Searches For New Phenomena

(PRELIMINARY RESULTS)

Serban Protopopescu

Brookhaven National Laboratory

for DØ collaboration

FNAL

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OUTLINE

- DØ detector
- Models beyond SM
- Jets + $\not\!\!E_T$ channel
- τ channel
- ee and $\gamma\gamma$ channels
  - ee+ℓ SUSY search
  - $\gamma\gamma$ SUSY search
  - Extra Dimensions
  - Z' mass limit

- $\mu\mu$ channel
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  - 2nd generation lepto-quarks
- $e\mu$ channel
  - General search
  - SUSY search
- Conclusions

Models beyond SM

SM enormously succesful. No experimental observations show convincing deviations so far. Nevertheless, there is a general consensus that SM is incomplete. For the next 5-6 years the Tevatron is best place to look for deviations from SM.

Supersymmetric models (SUSY) requiring partners between fundamental bosons and fermions are current favorite extensions to SM.

g	$\tilde{g}$
q (b,t)	$\tilde{q}$ ($\tilde{b}$, $\tilde{t}$)
$e,\ \mu,\ \tau$	$\tilde{e},\ \tilde{\mu},\ \tilde{\tau}$
$\nu_e,\ \nu_\mu,\ \nu_\tau$	$\tilde{\nu}_e,\ \tilde{\nu}_\mu,\ \tilde{\nu}_\tau$
$W,\ Z,\ \gamma$	$\tilde{W},\ \tilde{Z},\ \tilde{\gamma}$
H	$\tilde{h}$
G	$\tilde{G}$

No definitive predictions on masses, large no. of parameters.

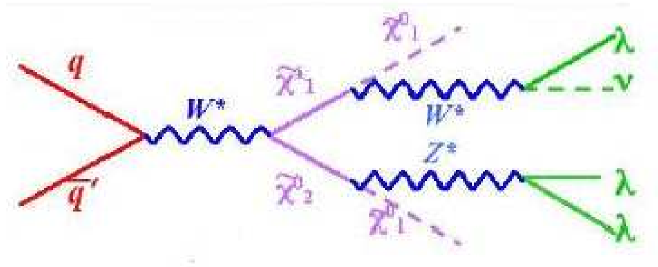
3rd generation $\tilde{q}$ and $\tilde{\ell}$ could be lighter than the others.

If $\tilde{g}$ and $\tilde{q}$ are light enough SUSY events in hadron colliders dominated by their production in pairs. In SUGRA Models the LSP is $\tilde{\chi}_1^0$. The typical $\tilde{g}$ and $\tilde{q}$ decay chains generate $\tilde{\chi}$ particles which in turn decay to lighter $\tilde{\chi}$ particles, leptons and an LSP.

=> high jet multiplicity, multiple leptons and $\not\!\!E_T$

Detector requirements are high efficiency for detecting all lepton types (e's, μ's, τ's) and hermeticity to detect presence of ν's and $\tilde{\chi}_1^0$'s via $\not\!\!E_T$.

Limits on $\tilde{g}$ and $\tilde{q}$ masses at the Tevatron make it more likely that SUSY may be discovered via direct production of $\tilde{\chi}$ pairs



=> tri-lepton final states with $\not\!\!E_T$ but little jet activity.

Other new phenomena searched for so far in DØ Run II:

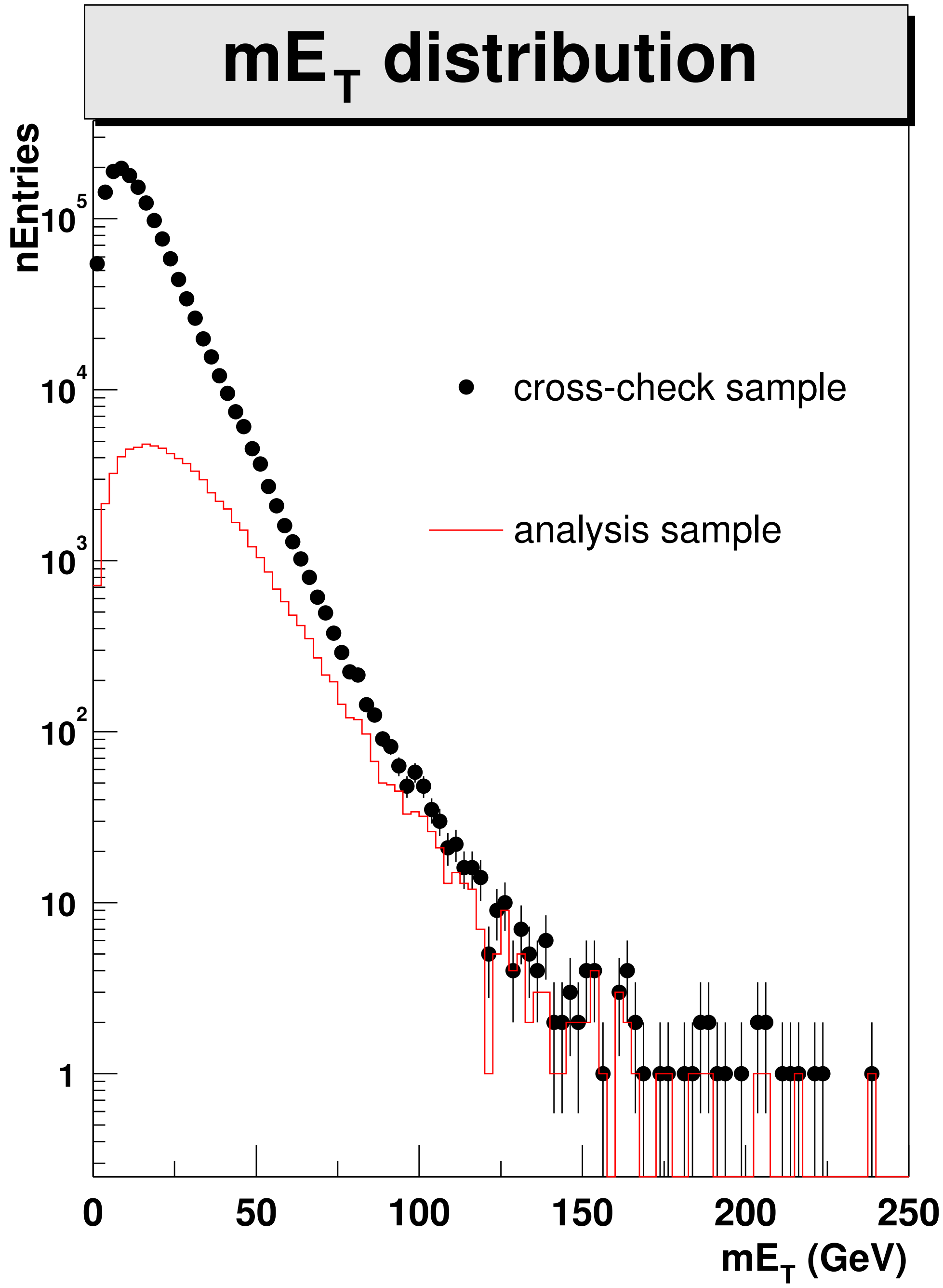
- Large Extra Dimensions: motivated by string theories and hierarchy problem with gravity
- Lepto-quarks: appear in extended gauge sector and composite models.
- Z': predicted by left-right symmetric model (restores parity symmetry at higher energy and accomodates small left-handed ν mass) and models with extra U(1).

Jets + $\not\!\!E_T$

Favored channel to look for $\tilde{g}$ or $\tilde{q}$. First DØ Run II look at this channel is based on a small subset of the data (4.1 pb^{-1}). The events were collected with:

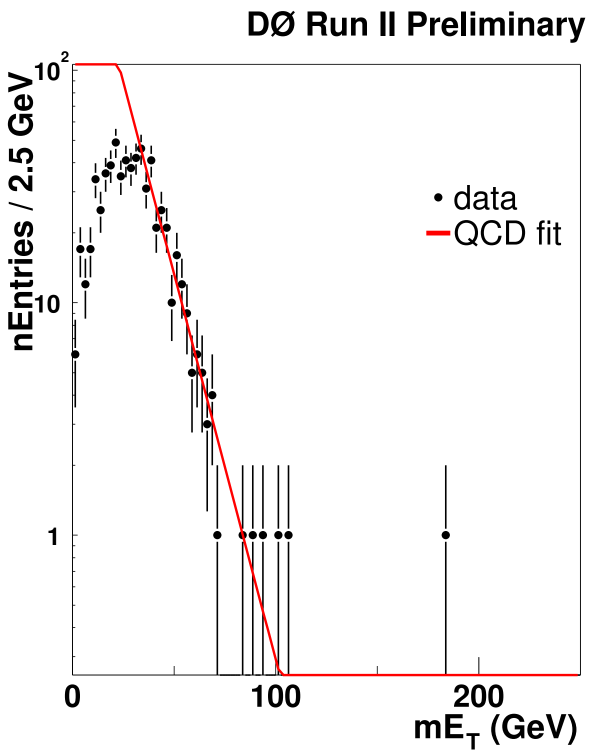
- a trigger requiring a jet with $pT > 65$ GeV (cone size 0.7) and $|\eta_{det}| < 0.8$ (JT_65TT).
- A control sample of data was taken with prescaled triggers requiring lower pT jets.
- Offline $p_T > 100$ GeV on leading jet, at which point the JT_65TT trigger is 100% efficient.
- $\not\!\!E_T$ calculated adding all calorimeter towers with $E > 200$ MeV.

Comparison of control and analysis samples



leading jet p_T

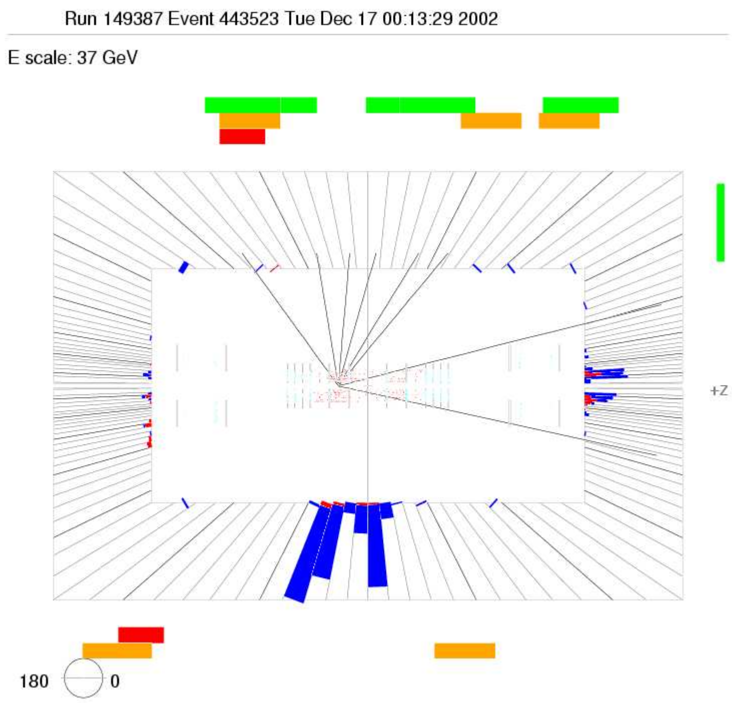
Topological cuts	analysis sample
Isolated lepton veto	10,751 (98.2%)
$\Delta\phi_{j_1,j_2} \leq 2.8$ rad	1,589 (15.1 %)
Jets and $\not\!\!E_T$ angular separation :	
$0.65 \leq \Delta\phi_{j1,\not E_T} \leq 2.9$ rad	1,266 (76.1 %)
$\Delta\phi_{j2,\not E_T} \geq 0.65$ rad	1,168 (50.3%)
$\Delta\phi_{j3,\not E_T} \geq 0.5$ rad	**653** (85.4 %)

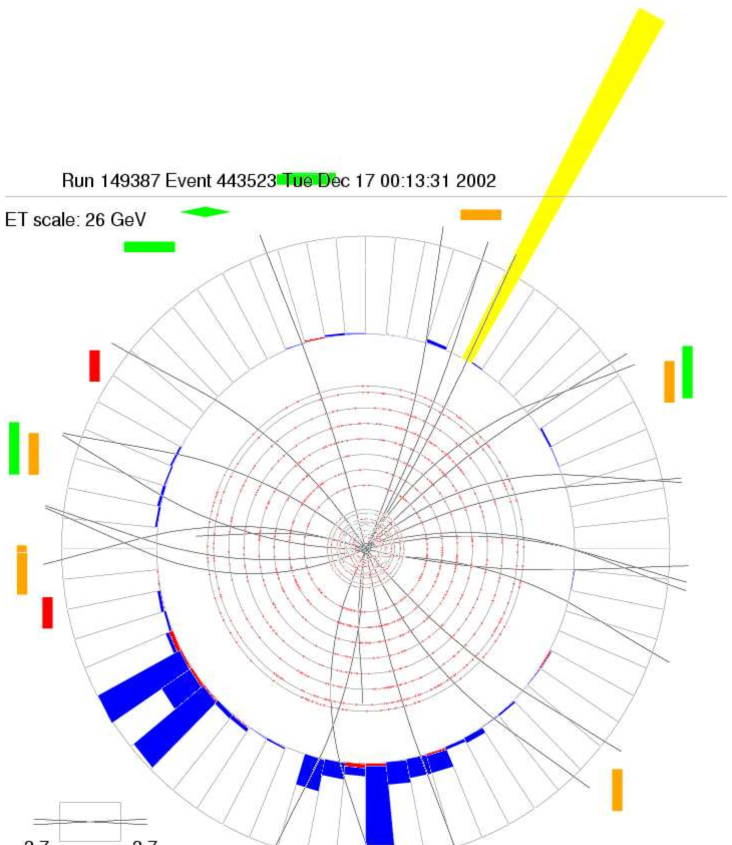


Fit $f(\not\!\!E_T) = a \cdot e^{b\not E_T}$ with $b < 0$.

