Thirteenth International Conference on Supersymmetry
and Unification of Fundamental Interactions

Searches for New Phenomena : non-SUSY scenarios

Emmanuelle PEREZ
DESY & CEA-Saclay, DSM / DAPNIA / Spp

- Searches in well-known final states :
  - indirect effects
  - resonances
- Searches in rare SM final states
- Funny experimental signatures…

Searches for New Physics : why & where

Mechanism of the EW symmetry breaking ?

→ Higgs (i.e. fundamental scalar) ? Find it…
  → structure of the Higgs sector ?
  → solution of the hierarchy problem ?

SUSY → M_{Pl} ? "Little Higgs" → ≈ 10 TeV ?
extra dimensions → no hierarchy ?

→ no Higgs ? Dynamical breaking ? (H ~ condensate)
  extra-dim physics ? (H ~ Gauge Field$|_{4d}$)

In most scenarios, new physics is expected at the TeV scale.
Also hoped for, that NP might answer some of the questions unexplained by the SM or by SM+SUSY (e.g. quantization of EM charge, particle masses etc)

Various strategies to track new physics, e.g. :
- high precision measurements (need good theoretical control)
- rare decays (K & B) , LFV processes
- searches at high energy colliders → LEP, Tevatron, HERA

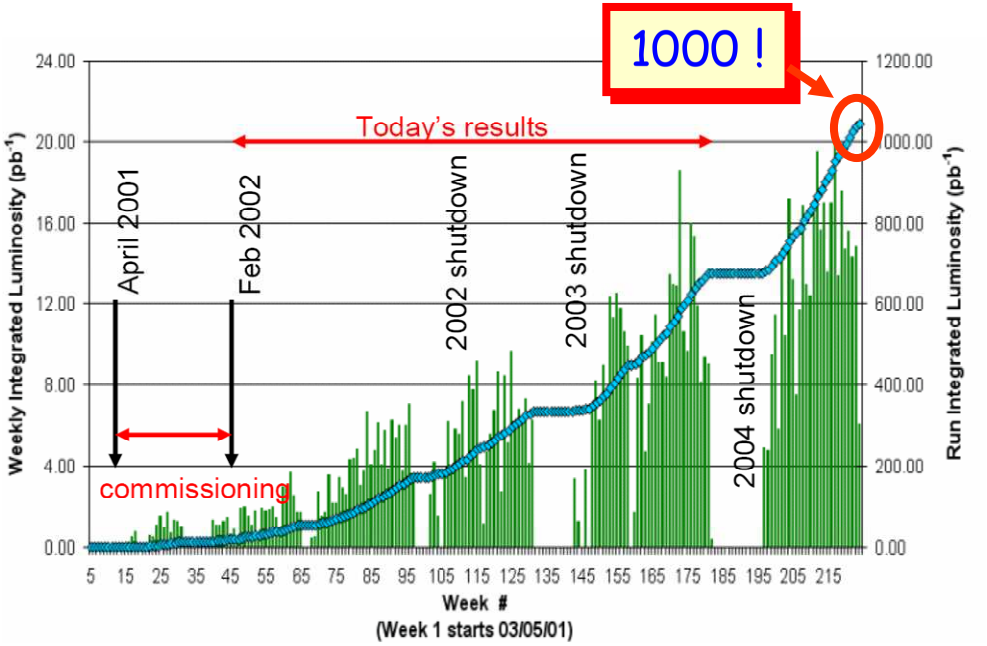
Some complementarities between these different approaches and between measurements at the three high energy colliders.

Good performances of our facilities !

Tevatron $p\bar{p}$, $\sqrt{s}$ = 1.96 TeV CDF & D0

Run I (92-96) : ≈ 110 pb^{-1} / exp

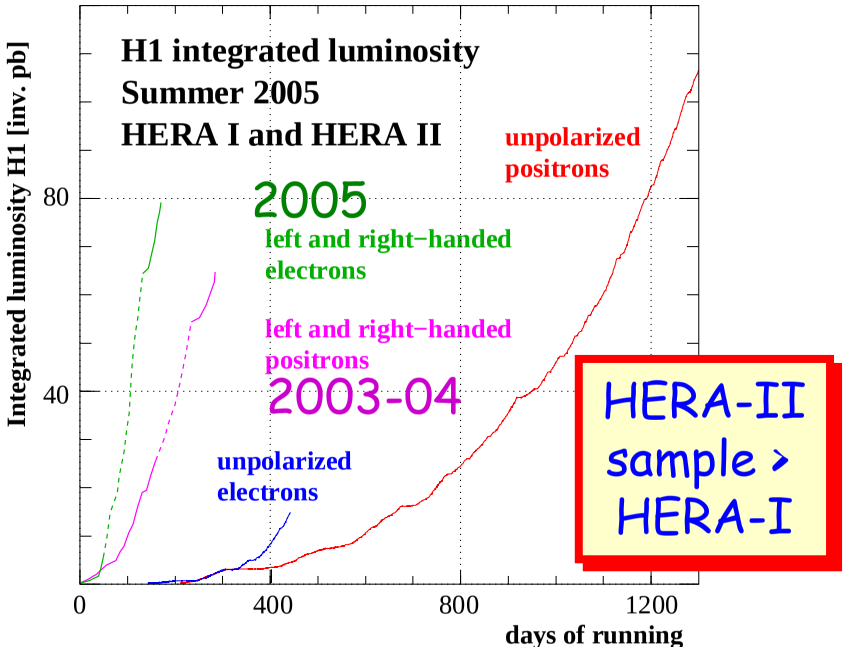
Run II (since 01) → ≈ 1 fb^{-1} delivered



Analyses presented here ≈ 200-450 pb^{-1} of Run II data (2002 - 2004)

HERA $e^{\pm}p$, $\sqrt{s}$ = 320 GeV H1 & ZEUS

until summer 2000 : ≈ 120 pb^{-1} / exp (mainly e+ p)



HERA I+II analyses : up to ≈ 200 pb^{-1}

+ LEP data ! Very relevant constraints on NP ! some final combinations are still to come
+ B-factories : BaBar and Belle collected 350 millions of BB pairs !

Some news from the Standard Model…

- $\sin^2\theta_W$ at NuTev ? Differs by ≈ 3 σ from global SM analysis

  Not clear… theoretical uncertainty ? e.g. asymmetry in s-$\bar{s}$, violaton of isospin in parton distributions due to QED effects ?

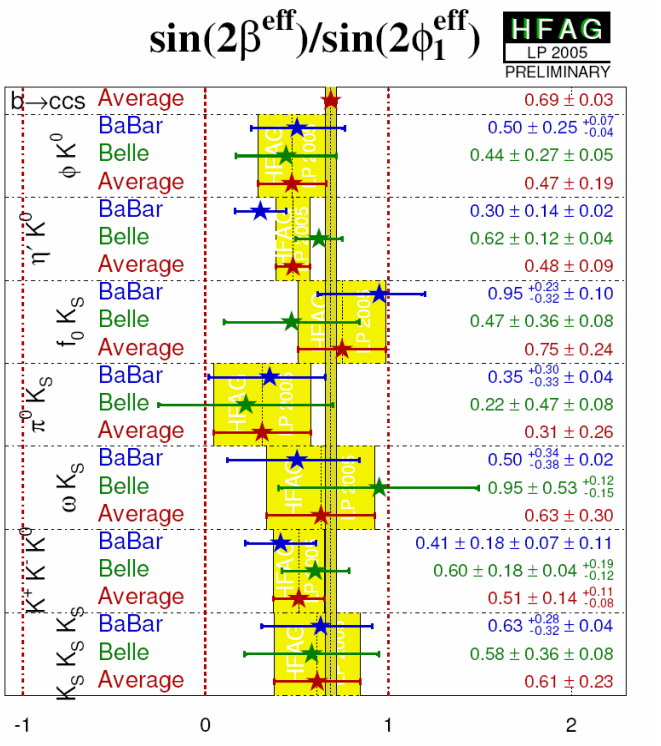
- $(g-2)_\mu$? Very precise measurement at BNL (0.5 ppm !)

?

Above the SM value (2.7 σ) if low energy e^+e^- data are used for a_μ^{HAD}

  - $e^+e^- \to 4\pi$ at BaBar using ISR photons : somehow in-between e^+e^- & τ
  - $\sigma(e^+e^- \to \pi\pi)$ by KLOE at DAΦNE ($\sqrt{s} \approx 1$ GeV) : confirms the other e^+e^- meas. …

