Tau fake rate from data

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Working on that:
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Motivations

- Technical motivation: do a *quick* study (missing so far) to be added in the Tau CSC note

- Physics motivation: present a method to evaluate the **tau fake rate** (by jets) **in data**

Goal:

We want to evaluate
the fraction of jets
selected by the 2 existing
tau algorithms
(TauRec/Tau1p3p)

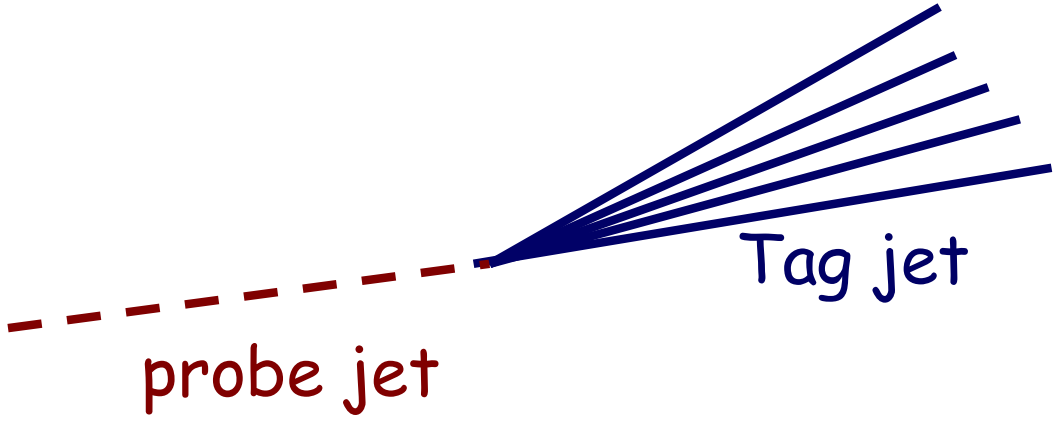
Method

Dijet QCD events will be dominant in **data**...
The idea is to select a sample of very likely QCD jets (eventually in data) and see how many are (wrongly) identified as taus.

Tag and Probe style

We make predictions using MC:

- **2 back to back objects**
- **One "nice" jet for the tag side (then we are confident that we also have a jet on the other side)**
- **We use the other side (probe jet) to compute the fake rate**



$$\text{Fake Rate} = \frac{\text{Nb Probe jets identified as } \tau}{\text{Nb Probe jets}}$$

MC Data Used

- QCD dijets samples (J0-J5) **(perform our studies)**
- Z to tau tau and W to Tau nu **(crosscheck that we will get rid of most of the "real" taus)**

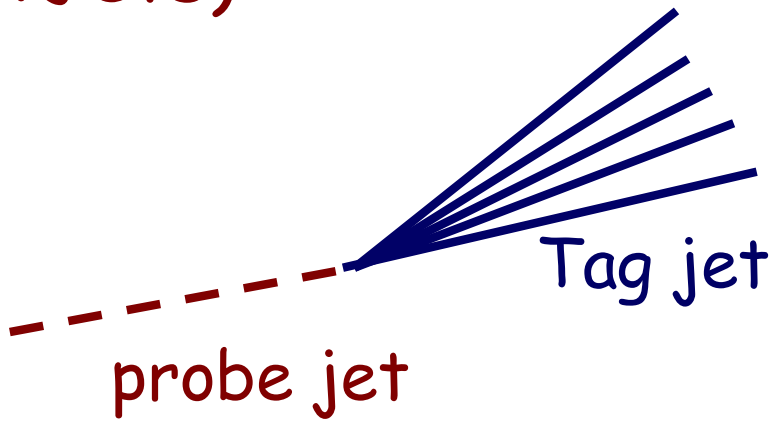
Dijet(J1, 17-35GeV)	1400000 nb
Dijet(J2, 35-70GeV)	93300 nb
Dijet(J3, 70-140GeV)	5900 nb
Dijet(J4, 140-280GeV)	308 nb
Dijet(J5, 280-560GeV)	12 nb
Z to tau tau	1.6 nb
W to tau nu	17.3 nb

- 2 independent setups:

• 12-series ntuples coming from the SUSYView production
• 13-series ntuples (CBNT) coming from private productions (Freiburg/Elzbieta)
Very nice to crosscheck each other!

Selections

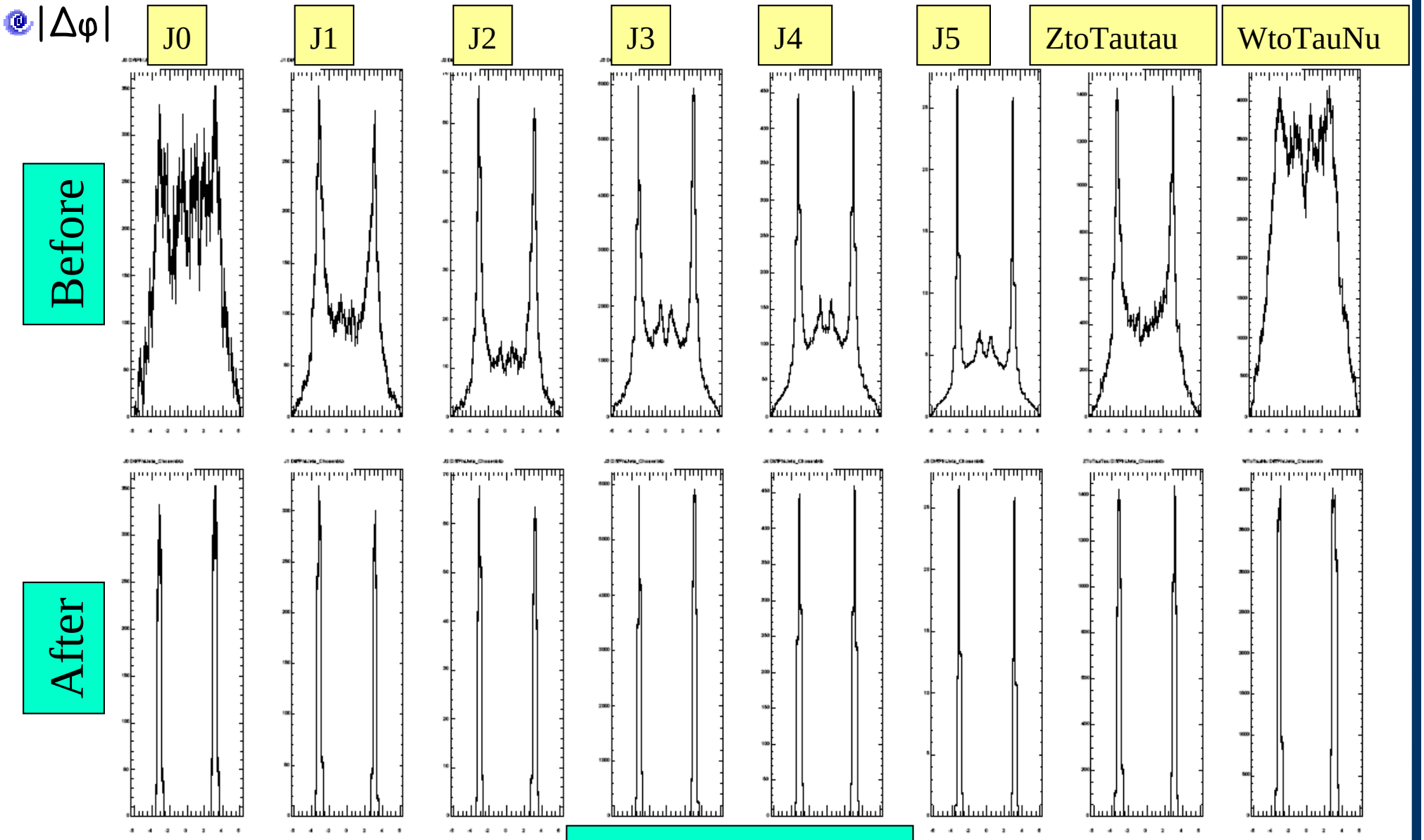
- 2 back to back jets (Cone4Jets)
  - |η| <= 2.5 for each jet
  - |Δφ| = π +/- 0.30
  - pt>=15 GeV for each jet
  - pt balance between 2 jets
    →Δpt < ptmax/2



