

Lepton+Track Triggers: Level 3 Trigger Efficiency for Taus

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Tau L3 Efficiency

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- > L3_Electron8_Track5_Iso XFT at L2
- > L3_CMUP8_Track5_Iso
- > L3_CMX8_Track5_Iso

Data Sample: gjet08 -> τ (passed offline cuts)

Match to L3: L3 trigger track matched to τ

Efficiency: number of L3 matched / τ s

Phase Space: 3-D(P_T^{-1} θ^{in} ΣP_T)

Tau Selection

Seed Tower $E_T > 6 \text{ GeV}$

Seed Track $P_T > 4 \text{ GeV}/c$

Seed Track $|z_0| < 60 \text{ cm}$

Seed Track $|d_0(\text{cor})| < 0.1 \text{ cm}$

Cal Iso $< 6.0 \text{ GeV}$

$P_T(\text{trk}+p_0) \gtrsim 4 \text{ GeV}/c$

$|h| \leq 1.0$

Mass (trk+p0) $< 1.8 \text{ GeV}/c^2$

$c \circ E_T\{\text{had}\} / \text{Spt} > 0.1$

$|D z_0|(\text{Seed Track, Closest Prim Vertex}) < 5 \text{ cm}$

No track ($> 1.0 \text{ GeV}/c$) in isolation annulus

No p_0 ($> 0.5 \text{ GeV}$) in isolation annulus

Fiducial for Seed Track:

$9 \text{ cm} \leq |z_{\{\text{CES}\}}(r=183.9\text{cm})| \leq 230 \text{ cm}$

$|z_{\{\text{COT}\}}(r=137\text{cm})| \leq 150 \text{ cm}$

$N_{\{\text{axial SL}\}}, N_{\{\text{stereo SL}\}} \gtrsim 3$

Fiducial in terms of L3 isolation

No track $P_T > 1.0 \text{ GeV}/c$, $|Dz_0| < 15 \text{ cm}$

in $0.175 \leq D R \leq 0.524$ around the seed

Offline

Level 3

Seed track $P_T \gtrsim 5 \text{ GeV}/c$ $|h| \leq 1.5$

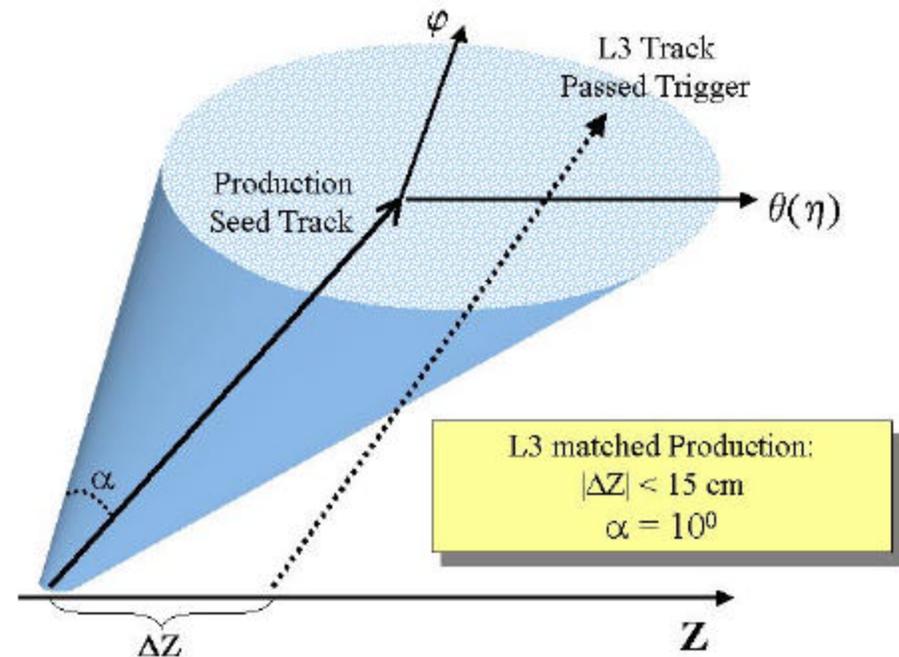
no tracks with $P_T > 1.5 \text{ GeV}/c$ and $|Dz_0| < 15 \text{ cm}$

in $0.175 \leq D R \leq 0.524$

Tau Matching

When do we say that the offline Tau is coming from L3 track that passed the trigger?

