New Phenomena at DØ

Extra dimensions
Z'
Leptoquarks
SUSY

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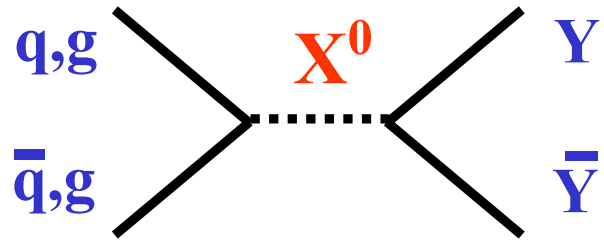
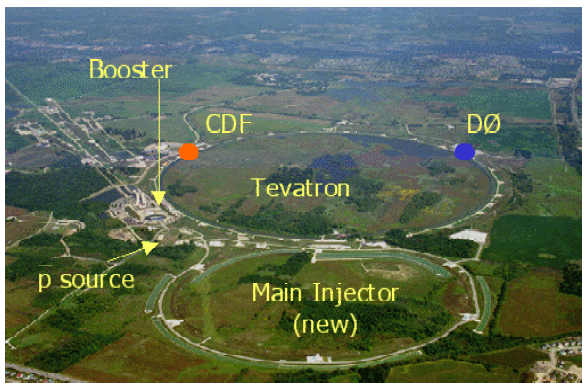
Searches for New Phenomena

The Standard Model is great, but leaves questions
New physics necessary to increase our understanding.

New phenomena are our clearest window into new physics:
SUSY, leptoquarks, string theory, GUTs, mass,…

At Tevatron:
annihilation → pair production
(exotic $Y\bar{Y}$)
or
intermediate propagator
(exotic X^0)

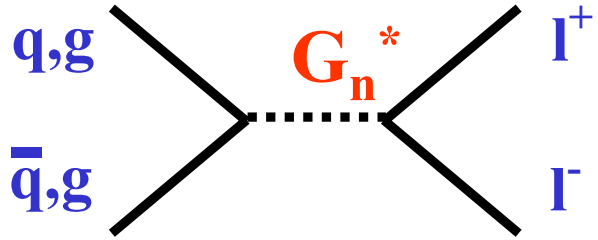




Upgraded detectors
Higher luminosity
Higher energy

Preliminary results (through summer 2003)

Large Extra Dimensions



Why is $M_{Pl} >> M_{Weak}$?

Possible solution: large extra dimensions

$4 + n_{extra}$ dimensions

At the Tevatron (pp): gravitons appear as contributions to di-lepton/ photon production

Gravitons are able to propagate in all dimensions

Extra dimensions compactified ($R_c < 1$ mm)

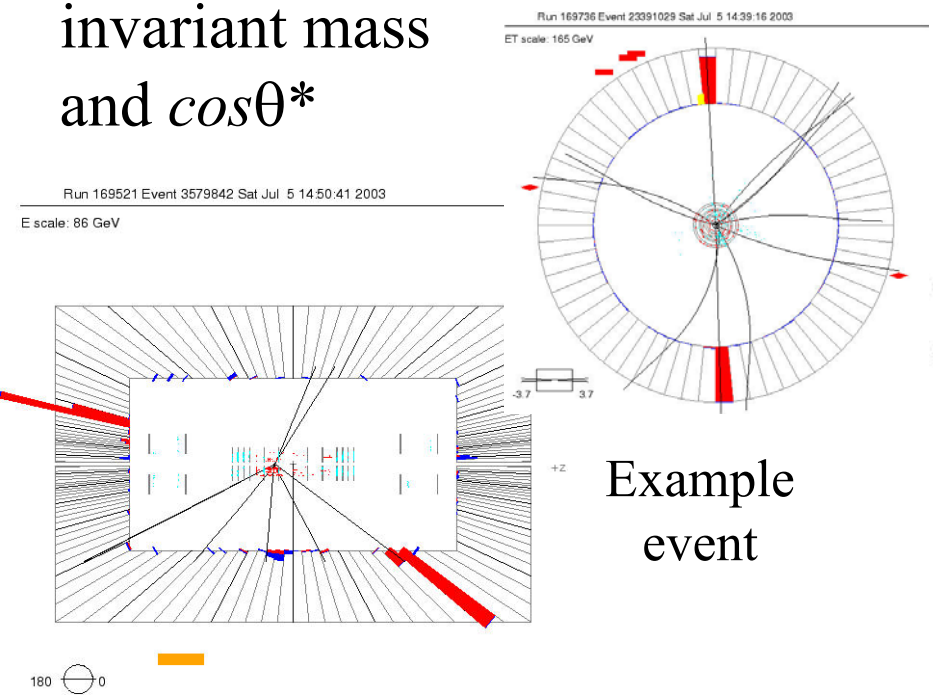
$$M_{Pl}^2 = M_S^{n_{extra}+2} \times R_c^{n_{extra}}$$

