High Mass Tau Tau in CDF Run 2

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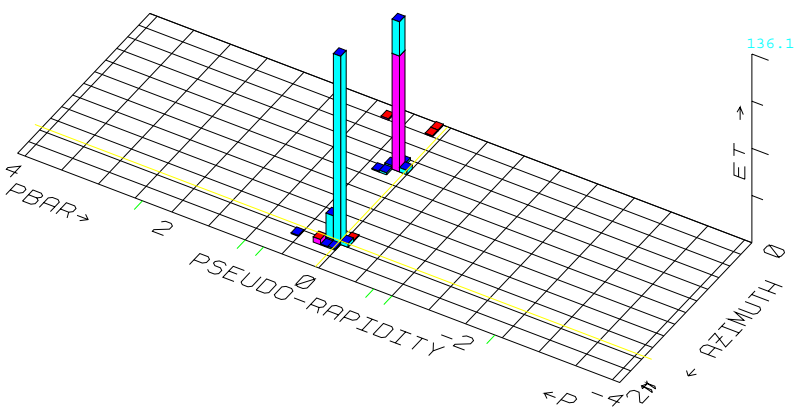
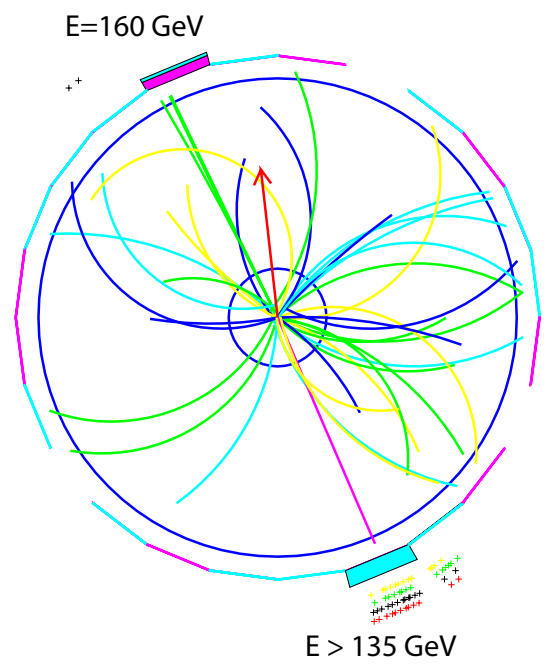
Motivation for Analysis

- Search for $Z' \to \tau\tau$, $A \to \tau\tau$ ...
- An amazing Run 1 ditau event





Method of Analysis

- Look at three final states: $\tau_e\tau_h$, $\tau_\mu\tau_h$, $\tau_h\tau_h$ (first time to look at $\tau_h\tau_h$ at hadron colliders)

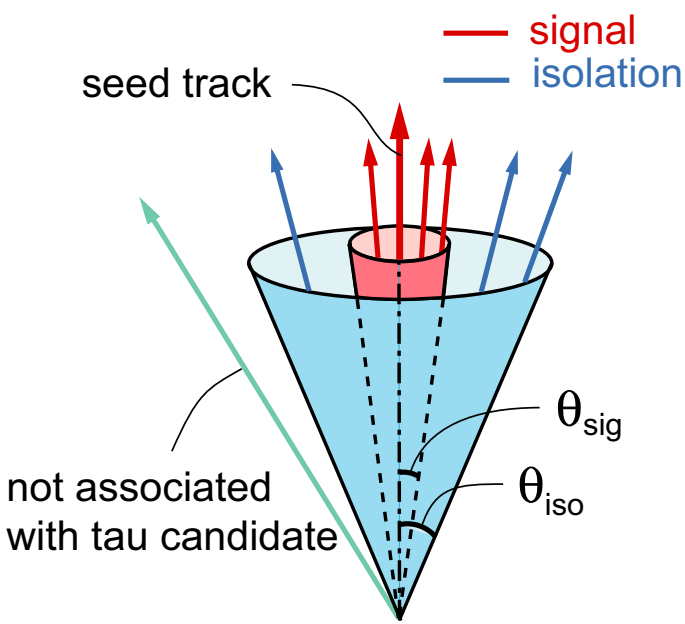
- Blind analysis: define $m_{\text{vis}} = m(l, \tau, \not{E}_{\text{T}})$