- 1 "nice" TAG jet:
  - nTrk (with pt > 1 GeV) in Jet >=4 + 1 trk / 50GeV slice
    (this removes most of the real taus)

- PROBE jet:
  - no further selections (to keep whole spectrum)
  - for Tau1p3p: can ask track (with pt min or not) in jet
  - check if identified as a tau (TauRec/Tau1p3p)

Example of Selections



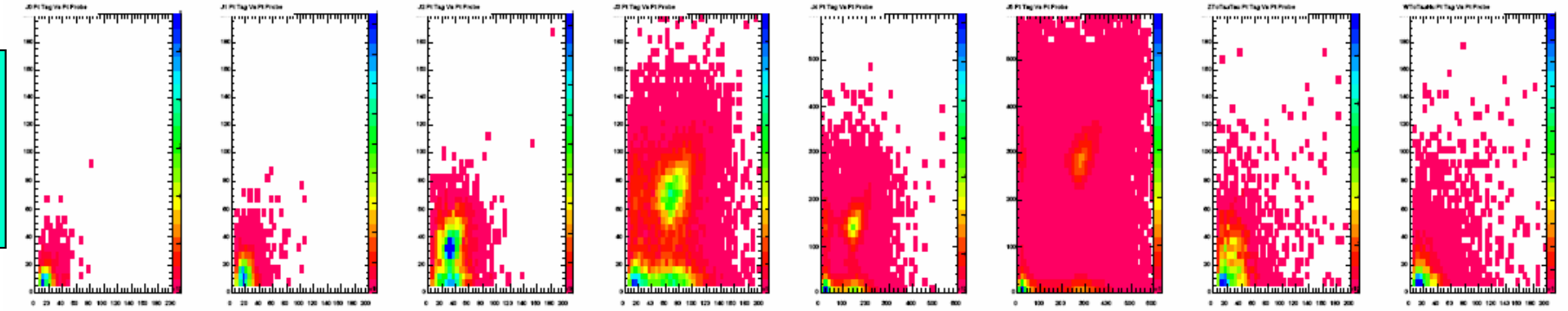
$|\Delta\varphi| = \pi$ +/- 0.30

Example of Selections

- pt min (15 GeV) and pt balance between 2 jets (Δpt < ptmax/2)

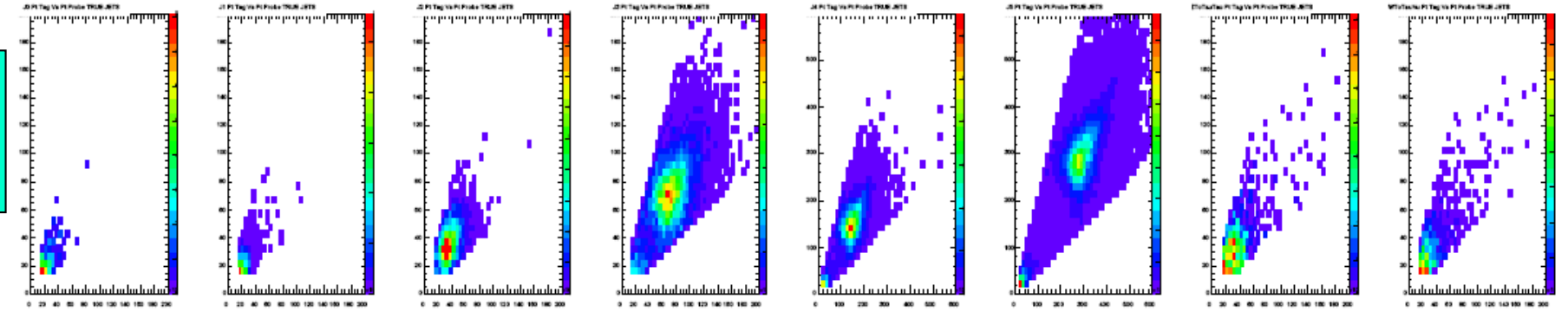
J0 | J1 | J2 | J3 | J4 | J5 | ZtoTautau | WtoTauNu