Current constraints require $n_{extra}>1$

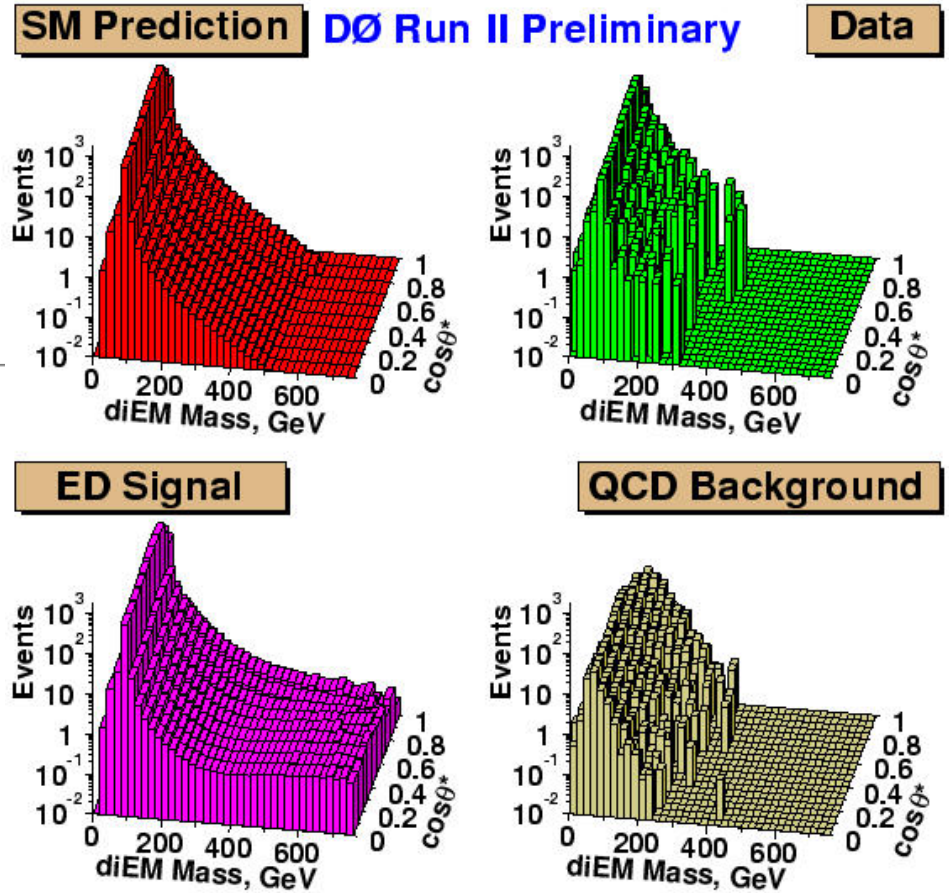
M_S = *fundamental* Planck scale

LED: ee and γγ

Search e^+e^- and γγ channels for excess events – large invariant mass and *cos*θ*



Example event



Luminosity = 129 pb^{-1}

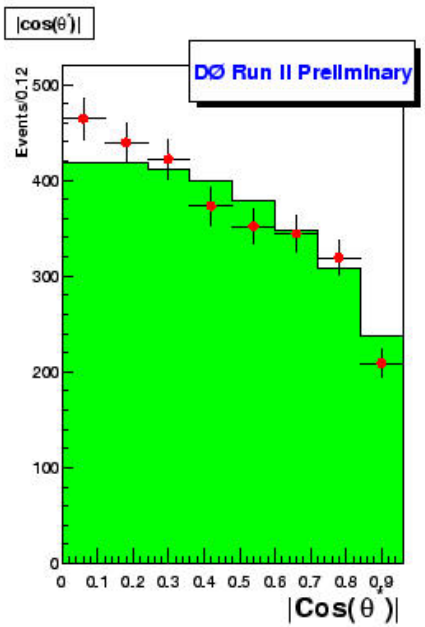
Select events with ≥2 electrons(photons) with E_T> 20 GeV

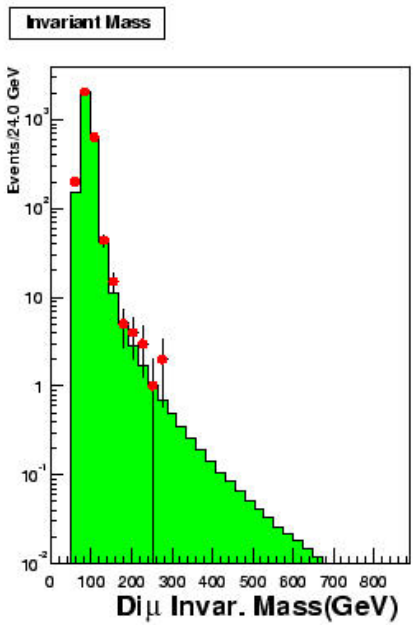
M_S > 1.28 TeV (95% CL)
Run 2 Preliminary

