LQ search in eejj channel

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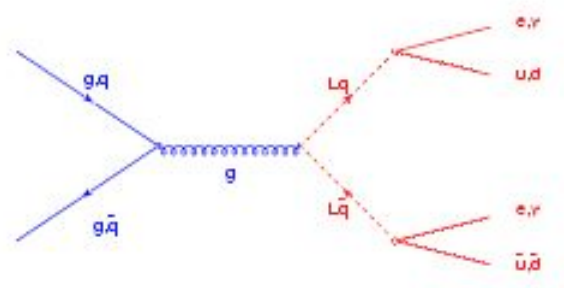
Introduction

- This analysis is an update of the result produced in March 2003
- Reprocessed data from March 2002 to September 2003, used - 203 pb^{-1}
- New categories added
  - use now CentralCentral and CentralPlug electrons;
- New good run list
- New evaluation of efficiencies and background
  - fakes

LQ production at the TeVatron

- Production
  - qg → LQ + LQbar
  - gg → LQ + LQbar
  - qqbar → LQ + LQbar
- Decay
  - LQLQ → l^+l^-qq, $l^\pm\nu qq$, $\nu\nu qq$



β = Br(LQ->eq)

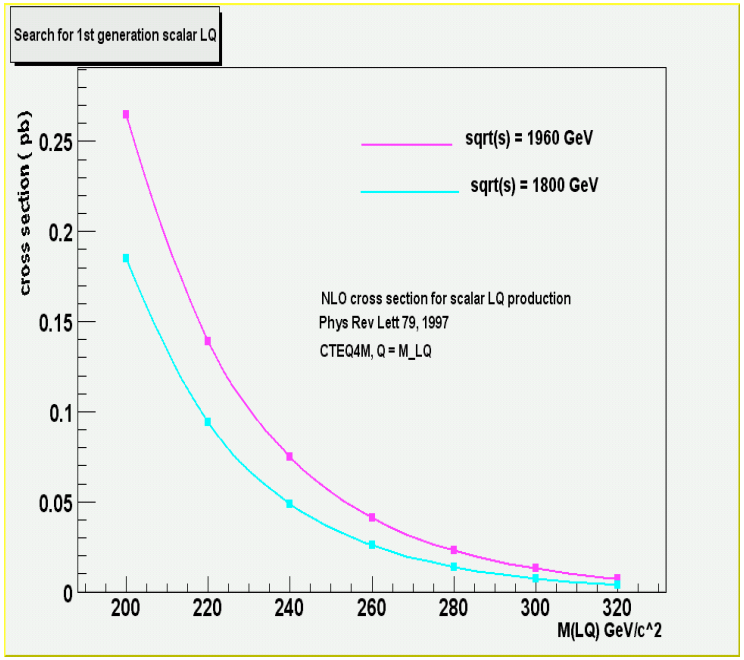
- Experimental signature:
  - High pt isolated leptons (and/or MET) + jets

LQ production at TeVatron

Theory Reference: Phys.Rev.Lett 79,1997

$\sqrt{s}$ = 1960 GeV
$Q^2 = M_{LQ}^2$
CTEQ4M pdf

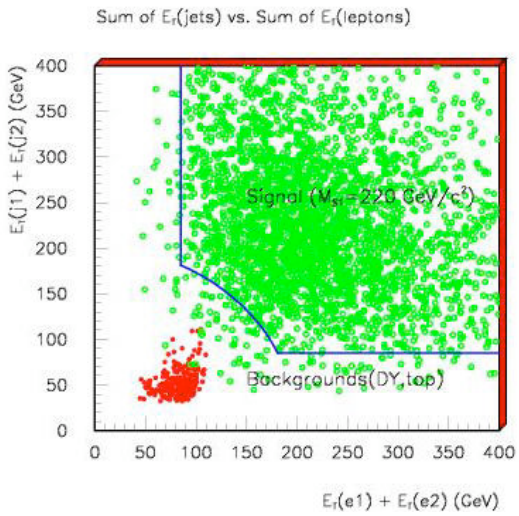
M_{LQ} (GeV/c^2)	(NLO) [pb]
200	0.265E+00
220	0.139E+00
240	0.749E-01
260	0.412E-01
280	0.229E-01
300	0.129E-01
320	0.727E-02



