



Tau Performance

(In $t\bar{t}$ events)

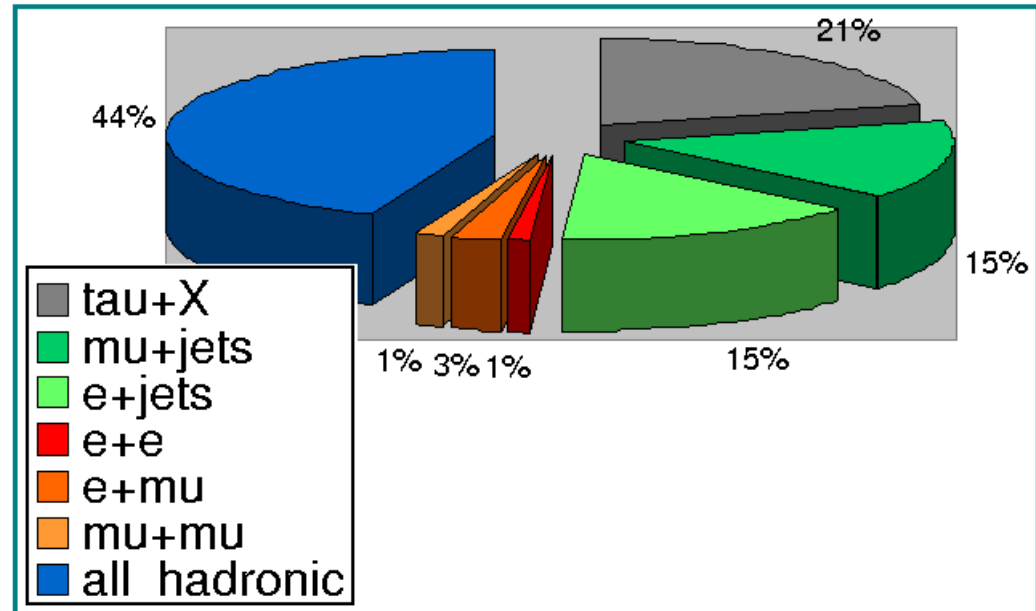


Contents



- Motivations
- Reconstructed tau algorithms
- Truth matching
- Good tau identification variables
- Examples of initial selection efficiency plots
- Future plans

- Make better use of the available $t\bar{t}$ events:
 - Many $t\bar{t}$ studies use the semileptonic channel but usually only considering the electron or muon cases. These together have a combined branching ratio of 30%.
 - 21% of $t\bar{t}$ events contain one or more decays to taus. By making use of $t\bar{t}$ events containing a single tau lepton the size of the useful semileptonic dataset may be extended.



- Tau final states are predicted for a number of as yet unseen (or predicted) processes:

- Standard model Higgs boson ($t\bar{t}h \rightarrow t\bar{t}\tau\tau$).
- MSSM Higgs bosons ($H/A \rightarrow \tau\tau$).
- Alternative SUSY processes etc.



Reconstruction types



- For Athena 13.0.30 there are two distinct reconstructed tau types:
 - TauRec : Calorimeter based
 - Tau1p3p : Track based
- Associated variables are stored in a series of different locations.
- Full details are available in the TauEDM:

https://twiki.cern.ch/twiki/bin/view/Atlas/TauEDM#Tau_AOD

- Using the 005200 series dataset (containing semileptonic and dileptonic $t\bar{t}$ with taus)



Truth matching



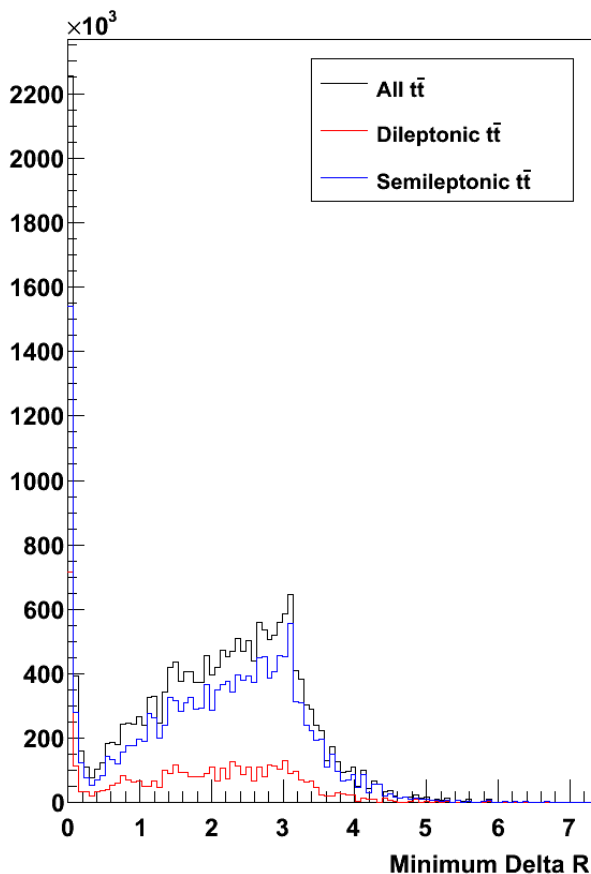
- Want to ultimately devise a series of cuts:
 - To identify which of the TauRec or Tau1p3p candidates correspond to real taus in each event
 - To identify dileptonic ttbar events containing taus from different top events and other background
- Use a ΔR comparison to identify the truth tau (final decaying taus only) which best matches each Tau1p3p candidate in each event.
- Examine the ΔR plots to decide what value corresponds to a good match



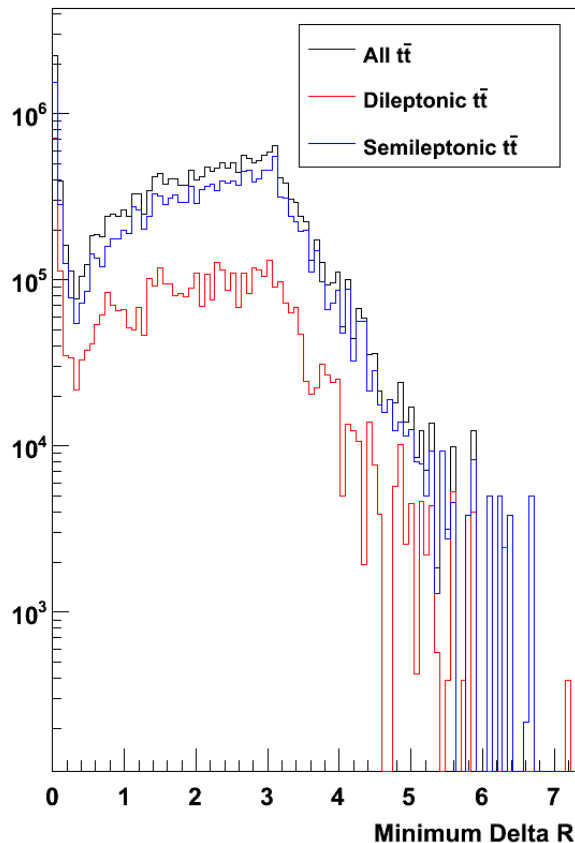
TauRec



Minimum Delta R (Between truth and rec. for TauRec)