KLOE, hep-ex/0407048
Burkhardt & Pietrzyk, hep-ph/0506323

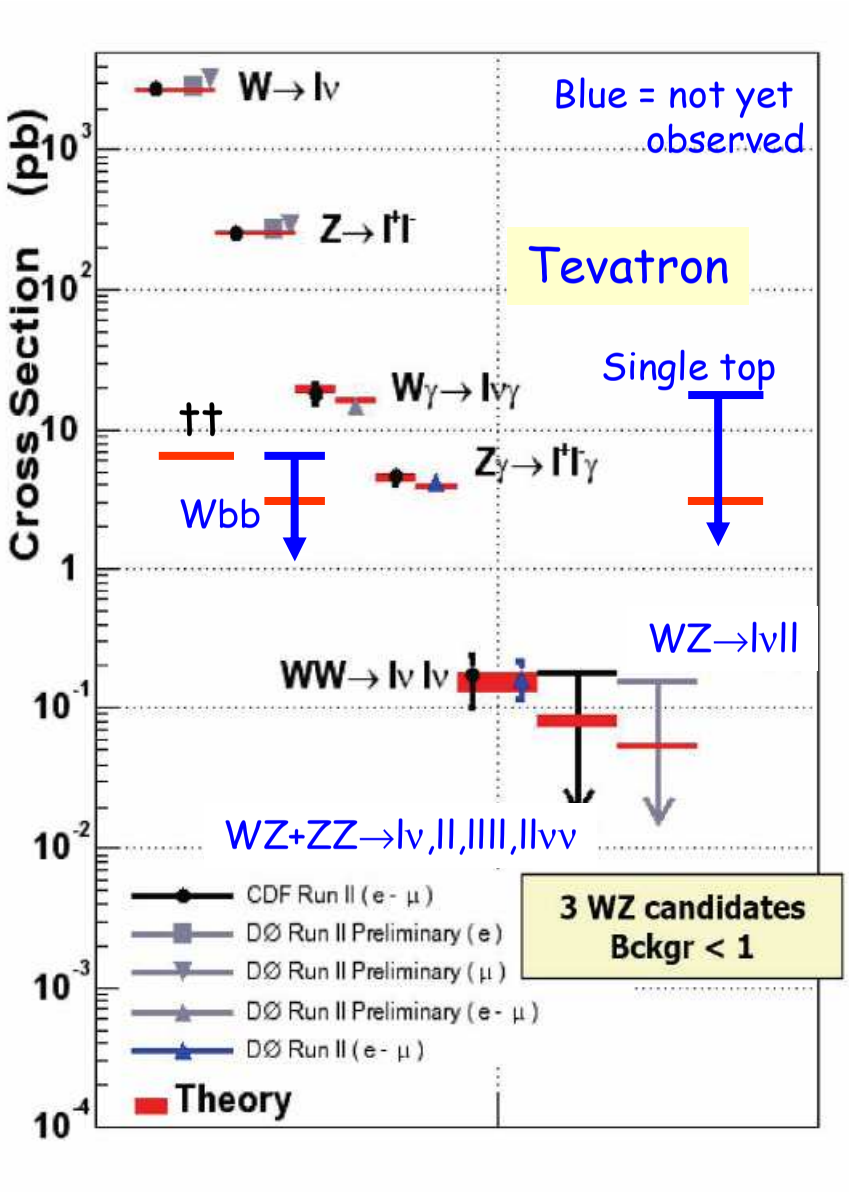


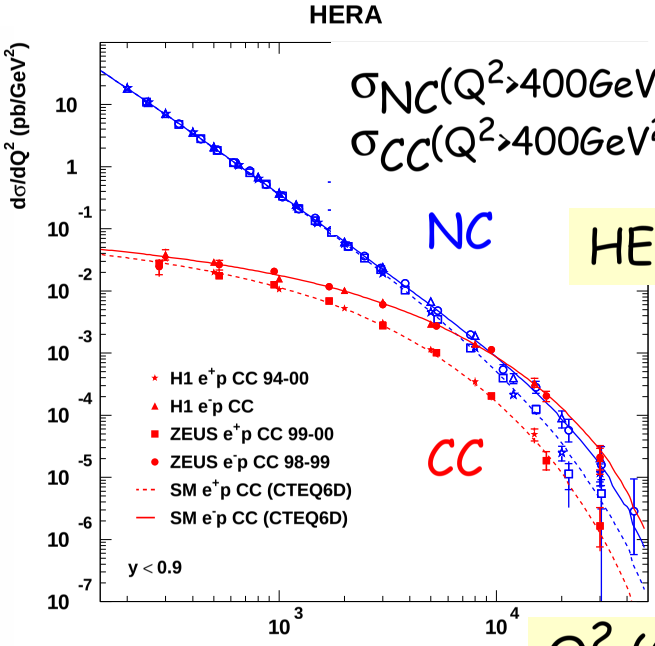
- New value of V_{us} : New measurements from KTeV and KLOE → unitarity restored !

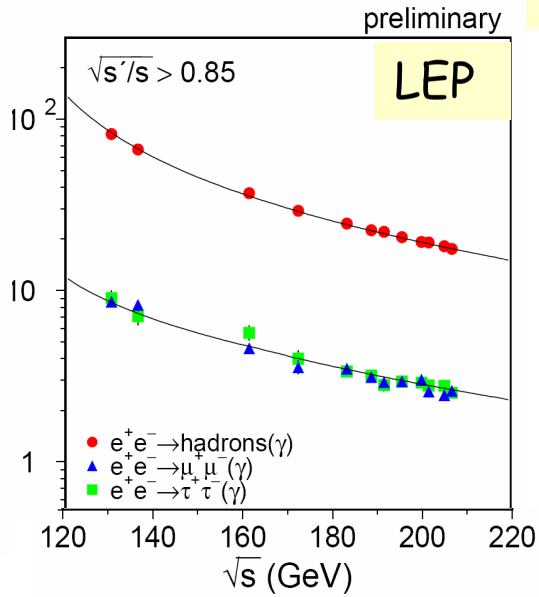
- sin(2β) from b → s penguins :
  WA. from charmonium modes went down (LP'05)
  Discrepancies seem to get smaller …

- Still discrepancies in polarisation data in B decays into vector meson when penguins are involved… could be explained by final state interactions ? Belle, PRL 94 (2005) 221804

Our backgrounds for NP searches at colliders

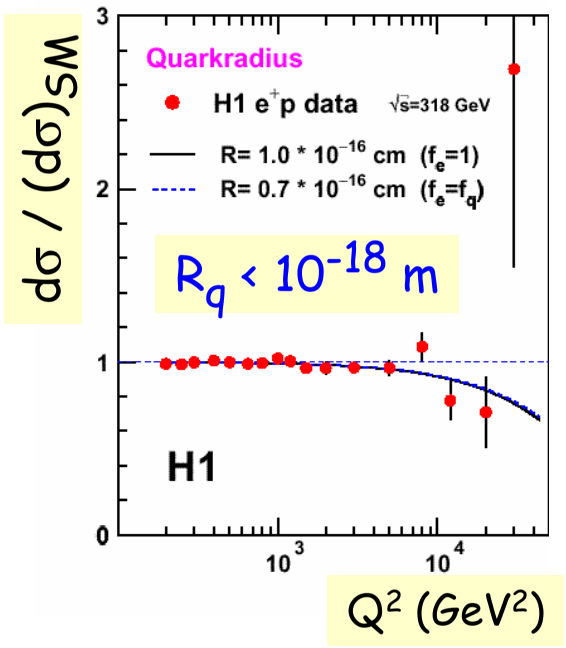






In this talk :
From well-known processes to rare & very rare processes

A lot to learn from "bread & butter" @ colliders

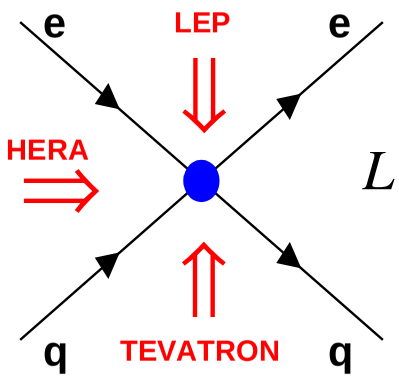


First simple example :

E.g. DIS as the golden process to study the structure of matter : (at HERA, $Q^2_{max} \approx 10^5$ GeV^2)

assign a finite size to the EW charge distributions.

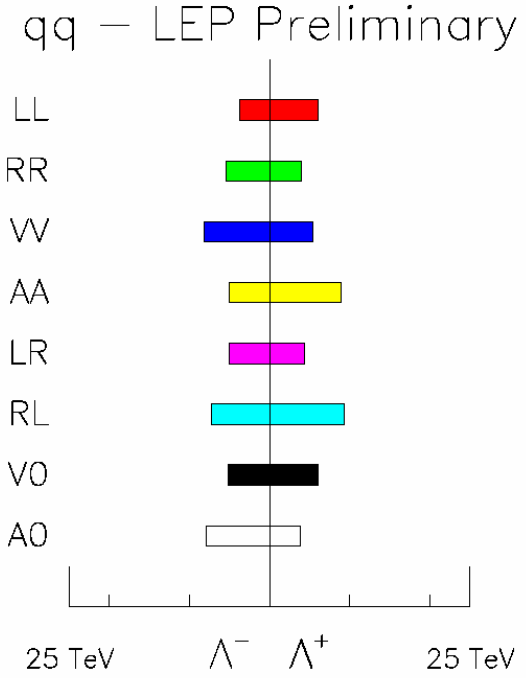
$$f(Q^2) = 1 - \frac{\langle r^2 \rangle}{6} Q^2$$



2nd "generic" example : assume that the scale Λ of NP is large, parameterize the effects of NP as a four-fermion interaction :

$$L = \sum_{i,j=L,R} \varepsilon^{e,q}_{i,j} \frac{4\pi}{\Lambda^2} (\bar{e}_i \gamma^\mu e_i)(\bar{q}_j \gamma_\mu q_j)$$

Typical bounds $\Lambda >$ 5 - 20 TeV

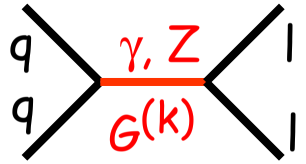


Next slides : examples of model-dependent constraints

Dileptons, $\gamma\gamma$, DIS & Extra Dim. Scenarios

Interference of KK exchange with SM processes (ee, $\mu\mu$, $\gamma\gamma$, DIS)

- Large extra-dim (AADD) : tower of gravitons $G^{(k)}$



e.g. ll, $\gamma\gamma$ at Tevatron :

At high mass :	
ee	DY, QCD "fake"
$\mu\mu$	DY

Effective coupling : $A \alpha \lambda / M_S^4$
(not a direct probe of M_D)

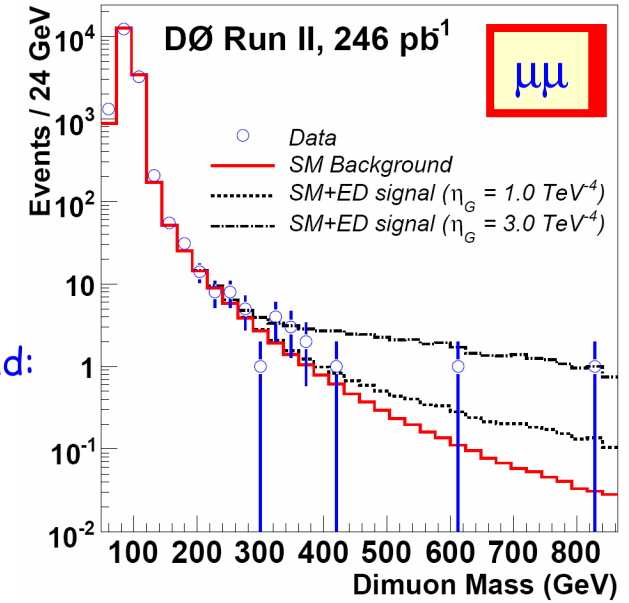
- ee & $\gamma\gamma$ at LEP : $M_S > 1.34$ TeV
- DIS at HERA : $M_S > 0.82$ TeV

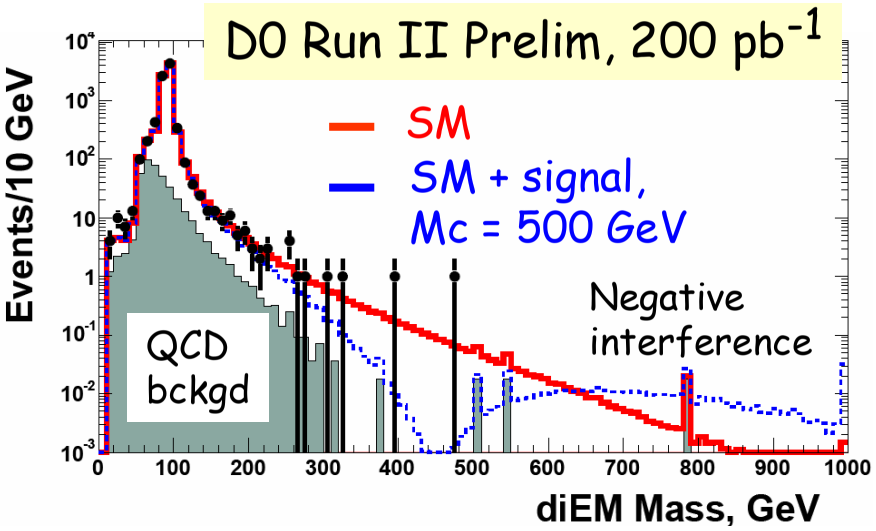
Tevatron 2 fb^{-1} : M_S up to ≈ 2 TeV

Most stringent collider bound:

D0 Run II + Run I, ee & $\gamma\gamma$: $M_S > 1.43$ TeV

D0, hep-ex/0506063





- Gauge bosons in "internal" extra-dim :

$M_C = 1/R_{//} \sim$ mass of $V^{(1)}$

$qq \rightarrow \gamma, Z, \gamma^{(1)}, Z^{(1)} \rightarrow ee$

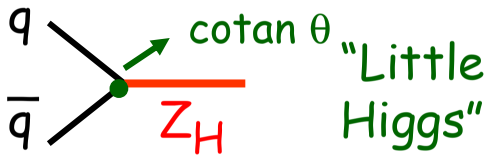
LEP & low energy $\rightarrow$ Mc > a few TeV