Before



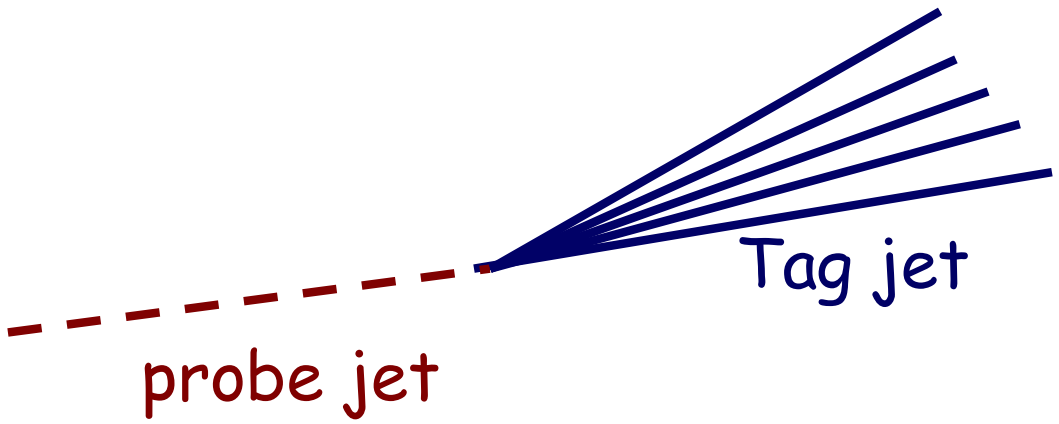
pt TAG vs pr PROBE

After



Then…

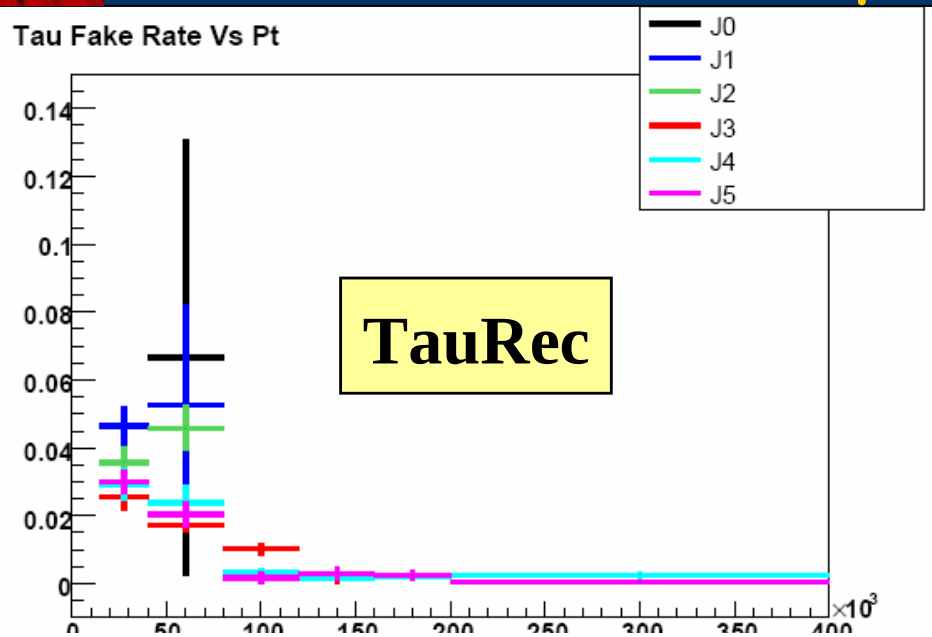
- Nice di-jet sample (unfortunately not a lot of statistics)
- Look for probe jets identified as tau
- Fake rate as a function of η and pt of the probe jet

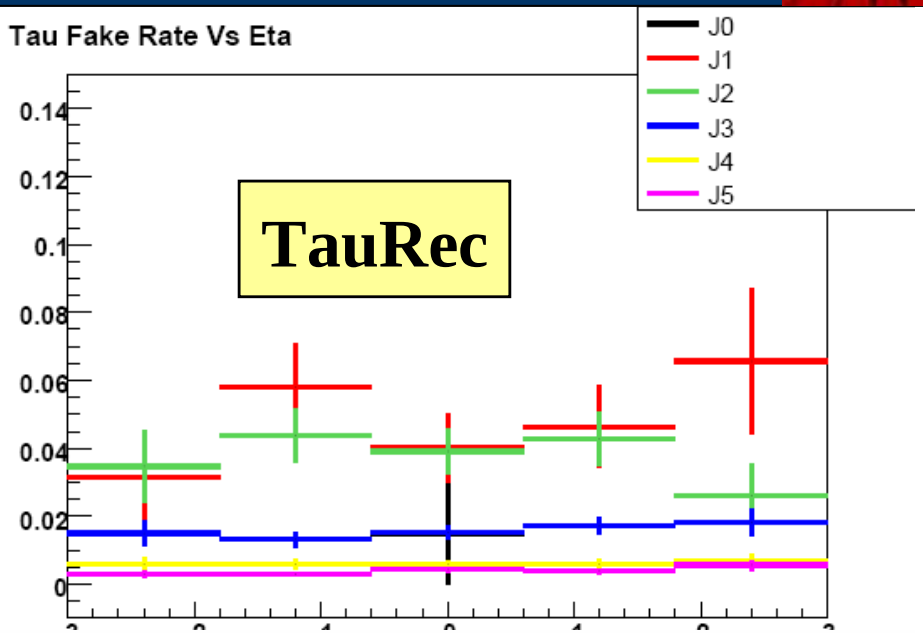


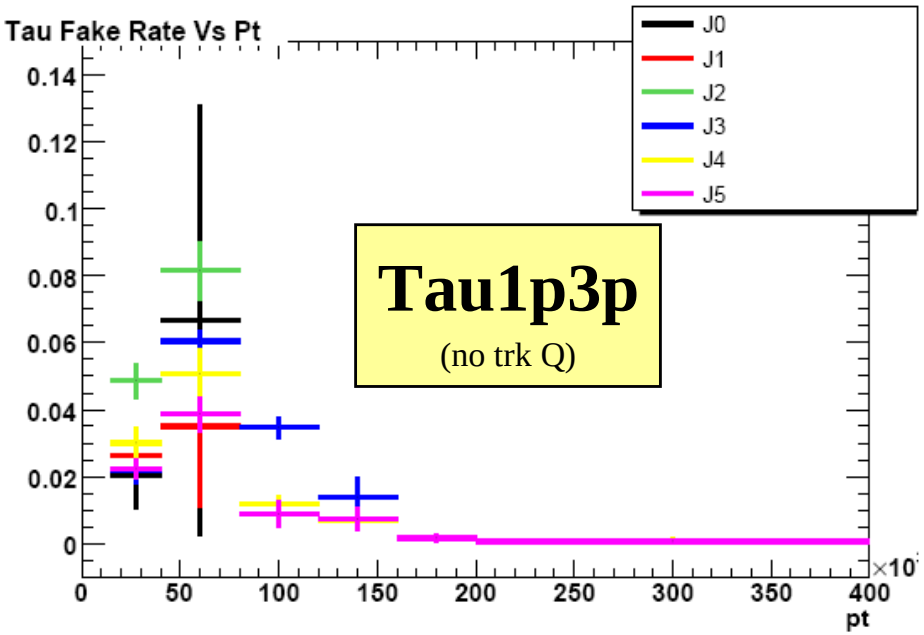
$$\text{Fake Rate} = \frac{\text{Nb Probe jets identified as } \tau}{\text{Nb Probe jets}}$$