	$\not\!\!E_T$ cut		
Backgrounds	$\geq$ 70 GeV	$\geq$ 80 GeV	$\geq$ 100 GeV
QCD (fit)	$17.37 \pm 7.90 \pm 2.74$	$8.49 \pm 4.98 \pm 1.73$	$2.02 \pm 1.72 \pm 0.58$
$W + jets$	0.63 ± 0.06	0.63 ± 0.06	0.63 ± 0.06
$Z + jets$	0.21 ± 0.02	0.21 ± 0.02	0.21 ± 0.02
$t\bar{t}$	0.16 ± 0.01	0.14 ± 0.01	0.09 ± 0.01
$dibosons$	0.03 ± 0.00	0.02 ± 0.00	0.01 ± 0.00
$total$	$18.39 \pm 7.90 \pm 2.74$	$9.49 \pm 4.98 \pm 1.73$	$2.66 \pm 1.72 \pm 0.58$
Data	7	6	3

This analysis (based on a small subset of the data) demonstrates $\not\!\!E_T$ is well understood.

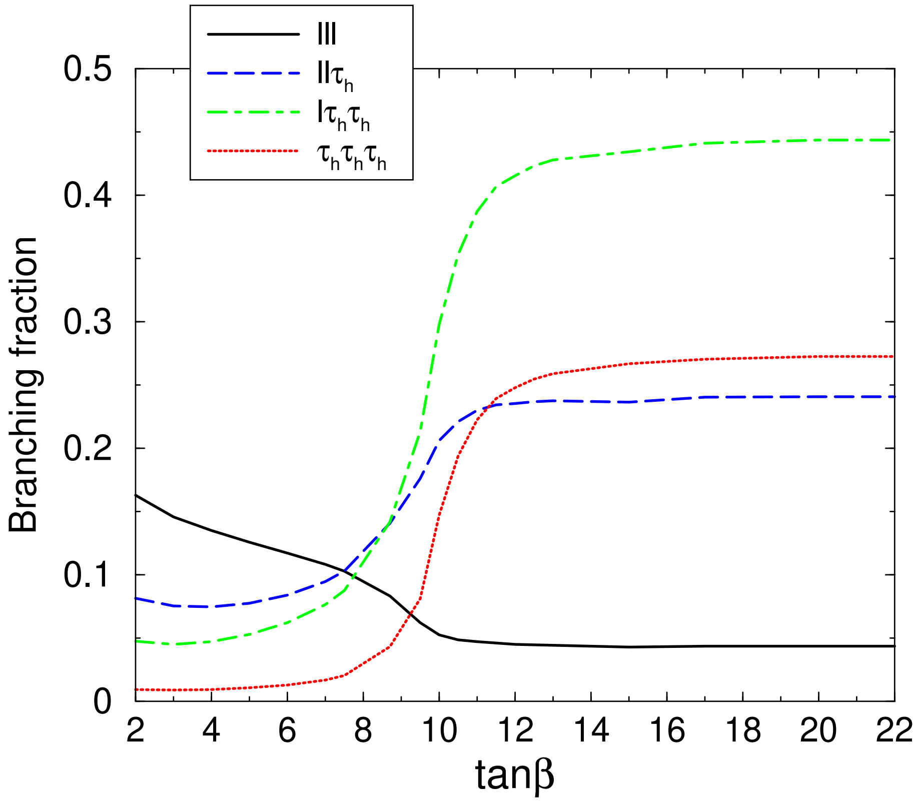




event with highest $\not\!\!E_T$, 180 GeV

τ channels

Branching fraction of $\tilde{\chi}^{\pm}\tilde{\chi}_2^0$ into final states with e, μ (ℓ) or hadronic τ's (τ_h):



For $tan\beta \geq 8$ the two-body decays

$$\tilde{\chi}_2^0 \rightarrow \tau\tilde{\tau}, \;\; \tilde{\chi}^{\pm} \rightarrow \nu\tilde{\tau}$$

begin to go on shell => final states dominated by τ's.

Observation of $Z \to \ell\tau_h$

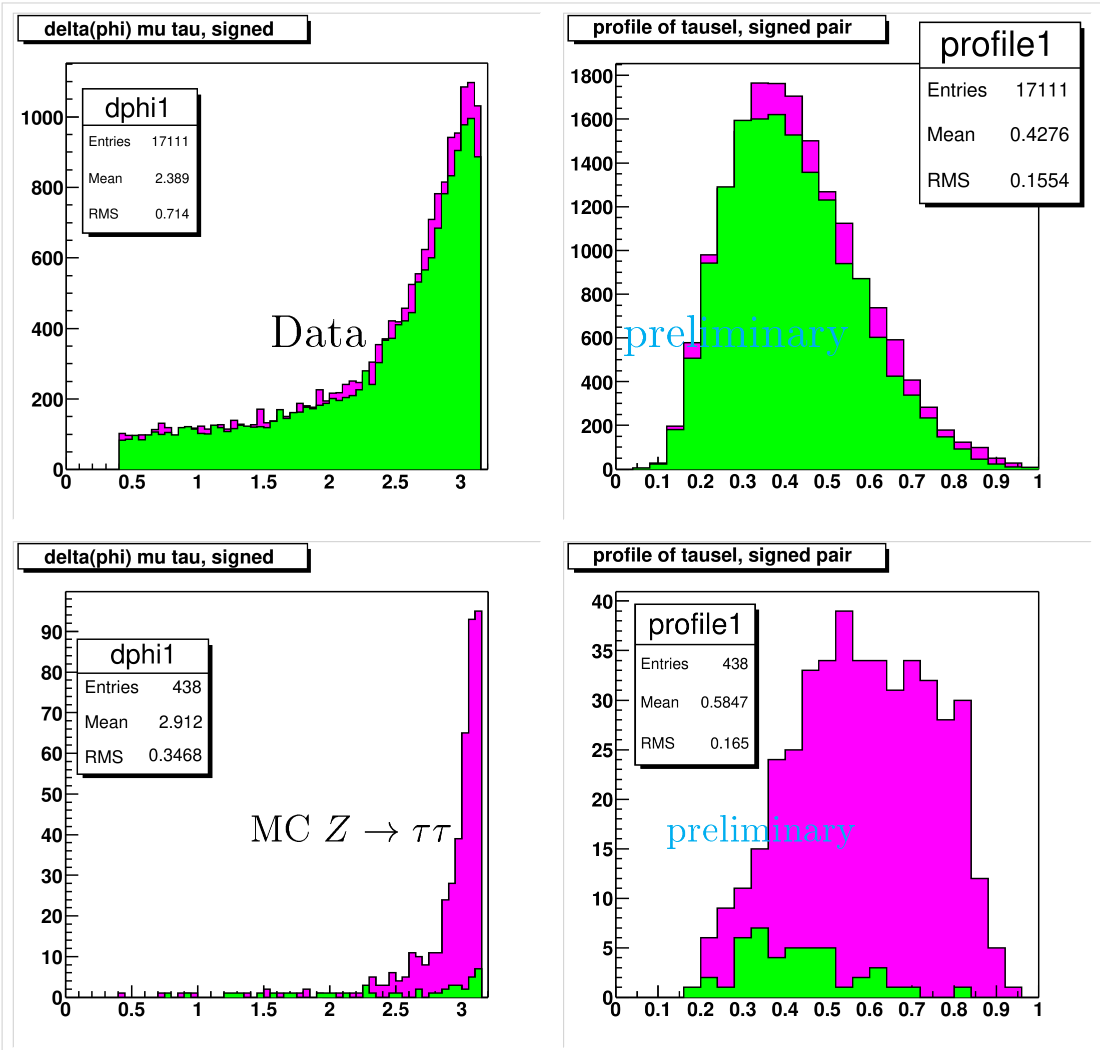
$Z \to \tau\tau \to \mu\tau_h$:

Start from event sample with

- a single μ, p_T^μ >7 GeV
- a loose τ candidate: (cal. cluster R=0.4, R_{rms} <0.25, at least 1 track)
- $|\phi^\mu - \phi^\tau|$ >0.4

