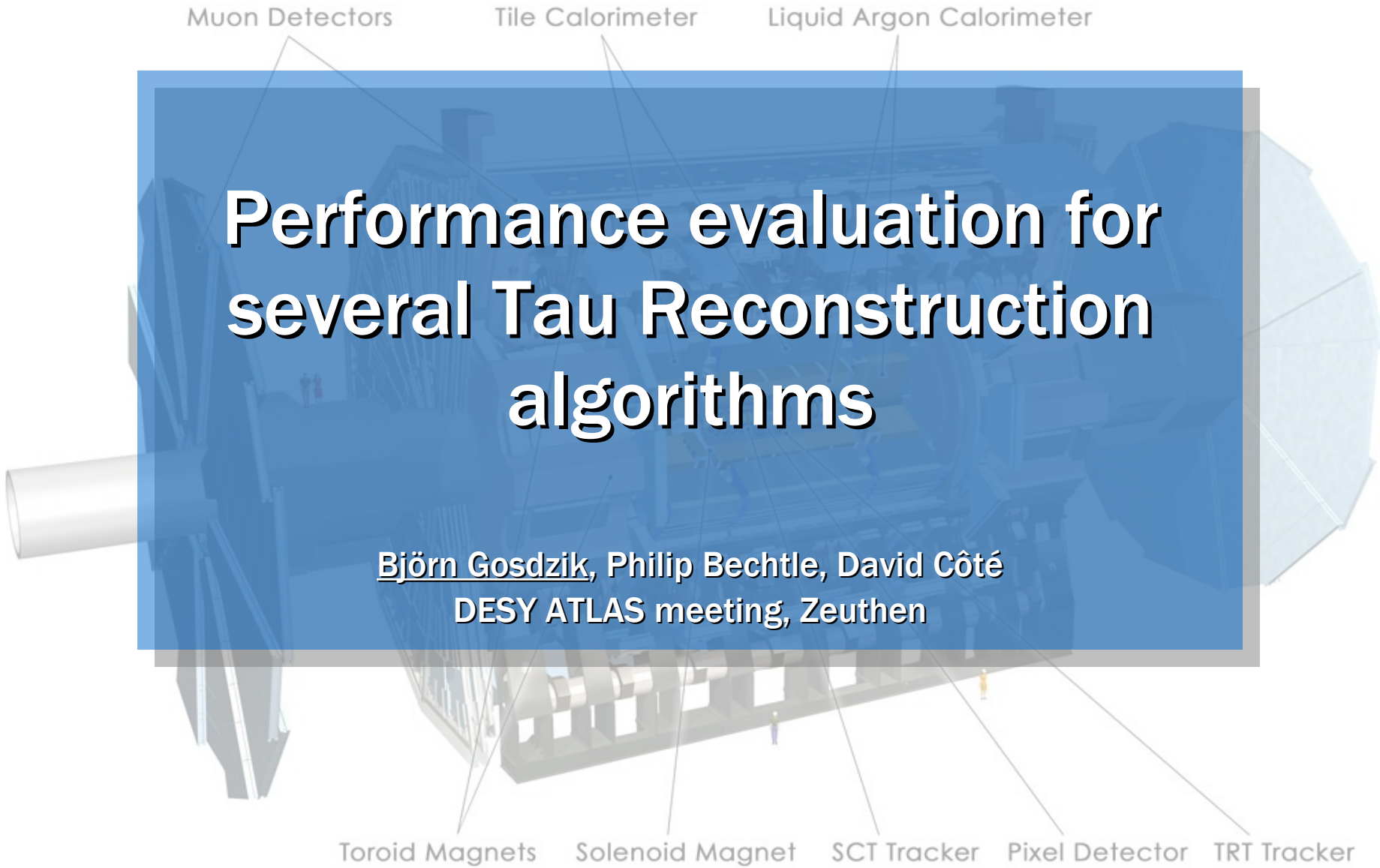


Performance evaluation for several Tau Reconstruction algorithms

Björn Gosdzik, Philip Bechtle, David Côté
DESY ATLAS meeting, Zeuthen

Overview

- TauDPDMaker
- Tau reconstruction algorithms in
  - TauWG
  - HighPtView/SUSYView
  - HiggsPhysics
  - TopView
- Performance evaluation
  - Efficiency
  - Rejection
- Conclusions

Motivation

- Different groups (TauWG, HighPtView/SUSYView, HiggsToTauTau, etc.) use several tau definitions
- Based on standard tau algorithm TauRec and Tau1p3p
- Crosscheck of different definitions
- Use new TauDPDMaker tool to create ntuples
- Simple C++ macro to provide performance plots

TauDPDMaker see David´s talk and:
https://twiki.cern.ch/twiki/bin/view/Atlas/TauDPDMaker

- TauDPDMaker-00-00-01 with release 13.0.30
- Input: AODs
- Output: „TauView“ ntuples for performance analysis
- Configuration of basic EventView tools

EventViewGroupArea: EVTags-13.0.30.1

Use default python modules of EventView:

- `EventViewConfiguration.DefaultModules`
- `EventViewBuilderAlgs.EventViewBuilderAlgsConf`

Define Inserter:

- **Reconstruction:** `EVTauJetInserter`
- **Truth Particles:** `EVTruthParticleInserter`

Define Associator:

- **Reconstruction:** `EVUDToEVTauJetAssociator`
- **Truth Particles:** `EVUDToEVINav4MomAssociator`, `EVUDToEVTruthParticleAssociator`

Looper over Inserter:

- `EVUDFinalStateLooper`

8 Tau Reconstruction algorithm:

- **Standard tau reconstruction:**
  - **TauRec**
  - **Tau1p3p**
- Other tau definitions in:
  - HighPtView/SUSYView:
    - HighPtTauRec
    - HighPtTau1p3p
  - HiggsPhysics:
    - HiggsToTauTau1P
    - HiggsToTauTau3P
  - TopPhysics:
    - TopTau
  - Additional:
    - TauRec+Electron Veto

TauRecContainer:

- TauRec
- TauRec+Electron Veto
- HighPtTauRec
- HiggsToTauTau1P
- HiggsToTauTau3P
- TopTau

Tau1P3PContainer:

- Tau1p3p
- HighPtTau1p3p

Cuts applied on all algorithm:

- DoPreselection = True
- NoOverlapCheck = True

TauRec

- Calo-based
- Reconstructed combined cluster as seeds
- Every combined cluster is considered as candidate
- Associates tracks within of dR < 0.3 of the cluster centre
- Build Likelihood for seeds on 8 different variables

Tau1p3p

- Track-based
- Identify leading track with pT > 9 GeV (good quality)
- Candidates defined by the track at vertex or barycentre
- Associate cells from calorimeter to candidates
- Compute set of discriminating variables
- Energy scale defined

TauWG

- TauRec:
  - No MultiTrackMassCut
  - No HadronicEnergyFraction
  - 3 or less tracks
  - Likelihood cut = 4.0
  - No Et cut
  - Additional: Electron Likelihood cut > 0

- Tau1p3p:
  - No MultiTrackMassCut
  - No HadronicEnergyFraction
  - 3 or less tracks
  - Discriminant cut = 1
  - Electron and Muon Veto
  - No Et cut

HighPtView/SUSYView

- HighPtTauRec:
  - MultiTrackMassCut = 1400 GeV
  - HadronicEnergyFraction = -1
  - Likelihood cut = 4.0
  - Charge = 1
  - Et Cut = 30 GeV

- HighPtTau1p3p:
  - MultiTrackMassCut = 1400 GeV
  - HadronicEnergyFraction = -1
  - Discriminant cut = 0.5
  - Charge = 1
  - Et Cut = 15 GeV

Higgs Physics

- HiggToTauTau1P:
  - No MultiTrackMassCut
  - Requires TrackMultiplicity
  - TrackMultiplicity = 1
  - Charge = 1
  - Et Cut = 40 GeV

- HiggToTauTau3P:
  - No MultiTrackMassCut
  - Requires TrackMultiplicity
  - TrackMultiplicity = 3
  - Et Cut = 40 GeV

TopView

- TopTau:
  - MultiTrackMassCut = 999 GeV
  - Likelihood cut = 6.0
  - TrackMultiplicity = 1
  - Charge = 1
  - Et Cut = 15 GeV

Signal: Ztautau
trig1_misal1_mc12.005188.A3_Ztautau_filter.recon.AOD.v13003002 (1.64 nb)

Background: di-jet
trig1_misal1_csc11.005009.J0_pythia_jetjet.recon.AOD.v13003002
trig1_misal1_csc11.005010.J1_pythia_jetjet,recon.AOD.v13003002
trig1_misal1_csc11.005011.J2_pythia_jetjet.recon.AOD.v13003002
trig1_misal1_csc11.005012.J3_pythia_jetjet.recon.AOD.v13003002
trig1_misal1_csc11.005013.J4_pythia_jetjet.recon.AOD.v13003002
trig1_misal1_csc11.005014.J5_pythia_jetjet.recon.AOD.v13003002

