Tau: Triggers, Reconstruction, and Validation

Alexei Safonov (UC Davis)

For CDF Tau Group

- Run II Triggers and Datasets. Physics with τ.
- τ-reconstruction status.
- Trigger commissioning.
- Validation (triggers/datasets/ID):
  - Online/Semi-Offline/Offline
- Summary.

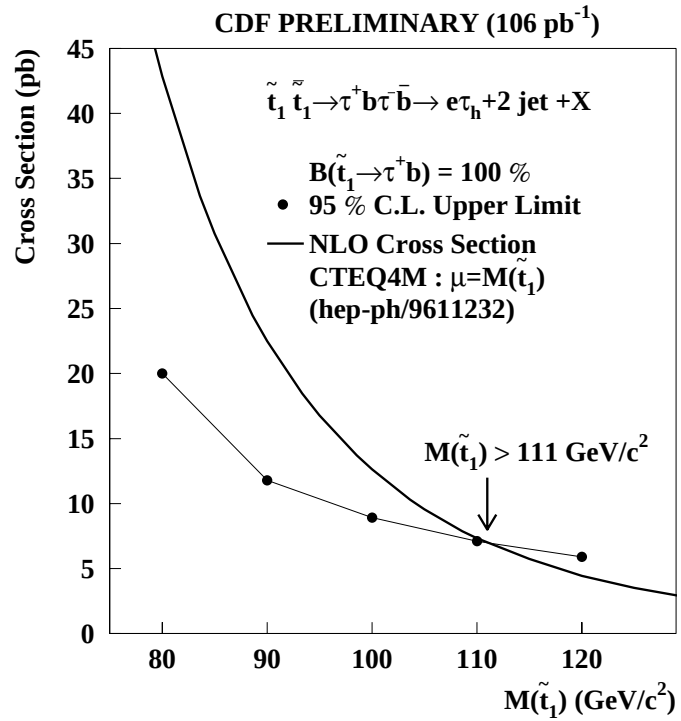
Triggers/Datasets Status

- Run II: Five Paths/Datasets:
  - TAU_MET
  - DITAU
  - TAU_ELECTRON8_TRACK5_IS0
  - TAU_CMUP8_TRACK5_ISO
  - TAU_CMX8_TRACK5_ISO
- All 5 triggers were included in the new trigger table, up and running since mid-January!

Tau Physics: Lepton+Track

Davis, Paris, Texas A&M, Waseda

- Calibration:
  - $Z \to \tau_e \tau_h$; $Z \to \tau_\mu \tau_h$; $Z \to ee$; $Z \to \mu\mu$;
- Analysis:
  - $t\bar{t} \to 2 \times (Wb \to e/\mu/\tau) \to (e/\mu)\tau + bb$
  - mSUGRA (small/large *tanβ*) $\chi^{\pm}\chi^{0} \to e(\mu)\tau\tau$ …
  - $\not{R}_P$ SUSY: $\tilde{t}\tilde{t} \to (b\tau)(b\tau)$
  - $\not{R}_P$ SUSY: $\tilde{\nu} \to \mu\tau$
  - GMSB scenario: $\tilde{\tau}$ is NLSP
  - Lepton Flavor Violating $gg \to H \to \mu\tau$
  - MSSM Higgs (large *tanβ*) $H^0/h^0/A^0 \to \tau\tau$;