L3 track is inside Tau 10^0 cone, $|\Delta Z| < 15$ cm



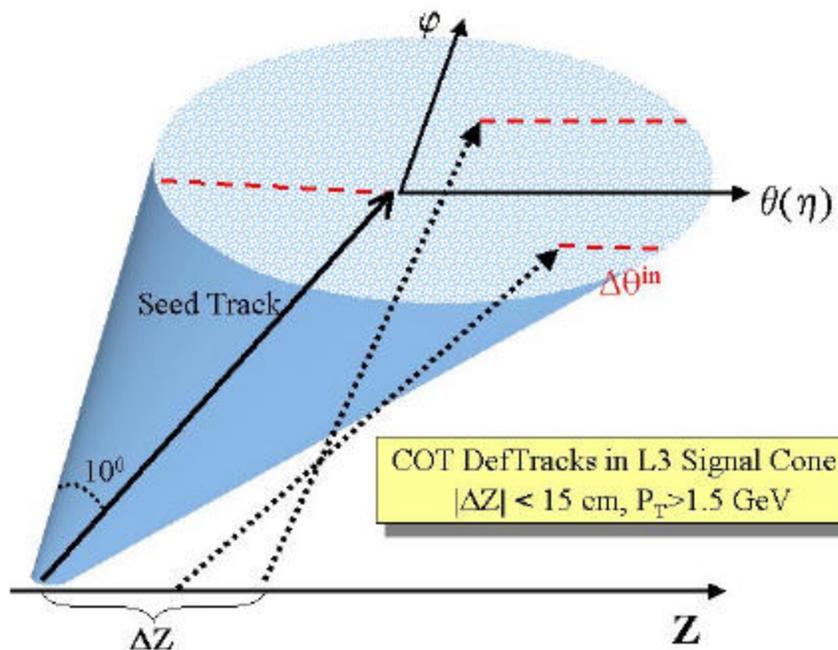
q^{in} Definition

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L3 finds track in isolation cone angle, PROD does not.

$\Delta\theta^{\text{in}}$ - minimum Theta angle between a track and the cone

Why θ ? The resolution is better in θ than in φ



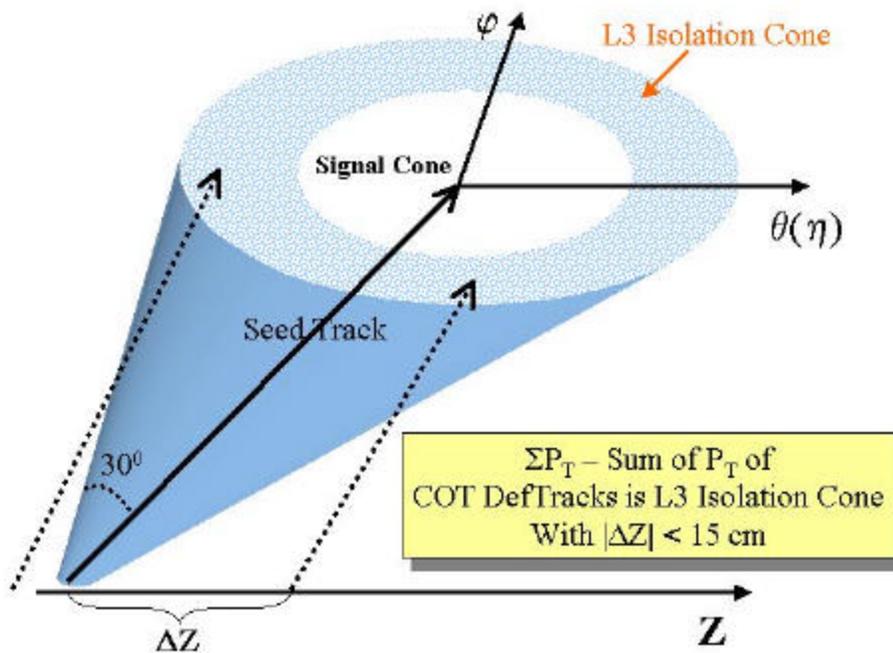
Pick COT DefTracks inside the signal cone,
 $P_T > 1.5 \text{ GeV}$, and $|\Delta Z| < 15 \text{ cm}$.
And find the closest to the border.

ΣP_T Definition

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Track in isolation cone: L3 measures the track momentum to be above 1.5 GeV while PROD thinks it is below 1 GeV.