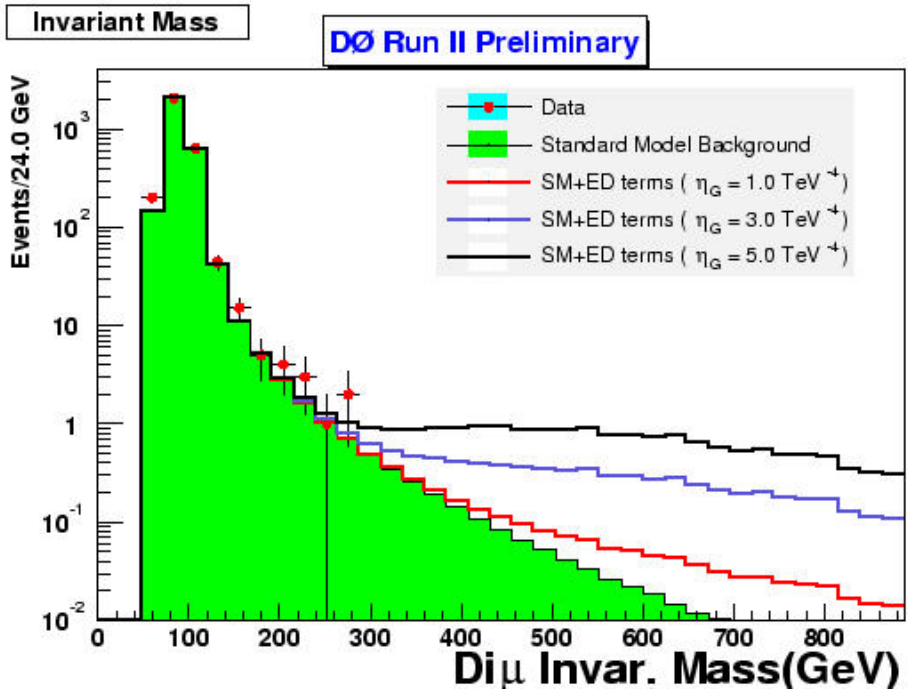
LED: μμ

First analysis of LED in μμ at $p\bar{p}$

Luminosity = 100 pb^{-1}





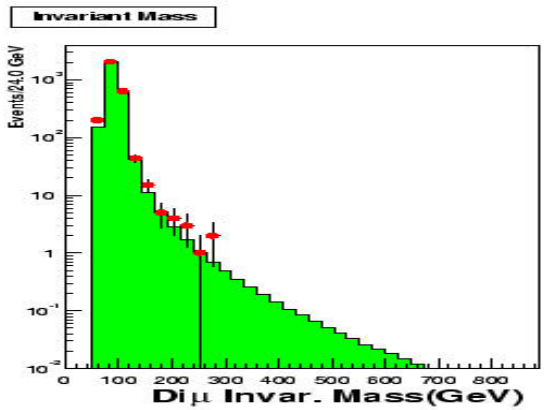


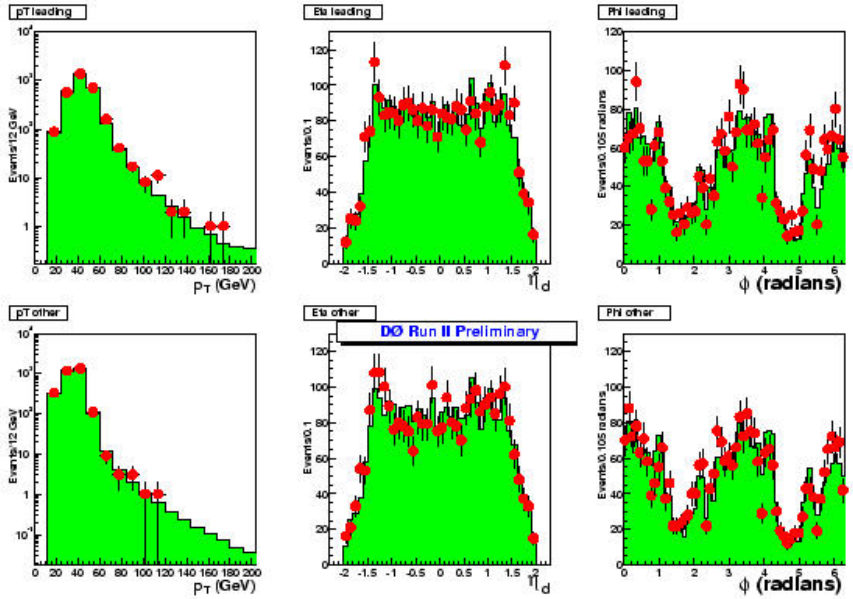
Select events with ≥2 muons with $P_T > 15$ GeV and $M_{\mu\mu} > 50$ GeV