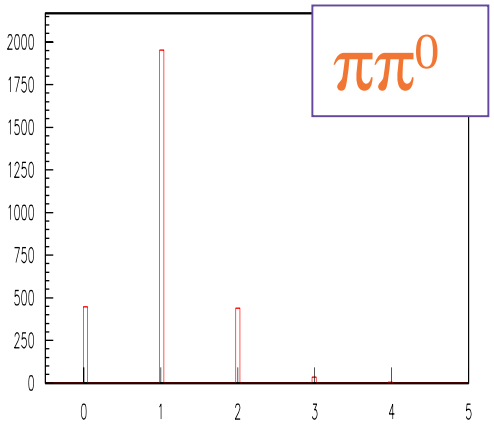


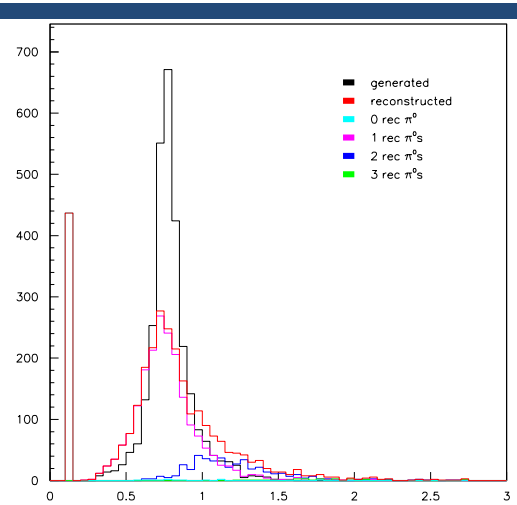
Tau Physics: Di-τ & $\tau+\not{E}_T$

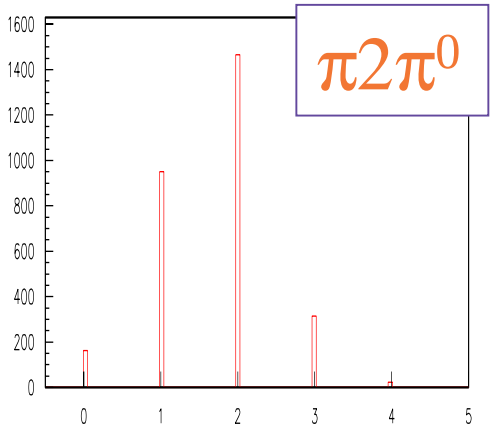
Fermilab, Rutgers

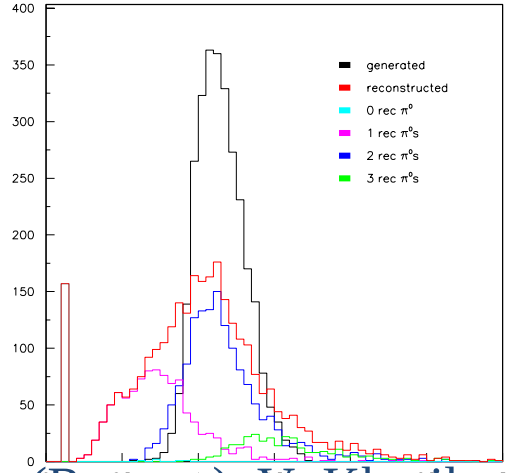
- τ+MET:
  - $Br(W\rightarrow\tau\nu)/Br(W\rightarrow e\nu)$
  - $tt\rightarrow H^+b\rightarrow l+\tau+Met+b_{tag}$
- Di-τ:
  - mSUGRA (small/large *tanβ*) $\chi^{\pm}\chi^0 \rightarrow e(\mu\tau)\tau_h\tau_h$ …
  - $Z\rightarrow\tau\tau$; $H(W/Z)\rightarrow\tau\tau$+leptons(jets)…;
  - $H^0/h^0/A^0\rightarrow\tau\tau$;
  - $tt\rightarrow(H^+b)\ (H^-b) \rightarrow \tau\tau+Met+bb$
- The 5 triggers are complementary.

Reconstruction: TauFinder Module









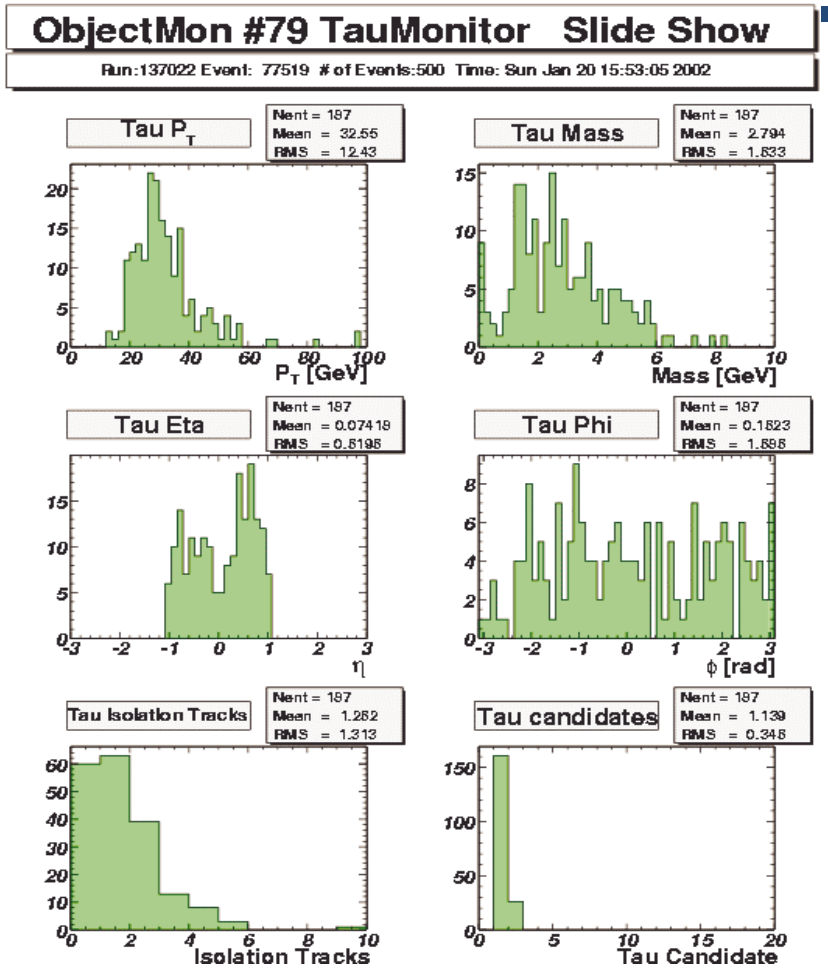
- TauFinder is reliable and used routinely in L3 and Production.
- Track-seeded recon recently added, tested and verified.
- $\pi 0$ reconstruction – next large priority, work in progress. Plot shows mass resolution using π^0s (by A.Anastassov).

