

Muon Detectors

Tile Calorimeter

Liquid Argon Calorimeter

# Update Safe Variables Study on cell systematics

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Tau mini workshop DESY

Toroid Magnets

Solenoid Magnet

SCT Tracker

Pixel Detector

TRT Tracker



## Overview

### I. Safe Variables

- Distributions
- Plans on Safe Variables

### II. Study on cell systematics

- Motivation
- First uncertainties

### III. Summary



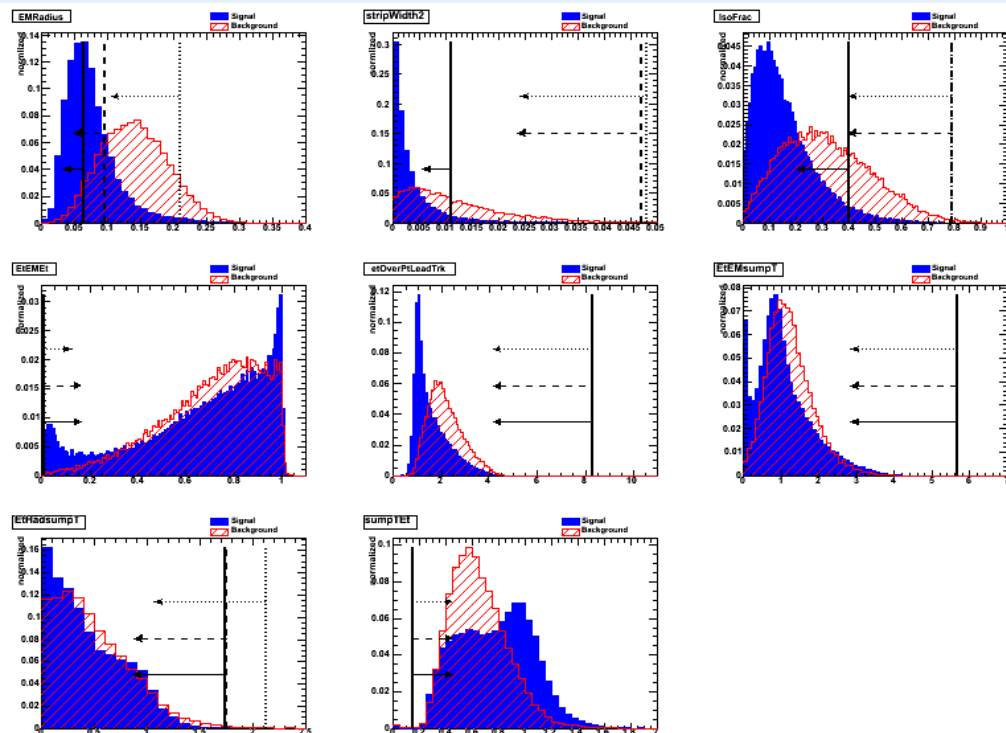
## Why distribution without cuts?

- Why are cuts set as they are set?
- How does a distribution look like if you cut on all variables except the one you are plotting?
- Better understanding of cuts, helps us to detect variables which are probably useless
- Will help us to find new/better variables (HadRadius, dRTrkAvg ...

<http://indico.cern.ch/getFile.py/access?contribId=3&sessionId=0&resId=0&materialId=slides&confId=43436> )