Mc > 1.12 TeV

First dedicated search at a collider

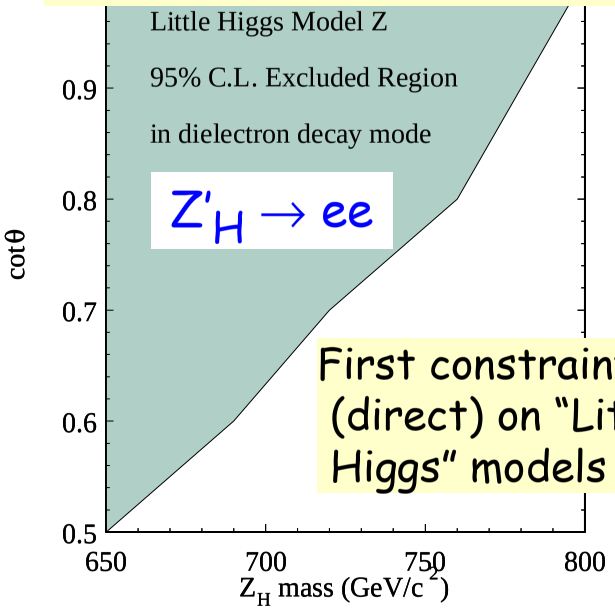
Examples of dilepton resonances

- New heavy gauge boson Z ', e.g. models with L-R symmetry or E_6 GUT inspired
- (Color-singlet) technirho in Technicolor models
- Kaluza-Klein gravitons in some extra-dim. models



- Intrinsic width of new particles usually small compared to the detector resolution
- At high mass acceptances do not depend too much on the spin (typically ~ 50% for ee)

CDF II Prelim, 200 pb^{-1}



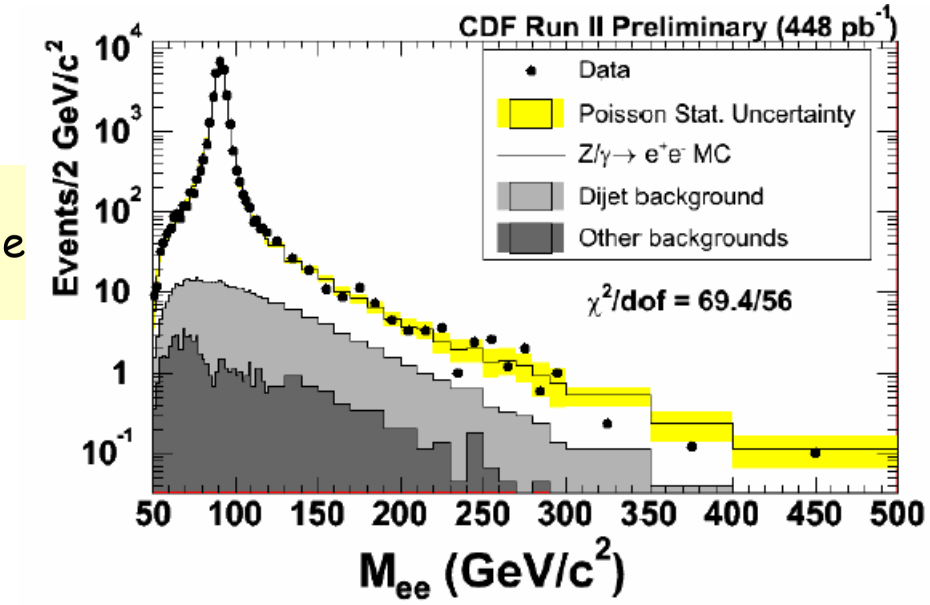
First constraints (direct) on "Little Higgs" models !

(although "minimal" models predict heavier Z_H, 2-6 TeV)

D0/CDF, from M_{ll} and ~ 200 pb^{-1}

$\sigma \times BR(e) < \sim 30$ fb from ee
$\sigma \times BR(\mu) < \sim 40\text{-}80$ fb from $\mu\mu$
$\sigma \times BR(\tau) < \sim 1$ pb from $\tau\tau$

above 600 GeV



Still good agreement with SM in 450 pb^{-1}

~ 100 evts above 200 GeV

Recent Z' searches

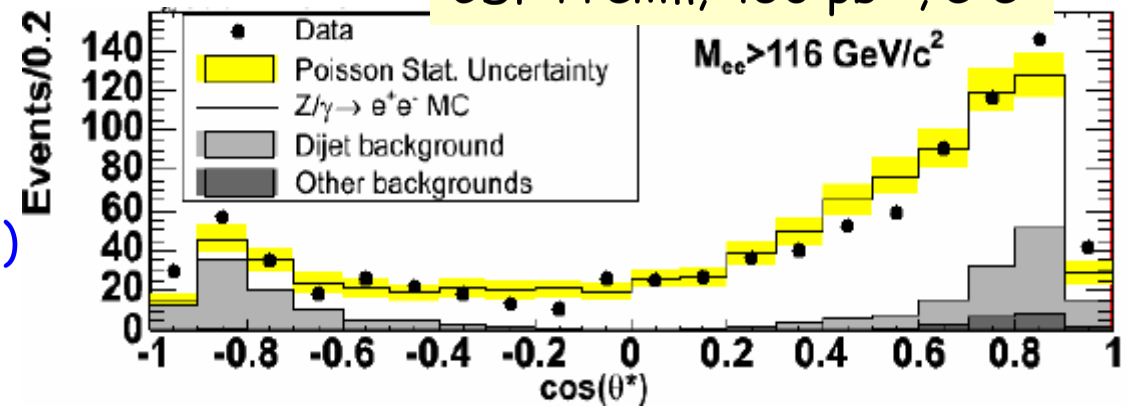
Limits & sensitivities on Z ' bosons often expressed in :

- SSM : Z ' couples to fermions like the SM Z
- E_6 inspired models :

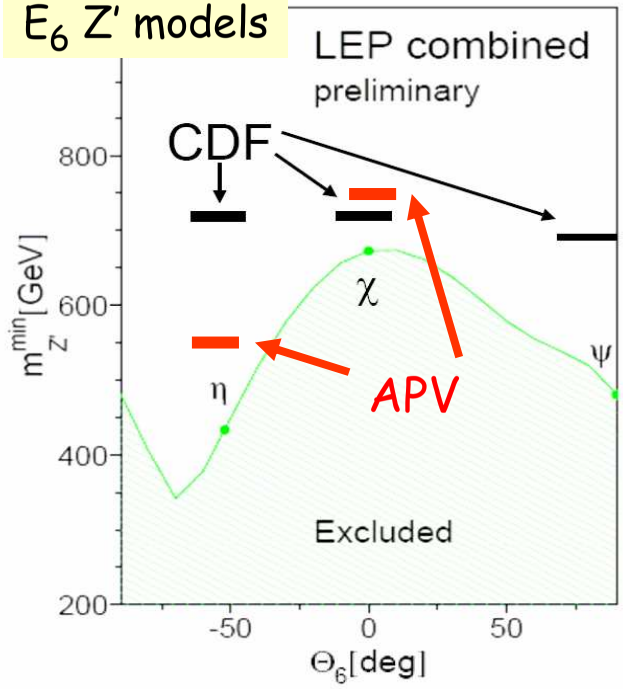
  $Z' = Z_\psi \sin\theta_6 + Z_\chi \cos\theta_6$

- Recent Tevatron searches for Z' use both Mee and cos(ϑ^*) (cf LEP sensitivity via A_{FB})

CDF Prelim, 450 pb^{-1}, e^+e^-



E_6 Z' models



Adding cos(ϑ^*) ≈ to 25% more $\mathcal{L}$!

$M(Z'_{SSM}) > 845$ GeV (LEP : 1.8 TeV)

$\sigma \times BR(e\nu) < 30$ fb @ 800 GeV

E_6 models : direct bounds from Tevatron better than the indirect LEP bounds

Indirect bounds from LEP much more model dependent

- New models tested, beyond E_6 M. Carena et al, PRD70 (2004) 093009
  - Relax GUT relations for $g_{Z'}$
  - Classify models according to the U(1)' charges of fermions :

Dilepton & diboson resonances : RS gravitons

"Localized gravity" on a "brane" at $d \neq 0$ from our brane; propagation of gravity in the extra dim is exponentially damped due to the (tuned) space-time metric

Randall & Sundrum models; "usual" version : n=1, $R_c \approx$ Planck length

PRL 83 (1999) 3370;
PRL 83 (1999) 4690

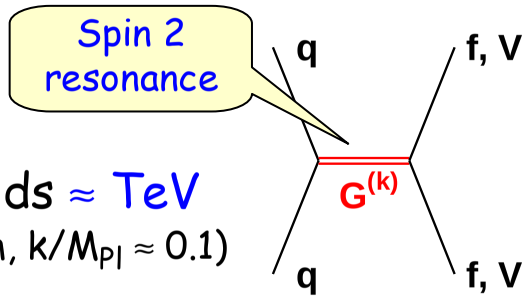
Graviton propagate in extra dim → Kaluza-Klein modes

In localized gravity :

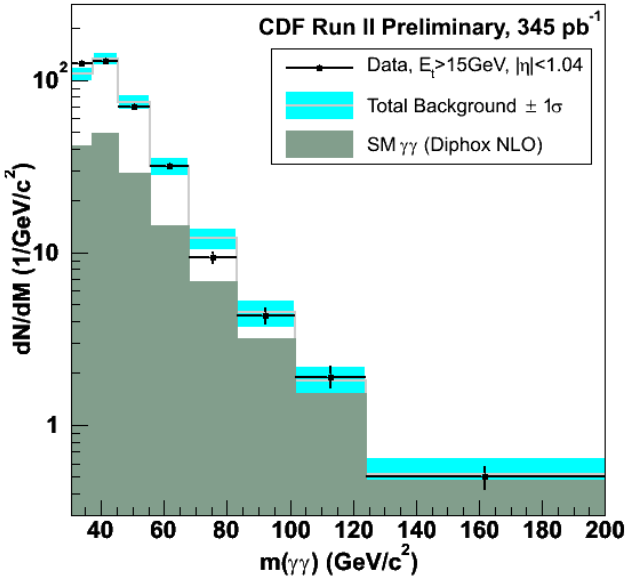
$G^{(k)}$ heavy, $G^{(1)} \approx$ TeV

Coupling of $G^{(k)}$ to SM fields ≈ TeV

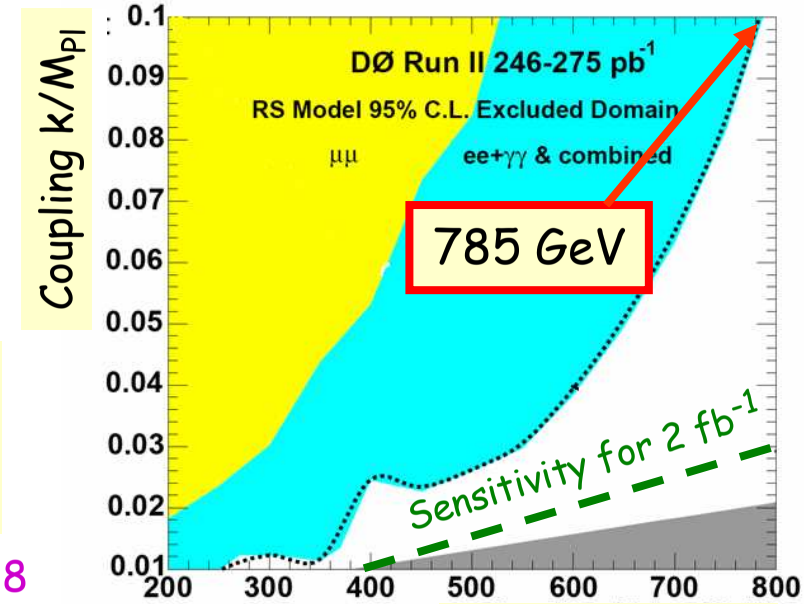
(determined by some model param, $k/M_{Pl} \approx 0.1$)



First direct constraints on Randall-Sundrum models !