F. Ratnikov, A. Anastassov (Rutgers), V. Khotilovich (TexasA&M)

Validation & Monitoring

- Online:
  - Tau plots in ObjectMon
- Semi-Offline:
  - TauTriggerValidation Module (in Production):
    - Performance and validation
    - Trigger efficiencies
  - TauValidationModule (in Production)
    - Tau ID validation and monitoring
- Completely Offline (analysis):
  - $W \rightarrow \tau\nu$
  - $Z \rightarrow \mu\mu$, $Z \rightarrow \tau_\mu \tau_h$;
  - $Z \rightarrow ee$, $Z \rightarrow \tau_e \tau_h$

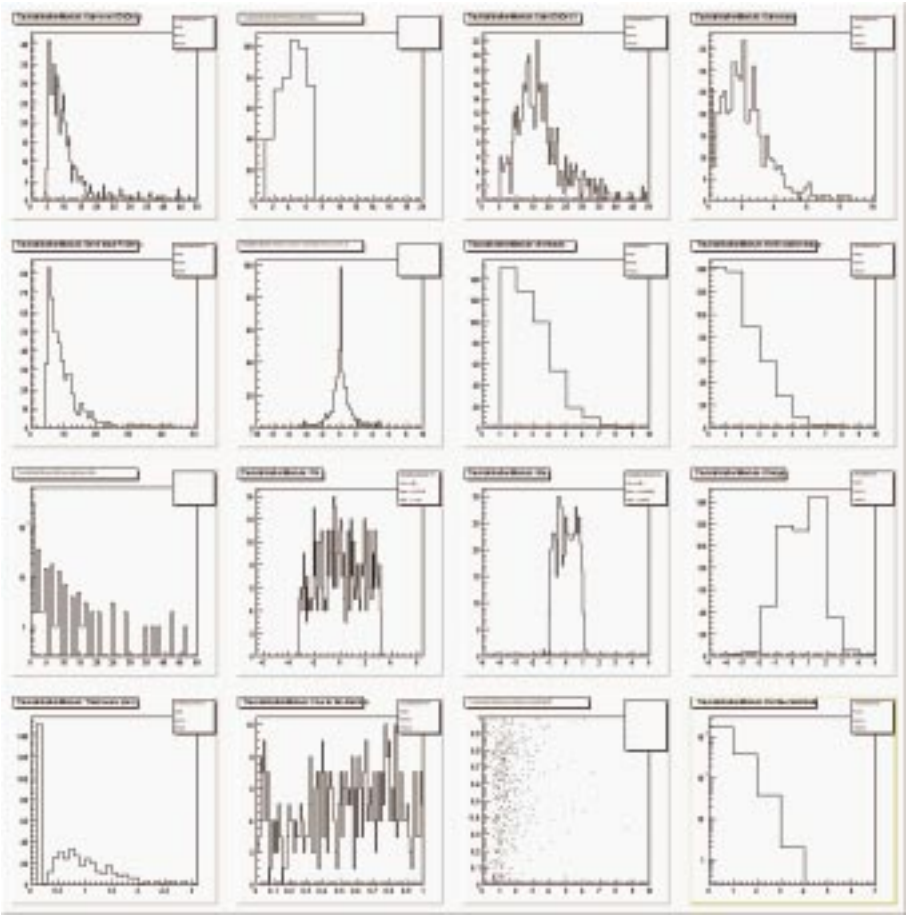
Online Validation (ObjectMon)



- Pilot version of the Tau Canvas in ObjectMon is ready.
- Being finalized and improved, new ObjectMon version will be available soon for CDF shifts.