All samples contain each 15000 Events

di-jet sample	pt Hard [GeV]	cross section
J0	8 – 17	17.6 mb
J1	17 – 35	1.38 mb
J2	35 – 70	93.3 µb
J3	70 – 140	5.88 µb
J4	140 – 280	308 nb
J5	280 – 560	12.5 nb

$$Efficiency = \frac{TrueParticlesMatchedToReconstructedTaus}{AllTrueParticles}$$

$$Rejection = \frac{1}{Efficiency}$$

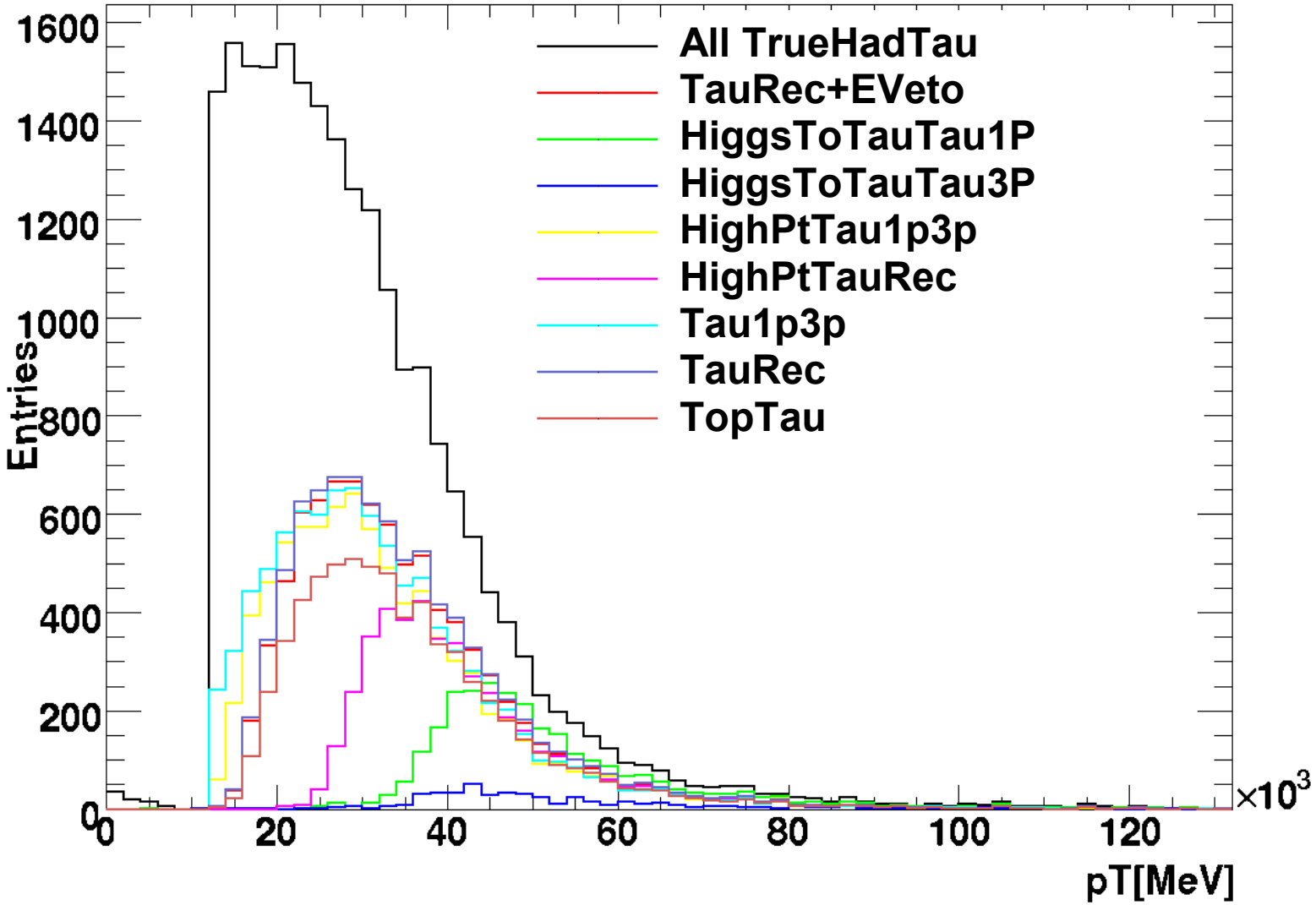
- Efficiency: True hadronic taus from Z->TauTau signal sample
- Rejection: True jets from di-jet background samples

Matched = dR of truth particle and reconstructed tau < 0.1
=> Particle reconstructed as tau

Definition of TrueJets

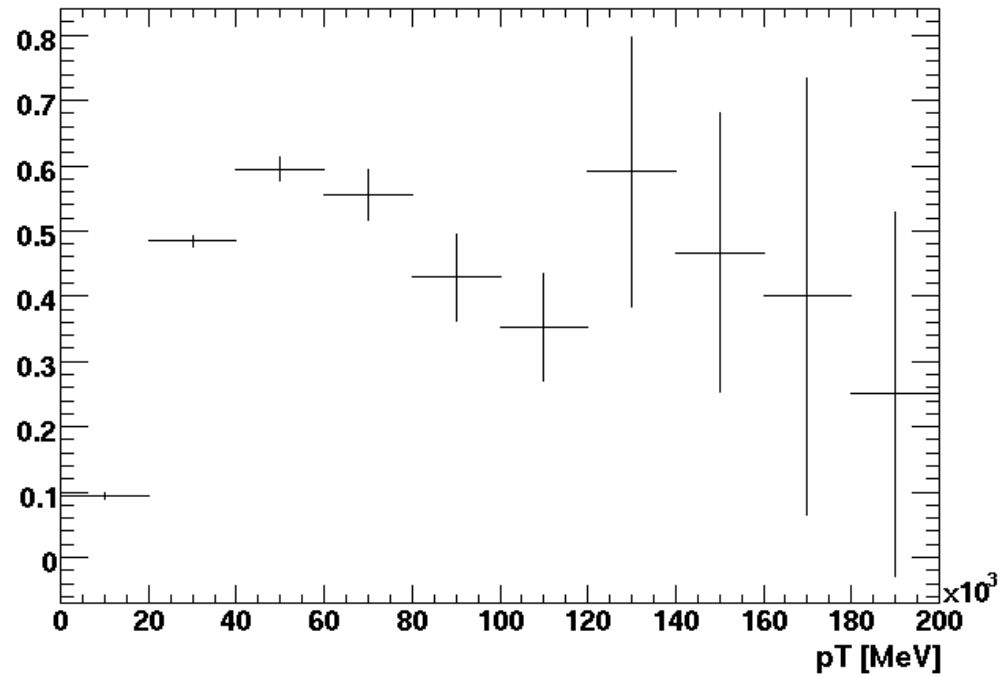
- Result of Cone4 jet algorithm taking truth paticles as input
- Container: Cone4TruthParticleJets
- Only consider TrueJets that don't overlap with true electrons, muons, taus or photons
- Et cut at 5 GeV

