Tau Pioneer Report

John Conway, Teruki Kamon,
Pasha Murat, Fedor Ratnikov
for τ group

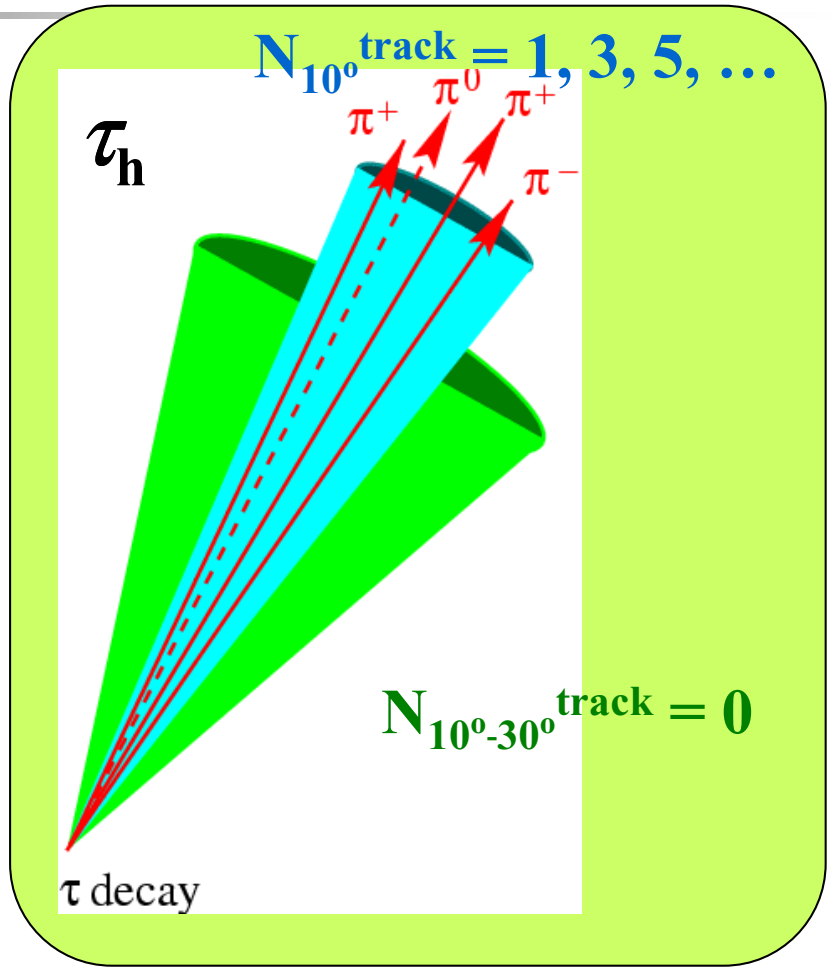
Selected Topics

Reconstruction/MC

- *TauFinder*
- *TAUOLA interface*

Triggers and Datasets

- *Lepton+track trigger*
- *Di-tau trigger*
- *$\not{E}_T$-tau trigger*



TauFinder

Fedor Ratnikov (Rutgers)