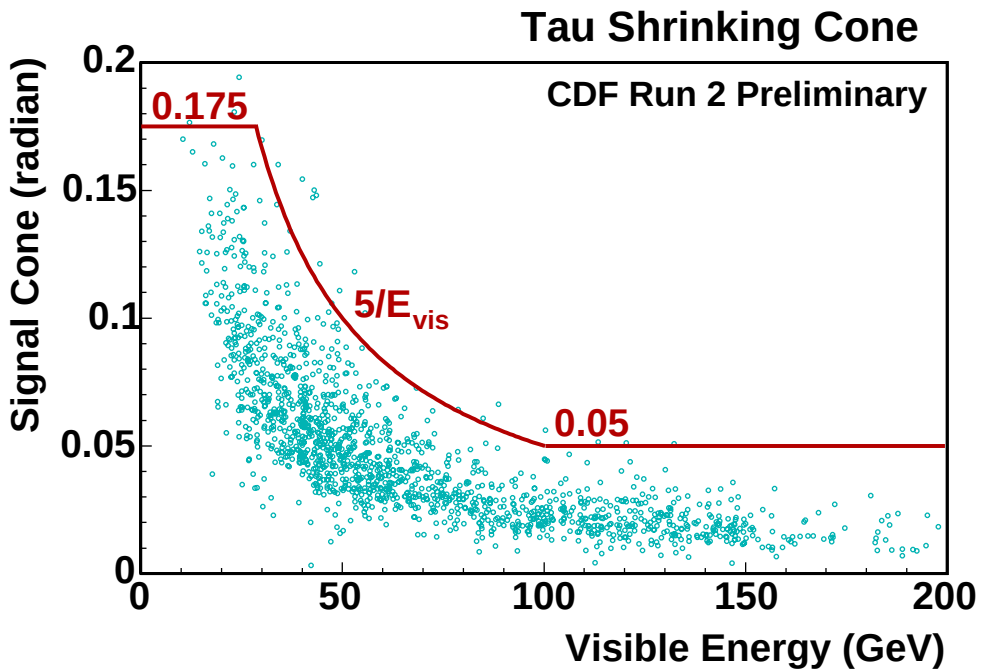
  - m_{vis} <120 GeV dominated by $Z/\gamma^* \to \tau\tau$ used as control region