pT of all true taus matched to reconstructed taus

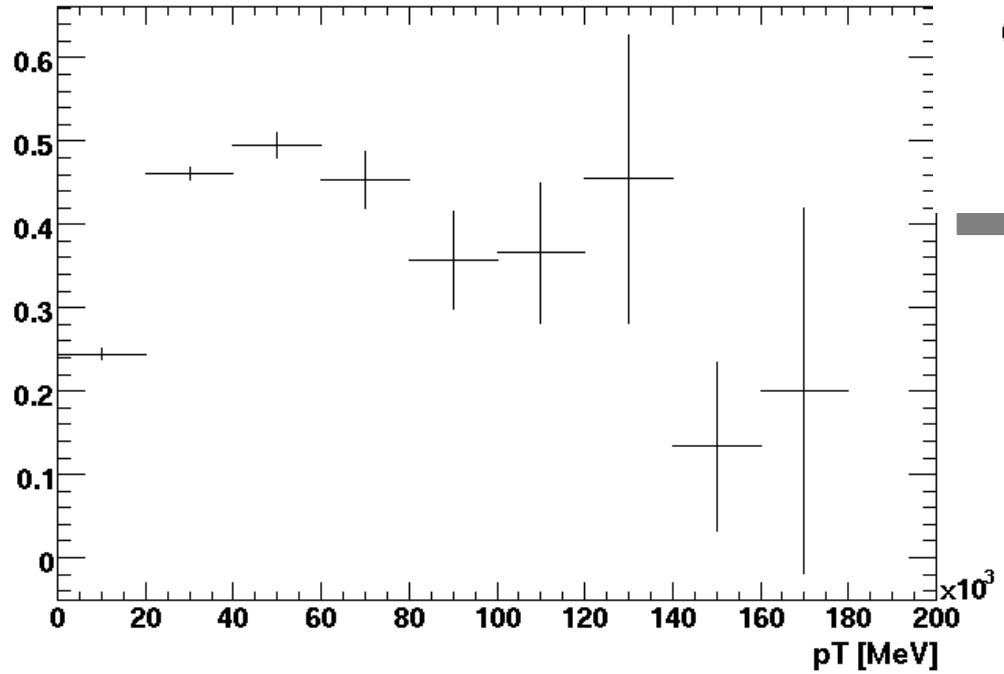


Efficiency / pT

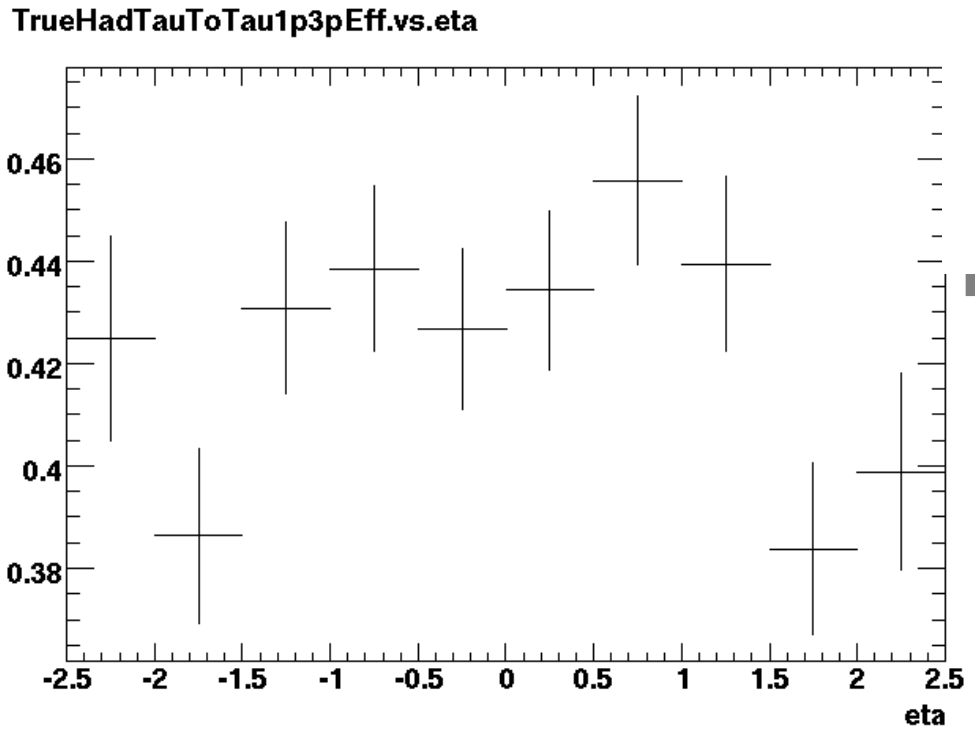
TrueHadTauToTauRecEff.vs.pT

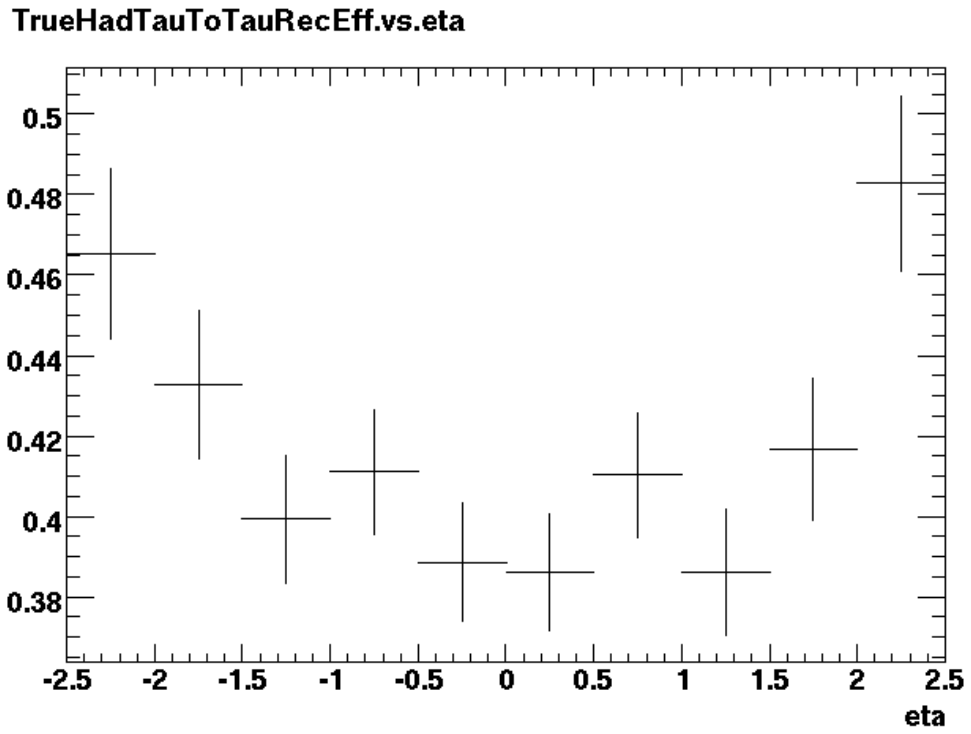


TrueHadTauToTau1p3pEff.vs.pT

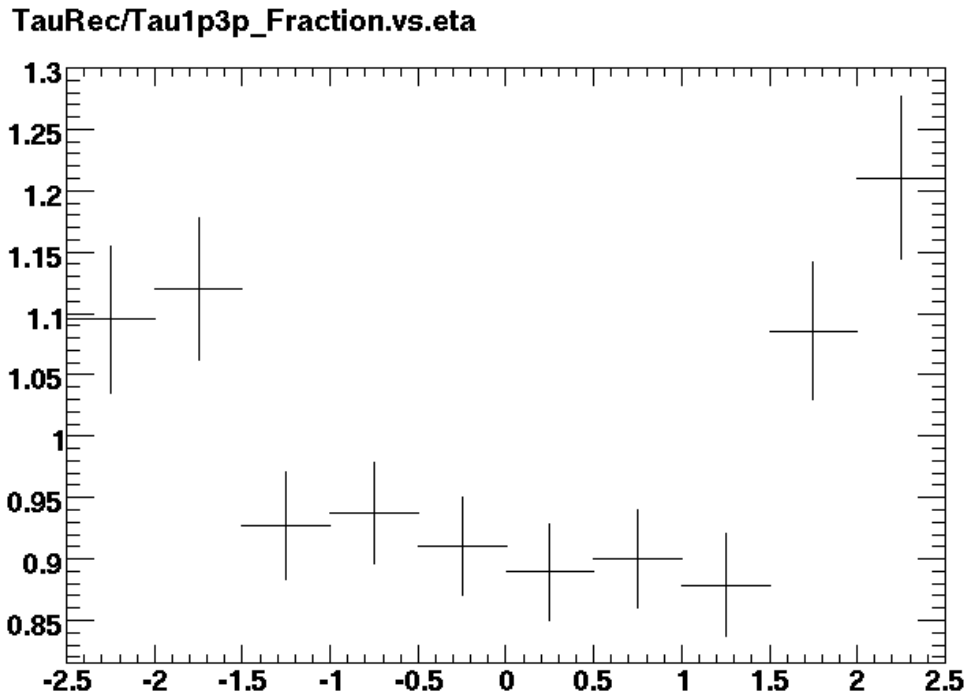


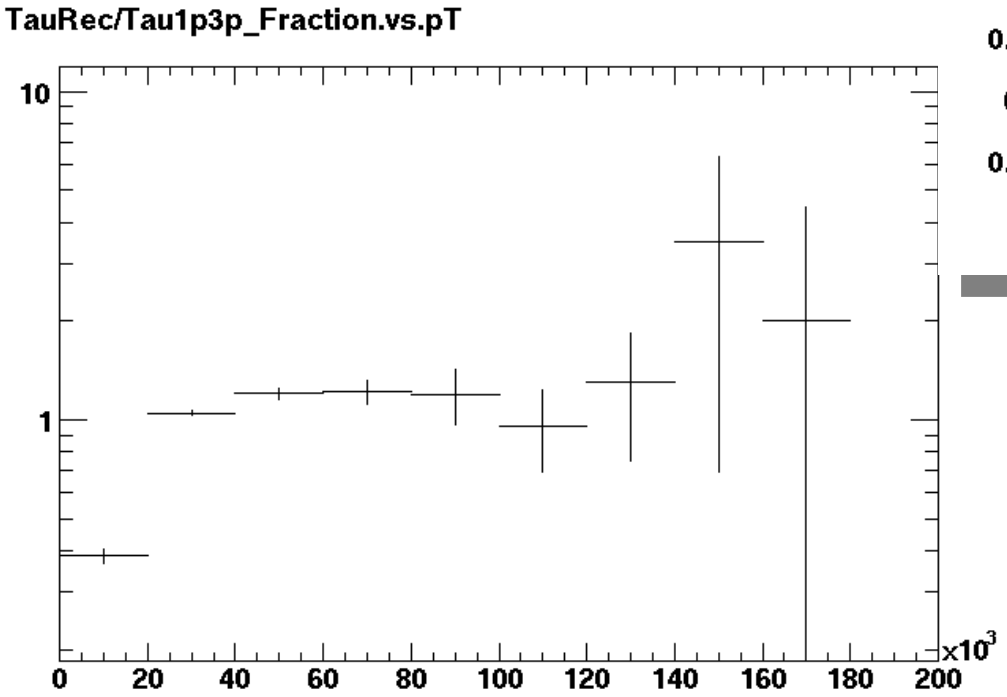
Efficiency / eta