Sungwon Lee, Teruki Kamon (Texas A&M)

Semi-Offline: Tau ID Validation

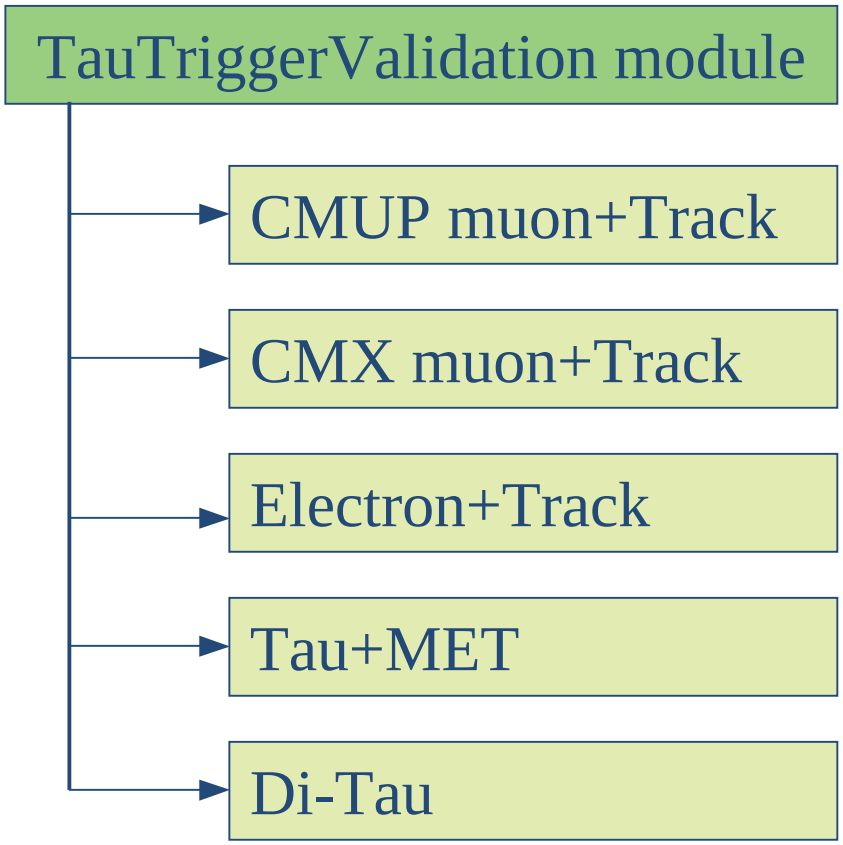


TauValidationModule (will go into Production)

- Monitoring Tau ID variables.
- Completed, will request to add in ProductionExe soon
- Example Canvas – from jet data.

Fedor Ratnikov (Rutgers)

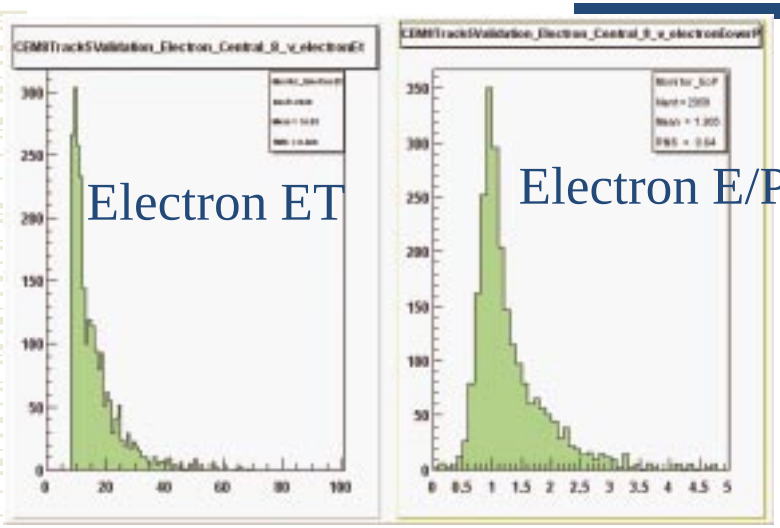
Semi-Offline: Trigger Validation

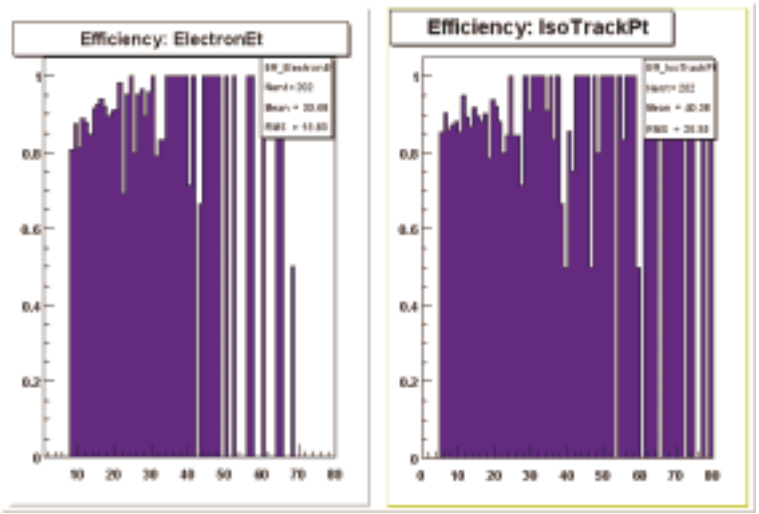


- Single module in Production for all tau triggers.
- Each sub-module can monitor several paths producing one set of histograms per path.
- Output will be used for monitoring and fast efficiency estimations.
- *Will help quickly define needed backup triggers and tolerable prescales.*