opposite sign μ τ

equal sign μ τ

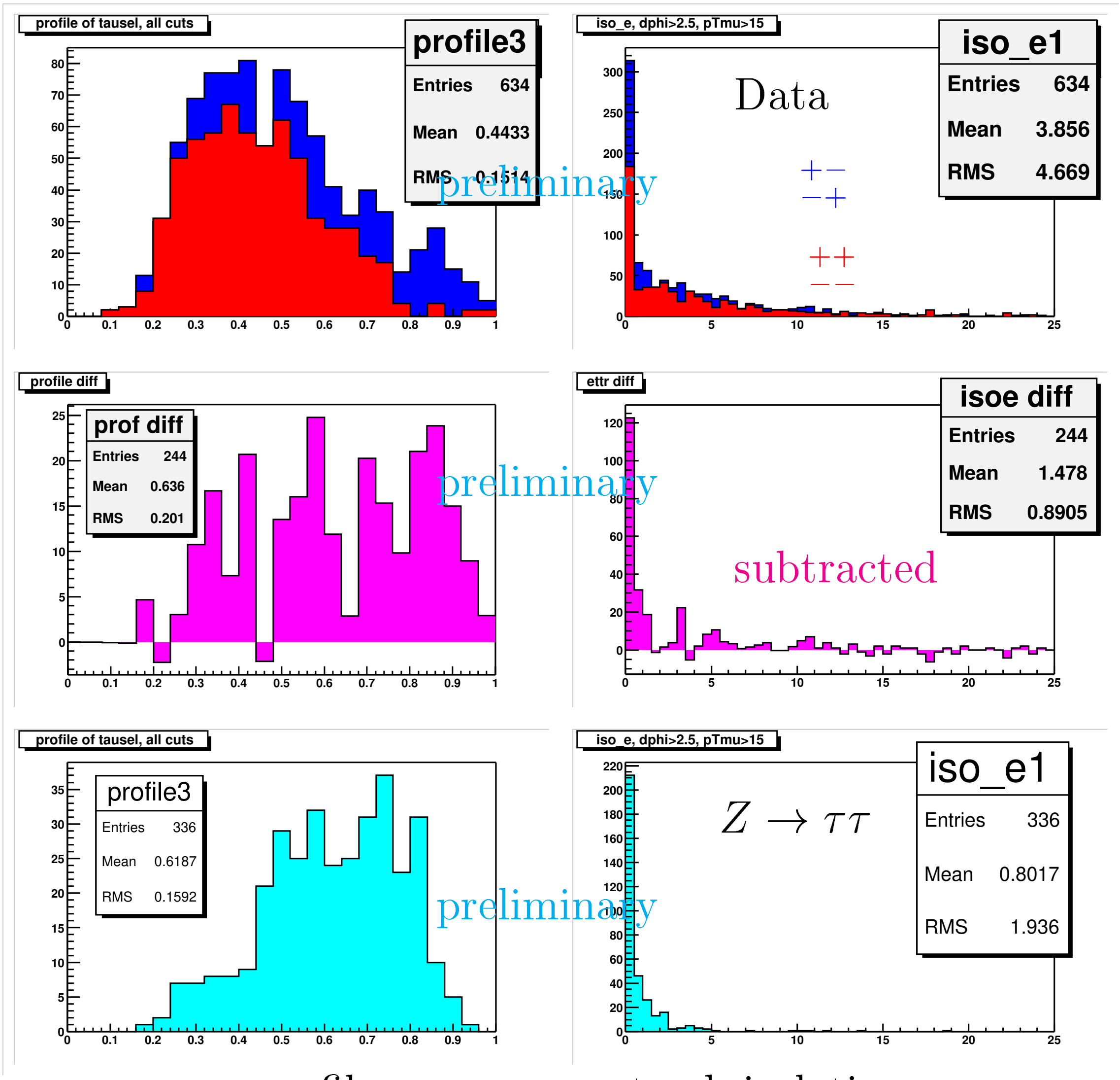


$\Delta\phi(\mu\tau)$ τ-profile

τ-profile$\equiv$ (Σ 2 highest E$_T$ towers)$/E_T^\tau$

τ-profile and track isolation Distributions

Cut:$\Delta\phi(\mu\tau) > 2.5$ & $p_T^\mu > 15$ GeV & 1 track τ



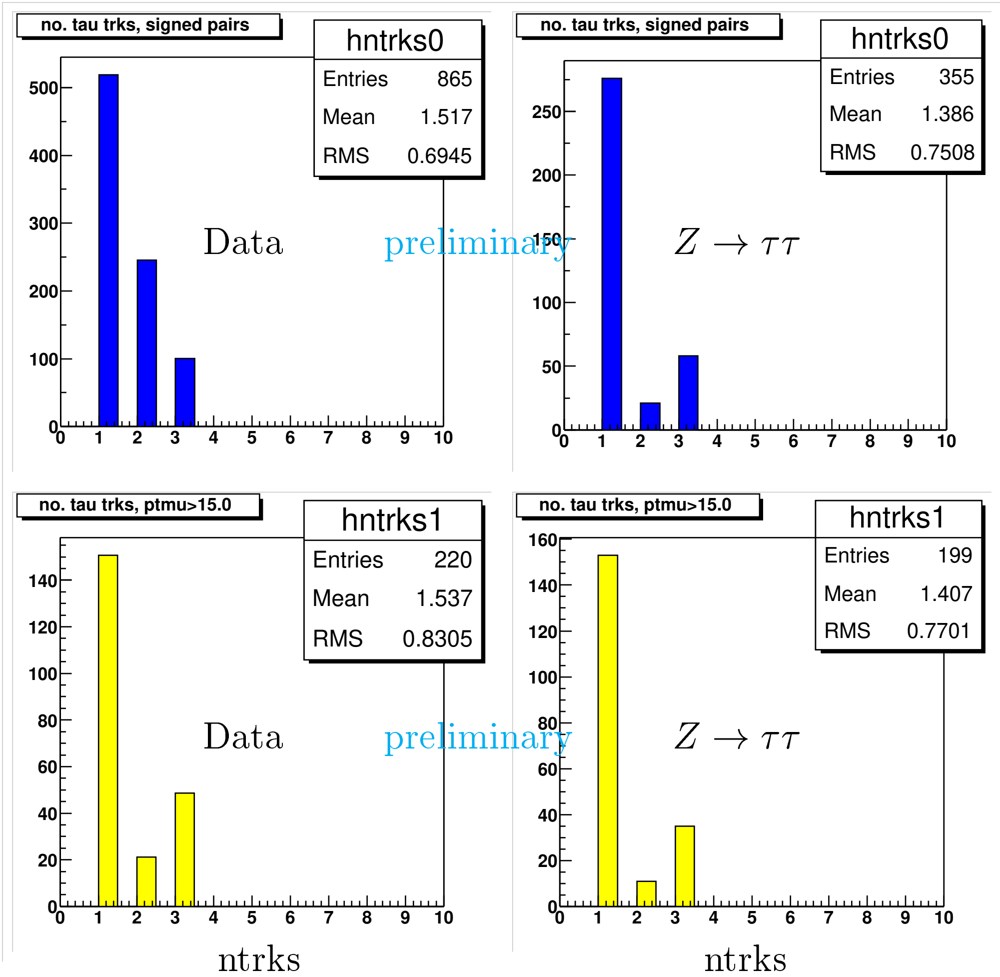
τ-profile track isolation

subracted$\equiv$ $\binom{+-}{-+}$ - 1.04* $\binom{++}{--}$

NTracks≡ no. consistent with τ-mass

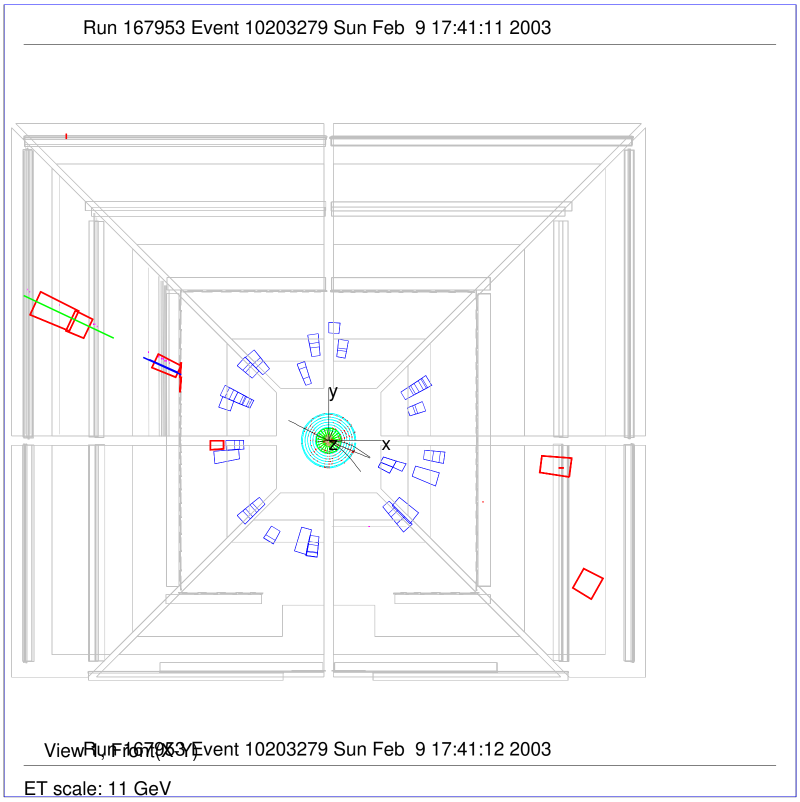
ntrks≡ Ntracks($^{+-}_{-+}$) - NTracks($^{++}_{--}$)

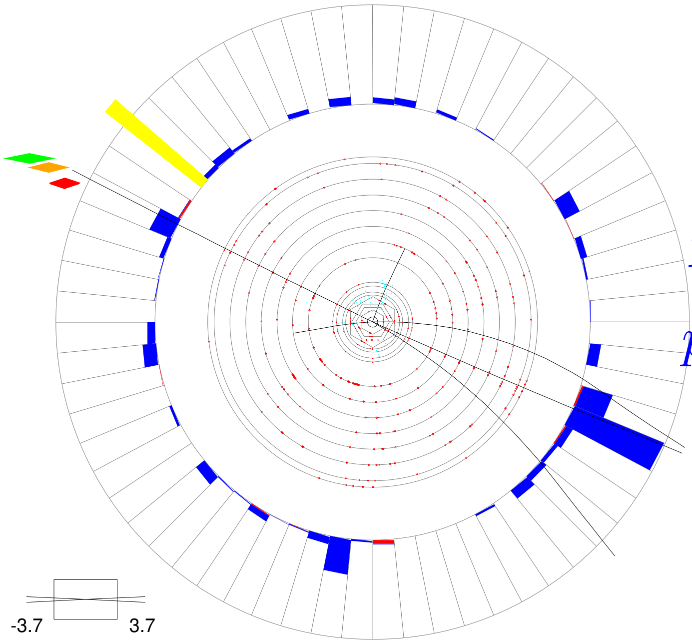
$p_T^{\mu} > 7$ GeV



p_T^{μ} >15 GeV, $|\phi_\mu - \phi_\tau|$ >2.5

$Z \to \tau\tau \to \mu\tau_h$ event





p_T^{μ} =25 GeV

$p_T^{\tau_h}$ =14 GeV

$Z \to \tau\tau \to e\tau_h$

Selected events with

- isolated e's $p_T > 15$ GeV and τ
- 1-prong τ candidates $p_T^{\tau} > 7$ GeV
- $M(e, \not\!\!E_T) < 60$ GeV (suppress W+jet)
- $M(e, \tau) < 60$ GeV (suppress $Z \to ee$)

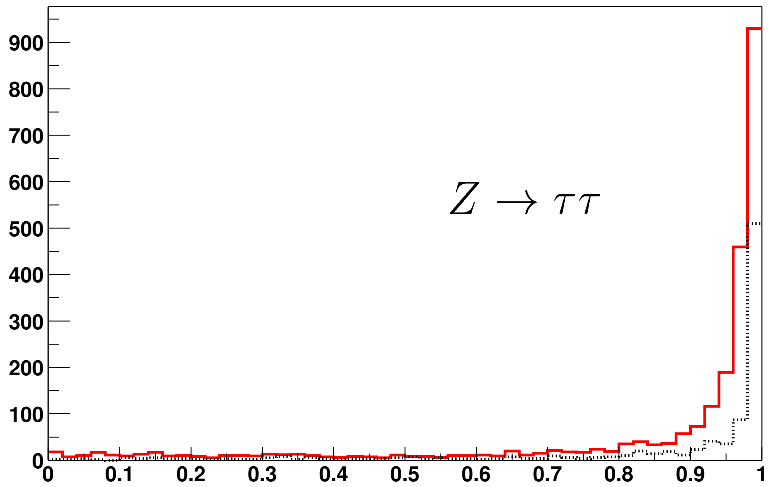
Separate τ candidates into 2 types:

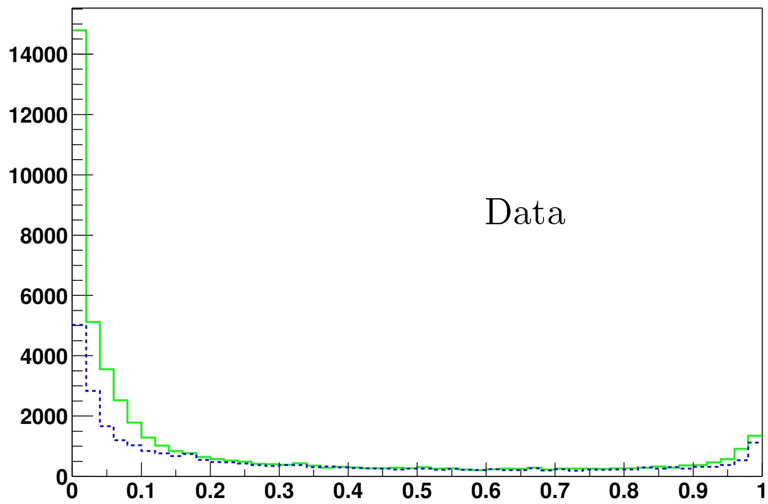
- type 1 1-prong and no EM clusters
- type 2 1-prong with EM clusters

Use different neural networks (NN) to characterize each type.

NN distributions

type 1 type 2





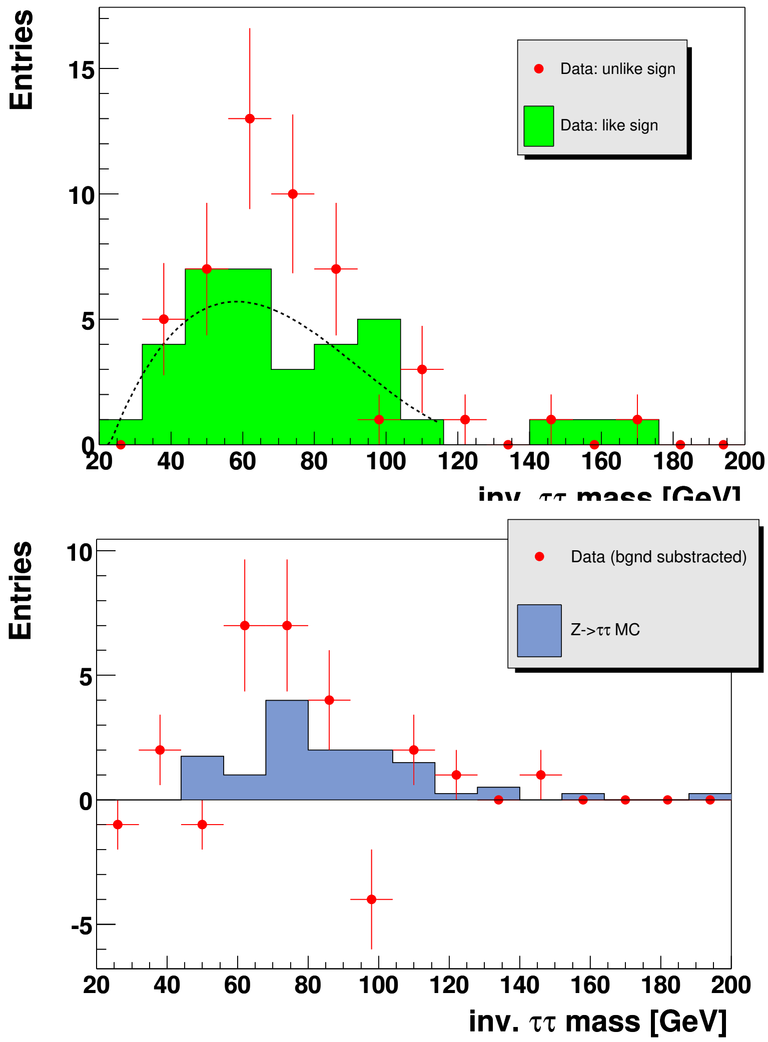
type 1 type 2

Calculated Z-mass

NN>0.95, $|\phi_e - \phi_\tau|$ <2.88

τ-momenta corrected with $\not\!\!E_T$ components

correction must increase p_τ and not change sign



14±9 events after subtraction

ee and $\gamma\gamma$ channel

Analyses in these channels used a sample of events with either single- or di-EM object triggers (no track requirements). Trigger efficiencies >90%. Reconstruction efficiencies are estimated using the $Z \to ee$ events observed in the data.

e and γ id require cal. clusters with

- em fraction > 0.90
- isolation<0.15 $\equiv (E(\Delta R = 0.4) - E(\Delta R = 0.2))/E((\Delta R = 0.2)$
- $\chi^2_H < 20$ 8 parameters: energy fractions in calorimeter layers, ϕ_{rms}, η_{rms} and vertex z

Efficiency estimated from Z sample at 85±3.6 ± 4.6%

e requires a track-cal. cluster matching:

$$\chi^2_{match} = (\delta\phi/\sigma_\phi)^2 + (\delta z/\sigma_z)^2 + ((E_T/p_T - 1)/\sigma_{E/p})^2$$