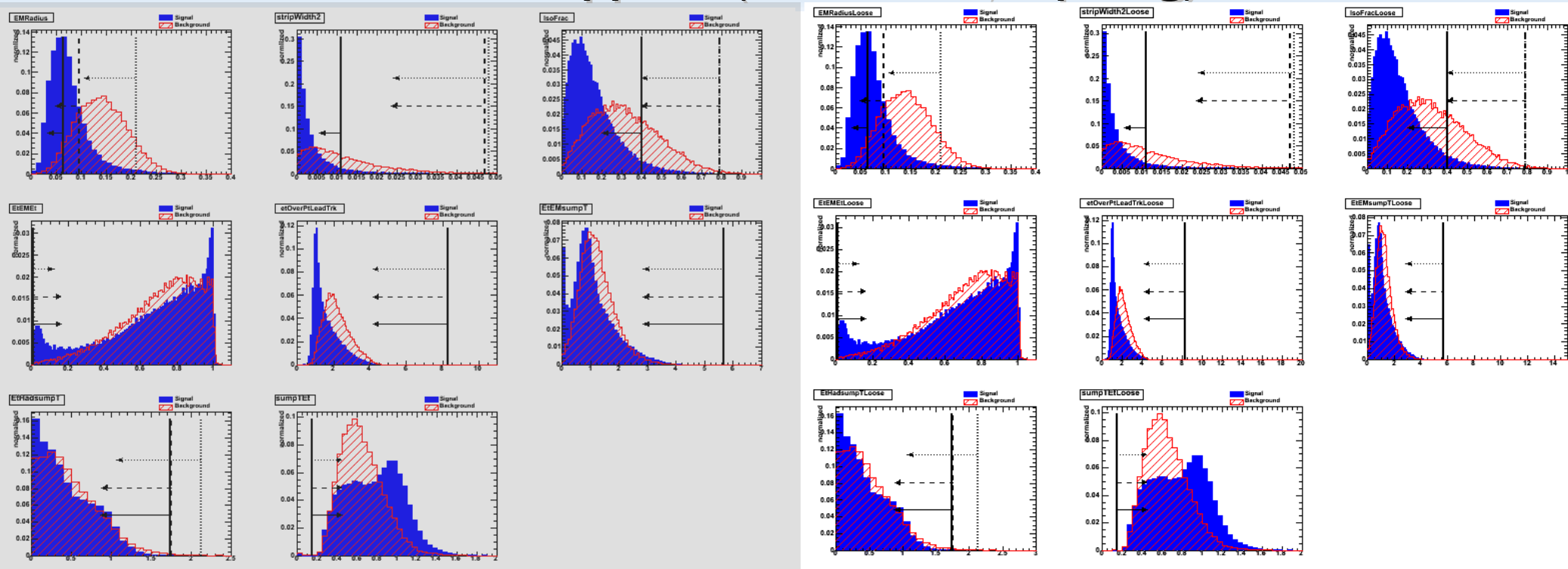


## Distributions no cuts applied (25-45 GeV, 1-prong)



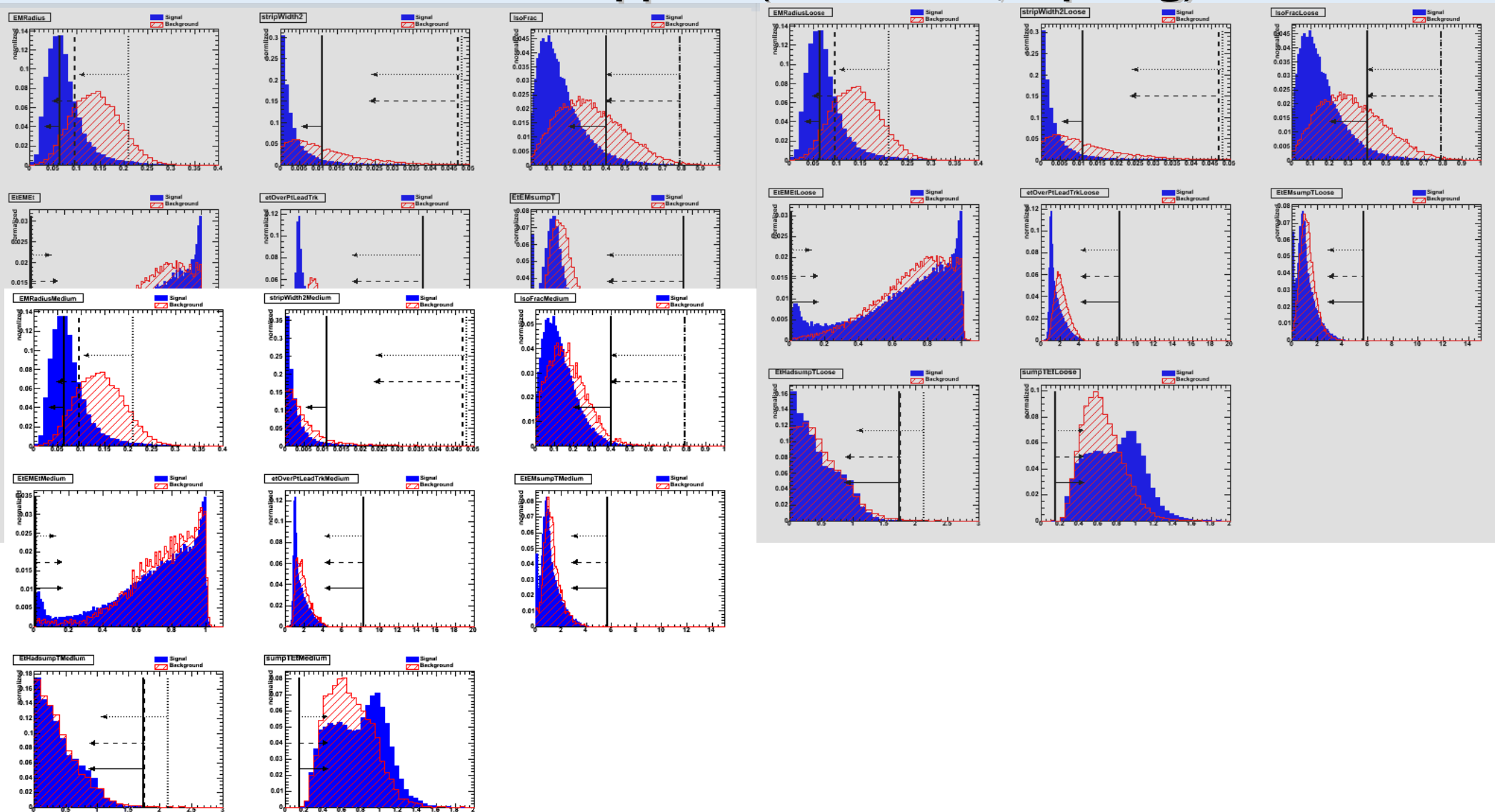


## Distributions loose cuts applied (25-45 GeV, 1-prong)



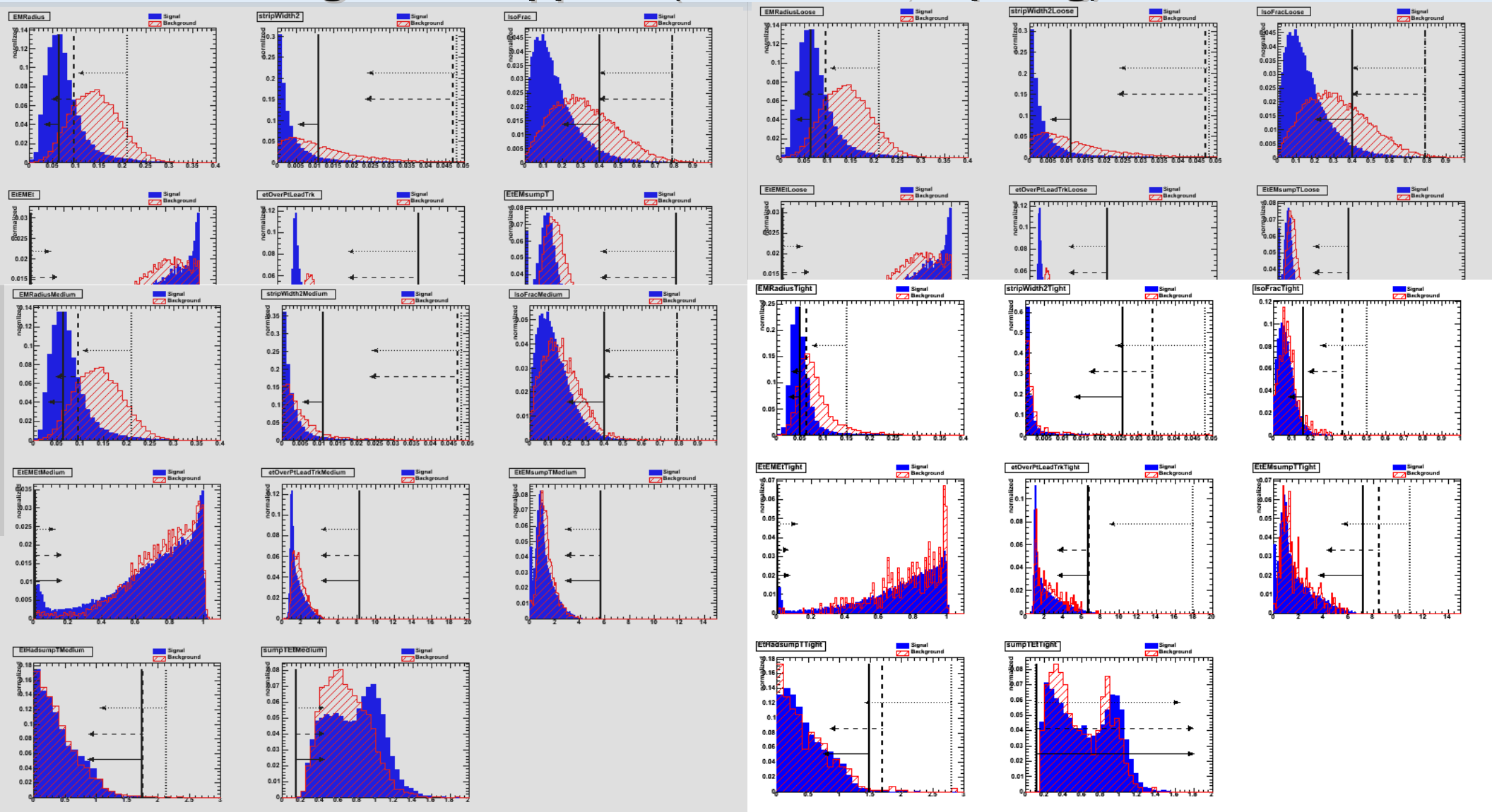


## Distributions medium cuts applied (25-45 GeV, 1-prong)



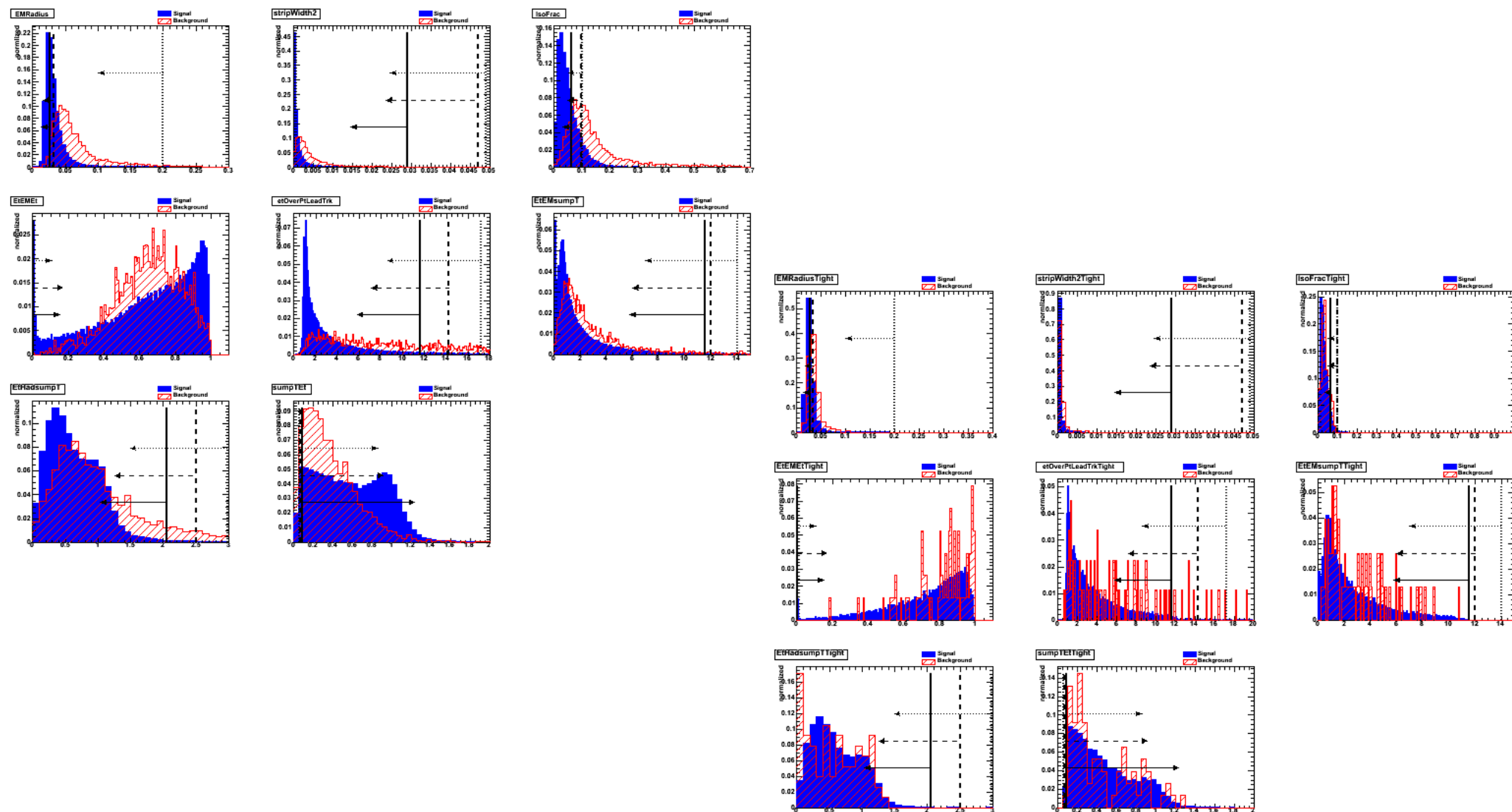


## Distributions tight cuts applied (25-45 GeV, 1-prong)





## No cuts vs. tight cuts (>100 GeV, 1-prong)



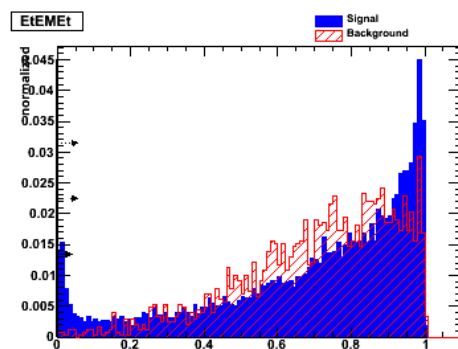
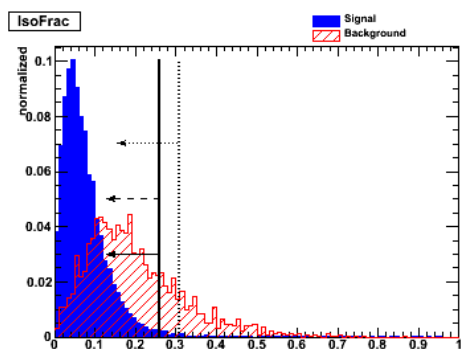
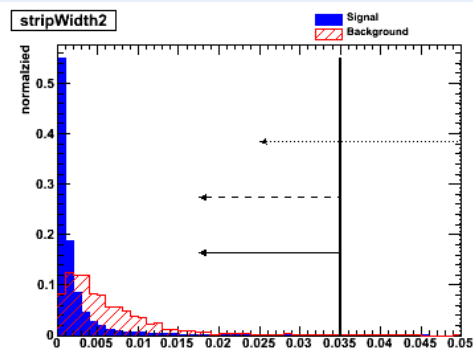
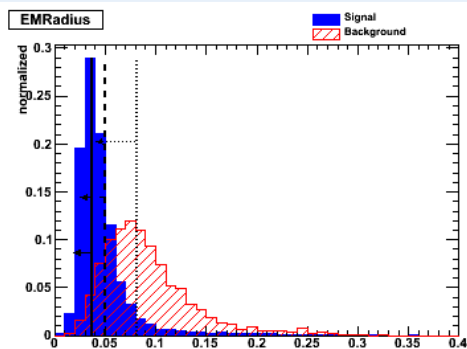