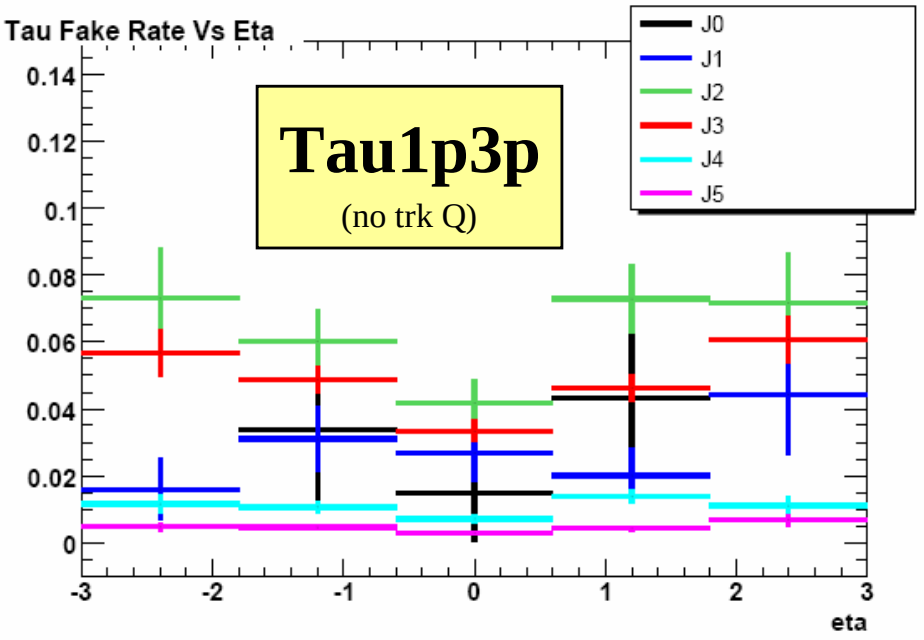
Results

Fake Rate in bins of pT and η









Results

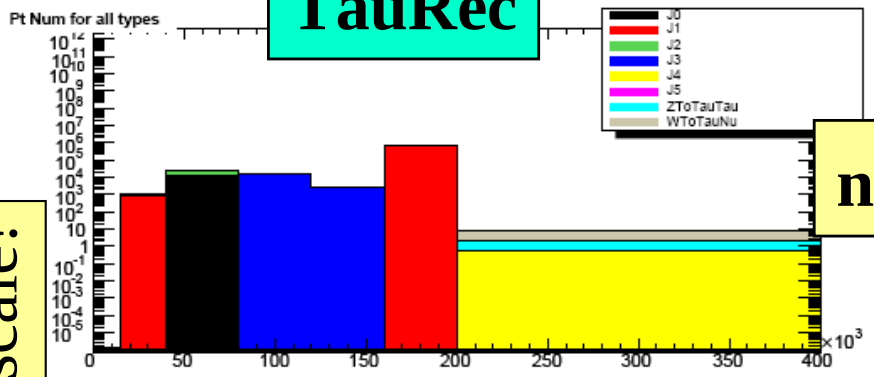
Fake Rate in bins of pT

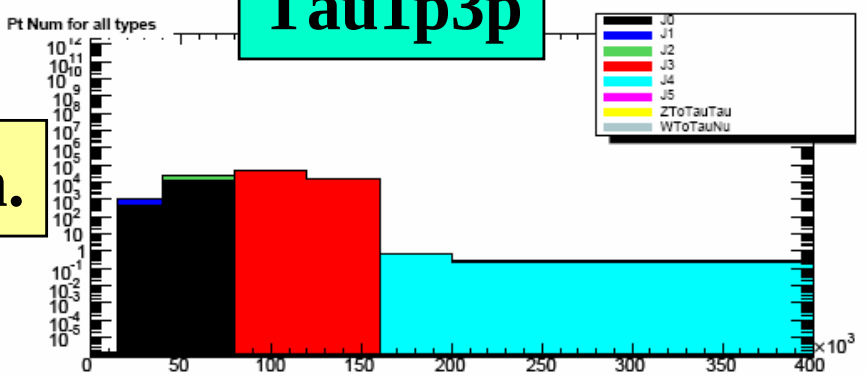
TauRec

Tau1p3p

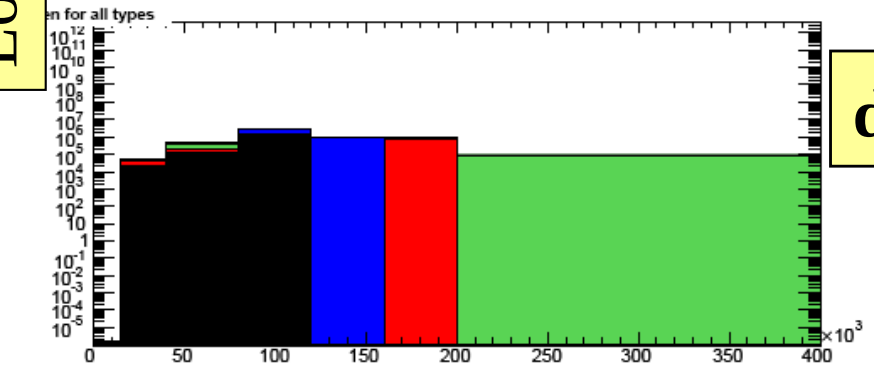
Log scale!

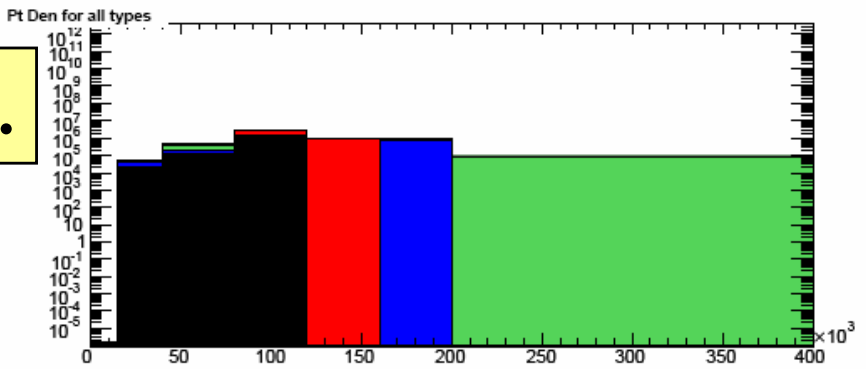
num.



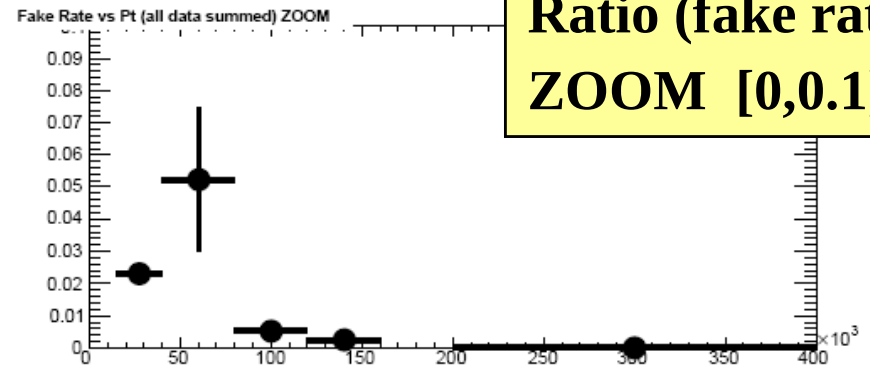


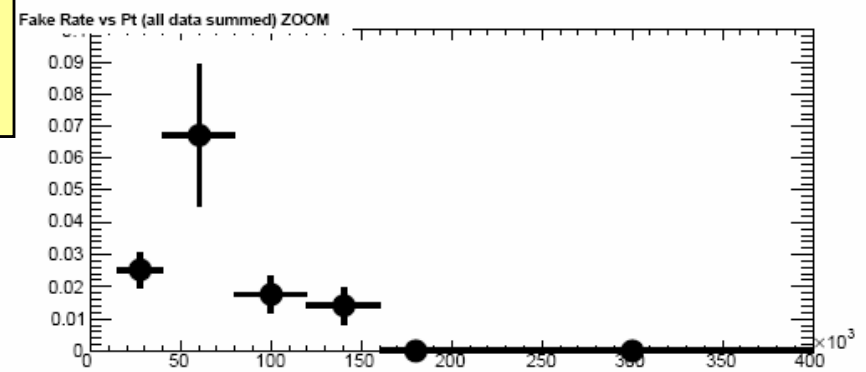
den.