γγ brings a large sensitivity to RS gravitons since large branching



D0 (γγ, ee, μμ) :
for M > 500 GeV,
σ x BR(γγ) < 18 fb

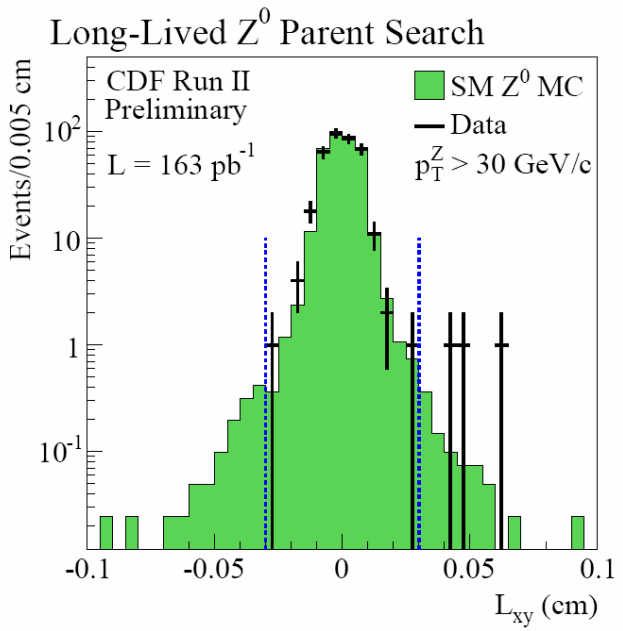
D0, hep-ex/0505018

Main bckgs in γγ :
- jets → π^0
- genuine γγ, dominates at high masses

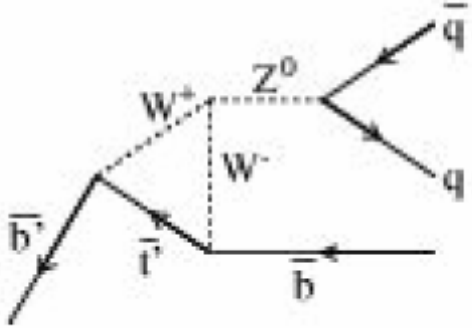
Z from a long-lived particle ?

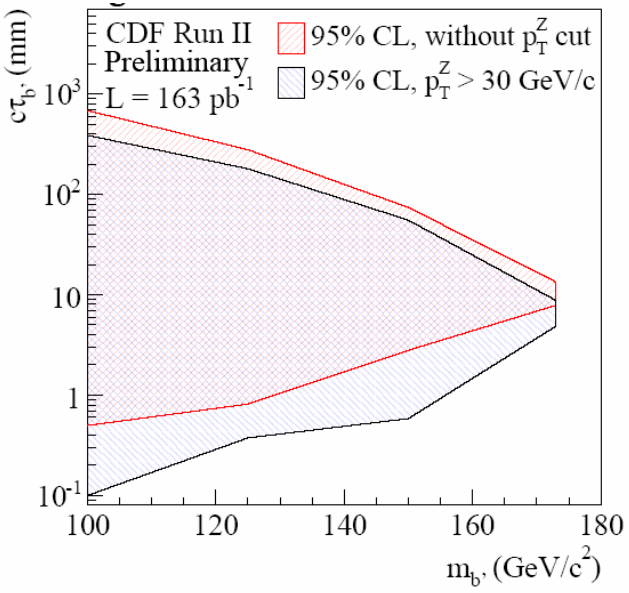
Look at the Z resonance itself… but in events where the Z decay vertex is displaced, e.g. in $Z \rightarrow \mu\mu$

Use of the silicon devices to measure the transverse dca of tracks; apply tight track quality criteria.



Could come from a 4th generation b' :
If m(b') < m(top) :
b' → bZ via loop decay



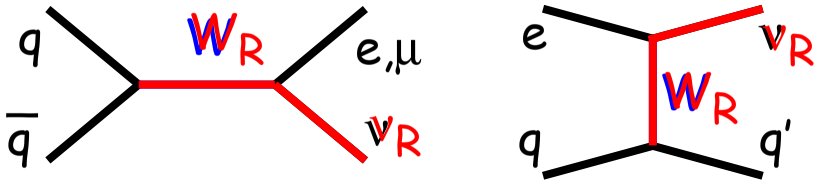


Acceptance depends mainly on cτ(b')

Complements earlier searches :
- b' → bZ, negligible lifetime, b-tag
- low mass b' via FCNC (b' → bγ, bg)

Analysis not optimised for the b' hypothesis
i.e. constraints are quite model-independent.

$W \rightarrow l\nu$, DIS and new W' bosons

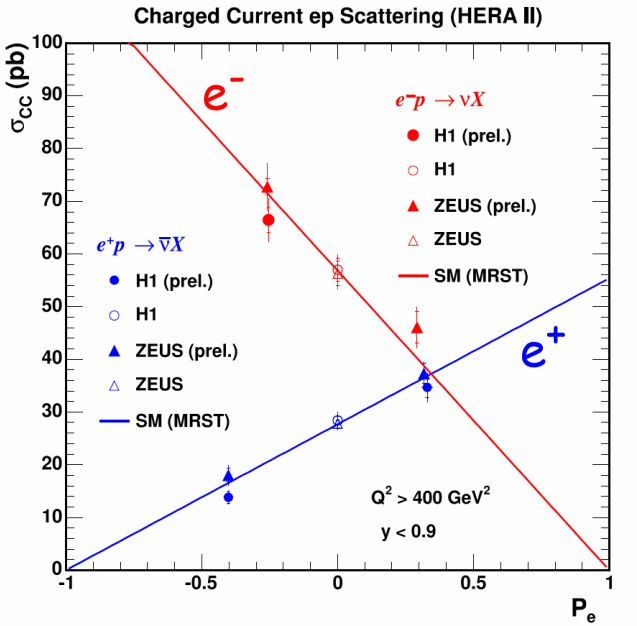


s-channel W production at Tevatron and t-channel exchange in DIS at HERA : very clean experimental signatures
→ Look for new W' boson, e.g. W_R

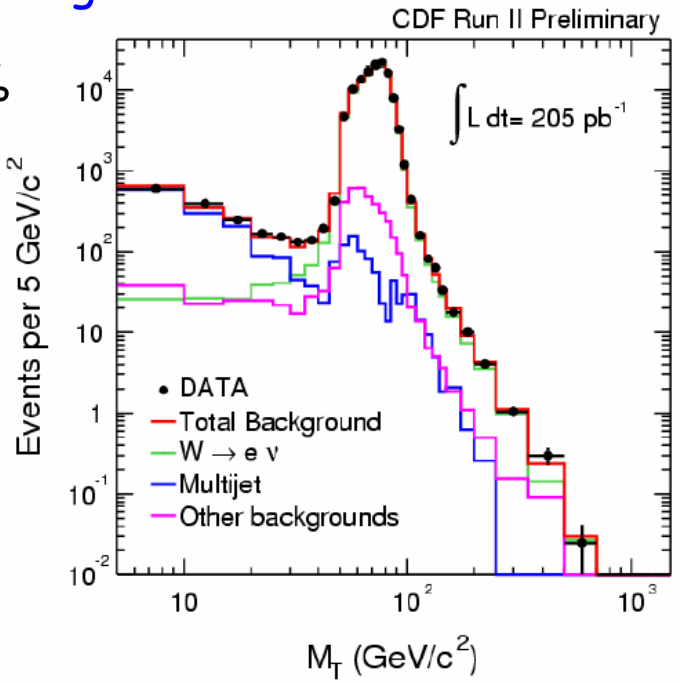
Same signature as W exchanged provided that ν_R is light and stable

- Tevatron : E_T and $\not{E}_T$ thresholds ~ 25 GeV, ε ~ 45%
  Likelihood fit of the M_T distribution :

$\sigma^*BR(W' \rightarrow e\nu) < 50 - 100$ fb for $M > 500$ GeV



For $g_L = g_R$:
$M(W') > 788$ GeV



- HERA : polarised $e_{L,R}$ beam since 2003

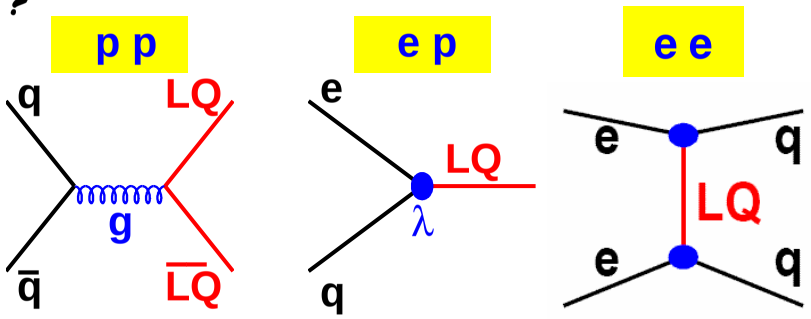
$\sigma_{CC}(e^{\pm}, SM) \sim (1 \pm Pe)$

Extrapolations to $Pe = \pm 1$ consistent with no W_R
(not competitive with Tevatron bounds, but nice "textbook" plot !)

DIS, Zjj, Wjj: Leptoquarks

Apparent symmetry between the lepton & quark sectors ?
Exact cancellation of QED triangular anomaly ?