# Update on Safe Variables

## Study on cell systematics

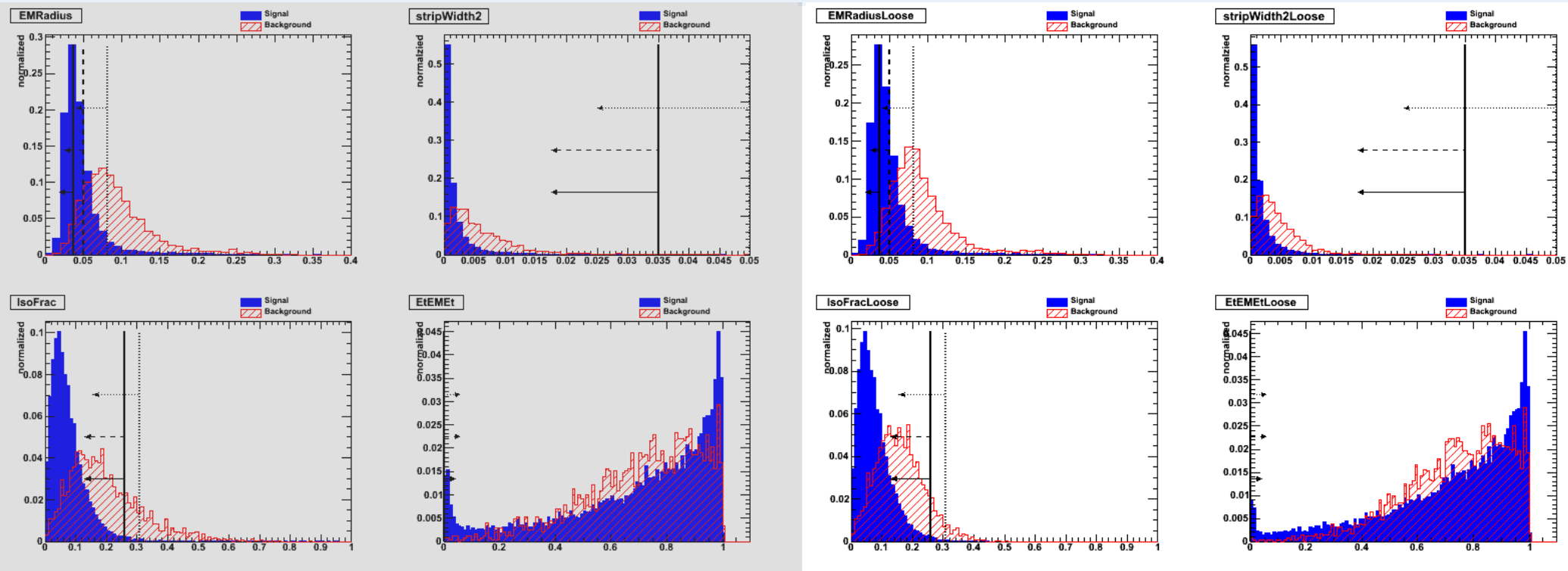


### Distributions no cuts applied (45-70 GeV, 1-prong)



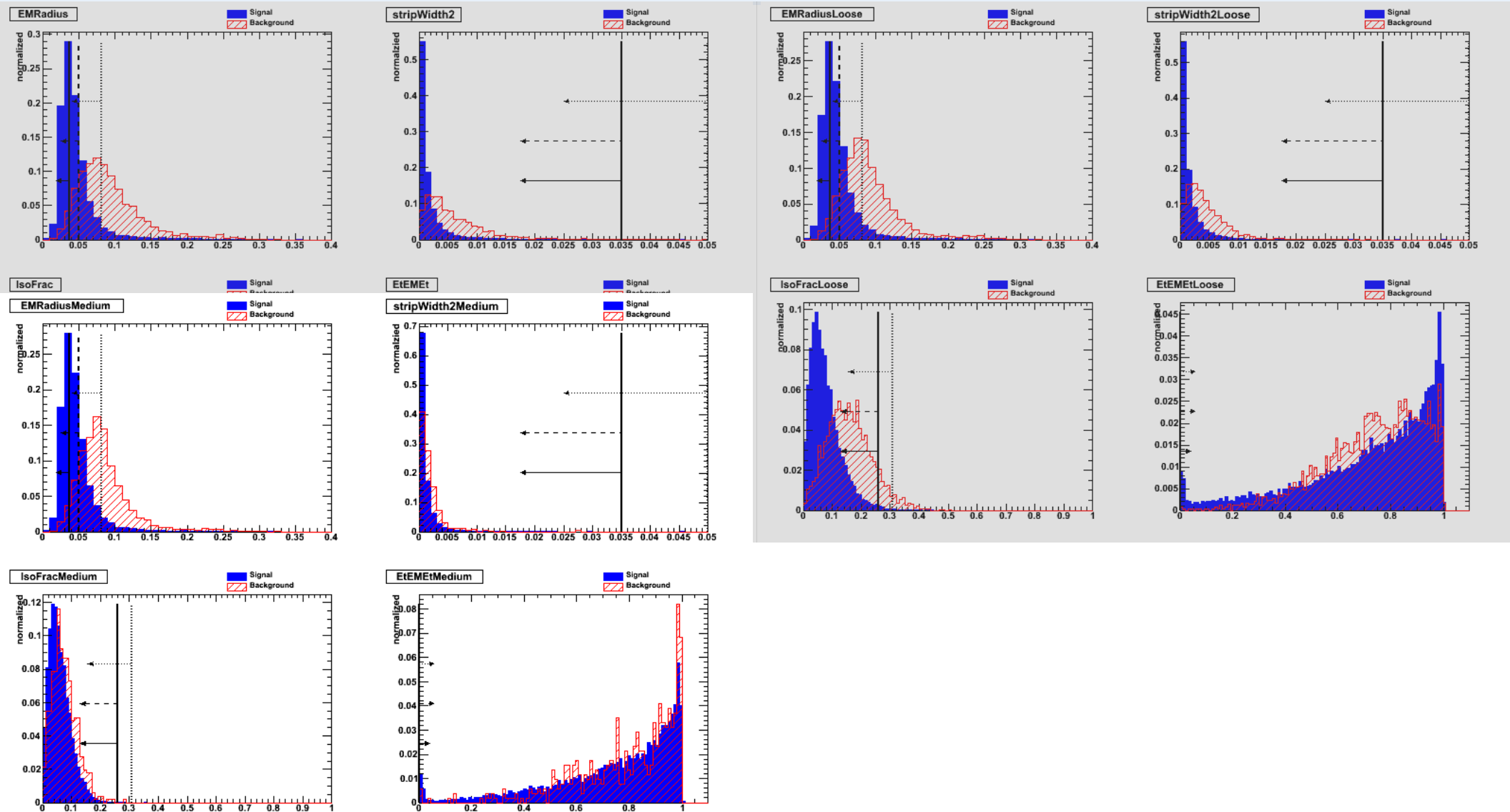


## Distributions loose cuts applied (45-70 GeV, 1-prong)



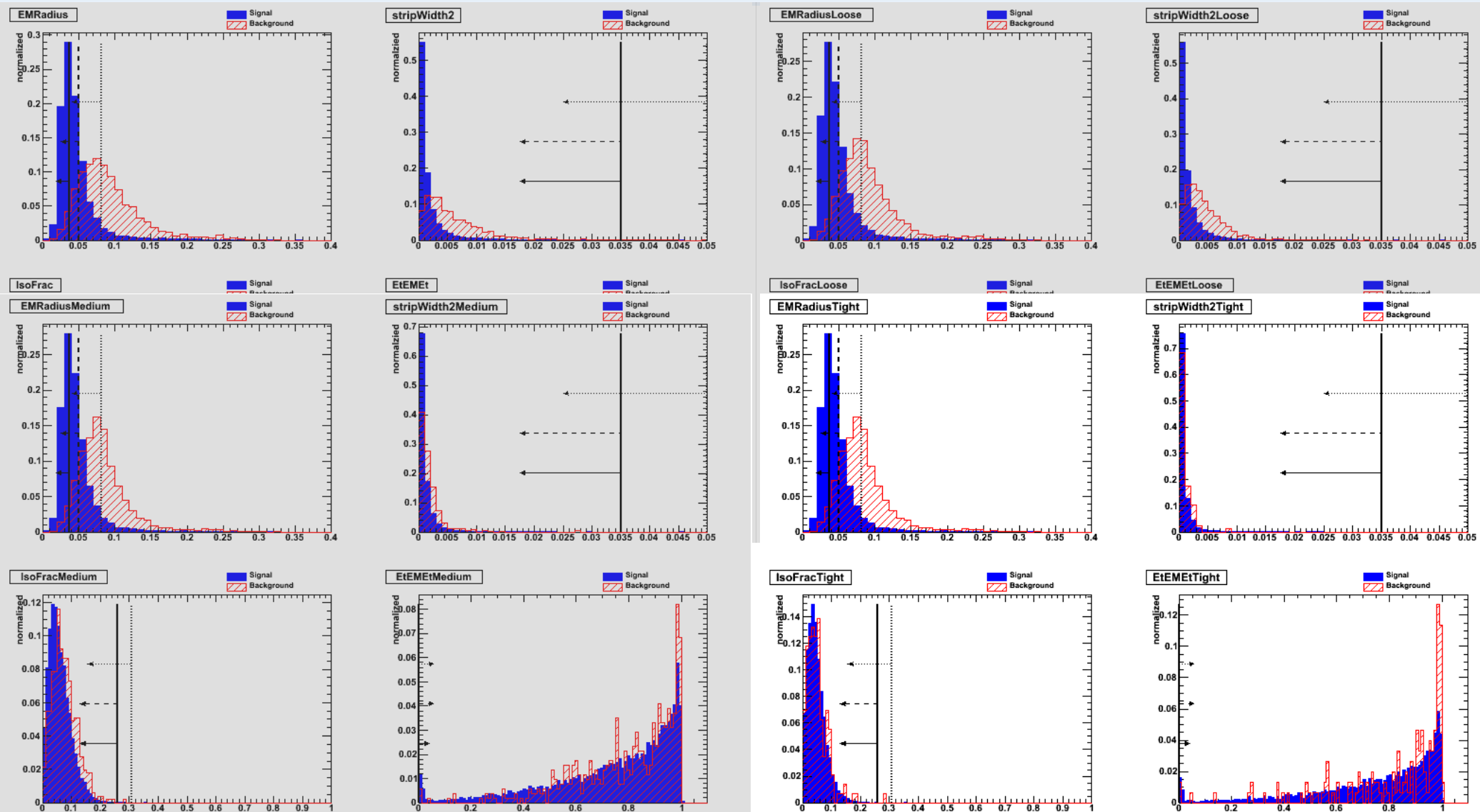


## Distributions medium cuts applied (45-70 GeV, 1-prong)



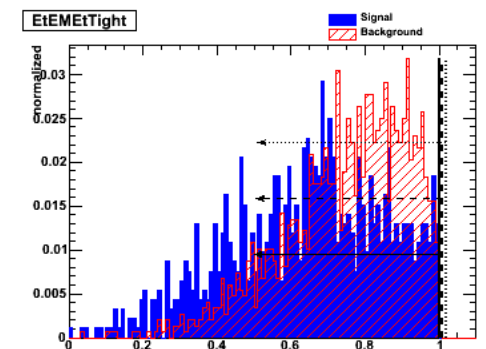
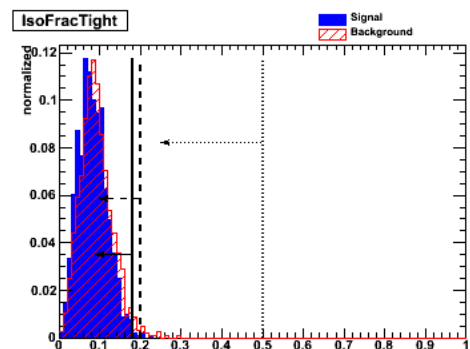
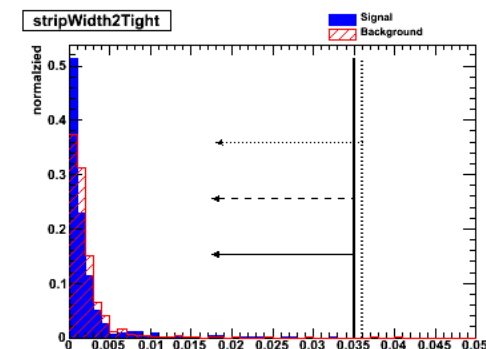
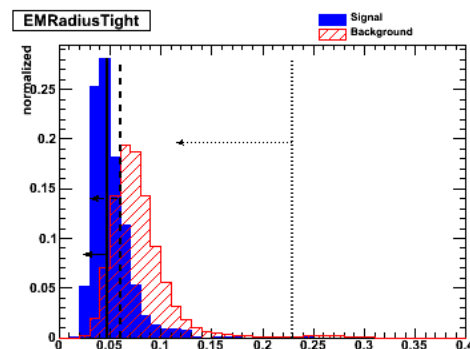
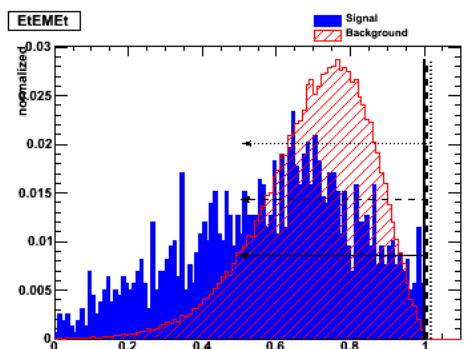
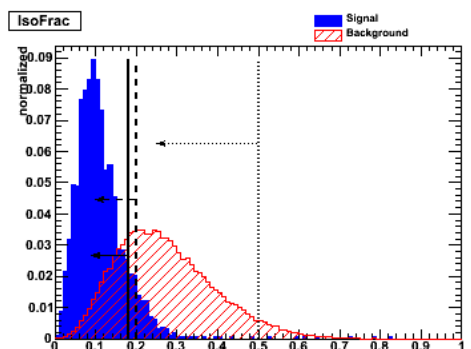
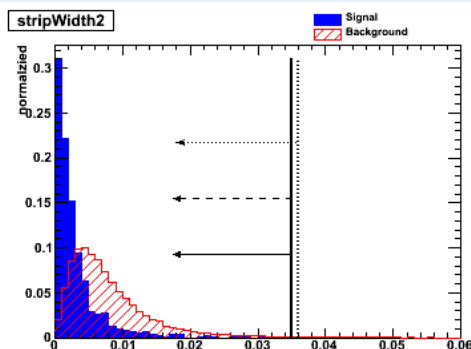
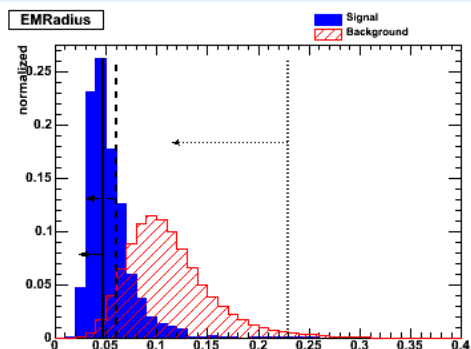


### Distributions tight cuts applied (45-70 GeV, 1-prong)





### No cuts vs. tight cuts (70-100 GeV, 3-prong)





## Summary/Plans

- **Summer student project:**
  - New optimization with new rel./samples
  - New variables (HadRadius, dRTrkAvg,...)
- **Z- $\rightarrow$ tautau- $\rightarrow$ lhad analysis with Safe Variables (Gordon Fischer, see talk tomorrow)**
- **Exciting what we can see with Safe Variables in first data ;) )**