T.Ogawa (Waseda), A.S. (Davis) et al

Semi-Offline: Trigger Validation

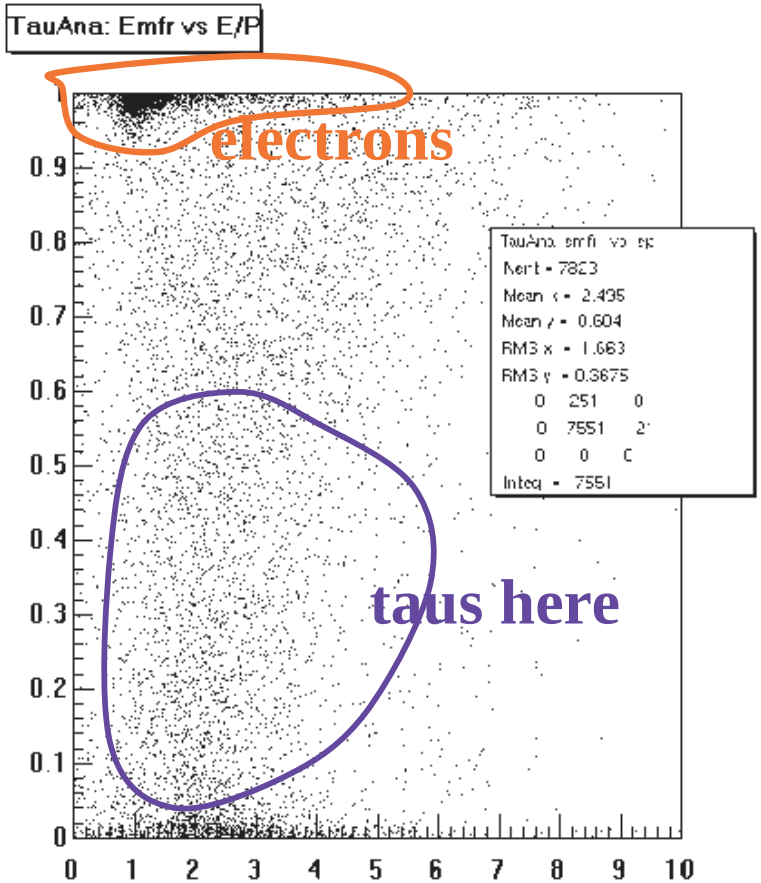


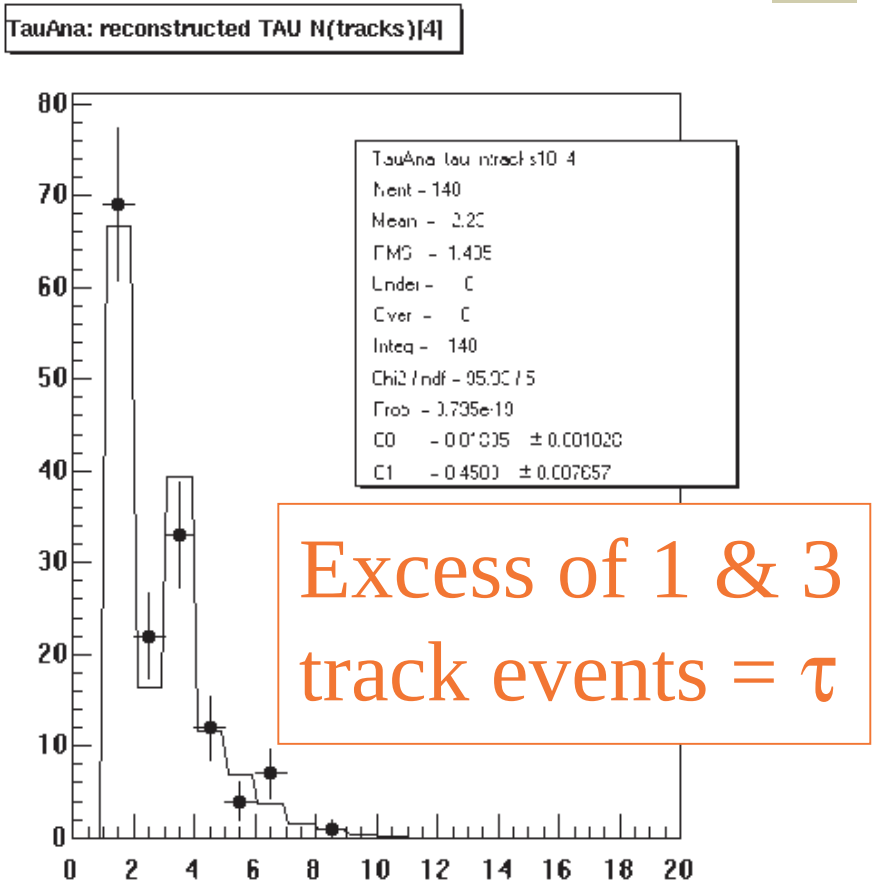


- Require that event "should have passed ideal trigger".
- Plots for events passing paths (set in tcl):