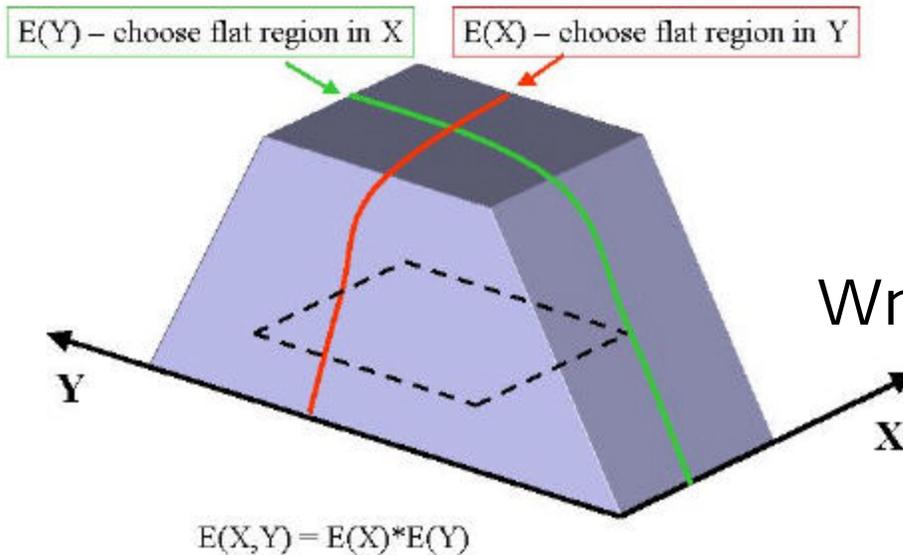
ΣP_T is a measure of activity in isolation cone.



Pick COT DefTracks in the isolation cone, $|\Delta Z| < 15$ cm. Find ΣP_T .

Procedure

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Want E_i in one dimension -
Select flat regions in others