  - m_{vis} >120 GeV defined as signal region

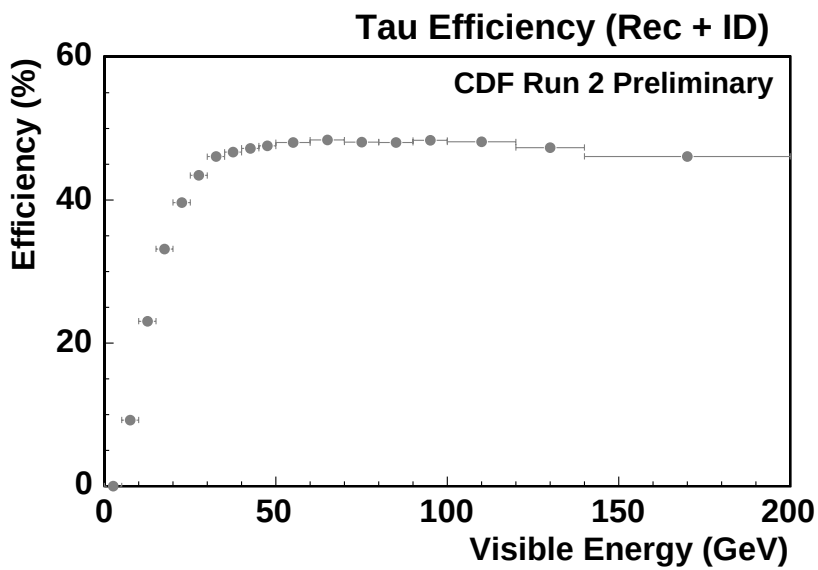
Tau Identification

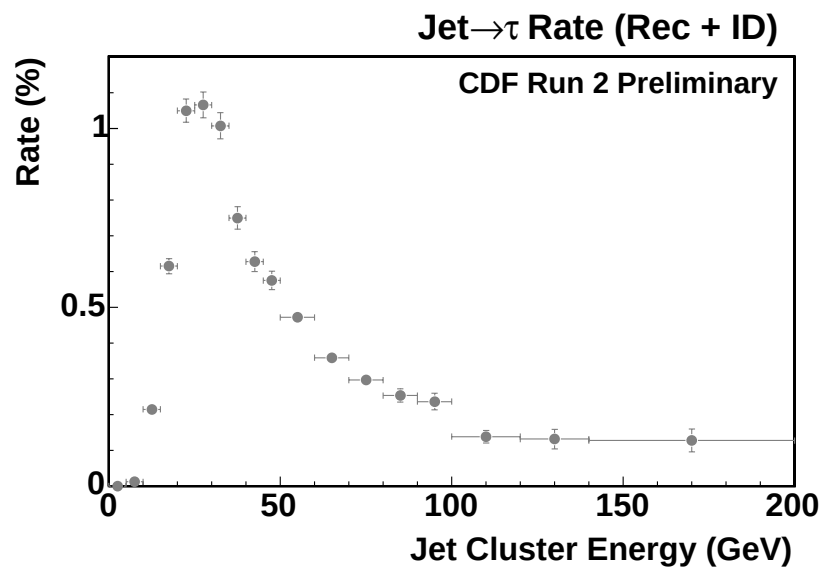
Definition of tau signal cone and isolation annulus





Tau ID Efficiency & Jet Misid. Rate





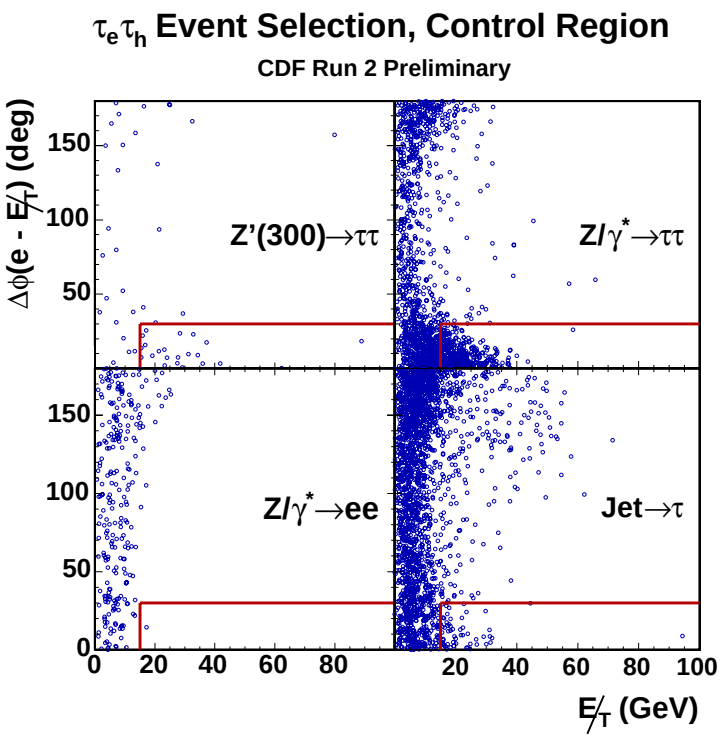
- Good tau ID efficiency
- Jet$\rightarrow \tau$ misidentification under control