γ require no track within $\Delta\phi$ of 50 mrad

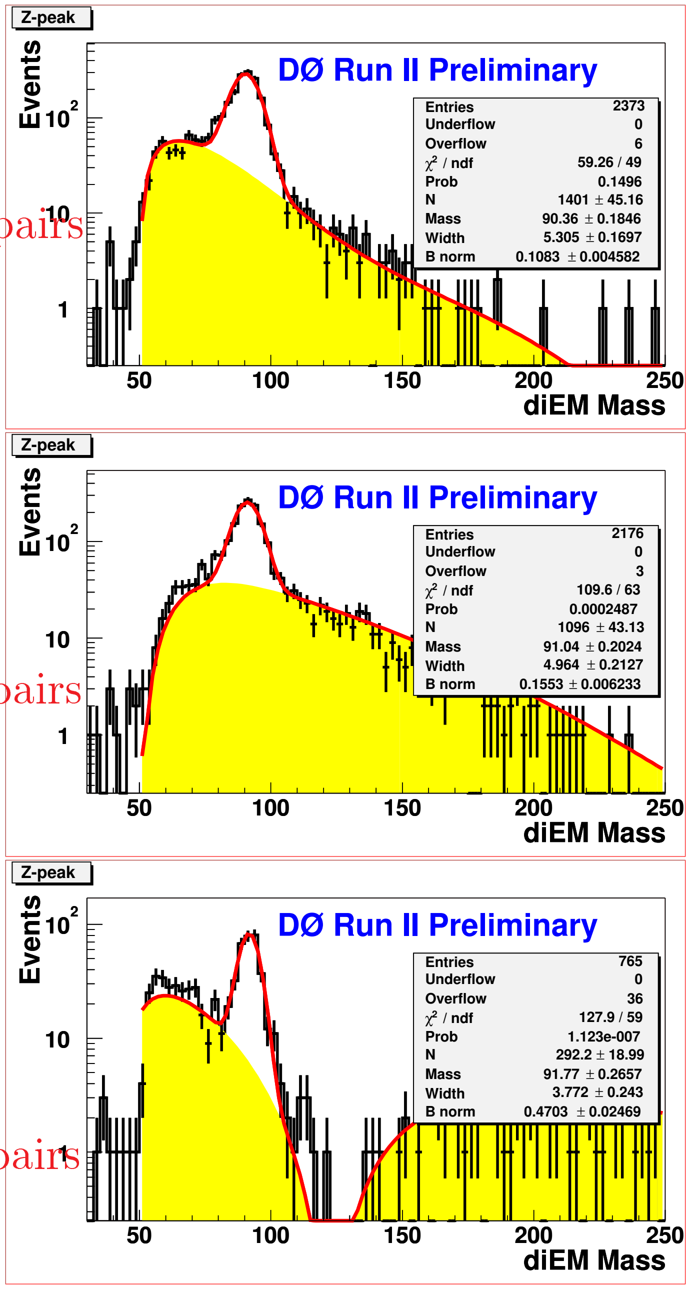
Depending on matching criteria the track matching efficiency varies from 70% to 89%.

Di-EM Mass Distributions, E_T^{EM} >25 GeV

CC-CC pairs

CC-EC pairs

EC-EC pairs

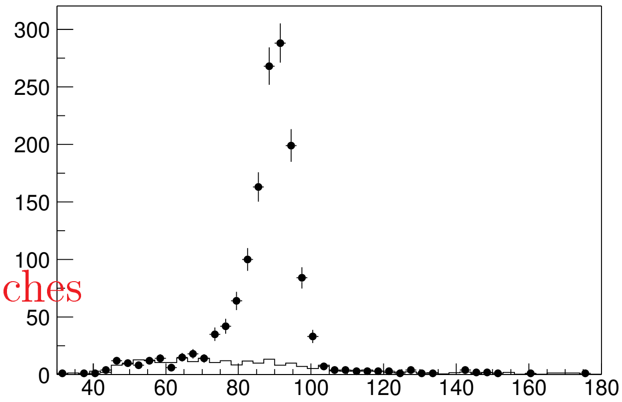


CC≡central calorimeter, EC≡end calorimeter

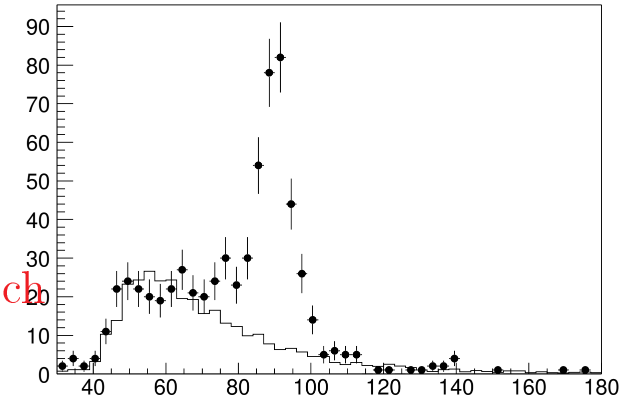
Fit gaussian + polynomial

Di-EM Mass Distributions

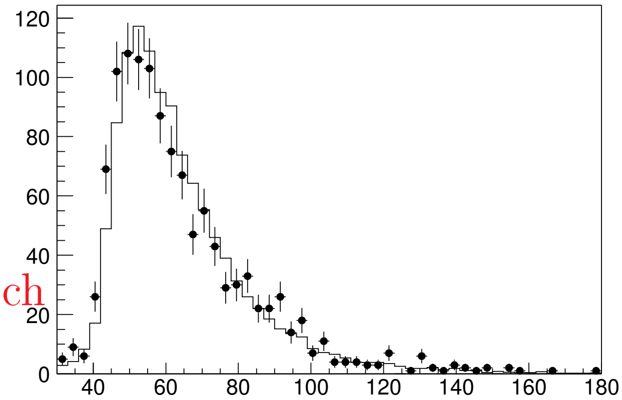
2 trk matches



1 trk match



0 trk match



ee SUSY search

Search for final states

$$p\bar{p} \to \tilde{\chi}^{\pm}\tilde{\chi}^{0}_{2} \to \ell ee\nu\tilde{\chi}^{0}_{1}\tilde{\chi}^{0}_{1}$$

The final states have relatively low pT e's and $\not{E}_T$.

SUGRA (Supergravity models): gauge couplings unify at a GUT scale => SUSY breaking with universal soft breaking terms related to EW scale by renormalization group. Minimal SUGRA appealing as it predicts masses and branching ratios from small no. of parameters.

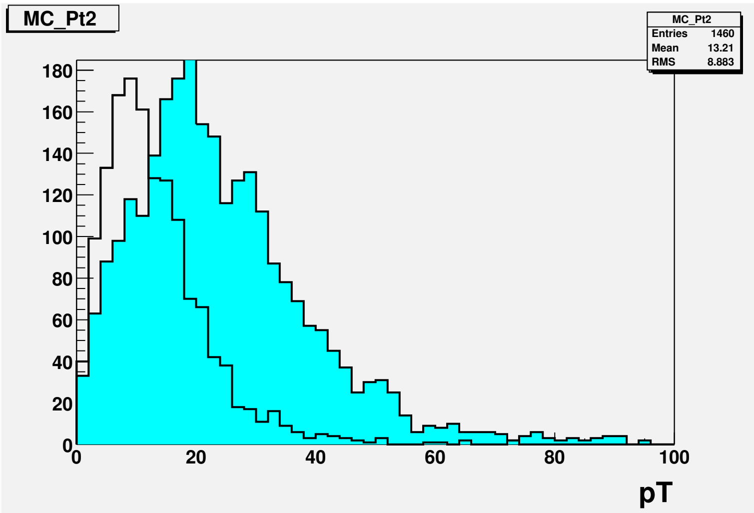
Minimal SUGRA models can be specified by 5 parameters:

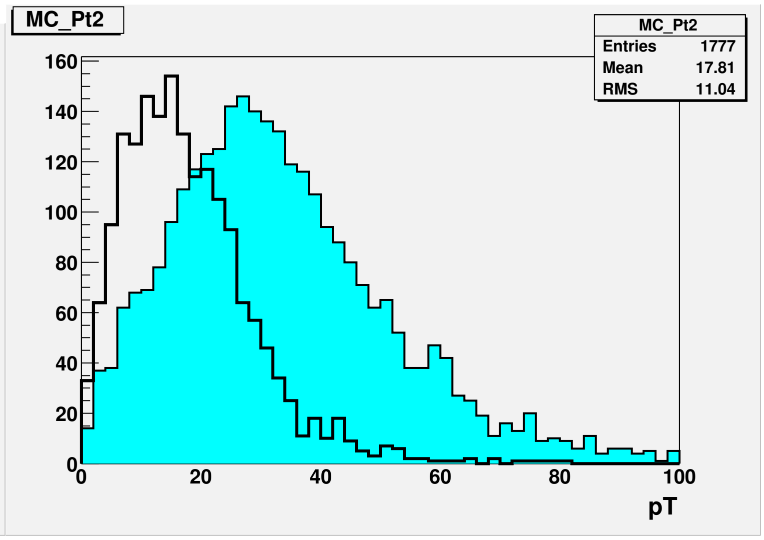
- m_0: scalar mass at GUT scale
- $m_{1/2}$: gaugino mass at GUT scale
- A_0: soft trilinear SUSY breaking parameter at GUT scale
- $tan\beta$: ratio of the Higgs vacuum expectation values at EW scale
- sign$\mu = \pm 1$: sign of the Higgsino mass term

neutral gauginos ($\tilde{\chi}_0$) are mixtures of $\tilde{Z}$,$\tilde{\gamma}$ and $\tilde{h}$, and the charged gauginos($\tilde{\chi}^{\pm}$) mixtures of $\tilde{W}^{\pm}$ and $\tilde{h}^{\pm}$. The lightest SUSY particle (LSP) is $\tilde{\chi}^0_1$.

Pick 2 points to compare to data (at $\tan\beta = 2$, signμ=-1)

p_T of leading and next-to-leading e's





$m_{\tilde{\chi}^{\pm}} \approx m_{\tilde{\chi}^0_2} \approx 2m_{\tilde{\chi}^0_1} \approx 90$ GeV

(Pt1)

$m_{\tilde{\chi}^{\pm}} \approx m_{\tilde{\chi}^0_2} \approx 2m_{\tilde{\chi}^0_1} \approx 125$ GeV

(Pt2)

The integrated luminosity of the sample= 42 pb^{-1}.

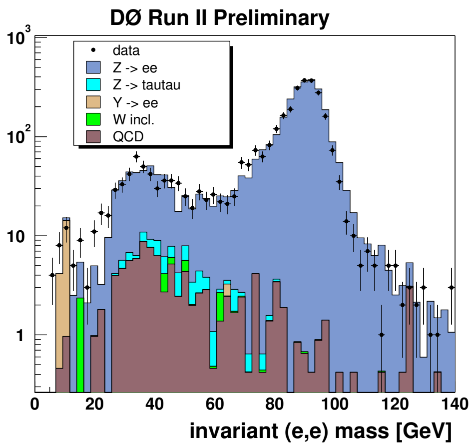
75% of triggered electrons pass isolation cuts and track matching.

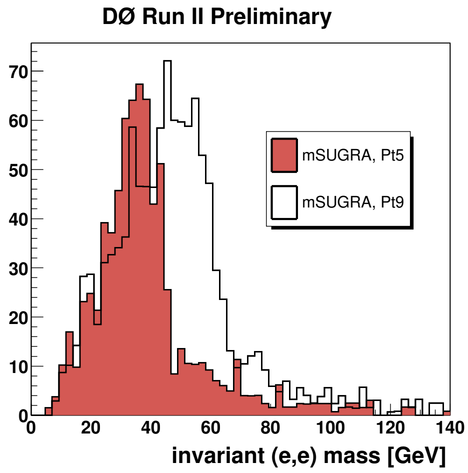
Reduce background events with following cuts:

1. at least 2 e's: leading e $p_T > 15$ GeV, 2nd e $p_T > 10$ GeV
2. $10 < M(ee) < 70$ GeV
3. $M_T(e, \not\!\!E_T) > 15$ GeV
4. a 3rd isolated track, $P_T > 5$ GeV, $|\eta| < 3.0$
5. $\not\!\!E_T > 15$ GeV

Cut 4 is a general signature for a 3rd lepton (e, μ, τ) After cut 5 signal efficiency ($\epsilon(3\ell)$) is 1.99(±0.12)% for Pt1 and 3.27(±0.15)% for Pt2.

