Recent results on top quark, electroweak and new physics searches from CDF

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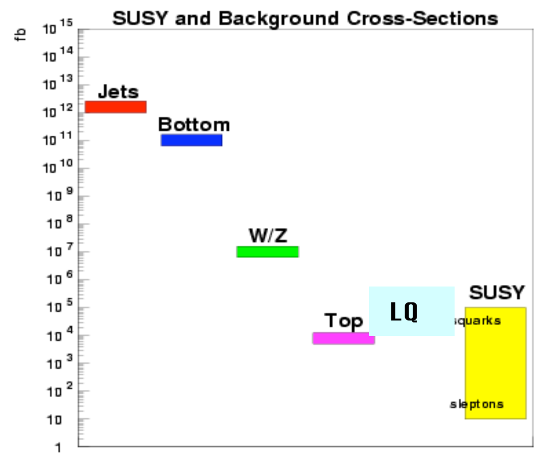
Introduction

CDF is finally producing Run II results !

several different physics groups
- Top quark
- W/Z physics
- Exotics

} High P_T

Cross sections for various physics processes vary over many orders of magnitude:
- processes of interest are often buried under heavy background
- need good rejection factors, selection and analysis strategies

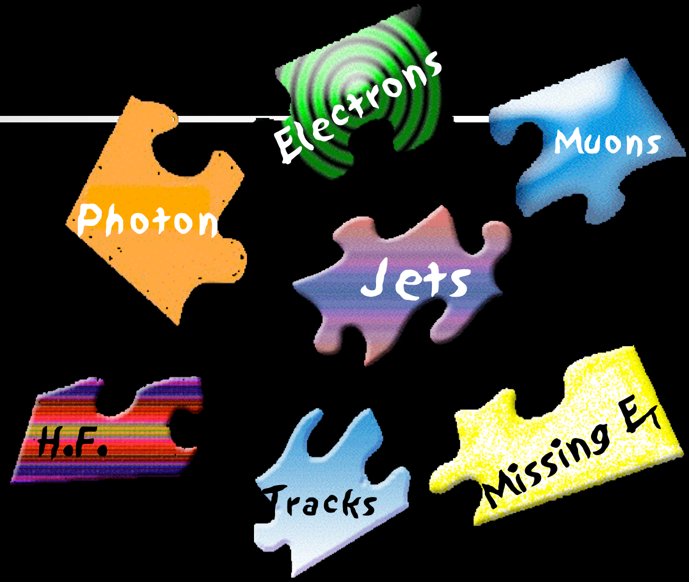


Optimize event selections for SM physics and new physics as in both cases the composition of the samples are important

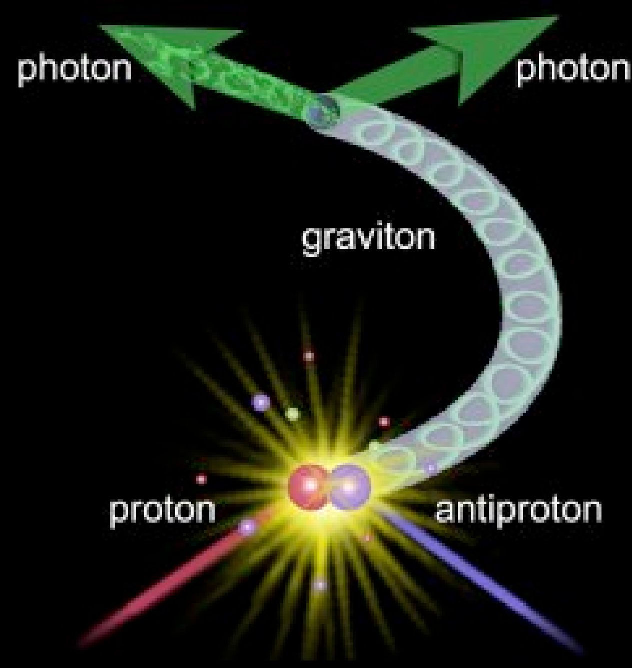
Common datasets

Common identification/reconstruction cuts

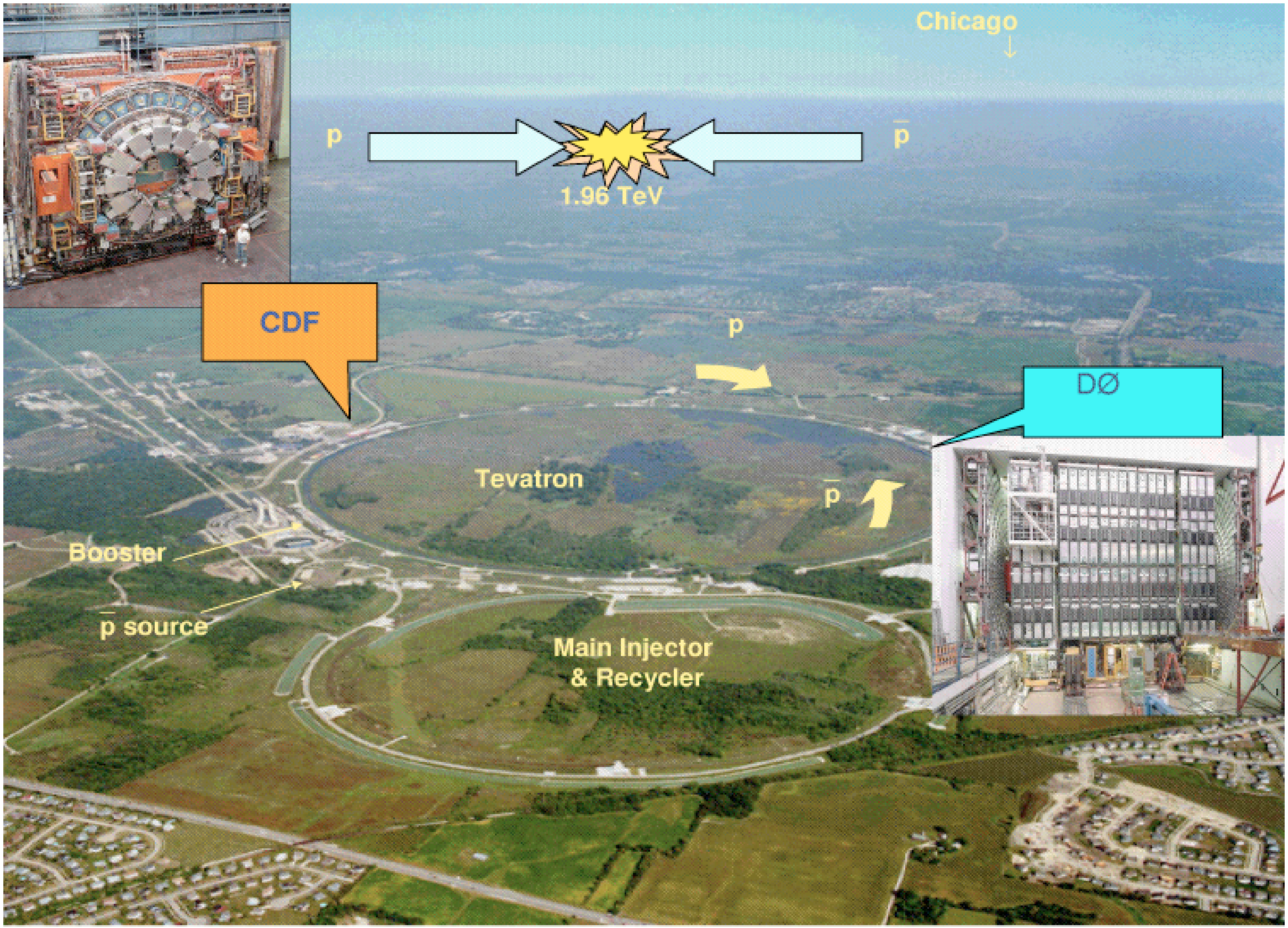
Outline of the talk



- **The Experimental Apparatus**
  - the Fermilab TeVatron
  - The CDF detector
- **Physics Processes and their Signatures**
  - From W/Z to the Top quark and Beyond
  - **Leptons-only final states (and isolated tracks)**
  - **… + Missing Energy and Photons**
  - **… + Jets and heavy flavors**
- **The puzzle of Nature….**