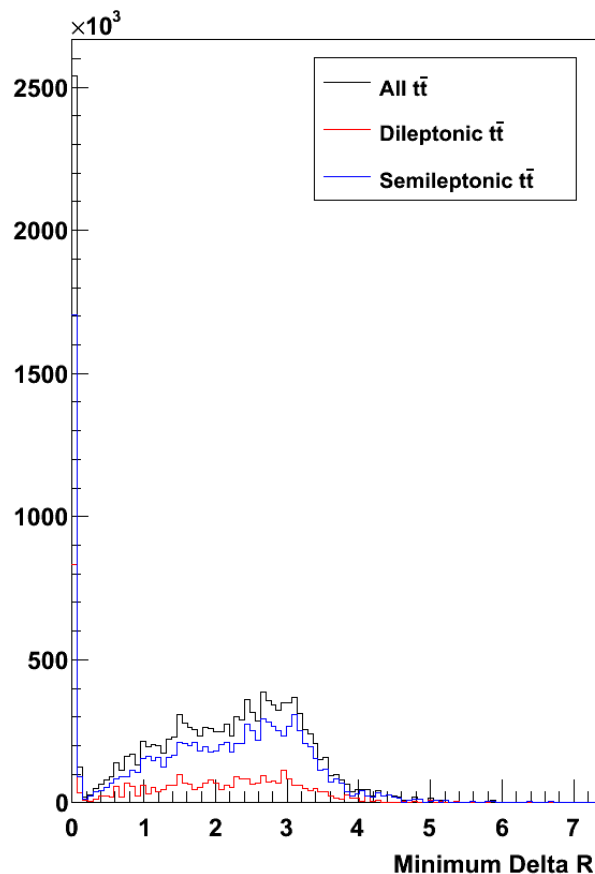


Minimum Delta R (Between truth and rec. for TauRec)

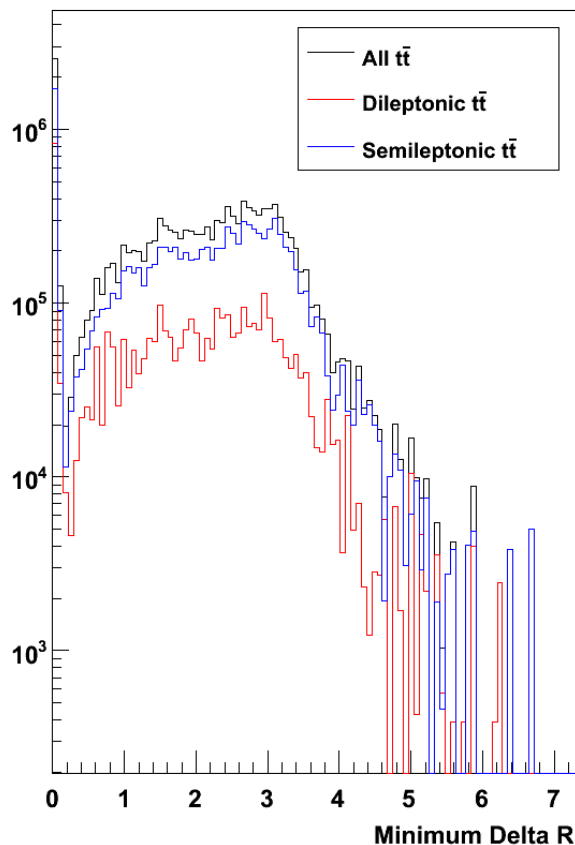


- Shapes appear comparable for the two $t\bar{t}$ event types.
- $\Delta R < 0.2$ appears to represent a good match between truth and reconstruction.
- Plot currently only shows events containing a truth tau.
- Compares reasonably well to $Z \rightarrow \tau\tau$ results.

Minimum Delta R (Between truth and rec. for Tau1p3p)



Minimum Delta R (Between truth and rec. for Tau1p3p)



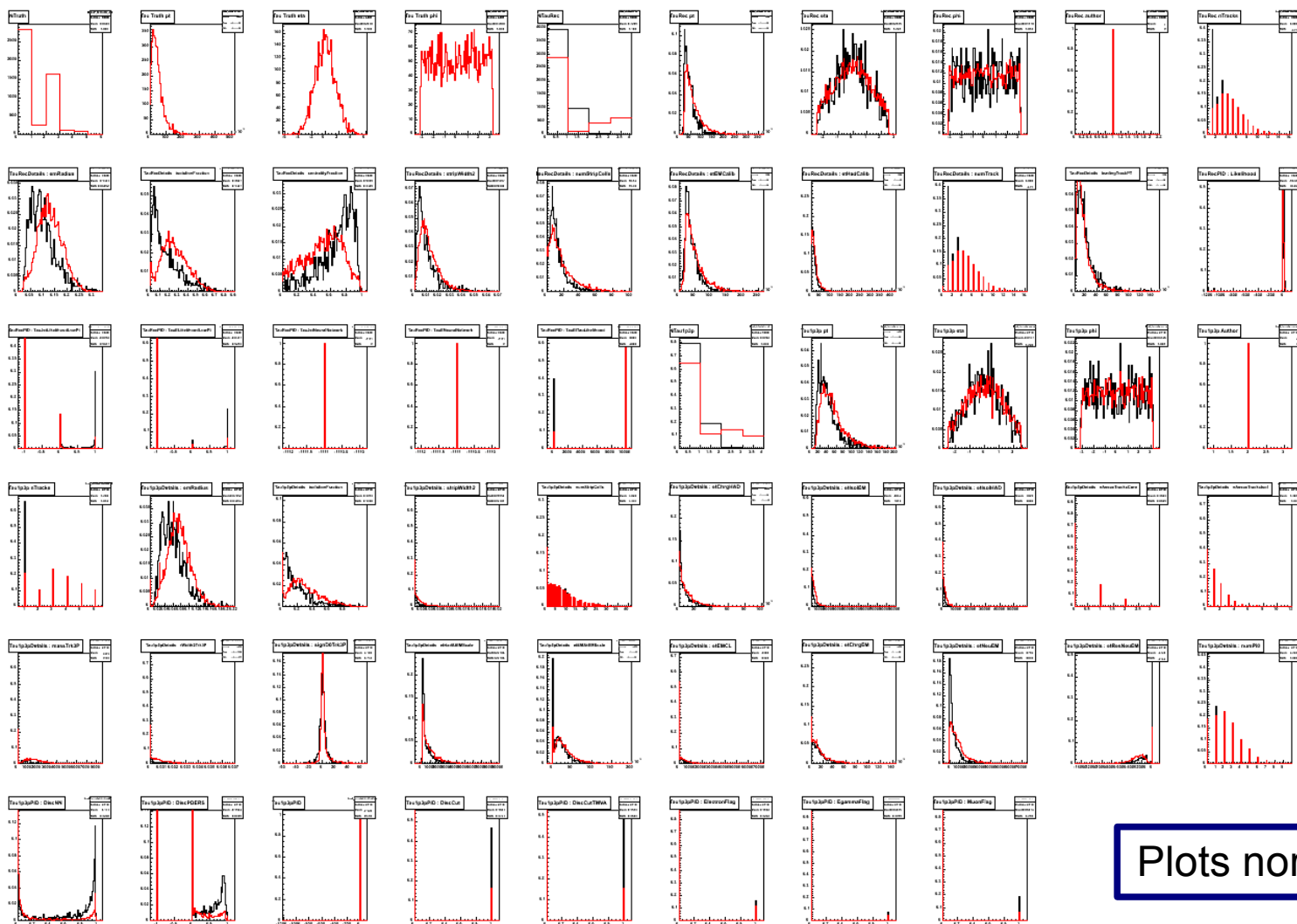
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Matching Comparison