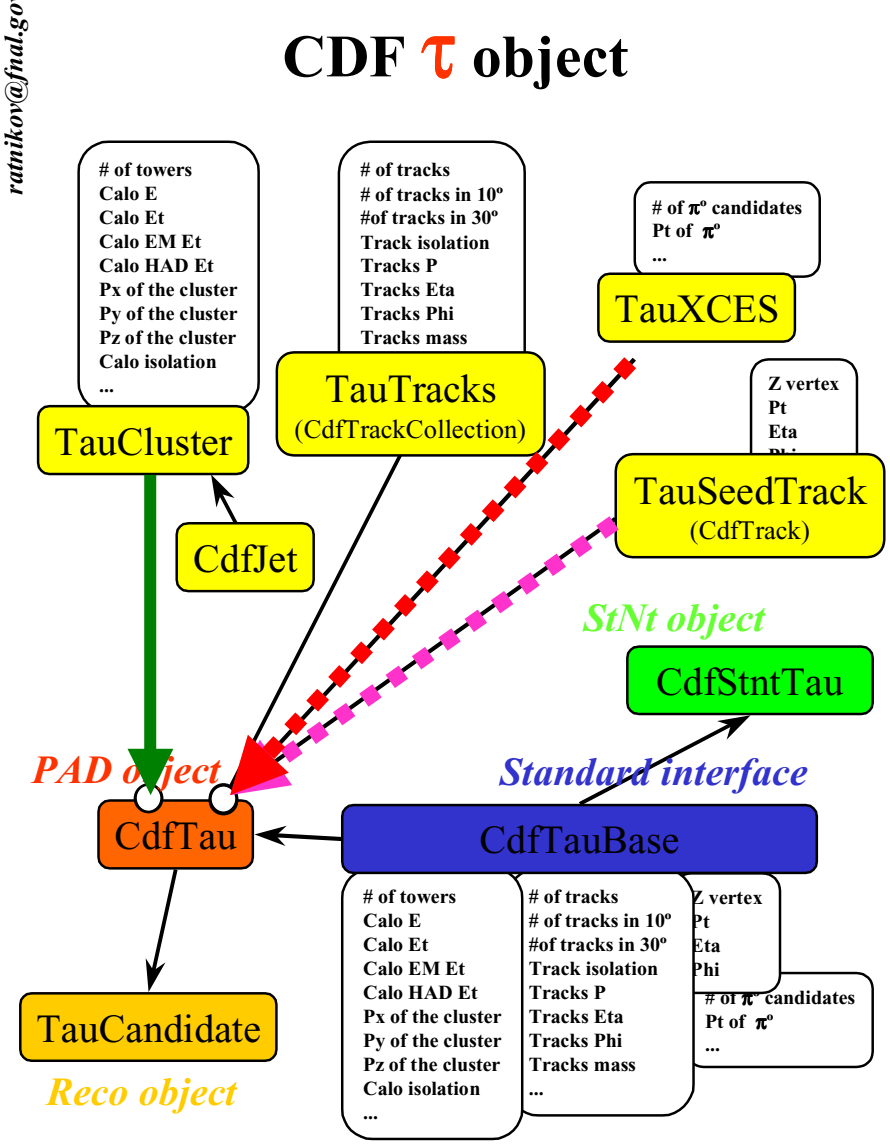
ratnikov@fnal.gov

Default cuts:

1. **CaloSeedEt:10 GeV**
   CaloShoulderEt:1 GeV
2. **SeedTrackPt: 5 GeV**
   ShoulderTrackPt: 1 GeV
3. **….**

Status: working on:

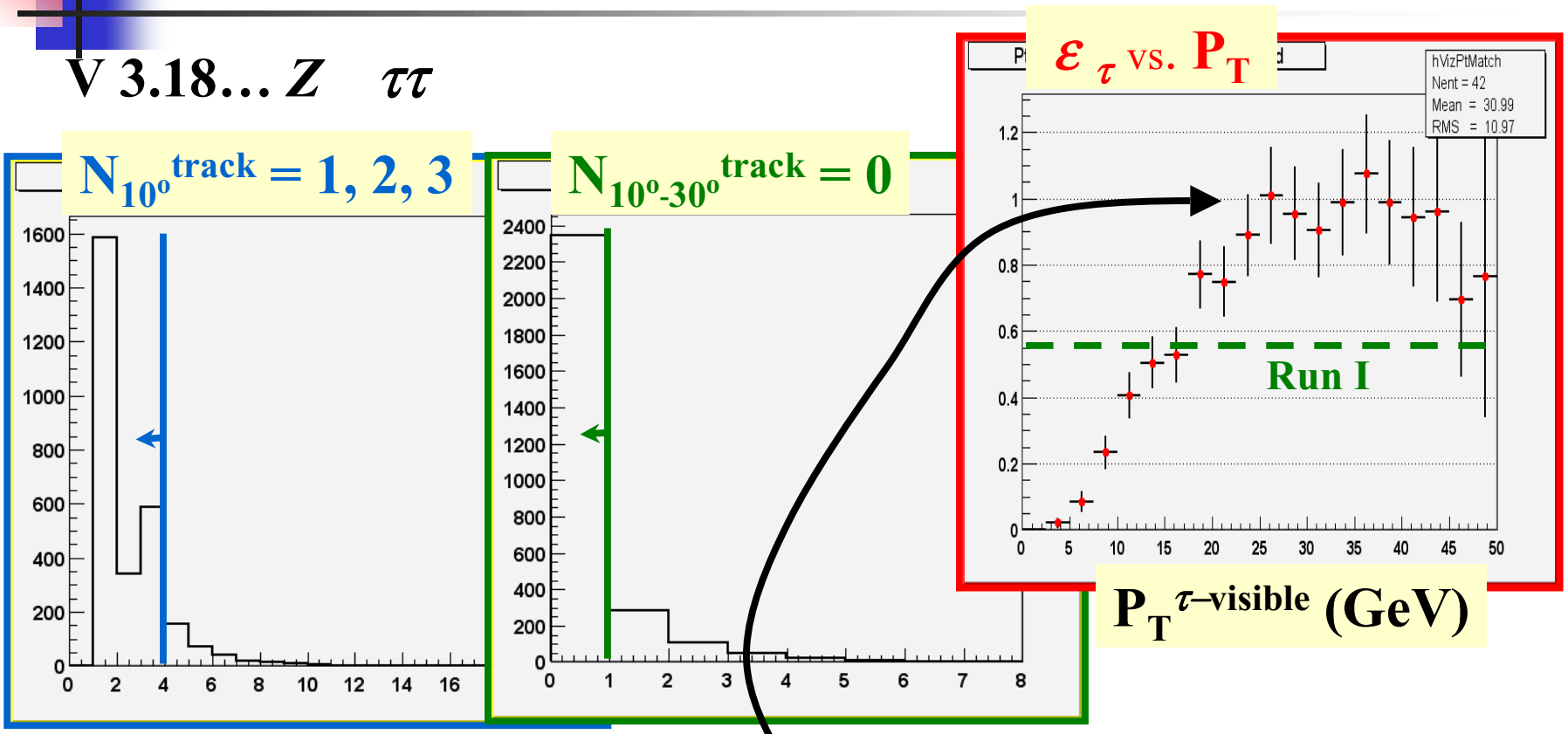
1. **π^0 reconstruction by**
   Anton Anastassov
   and Vadim Khotilovich;
2. **track-seeded recontruction.**



TauFinder – Quick MC Check

Fedor Ratnikov (Rutgers)

