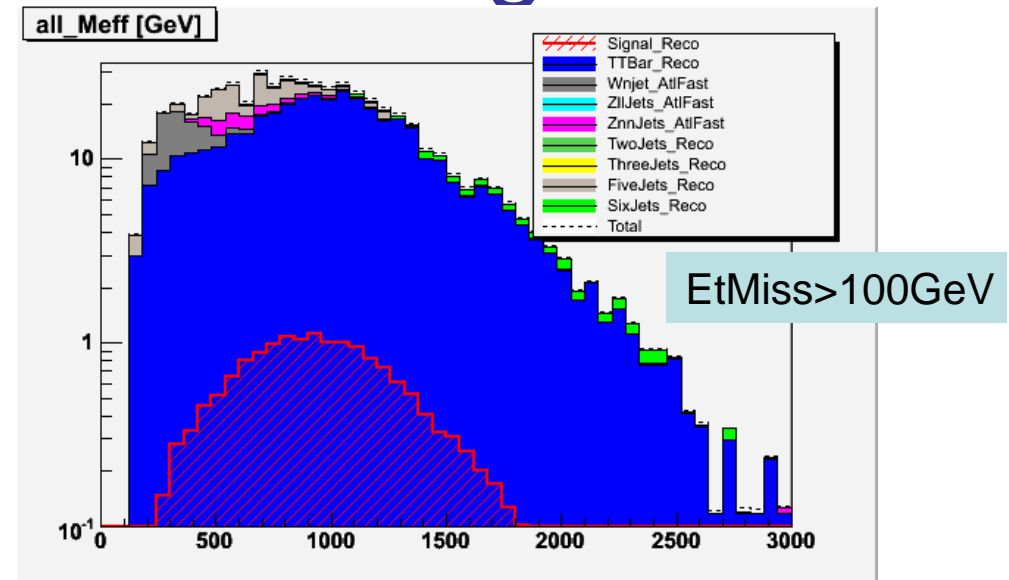
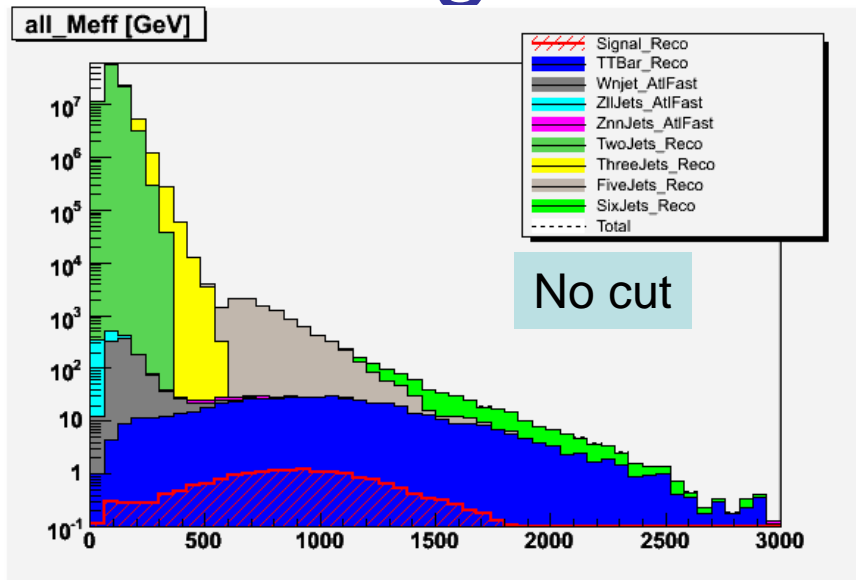


Looking at MissingEt reco

Et miss resolution (top) and bias (bottom) versus eta of hardest jet (left) and true Pt[0] (right plot)