- Define a reconstructed tau as being a 'good tau' if it matches to a truth tau with a $\Delta R < 0.2$
- Plot all the 'tau ID' variables for all ttbar events in the 5200 sample that contain reconstructed tau candidates
- Plot reconstruction variables for both good and bad taus:
 - Good tau $\rightarrow \Delta R < 0.2$ match to closest truth tau
 - **Bad tau $\rightarrow \Delta R > 0.5$ match to closest truth tau**



17 September 2008



Potential Discriminators



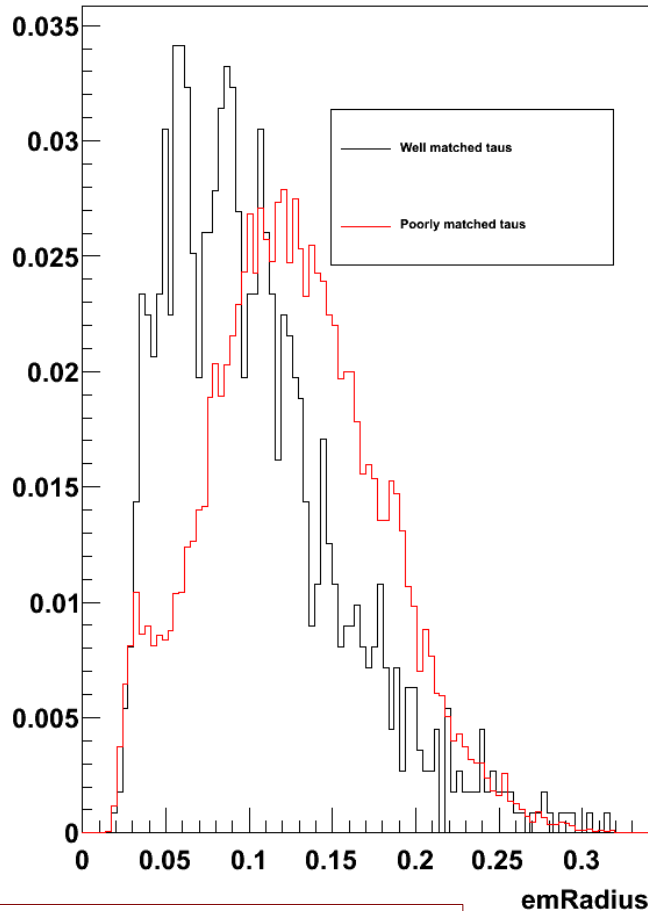
- Variables which currently look most promising to separate well and poorly matched taus are:
- TauRec:
 - EmRadius
 - IsolationFraction
 - CentralityFraction
 - StripWidth2
- Tau1p3p:
 - EmRadius
 - IsolationFraction
 - **DiscNN**
 - **DiscPDERS**
- Currently producing plots of signal selection efficiency and background rejection efficiency for the promising variables.



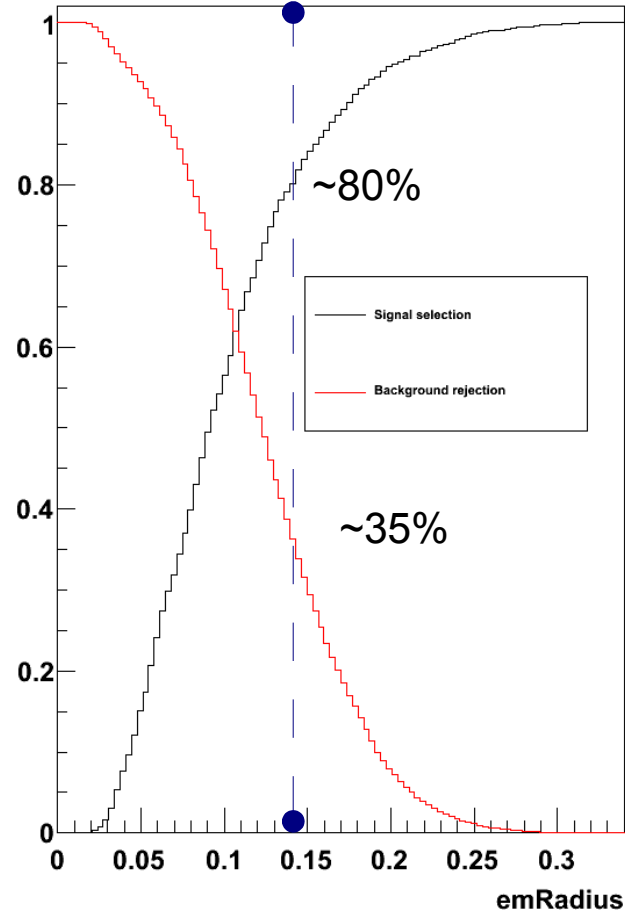
TauRec emRadius



TauRecDetails : emRadius



TauRecDetails : emRadiusEff



Dotted line illustrates that a cut of ~ 0.14 would retain $\sim 80\%$ of the signal but would only reject $\sim 35\%$ of the background

