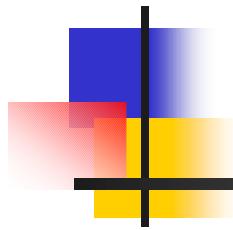
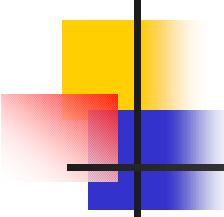


LQ search in eejj channel



Simona Rolli (TUFTS)
-blessing-



Introduction

- Some beyond the SM models assume additional symmetry between leptons and quarks
- LeptoQuarks – transition between leptons and quarks
 - Have both lepton and baryon numbers
 - λ - unknown coupling to leptons and quarks

LQ production at the TeVatron

■ Production

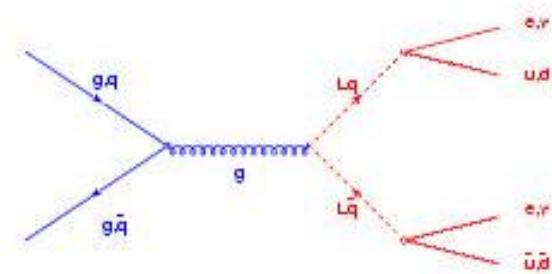
- $qg \rightarrow LQ + L\bar{Q}$
- $gg \rightarrow LQ + L\bar{Q}$
- $q\bar{q} \rightarrow LQ + L\bar{Q}$

■ Decay

- $LQL\bar{Q} \rightarrow l^+l^-q\bar{q}, l^\pm n\bar{q}q, nn\bar{q}\bar{q}$ $\beta = \text{Br}(LQ \rightarrow eq)$

■ Experimental signature:

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



LQ production at TeVatron

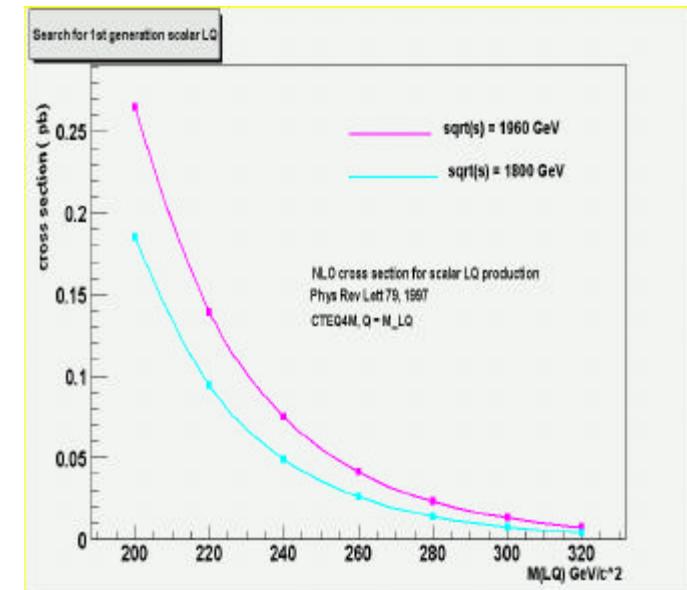
Code from Michael Kraemer (Phys.Rev.Lett 79,1997)

M_{LQ} (GeV/c^2)	$\sigma(\text{NLO})$ [pb]
200	0.185E+00
220	0.094E+00
240	0.489E-01
260	0.259E-01
280	0.138E-01
300	0.746E-02
320	0.401E-02

M_{LQ} (GeV/c^2)	$\sigma(\text{NLO})$ [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