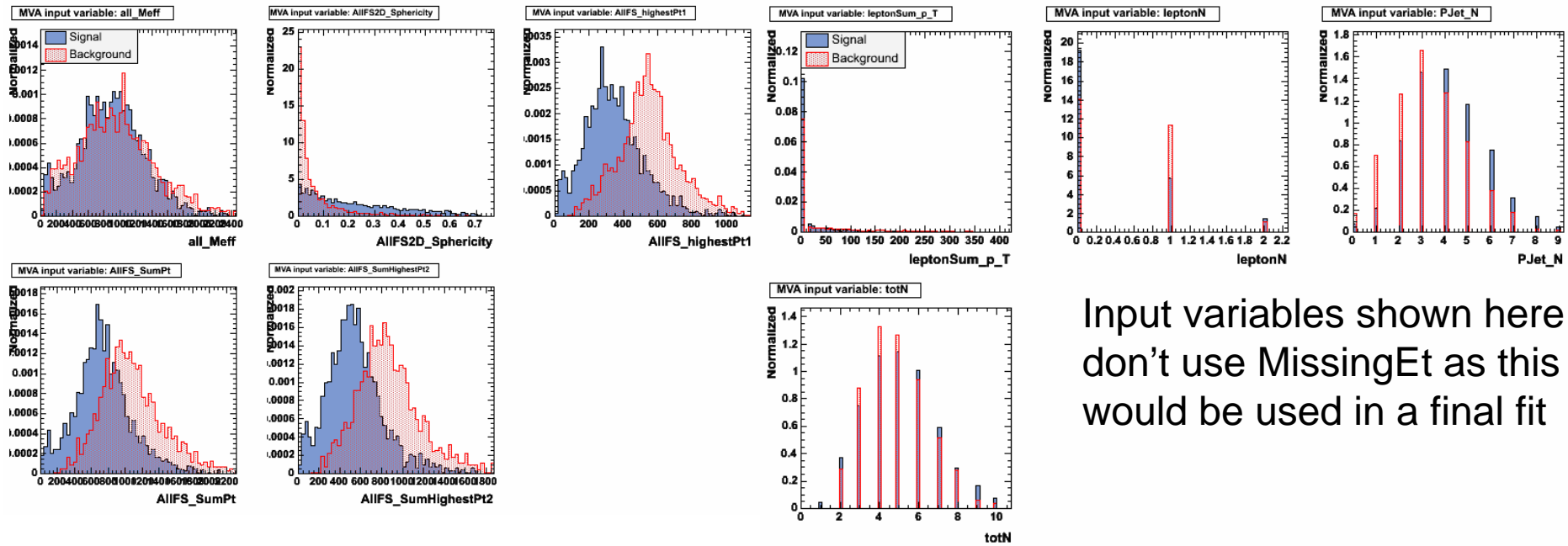
Looking at Combined backgrounds



Completely dominated by top background

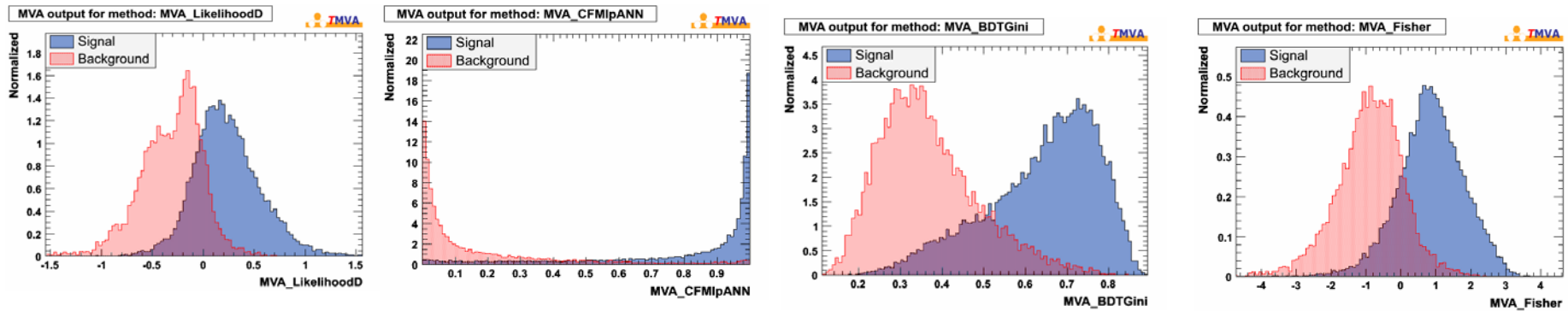
Looks like normalisation of top/susy is wrong (using su3=19.3 pb, top = 578 pb)