$M_S > 880$ GeV (95% CL)
Run 2 Preliminary

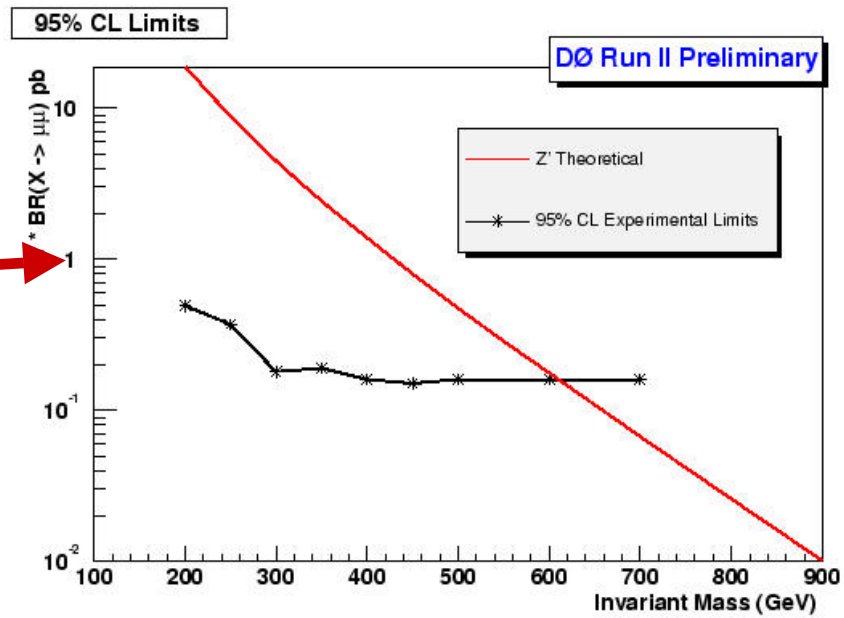
Z′: μμ and ee

We can use the same dimuon sample to search for heavy Z-like resonances



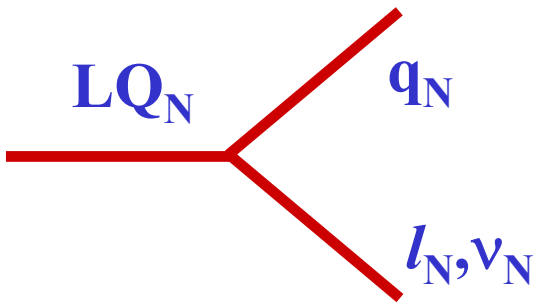


No evidence: Set limits
M(Z’) > 610 GeV
also in Z’→ee
M(Z’) > 719 GeV
Run 2 Preliminary



Leptoquarks

Included in many SM extensions:
enlarged gauge structure, compositeness, more

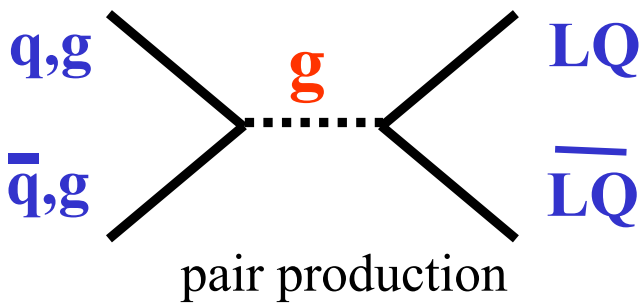


Carry lepton & baryon number
Fractional EM charge

Assume: intra-generational coupling only
(e.g. 1st generation LQ (LQ1) → eq, ν_eq,
2nd generation LQ (LQ2) → μq, ν_μq)

$\beta = BF(l^{\pm}q)$

At Tevatron:



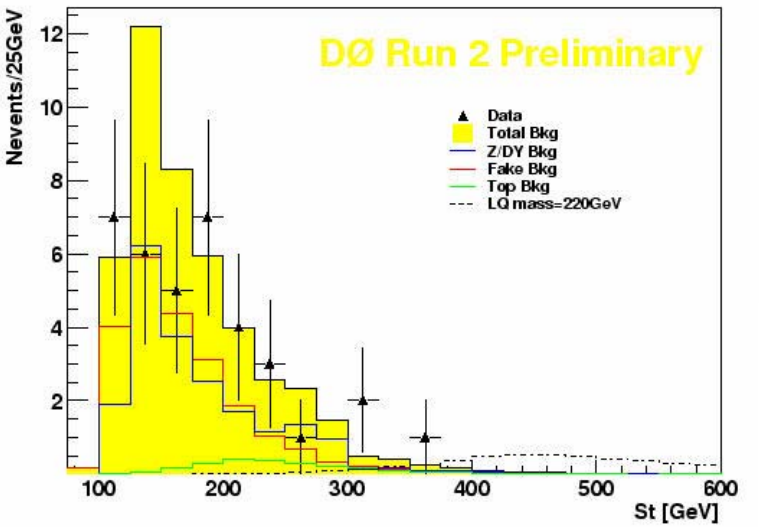
Search for excess of events *or* M(lq) spectrum