V 3.18… $Z \quad \tau\tau$



because of no π^0 recontruction

TauFinder - Efficiency

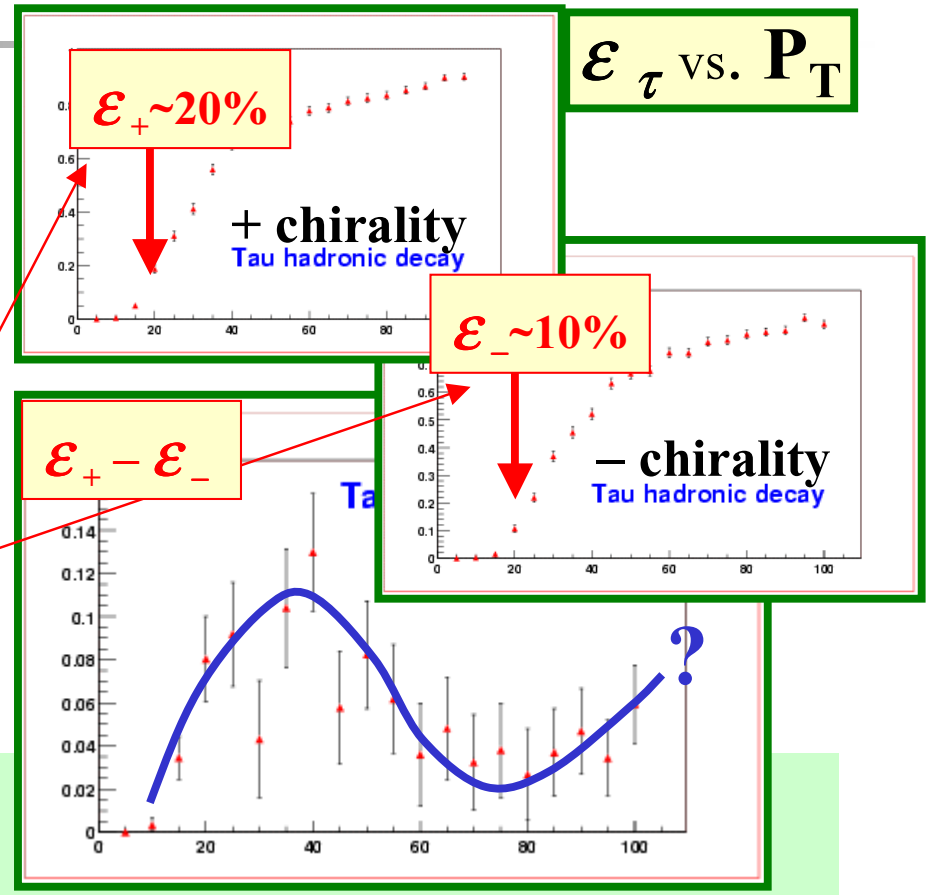
Dongwook Jang, Amit Lath, Anton Anastassov, Fedor Ratnikov (Rutgers)

MC: 1000 single τ's per P_T

- $P_T = 5 \sim 100$ GeV, $|\eta| < 1$
- Flat distr. *w.r.t.* P_T and η
- Two chirality datasets

Reconstruction with version 4.0.0

- ProductionExe
- TauFinder
  - CaloSeedEt > 10 GeV
  - SeedTrackPt > 4.5 GeV



Status: Working on

1. Efficiency as a function of η in various conditions on tracks (N_{10}=1,3,5.., $N_{10\text{-}30}$=0, $|\Sigma Q_i| = 0$);
2. Statistical error estimate.

TAUOLA – Ready!

Tania Moulik (Purdue Univ.)
http://cdfsga.fnal.gov/~tmoulik/tauola_oct05.ps

Aug. 31, 2001

V 3.18.0 V4.0.0

a. is interfaced with Pythia, Isajet, and Herwig

b. handles polarized τ leptons

Documentation:

see CDF 5719

Origin	Chirality τ^+	Chirality τ^-	Probability
Neutral Higgs bosons: h^0, H^0, A^0	+1	+1	0.5
	-1	-1	0.5
Charged Higgs boson H^+, H^-	-1	+1	1.0
Charged vector boson W^+, W^-	+1	-1	1.0
Neutral Vector boson Z^0/γ^*	+1	-1	P_Z
	-1	+1	$1-P_Z$
Other	+1	+1	0.5
	-1	-1	0.5

0.5
0.5

- From version **4.0.0int1**, for Z bosons, we generate spin configurations +1,-1 (-1,+1) as P_Z (1-P_Z) instead of 0.5. (Ref. hep-ph/0101311, Z. Was et. al.)