Using TMVA to distinguish signal from top bkgd

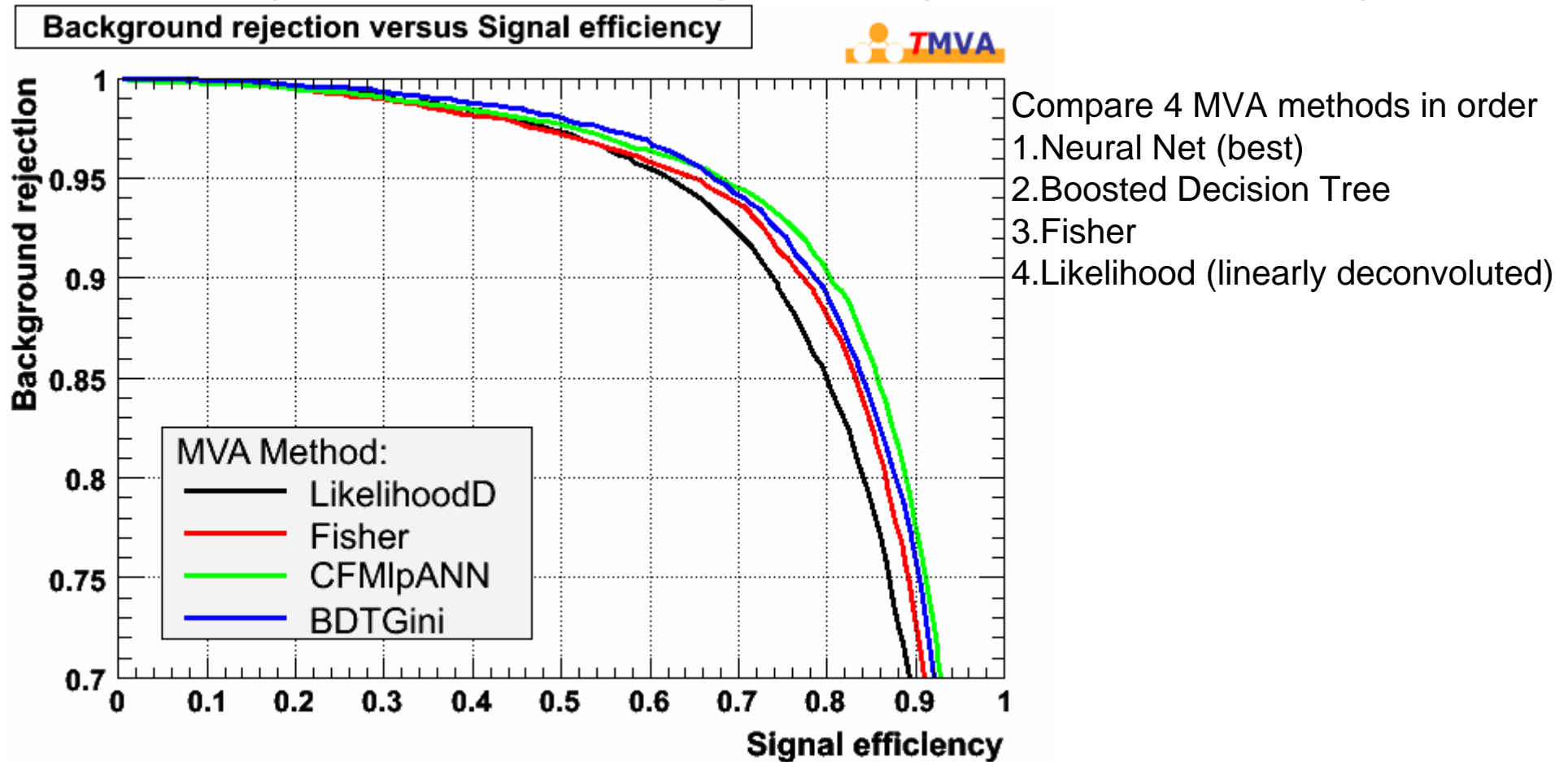


Input variables shown here don't use MissingEt as this would be used in a final fit

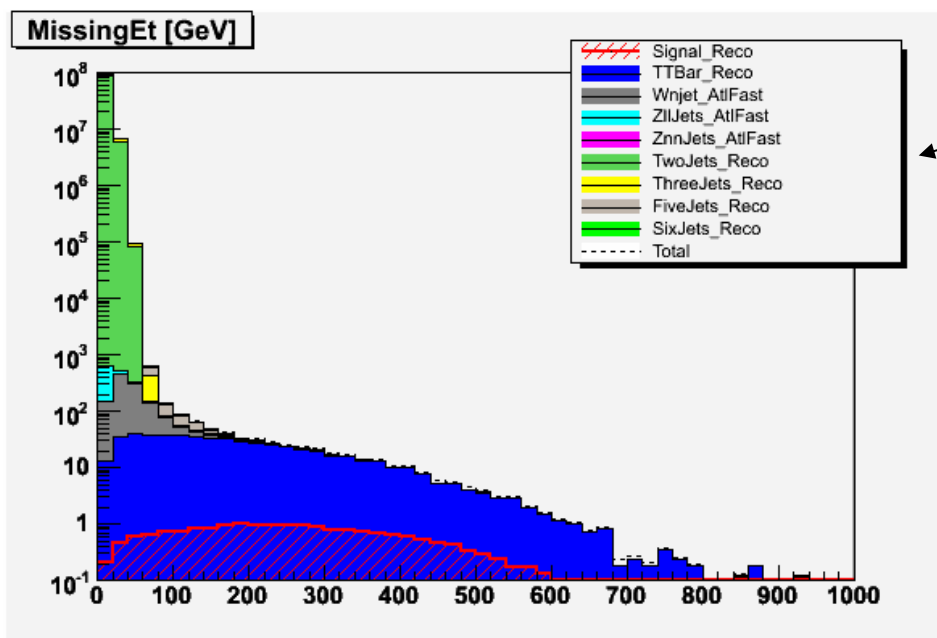
Output distributions for: Likelihood, NN, Boosted Decision Tree, Fisher