- LQs appear in many extensions of SM
- Scalar or Vector color triplet bosons
- Carry both L and B, frac. em. charge

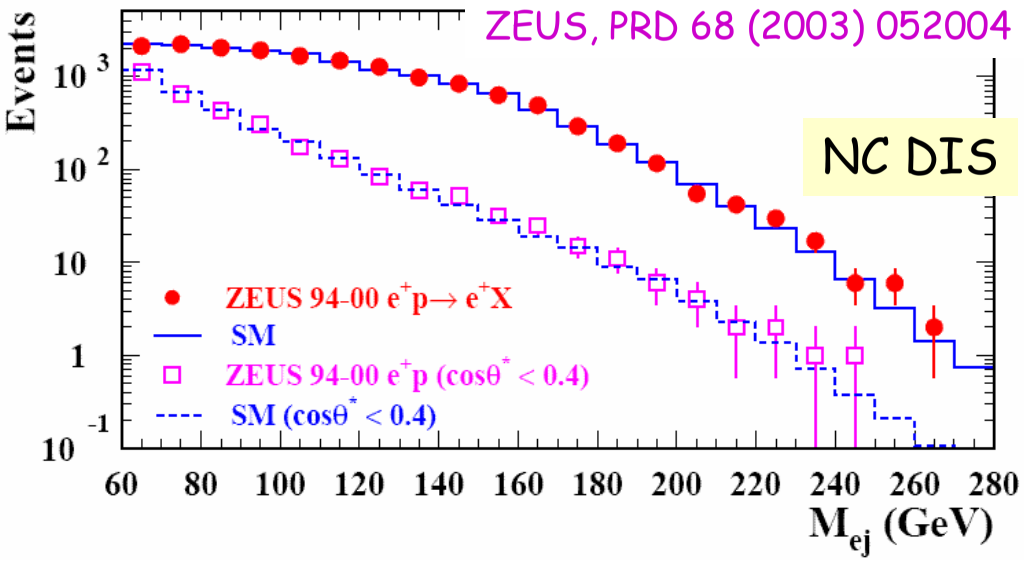


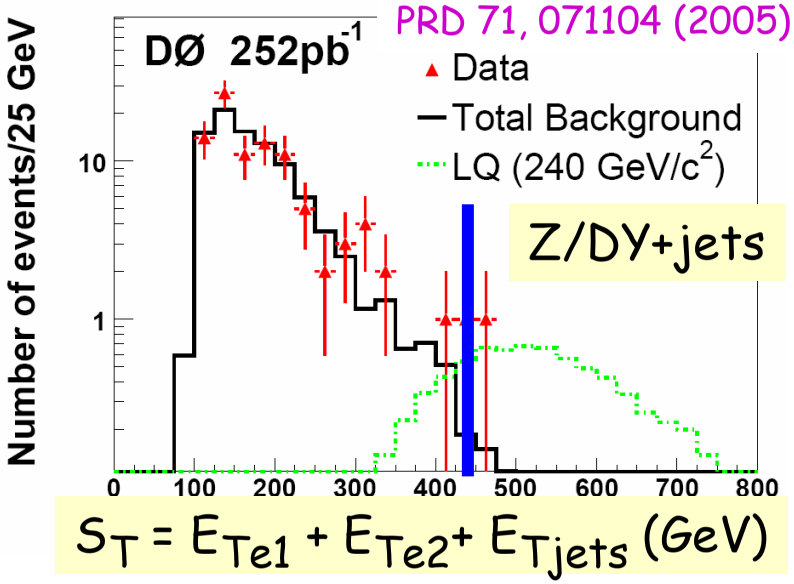
λ (unknown) Yukawa coupling l-q-LQ

LQ decays into (lq) or (νq) :

HERA		TEVATRON		
eq	νq	llqq	lνqq	ννqq
NC DIS	CC DIS	Z/DY + jj QCD	W + jj	W/Z + jj QCD

- HERA : resonant peak, ang. distr.
- Tevatron : highest E_T events





Existing Bounds on 1st Generation LQs

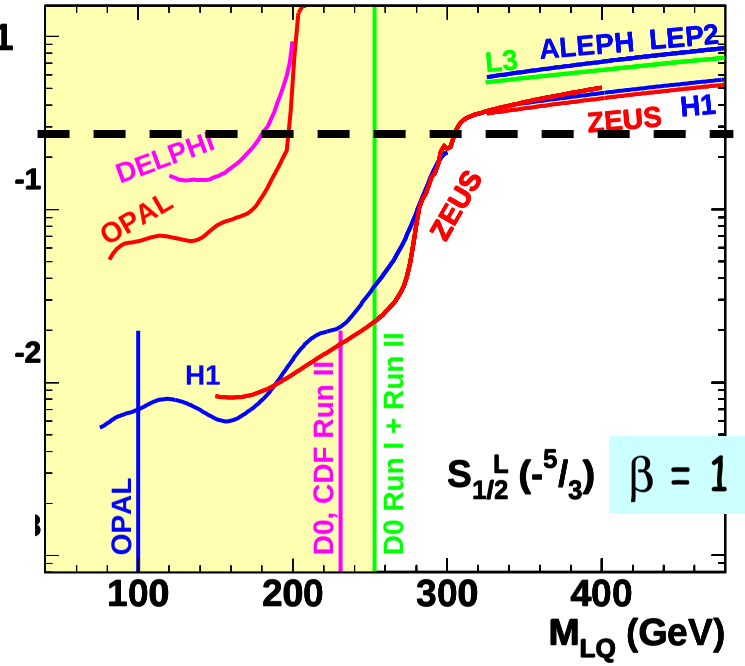
β = BR(LQ $\rightarrow$ eq)

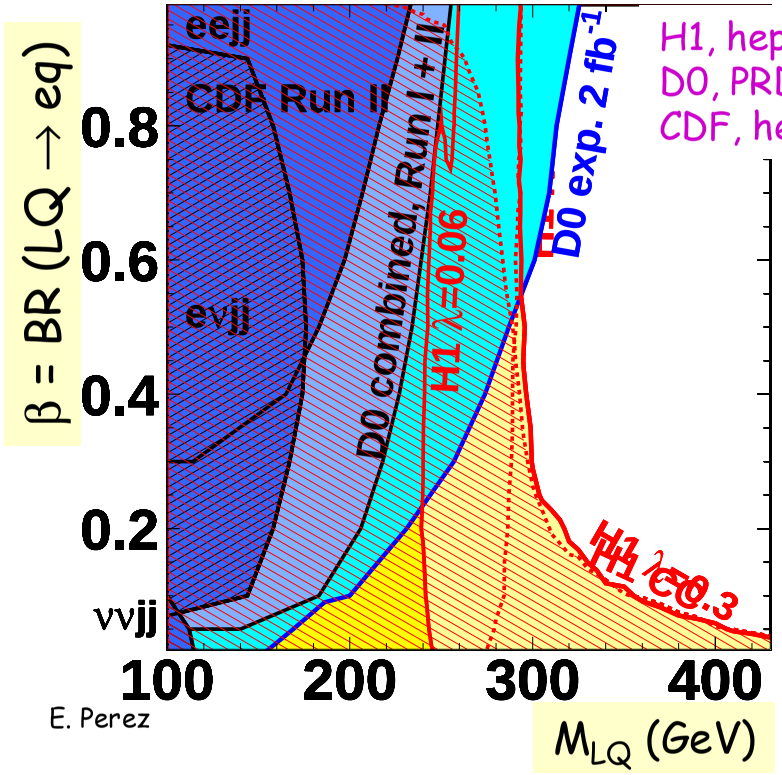
β_e	Run II bounds	
1	241	D0
1	235	CDF
0.5	208	D0 (evjj)
0.5	176	CDF (evjj)
0	117	CDF

For $\lambda = \sqrt{4\pi\alpha_{em}} \approx 0.3$:

HERA rules out LQ masses $< \approx$ 290 GeV @ 95 % CL

D0 Run II + D0 Run I : M > 256 GeV for β=1





H1, hep-ex/0506044
D0, PRD 71, 071104 (2005)
CDF, hep-ex/0506074

- Tevatron probes large masses for large β (LQ $\rightarrow$ eq) independently of λ
- HERA better probes LQs with small β provided that λ not too small

$\rightarrow$ Complementarity of both facilities

NB : at HERA, e^+ / e^- + polarisation could help in disentangling the LQ quantum nbs

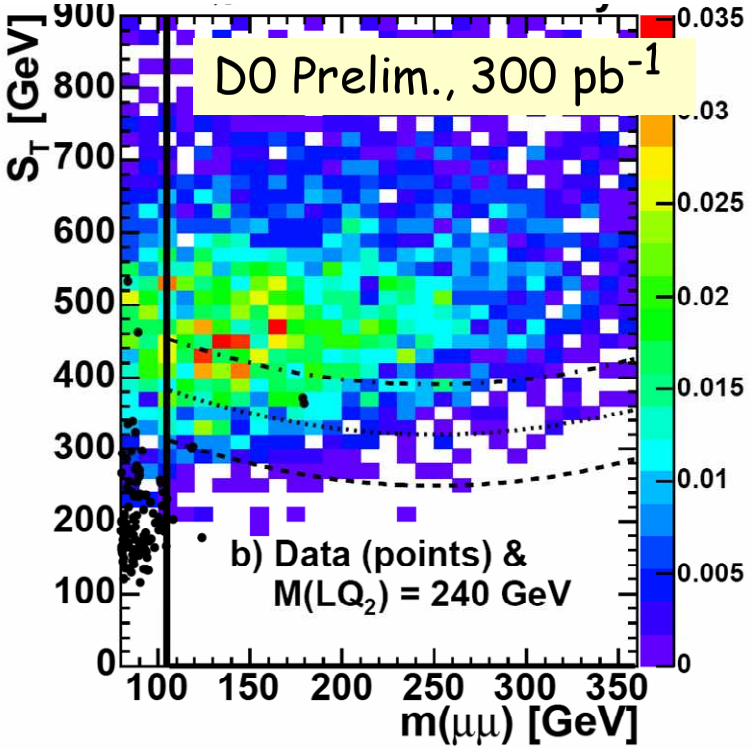
Second and Third Generation Leptoquarks

So far, $LQ_{2,3}$ with M > 100 GeV can be probed ≈ exclusively at the Tevatron !

- Search for LQ_2 in Run II data :

  μμ + at least 2 jets : bckgd = only DY+jets

  ~ no bckgd at the end while ε ~ 20%



Combined with DØ Run I :

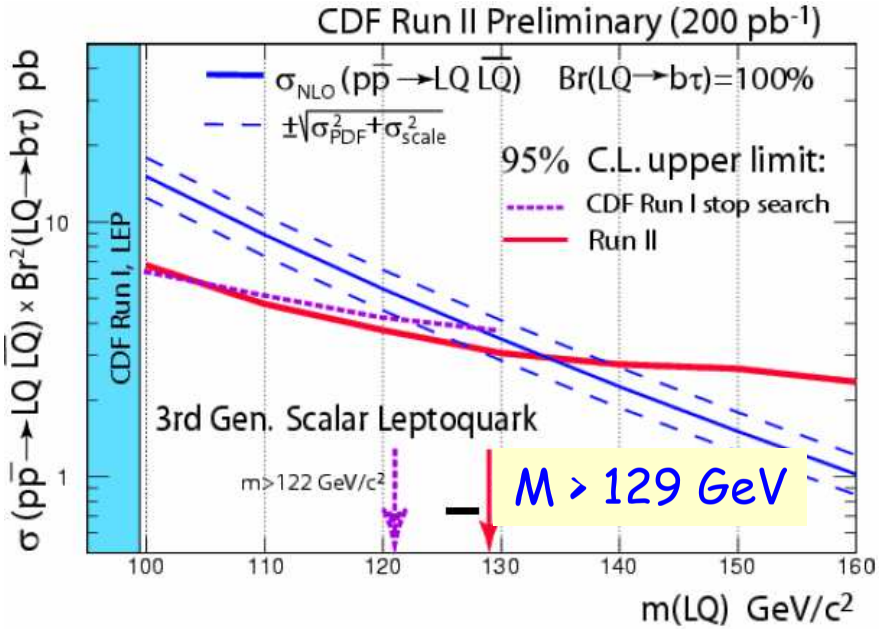
M_{LQ} > 251 GeV for β_μ = 1

- Search for $LQ_3 \rightarrow \tau b$:

  one $\tau \rightarrow$ e or μ, the other $\tau \rightarrow$ had.