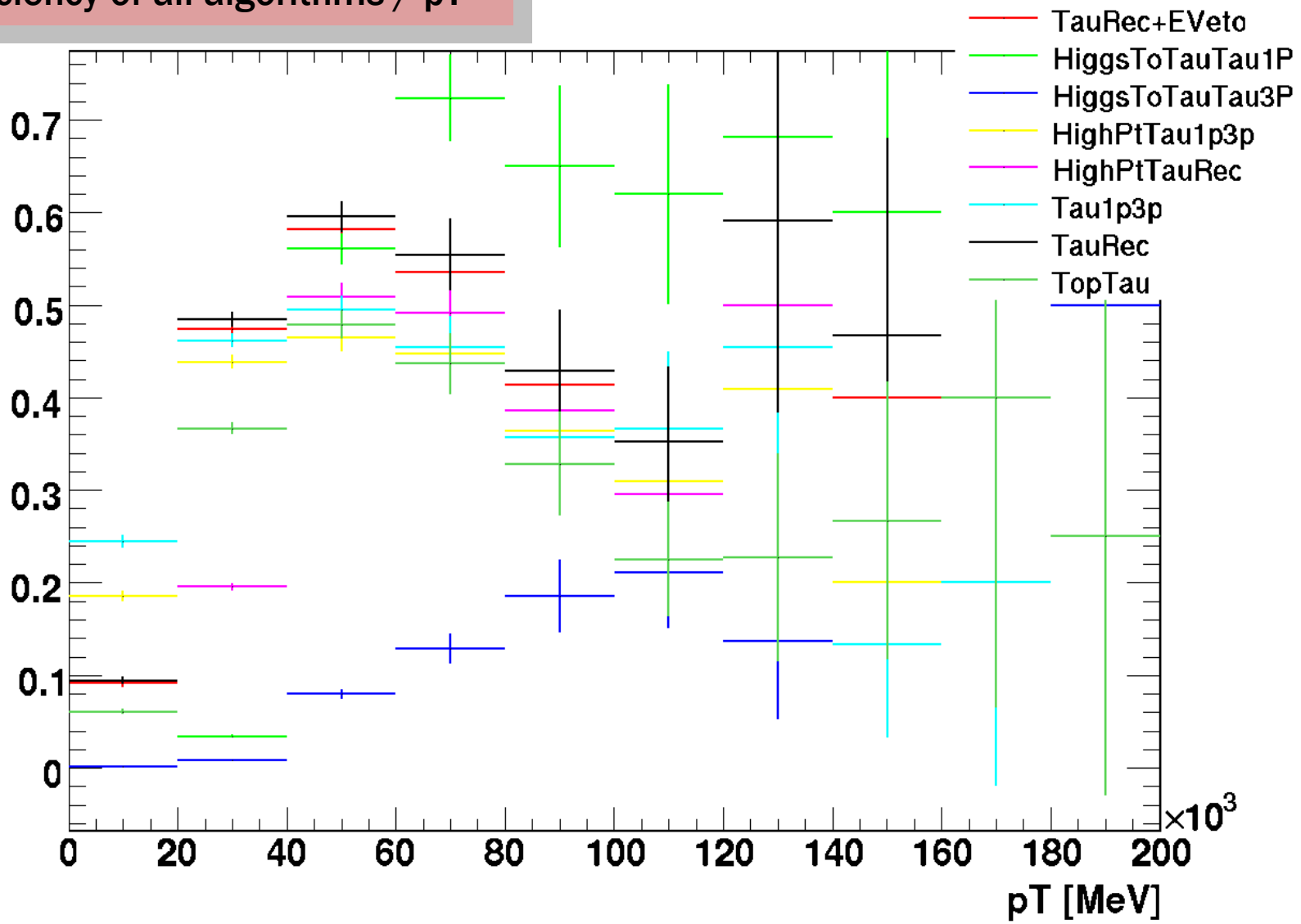


Fraction TauRec / Tau1p3p vs. pT and eta

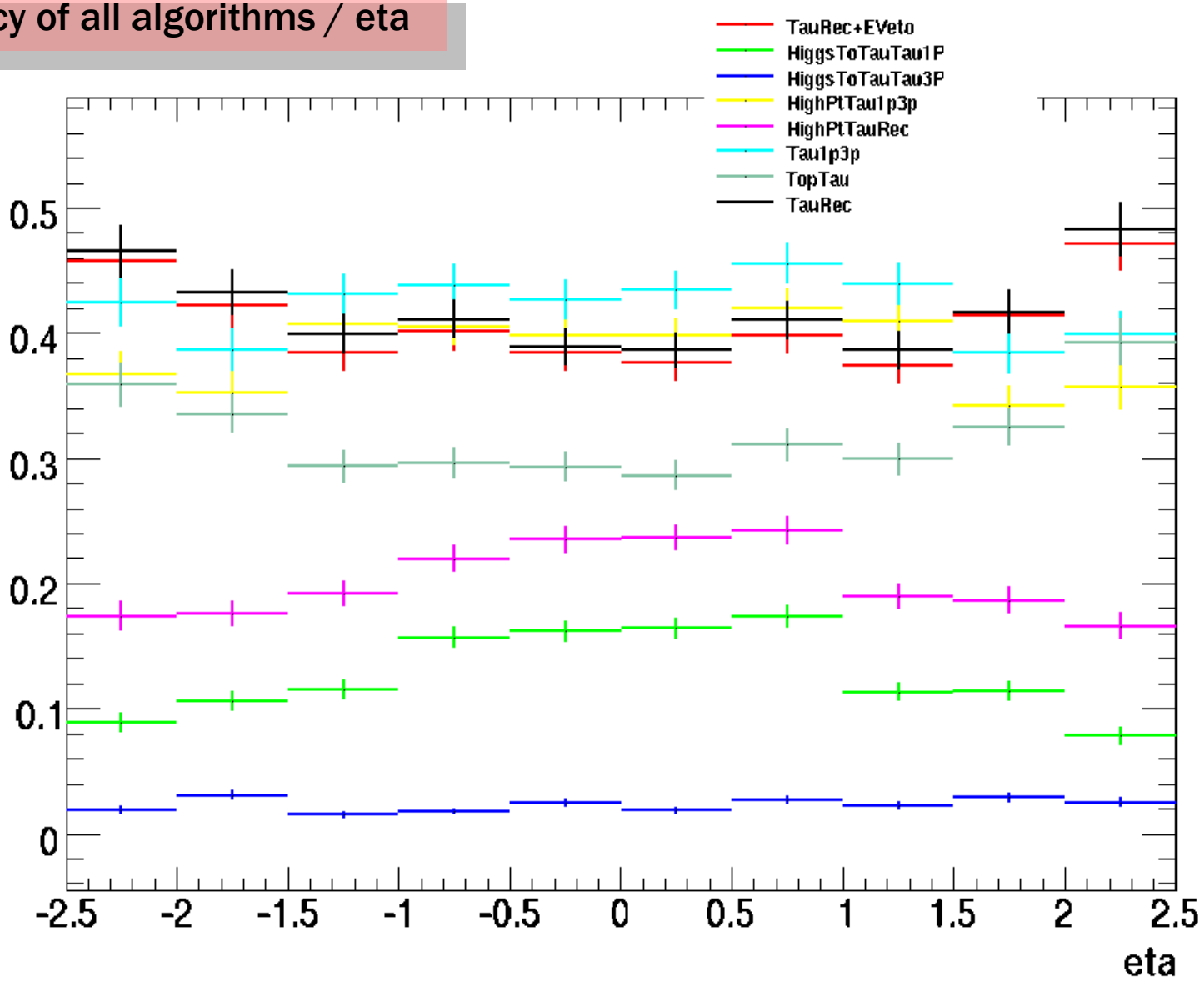




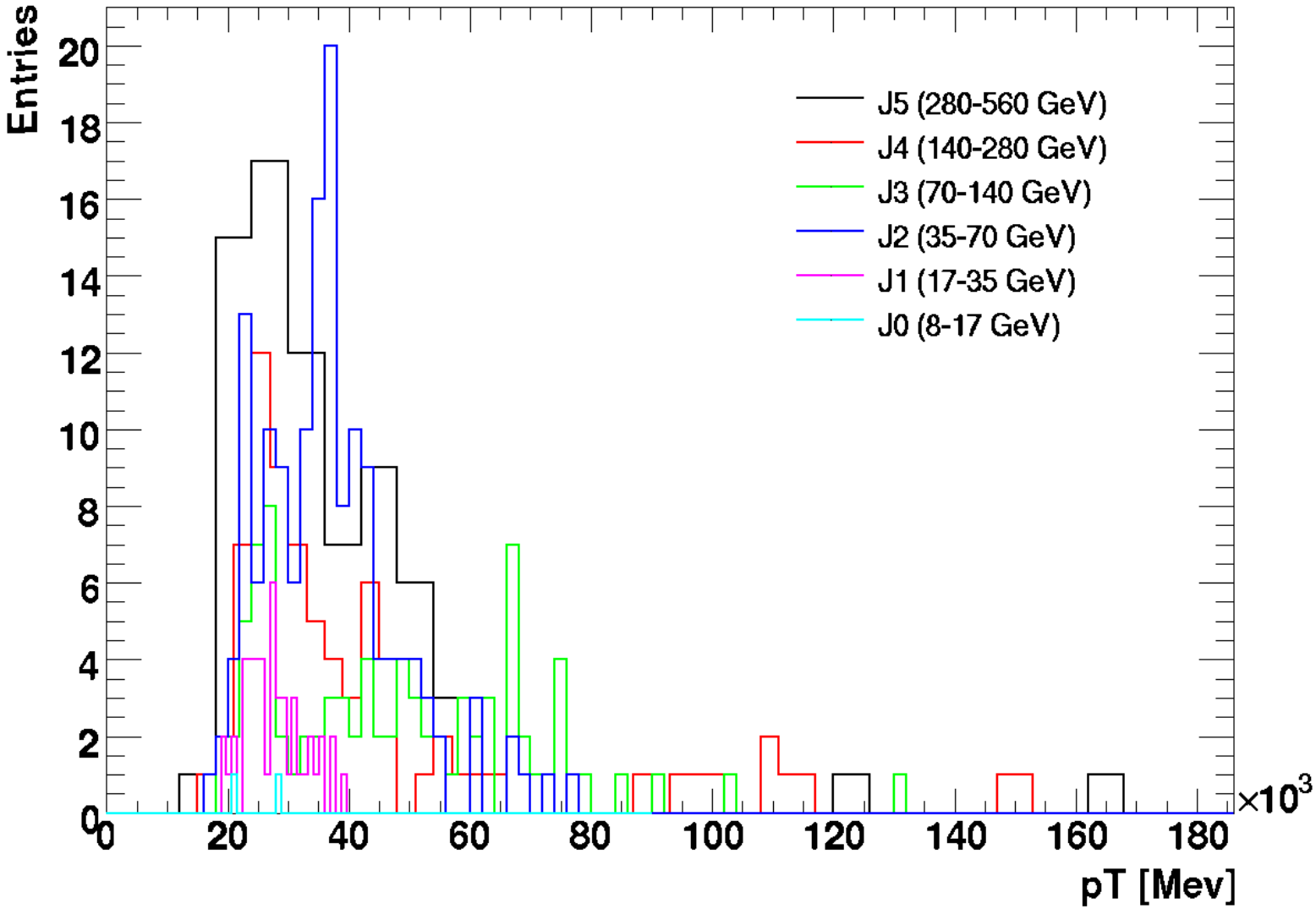
Efficiency of all algorithms / pT



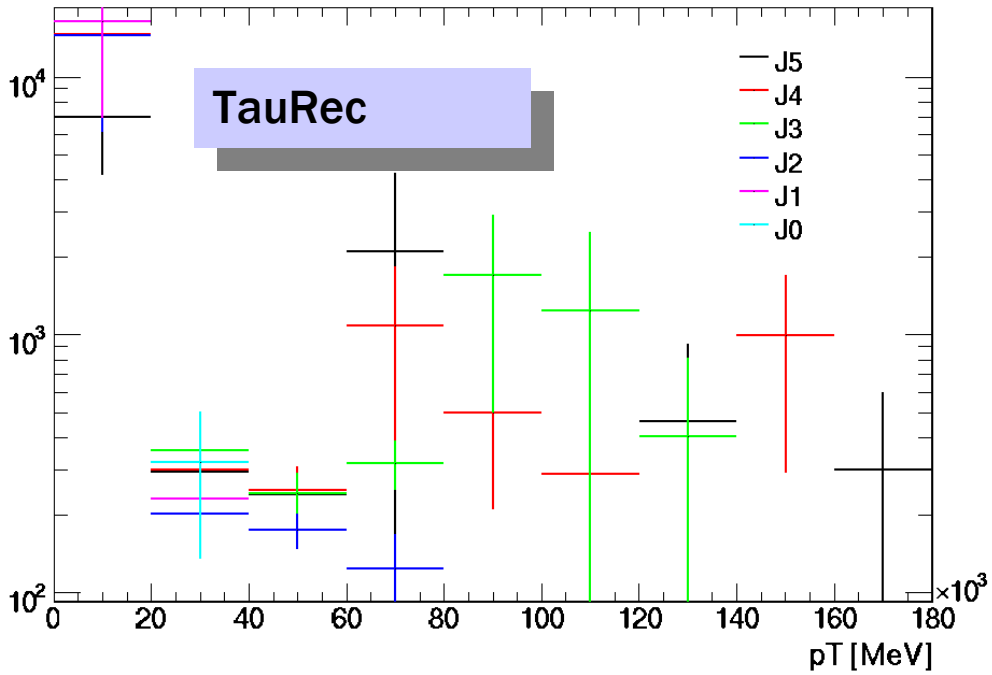
Efficiency of all algorithms / eta

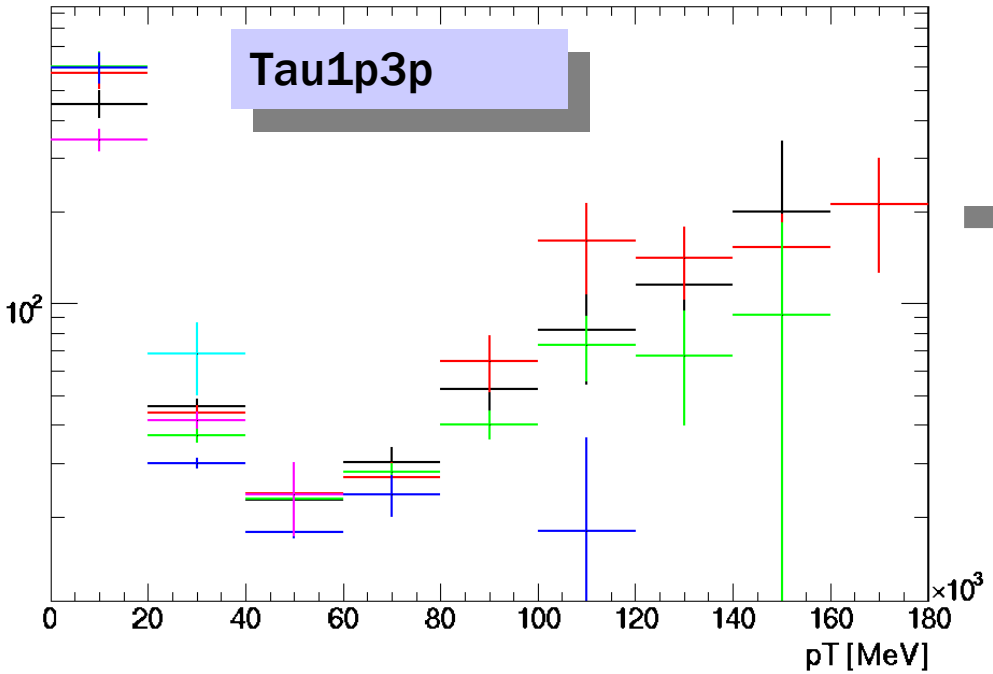


pT for TrueJets matched to reconstructed taus with EVeto