## Motivation for cell systematics

- **Study uncertainties on cell energy:**
  - Smearing of EM scale – had scale
  - Smearing of individual cells
  - Add noise
- **Understanding of calorimetric uncertainties**
- **Understanding of discriminating variables**



## Motivation

- Topological cell cluster are associated to TauJets
- Uncalibrated cells are used to calculated discriminant variables
- Uses all cells of the associated TopoCluster within a certain  $dR$  (e.g.  $dR < 0.4$  for EMRadius)
- How safe are the Safe Variables relating to uncertainties of cell measurements (cell Et)



## Calo-based variables

### Radius in EM Calorimeter

$$R_{em} = \frac{\sum_{i=1}^n E_{T,i} \sqrt{(\eta_i - \eta_{cluster})^2 + (\phi_i - \phi_{cluster})^2}}{\sum_{i=1}^n E_{T,i}}$$

runs over all cells in the EM in a cluster with  $dR < 0.4$

### Isolation Fraction

$$\Delta E_T^{12} = \frac{\sum_i E_{T,i}}{\sum_j E_{T,j}}$$

ring of  $0.1 < dR < 0.2$  as isolation region  $i$  and  $j$  run over all EM cells in a cone with  $0.1 < dR < 0.2$  and  $dR < 0.4$  respectively