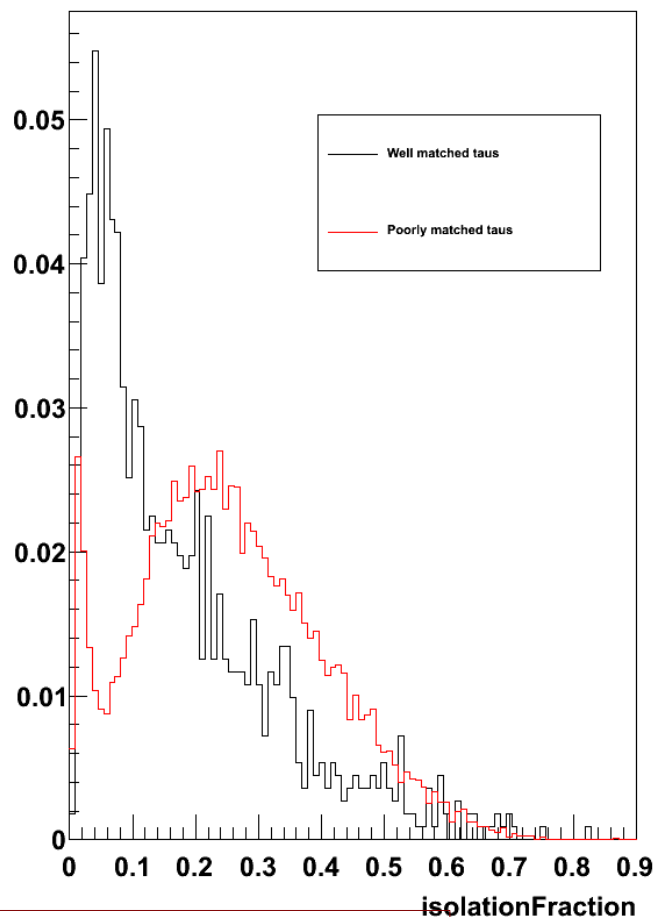
Keeping values $<$ Cut value



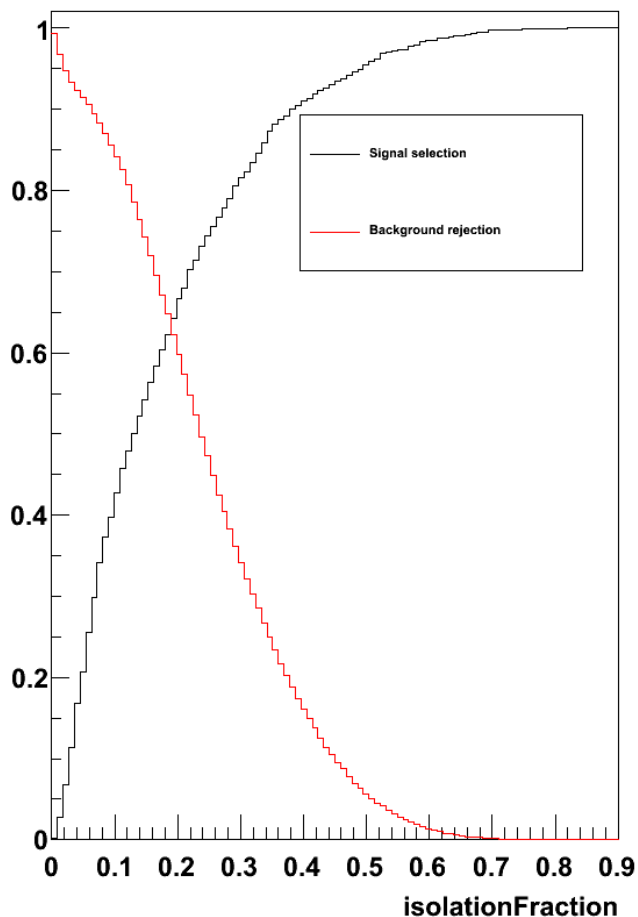
TauRec isolationFraction



TauRecDetails : isolationFraction



TauRecDetails : isolationFractionEff



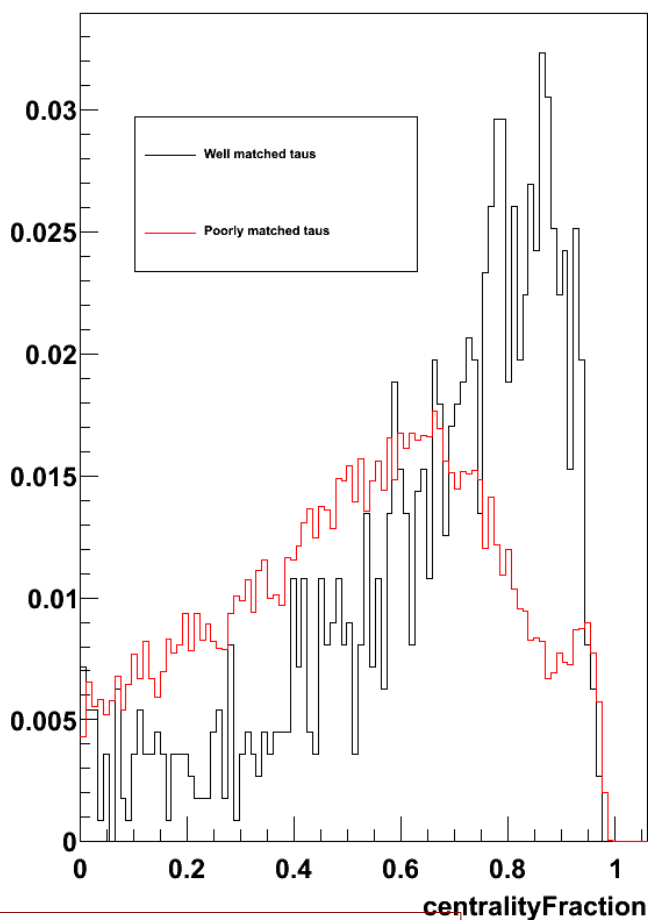
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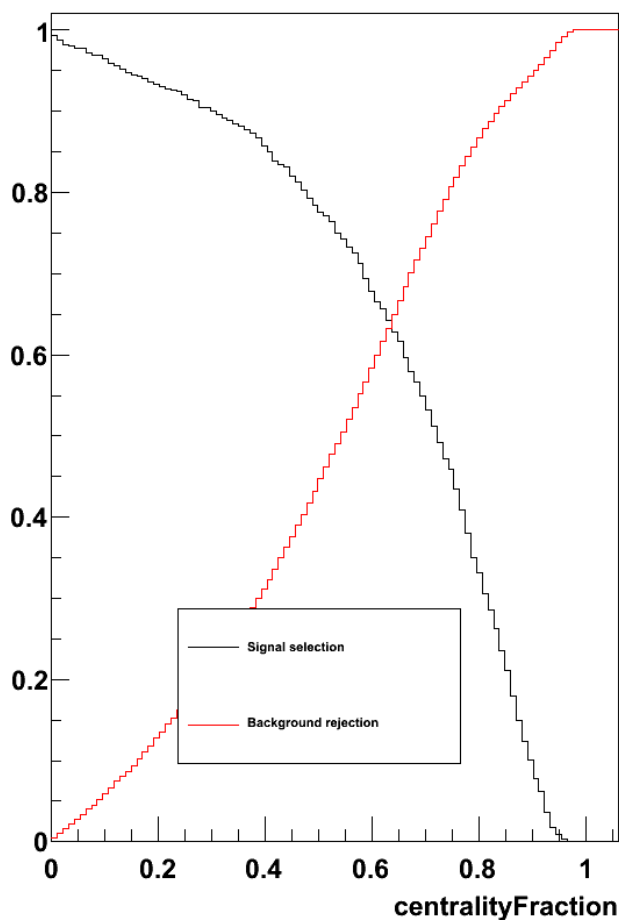
TauRec centralityFraction