Write combined $E = K * E_1 * E_2 * \dots$

K - from global 3D fit

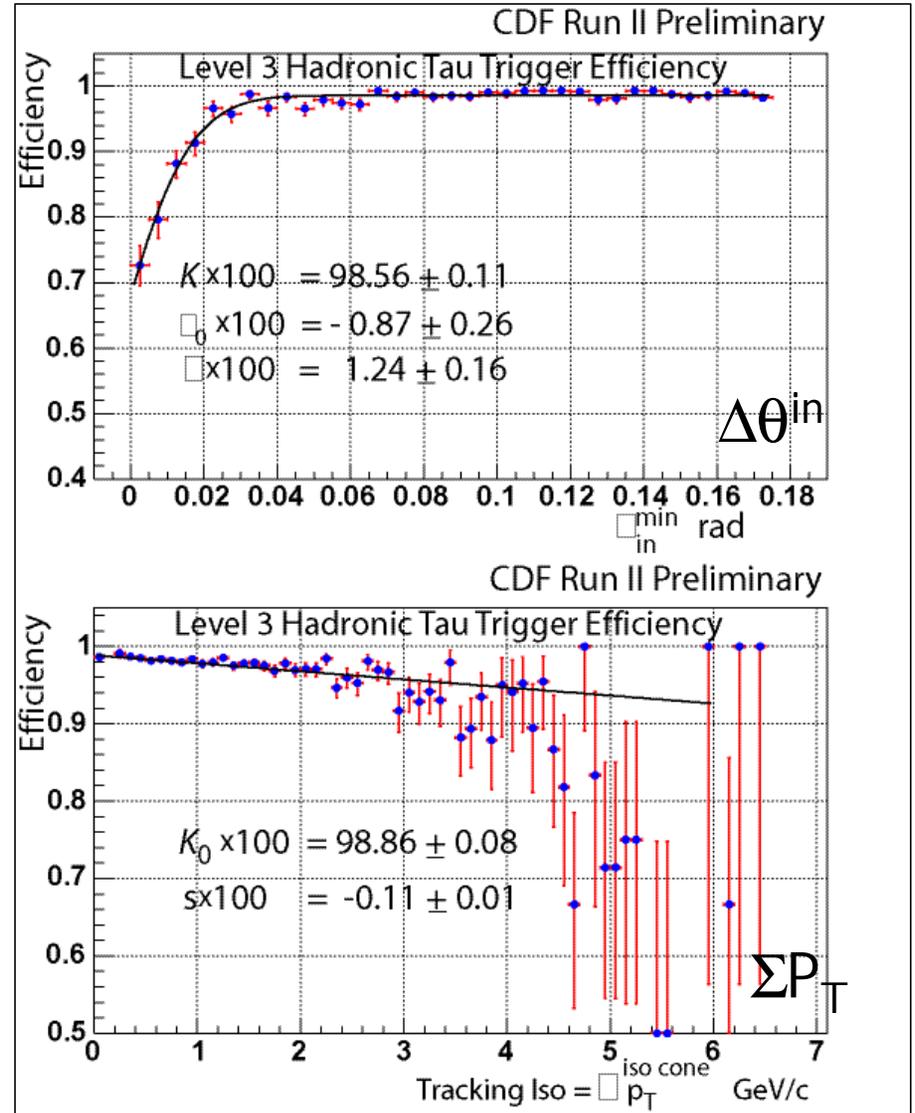
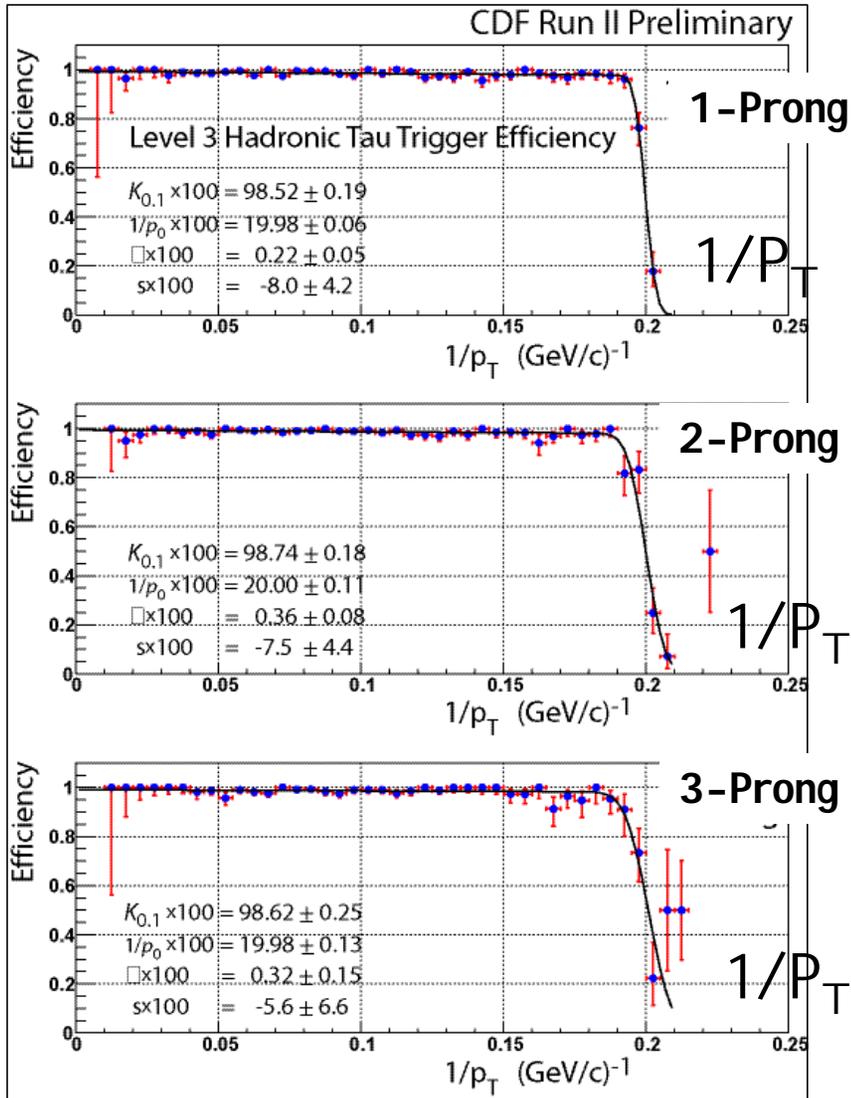
Simulation: take all Taus \rightarrow throw against $E \rightarrow$ number of
"matched to L3" Taus $\rightarrow E^{sim}$

Is it true: $E_i^{sim}_{inc} = E_i_{inc}$?