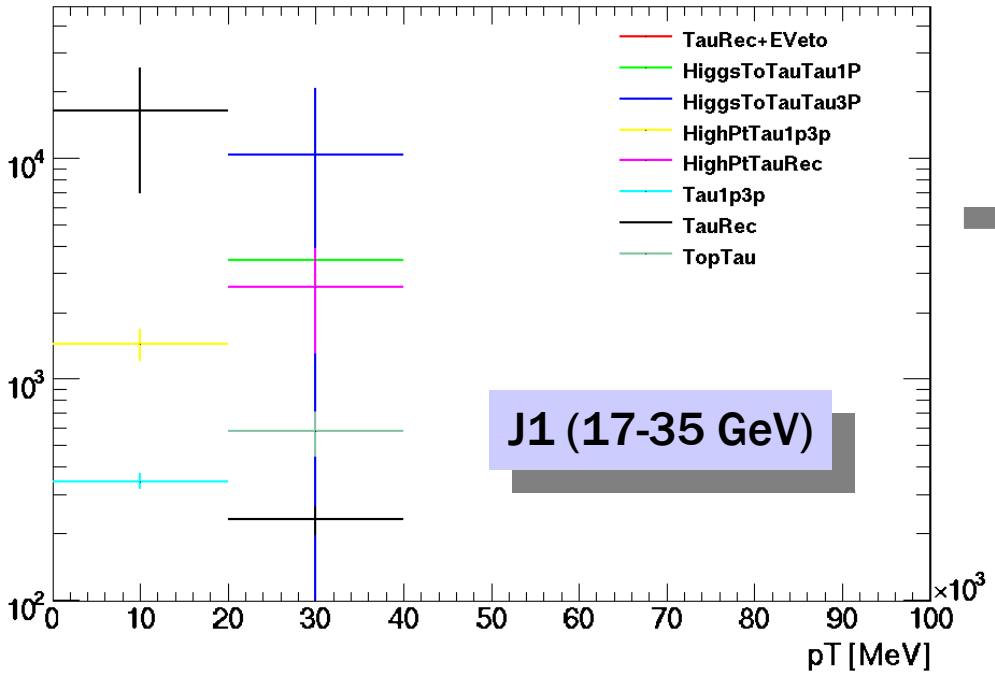


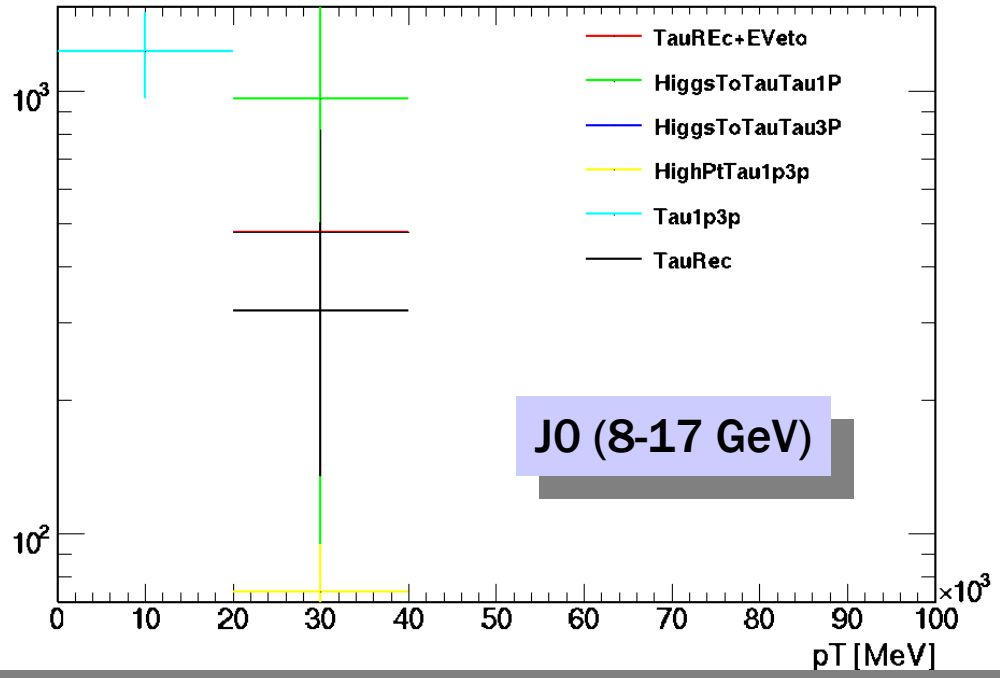
Rejection / pT



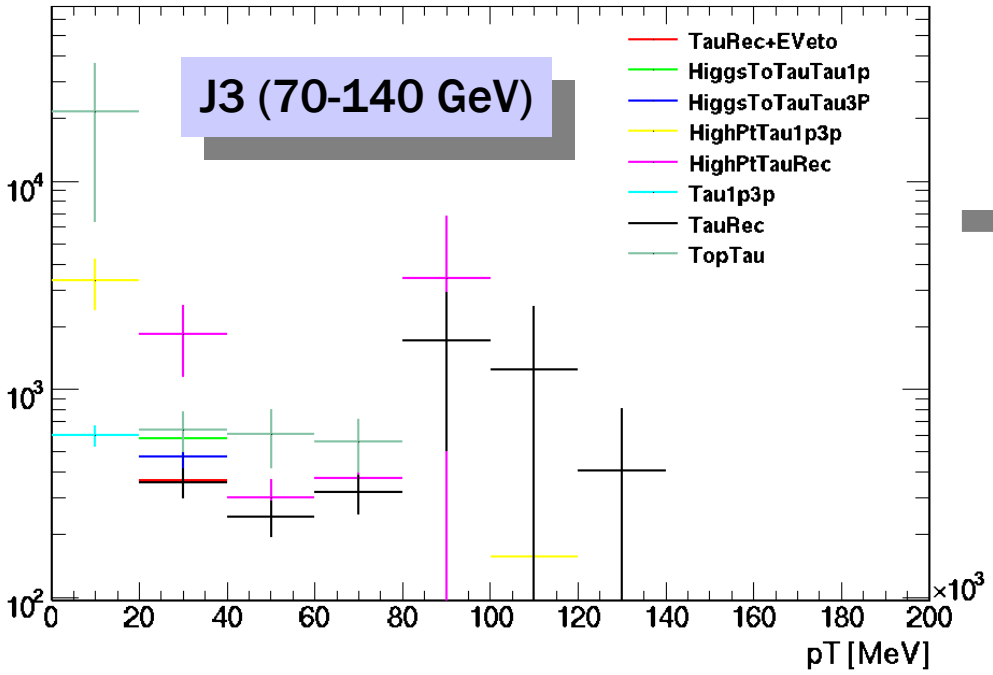


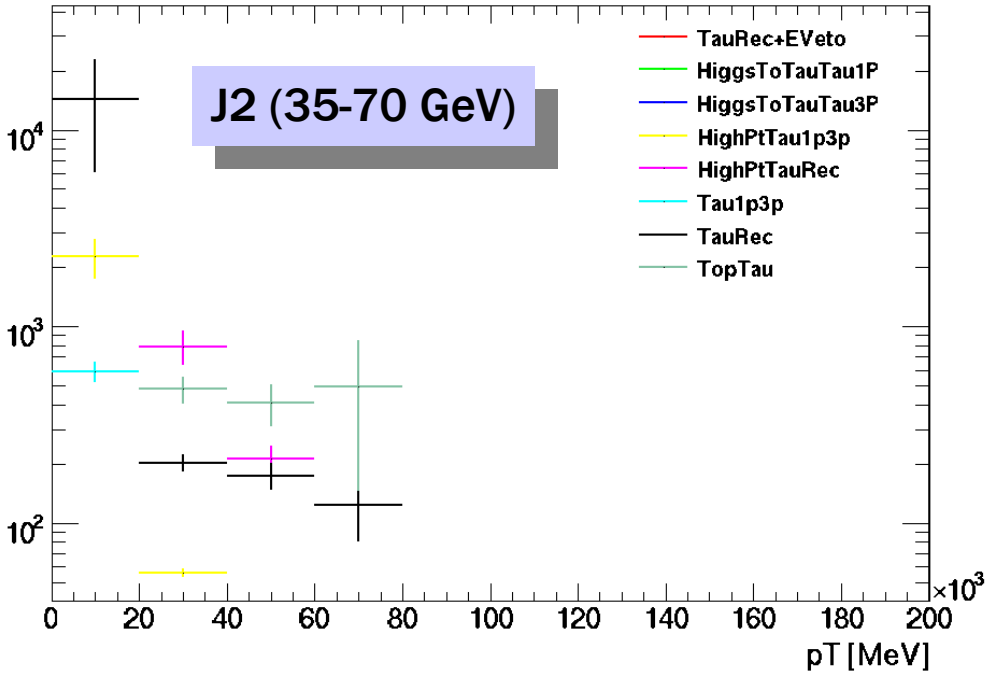
Rejection / pT



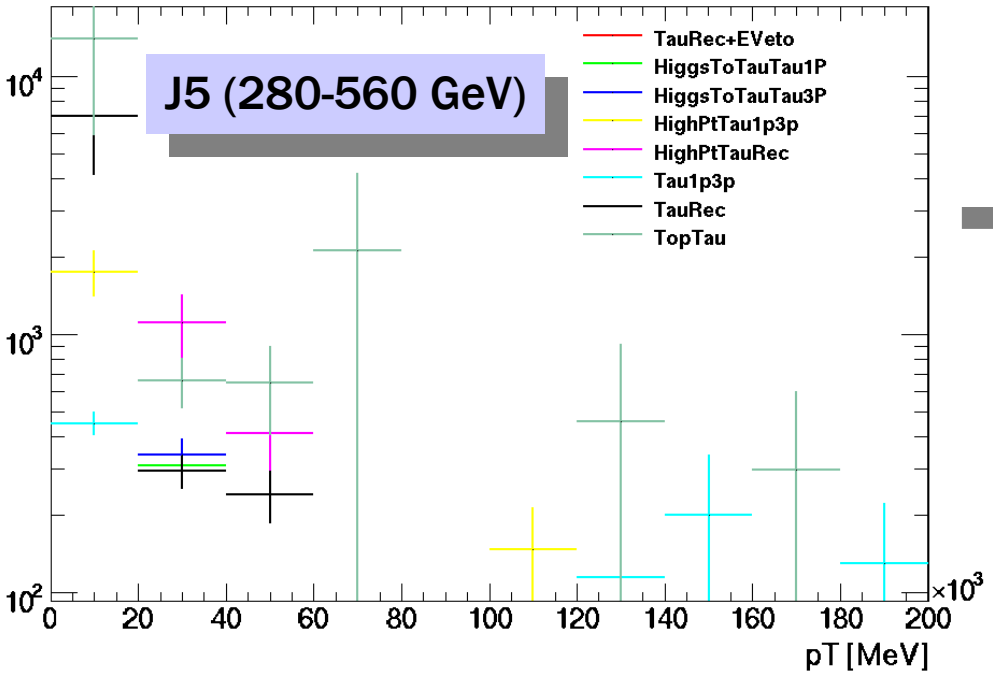


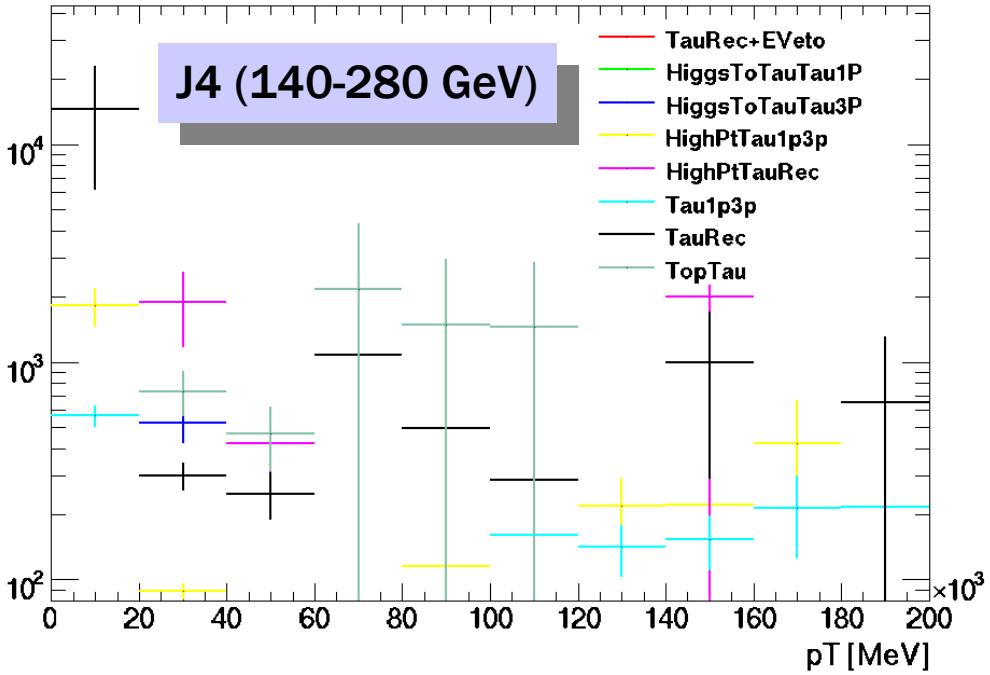
Rejection / pT





Rejection / pT



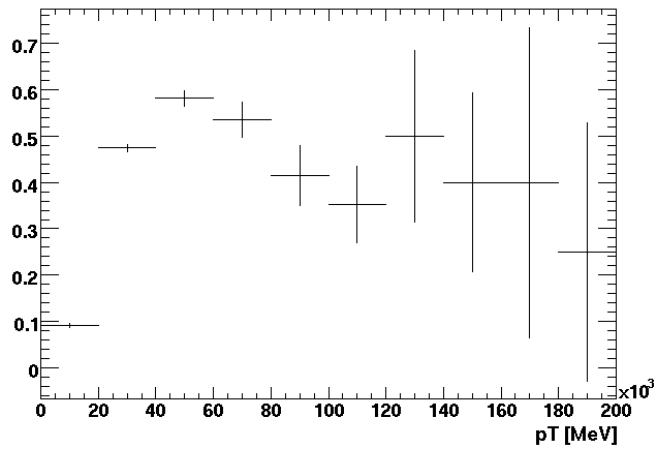


- Publish on Twiki page for crosschecks with other algorithms
- Additional samples:
  - Electron sample for fake rate studies (5144 Zee)
  - Muon sample for fake rate studies (5145 Zmumu)
  - Tausample for advanced pT (1546 Ztautau, 5862 Atautau)
  - b-jet sampel for fake rate studies (5859 WH120bb)
- Compare with Sylvie's tau fake rate analysis
- 13.0.40 and as soon as available 14.x.x with TopoJets