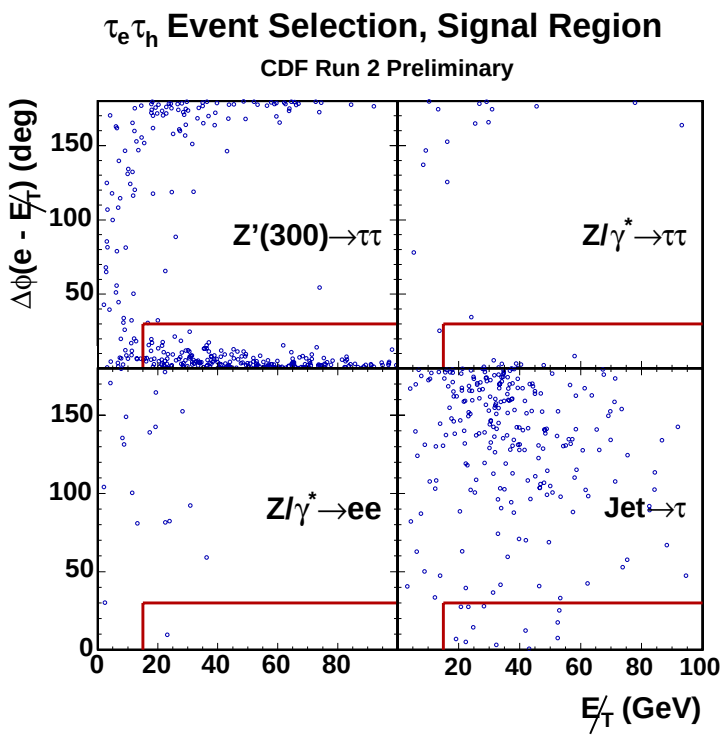
Data Sample & Event Selection

Channel	$\tau_e\tau_h$, $\tau_\mu\tau_h$	$\tau_h\tau_h$
Data sample	lepton + track	tau + $\not{E}_T$
Luminosity	195 pb^{-1}	72 pb^{-1}
Selection	P_T^{τ}(tracks + π^0s) >25 GeV/c E_T^e >10 GeV (P_T^{μ} >10 GeV/c)	$P_T^{\tau 1}$(tracks + π^0s) >25 GeV/c $P_T^{\tau 2}$(tracks + π^0s) >10 GeV/c