"Inc" means "inclusive" - no flat regions

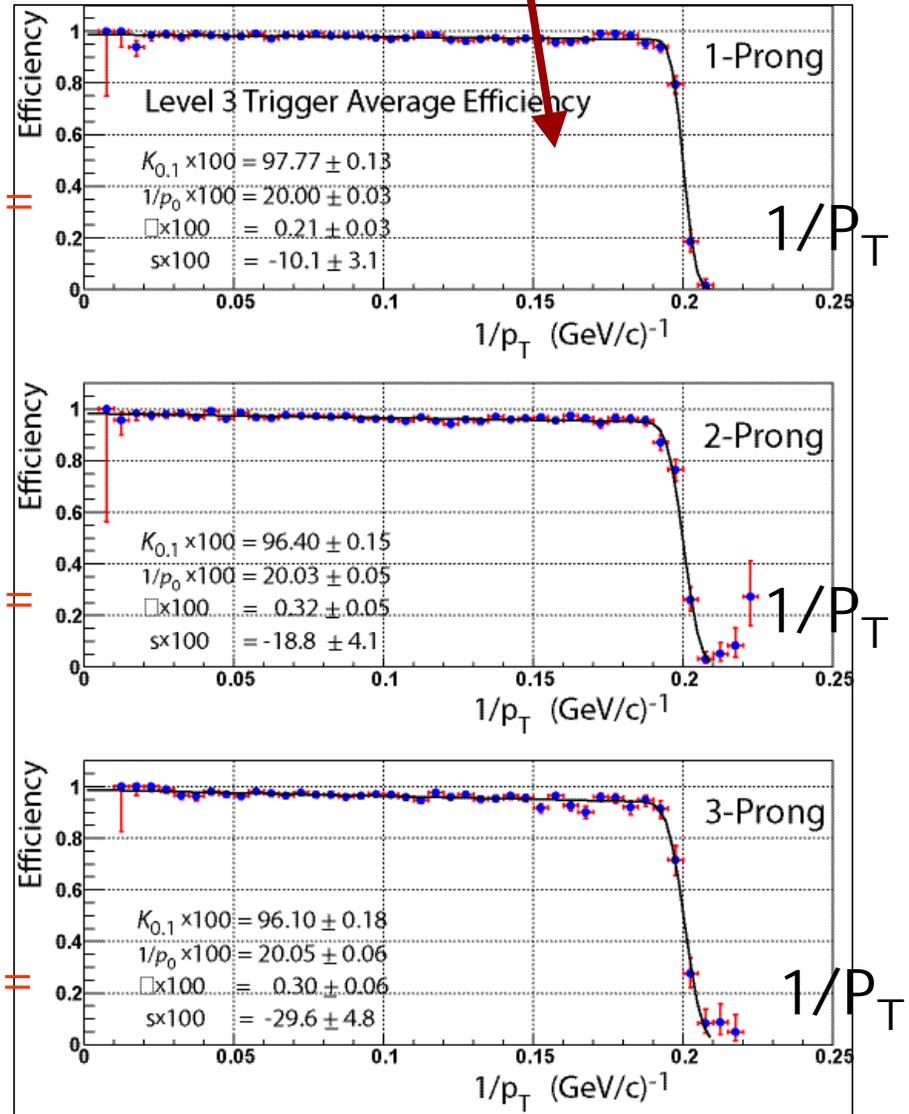
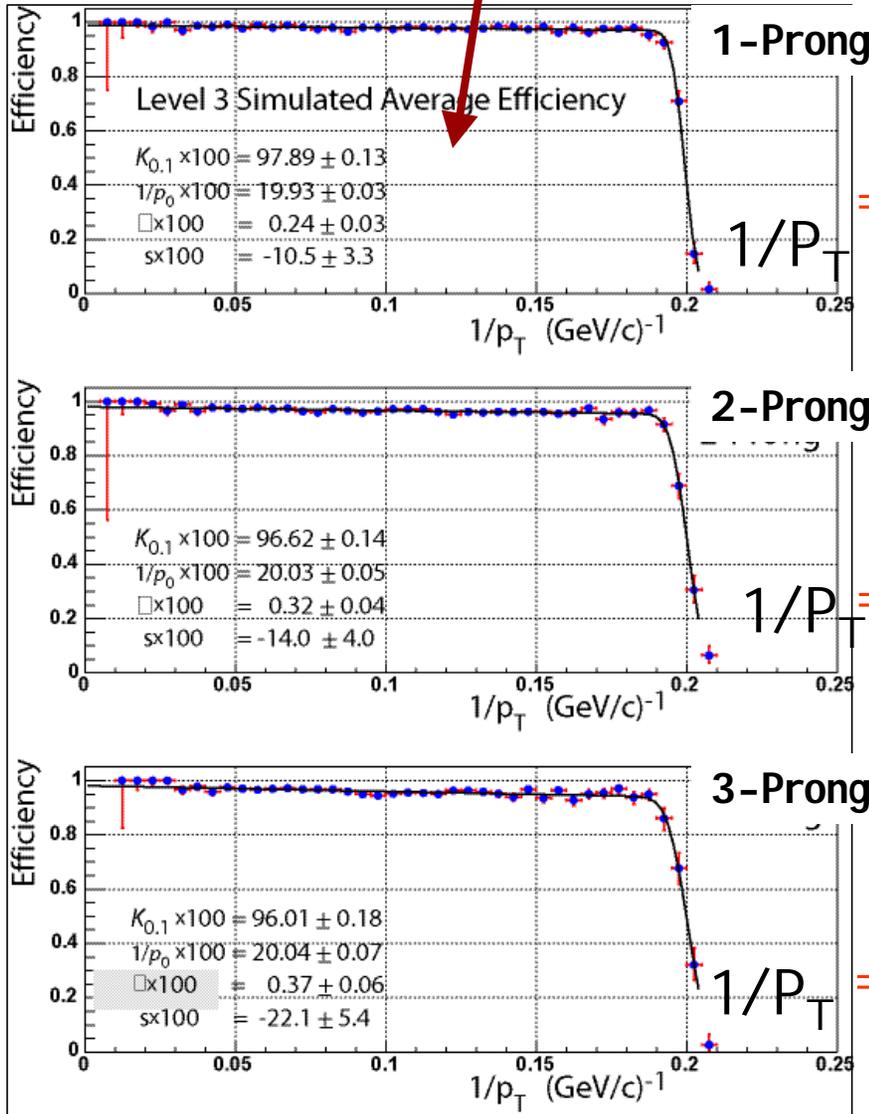
Results: Total Efficiency