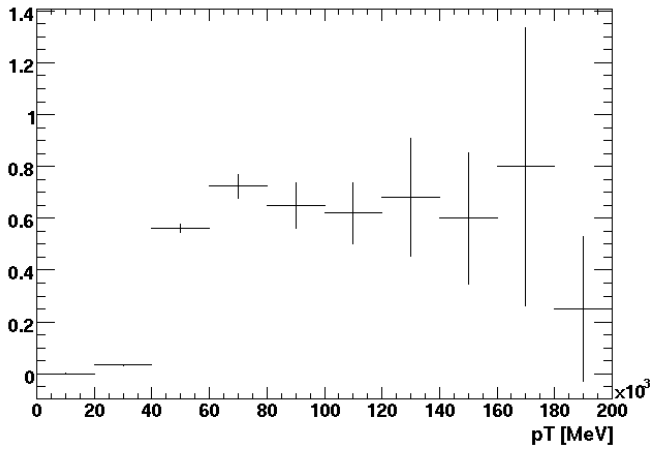
Backup Slides

Efficiency / pT

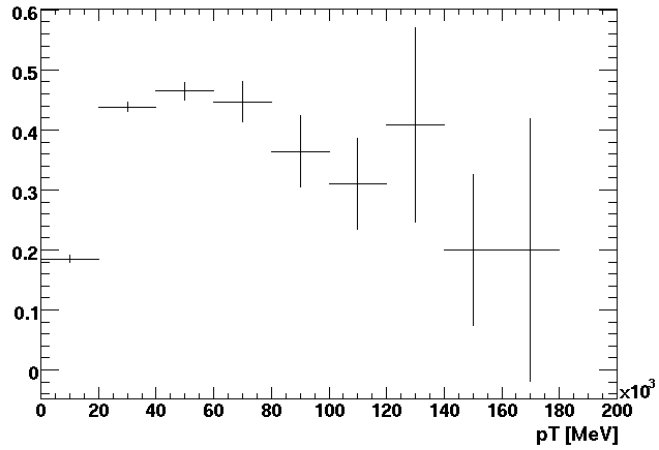
TrueHadTauToEVetoTauRecEff.vs.pT



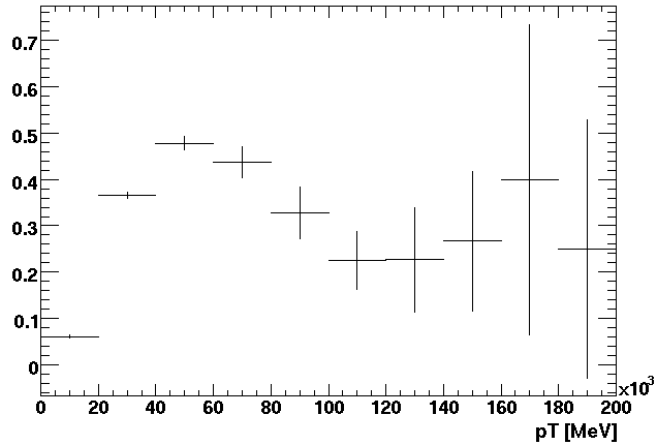
TrueHadTauToHiggsToTauTau1PEff.vs.pT



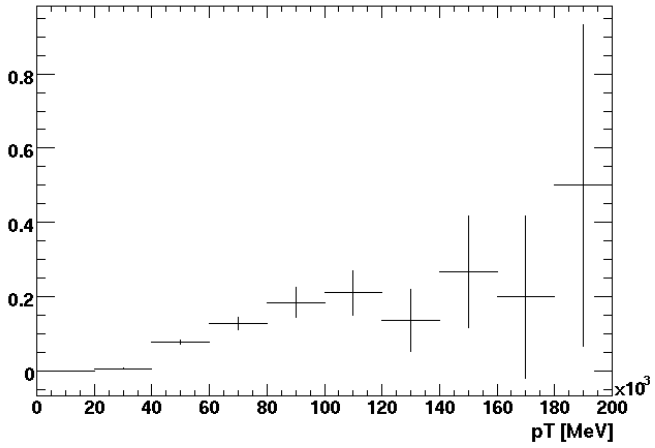
TrueHadTauToHighPtTau1p3pEff.vs.pT



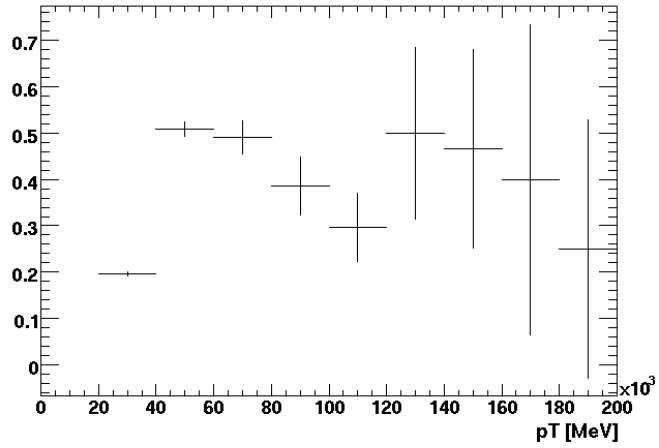
TrueHadTauToTopTauEff.vs.pT



TrueHadTauToHiggsToTauTau3PEff.vs.pT

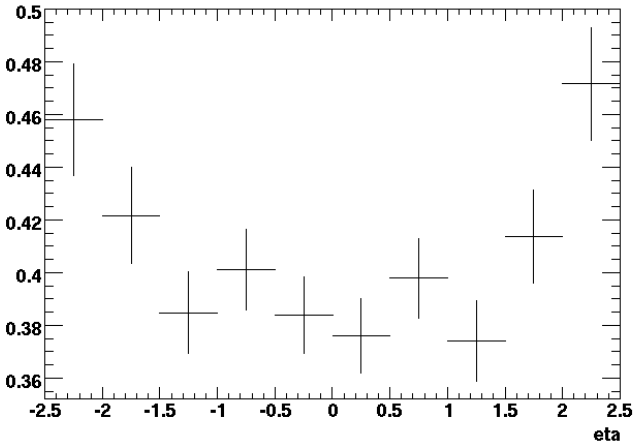


TrueHadTauToHighPtTauRecEff.vs.pT

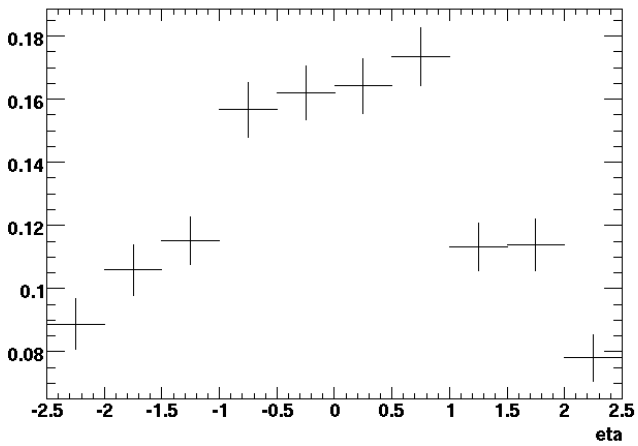


Efficiency / eta

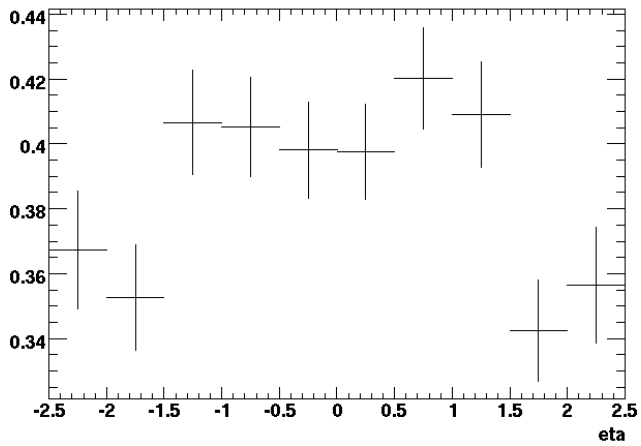
TrueHadTauToEVetoTauRecEff.vs.eta



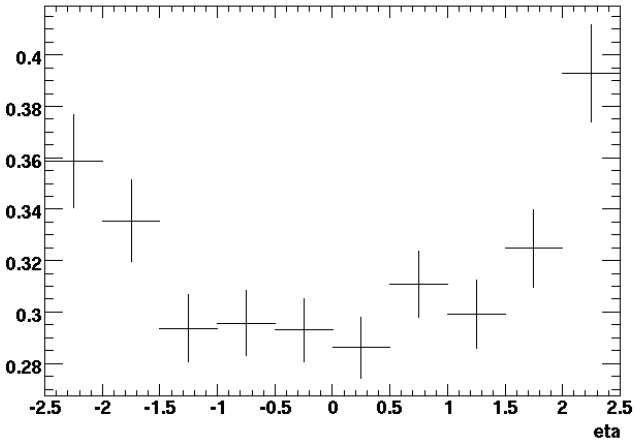