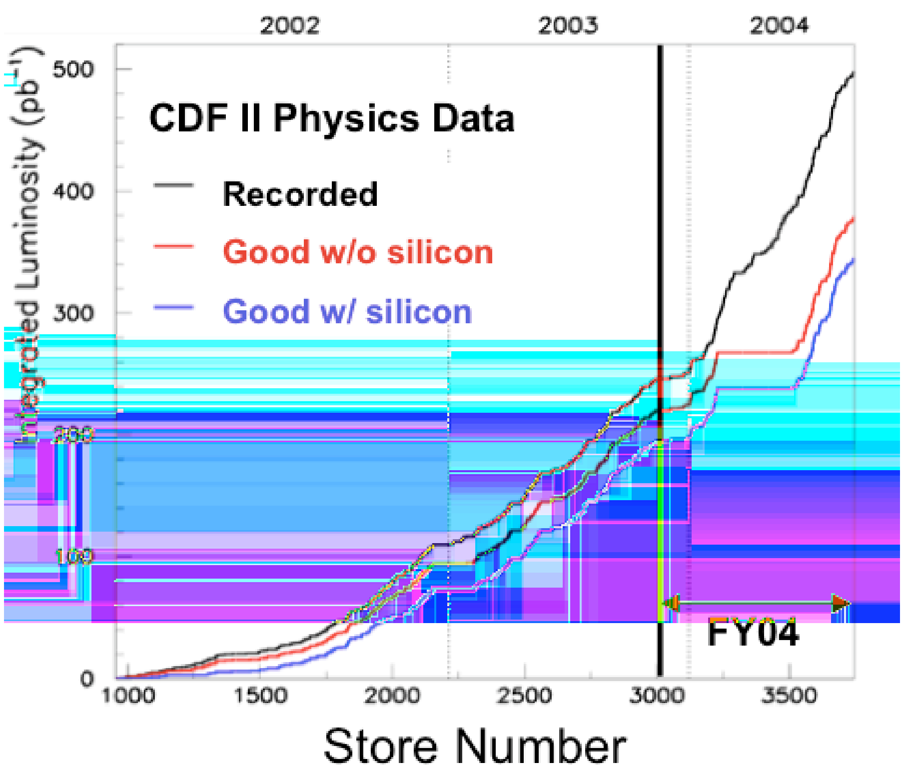


The Experimental Apparatus

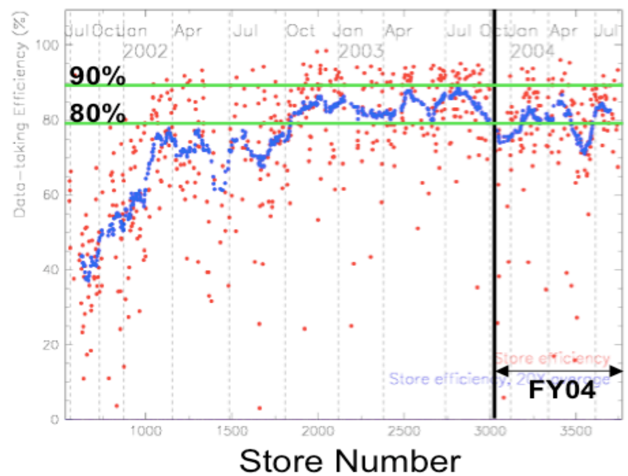


Run II Luminosity

Data for Physics 340 - 390 pb^{-1}
excluding "compromised
COT performance period"



Data Taking Efficiency
L(recorded) / L(delivered):
beam losses, Triggers/DAQ,
COT related, other systems



Run II Goal > 90%

Error on luminosity is ± 6%

- 1.6% due to CLC systematic error on CLC rate
- 4.0% due to CLC acceptance sys
- 3.8% due to limited by knowledge of pp inelastic cross section.

The Thrill of Discovery: A Brief History of CDF

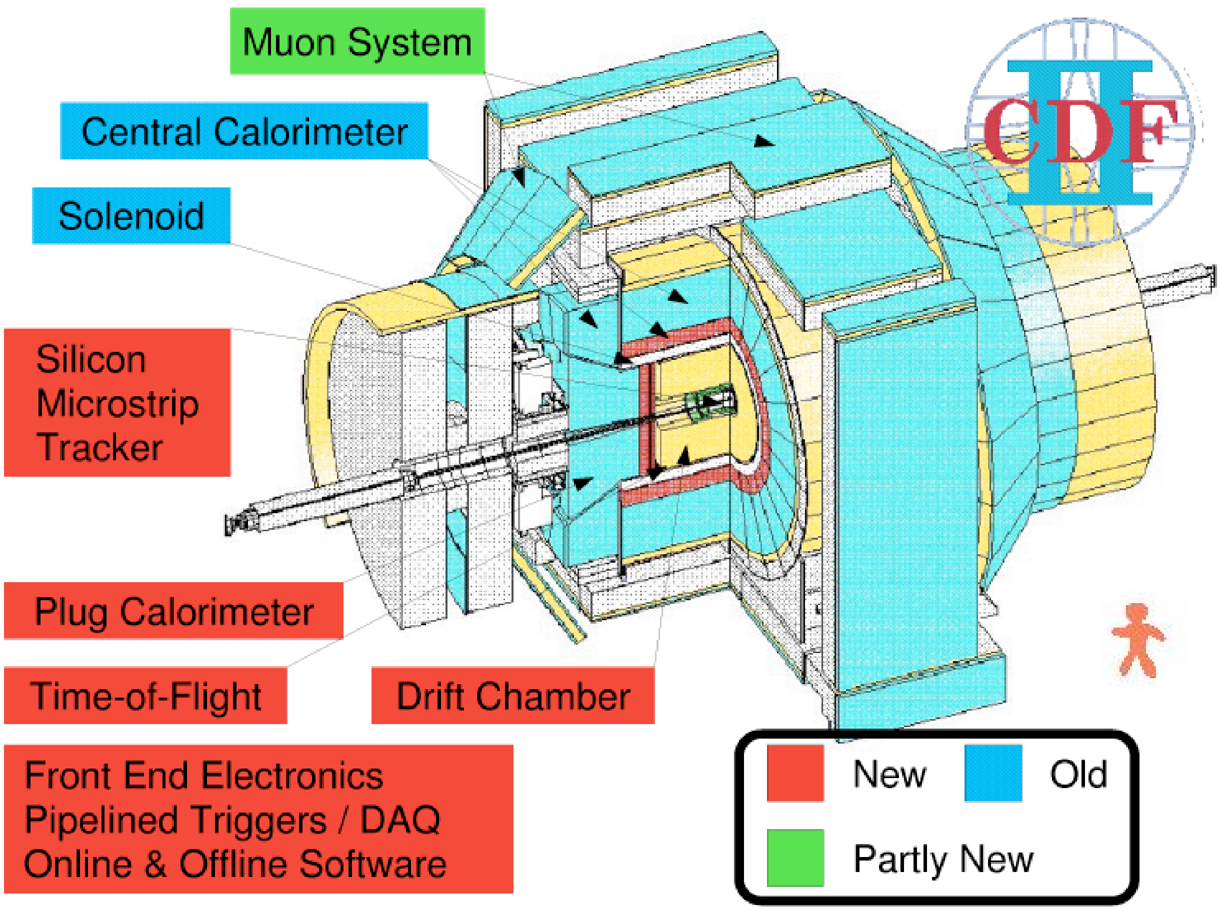
- 1985: First collisions with partial detector
- 1987: Core detector in place. Jet Physics
- 1988-89: “Run 0” 4x the expected data, seen lots of W/Z’s
- 1992-1995 : “Run I” -added silicon detector. Top quark discovered!

- 2001-present: Run II era begins with essentially a new detector, higher collisions energy and more data.
- 2004: First Run II physics papers published

12 countries, 59 institutions
706 physicists

The CDF Detector

The Experiment studies interesting collisions between protons and antiprotons



Transparent tracking in a magnetic field

Absorb most particles with calorimeters

Surround the outside with muon chambers

Electronics to read out each subsystem

Computers to record and analyze data

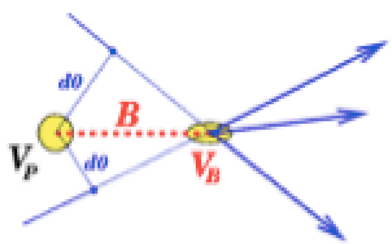
Trigger and DAQ

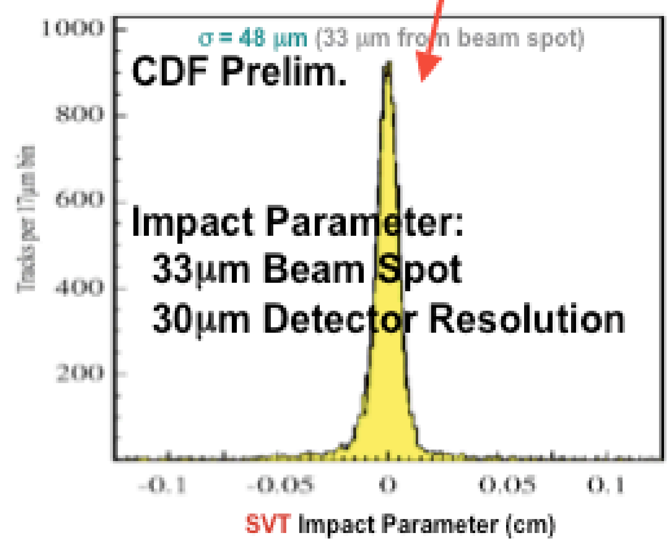
Level	Input / Output	Rejection Rate	# Paths	Information
1	1.7MHz / 25kHz	~70	40	Tracks, EM/Had Cal, Muon
2	25kHz / 350Hz	~70	120	Shower Max, SVT Algorithms run in Processor
3	350Hz / 70Hz(20MB/s)	~5	300	Full Detector Readout Offline Reconstruction

Trigger Paths:

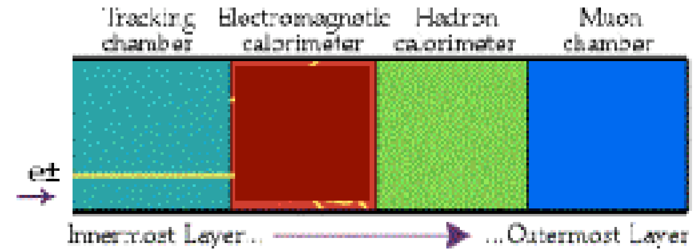
- e, μ, τ, γ, track, jet, B, ν, …
- Combinations of these objects