Kinematic Cuts

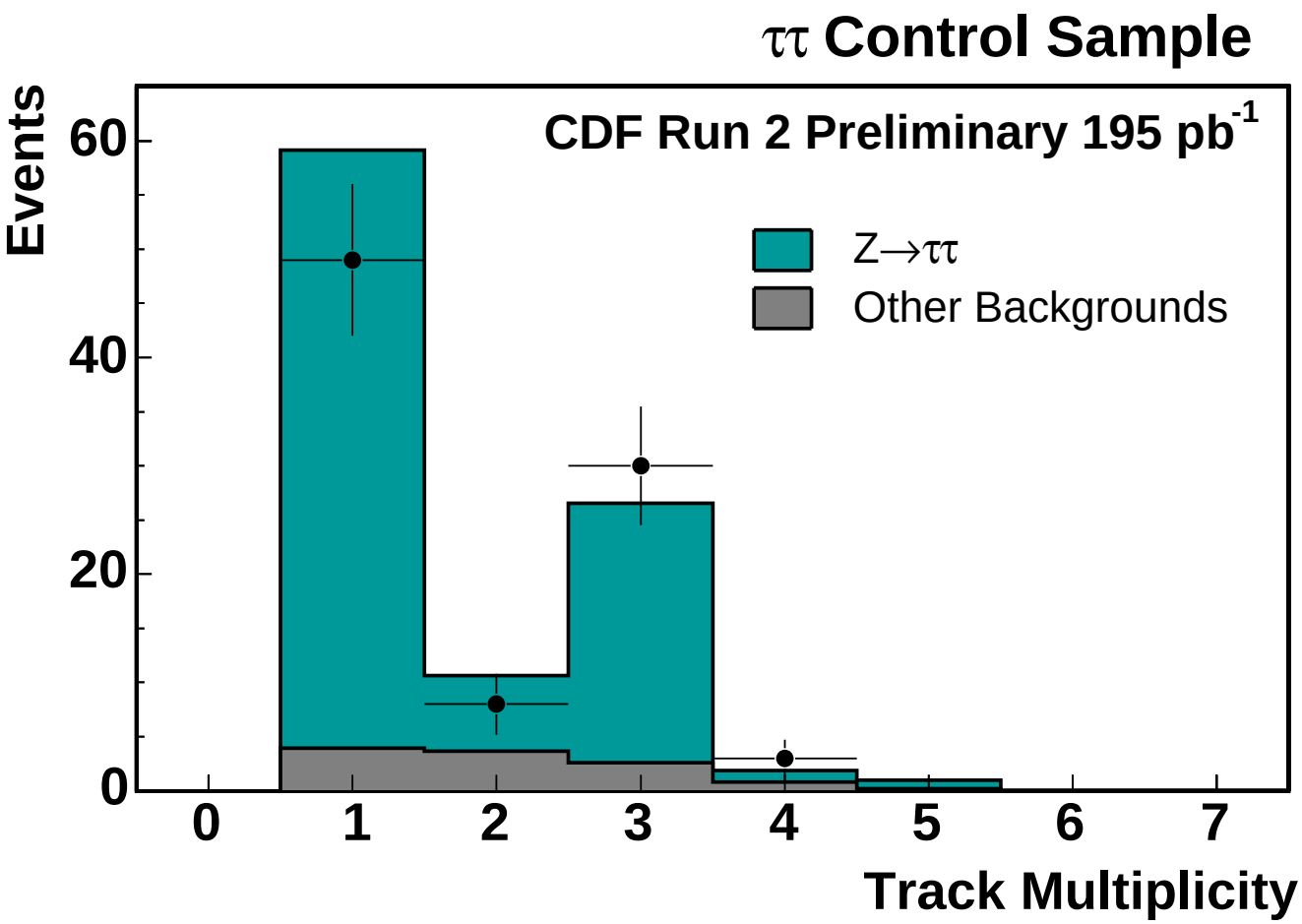
- $\Delta\phi(l - \not{E}_{\mathrm{T}}) < 30^{\circ}$, $l = e, \mu$, or lower-P_{T} τ for $\tau_h\tau_h$
- $\not{E}_{\mathrm{T}}$ >15 (25) GeV for $\tau_e\tau_h$, $\tau_\mu\tau_h$ ($\tau_h\tau_h$)