  - Ele+Track (primary)
  - Backup triggers (Electron4, MinBias, …, any trigger)

T.Ogawa (Waseda), A.S. (Davis)

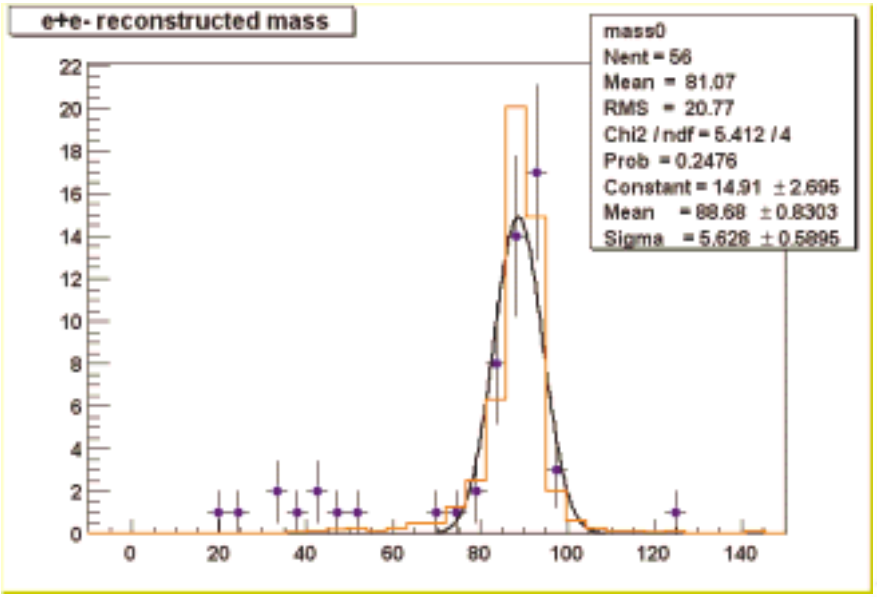
Offline: $W \rightarrow \tau + \not{E}_T$

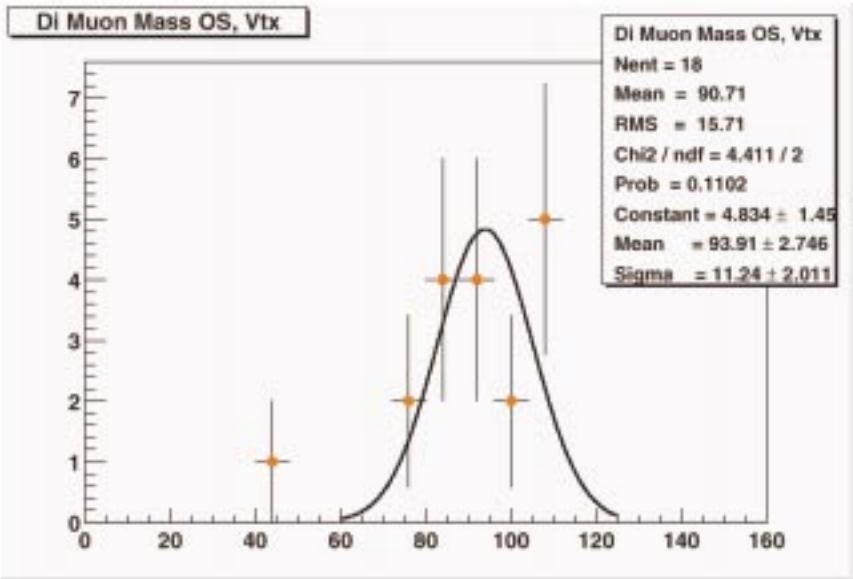




Pasha Murat (Fermilab)