### Width in strip layer

$$\Delta \eta = \sqrt{\frac{\sum_{i=1}^n E_{T,i}^{strip} (\eta_i - \eta_{cluster})^2}{\sum_{i=1}^n E_{T,i}^{strip}}}$$

transverse energy width in strip layer (first layer of EM barrel)

### Et(EM)/Et

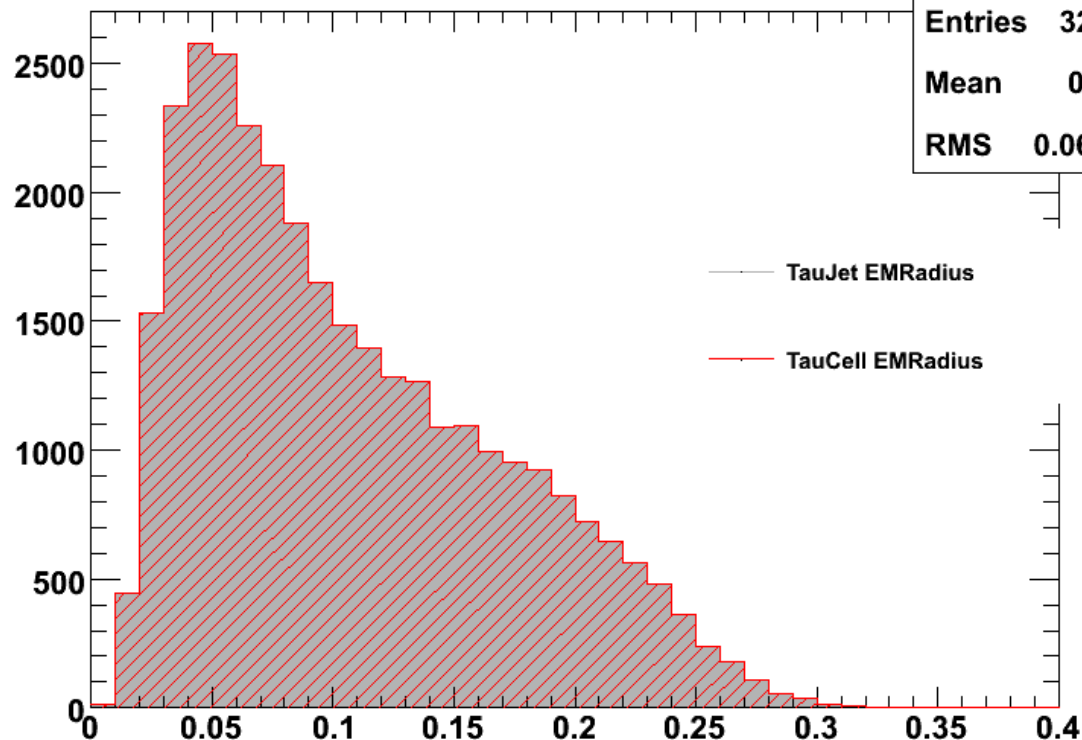
$$\Delta E_T^{EM} = \frac{E_T^{EM}}{E_T^{total}}$$

Fraction of transverse energy in the electromagnetic calorimeter and the total transverse energy