Control Region: $m_{\text{vis}} < 120$ GeV

Tau Signature in Control Region

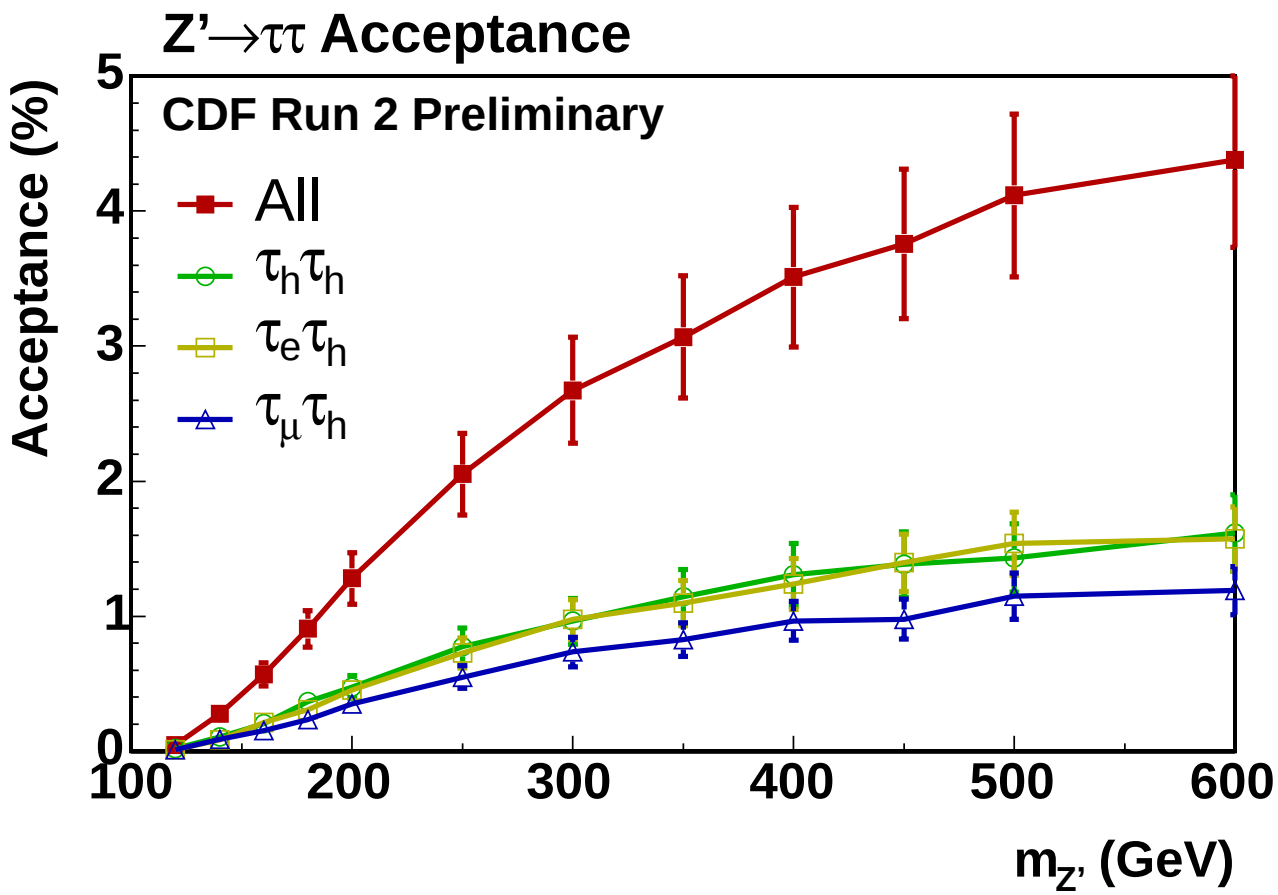


Predicted & Observed Events in Control Region

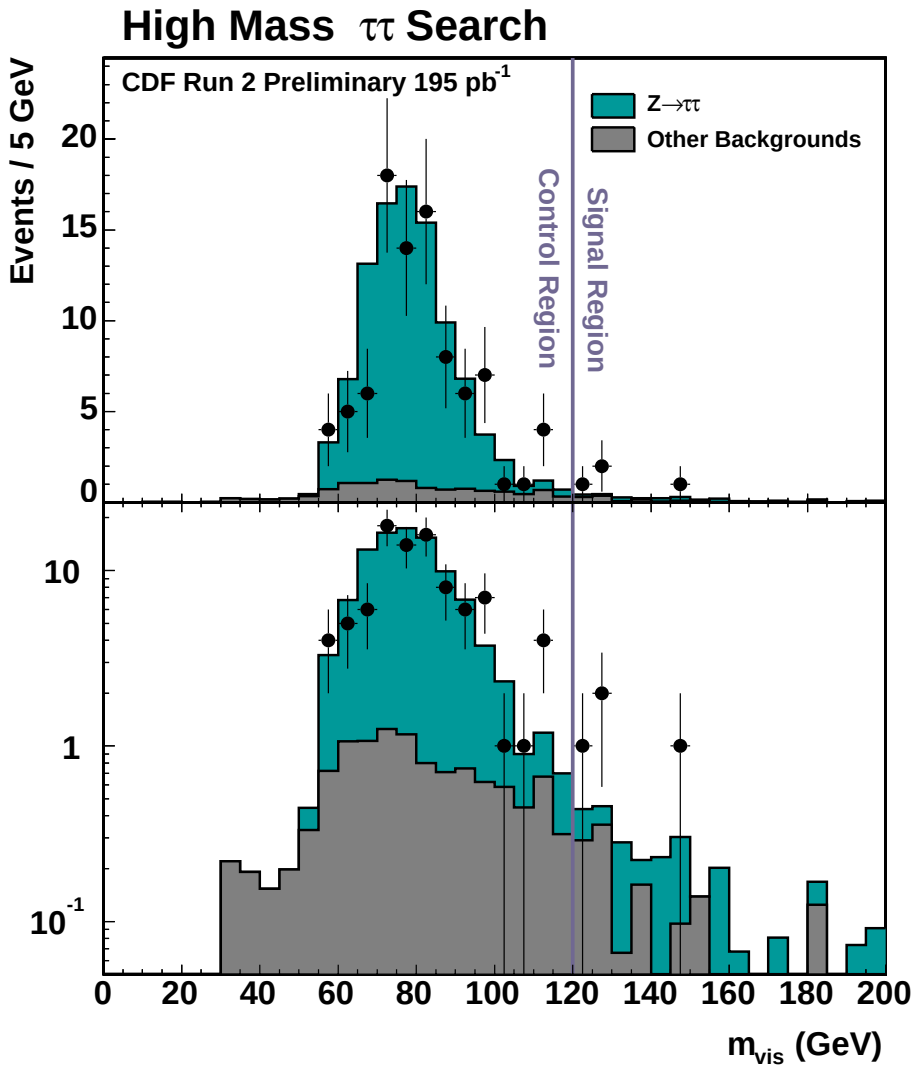
Source	$\tau_e\tau_h$	$\tau_\mu\tau_h$	$\tau_h\tau_h$	Total
$Z/\gamma^* \to \tau\tau$	45.36±6.84	38.39±5.72	4.19±0.77	87.94±12.38
$Z/\gamma^* \to ee$	0.14±0.14	0	0	0.14± 0.14
$Z/\gamma^* \to \mu\mu$	0	0.48±0.25	0	0.48± 0.25
Jet→ τ	3.83±1.03	3.72±0.88	3.16±0.55	10.71± 1.46
Total	49.32±6.94	42.59±5.85	7.35±0.95	99.27±12.55
Observed	46	36	8	90

Signal Region: $m_{\mathrm{vis}} > 120$ GeV

$Z' \to \tau\tau$ Acceptance



Opening The Box ...