$$P_T^{-1} < 0.18 \quad \Sigma P_T < 0.3 \quad \theta^{in} > 0.05$$



Inclusive vs. Simulated

Simulated Inclusive matches Observed?

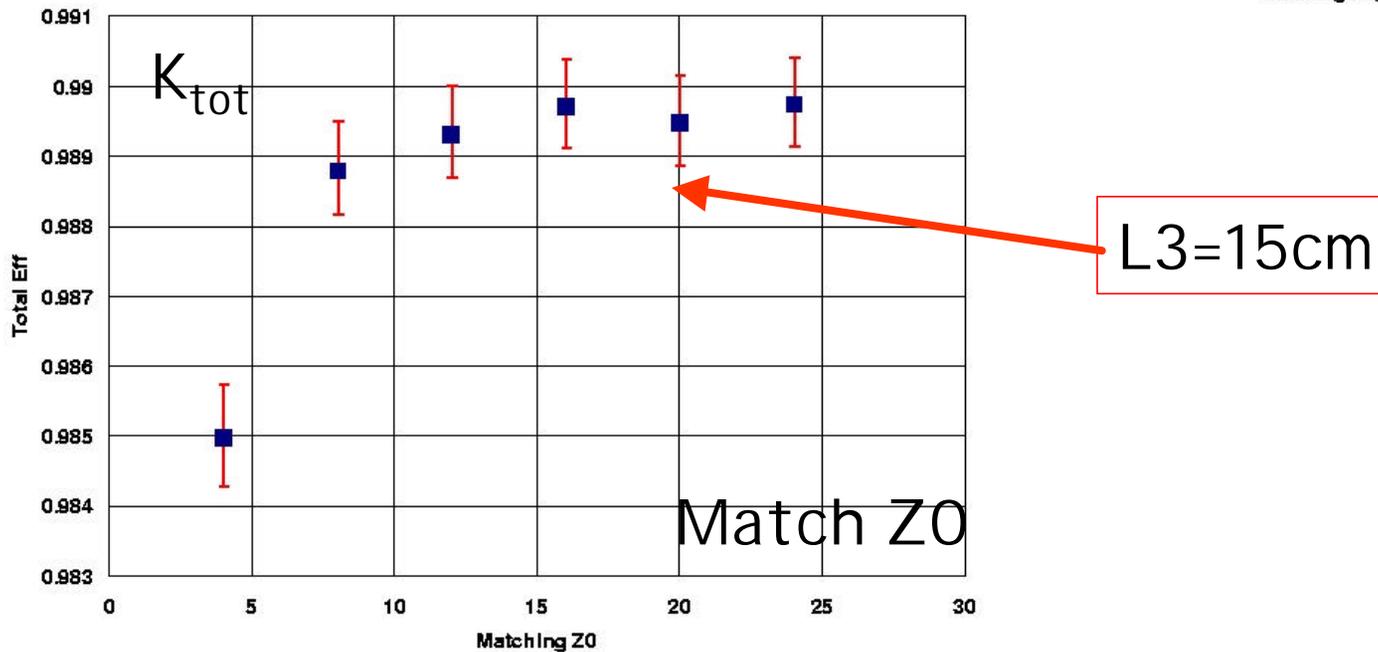
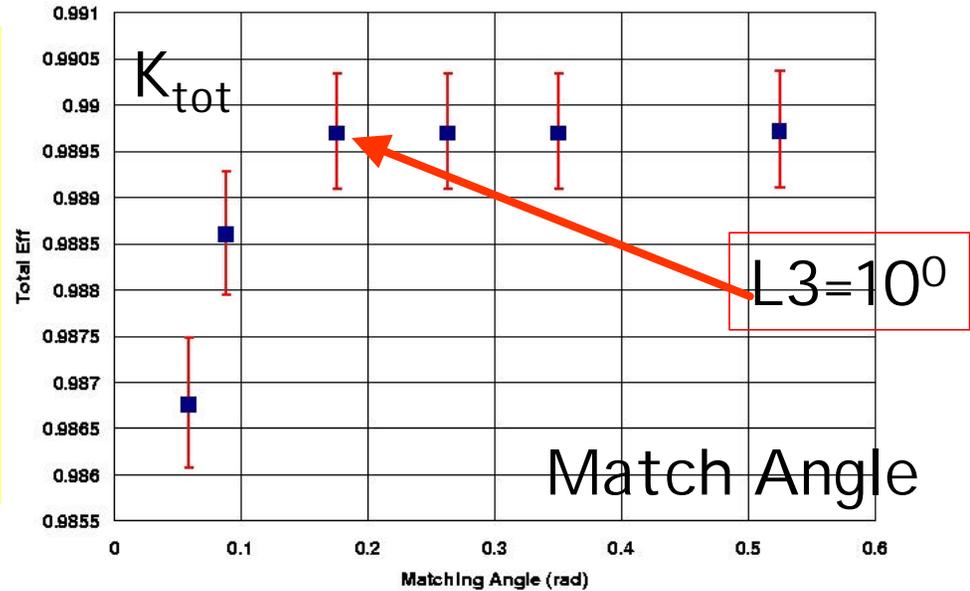