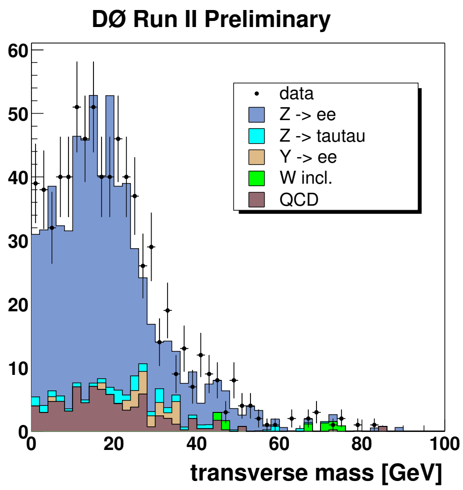
$M(ee)$ after Cut 1

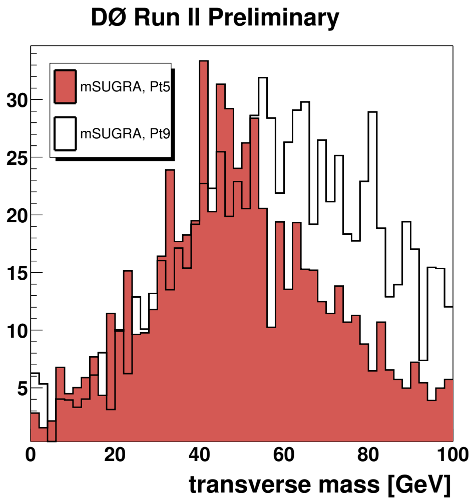




Data and bkg contributions Signal (Pt1) Pt2

$M_T(e, \not{E}_T)$ after Cut 2

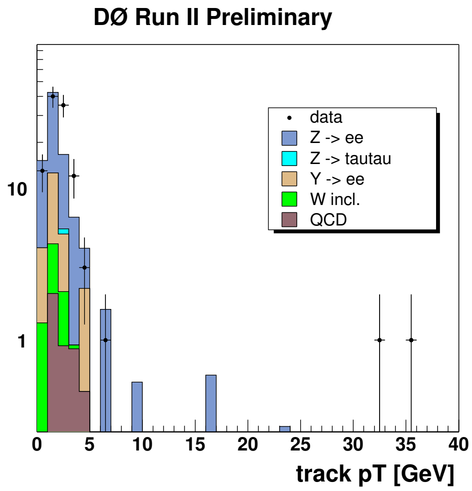


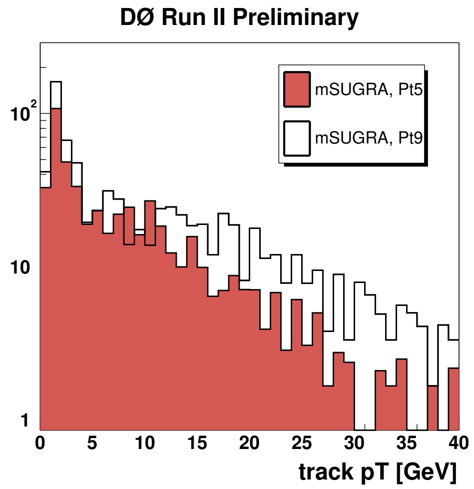


Data and bkg contributions Signal (Pt1) Pt2

QCD bckg$\equiv$ misidentified e's

p_T of 3rd isolated track (after Cut 3)





Data and bkg contributions

Signal (Pt1) Pt2

CUT	Data	Bkgnd	Pt1	Pt2
1	3132	3216(±43)	1.43(±0.05)	0.95(±0.03)
2	721	660(±19)	1.21(±0.05)	0.88(±0.03)
3	123	96.4(±8.1)	1.07(±0.05)	0.72(±0.03)
4	3	3.2(±7.8)	0.59(±0.03)	0.41(±0.03)
5	0	0.0(±1.4)	0.50(±0.03)	0.39(±0.02)

Background: sum of $t\bar{t}$, WW, $W+\gamma$, $W+jets$, $Z(\tau\tau)$, and QCD.

$\gamma\gamma + \not{E}_T$ SUSY search

Motivated by GMSB (Gauge Mediated SUSY Breaking model): SUSY mediated through gauge interactions with messenger fields at a scale $M_m << M_{Planck}$ proportional to gauge couplings $\times\ \Lambda_m$. In these models the lightest SUSY particle is an almost massless $\tilde{G}$ ($M_{\tilde{G}} \ll 1$eV) .

Parameters defining GMSB models are:

- $\Lambda = F/M_m$: scale of SUSY masses
- $M_m > \Lambda$: messenger mass scale
- N_5 : equivalent number of $5\ +\ \bar{5}$ messenger fields (can be non-integer)
- $tan\beta$: ratio of Higgs vacuum expectation values at EW scale
- sgn$\mu = \pm 1$: sign of Higgsino mass term
- $C_{grav} \geq 1$: ratio of $M_{\tilde{G}}$ to value it would have if SUSY breaking scale were F.

Signatures for most Gauge Mediated SUSY Breaking (GMSB) models: In these models the decays to $\tilde{G}$ may be long or short lived with very different signatures.

C_{grav} scales $M_{\tilde{G}}$ and thus lifetime of next lightest SUSY particle (NLSP).

Phenomenology is determined by the NLSP.

If NLSP is $\tilde{\chi}_1^0$ then tell-tale signature is high p_T γ's + $\not{E}_T$ from $\tilde{\chi}_1^0 \to \gamma\tilde{G}$

If NLSP is $\tilde{\tau}$ then tell-tale signature are τ's from $\tilde{\tau} \to \tau\tilde{G}$.

LONG LIFETIME:

- Non-pointing photons from long-lived $\tilde{\chi}_1^0 \to \gamma\tilde{G}$.
- Quasi-stable sleptons — look like muons with $\beta < 1$.
  Very striking signature.

SHORT LIFETIME:

Typical decay chains usually include high p_T leptons and γ's.

Analysis starts from the subset of events with 2 EM objects, both: $p_T > 20$ GeV and $|\eta|_{det} < 1.1$ (CC)

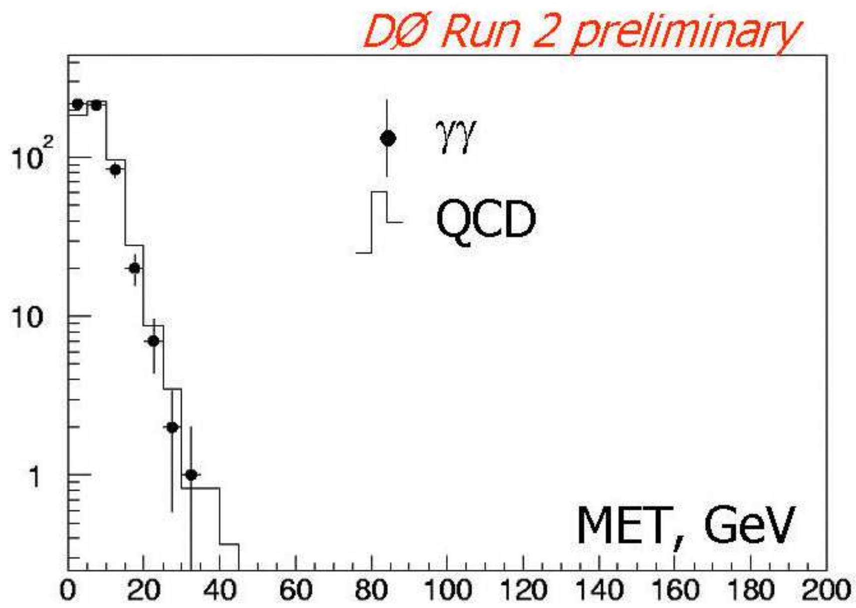
Integrated luminosity of sample 42 pb^{-1}

Additional requirements are:

- EM clusters point to same vertex within 25cm
- jets reconstructed with cone $R = 0.7$
- $\Delta\phi$ between leading jet and $\not\!\!E_T < 2.5$ rad.
- No jets in ICD region of detector $(1.0 < |\eta|_{det} < 1.5)$

545 events after cuts

$\not\!\!E_T$ after all cuts



Points are data.

Histogram is background

(from QCD sample distribution normalized at $\not\!\!E_T$ <20 GeV)

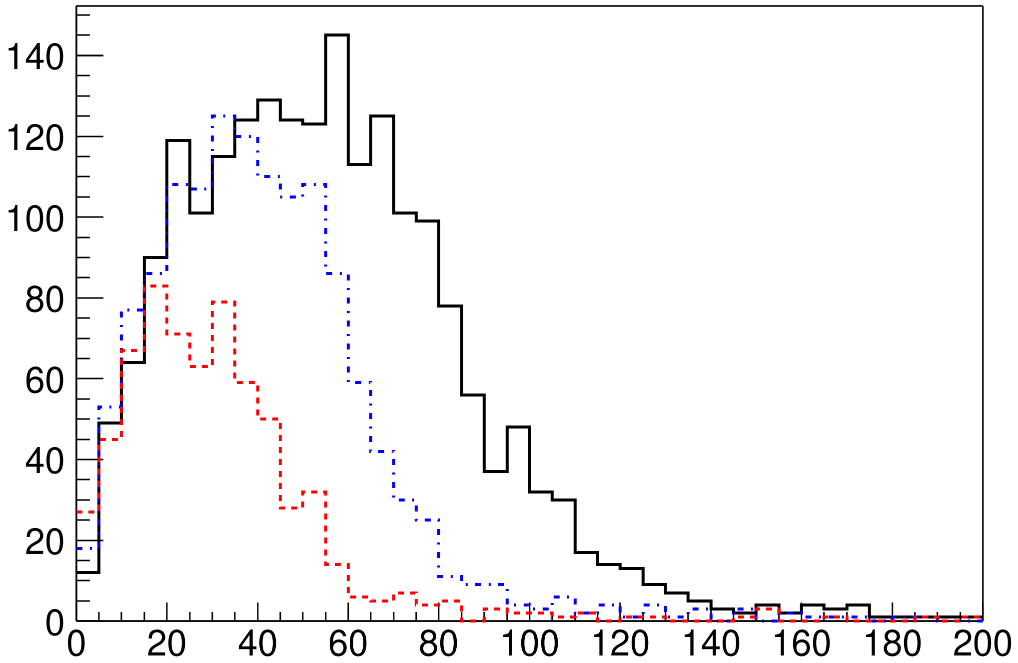
Background completely dominated by QCD fake γ's (1 or 2).

GMSB model used to set limits is one with

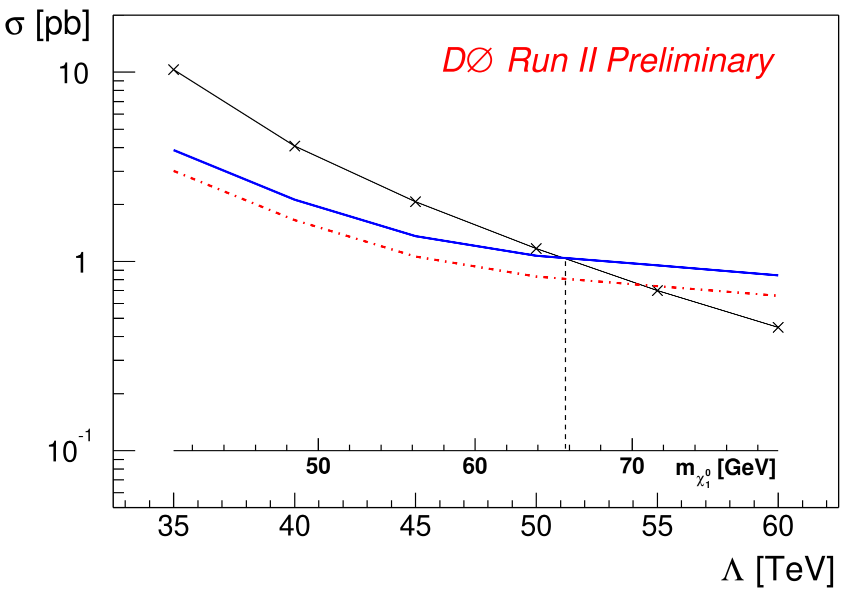
$M_m = 2 \times \Lambda_m$, $N_5 = 1$, $tan\beta$=15, and sign$\mu > 0$

$\not\!\!E_T$ distributions for SUSY events

(Λ=35, 45, and 60 TeV)



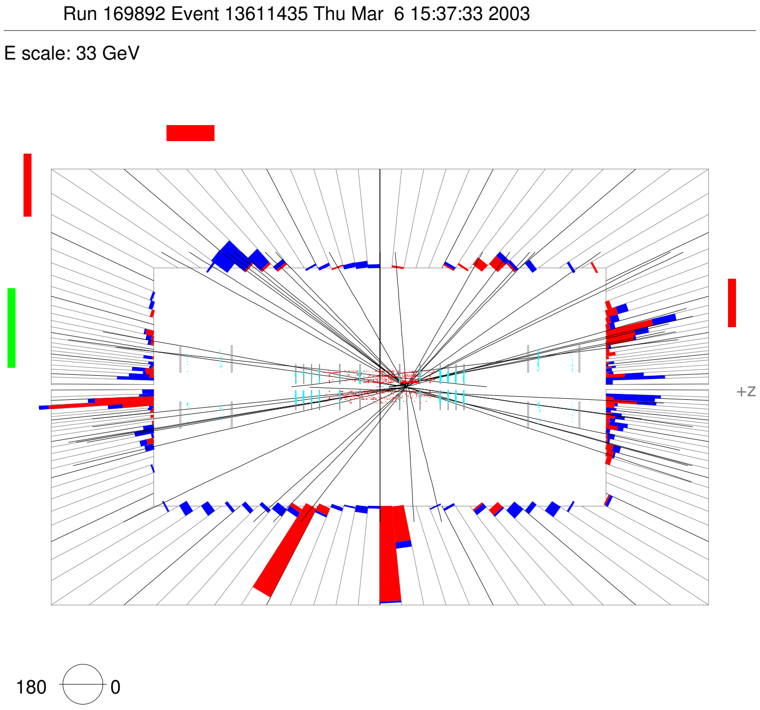
GMSB σ vs Λ (black line) and 90% and 95% CL limits

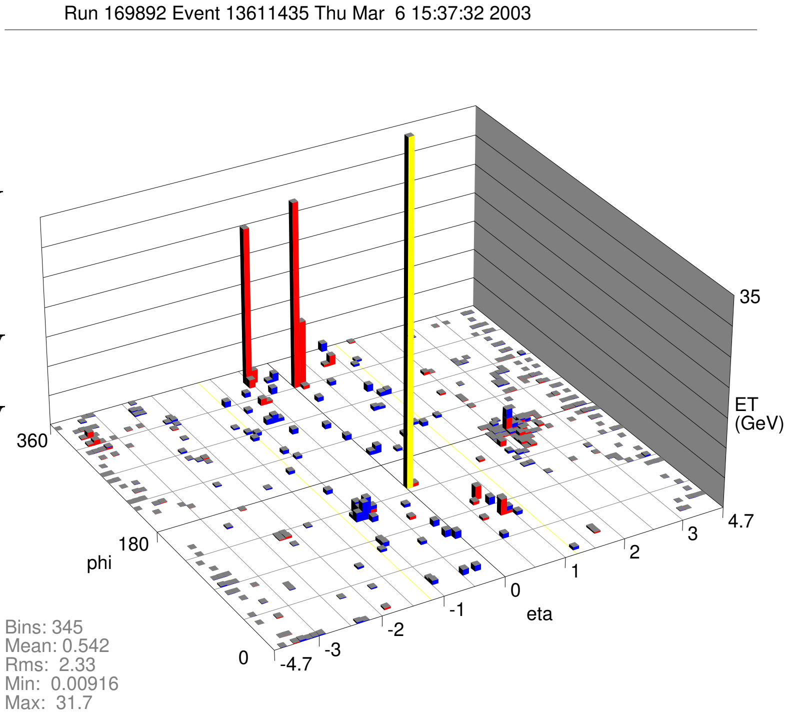


95% CL limit: $m_{\tilde{\chi}_1^0} > 66$ GeV, $\Lambda > 52$ TeV

DØ Run I limit $m_{\tilde{\chi}_1^0} > 75$ GeV

Λ, TeV	95% CL, pb		
	$\not{E}_T > 25$ GeV	$\not{E}_T > 30$ GeV	$\not{E}_T > 35$ GeV
35	3.82	3.87	4.36
40	2.11	2.12	2.14
45	1.45	1.36	1.30
50	1.16	1.07	0.95
55	1.04	0.95	0.84
60	0.94	0.85	0.72
data	3	1	0





$p_T^{\gamma_1}$=115 GeV

$p_T^{\gamma_2}$=24 GeV

$p_T^{jet_1}$=41 GeV

$p_T^{jet_2}$=26 GeV

$\not{E}_T$=38 GeV

$\gamma\gamma$ event with highest $\not{E}_T$

Search for Extra Dimensions in ee and $\gamma\gamma$ channel

String theories atttempting to unify gravity to other other interactions require extra dimensions. Compactified to small sizes of order of Planck scale ($M_{\rm Pl}^{-1} = 10^{-19} GeV^{-1}$).