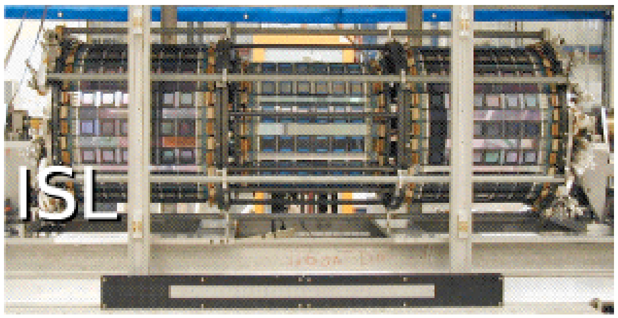
Silicon Vertex Trigger (SVT)

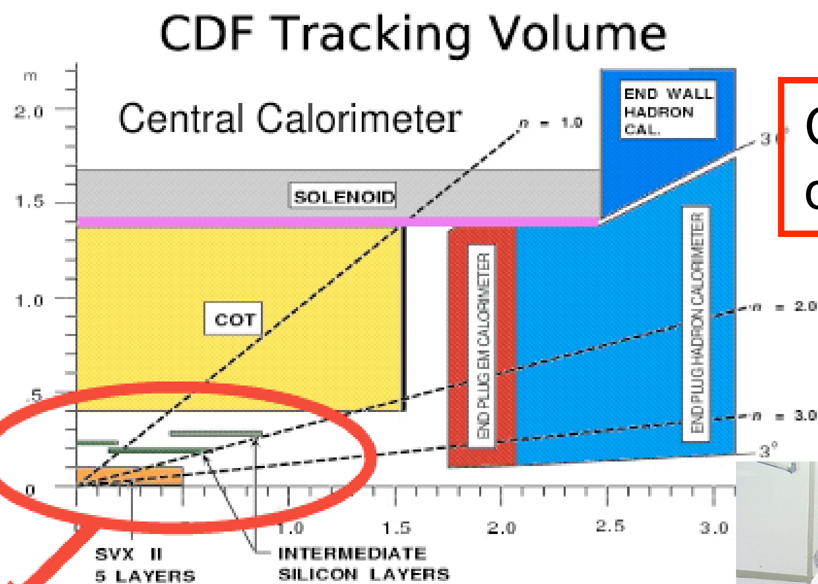




Tracking

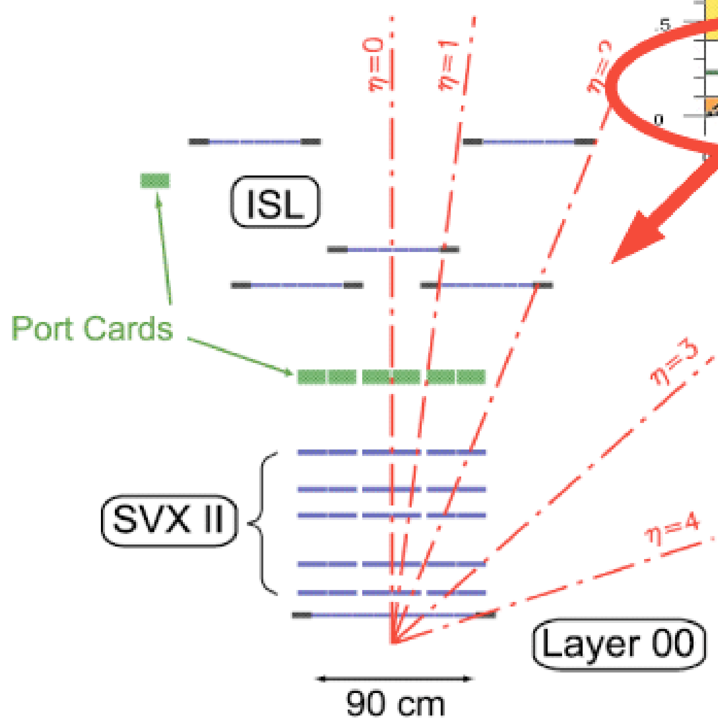


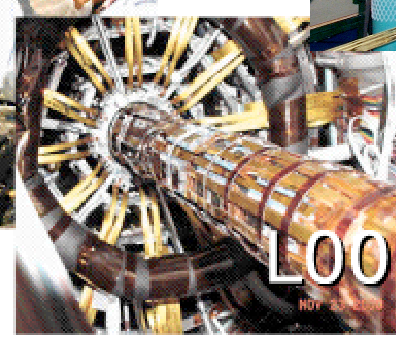




COT: open cell drift chamber

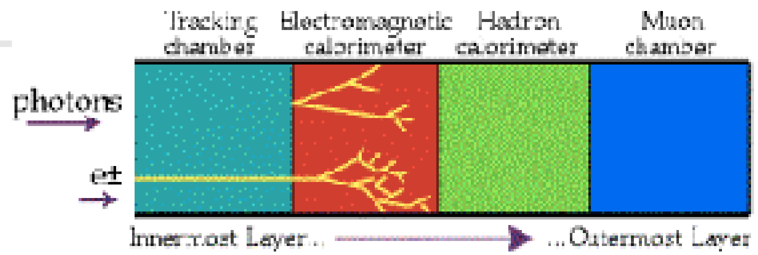
$\eta = -\log(\mathrm{tg}\,\theta)$

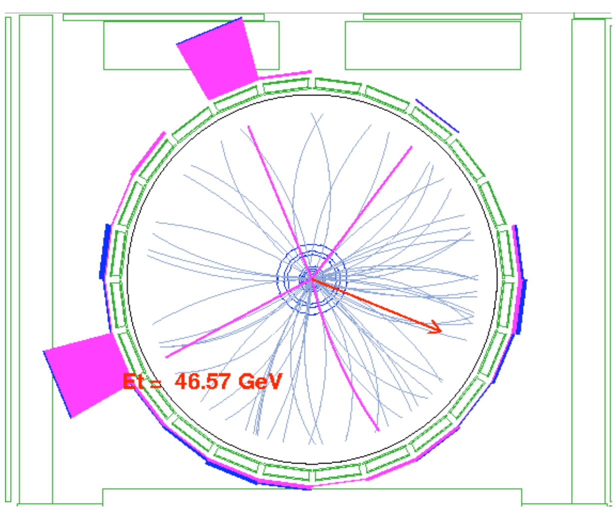


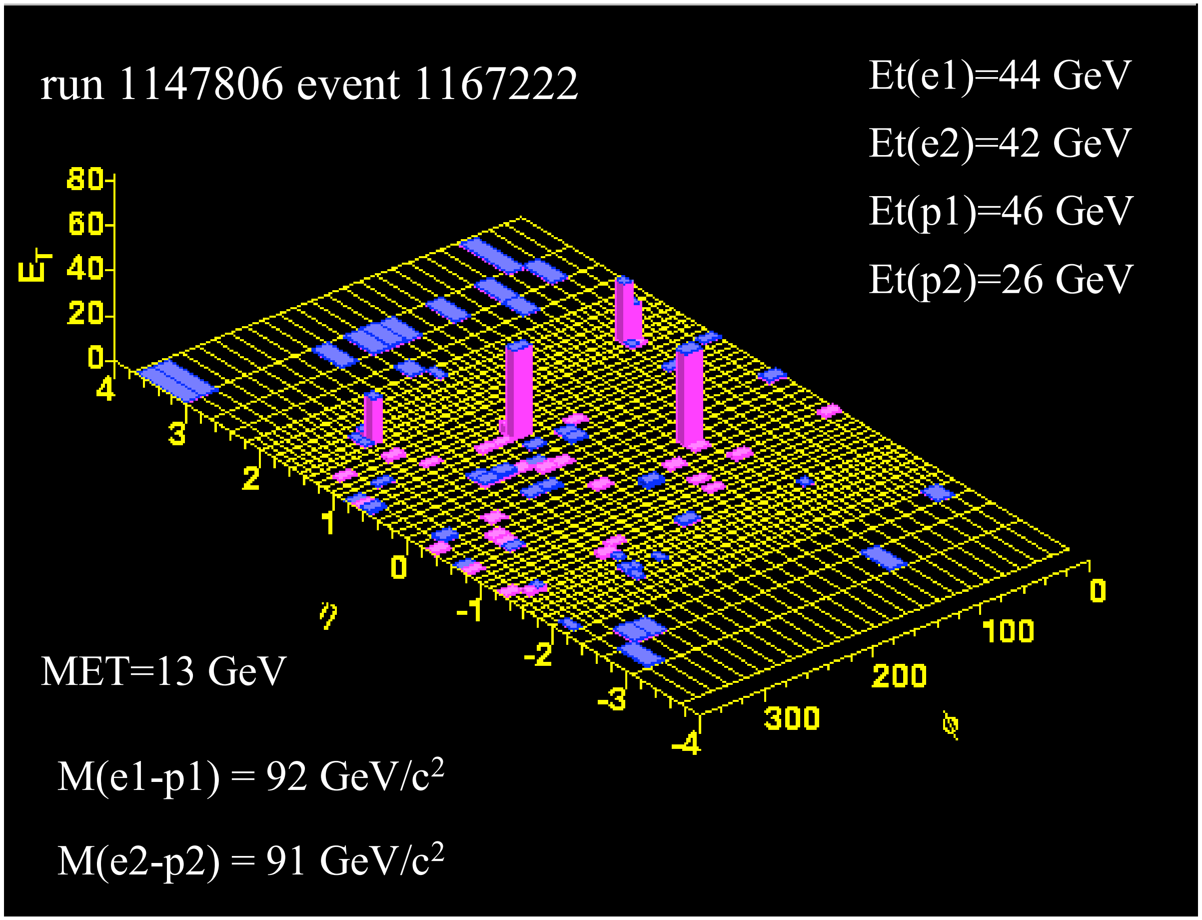


Electrons and Photons

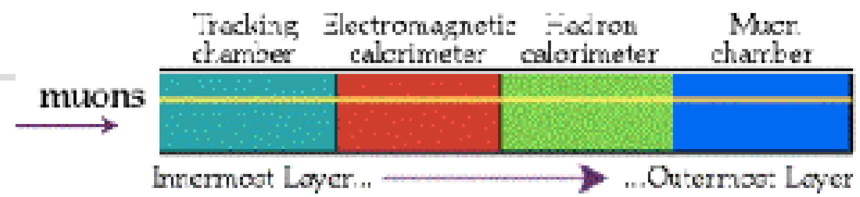
- Electrons and Photons get easily absorbed by the calorimeter
- Tracking association gives the ability to identify a charge particle, the electron.