  Same analysis as RPV stop $\rightarrow \tau b$

  Total acceptance ~ a few %



... New physics might couple mainly to 3rd gene fermions

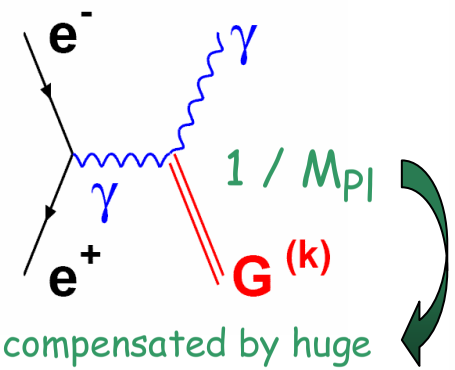
More sensitivity expected by using b-tagging techniques

Searches in radiative processes

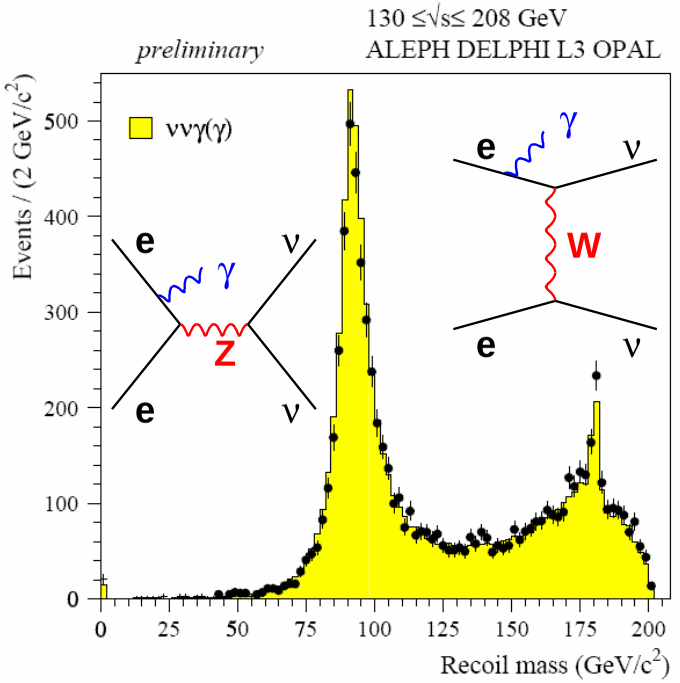
- $\gamma + \not{E}$ at LEP sets strong constraints on large extra-dim (ADD) : (also branons)

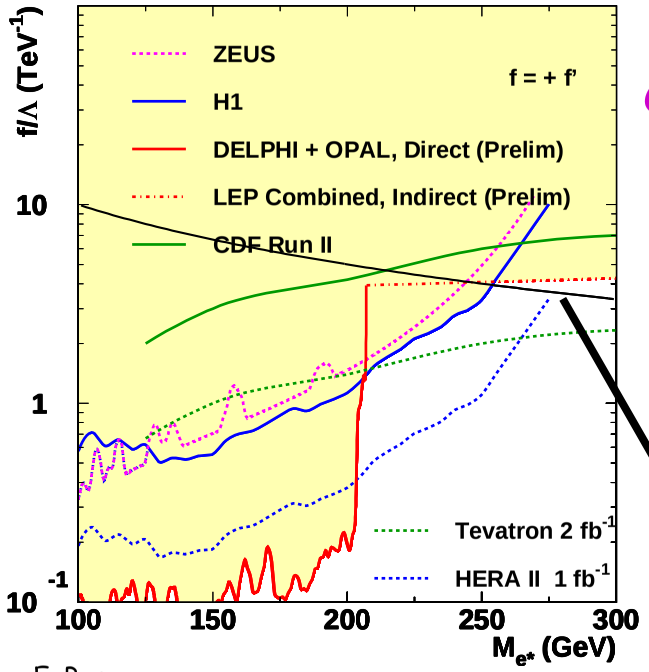
Coupling of $G^{(k)}$ to SM fields α 1 / M_{Pl} $\rightarrow$ $G^{(k)}$ stable !
May be copiously produced

n=2 : M_D > 1.5 TeV
n=4 : M_D > 0.9 TeV



compensated by huge multiplicity of states

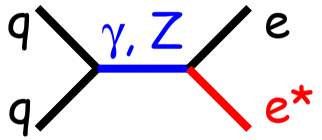




E. Perez

CDF, PRL 94 (2005) 101802

- Searches for singly produced excited fermions, e.g. e* $\rightarrow$ e γ, search for a (eγ) resonance
  - Z/DY + γ at Tevatron
  - radiative Bhabha at LEP
  - radiative DIS, QED Compton at HERA



For f/Λ = 1/M(e*) :

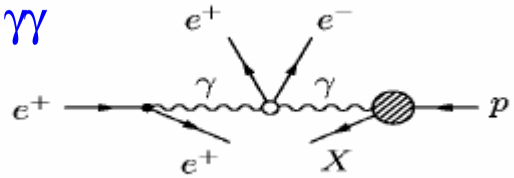
$\rightarrow$ M(e*) > 250 GeV

LEP & HERA : all decay modes considered

Multilepton events at HERA

Events with ≥ 2 leptons in final state. Mainly produced via $\gamma\gamma$

Cross-section when both leptons are central,
P_{T1} > 10 GeV, P_{T2} > 5 GeV : ~ 0.6 pb



H1 data 94-00 : excess of 2e+3e events at high M_{12} = mass of two highest P_T e

No such excess seen in ZEUS HERA-I data

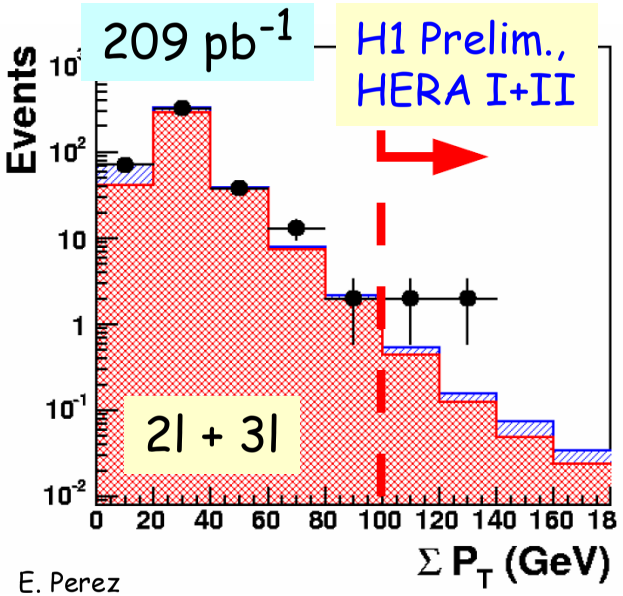
The H1 evts are not consistent with

$e\gamma \rightarrow H^{++}$ (e) $\rightarrow$ ee(e) (H1 prelim.)

H1 94-00 data — obs. / exp.

selection \ expt	H1 (115 pb^{-1})
2e, M_{12} > 100 GeV	3 / 0.30 ± 0.04
3e, M_{12} > 100 GeV	3 / 0.23 ± 0.04

H1, EPJ C31 (2003) 17



H1 analysis extended to include 03-05 data

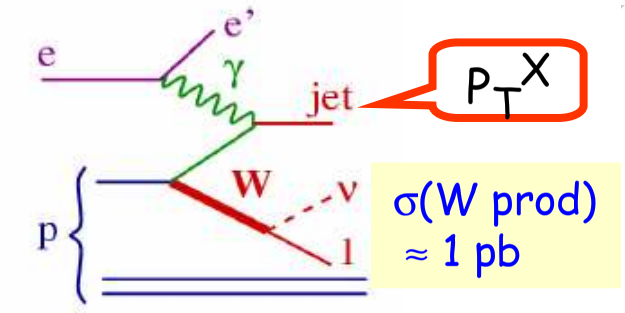
Extended to other 2l & 3l topologies :
Now ee, μμ, eμ, eee, eμμ are considered

- no new 2e / 3e evt at M_{12} > 100 GeV
  (but one high mass 3e event …)
- one eμμ evt at $M_{\mu\mu}$ > 100 GeV, one at $M_{e\mu}$ > 100 GeV

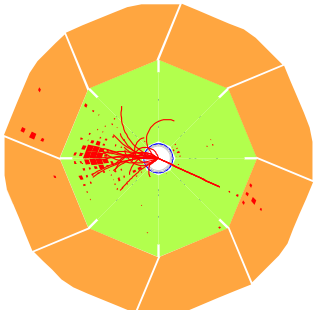
Altogether, at ΣP_T > 100 GeV :
N_{obs} = 4, N_{exp} = 0.81 ± 0.14

W Production at HERA

Main SM contribution for single W production at HERA :



$e\,p \rightarrow l + jet + P_{T,miss}$

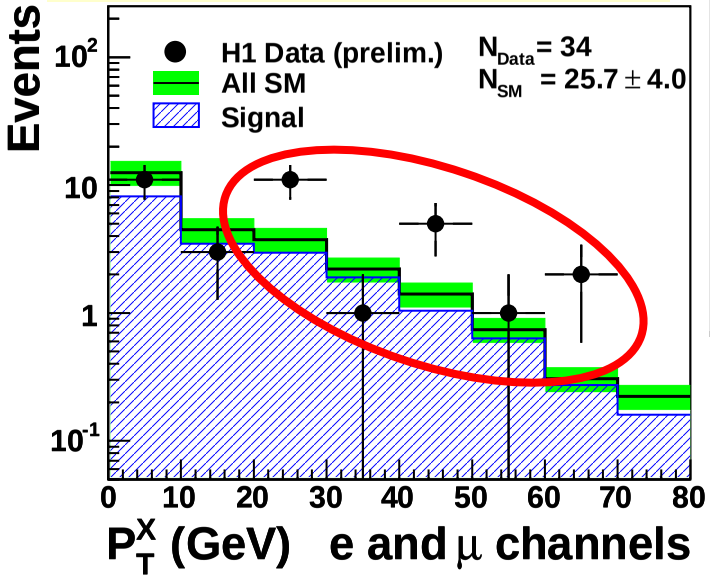


HERA I : excess (H1) of observed evts at high P_T^X w.r.t. SM expectation

H1, PLB 561 (2003) 241

H1 ep data, 118 pb^{-1}	Combined e & μ
P_T^X > 25 GeV	11 / 3.4 ± 0.6

H1 prelim 94-05, $e^{\pm}p$, 211 pb^{-1}



Such evts are still observed in HERA II H1 data...

P_T^X > 25 GeV	e channel	μ channel	Combined e & μ
H1 94-05 211 pb-1	11 / 3.2 ± 0.6	6 / 3.2 ± 0.6	17 / 6.4 ± 1.1
ZEUS 99-05 106 pb-1	1 / 1.5 ± 0.18		

But still do not show up in ZEUS data...

- no new μ evt in H1 HERA II data
- new ZEUS analysis : close to H1 cuts
- ZEUS & H1 expectations agree...
- no significant excess in H1 e^-p data (53 pb-1)

HERA events with isolated lepton + $P_{T,miss}$

H1 Preliminary, 211 pb-1

obs. / exp.

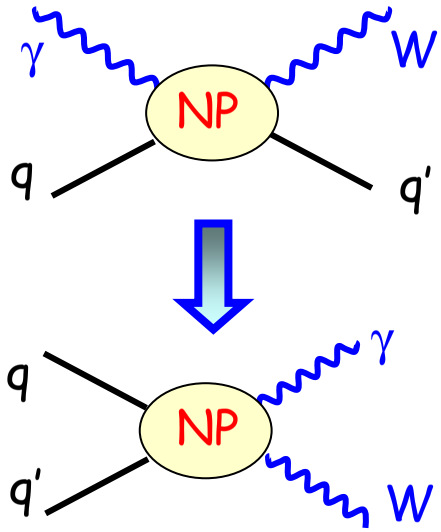
P_T^X > 25 GeV	e channel	μ channel	Combined e & μ
Electrons, 98-05 53 pb-1	2 / 0.9 ± 0.2	0 / 0.9 ± 0.2	2 / 1.8 ± 0.3
Positrons, 94-04 158 pb-1	9 / 2.3 ± 0.4	6 / 2.3 ± 0.4	15 / 4.6 ± 0.8

A "leptoquark-like" interaction, e.g. RpV SUSY $e^+ d \rightarrow$ stop ?