Gravitational potential in 3D is $V = m/(M_{\rm Pl}^2 r)$.

Arkani-Hamed, Dimopoulos and Dvali pointed out that in (3+n)D, with gravity restricted in extra dimensions to their size R, one can have (for $r >> R$)

$$V = \frac{m}{(M_{\rm Pl}^{[3+n]})^{n+2} R^n \, r}$$

The effective gravitational constant is then given by

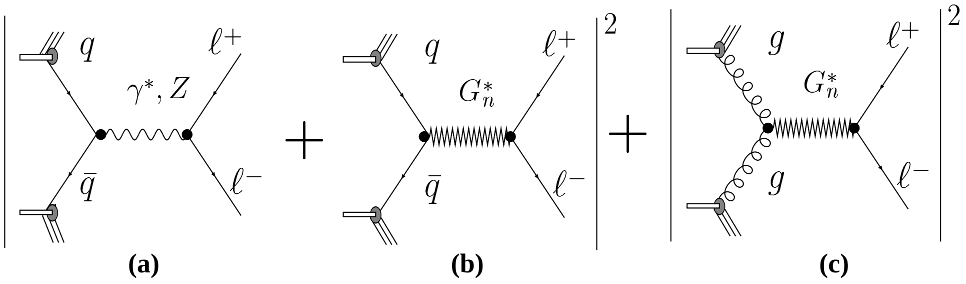
$M_{\rm Pl}^2 \equiv M_S^{n+2} \, R^n$ where M_S is the *fundamental Planck scale.*

Thus

$$R \sim \frac{1}{M_S} (M_{\rm Pl}/M_S)^{2/n}.$$

To solve the hierarchy problem, one can have M_S in the TeV range for $n \geq 3$ and $R < 3nm$.

Extra dimensions can be probed by single γ/jets production or by fermion or boson pair production via virtual gravitons.



Cross section can be written as

$$\frac{d^2\sigma}{dM d\cos\theta^*} = f_{\rm SM} + f_{\rm int}\eta_G + f_{\rm KK}\eta_G^2, \qquad (1)$$

where $f_{\rm SM}$, $f_{\rm int}$, and $f_{\rm KK}$ are functions of $(M, \cos\theta^*)$ and denote the SM, interference, and $G_{\rm KK}$ terms.

$\cos\theta^*$ is the cosine of scattering angle in c.o.m. frame,

and $\eta_G = F/M_S^4$ $\qquad F$ model dependent ≈ 1

Sample of events from same triggers as previous analyses.

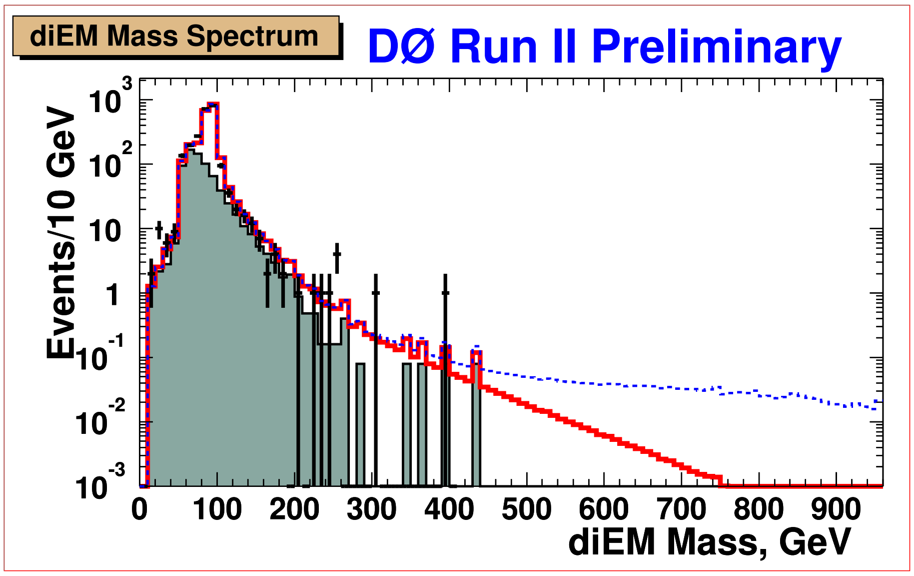
Luminosity used in this analysis was 46 pb^{-1}

No track requirements, but additional cut

E_T^{EM} >25 GeV and $\not\!\!E_T$ <25 GeV

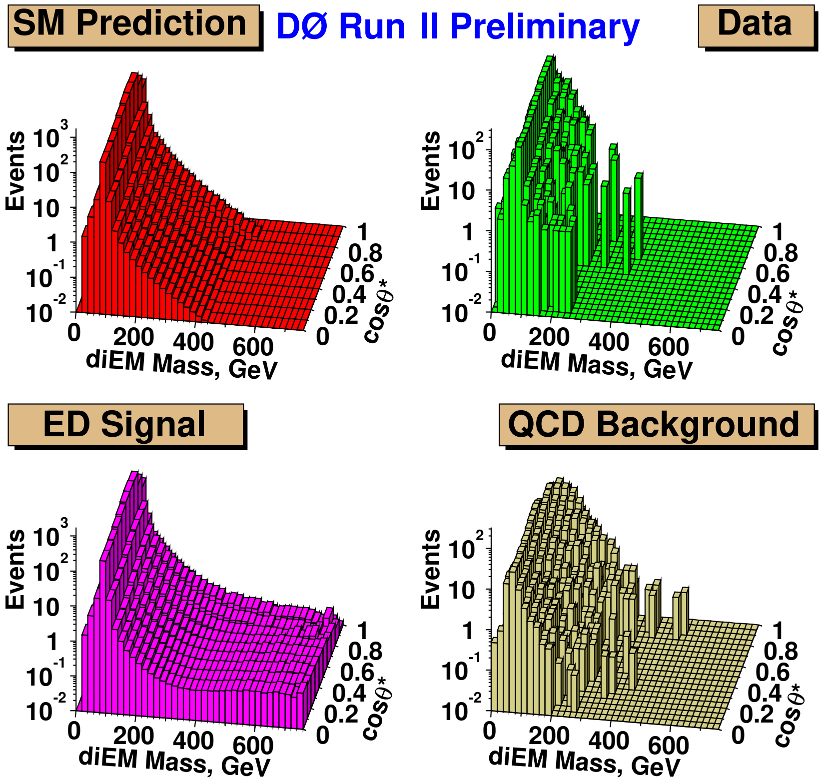
5350 events but most of the sensitivy to ED

from CC-CC pairs = 2388 events.



Points are data, QCD Bckg, QCD bckg + SM Drell-Yan, ED signal with η_G=0.6 TeV^{-4}

Signal well separated from SM predicted and QCD instrumental backgrounds in $[M(diEM), \cos\theta^*]$ space.



From the $M(DiEM)$ vs. $\cos\theta^*$ distributions one can extract η_G by fitting with 2D templates for f_{SM}, f_{int} and f_{KK}.

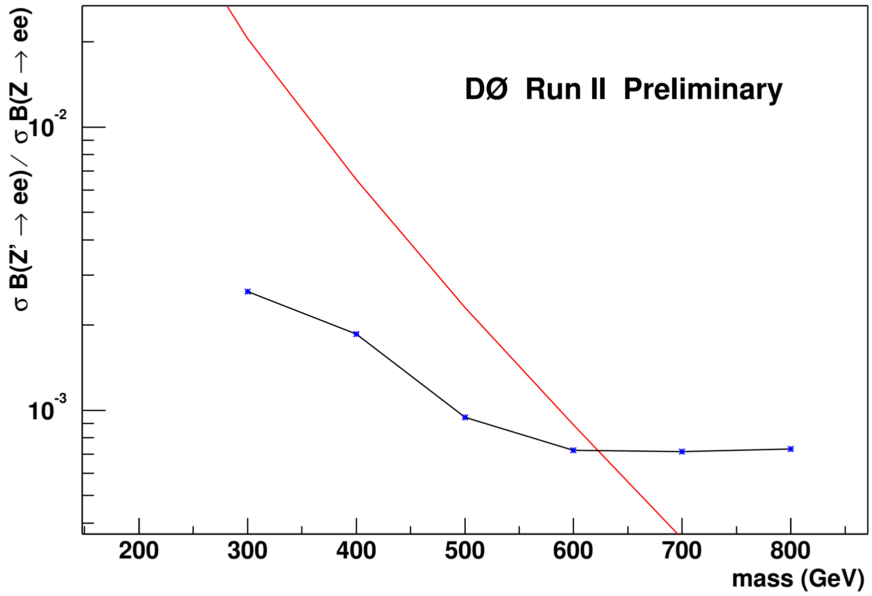
$$\eta_G = 0.0 + 0.27 \text{ TeV}^{-4}$$

$=>$ 0.63 TeV^{-4} ($M_S > 1.12$ TeV for F=1) 95% CL l.l.

(Run I limit $M_S > 1.20$ TeV)

Z' mass limit

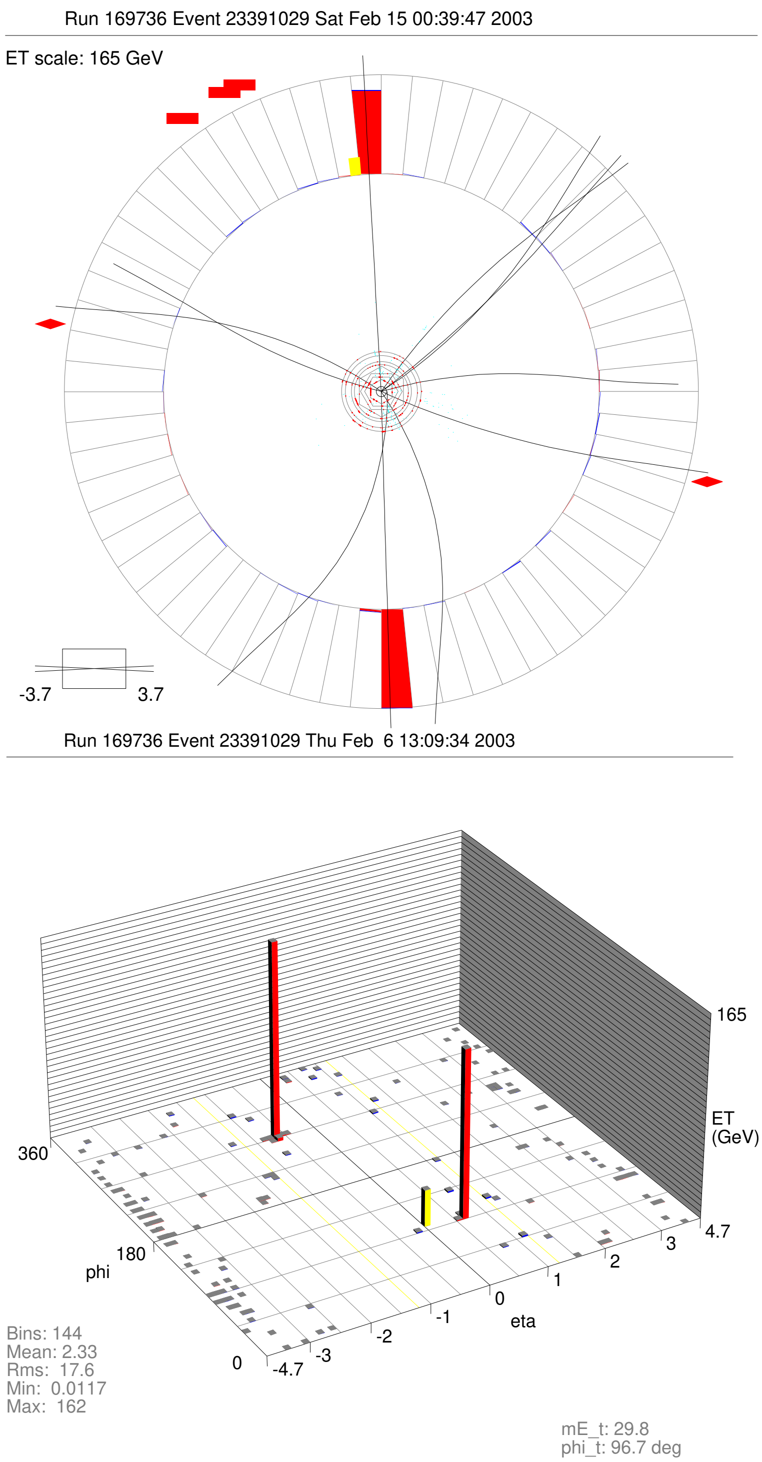
Assuming SM-like coupling to fermions the good agreement between data and SM background found in previous analyses can be used to set limit on Z'.