TauRecDetails : centralityFraction



TauRecDetails : centralityFractionEff



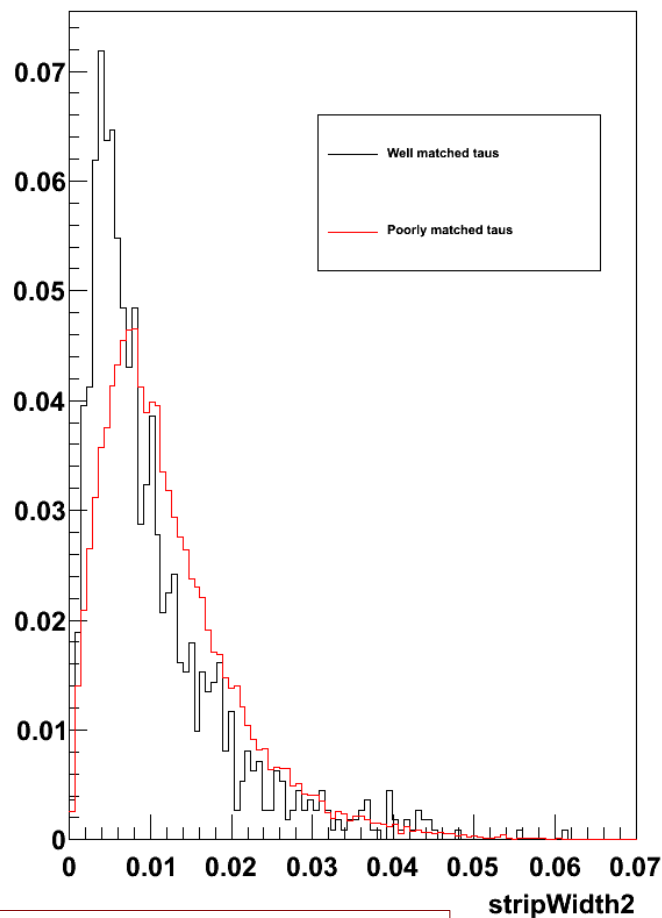
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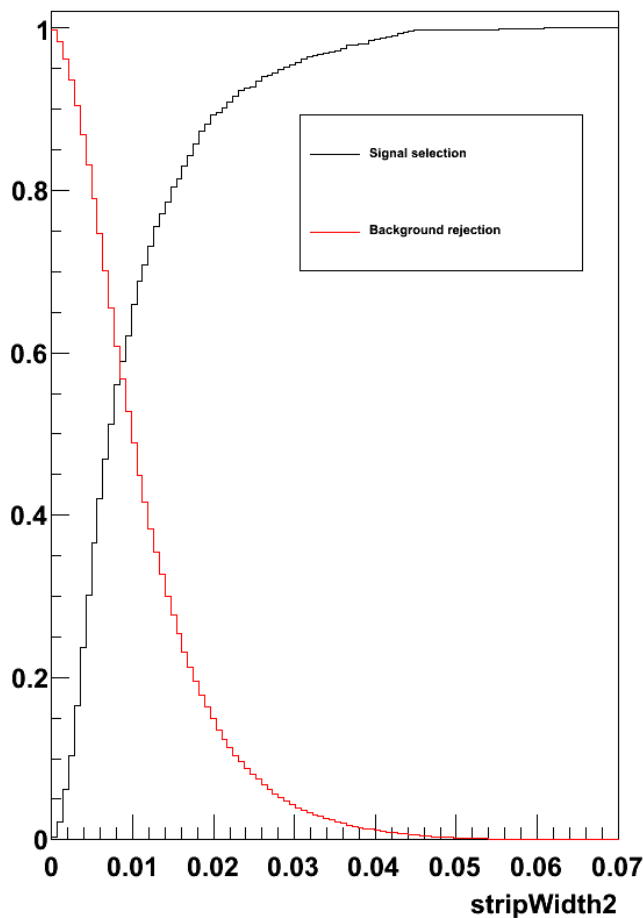
TauRec stripWidth2



TauRecDetails : stripWidth2



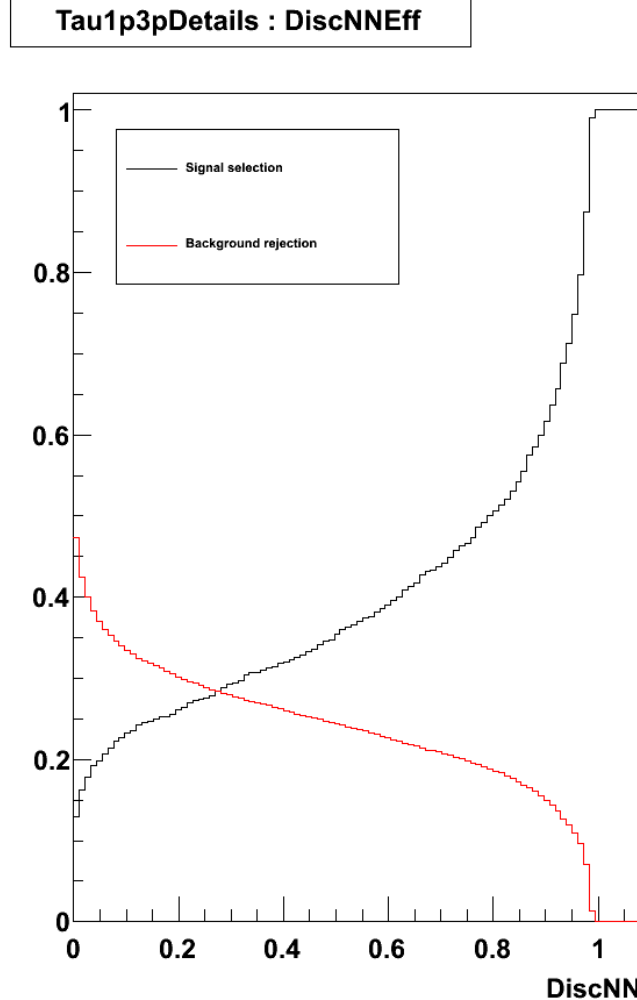
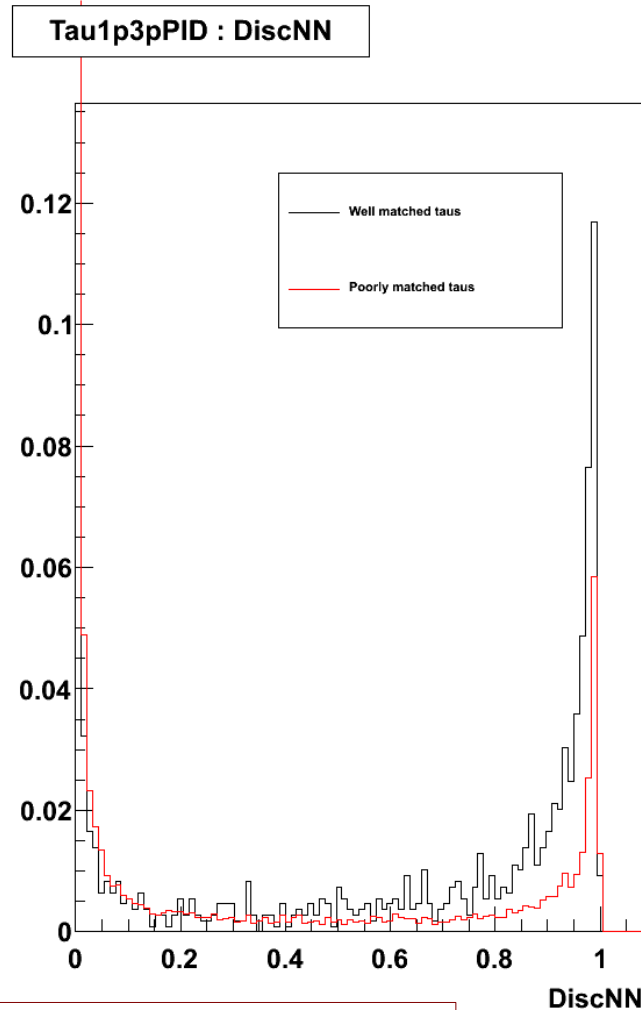
TauRecDetails : stripWidth2Eff



Keeping values < Cut value



Tau1p3p DiscNN



Very preliminary plot of one of the neural net variables available to be used for good tau selection. These will require tuning in early data.