$$P_Z(s,\theta) = \frac{\frac{d\sigma_{Born}}{d\cos\theta}(s, cos\theta; 1)}{\frac{d\sigma_{Born}}{d\cos\theta}(s, cos\theta; 1) + \frac{d\sigma_{Born}}{d\cos\theta}(s, cos\theta; -1)}$$

$$\frac{d\sigma_{Born}}{d\cos\theta}(s, cos\theta; p) = (1+\cos^2\theta)F_0(s) + 2\cos\theta F_1(s) - p((1+\cos^2\theta)F_2(s) + 2\cos\theta F_3(s))$$

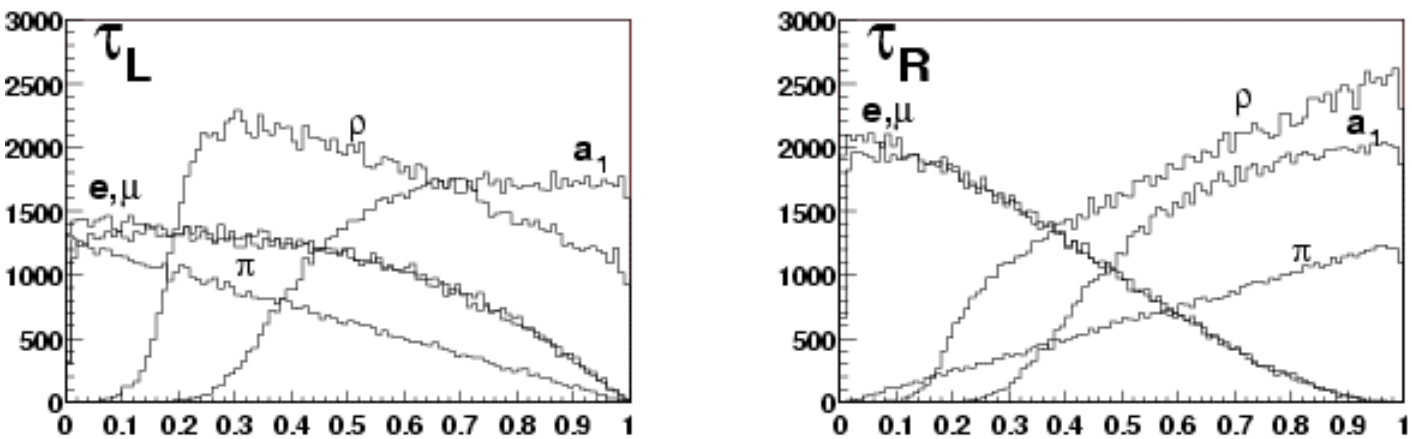
Status: Working on

1. Storage of the τ polarization vector into TAUG bank (or stotableObject?) by Alexei Safonov and Stephane Tourneur.

TAUOLA – Validation

Tania Moulik (Purdue)
http://cdfsga.fnal.gov/~tmoulik/tauola_oct05.ps

- Momentum distributions of the τ decay products are known to be sensitive to the polarization of the τ-lepton.
- In the colliner limit $P_\tau >> M_\tau$ convenient to study fraction of energy taken by the τ daughter d = (e,μ,π,ρ,a_1) $z_d = \frac{E_d}{E_\tau}$



$\frac{E_{dau}}{E_\tau}$ for left-handed and right-handed τ's

Lepton+Track Trigger

M.Chertok, T.Kamon, Y.Kato, V.Khotilovich, S.Krutelyov, T.Ogawa, A.Safanov
A.Savoy-Navarro, K.Yamamoto (UC Davis, TAMU, Osaka City, Waseda, Paris)

Many unrelated tracks!

Design (CDF-4807, 5157):

***A.* Electron+Track (50 nb)**

- EM > 8 GeV, P_T > 8 GeV
- Had/EM < 0.125
- No isolation cuts

***B.* Muon+Track (2 nb)**

- CMU stub
- P_T > 8 GeV
- Δx < 10 cm

***C.* Track**

- P_T > 5 GeV
- No tracks with P_T > 1.5 GeV between 10° and 30°

Run II	e +track	μ+track
Stream	B	J
L1 Trigger	CEM8_PT8	CMU6_PT8
σ(L3-out)	80 nb	80 nb
N(event)/5pb^-1	400k	400k
Event Size	335 kb	290 kb
Disk Space	135 Gb	120 Gb

Status: The filters was Tested and ready, but not included in the fall 2001 run.