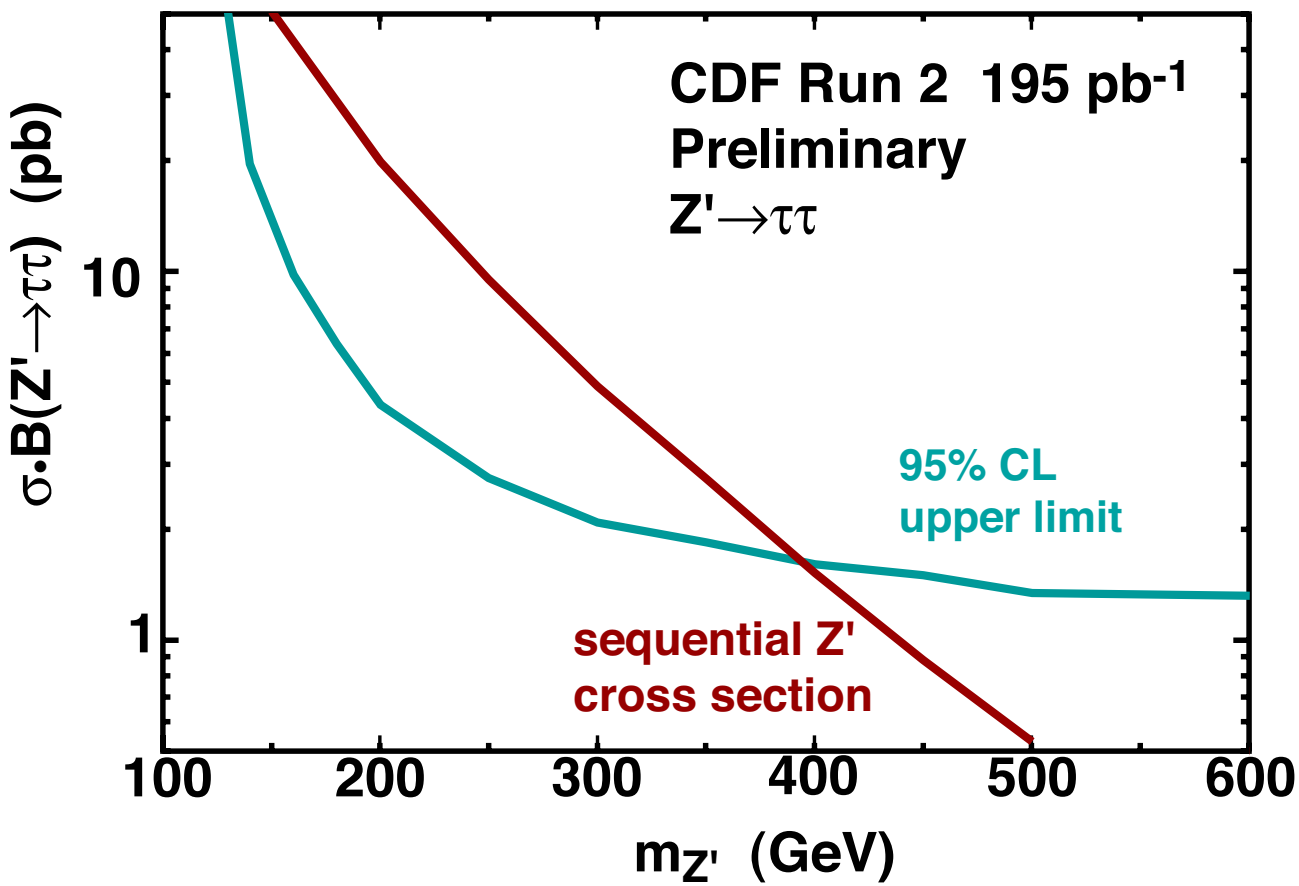
Backgrounds & Observed Events in Signal Region

Source	$\tau_e\tau_h$	$\tau_\mu\tau_h$	$\tau_h\tau_h$	Total
$Z/\gamma^* \to \tau\tau$	0.56±0.11	0.50±0.10	0.36±0.08	1.42±0.23
$Z/\gamma^* \to ee$	0.16±0.14	0	0	0.16±0.14
$Z/\gamma^* \to \mu\mu$	0	0.50±0.26	0	0.50±0.26
Jet$\to \tau$	0.29±0.14	0.18±0.09	0.28±0.10	0.75±0.19
Total Bkgd	1.01±0.24	1.18±0.30	0.64±0.13	2.83±0.46
Observed	4	0	0	4

Systematic Uncertainties

	Uncertainty (%)	Applies to:
PDF	8	All channels
Luminosity	6	All channels
e ID	5	$\tau_e \tau_h$
μ ID	5	$\tau_\mu \tau_h$
τ ID	10	All channels
$\not{E}_{\mathrm{T}}$	6	All channels
Jet$\rightarrow \tau$ fake rate	20	All channels

Result


CDF Run 2 195 pb-1
Preliminary
Z'→ττ
95% CL
upper limit
sequential Z'
cross section
σ•B(Z'→ττ) (pb)
10
1
100
200
300
400
500
600
mZ' (GeV)

Summary

- Performed blind search for high mass $\tau\tau$
- No significant excess of events oberserved
- Sequential Z' with SM couplings with $m_{Z'}$ <394 GeV is excluded at 95% CL
- Will add new interpretations for $Z' \to \tau\tau$ at the Tevatron (Carena, Daleo, Dobrescu, Tait, hep-ph/0408098)
- Will add $A \to \tau\tau$ ...