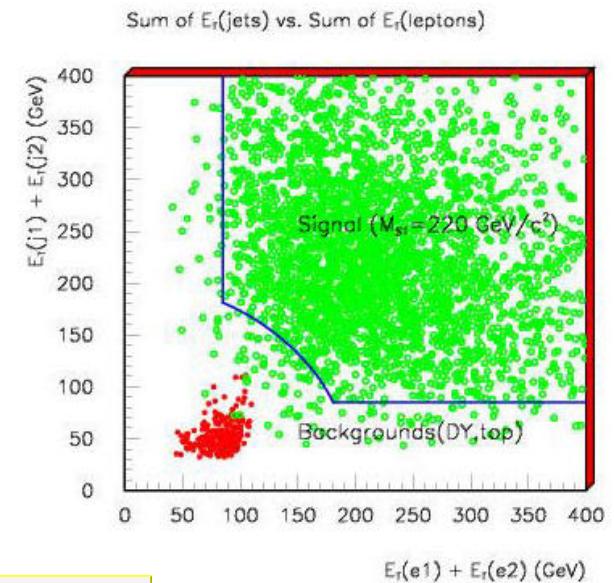
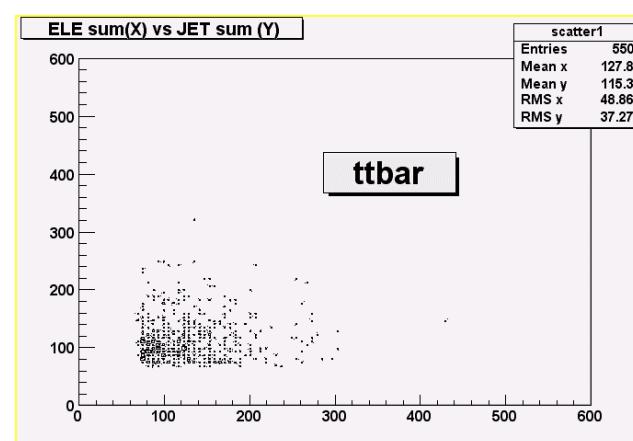
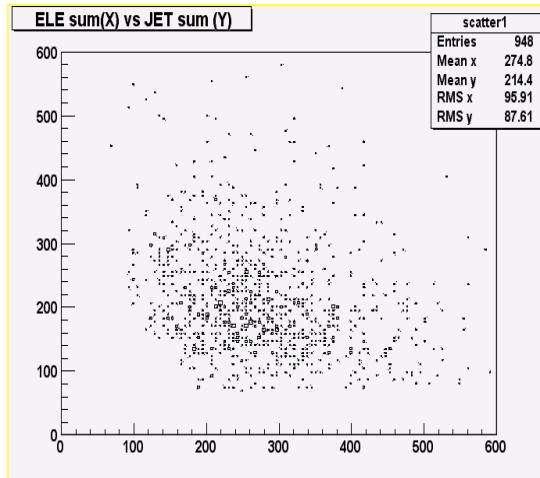
$\sqrt{s} = 1800 \text{ GeV}$
 $Q^2 = M_{LQ}^2$
CTEQ4M pdf