1st Generation LQ in eejj

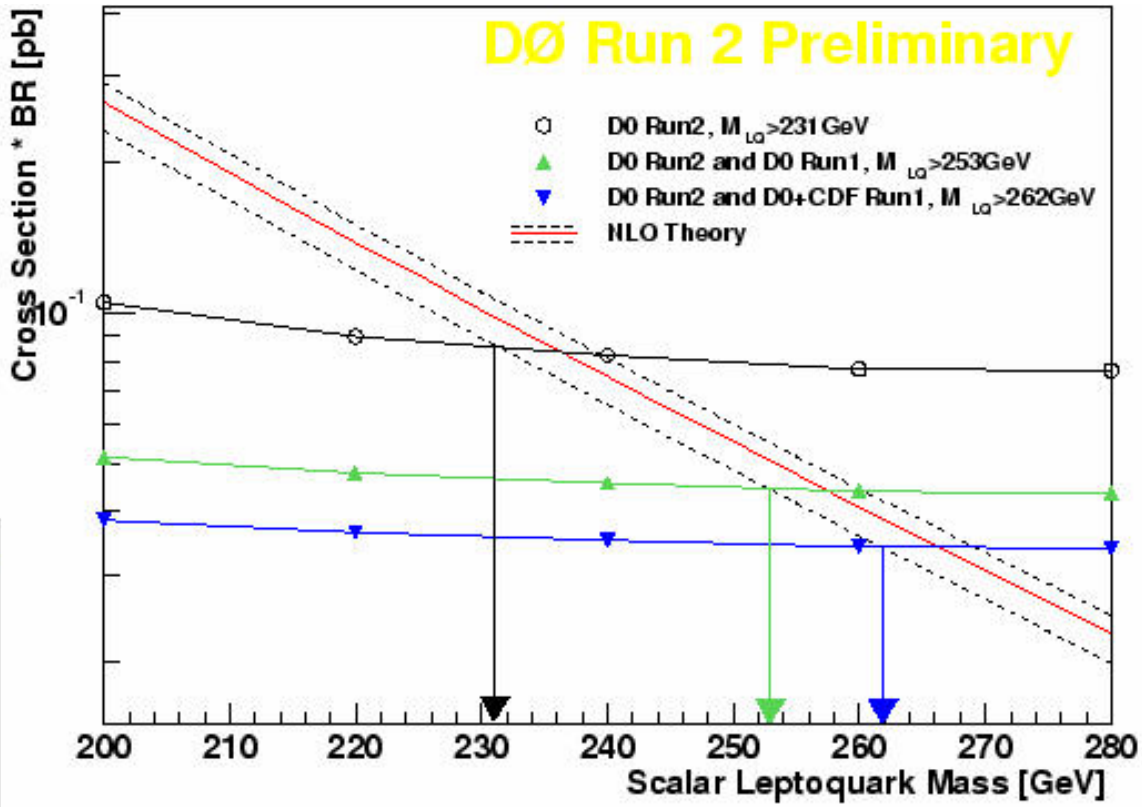
Luminosity = 135 pb^{-1}

Require:

- 2 electrons
  - w/ $E_T(e)>25$ GeV
- ≥2 jets
  - w/ $E_T(jets)>20$ GeV
- veto $Z\rightarrow ee$
- $S_T>375$ GeV



$$S_T = E_T^{e1} + E_T^{e2} + E_T^{j1} + E_T^{j2}$$



Data: 0 events

Bkgd: 0.9±0.25

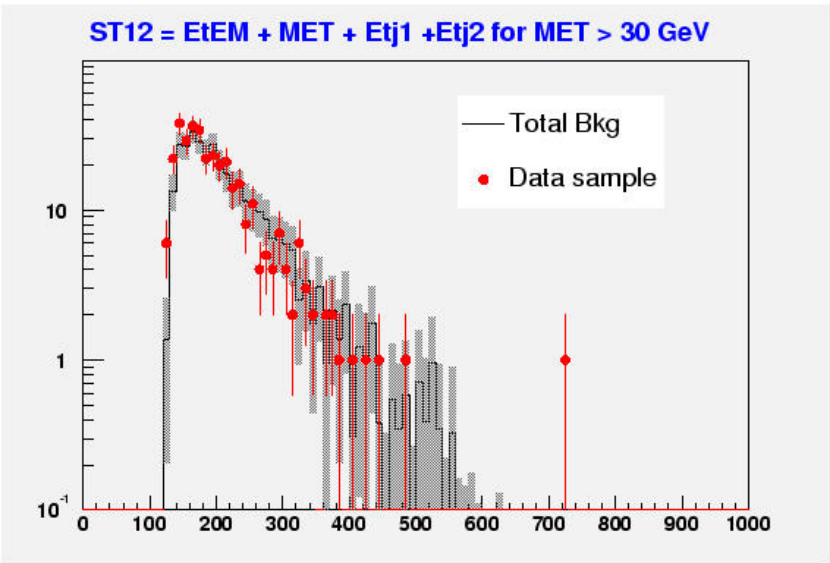
M(LQ1) > 231 GeV
for β=1
Run 2 Preliminary