Offline: Z→ee/μμ (Prelim)





- Electron+track filtered data:
  - 2 central electrons
  - Vertex req.
  - Isolation cuts
  - Track cuts

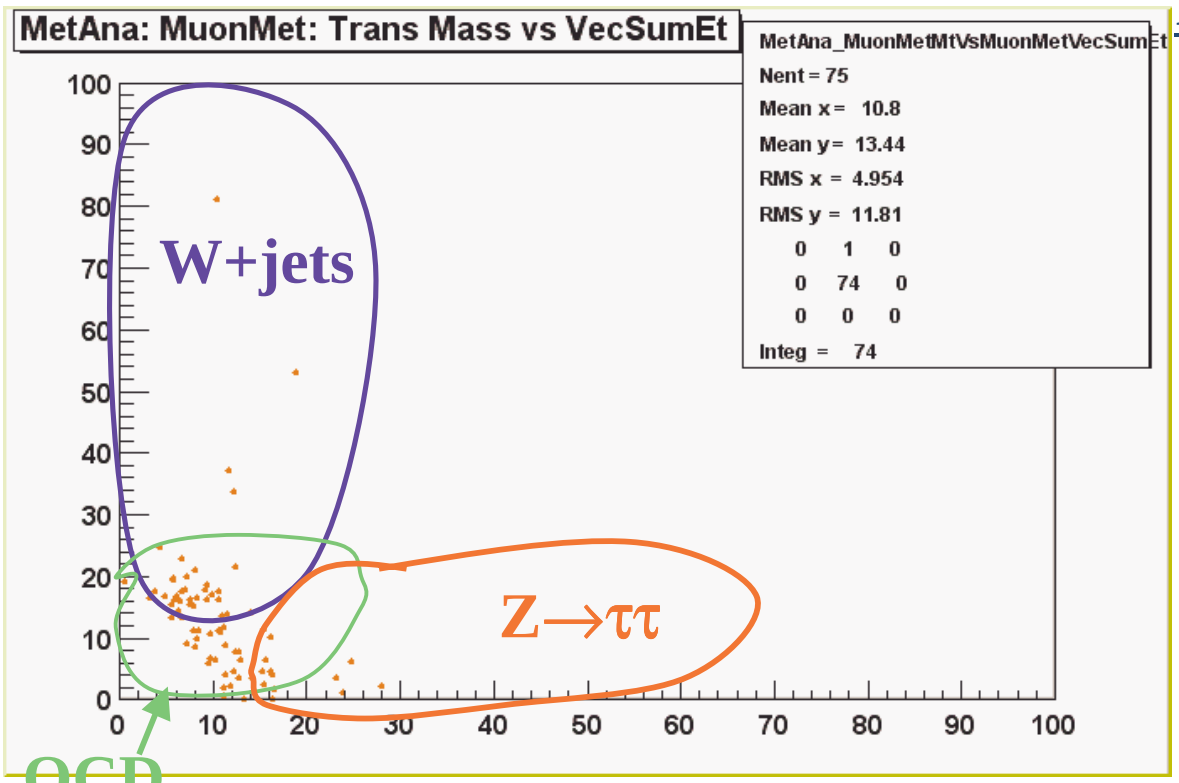
Stephane Tourneur, A.S. (Davis)

- Muon+Track filtered data (4.0.0):
  - 1st leg is CMUP;
  - 2nd leg – any Cdf muon
  - Vertex requred
  - Cosmics removed

T. Ogawa(Waseda) & A.S.(Davis)

Offline: $Z \rightarrow \tau_\mu \tau_h$ (First look)