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



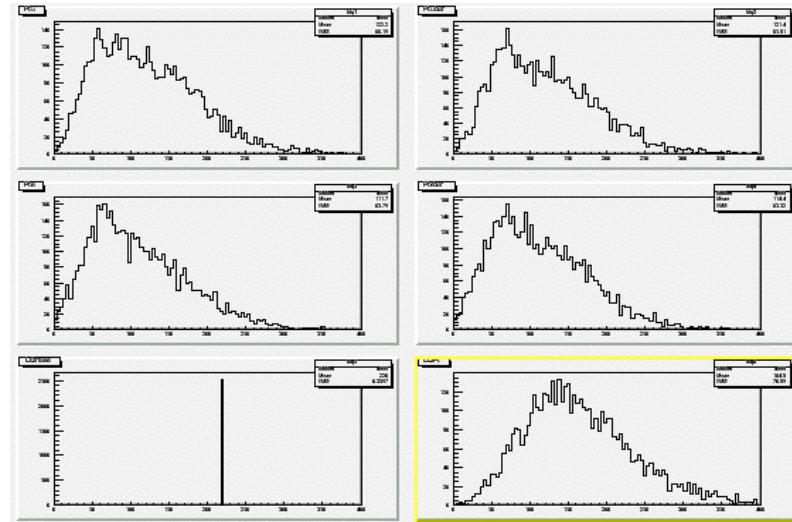
LQ search in eejj

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

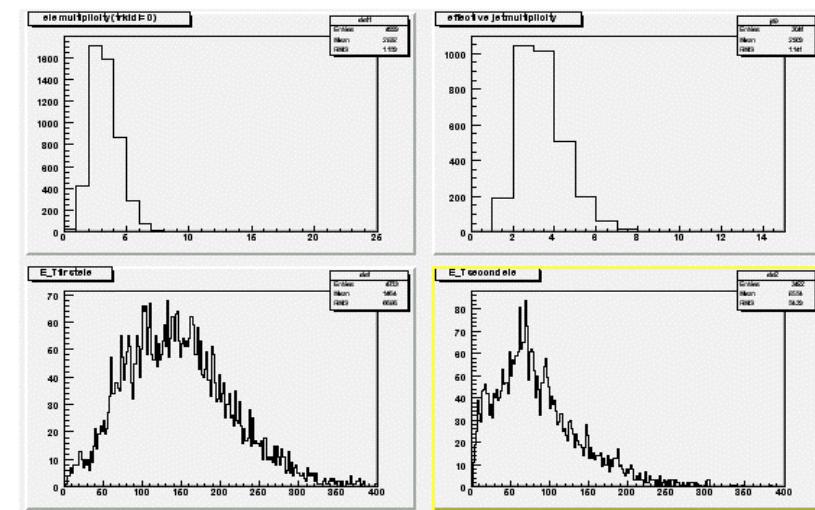


Tools

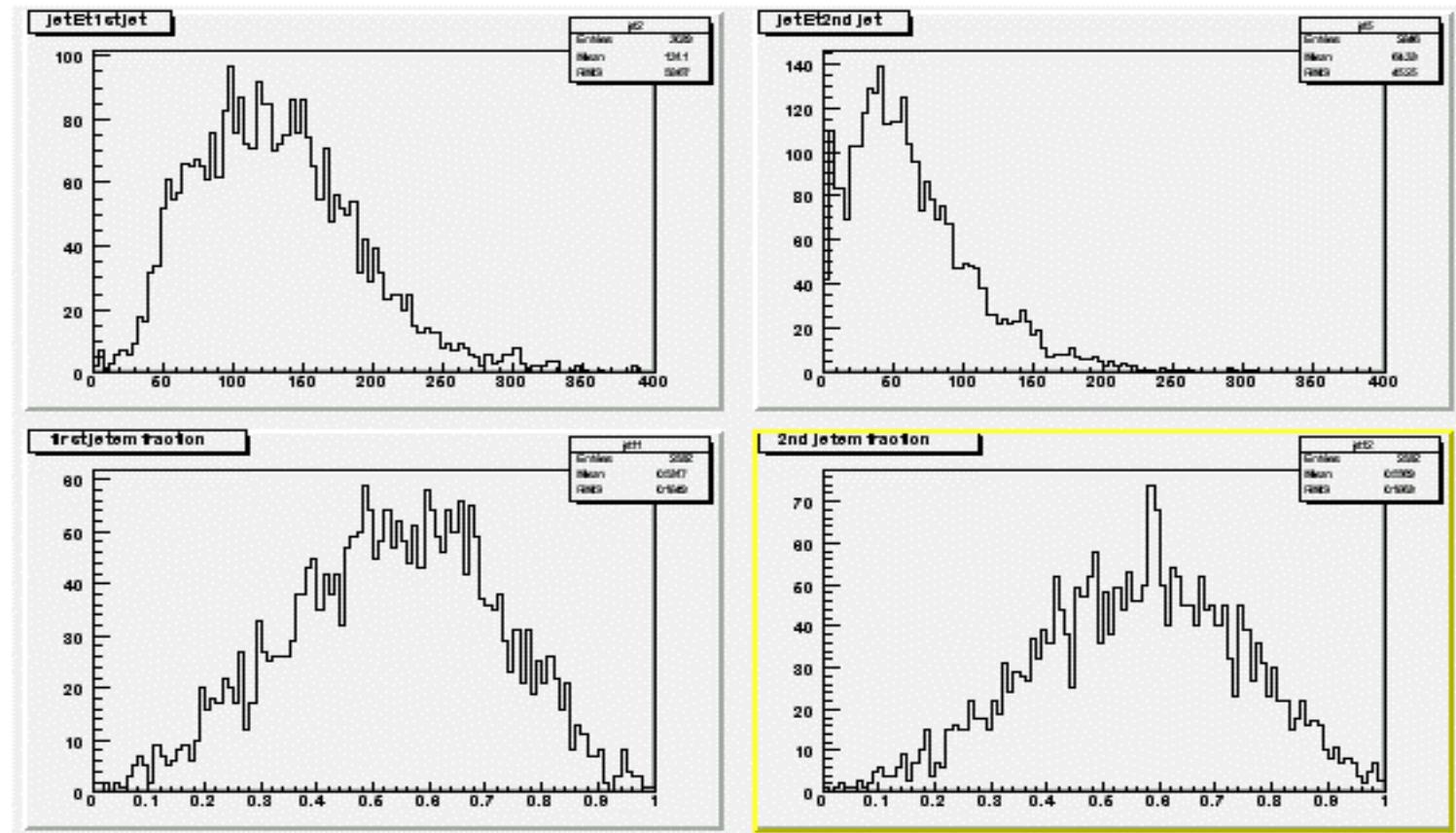
- Signal generated with Pythia
 - for cross section we used Kraemer et al.
 - 5000 events at masses from 200 to 320