1st Generation LQ in eνjj

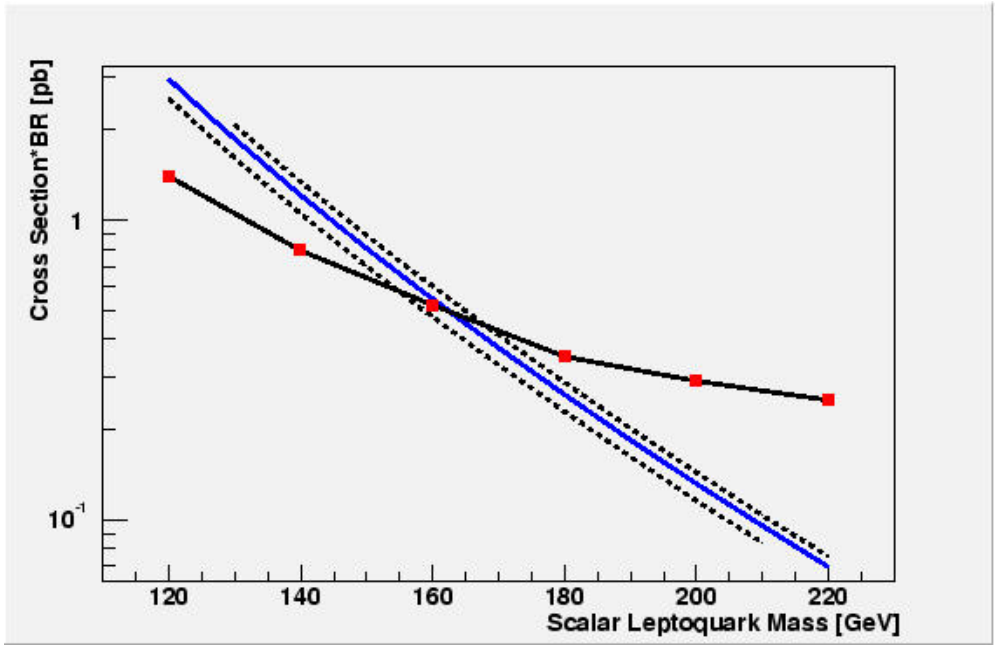
Luminosity = 121 pb^{-1}

Require:

- 1 electron w/ $E_T(e) > 35$ GeV
- ≥2 jets w/ $E_T(jet) > 25$ GeV
- missing $E_T > 30$ GeV
- $ST_{12} > 330$ GeV
- $M_T^{ev} > 110$ GeV



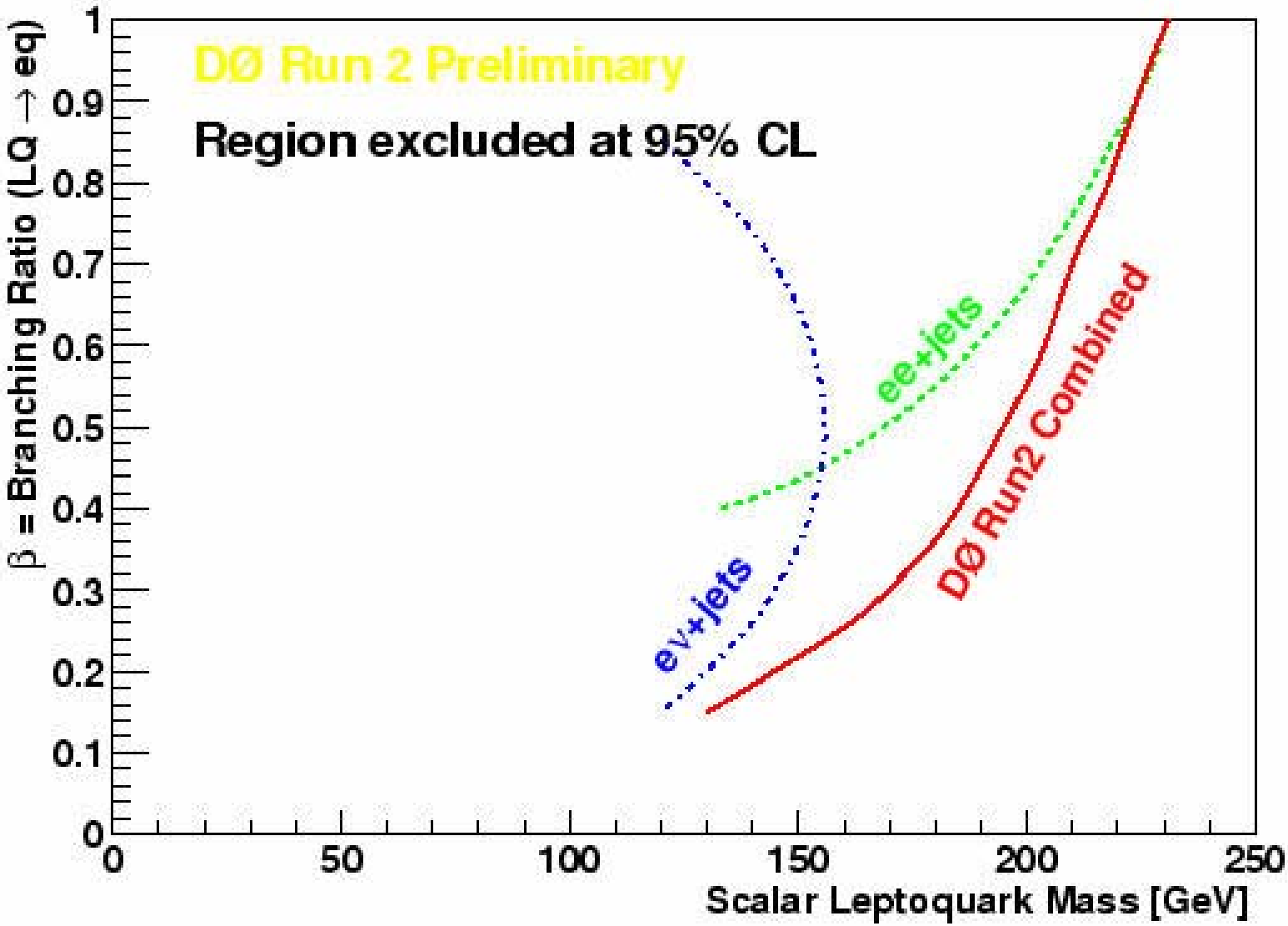
$$ST_{12} = E_T^e + \not{E}_T + E_T^{j1} + E_T^{j2}$$