Lepton+Track Trigger

M.Chertok, T.Kamon, Y.Kato, V.Khotilovich, S.Krutelyov, T.Ogawa, A.Safanov
A.Savoy-Navarro, K.Yamamoto (UC Davis, TAMU, Osaka City, Waseda, Paris)

Fall 2001 Sample:

L3 e/μ+track trigger (filter)

- **Was tested and ready, but not included.**

  The e/μ+track datasets will be stripped from B/J.
- **Was implemented by Christoph Paus and stripped a small data.**

  The data looks okay!

However:

- **The muon sample is quite enriched with cosmic ray muons (~50%);**
- **A large fraction of events passed the cuts because of poorly recontracted tracks with just a couple of segments (therefore, relatively large P_T)**

Status: Working in progress to identify additional cuts to remove those unwanted background events throughout validation of the data at /cdf/data37a/s0/bottom/prod/strip/dst/*.Dst-T on fcdfsgi2

Many phototube spikes!

Di-τ Trigger

Fedor Ratnikov (Rutgers)
Pasha Murat (FNAL)

Design:

L1: 2 central towers with

$E_T > 5$ GeV (6.3 μb)

L2: $E_T^{jet} > 10$ GeV, with

$P_T^{seed} > 6$ GeV (55 nb)

L3: 2 CdfTau objects with

$E_T > 10$ GeV (5 nb)

Analysis:

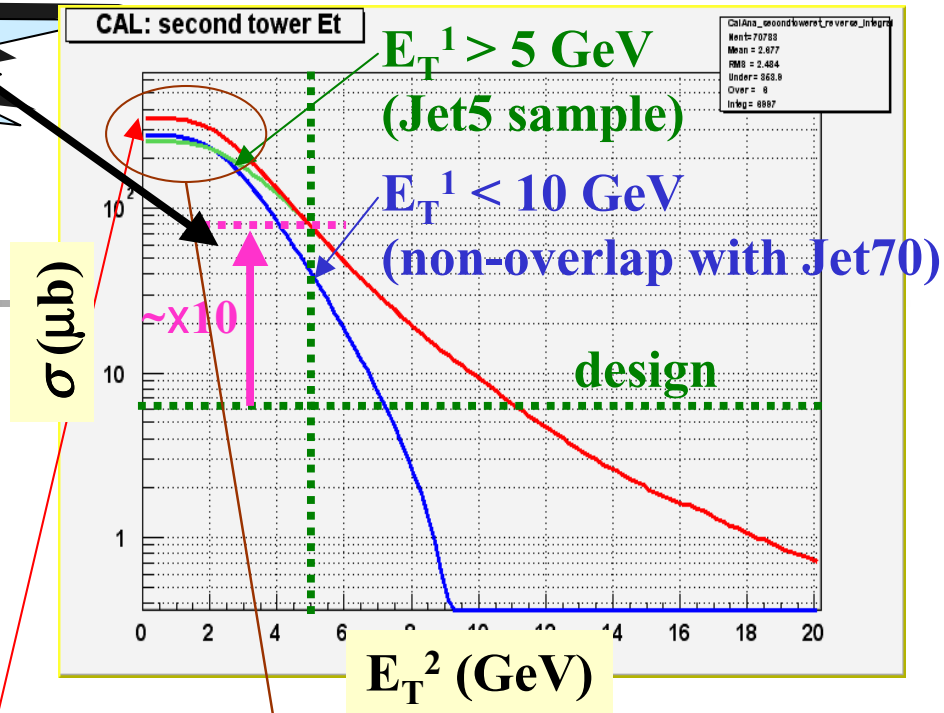
Stream G: Run 119619 (40 nb^{-1})