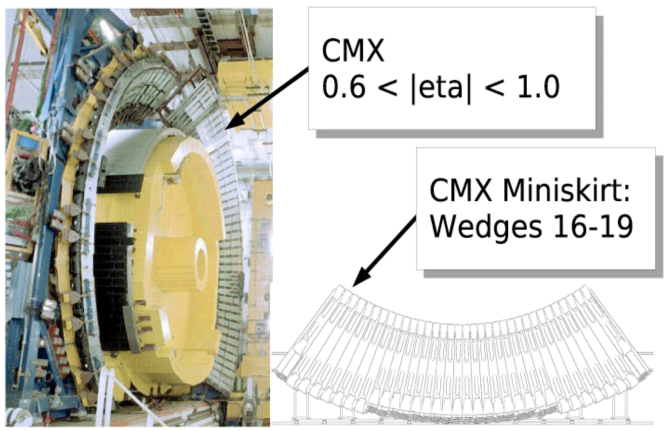


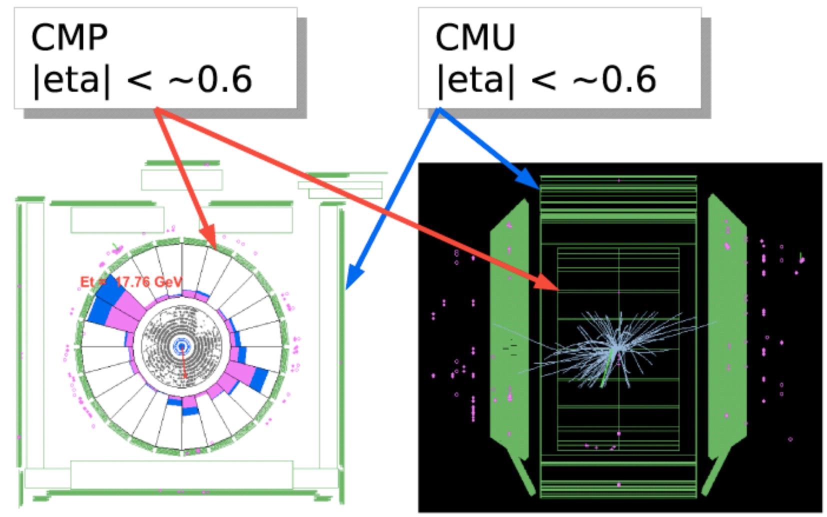


Muons and Neutrinos

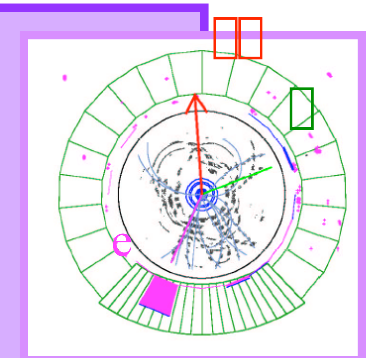


- Muon can penetrate lots of material before getting absorbed.
- Easily identified as coincidence between tracks and muon chambers hits: MIP

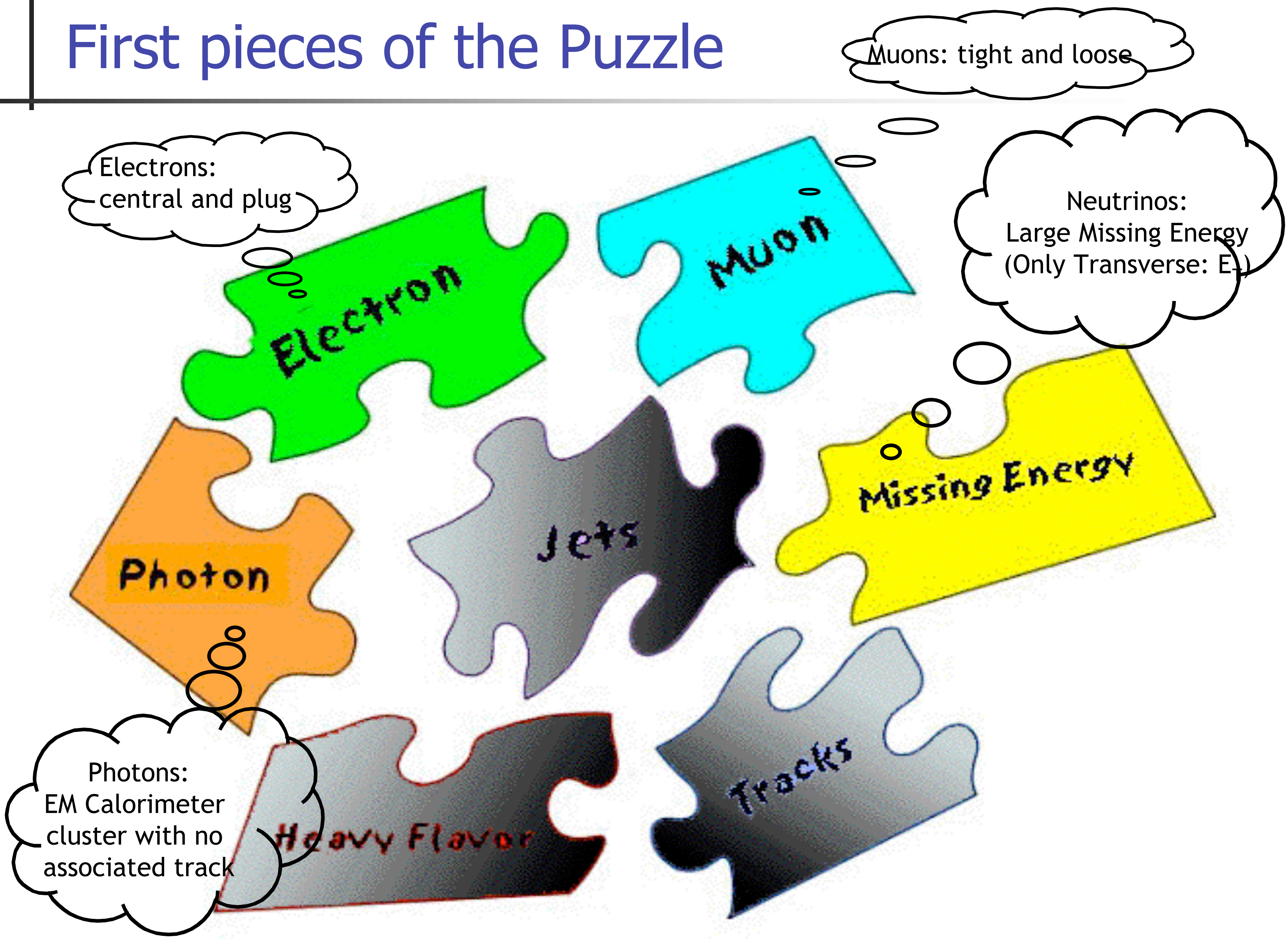




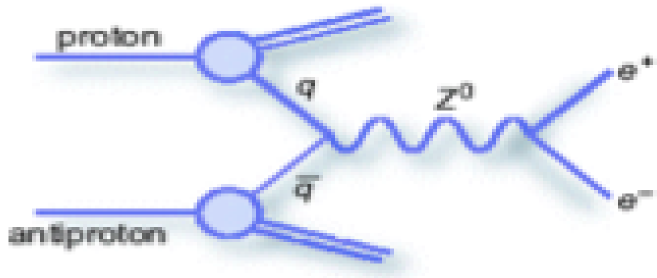
- Neutrinos rarely interact at all.
  - Since they have no charge, there is no track associated to them.
  - They don’t leave energy in the calorimeter
  - They leave the detector undisturbed…
- The presence of the neutrino is inferred by its absence!
- Missing energy to the total energy of the event.