## Recalculate discriminants: **EMRadius**

Comparison TauJet\_EMRadius/TauCell\_EMRadius



TauRec\_EMRadius

Entries	32098
Mean	0.107
RMS	0.06356

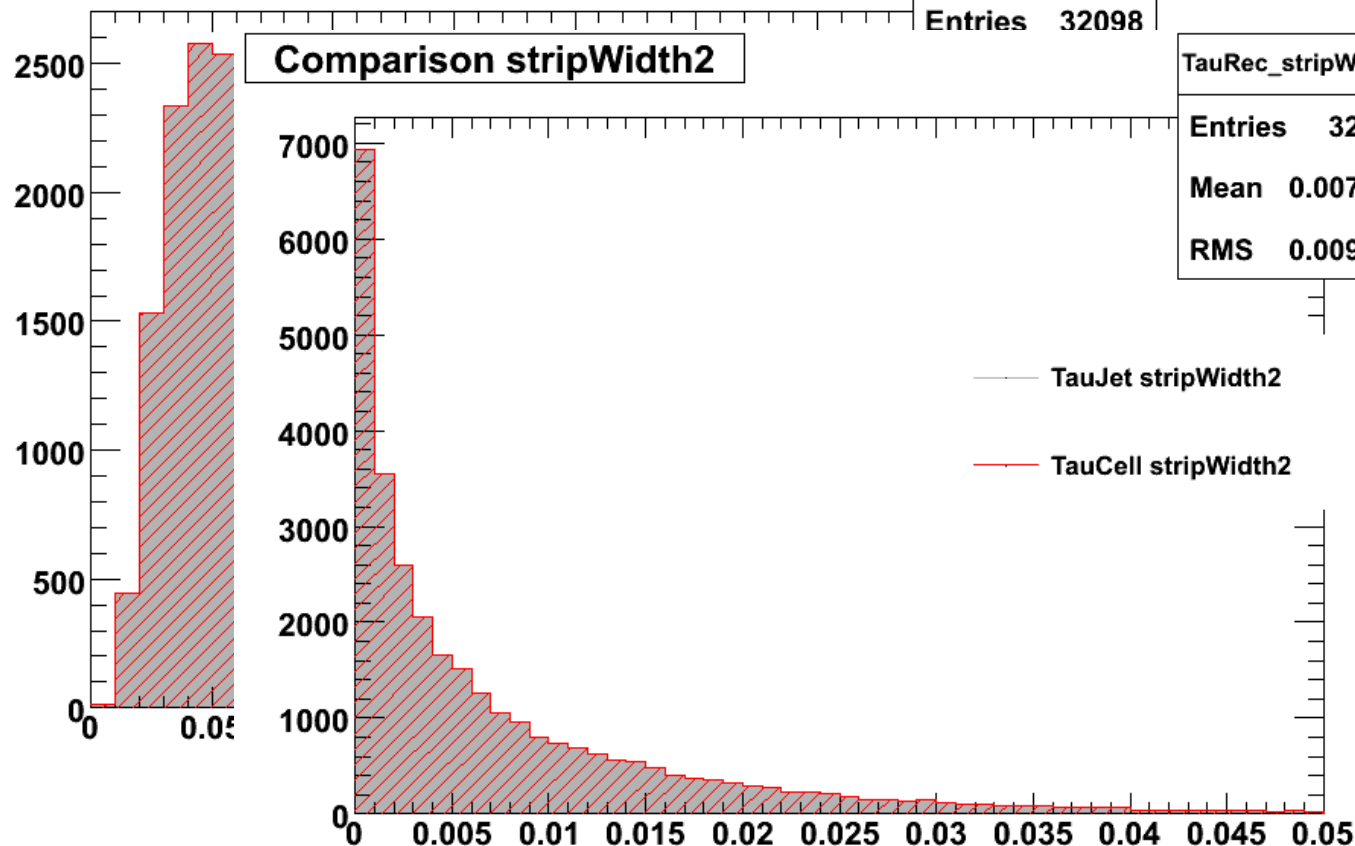


# Recalculate discriminants: **stripWidth2**

Comparison TauJet\_EMRadius/TauCell\_EMRadius

TauRec\_EMRadius

Entries 32098



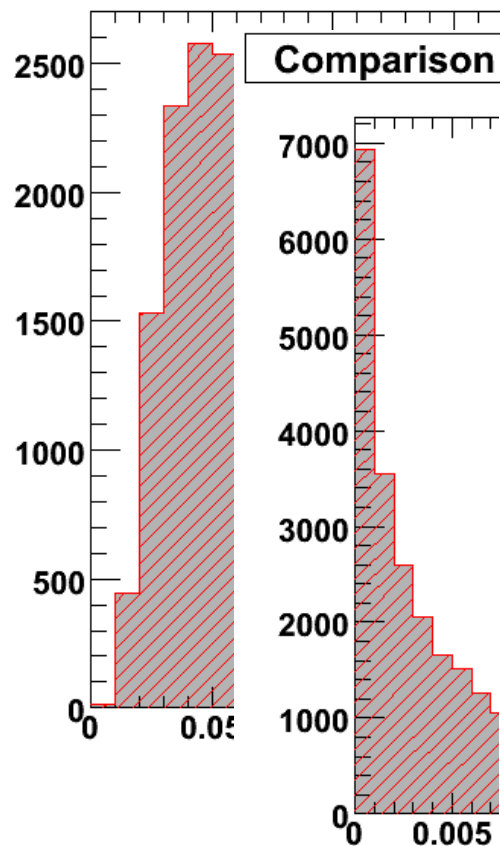


# Recalculate discriminants: IsoFrac

Comparison TauJet\_EMRadius/TauCell\_EMRadius

TauRec\_EMRadius

Entries 32098



TauRec\_stripWidth2

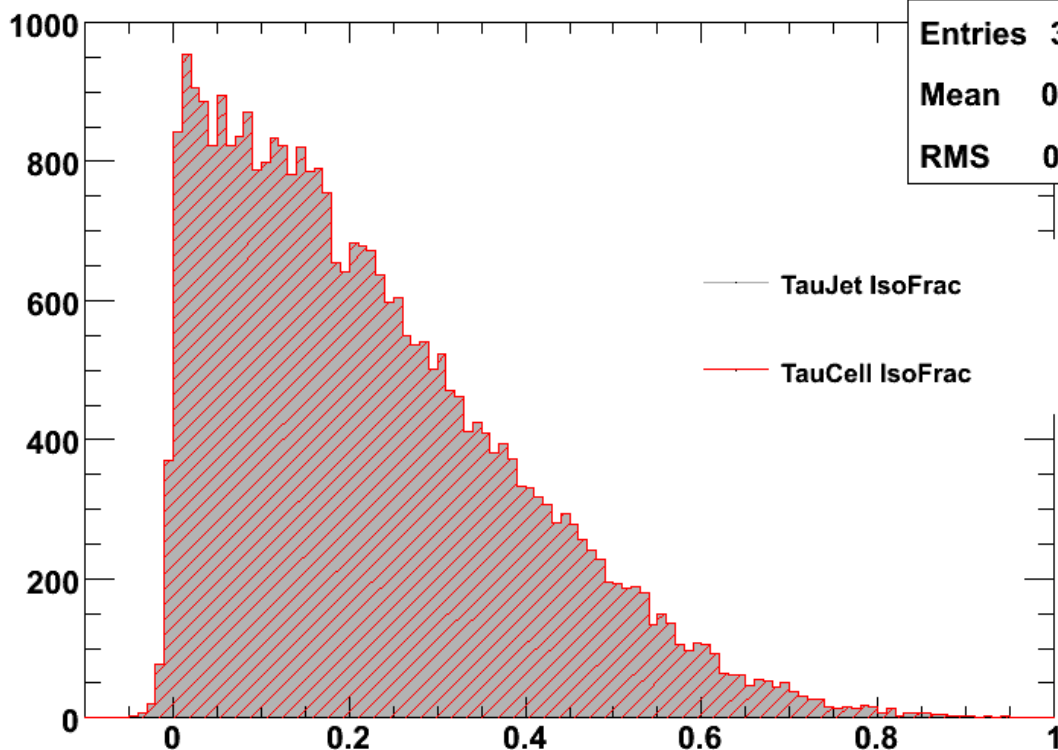
Comparison TauJet\_IsoFrac/TauCell\_IsoFrac

TauRec\_IsoFrac

Entries 32098

Mean 0.2224

RMS 0.1682





# Recalculate discriminants: **EtEMEt**

Comparison TauJet\_EMRadius/TauCell\_EMRadius

TauRec\_EMRadius

Entries 32098

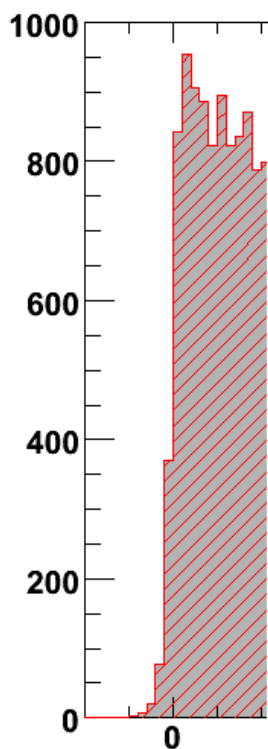
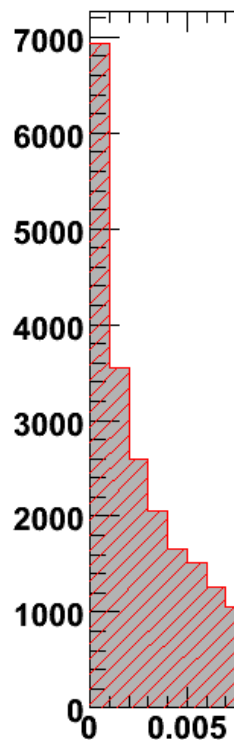
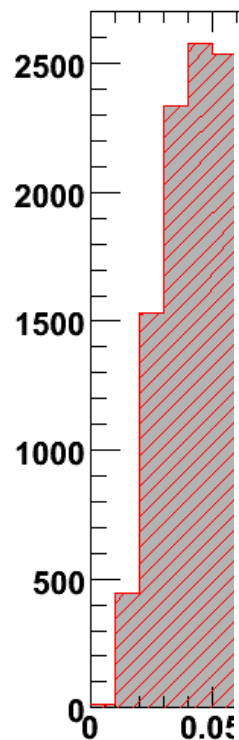
Comparison stripWidth2

TauRec\_stripWidth2

Comparison TauJet\_IsoFrac/TauCell\_IsoFrac

TauRec\_IsoFrac

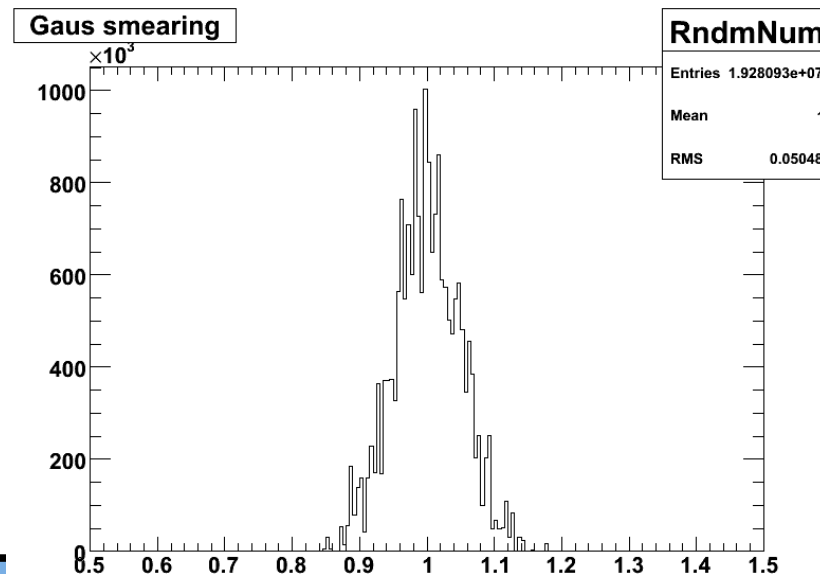
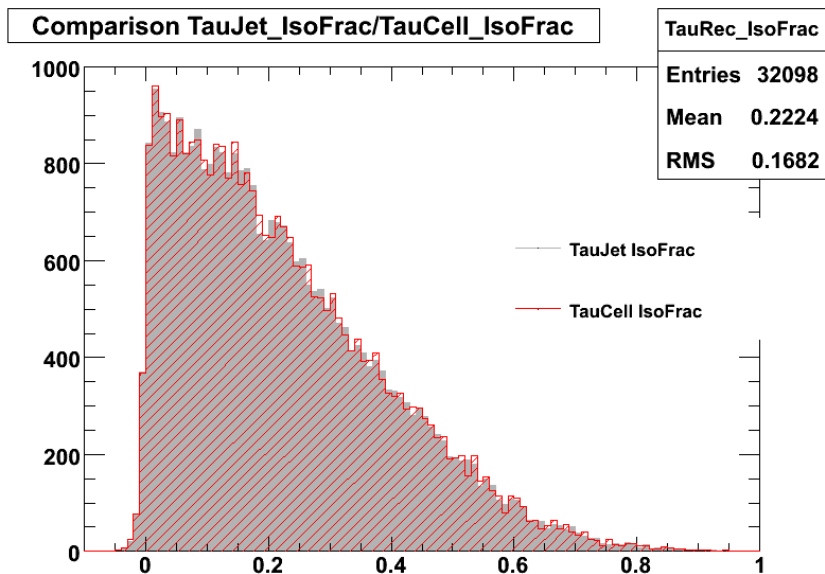
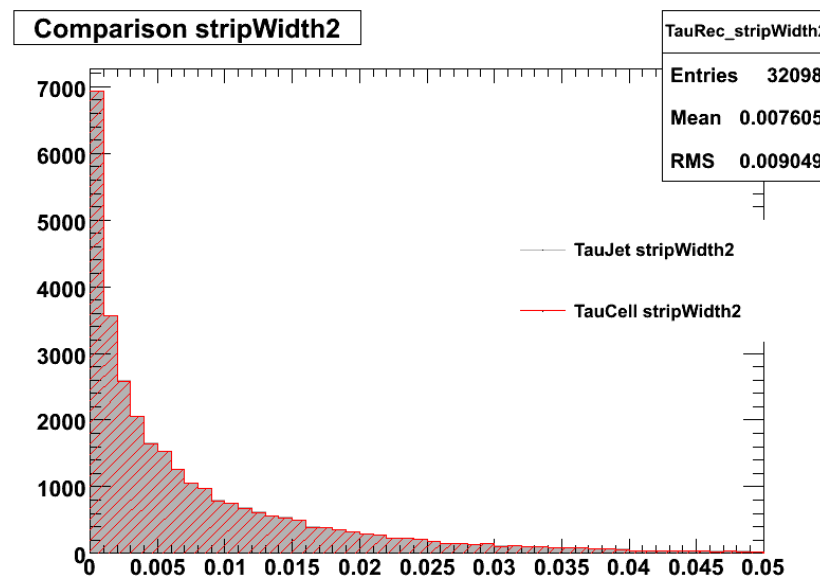
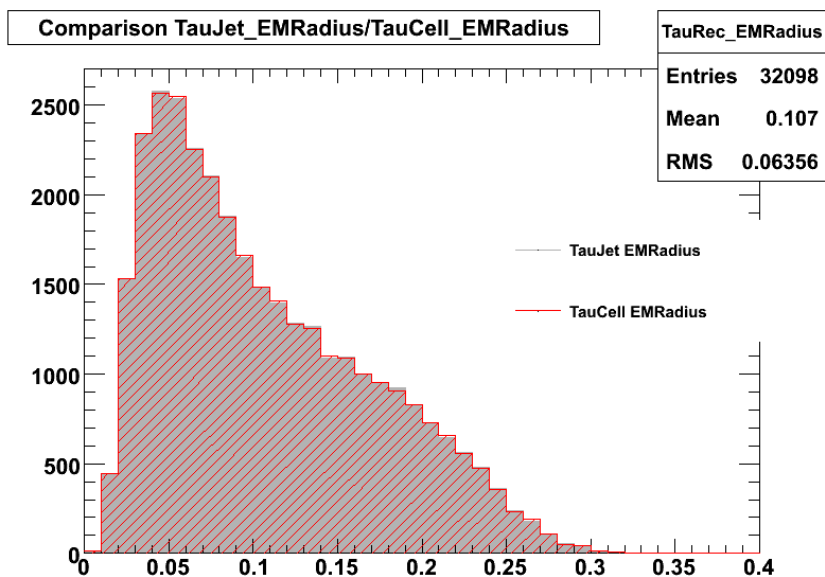
Entries 32098