Ratio (fake rate)
ZOOM [0,0.1]





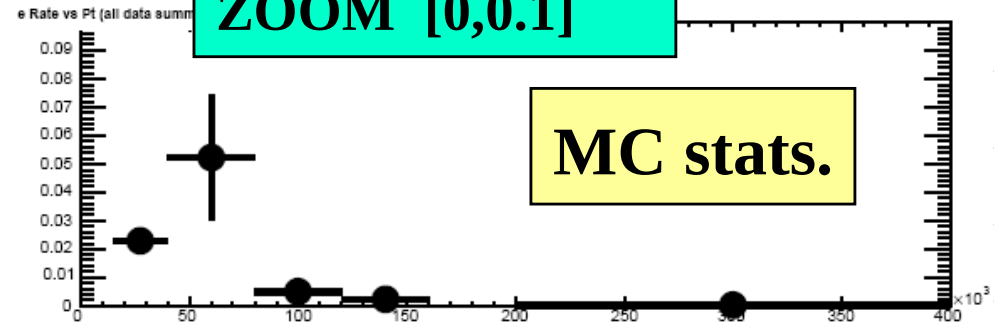
Syl ting

Results

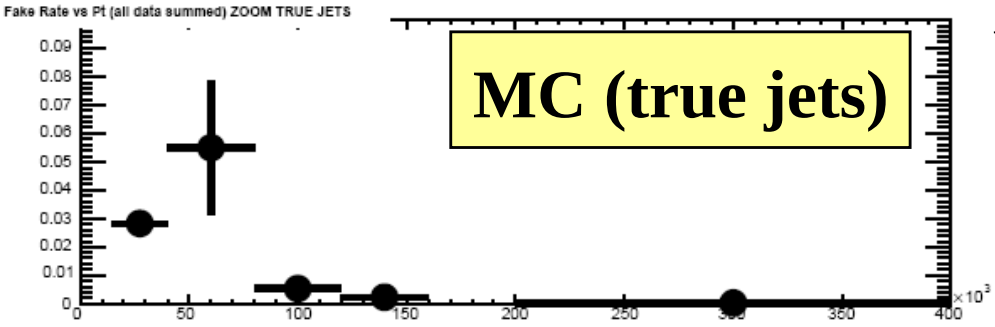
Fake Rate in bins of pT
Expected Stats in DATA

TauRec

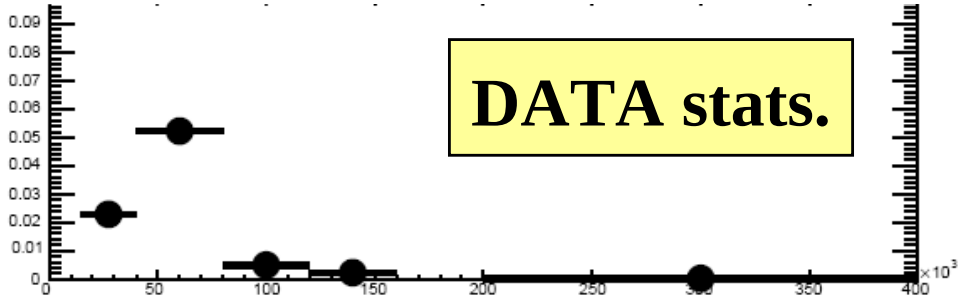
Ratio (fake rate)
ZOOM [0,0.1]



MC stats.



MC (true jets)



DATA stats.

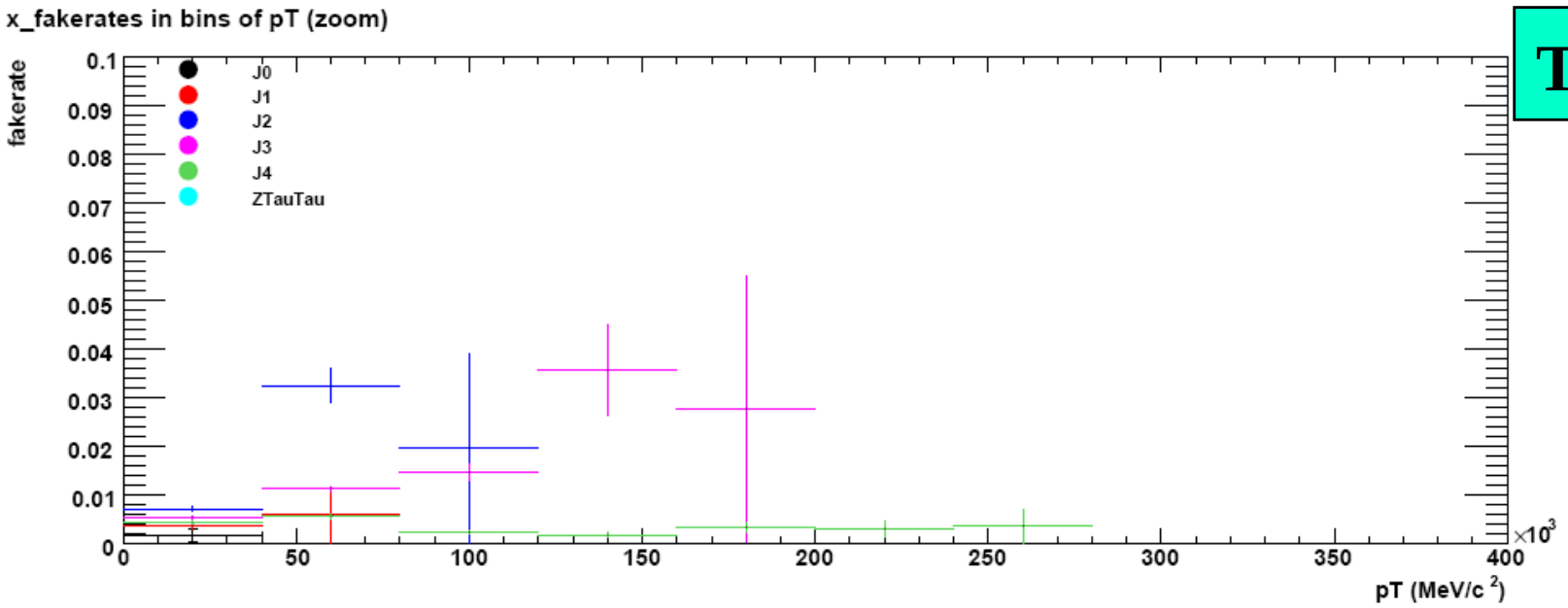
Numbers for MC stats.