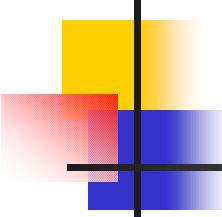


$$M(LQ) = 220 \text{ GeV}/c^2$$



MC distributions (cont'd)

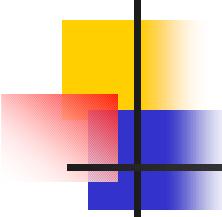




Efficiencies & acceptance

$$\epsilon_{\text{tot}} = \epsilon_{\text{Acc}}(M) \times \epsilon_{\text{ID}} \times \epsilon_{z0} \times \epsilon_{\text{trig}}$$

- Trigger
 - Top/EW - as in Z' analysis we use $99.1 \pm 0.1\%$
- Efficiencies for electron selection cuts
 - Z' analysis
 - $\epsilon_{\text{CC}} = 83.2 \pm 0.8$
- Other
 - efficiency on the vertex cut ($|z_0| < 60$ cm) 95.2 ± 0.1 (stat) ± 0.5 (sys)



Electron ID (Z' analysis)

- Central electron (loose or tight)

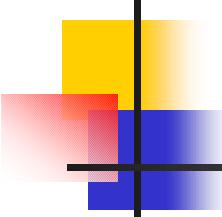
- $E_t \geq 25 \text{ GeV}$
- $p_t > 10 \text{ GeV}$
- hadem $\leq 0.055 + 0.00045 * E$
- $E/p < 4$ (for $E_T < 200 \text{ GeV}$)
- iso4e/emet < 0.1 (0.2 for second central loose)
- $|\Delta x| < 3.0$
- $|\Delta z| < 5.0 \text{ cm}$
- Fiducial = 1
- Ishr < 0.2

$$\epsilon_{CC} = 83.2 \pm 0.5\%$$

$$\epsilon_{CP} = 69.3 \pm 0.8\%$$

Second Loose Plug electron
(not used in this analysis)

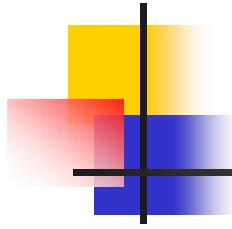
- $E_t \geq 25 \text{ GeV}$
- Isolation < 0.1
- hadem $\leq 0.055 + 0.00045 * E$
- Fiducial $1 < |\eta| < 3$