**EtEMEt**  
coming soon

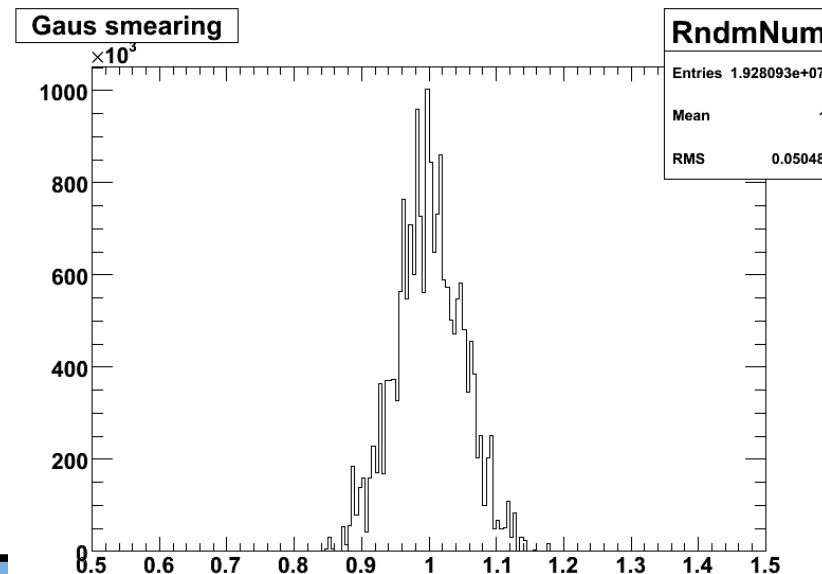
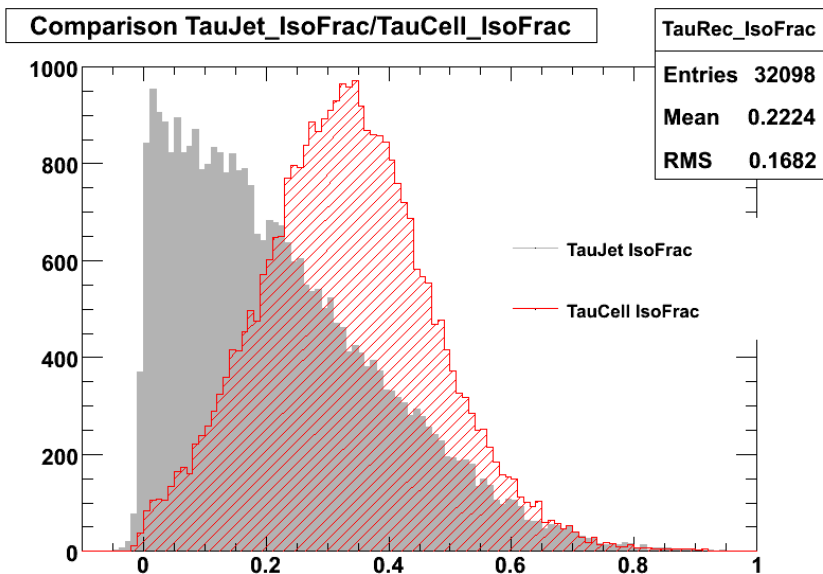
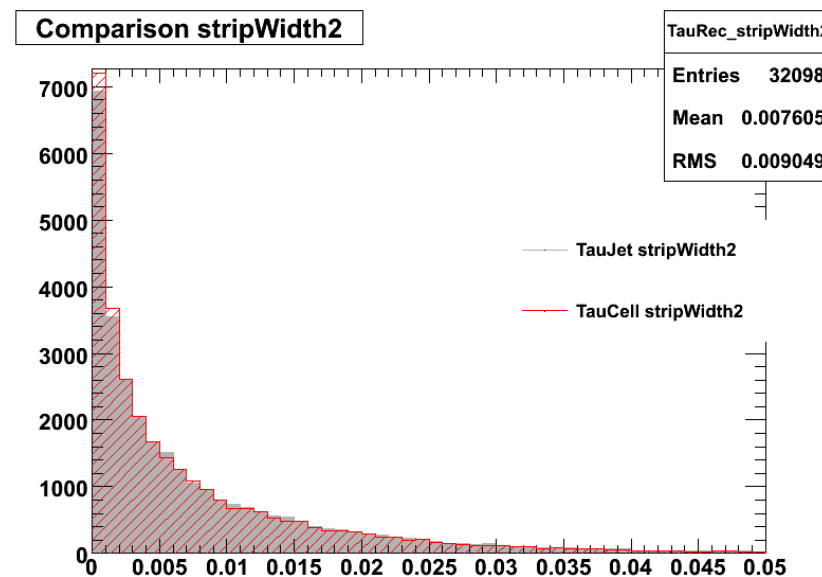
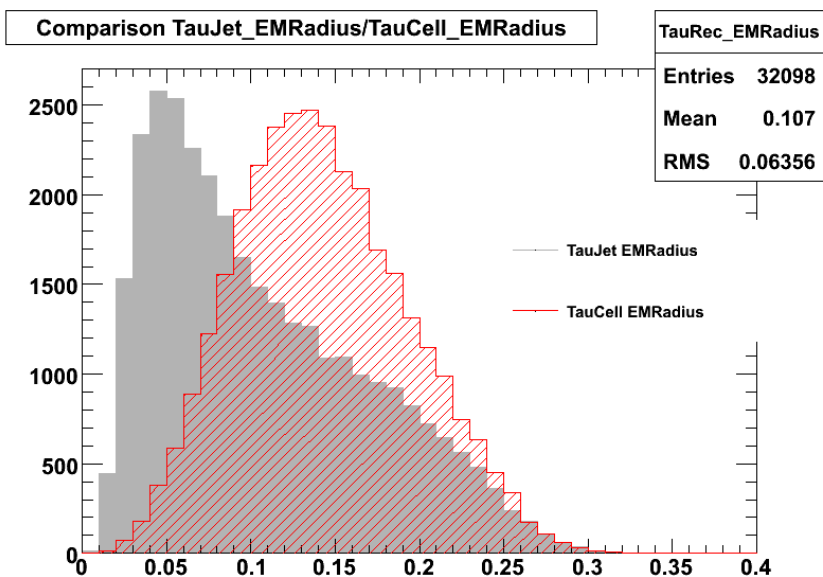