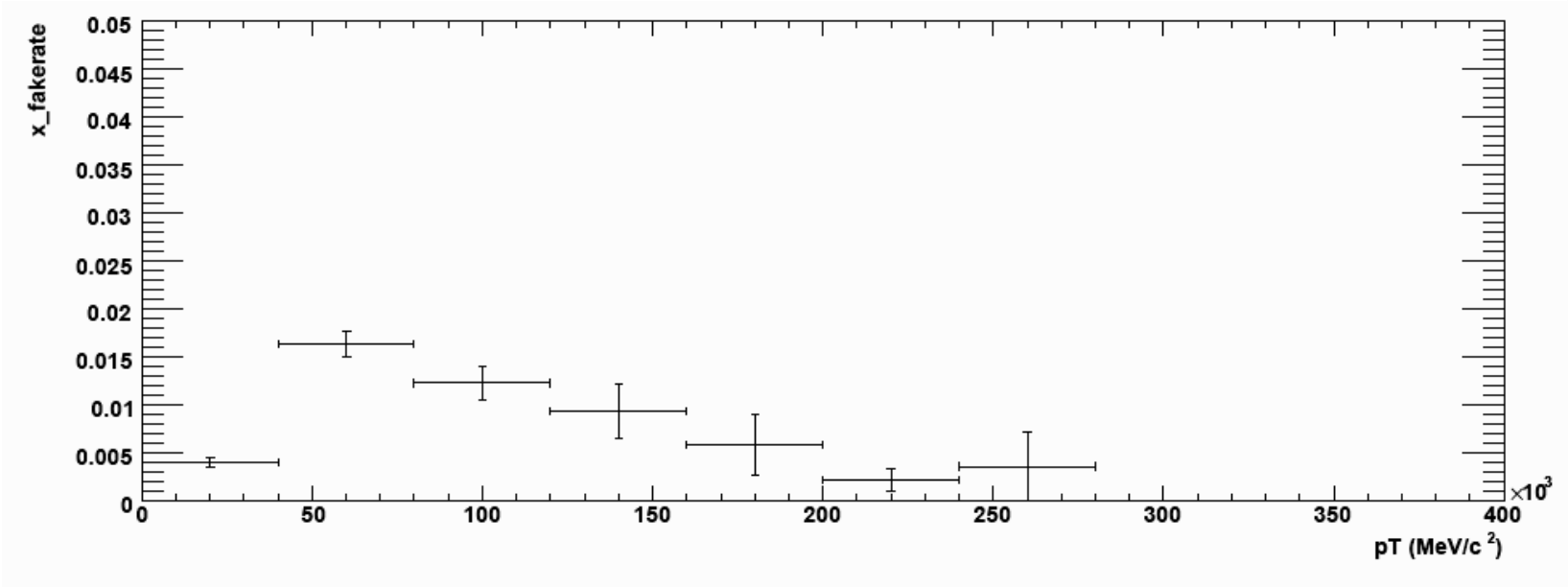
bin 1 (0-15) No events (our selection)
bin 2 (15,40) = 0.023 +/- 0.003
bin 3 (40,80) = 0.052 +/- 0.022
bin 4 (80,120) = 0.005 +/- 0.002
bin 5 (120,160) = 0.002 +/- 0.002
bin 6 (160,200) = 0.82 +/- 0.18
bin 7 (200,400) = 0.000085 +/- 0.000100

- Not enough MC stats!! (+scaling factors are sometimes huge) so numbers not sooo meaningful.
- However:
  - Will not be a problem in data
  - proof of principle is there.

Results from 12-release setup (SUSYView production)

TauRec





Summary/Conclusions

- We have a method to evaluate the tau fake rate (from jets) in data. Targeted for the tau CSC note.
- We use a "tag and probe" approach. The tags are there to select clean dijet events, we compute the fake rates with the probe jet.
- We have 2 independent setups, very useful to investigate problems and crosscheck results
- We've produced results for both TauRec and Tau1p3p
- Tau Conveners happy with our studies
- Main item on to-do list:
  write text and produce final plots for CSC note

Backup

What we have learned so far

- Bad news: We select some real taus in the Z to tau tau and W to tau nu samples *(can increase the nTrk requirement on the tag side if we want to further kill these events).*

- Good News: However, the cross-section is so small compared to the dijets that it will be negligible
(Nevertheless, we want to put a number on this "negligible")

Some expected cross-sections:

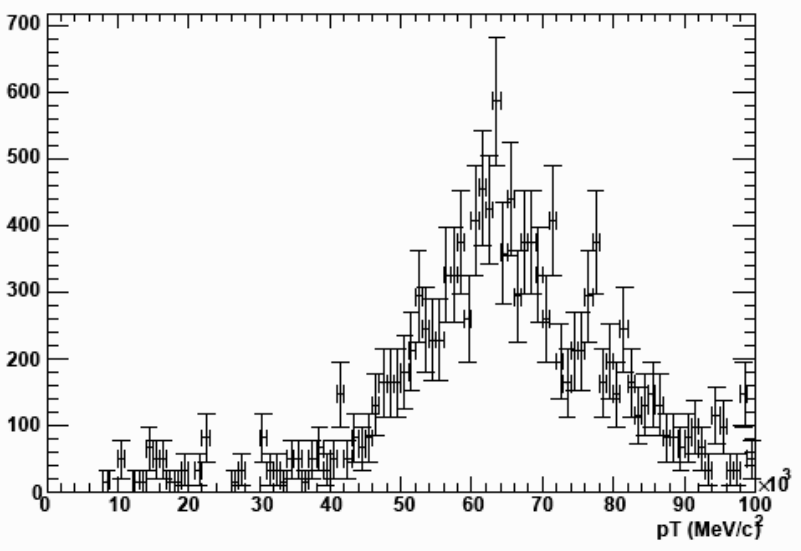
Dijet(J1, 17-35GeV)	1.4 mb
Dijet(J2, 35-70GeV)	93.3 um
Dijet(J3, 70-140GeV)	5.9 um
Z to tau tau	1.6 nb
W to tau nu	17.3 nb

One of the remaining puzzles: pt distribution

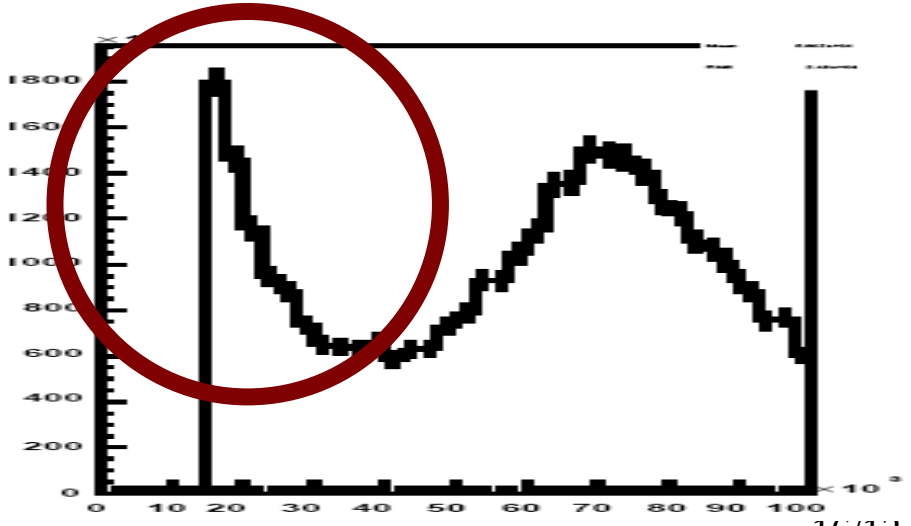
- In Sylvie's ntuples, seems to have some garbage jets remaining… Need more clean-up. Not seen in Sebastian's ntuples…
  - Related to overlap removal/isolation?
  - track quality cuts for the tag side?
  - other cuts made in SUSYView?