Data: 3 events Bkgd: 4.19±1.0 events

M(LQ1) > 156 GeV
for β=0.5
Run 2 Preliminary

LQ1 Combined Limit

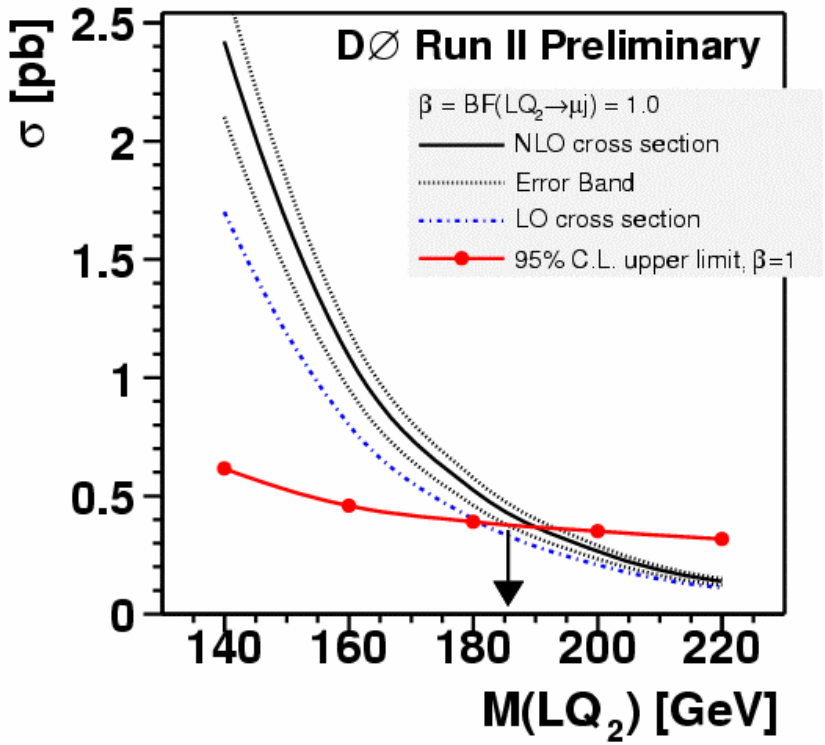


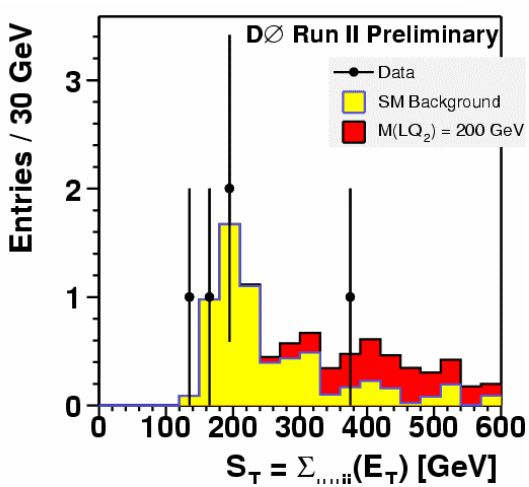
2nd Generation LQ in μμjj

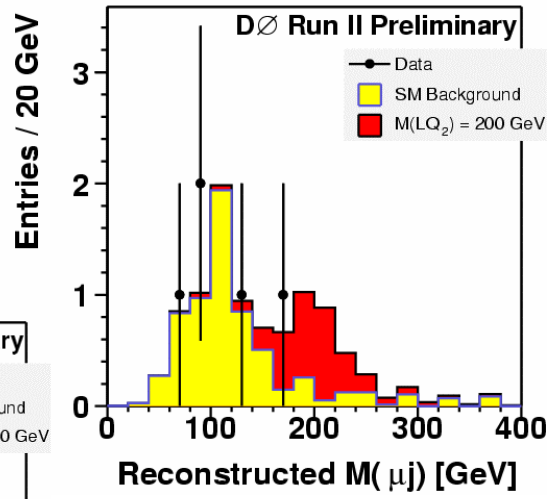
Luminosity = 104 pb^{-1}

Require:

- 2 muons w/ $E_T(\mu)>15$ GeV
- ≥2 jets w/ $E_T(jet)>25$ GeV
- $M(\mu\mu)>110$ GeV
- $S_T>280$ GeV