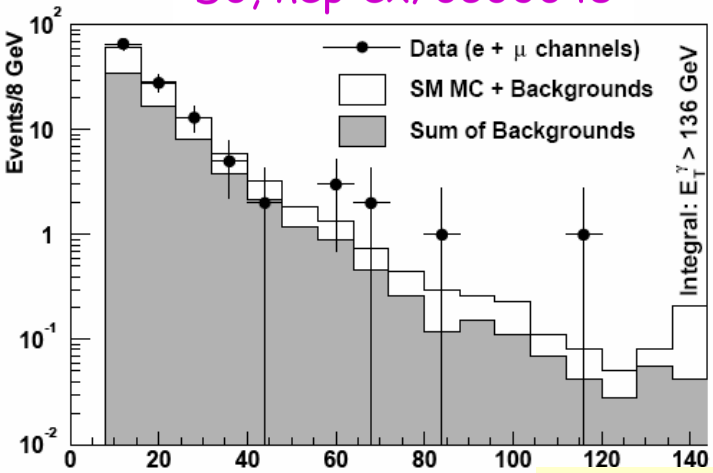
(was not supported by HERA-I data alone)

Wait for more e^- data...

- Non SM W production in eγ ? Most likely smthg should have been seen at LEP...
- New physics in γq ?

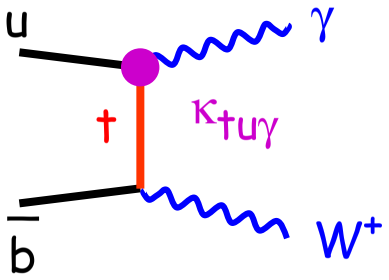


D0, hep-ex/0503048



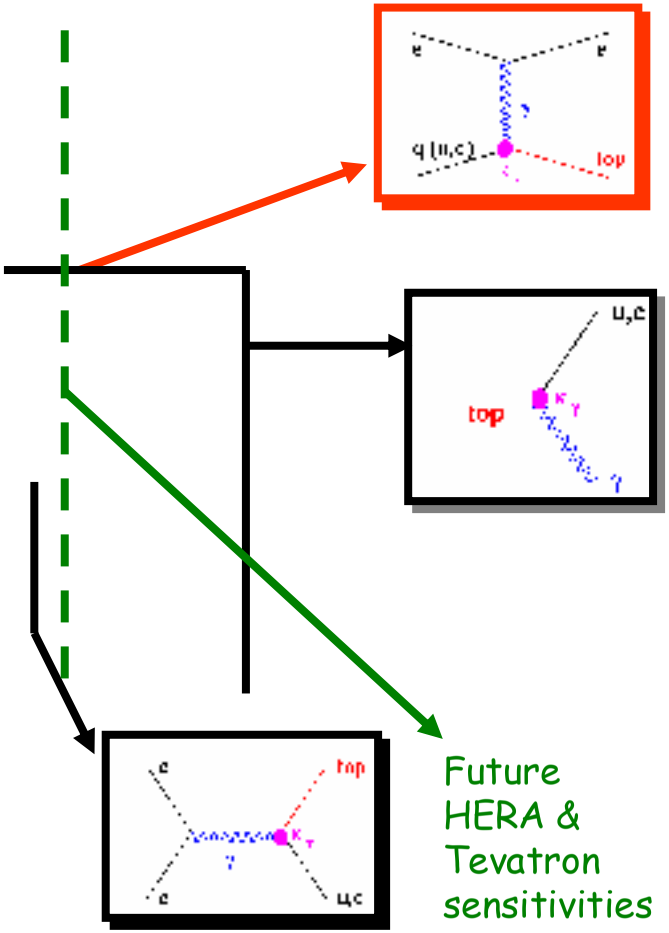
Wγ production at Tevatron agrees with SM...

But NP might not be seen in Wγ if q' is a b, e.g. FCNC coupling to the top quark ?



FCNC couplings tqγ, tqZ (tqg) where q = u,c can be searched for in single top prod. at LEP & HERA, in t → qV decays in tt pairs at Tevatron.

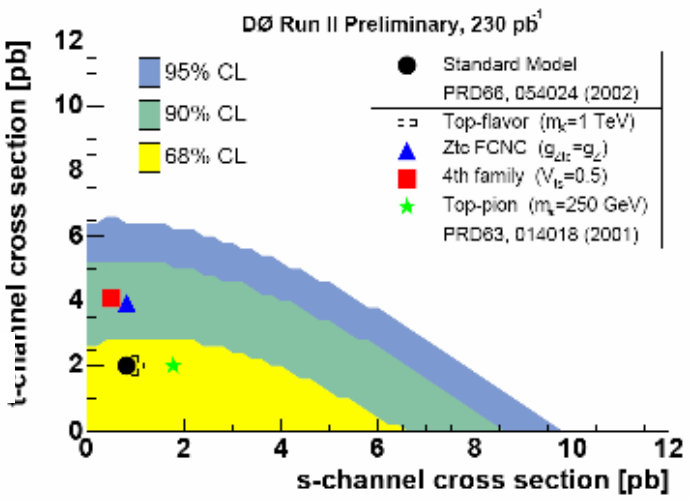
H1, EPJ. C33 (2004) 9
ZEUS, PLB 559 (2003) 153.



Future HERA & Tevatron sensitivities

NB : getting close to observe SM single top at Tevatron !

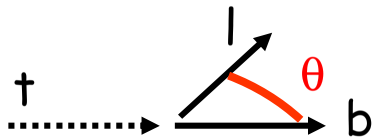
D0, hep-ex/0505063

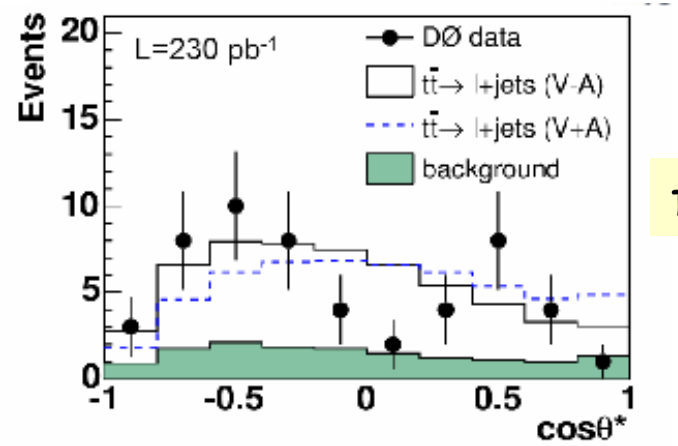


Other searches for NP in the top sector

Pair-production of top at Tevatron Run II: $\sigma \sim 7$ pb

- Searches for $t\bar{t}$ resonances
- Tests of the (V-A) nature of the tbW vertex :





W from t decays are mainly longitudinal ($f_0 = 70\%$). Rest has λ=-1 ($f_{-1} = 30\%$). Fit to $\cos(\vartheta^*)$ yields :

$f_{+1} < 0.25$ @ 95% CL

Yields to (my interpretation) :

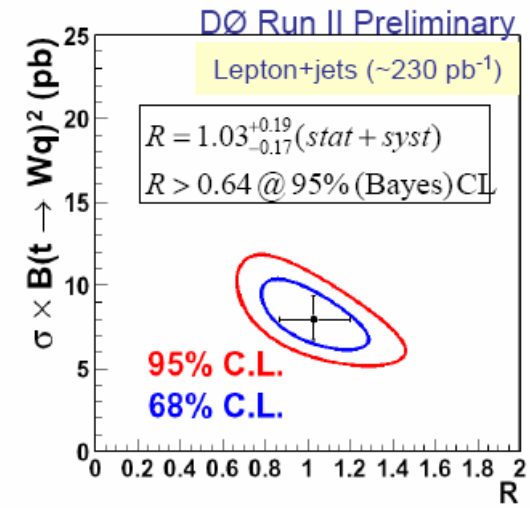
$|\kappa_R| < 1.05$

if the tbW vertex is :

$t\,\gamma^\mu\,[\,(1+\kappa_R) - (1-\kappa_R)\,\gamma_5\,]\,b\,W_\mu$

(more stringent bounds from $b \to s\gamma$ but model dependent)

- Constraints on $R = \Gamma(t \to b\,W) / \Gamma(qW)$



By comparing the number of tt candidates with 0, 1 or 2 b-tags.

Excess in eμ, not stat. significant (yet…)

- Flavor anomaly in dilepton tt ?

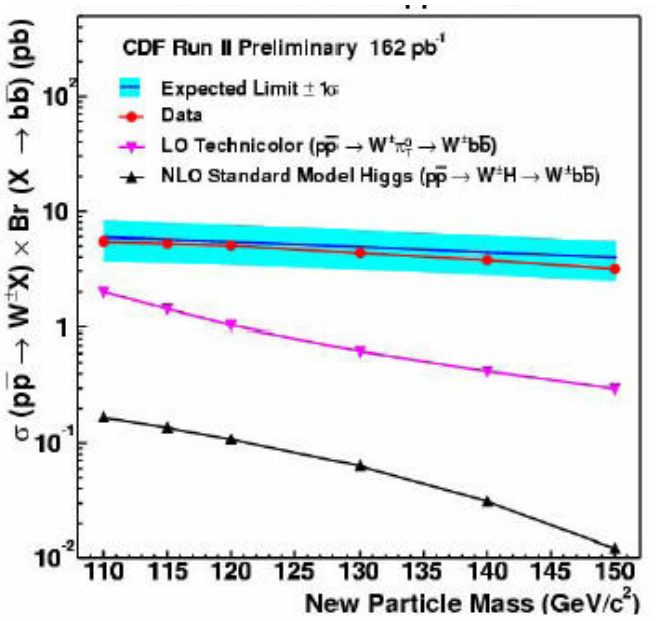
(*) Assuming σ_{tt}=6.7 pb		ee+μμ	eμ
CDF Run II (~200 pb^{-1})	Expected (*)	3.9±0.7	4.3±0.8
	Observed	4	9
DØ Run II (~230 pb^{-1})	Expected (*)	5.5±0.7	5.9±0.6
	Observed	5	8
CDF+DØ Run II	Expected (*)	9.4±1.0	10.2±1.0
	Observed	9	17

Wbb production at Tevatron

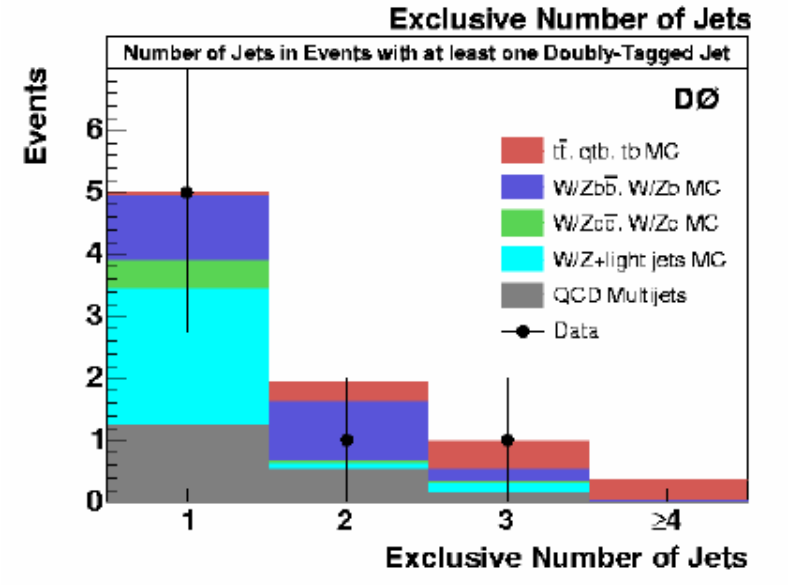
- Enhanced Wbb production ? may occur from
  - WH followed by $H \rightarrow bb$
  - technicolor resonances ($\rho_T \rightarrow \pi_T W$, $\pi_T \rightarrow bb$)

1 b-tagged jet, sample of ~ 100 events
Search for a mass peak in M(jj) & M(Wjj)

Sensitivity getting close to theo. predictions.