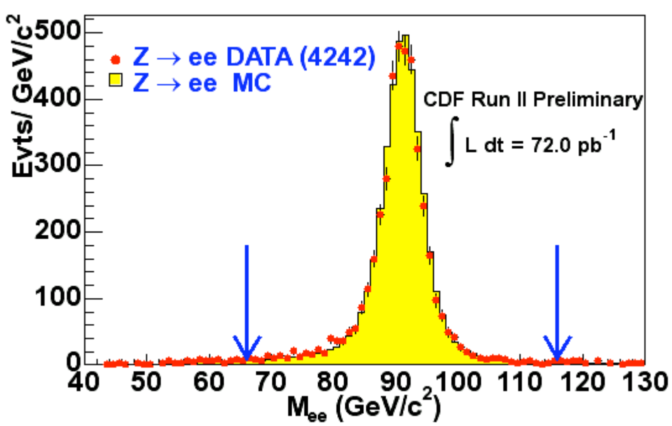
First pieces of the Puzzle



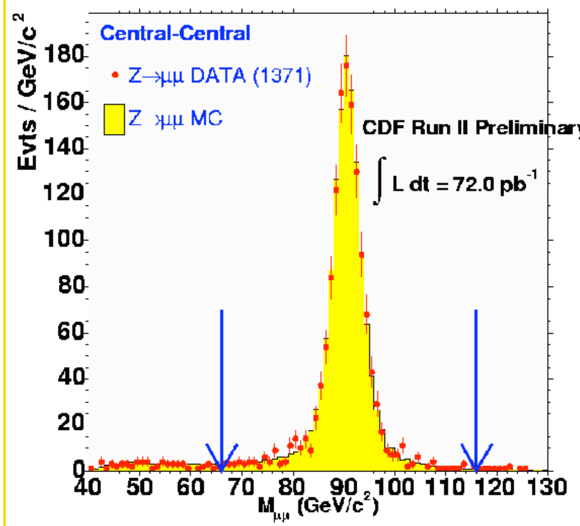
Z^0 Vector Boson Production



Very low backgrounds (QCD, $Z \to \tau\tau$, cosmics) : < 1%
Important systematics : PDF's, Material Descriptions



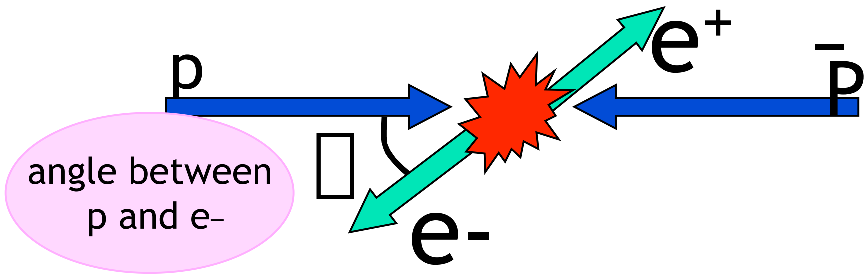
Standard candle



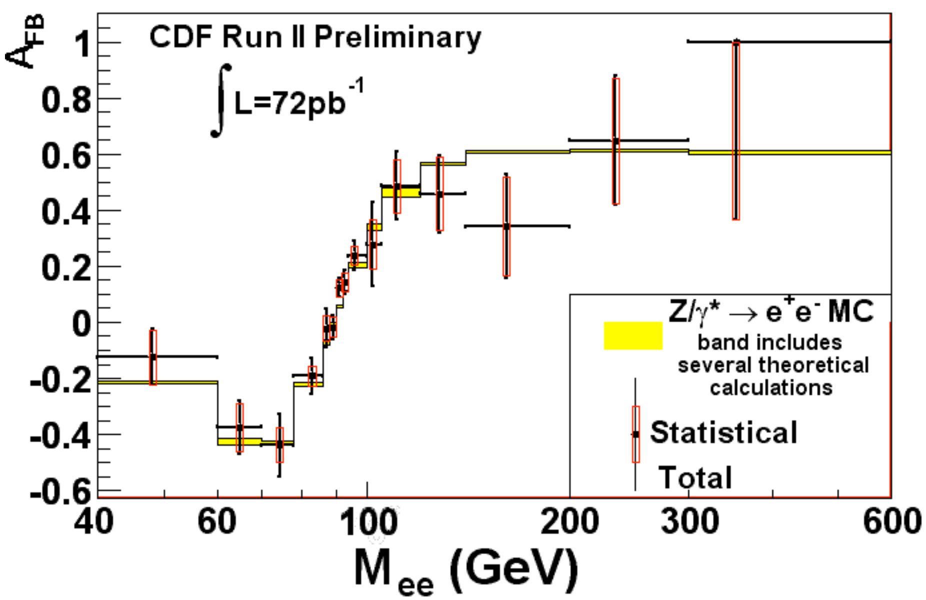
$\sigma \cdot BR(Z \to ee) = 255.2 \pm 3.9(stat) \pm 5.5(sys) \pm 15.3(lum)$ pb
$\sigma \cdot BR(Z \to \mu\mu) = 248.9 \pm 5.9(stat)\ ^{+7.0}_{-6.2}(sys) \pm 14.9(lum)$ pb

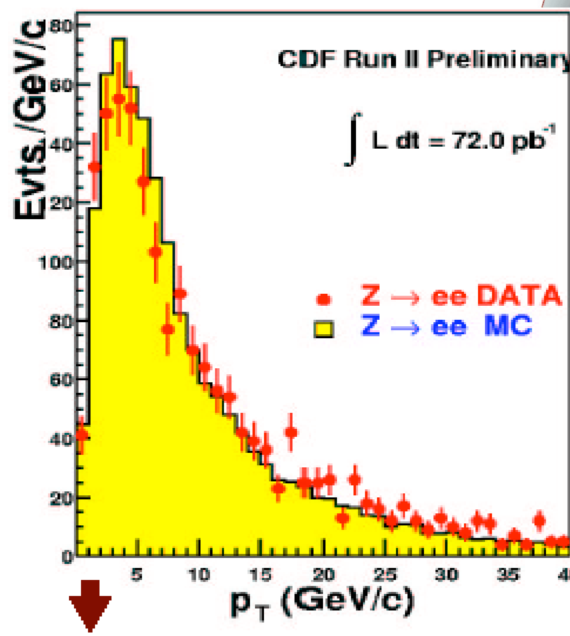
Extended measurements of cross section are well advanced

Drell-Yan Measurements



$$A_{fb} = \frac{\sigma(\cos\theta > 0) - \sigma(\cos\theta < 0)}{\sigma(\cos\theta > 0) + \sigma(\cos\theta < 0)}$$

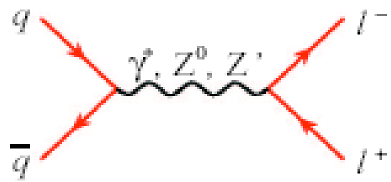


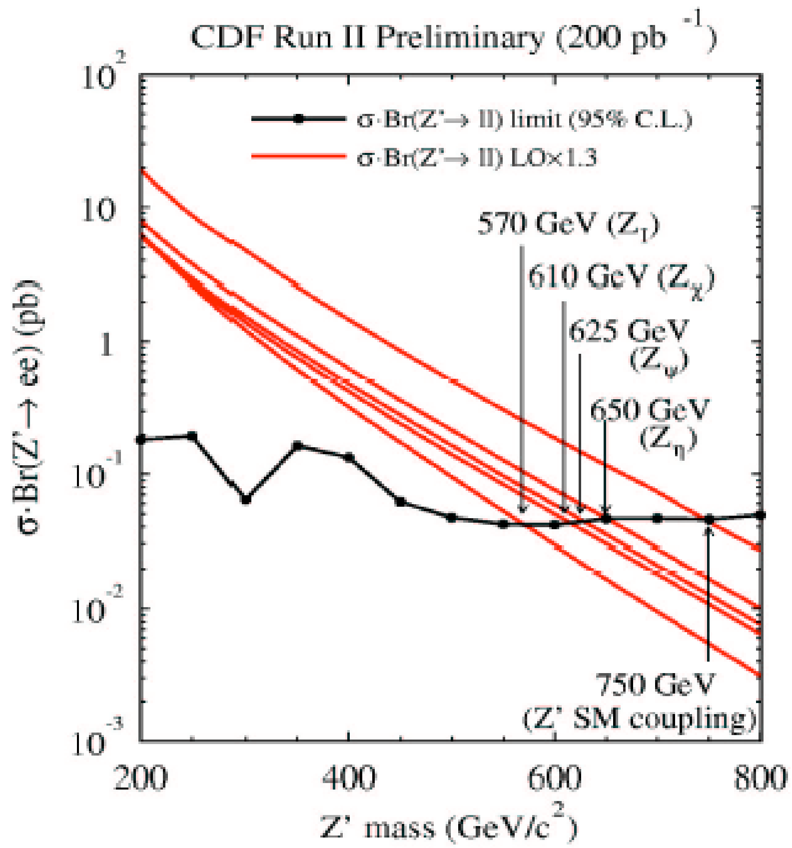


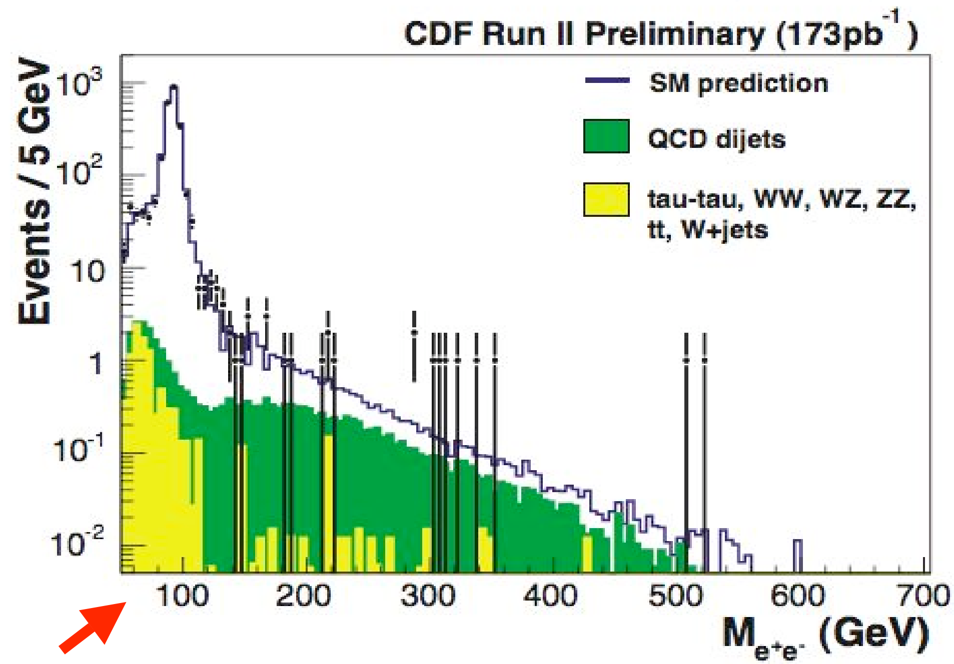
- Production properties : eventually feed into precision measurements (M_W)