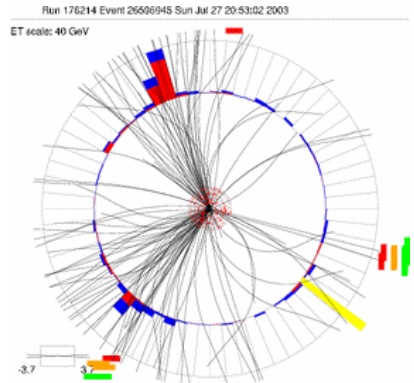


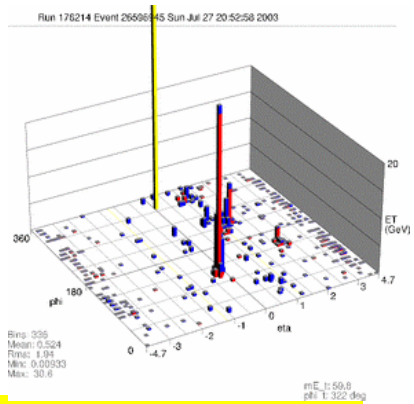


Data: 1 event

Bkgd: 1.59±0.49

M(LQ2) > 186 GeV
for β=1
Run 2 Preliminary





GMSB in $\gamma\gamma$ + Missing Energy

Luminosity = 128 pb^{-1}

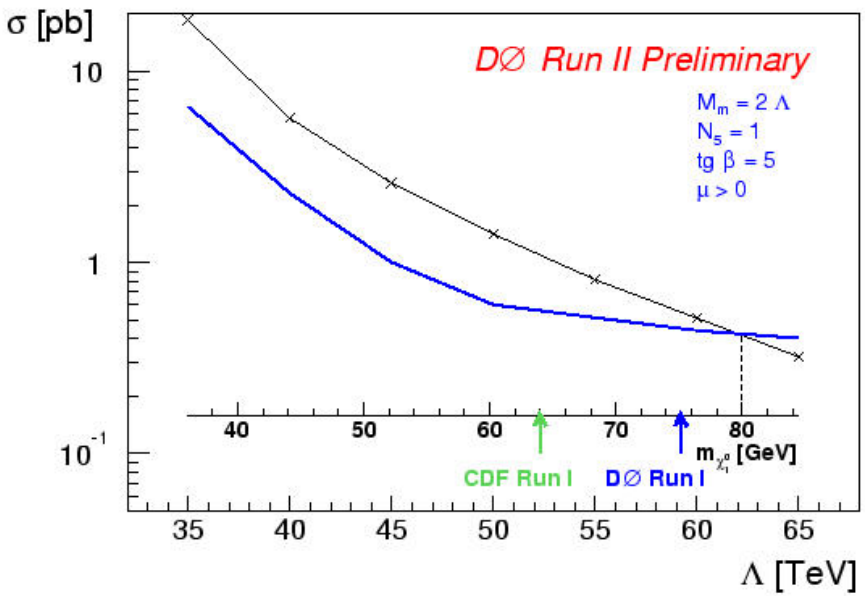
Gauge mediated SUSY breaking with NLSP χ_0^1

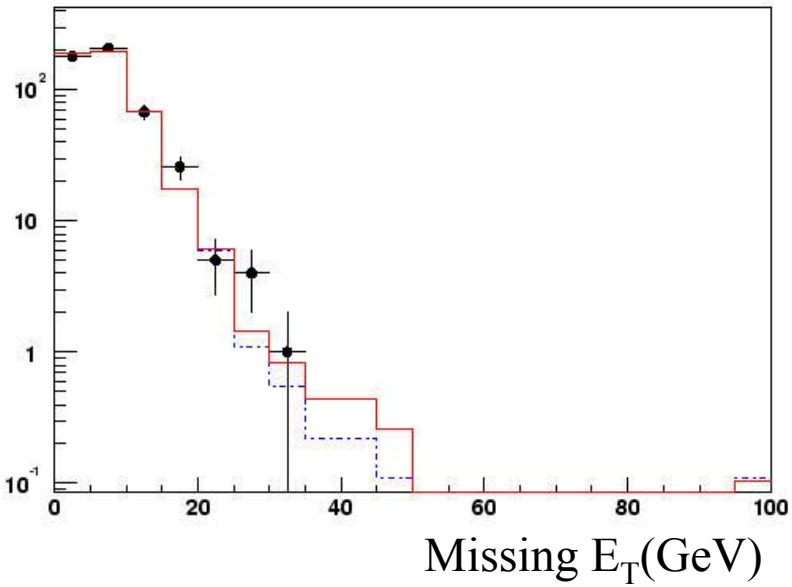
Require:

2 photons w/ $E_T(\gamma)>20$ GeV

missing $E_T>35$ GeV

remove events with likely mis-measured jets or electrons





Data: 0 events Bkgd: 1.38±0.30

$M(\chi_0^1) > 80$ GeV
Run 2 Preliminary

Summary

- Lots of interesting preliminary results
  - Other analyses available on DØ website
- First publications this spring

Stay Tuned!

Topic	Prelim. Run 2	Runs I + 2
LED : ee and $\gamma\gamma$	M_S>1.28 TeV	>1.37 TeV
LED : $\mu\mu$	M_S>880 GeV	
Z′ : $\mu\mu$	M(Z′)>610 GeV	
Z′ : ee	M(Z′)>719 GeV	
LQ1 : eejj	M(LQ1)>231 GeV	>253 GeV
LQ1 : eνjj	M(LQ1)>156 GeV	
LQ2 : $\mu\mu$jj	M(LQ2)>186 GeV	
GMSB : $\gamma\gamma$ + MET	M(χ_0^1)>80 GeV	