93,772 events

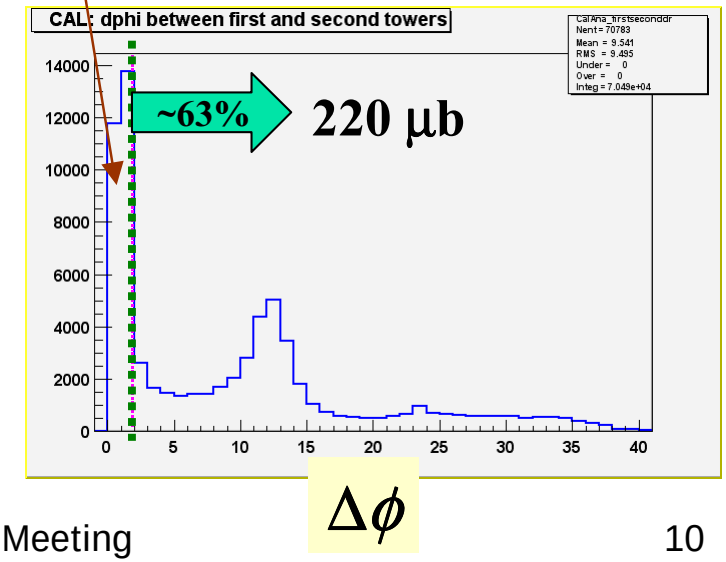
Use Jet5 (L1 PS20, L3 PS10)

70,783 events (350 μb)

L1 Trigger Rate?



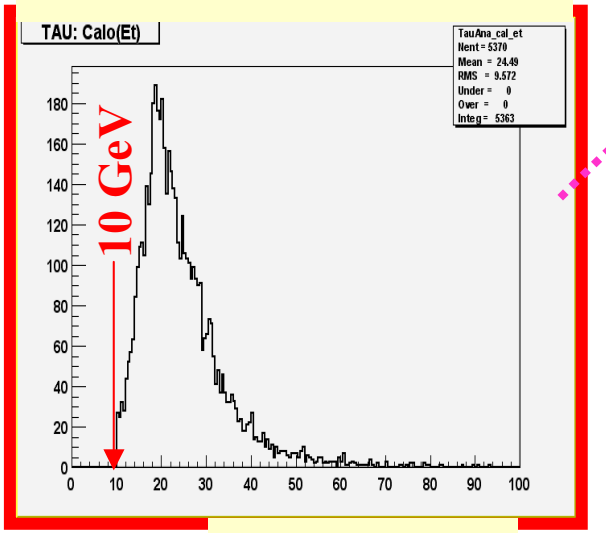
Events With 2 Not Adjacent Towers



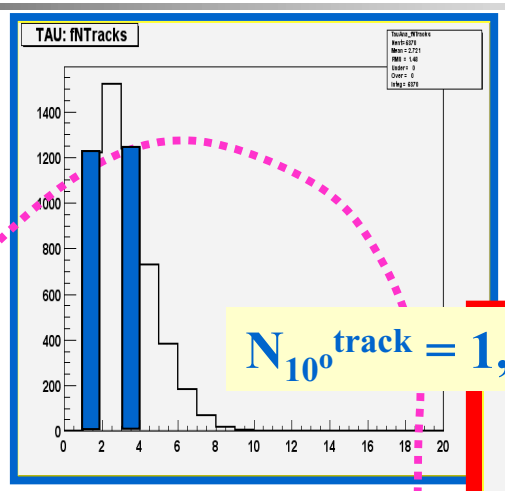
Di-τ Trigger (Cont'd)

Fedor Ratnikov (Rutgers)
Pasha Murat (FNAL)