Using TMVA to distinguish signal from top bkgd

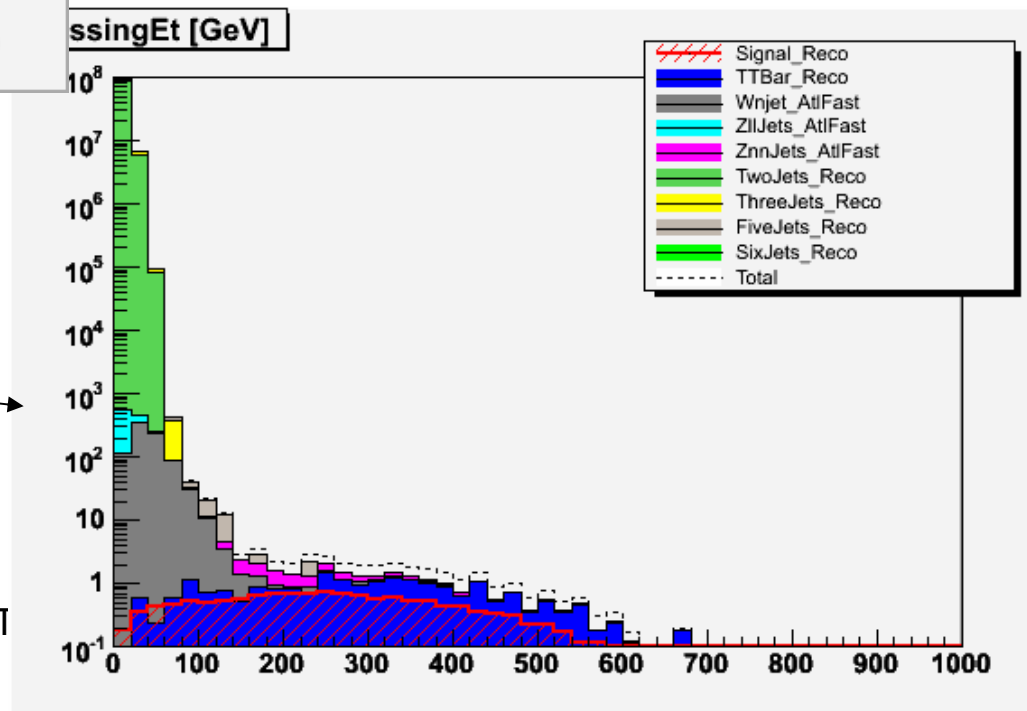


With a cut on the MVA



MissingEt distbn with no cuts

Missing Et distbn after a cut on the
 $NN > 0.9$



CAT

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Near future improvements

- The physics analysis software in release 12 should fix a number of problems
 - Truth jets in AtIFast
 - AtIFast AOD produced with fullAOD for detailed AtIFast/FullAOD comparisons
- Amir is working on speeding up some of the core EventView software which is currently quite slow

Near future plans

- Fix bugs in SUSYView and confirm the ntuple has what we want in it
 - Run over all the AtlFast SUSY background samples
 - Run over all available full AOD MC
- This will require
 - lots of CPU (will be helped by the new CAT Physics queue)
 - lots of disk space
- Make SFrame into a complete root analysis package
 - Automate as much as possible ntuple making so we can easily run on more data as it becomes available
- Study cuts for selecting particles
- Use TMVA to decide on what are the most useful variables and how to combine them

Future plans

- Concentrate on analyses including leptons
 - We will be looking at single lepton + Jets inclusive analysis
 - We will also look at 2 lepton final states...
 - We want to be involved in detailed studies of lepton Identification + E_T Miss
- We will contribute to the CSC notes on these topics