Expected signal events

Number of
expected events
in 72 pb^{-1}

Mass (GeV/c^2)	n Theory CTEQ4M (pb)	n Theory CTEQ4M (pb)
	$Q^2 = M_{\text{LQ}}^2/4$	$Q^2 = 4M_{\text{LQ}}^2$
200	8.768	7.07
220	4.89	3.95
240	2.86	2.3
260	1.62	1.29
280	0.93	0.74
300	0.54	0.43
320	0.32	0.25



Background

- tt with both $W \rightarrow e\nu$ 0.25 ± 0.03 events
 - pythia
- DY + 2 jets 3.13 ± 2.8 events
 - alpgen + PS
- Total 3.39 ± 3.15

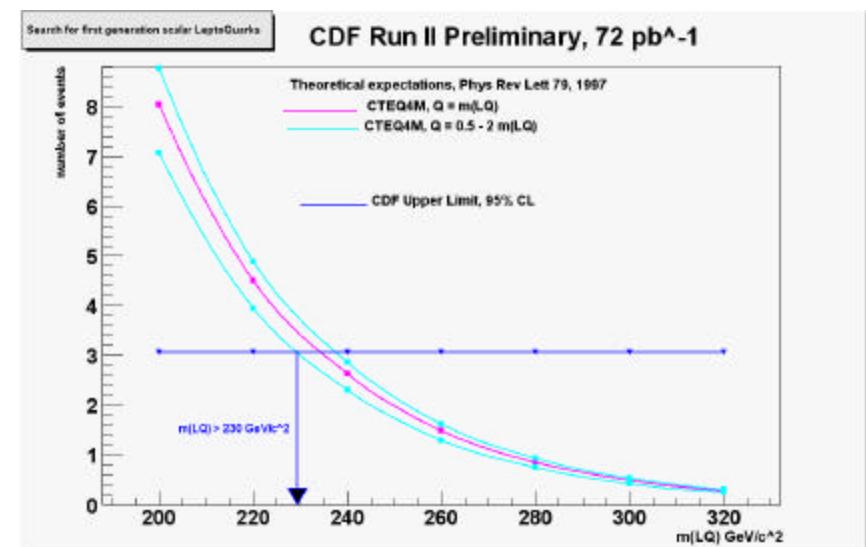
Analysis results

0 events survive the analysis cuts:

Number of events with 2 ele > 25	1970
2 jets with $E_T(j1) > 30$ and $E_T(j1) > 15$ GeV	26
removal of events with $76 < M_{ee} < 110$ GeV	9
$E_T(j1) + E_T(j2) > 85$ GeV $\&\&$ $E_T(e1) + E_T(e2) > 85$ GeV	2
$\sqrt{(E_T(j1) + E_T(j2))^2 + (E_T(e1) + E_T(e2))^2} > 200$ GeV	0