### Energy smearing gaussian



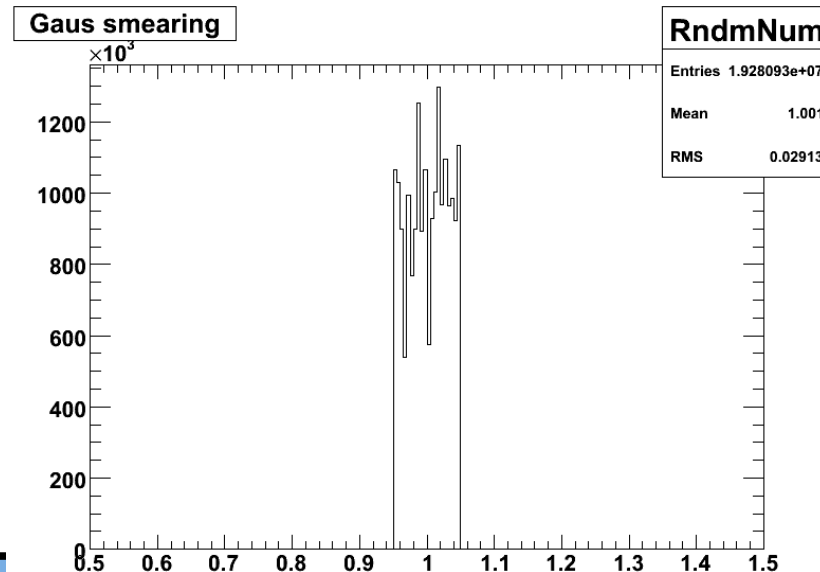
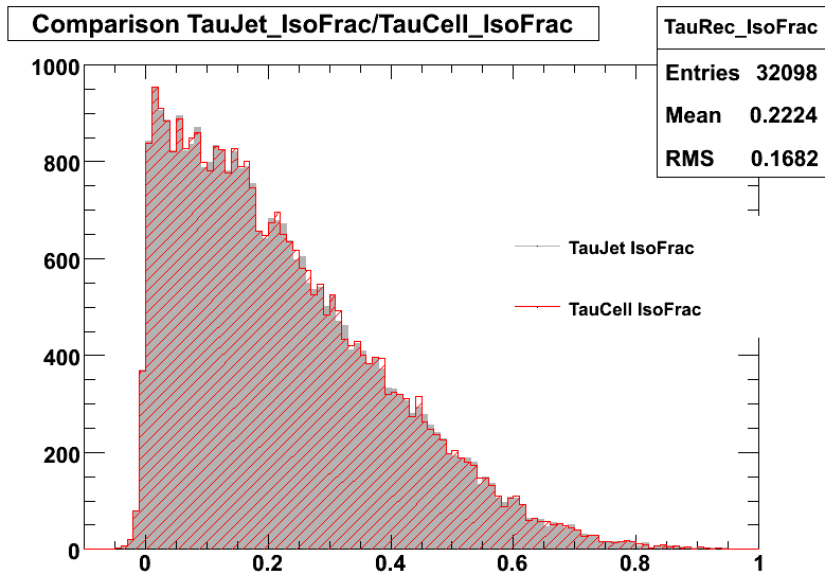
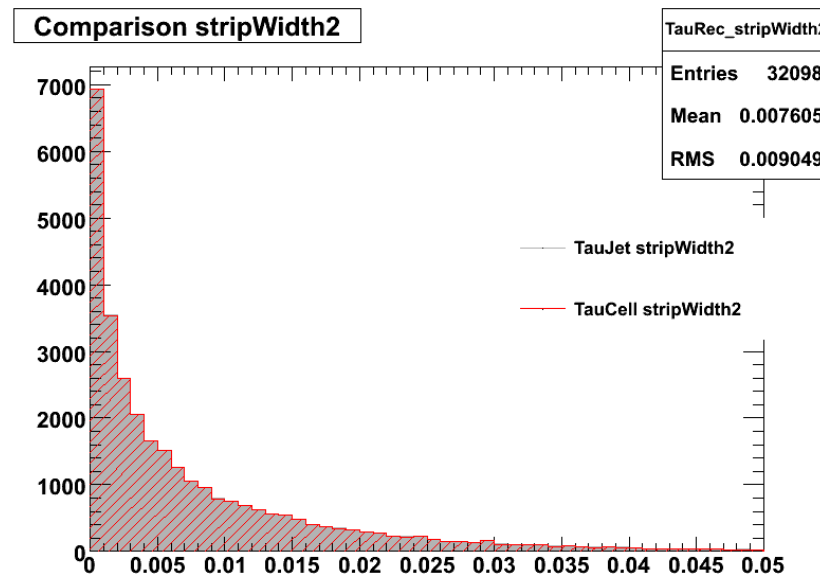
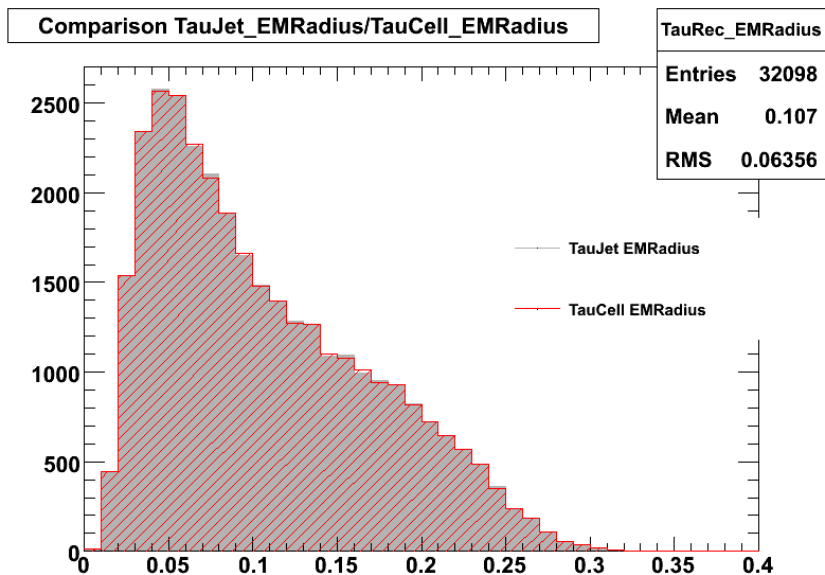


### EnergyEtaPhi smearing gaussian





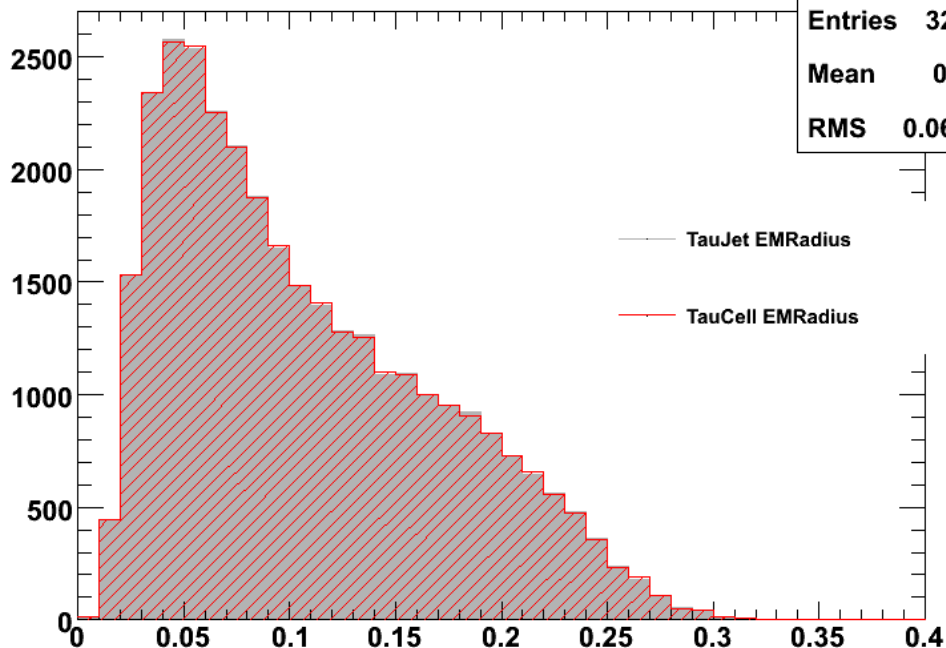
### Energy smearing uniform





### Energy smearing gaus vs. uniform

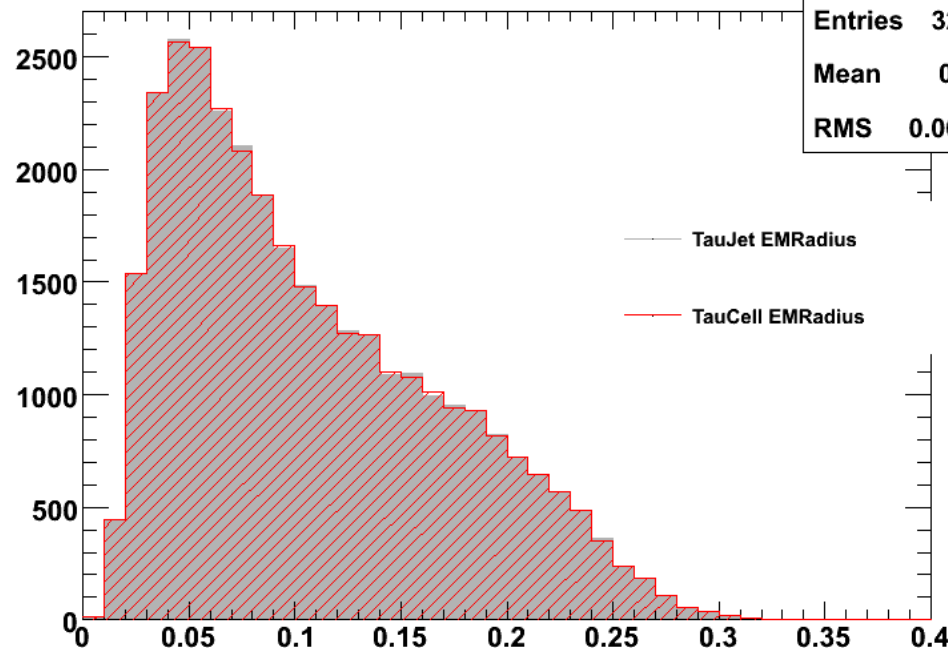
Comparison TauJet\_EMRadius/TauCell\_EMRadius



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TauRec\_EMRadius

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Mean	0.107
RMS	0.06356



## Summary

- **Update on Safe Variables:**
  - Distribution with reduced cuts give us a better understanding of the Safe Variables
  - Summer student project on new optimization and new variables
  - First studies started or will start soon with Safe Variables (Gordon, Carl Gwilliam:  
<http://indico.cern.ch/getFile.py/access?contribId=3&resId=0&materialId=slides&confId=49847>)



## Summary

- **Study on cell systematics:**
  - We can now dump all uncalibrated cells associated to a TauJet -> re-calculate discriminants
  - Have the options now to apply noise or energy smearing on individual cells and on EM or/and Had
  - Smearing on Et has no big effect on EMRadius, stripWidth2 and IsoFrac -> Safe Variables are safe!?
  - Smearing on Eta and Phi not reasonable, we should know the exact cell position; better: smearing of cluster position



# Backup