Currently Investigating that…

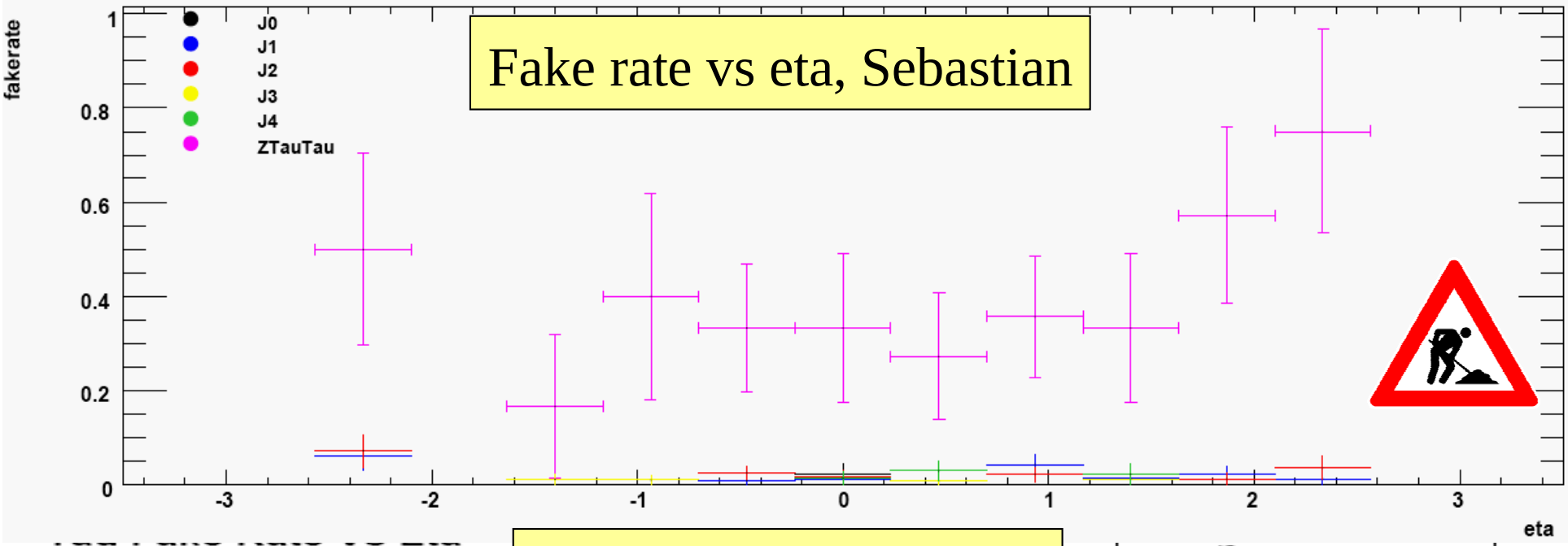
J3, pt, den., Sebastian

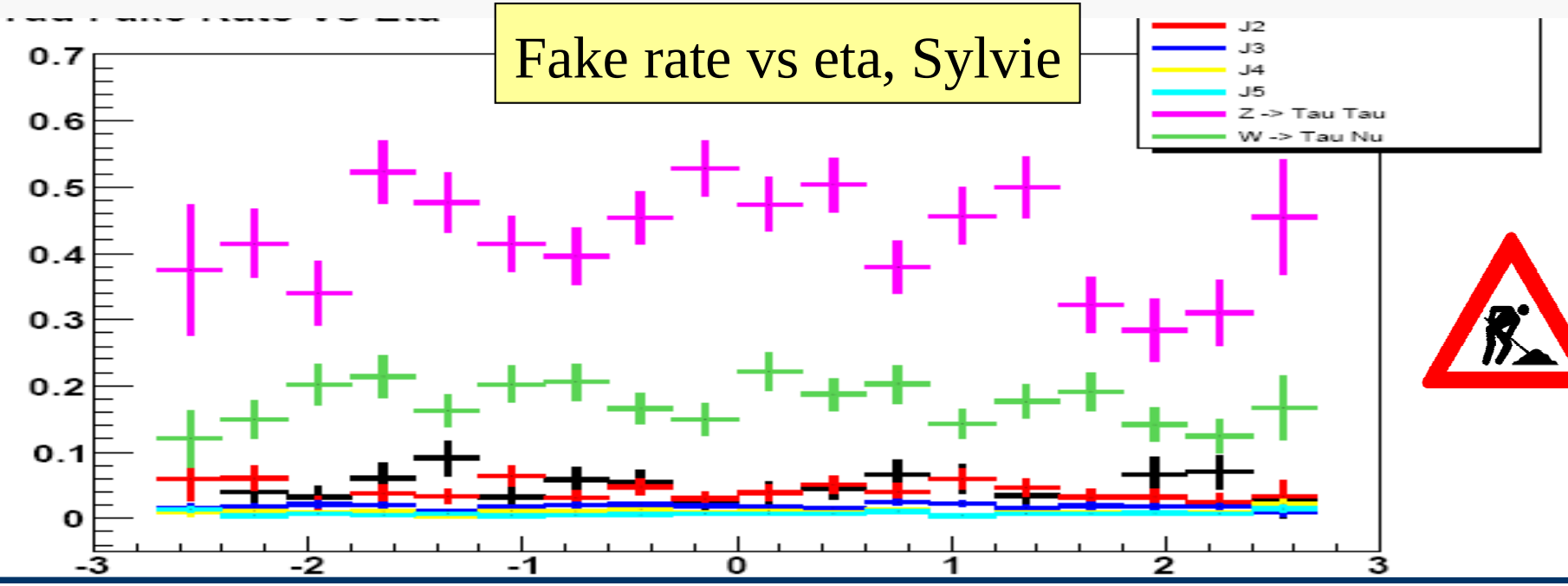


J3, pt, den., Sylvie



What we have learned so far

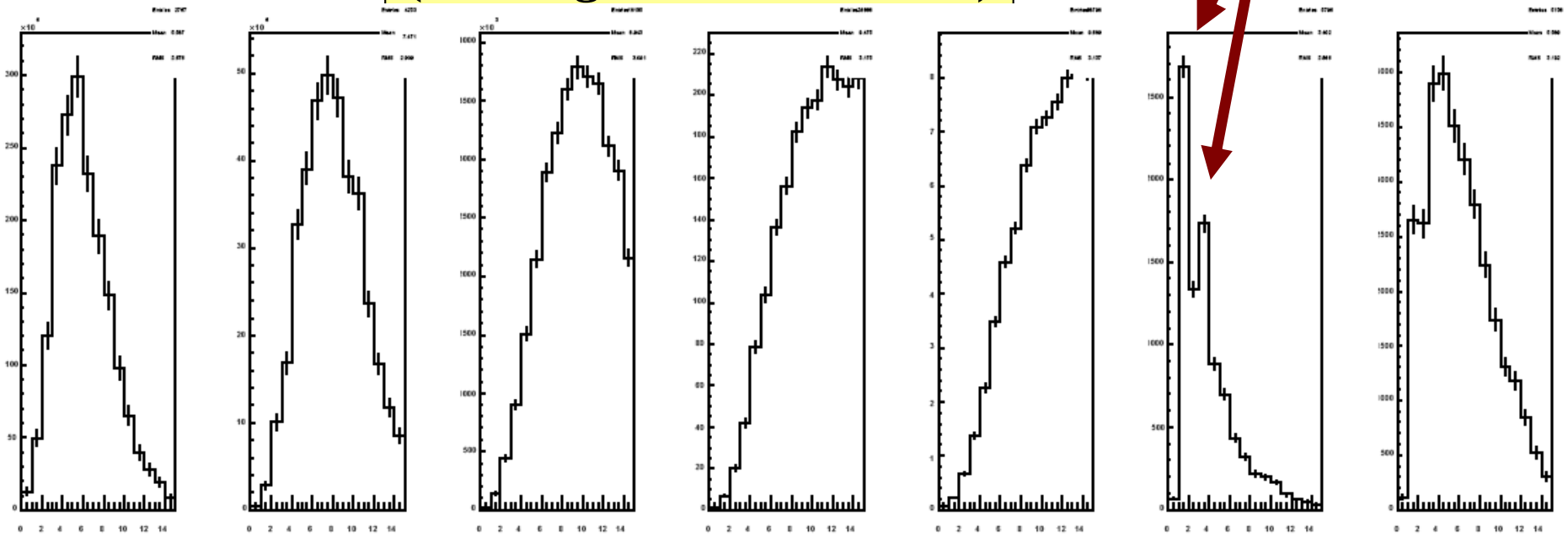




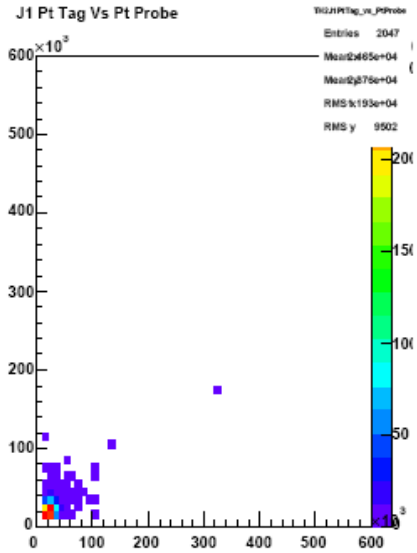
S

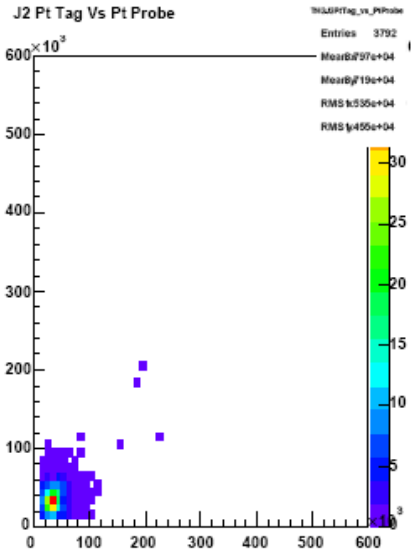
Some interesting plots…

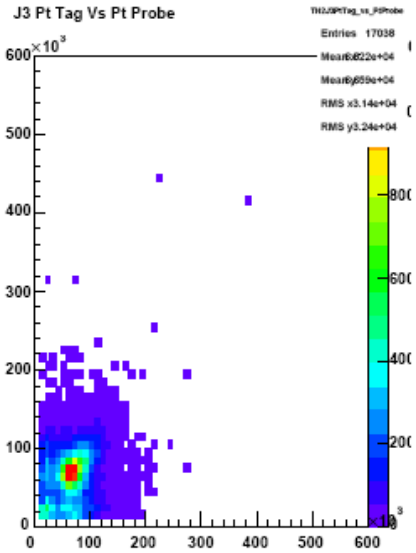
tracks per jets