- $|\eta^e|<3.0$: using full detector coverage
- extract quark, lepton couplings & $\sin^2\vartheta_W$
- sensitive to new physics

Searches in dileptons

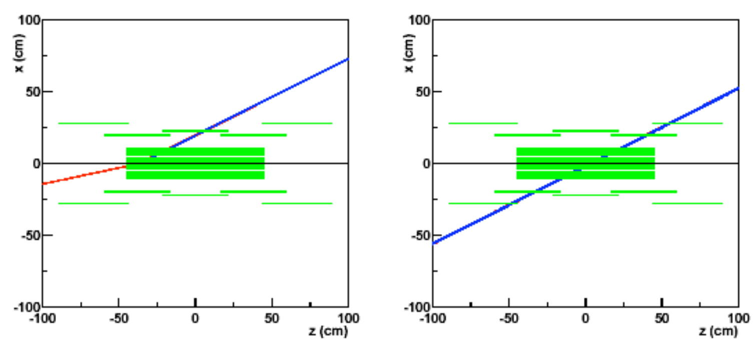






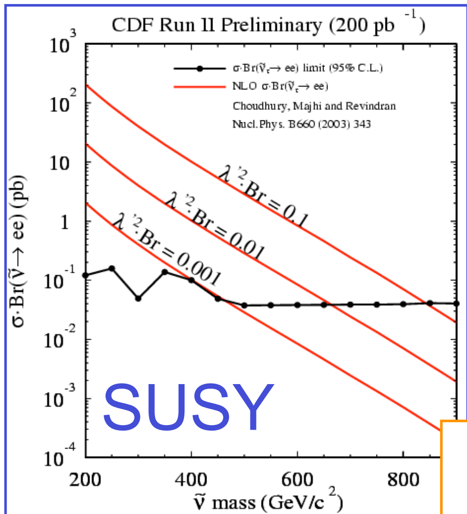
Forward electrons : $1.2 < |\eta| < 2.5$

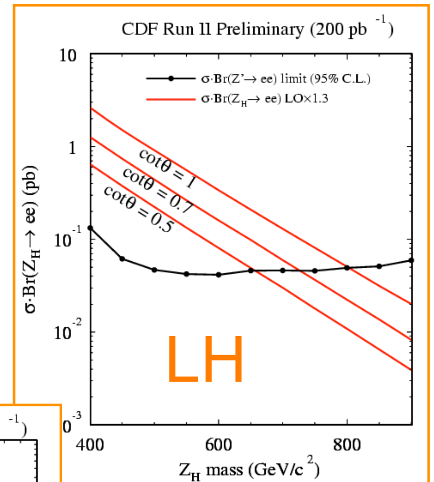
Calorimeter seeded Si tracking

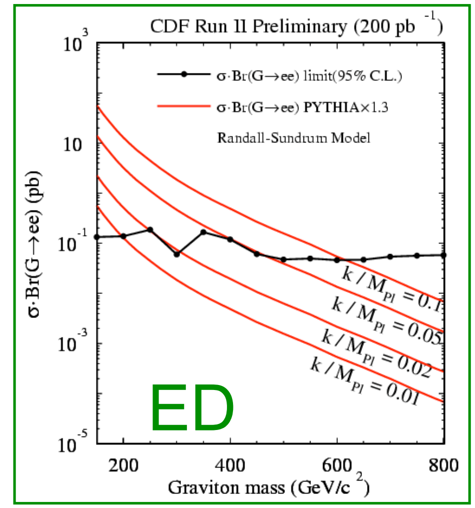


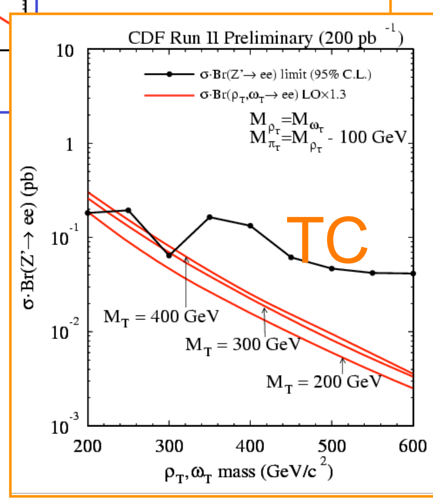
New Physics in Dileptons

Calculate the acceptances for resonant states for 3 different spin assumption (0,1,2)









- Randall-Sundrum graviton model

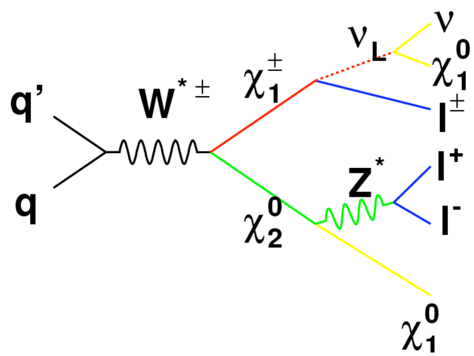
  4-dimensional metric multiplied by *warp* factor exponentially changing with the additional dimension

  Generating a large hierarchy does not require a large r_c

  The coupling of individual KK states to matter is set by the weak scale (parameters : M_G and $k/M_{P\,lanck}$)

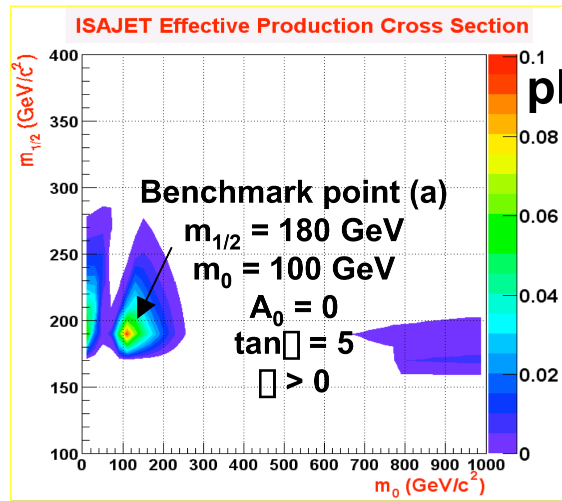
  KK states can be observed as spin 2 resonances

SUSY in trileptons



Signature: 3 isolated leptons and large MET

$$\sigma(qq' \to \chi_1^\pm \chi_2^0)\cdot BR(\chi_1^\pm,\chi_2^0 \to lll)$$



Sensitivity study for trilepton channel in mSUGRA scenario

Detailed scan of the parameter space: $m_{1/2}$, m_0, A_0, $\tan\beta$, sign(μ)

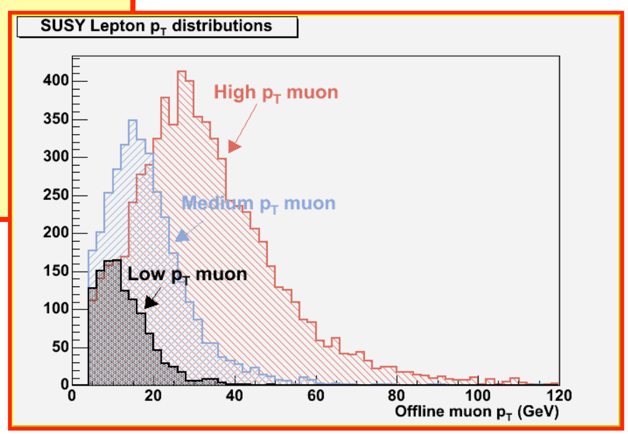
- Current limits

LEP (2000):

$m(\chi_1^\pm) > 103.5$ GeV/c^2

$m(\chi_1^0) > 46$ GeV/c^2

D0 Run II: $\sigma \cdot BR < 0.4$ pb



4 independent analyses to maximize acceptance

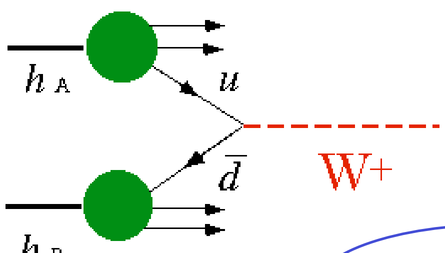
High p_t $\mu\mu$ + lepton & ee + lepton