Keeping values < Cut value



Future Plans



- Run over a larger dataset (only 5000 events used to date)
- Look at producing selection and rejection efficiencies for the various variables which can be compared to existing studies (e.g. Any appropriate CSC results)
- Examine cuts to select out dileptonic events containing taus from assorted $t\bar{t}$ and general background
- Evaluating possibility of branching fraction measurement in early data
- Return to trigger work : look at a tag and probe study of the LVL1 tau trigger performance in dileptonic $t\bar{t}$ events (again focused on early data)



Backup slides



'Variable' access



- TauJet :
 - Main class for both tau types
 - Basic information about reconstructed tau
 - Links to objects providing more detail
- TauPID :
 - Associated with TauJet
 - Holds results of the identification algorithms
 - Variables work for TauRec **or** for Tau1p3p but not both (With the exception of isTau which is intended to work for both but is not available in 13.0.30)
 - Contain a mixture of discriminants and flags (not all working in release used)



'Variable' access



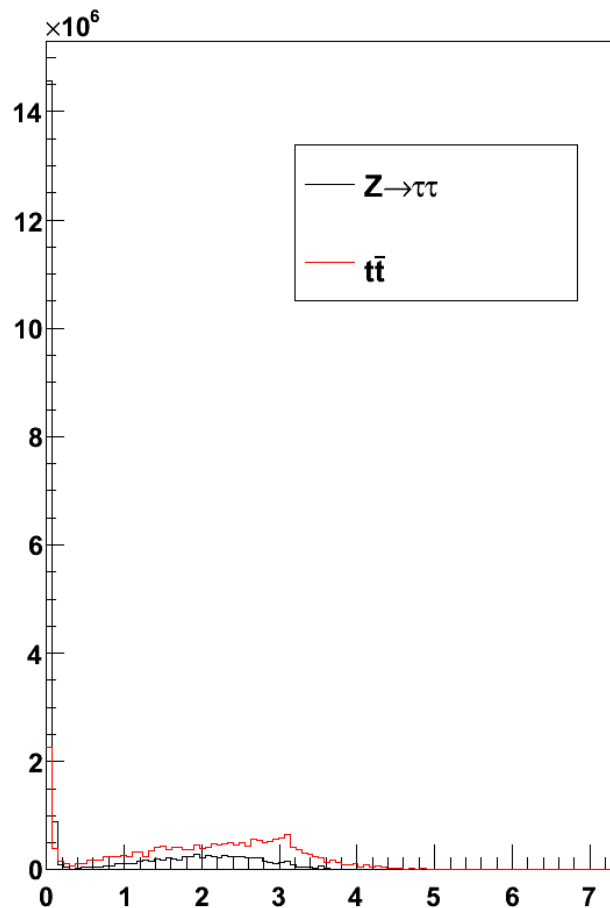
- TauRecDetails:
 - Provides further information for TauRec with respect to different regions of the calorimeter and tracker
 - Available in the AOD
- TauRecExtraDetails:
 - Further detail similar to above
 - **Only available in ESD**
- Tau1P3PDetails:
 - Provides further information for TauRec with respect to different regions of the calorimeter and tracker
 - Available in the AOD
- TauRecExtraDetails:
 - Further detail similar to above
 - **Only available in ESD**



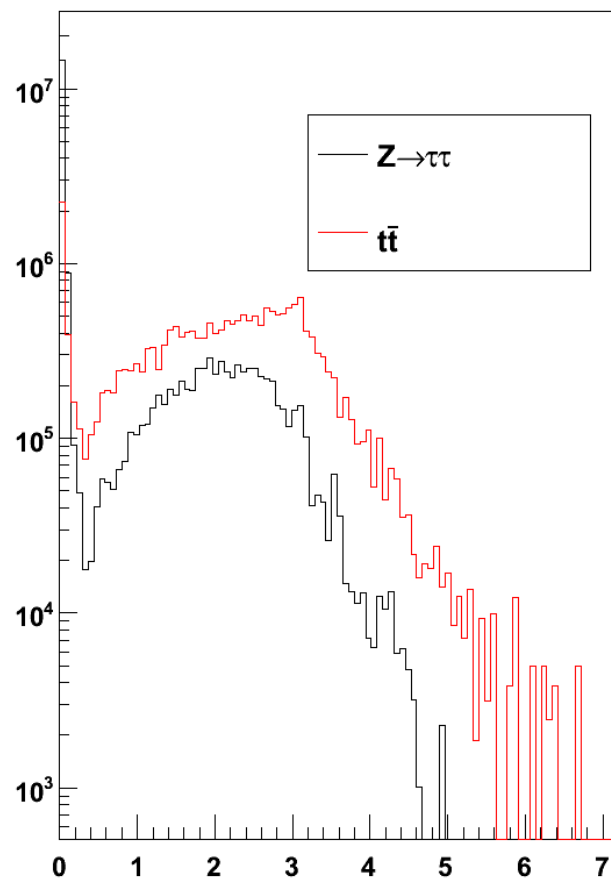
Comparison to $Z \rightarrow \tau\tau$



Minimum Delta R (Between truth and rec. for TauRec)



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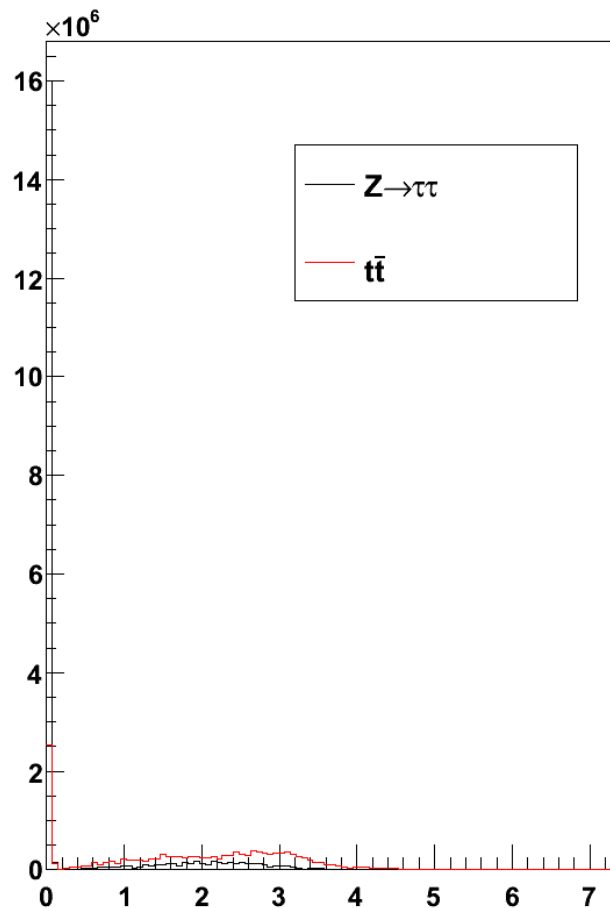