Theoretical calculation of $(\sigma B)_{Z'}/(\sigma B)_Z$ vs $M_{Z'}$

95% CL upper limit $M_{Z'}$ >620 GeV

(Run I $M_{Z'}$ >690 GeV)



Event with highest invariant mass ($M_{ee} = 386.0$) GeV in CC-CC topology

$\mu\mu$ channel

Events selected with a di-μ trigger which has $>90\%$ for $|\eta|<2.0$ after excluding region $|\eta|<1.0$ and $-1.96<\phi<-1.17$ (detector support)

Reconstruction requirements:

Cosmic Ray Muons Removed

Central track match

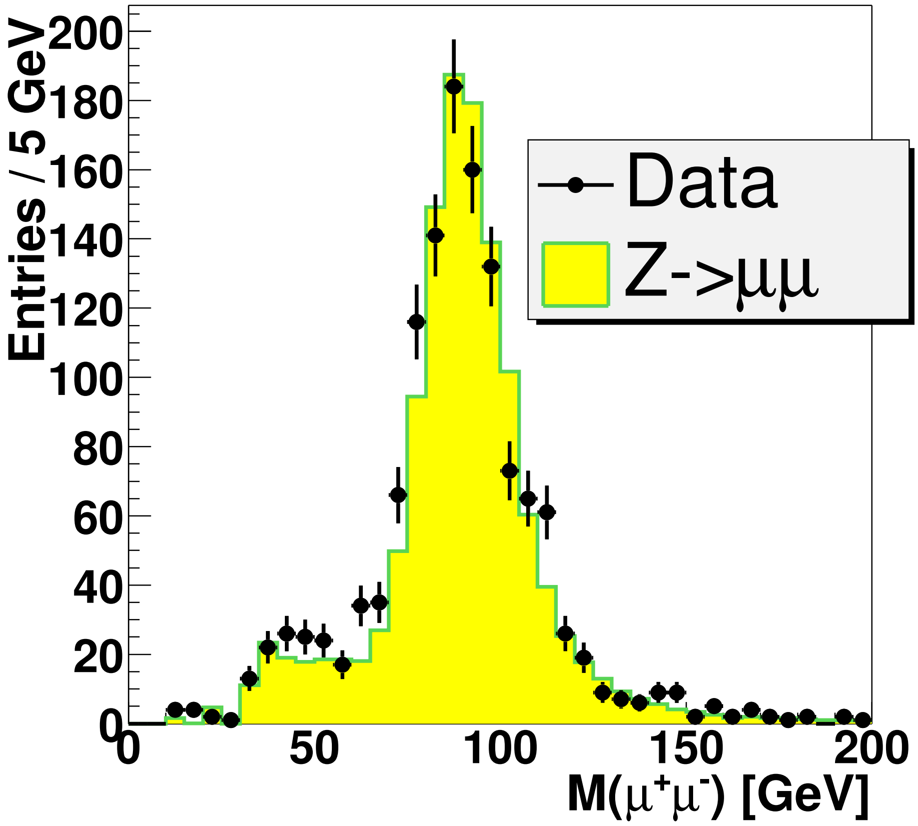
Both Muons $p_T > 15$ GeV

$\mu\mu$ Invariant Mass > 40 GeV

$$\left.\begin{array}{l}\text{Cal. Halo(0.4,0.1)} < \text{ 2.5 GeV} \\ \text{Track Halo(0.5)} < \text{ 2.5 GeV}\end{array}\right\} \text{Isolation Criteria}$$

Cal. Halo(0.4,0.1)$\equiv$ E in cone R=0.4 - E in cone R=0.1

Track Halo(0.5)$\equiv$ Σ tracks p in cone R=0.5 excluding μ



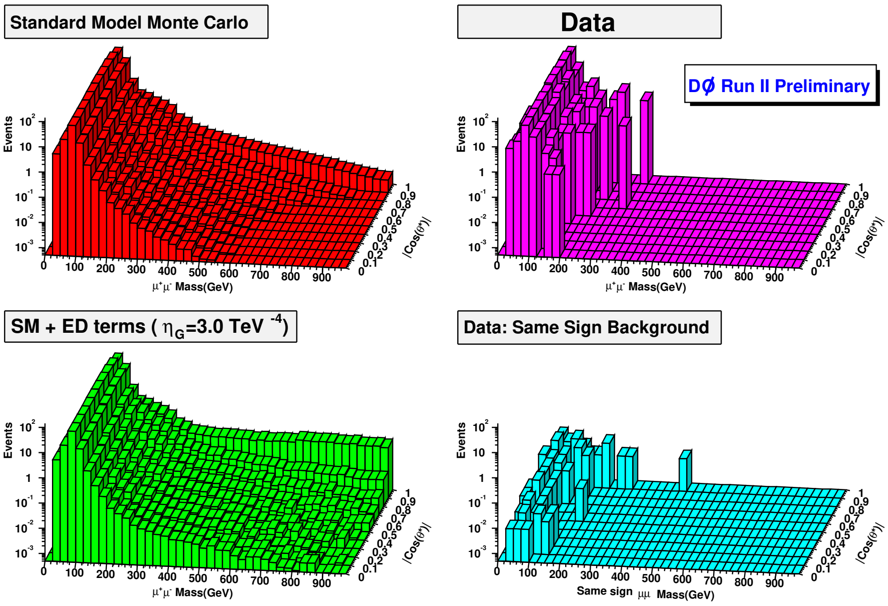
μ efficiency after all cuts 60%

1242 events left

Luminosity of sample used is 38 pb^{-1}

Search for Extra Dimensions in $\mu\mu$ channel

This analysis uses the 1242 event sample and follows the same strategy as the search in the ee and $\gamma\gamma$ channel.



The lower lego plots show expected distributions for SM, Data, SM+ED(η_G=3.0 TeV^{-4}) and same sign data

Fit to the 2D distributions yield

$$\eta_G = 0.02 + 1.35 \text{ TeV}^{-4}$$

=> 2.5 TeV^{-4} ($M_S >$ 0.79 TeV for F=1) 95% CL l.l.

Same limit as set by LEP2

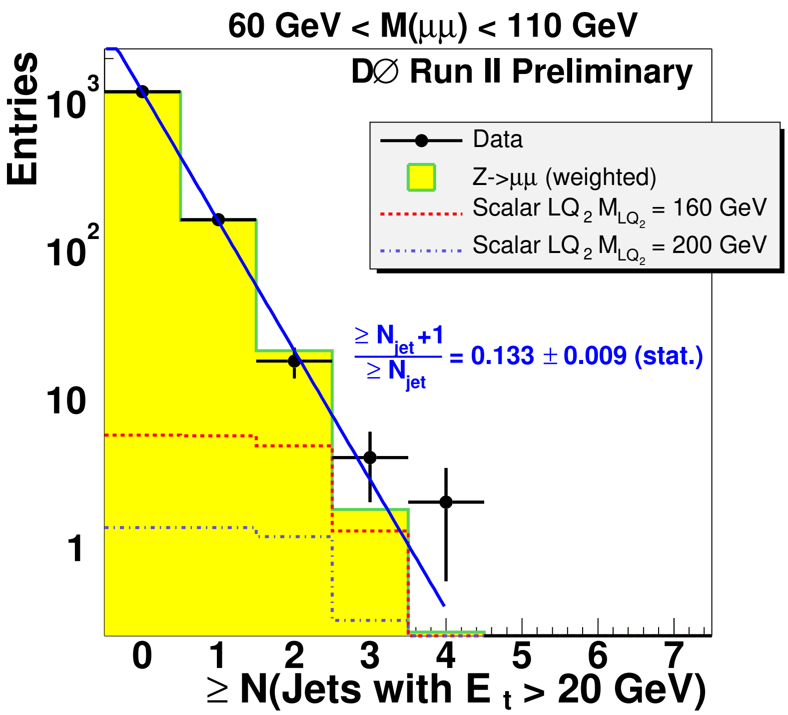
Search for 2^{nd}-Generation Leptoquarks

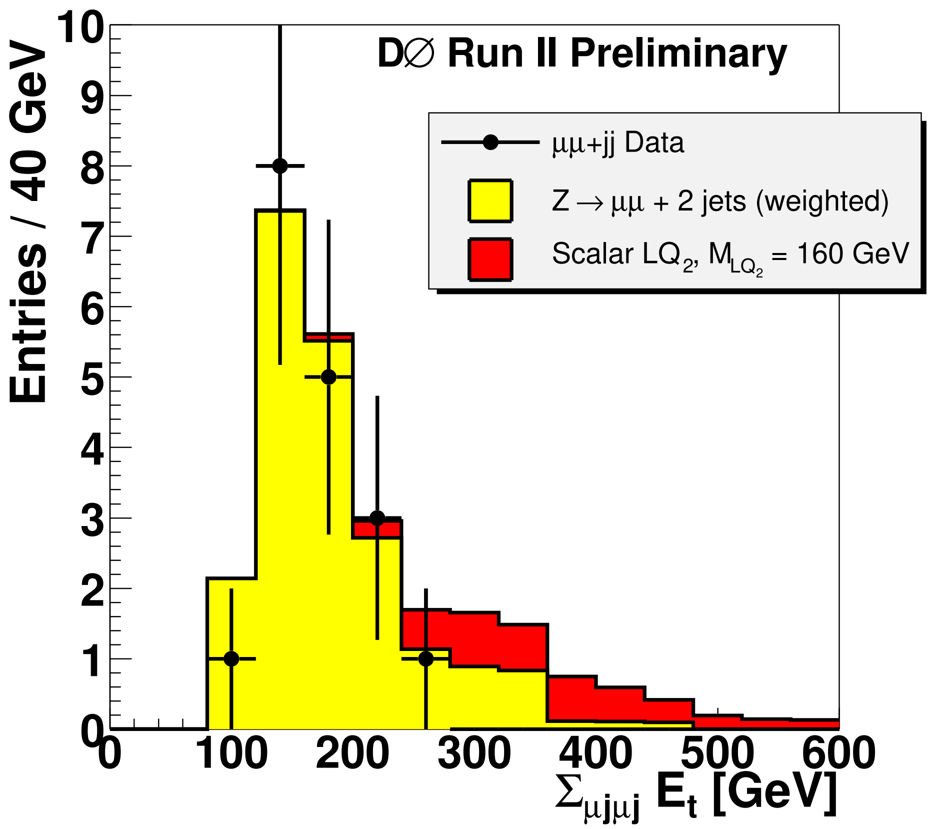
Leptoquarks:

- Hypothesized particles carrying color, fractional charge, and baryon/lepton numbers.
- Appear in extended gauge sectors and composite models.
- decay to quarks and leptons.
- At the Tevatron they would be pair produced through gluon splitting.
- Limits on flavor changing neutral currents constrain them to couple to quarks and leptons of the same generation.