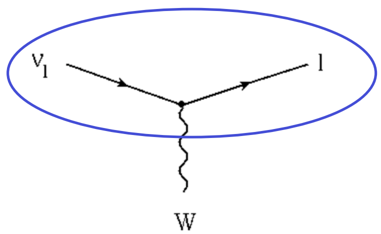
Low p_t $\mu\mu$ + lepton & ee + track

Prelim. Results in a few weeks - Comparable to current D0 limit

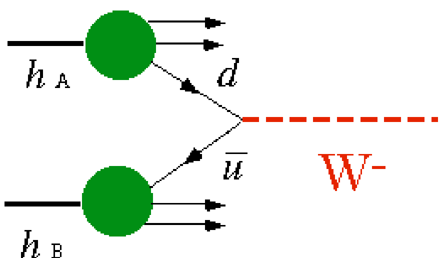
$W^{\pm}$ vector boson production

W^{+} Production

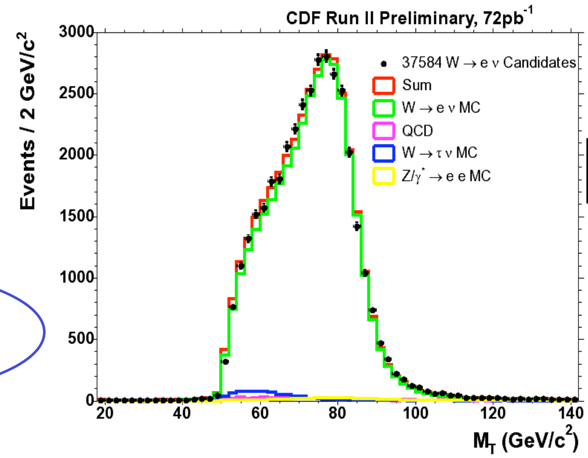




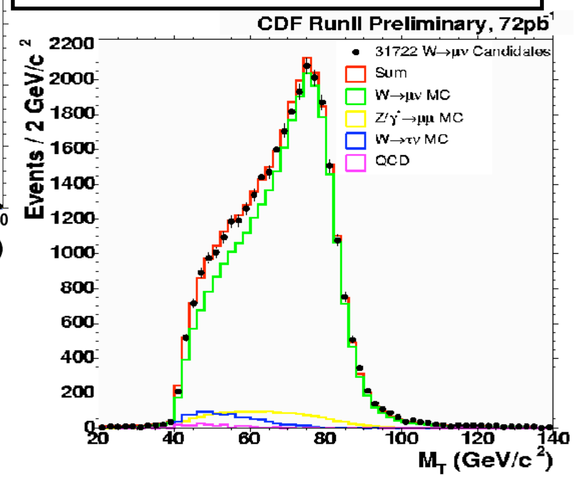
W^{-} Production

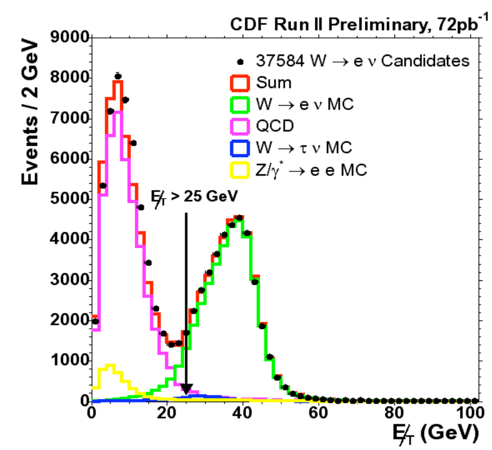


Transverse Mass - W→ eν



Transverse Mass - W→ μν





Backgrounds (QCD, W→τν, Z, cosmics) : 6% (e), 11% (μ).
Important systematics : PDF's, Energy Scales, Material Description

$$\sigma \cdot \mathrm{BR}(p\bar{p} \to W \to e\nu) = 2782 \pm 14(stat)^{+61}_{-56}(syst) \pm 167(lum)\,\mathrm{pb}$$

$$\sigma \cdot \mathrm{BR}(p\bar{p} \to W \to \mu\nu) = 2772 \pm 16(stat)^{+64}_{-60}(syst) \pm 166(lum)\,\mathrm{pb}$$

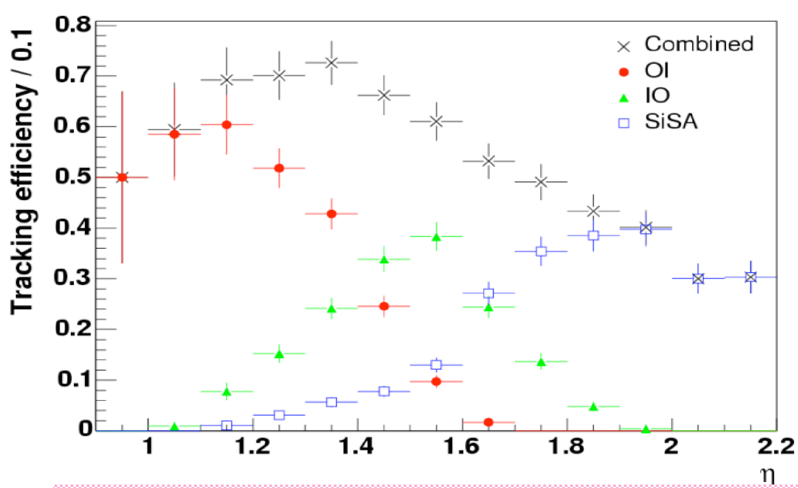
Inclusive W cross section (cont'd)

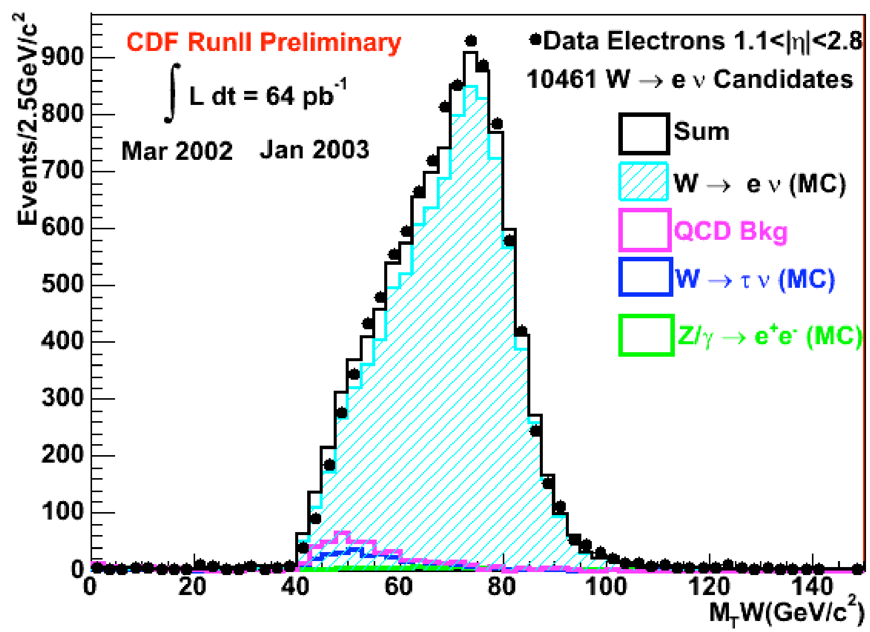
Following the same strategy pursued in the |η| <1 region, full tracking is used in the forward region

EM cluster is matched to a 3D track reconstructed using the Silicon detector only in the region 1 < |η| < 2.8

- Two 3-D hits & vertex seed silicon track (SISA)
- OI seeded by COT hits
- IO attaches COT hits to SISA

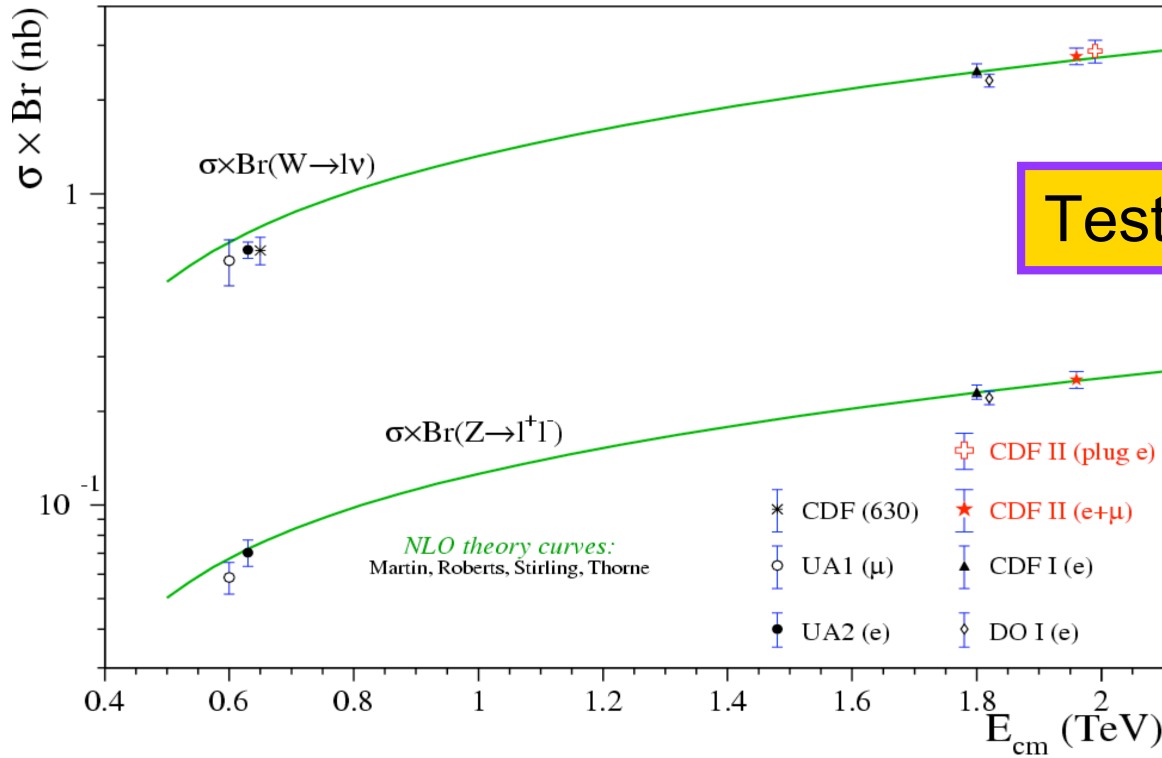
Tracking Efficiency





σ × BR(W→ eν) = 2874 ± 34 (stat) ± 167 (sys) ± 172 (lumi) pb

Summary and X-Sections Ratio



Test of SM!