$$M_T = \sqrt{(P_T(MET)+P_T(\mu))^2 - (\vec{P}_T MET)+\vec{P}_T(\mu))^2}$$

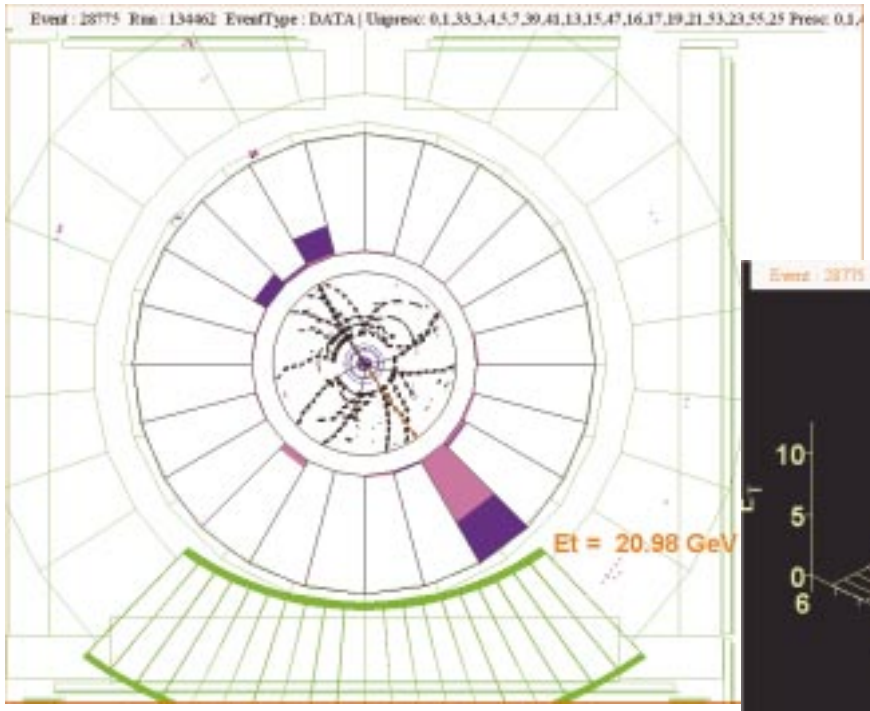


$$P_T^{\mu+met} = |\vec{P}_T(met)+\vec{P}_T(\mu)|$$

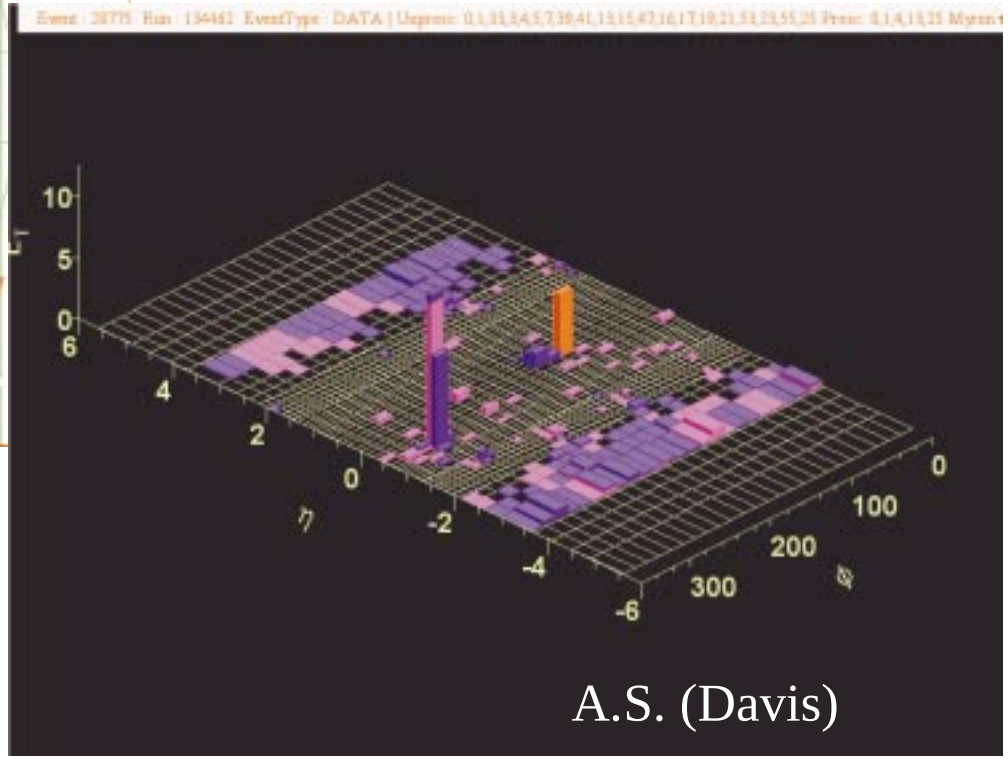
Muon+track data:

- Good CMUP μ
- τ - candidate:
  - no shoulder tracks,
  - 1- or 3-prong
  - μ/e rejection
- Then select $Z \rightarrow \tau\tau$ candidates
  - MET ~ along muon
  - Small 2D-mass

Offline: $Z \rightarrow \tau_\mu \tau_h$ (First look)



Likely candidate (backgrounds are low)



A.S. (Davis)

More data needed!

Summary

- Trigger Commissioning and Validation:
  - Work with L3 group
  - Improvements to TriggerValidation, machinery to analyze output.
  - Decisions on backup triggers (specs, prescales).
- Reconstruction:
  - Large progress in $\pi 0$ reconstruction, will be included in TauFinder when completed.
  - Track-seeded reconstruction is completed and part of the official package.
- Tau ID Validation and Monitoring:
  - ObjectMon tau canvas is ready.
- Physics:
  - Have presentable results on “calibrations” and RP-violating τ search by summer