Matching PROD with L3

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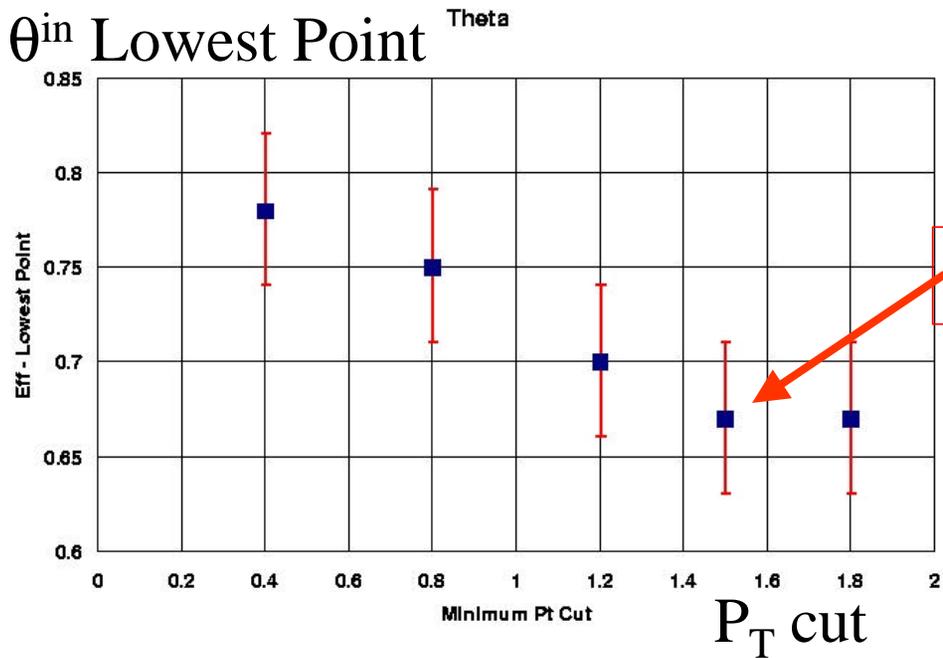
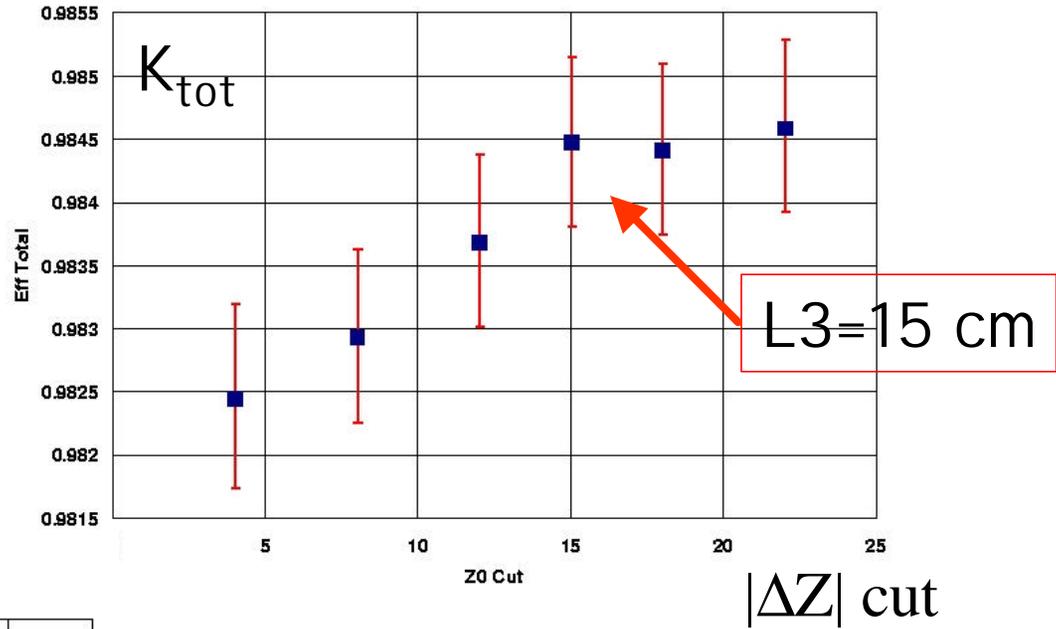
We choose matching to be consistent with L3:
 10° cone, $|\Delta Z| < 15$ cm.