LQ search in eejj

- 2 ele with $E_T > 25$ GeV
- 2 jets with $E_T(j1) > 30$ and $E_T(j1) > 15$ GeV
- removal of events with $76 < M_{ee} < 110$ GeV and $M_{ee} > 15$ GeV
- $E_T(j1) + E_T(j2) > 85$ GeV && $E_T(e1) + E_T(e2) > 85$ GeV
- $((E_T(j1) + E_T(j2))^2 + (E_T(e1) + E_T(e2))^2) > 200$ GeV

High P_T electron triggers (ele_18 and Ele_70)
One tight electron and one loose or plug



Tools

- Signal generated with Pythia
  - 5000 events at masses from 200 to 320
- Background
  - DY + 2 jets
    - generated with alpgen + HERWIG
      - For cross section we used mcfm NLO
      - 50K events for $15 < m_{ee} < 75$
      - 27.5K events for $75 < m_{ee} < 105$
      - 50K events for $105 < m_{ee} < 800$
  - Top
    - Pythia 5K events tt into dileptons
- Fakes from data, with isolation method and same-sign method as cross check;

Efficiencies & acceptance

$$\varepsilon_{tot} = \varepsilon_{Acc}(M) \times \varepsilon_{D} \times \varepsilon_{z0} \times \varepsilon_{trig}$$

- Trigger
  - Top/EW - same as in Z` analysis
    - 99.9 CC
    - 96.8 CP
- Efficiencies for electron selection cuts
  - From Z' analysis
    - ε_{CC} = 92.4 ± 0.4
    - ε_{CP} = 79.2 ± 0.4
- Others
  - efficiency on the vertex cut: 95.1 ± 0.1 (stat) ± 0.5 (sys)

Kinematical and geometrical acceptance

- Events are selected where the HEPG electron is matched in a $\Delta R = (\Delta\eta^2 - \Delta\phi^2)$ cone to the reconstructed electron ;
  - Events are further selected if falling in one of 3 categories (geometrical acceptance - ε^{id}):
    - events with 2 central electrons (fidele == 1)
    - events with 2 central-plug electrons ($1 < |\eta| < 3$)
    - events with 2 plug-plug electrons ($1 < |\eta| < 3$) -- tiny
  - Weights are derived for the 3 contributions ;
- The kinematical cuts are applied and the resulting efficiency weighted according to the CC or CP population.

Electron ID (Z' analysis)

- Central electron (loose or tight)
  - $E_t \geq 25$ GeV
  - $p_t > 15$ GeV
  - hadem <= 0.055 + 0.00045 * E
  - E/p < 4 (for $E_T > 100$ GeV)
  - iso4e/emet < 0.1 (0.2 for second central loose)
  - lDeltaX l < 3.0
  - l DeltaZ l < 5.0 cm
  - Fiducial = 1
  - lshr < 0.2