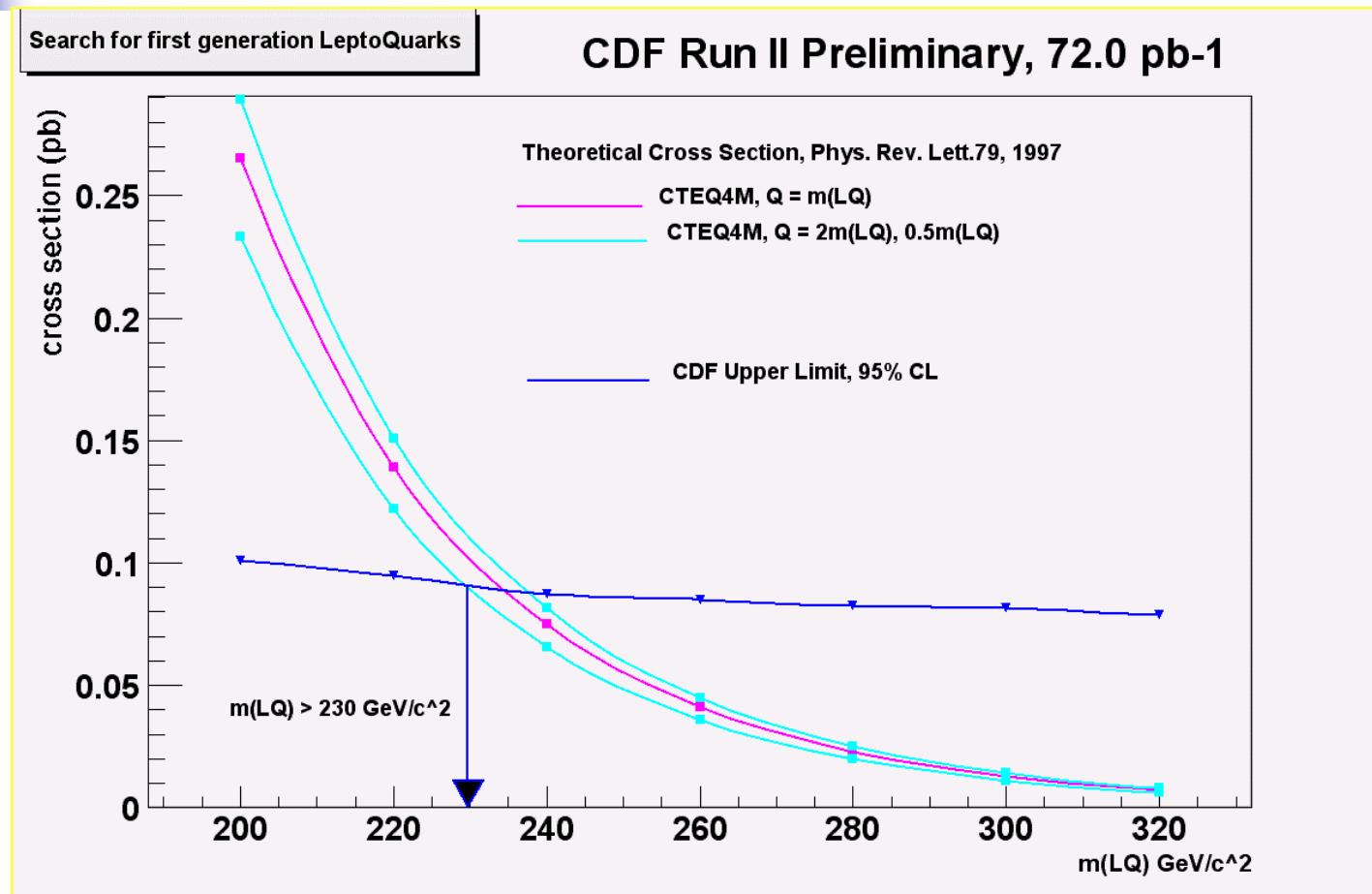
Number of events

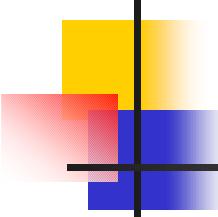
$M_{LQ} > 230$ GeV @ 95% CL



25% increase in the cross section
~factor 1/3 less luminosity
acceptances slightly higher

Cross section Limit

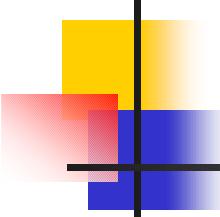




Systematic uncertainties

- Luminosity: 6%
- Acceptance
 - pdf 4.3%
 - statistical error of MC 2.2%
 - jet energy scale (Level 3) 2.9 - 0.7 % (absolute uncertainty)
- Electron ID efficiency (Z')
 - statistical error of $Z \rightarrow e^+e^-$ sample: 0.8%
 - energy scale : 3.7%
- Event vertex cut : 0.5%

Final relative
uncertainty on
acceptance 9%



Conclusions

- A preliminary 95% CL cross section lower limit as a function of M_{LQ} , for leptoquarks decaying with 100% branching ratio into eq ($\beta = 1$) has been set.
- Comparing it to the NLO theoretical predictions for leptoquark pairs production at the TeVatron, an upper limit on the Leptoquark mass is obtained at

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

- consistent with run I limit at $220 \text{ GeV}/c^2$