Cross-check: efficiency flattens out



ΣP_T and q^{in}

What P_T and $|\Delta Z|$?
To be consistent with L3
The efficiency flattens out as well



Results

Effect	Negative	Positive
Matching Angle	-0.50%	+0.60%
Matching Δz	-0.05%	+0.05%
Super-Layers	-0.04%	+0.40%
Total	-0.50%	+0.72

1-Prong: $98.90 \pm 0.12(\text{stat}) \pm 0.72(\text{sys}) \%$

2-Prong: $98.95 \pm 0.11(\text{stat}) \pm 0.72(\text{sys}) \%$

3-Prong: $99.01 \pm 0.13(\text{stat}) \pm 0.72(\text{sys}) \%$

We have tables without XFT at L2,
And with only 1 Primary Vertex events

CDF Note 6553

PROD vs. L3 for Tau

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There are differences in Tau objects in L3 and PROD

L3
>1.5 GeV
15 cm
 η - ϕ Cone

Tracks min P_T
 $|\Delta Z|$ from Seed
Cone around Seed

PROD
>1.0 GeV
10 cm
3D Cone



Improve in the
next Trigger
reincarnation?

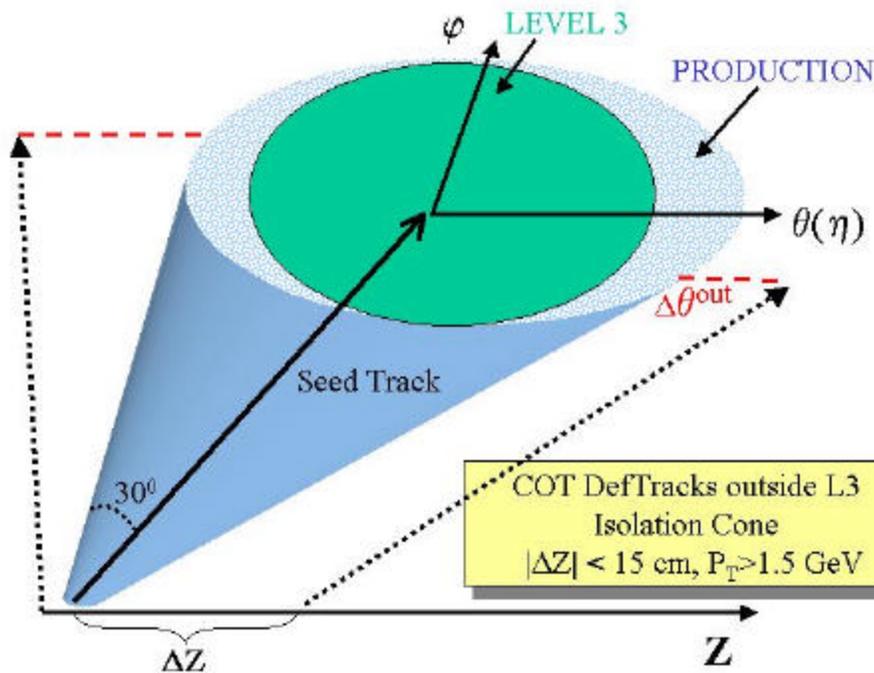
Red: cut is harder Blue: cut is softer

Conventional wisdom: L3 cuts should be softer

q^{out} Definition

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θ^{out} is like θ^{in} , only for tracks outside Tau isolation cone.
Now L3 and PROD have different cones.



Pick COT DefTracks outside the isolation cone,
 $P_T > 1.5 \text{ GeV}$, and $|\Delta Z| < 15 \text{ cm}$.
And find the closest to the border.

By requiring isolated Tau offline, we do not get tracks close to the isolation cone at L3, so for now we do not use this variable