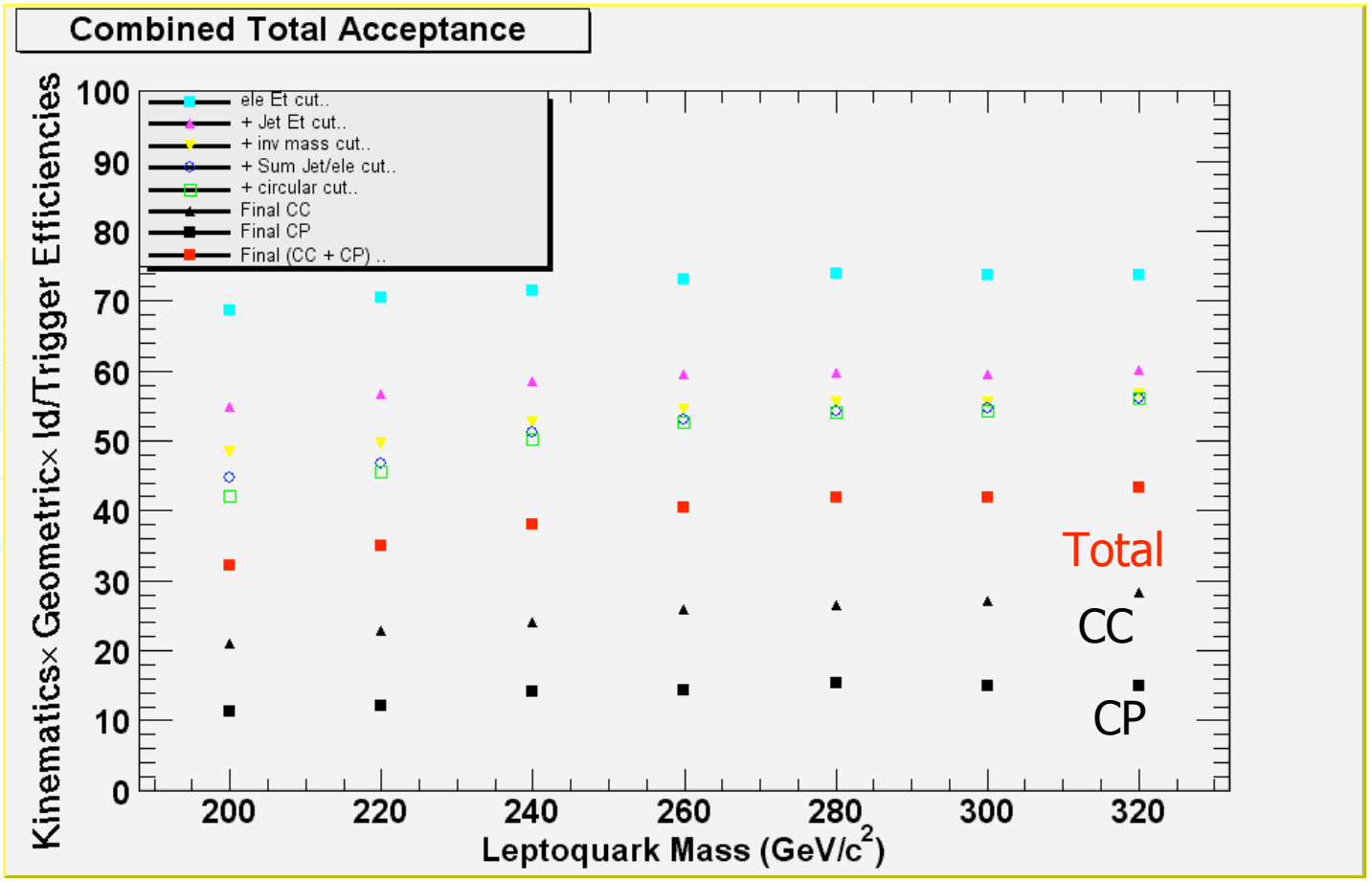
$\varepsilon_{CC} = 92.4 \pm 0.4\%$

$\varepsilon_{CP} = 79.2 \pm 0.4\%$

Second Loose Plug electron

- $E_t \geq 25$ GeV
- Isolation < 0.1
- hadem <= 0.055 + 0.00045 * E
- $\chi^2_{3x3} < 10$
- Fiducial $1 < |\eta| < 3$

Total acceptance



Background expectations

tt with both W ->e	pythia	0.35 ±0.03 events
DY + 2 jets	alpgen+PS/mcfm	1.89 ±0.44 events
Fakes	Isolation	4.0 ± 2.0 CP
		$0.0^{+0.7}_{-0}$ CC
	Total	$6.24\ ^{+3.1}_{-2.5}$

Analysis results

4 events survive the analysis cuts:

Number of events with 2 electrons with $E_T > 25$ GeV	12461
2 jets with $E_T(j1) > 30$ GeV and $E_T(j1) > 15$ GeV	138
removal of events with $76 < M_{ee} < 110$ GeV	46
$E_T(j1) + E_T(j2) > 85$ GeV && $E_T(e1) + E_T(e2) > 85$ GeV	21
$((E_T(j1) + E_T(j2))^2 + (E_T(e1) + E_T(e2))^2) > 200$ GeV	4