- Run I CDF data : excess of W + 2,3 jets where both a secondary vertex and a soft lepton are found in one jet ("superjets")



Similar analysis carried out on Run II data,
$W \rightarrow e$ or μ D0, PRL 94 (2005) 152002

Dominant SM contributions from
Wbb (σ ~ 3 pb), tt & single top, mistags

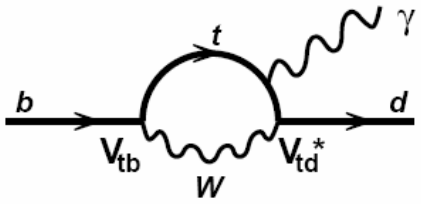
No excess observed in the "doubly-tagged" jet sample in Run II data.

Very rare processes : B decays

Probe very rare processes : better have a huge lumi… e.g. B-factories.
Tevatron also probes very rare decays, e.g. $B_{s,d} \to \mu\mu$
Branchings as low as a few 10^{-8} can be observed.

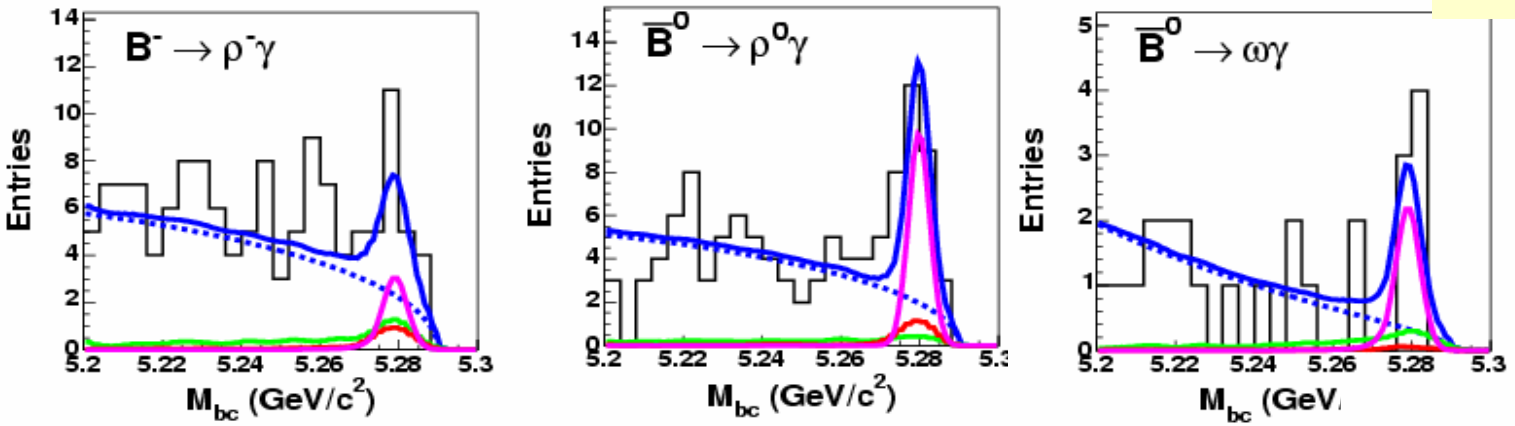
Known that $b \to s\gamma$ (~ 3 x 10^{-4}) is a sensitive probe to NP. Eg SUSY, top couplings, ..

Recent observation of $b \to d\gamma$ (5σ) !



Belle, hep-ex/0506079

Large bckgd (continuum & $b \to s\gamma$)
Look in exclusive modes $B^+ \to \rho^+\gamma$,
$B^0 \to \rho^0\gamma$, $B^0 \to \omega\gamma$. Simultaneous fit assuming isospin relations

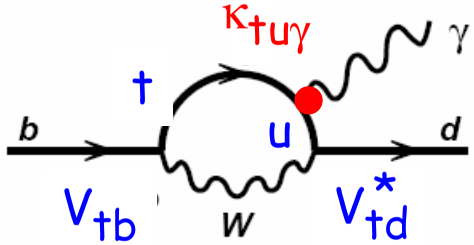


$BR(B \to \rho/\omega + \gamma) =$

$1.34^{+0.34+0.14}_{-0.31-0.10} \times 10^{-6}$

Consistent w/ CKM

… Constraints on FCNC top coupling t-u-γ ?



Lepton Flavor Violation

- New results (BaBar) on $\tau \to \mu\gamma$ and $\tau \to e\gamma$:

  $BR(\tau \to \mu\gamma) < 6.8 \times 10^{-8}$ (hep-ex/0502032)
  $BR(\tau \to e\gamma) < 1.1 \times 10^{-7}$ (prelim.)

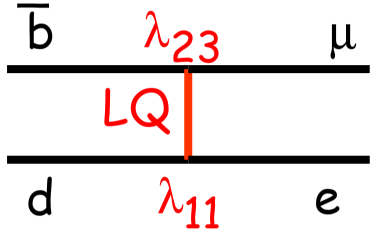
  BR ~ 10^{-40} in SM but could be much enhanced beyond SM
  NB : 200 M of ee $\to \tau\tau$ evts !

  e.g. $\tau \to \mu\gamma$ constrains a particle coupling both to (μl) and to (τl), l=e,μ,τ

  Example for a doubly-charged Higgs: $h_{\mu l}\, h_{\tau l} < 0.18\ (M_H/1\ \text{TeV})^2$ (my interpretation)

  Similar constraints from $\tau \to e\gamma$ and $\mu \to e\gamma$ (latter : BR < 1.2×10^{-11}, MEGA Coll.)

- Searches for LFV B-decays : eg $B_d \to e\mu$: $BR(B_d \to \mu e) < 1.7\ 10^{-7}$ Belle, PRD 68 (2003) 111101



→ Bounds on $\lambda_{ed}\, \lambda_{\mu b} / M^2_{LQ}$

e.g. case of Pati-Salam LQs where $\lambda = \alpha_S(M_{LQ})$: M > 46 TeV

Such exchanges are also probed in DIS :

Several examples where DIS constraints are competitive with those from rare B decays

ZEUS, hep-ex/0501070

ZEUS bounds on $\lambda_{eq\alpha}\, \lambda_{\mu q\beta} / M_{LQ}^2$ in units of TeV^{-2}, for ≠ LQ types

ed → μb

1 3	*	$B \to \mu e$ 0.4 1.8	$B \to \mu e$ 0.4 1.9

eb → μs

3 2	*	$B \to \tau \bar{e} X$ 14 **11**	$B \to \tau \bar{e} X$ 14 **10**

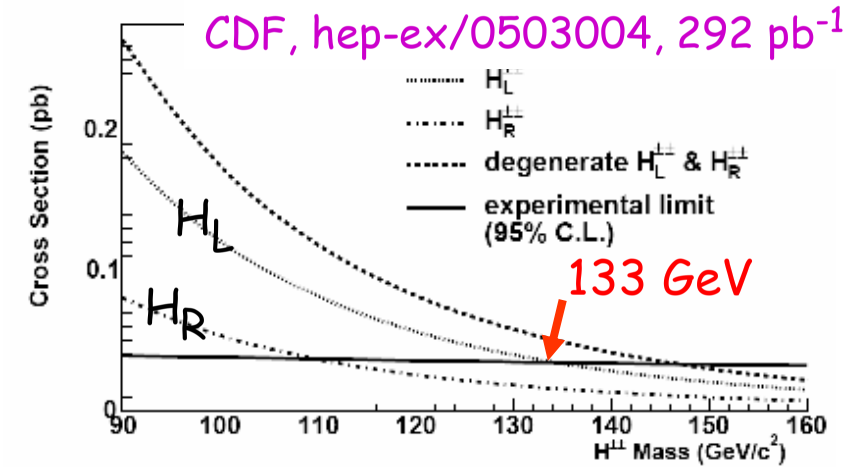
Exotic experimental signatures

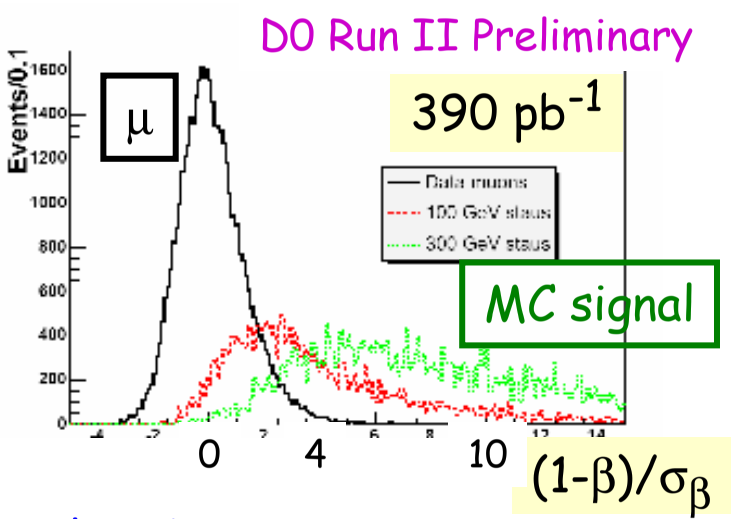
Rich detector capabilities ! search for particles which behave in an exotic way :

Charged quasi-stable particles : will look like anomalous μ. Large mass implies :

- a fraction of them will have low β=v/c
  i.e. reach our muon detector "late"
  Use timing information from μ det. to reco β
  e.g. allows to set a limit on stable charginos :

M(χ±, "stable", gaugino-like) > 174 GeV





- Large energy loss by ionisation
  → exploit the dEdx measurement
  e.g. with cuts for a doubly-charged Higgs, no candidate while ε ~ 40%

Magnetic monopoles M :

eg = nhc/4π $\alpha_m \sim 34\, n^2 \gg \alpha_e$

- exploit the large energy loss (CDF Prelim.)
- E_{loss} could be so large that M may stop in the beam-pipe !

H1, DESY 04-240
EPJC xxx (2005)

→ Upper bounds on pp & ep σ(MM) as a function of M mass

Conclusions

The search for new physics is a very active field.

Tevatron & HERA are working very well, the experiments might "see" something in the near future !
Constraints set on many models, often the most stringent up to date.

e.g. Z' and W' above ~ 750 GeV
Leptoquarks > ~ 250 GeV (Tevatron)
> ~ 290 GeV (HERA, coupling of EM strength)
Randall-Sundrum gravitons > 780 GeV (coupling 0.1)

Complementarity between the experiments.

"Puzzling" events observed at HERA by H1. Clarification (or discovery ?) should come soon with the increasing HERA-II luminosity.