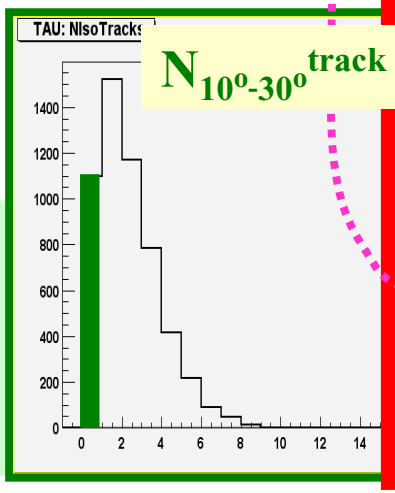
L3 before ISO cuts



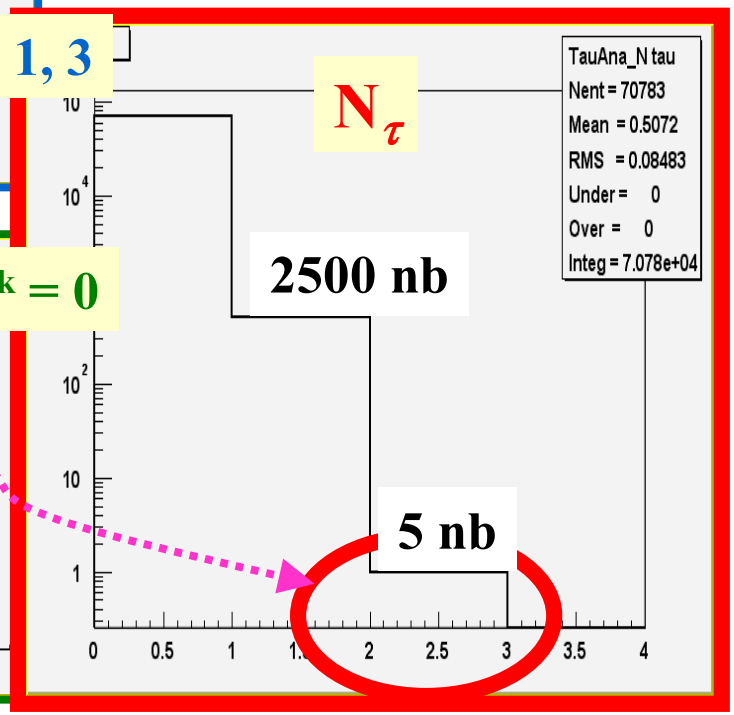
E_T^{calo} (GeV)



$N_{10^o}^{track} = 1, 3$



$N_{10^o\text{-}30^o}^{track} = 0$



Status: We have **one** event with $N_\tau \geq 2$ after ISO cuts, which corresponds to **5nb** at Level 3, as designed!!!

$\not{E}_T$ - τ Trigger

Fedor Ratnikov (Rutgers)
Pasha Murat (FNAL)

Fall 2001 Sample (~4 pb^{-1}):

- No tau triggers at L3
- We expect ~200 $W \quad \tau\nu$ events from L1 MET > 25 GeV trigger sample in Stream G.

1st Event Reduction:

- Selected events with
  MET > 20 GeV
  $N_j^{central} \geq 1$ (E_T > 20 GeV)
  based on L3 reconstruction;
- ~1% of Stream G events passed the cuts

Production:

- Close to completion…

Status:

1. ~250,000 events on fcdfsg12:/cdf/data37b/s0/exotic/murat/jm2020
2. Hopefully see the $W \quad \tau\nu$ events…

Summary

TauFinder:

- **Working on track-seeded reconstruction and π^0 reconstruction;**
- **Progress on a systematic study on the tau finding efficiency.**

TAUOLA

- **Ready!**

Trigger/datasets:

- **Working on three trigger/ datasets**
  - **Feedbacks from the fall 2001 data samples**
  - **Validation**
  - **Physics-oriented plots**

Tau group meeting:
4 pm, CDF theater, Friday, on-week