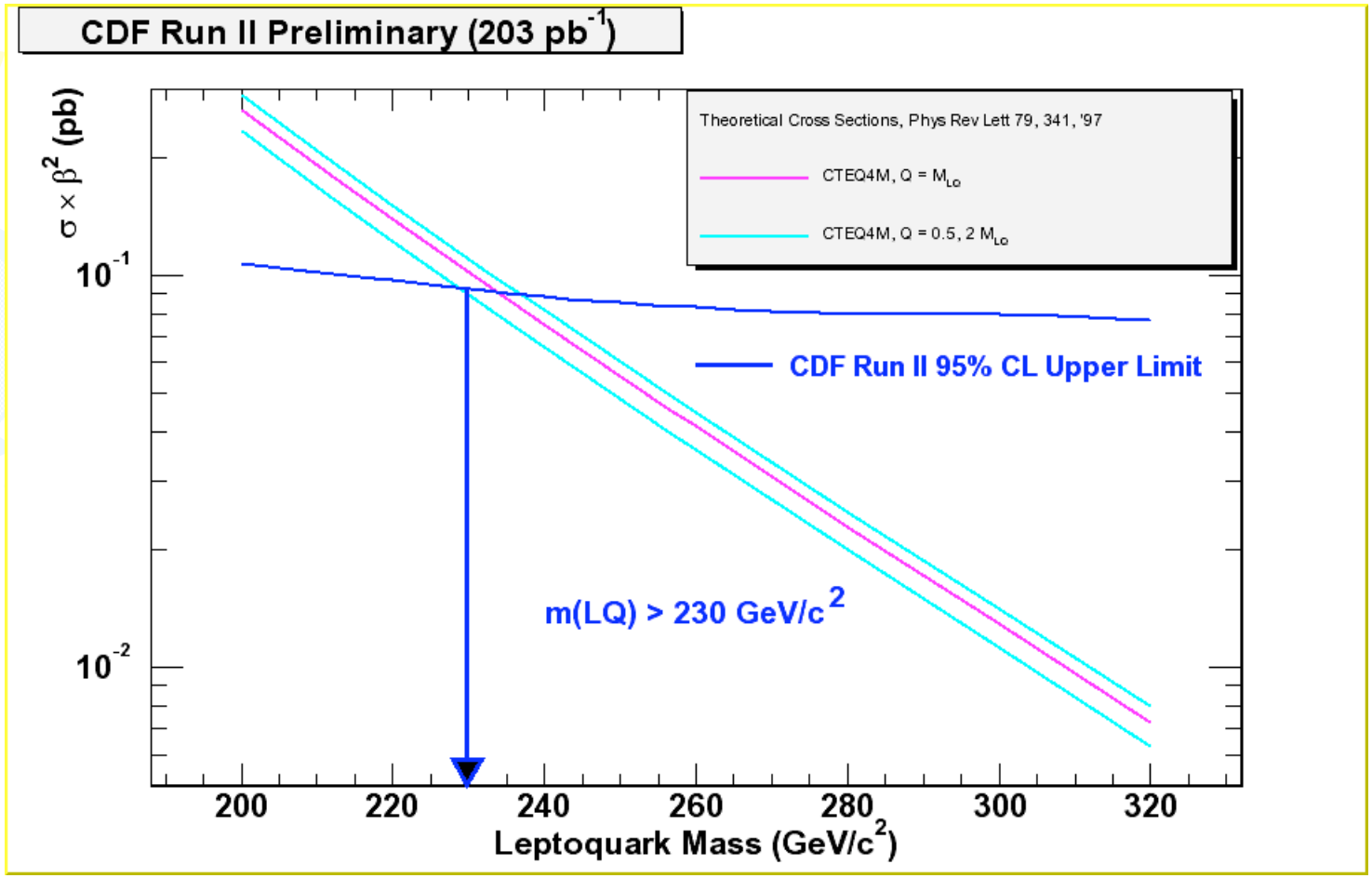
Systematics and combined relative uncertainty

- Luminosity……6%
- Acceptance
  - –pdf …… 4.3%
  - –statistical error of MC…….. 2.2%
  - –jet energy scale …7.6 -1.3 %
- Electron ID efficiency (Z') …0.8%
- Event vertex cut …….5%

LQ mass	Acceptance (%)	Abs Stat	Abs Sys	Tot Relative
200	32.24	± 0.85	± 4.57	0.14
220	35.07	± 0.79	± 4.13	0.12
240	38.11	± 0.80	± 3.8	0.10
260	40.4	± 0.82	± 3.7	0.09
280	41.8	± 0.84	± 3.6	0.087
300	41.9	± 0.84	± 3.5	0.084
320	43.3	± 0.84	± 3.4	0.080

Final relative uncertainty on acceptance 13-9%

Cross section Limit



Conclusions

- A preliminary 95% CL cross section lower limit as a function of M_{LQ}, for leptoquarks decaying with 100% branching ratio into eq ($\beta = 1.0$) has been set.
  - CC and CP electrons have been used;
- Comparing it to the NLO theoretical predictions for leptoquark pairs production at the TeVatron, an upper limit on the Leptoquark mass is obtained at

$$m_{LQ} > 230 \text{ GeV}/c^2$$