TrueHadTauToHiggsToTauTau1PEff.vs.eta



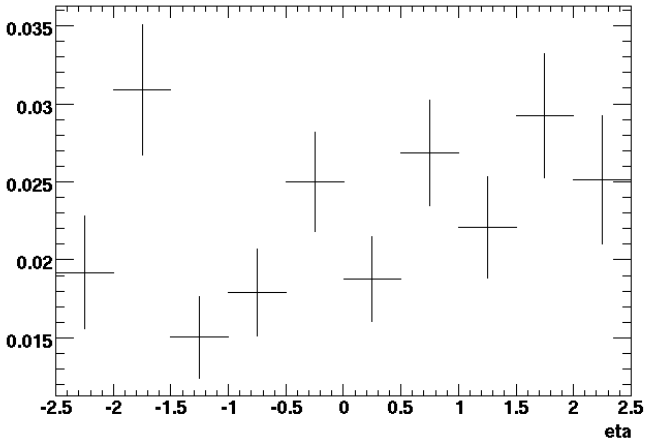
TrueHadTauToHighPtTau1p3pEff.vs.eta



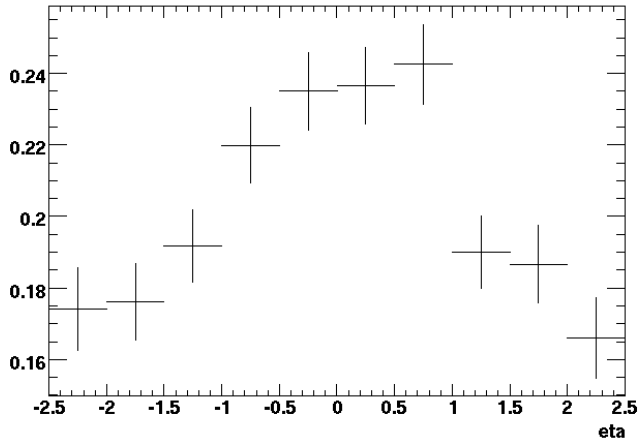
TrueHadTauToTopTauEff.vs.eta



TrueHadTauToHiggsToTauTau3PEff.vs.eta

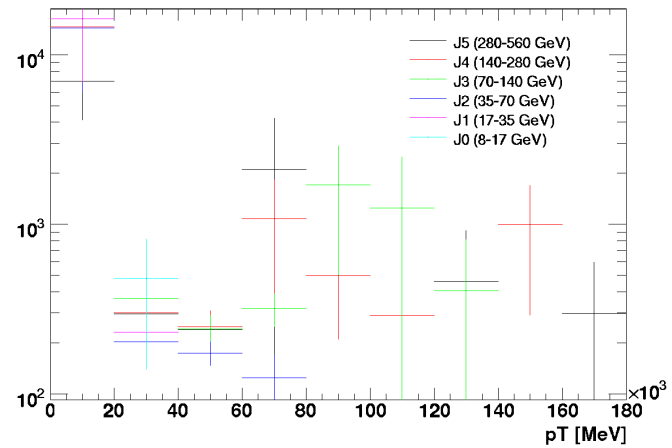


TrueHadTauToHighPtTauRecEff.vs.eta

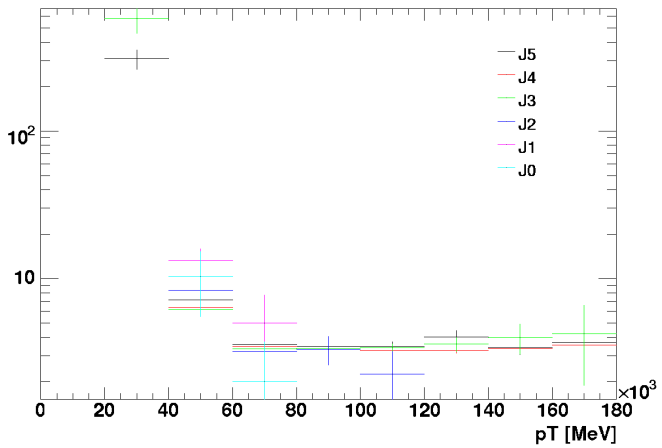


Rejection / pT

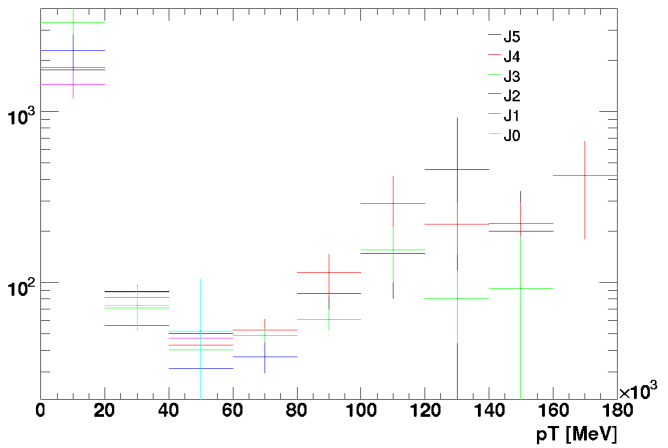
TrueJetToEVetoTauRecRej.vs.pT



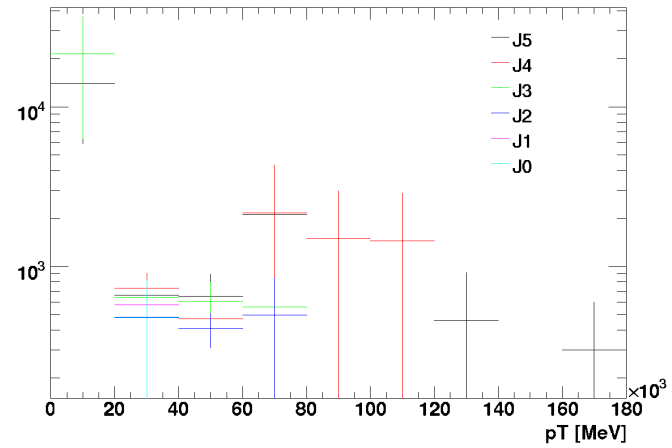
TrueJetToHiggsToTauTau1PRej.vs.pT



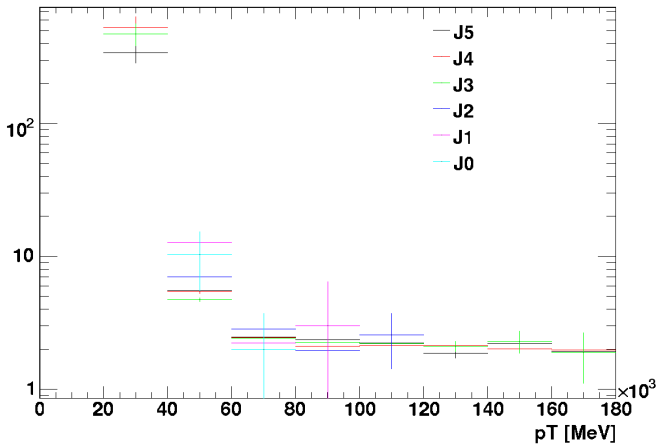
TrueJetToHighPtTau1p3pRej.vs.pT



TrueJetToTopTauRej.vs.pT



TrueJetToHiggsToTauTau3PRej.vs.pT



TrueJetToHighPtTauRecRej.vs.pT