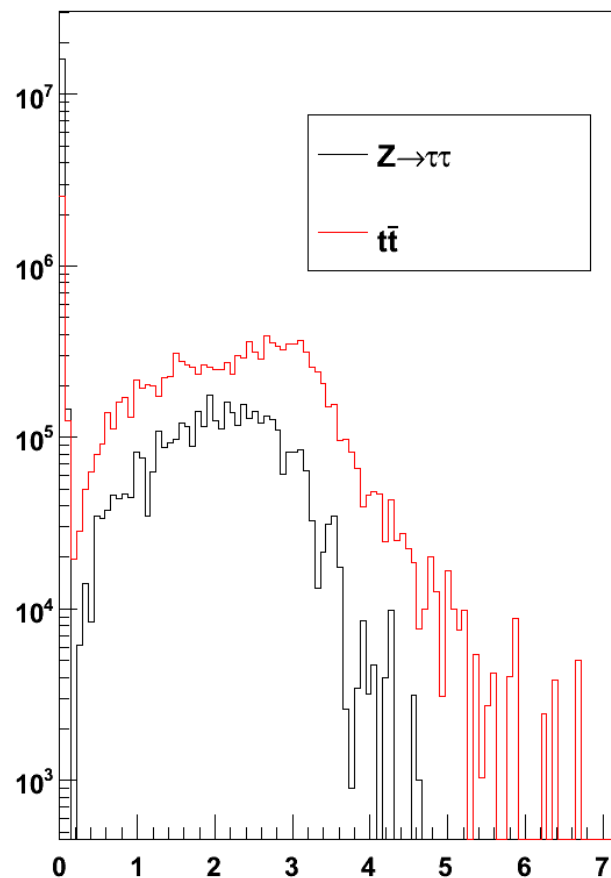
Comparison to $Z \rightarrow \tau\tau$



Minimum Delta R (Between truth and rec. for Tau1p3p)



Minimum Delta R (Between truth and rec. for Tau1p3p)