(x axis goes from 0 to 14)

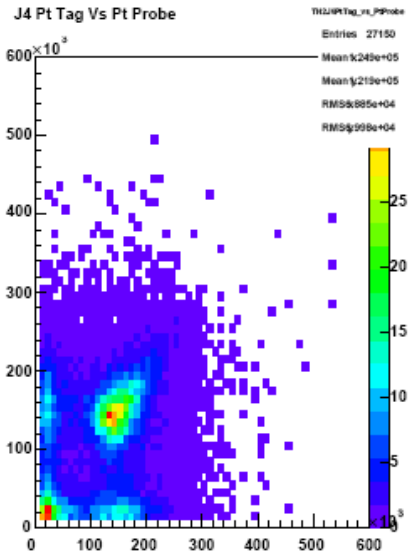


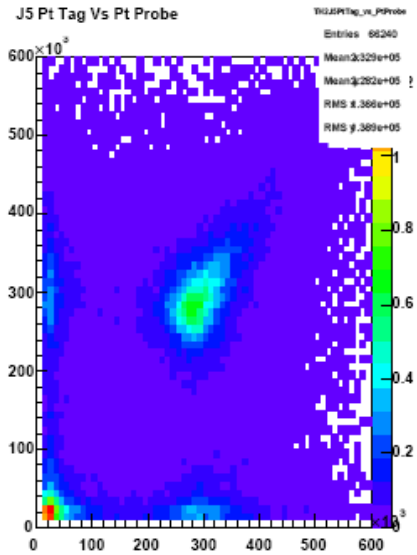
J1 J2 J3 J4 J5 ZtoTautau WtoTauNu

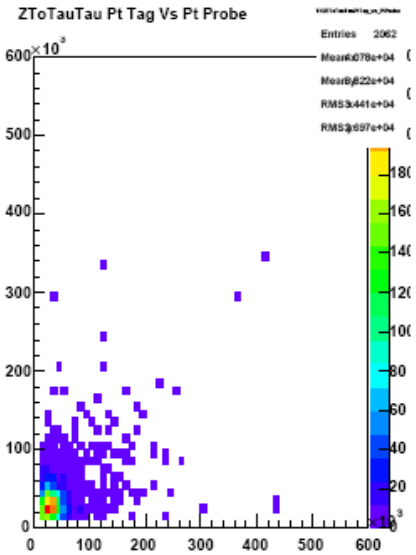

J1 Pt Tag Vs Pt Probe

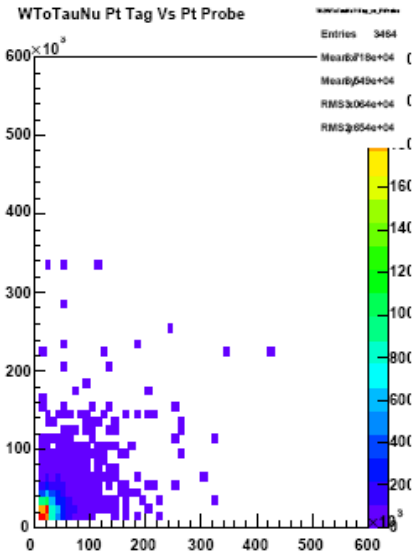

J2 Pt Tag Vs Pt Probe


J3 Pt Tag Vs Pt Probe


J4 Pt Tag Vs Pt Probe


J5 Pt Tag Vs Pt Probe


ZToTauTau Pt Tag Vs Pt Probe


WToTauNu Pt Tag Vs Pt Probe