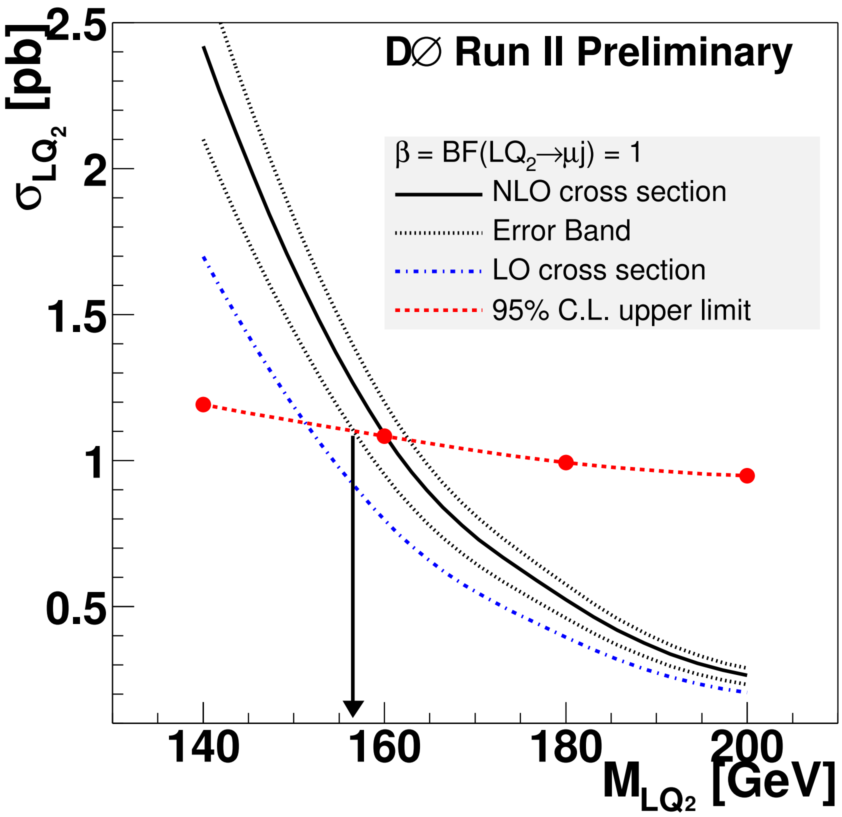
Same sample used as in previous analysis with additional requirements:

- $M_{\mu\mu} > 60$ GeV
- at least 2 0.5-cone jets, $E_T > 20$ GeV, $|\eta| <2.4$





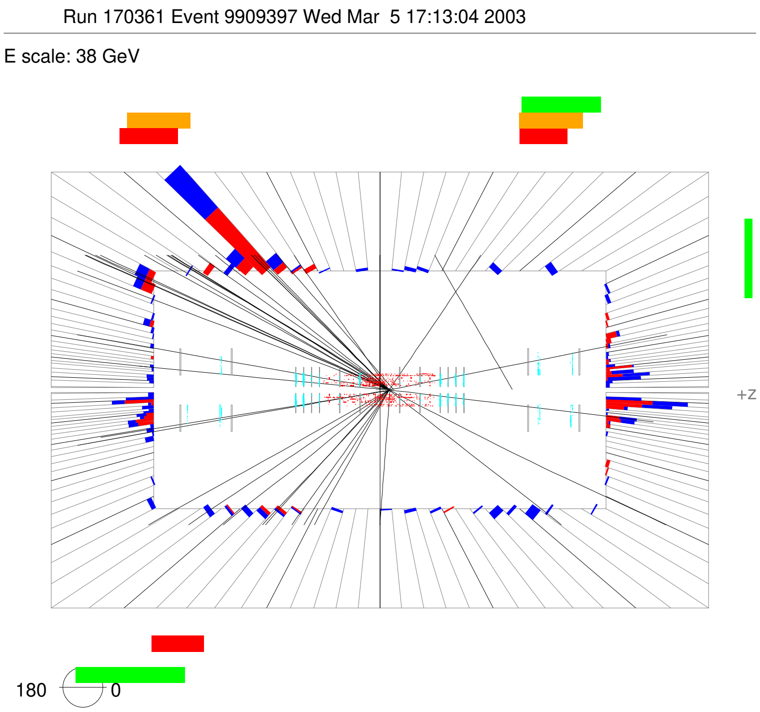
	2 isol. muons $p_t^\mu > 15$ GeV $M(\mu\mu) > 60$ GeV	≥ 1 jets $E_t > 20$ GeV	≥ 2 jets $E_t > 20$ GeV	$M(\mu\mu)$ > 110 GeV
$t\bar{t}$	0.257 ± 0.004	0.253 ± 0.004	0.193 ± 0.004	0.081 ± 0.003
WW	0.371 ± 0.013	0.038 ± 0.004	0.002 ± 0.001	0.001 ± 0.001
M_{LQ} (160 GeV)	5.7 ± 0.1	5.6 ± 0.1	4.8 ± 0.1	3.5 ± 0.1
DY-Z	1179.5 ± 9.5	162.5 ± 4.1	21.5 ± 1.4	4.0 ± 0.6
Data	1194	168	18	0

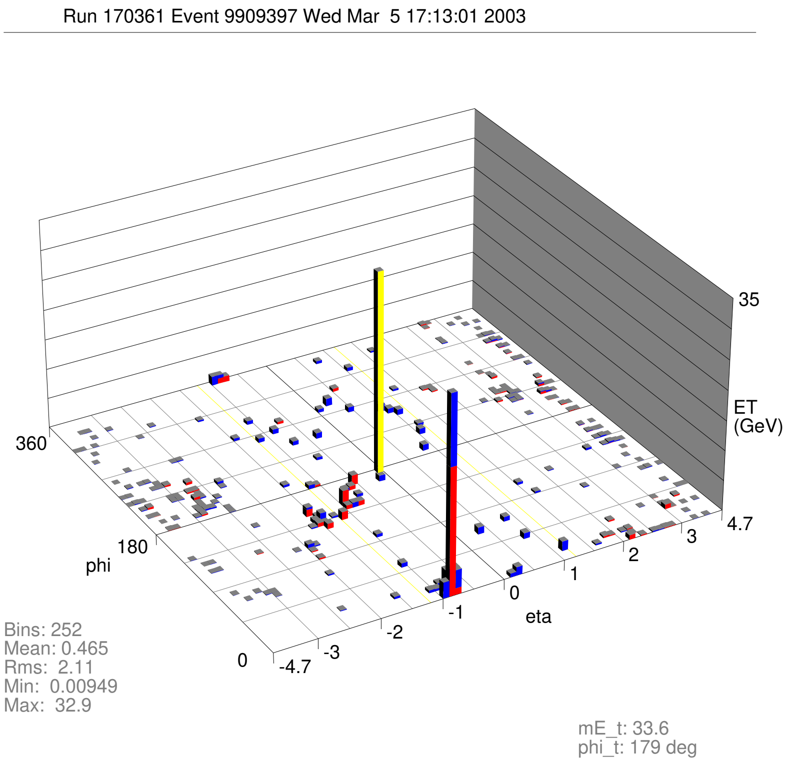


For $\beta = BF(LQ_2 \to \mu j) = 1$ the 95% CL upper limit on σ gives a lower bound on

$M_{LQ_2} > 157$ GeV for $\beta = 1.0$

DØ Run I limit $M_{LQ_2} > 200$ GeV





event with highest $M_{\mu\mu}$ (=108 GeV) and 2 jets

Search in $e\mu$ channel

The $e\mu$ channel is favored for general search of deviations from SM as the expected backgrounds are small.

Events collected with a $e - \mu$ trigger requiring:

- a level 1 EM tower object with $E_T > 5$ GeV
- a level 1 muon scintillator trigger
- a level 3 electron $p_T^e > 10$ GeV

The trigger efficiency for events with $p_T^\mu > 5$ GeV and p_T^e >15 GeV is 94%.

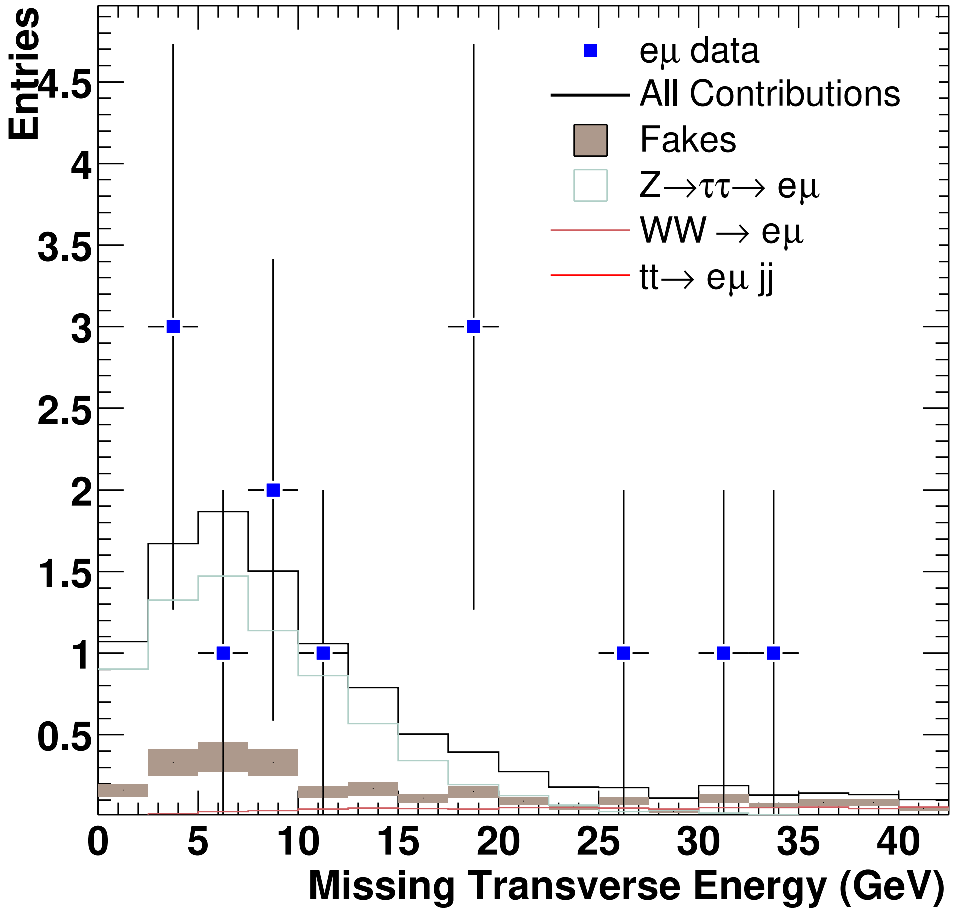
Reconstruction requirements for e and μ same as for the ee and $\mu\mu$ channels.

Subsample selected for a general search of non-SM signal:

- p_T^μ >15 GeV
- p_T^e >15 GeV, $|\eta_{det}^e| < 1.1$
- no jets with E_T >15 GeV (R=0.5 cone)

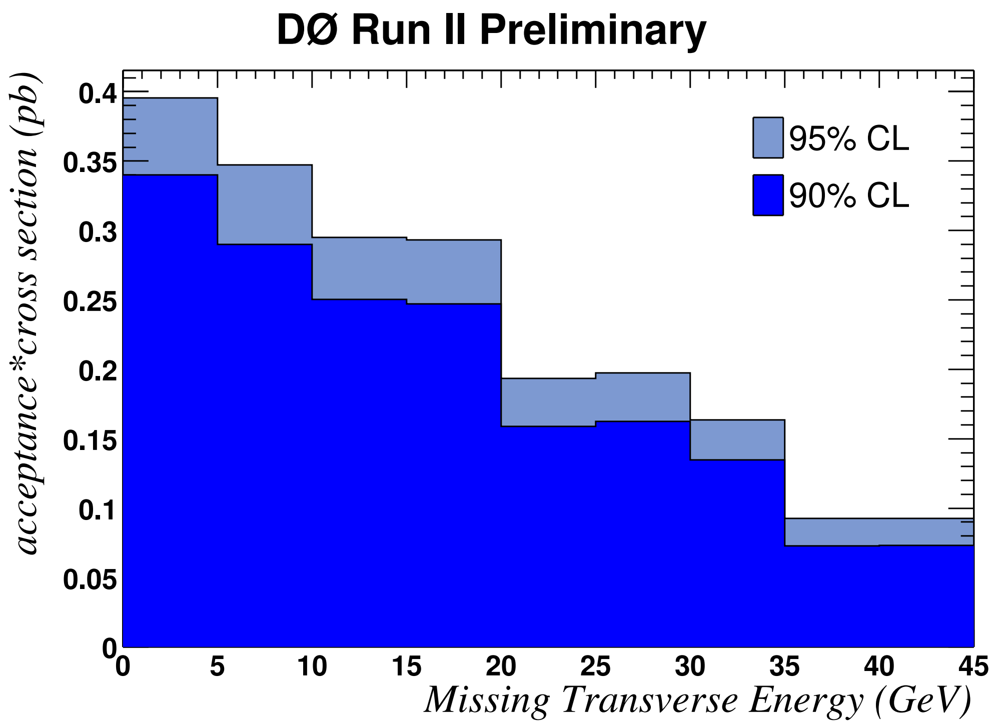
13 events left

Luminosity of sample 33 pb^{-1}



For $\not\!\!E_T$ <15 GeV $Z \to \tau\tau$ events dominate and for $\not\!\!E_T$ >15 GeV misidentified QCD background.

Given the $\not\!\!E_T$ distribution of the $e\mu$ events one can put limits on the production cross section *acceptance ($\sigma \cdot BR(e\mu) \times A$) of non-SM processes with $e\mu$ final states as function of $\not\!\!E_T$ cut:



The 95% CL upper limits range from 400 fb for no $\not\!\!E_T$ cut to 90 fb for $\not\!\!E_T$ >40 GeV.

A for a process like $WW \to e\mu$ is 17%.

($\sigma_{t\bar{t}} \cdot A \approx 100$ fb)

Set of $e\mu$ events with somewhat lower p_T^μ(<10 GeV) requirement were used to search for direct gaugino production.

3 cuts applied

1. 2 track matches + isolation
2. $\not{E}_T > 20$ GeV, $\Delta R(\not{E}_T, jet) > 0.5$
3. $p_T^\mu > 20$ GeV or $M_T(e, \not{E}_T) > 80$ GeV

CUT	Data	Bkgnd	Pt1	Pt2
1	22	$22(\pm 2.1 \pm 2.2)$	$1.32(\pm 0.06)$	$1.20(\pm 0.012)$
2	4	$2.2(\pm 1.7 \pm 0.2)$	$0.8\ (\pm 0.05)$	$0.79(\pm 0.03)$
3	2	$1.4(\pm 1.5 \pm 0.1)$	$0.75(\pm 0.04)$	$0.70(\pm 0.03)$

Background: sum of $t\bar{t}$, WW, $W+\gamma$, $W+jets$, $Z(\tau\tau)$, and QCD.

Adding ee and $e\mu$ channels: 2 events observed, bckg 1.4 ± 2.0, $\approx$1 event predicted by Pt1 or Pt2

Conclusions

- There are already many DØ Run II analyses that are approaching DØ Run I limits
- DØ is ready to start searches using τ's decaying hadronically
- Many more analyses coming.