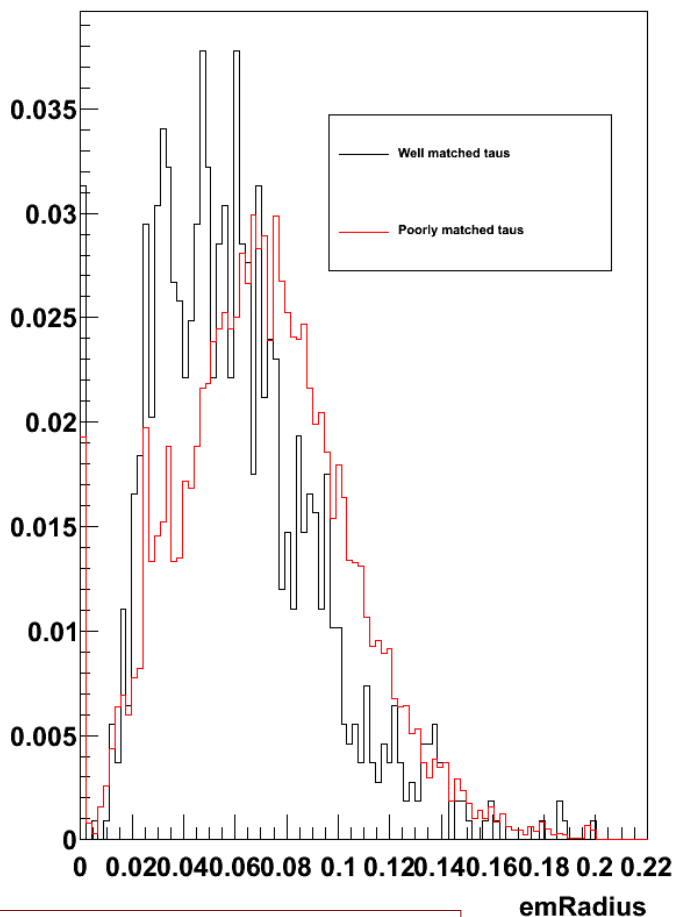




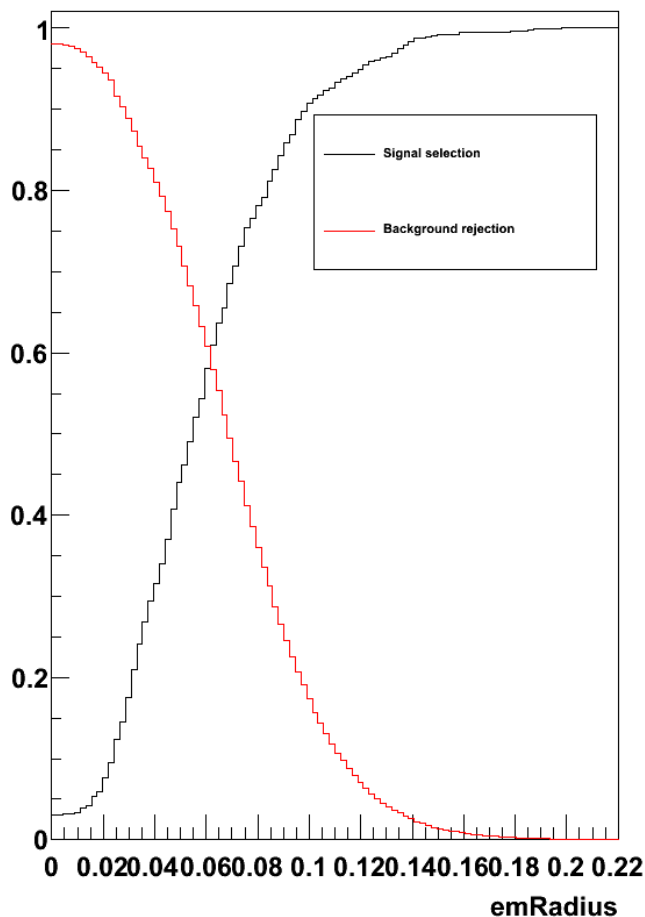
Tau1p3p emRadius



Tau1p3pDetails : emRadius



Tau1p3pDetails : emRadiusEff



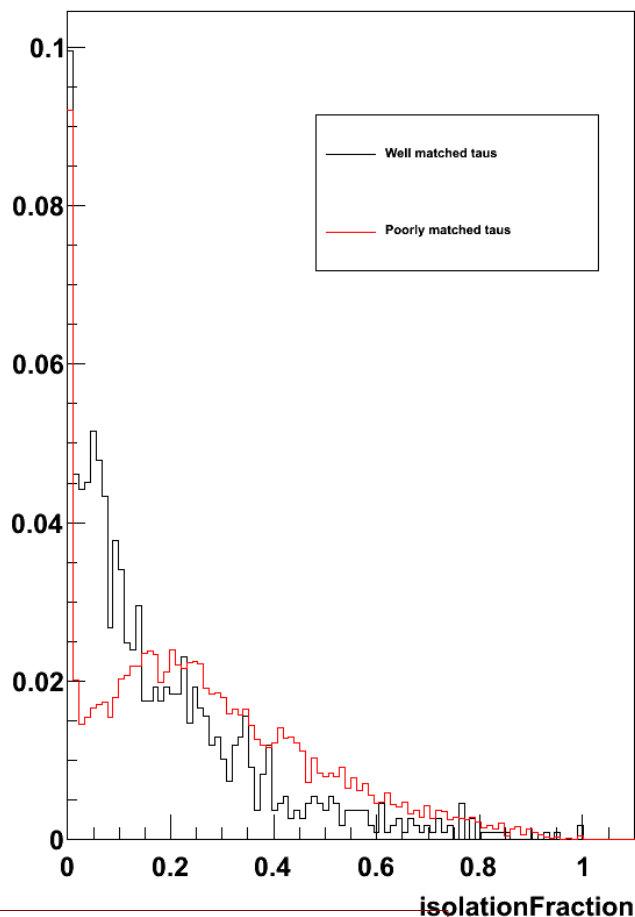
Keeping values < Cut value



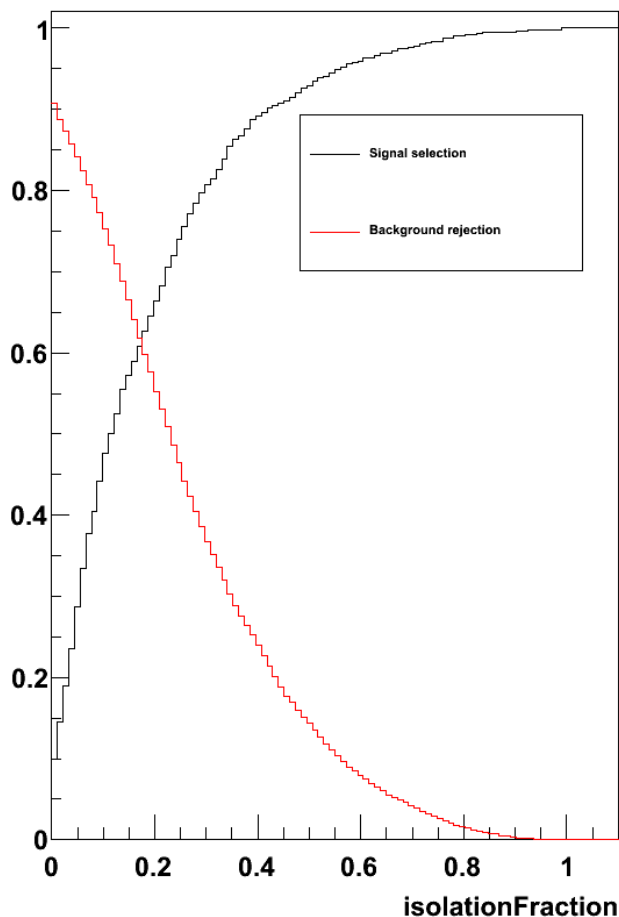
Tau1p3p isolationFraction



Tau1p3pDetails : isolationFraction



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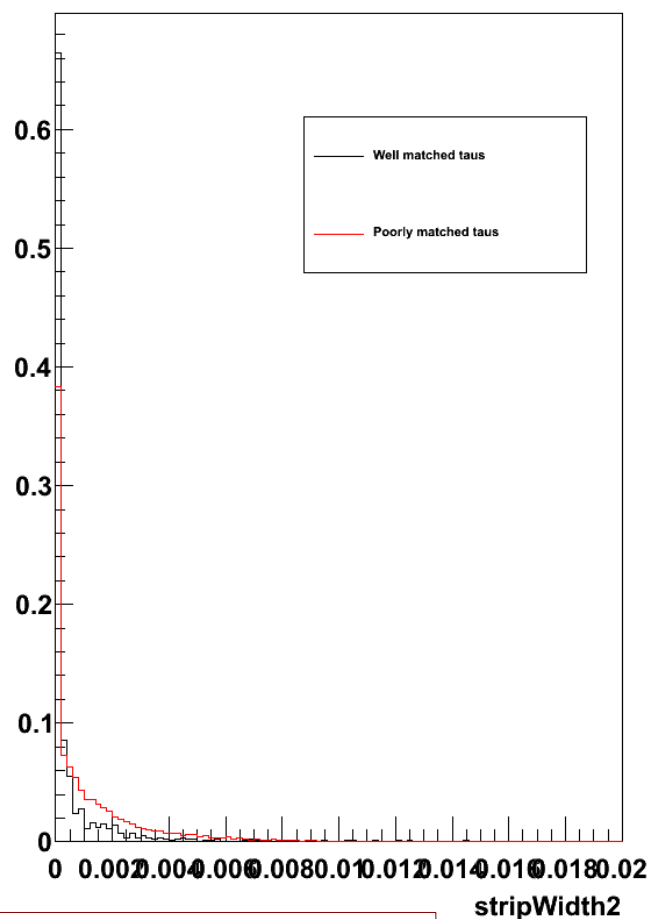
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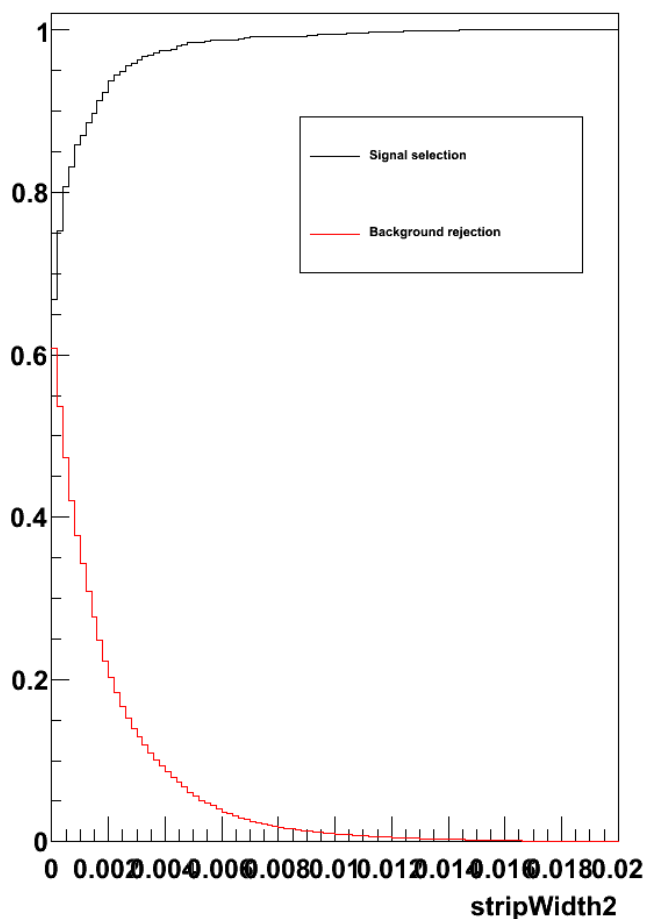
Tau1p3p stripWidth2



Tau1p3pDetails : stripWidth2



Tau1p3pDetails : stripWidth2Eff



Keeping values < Cut value



A Distraction !