$$R = \frac{\sigma \cdot Br(p\bar{p} \to W \to \ell\nu)}{\sigma \cdot Br(p\bar{p} \to Z \to \ell^+\ell^-)} = \frac{\sigma(p\bar{p} \to W)}{\sigma(p\bar{p} \to Z)} \times \frac{\Gamma_Z}{\Gamma_Z(\ell^+\ell^-)} \times \frac{\Gamma_W(\ell\nu)}{\Gamma_W}$$

$$R_e = 10.86 \pm 0.18_{(stat)} \pm 0.16_{(syst)}$$

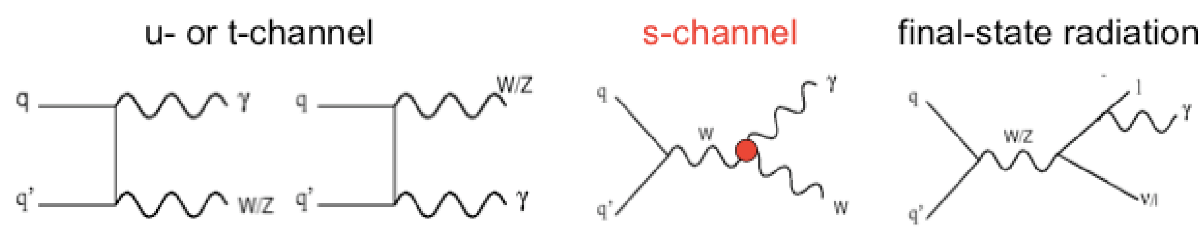
$$R_\mu = 11.10 \pm 0.27_{(stat)} \pm 0.17_{(syst)}$$

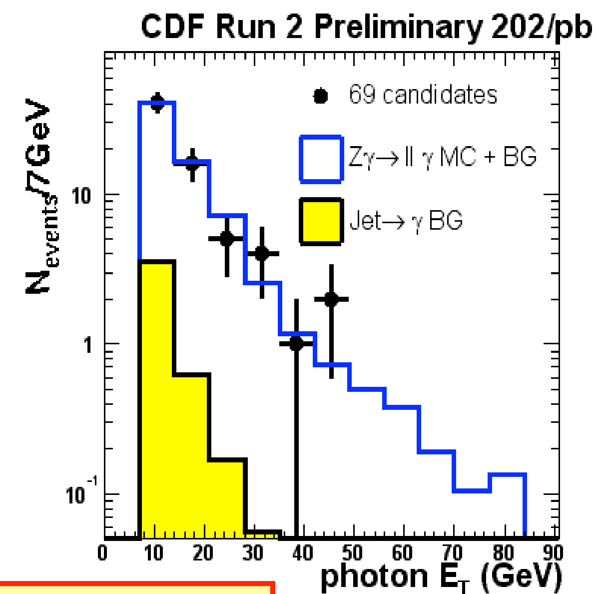
$$R = 10.94 \pm 0.15_{(stat)} \pm 0.13_{(syst)}$$

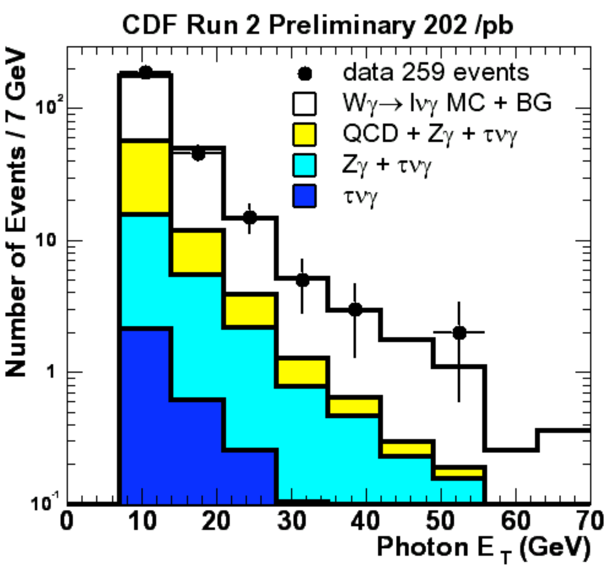
The combined ratio is precise at 1.8% independent on the luminosity

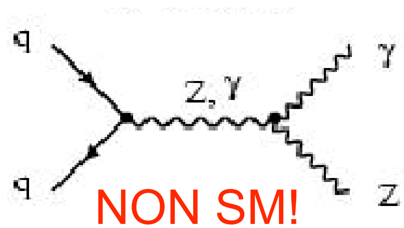
W□and Z□

Test of gauge couplings (as predicted by the SM) and a window on new physics



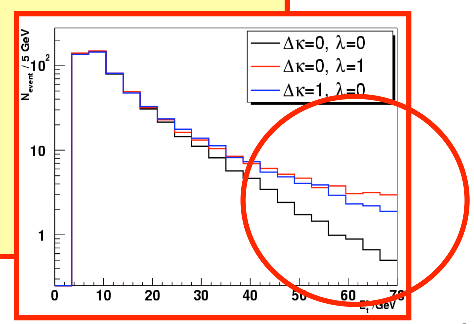






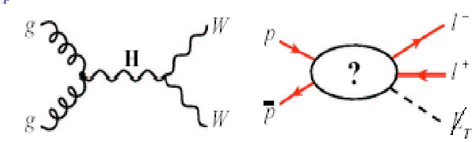
Now V+□cross-sections well established, we are:

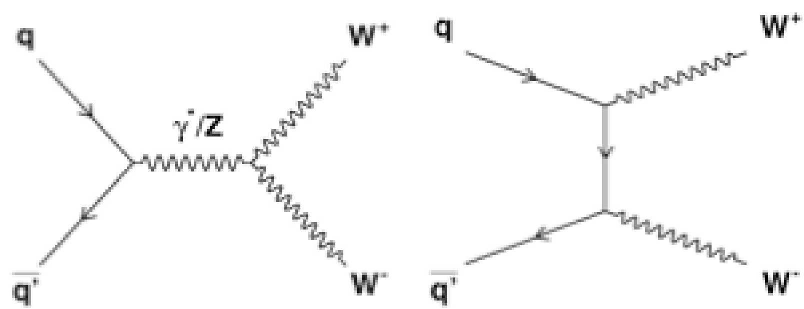
- optimizing sensitivity to anomalous coupling and new physics
- testing the Standard Model in ways unique to the TeVatron (e.g. observing RAZ in W □production)



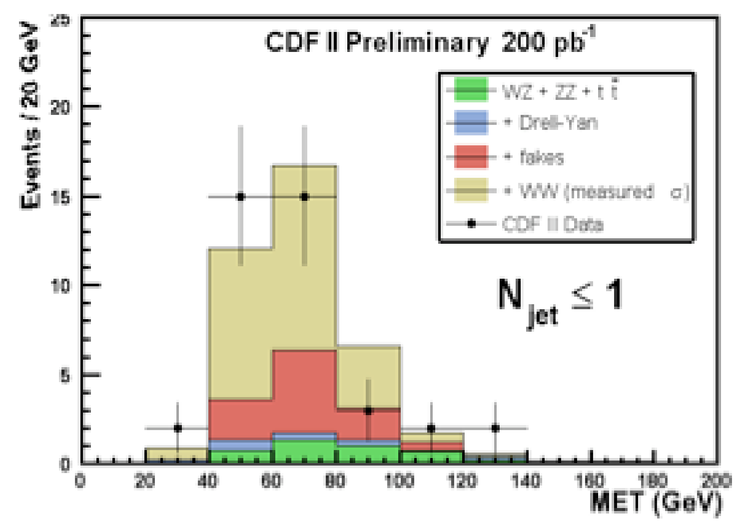
WW and WZ

- WW (SM 12.5 ± 0.8 pb)
  - Trilinear Gauge Coupling - hard to beat LEP (40k WW)
  - Tevatron can produce higher mass than LEP.
  - Important backgrounds to Higgs search (H -> WW)!





$$\sigma(WW) = 14.3 \pm^{5.6}_{4.9} \pm^{1.8}_{1.8} pb$$

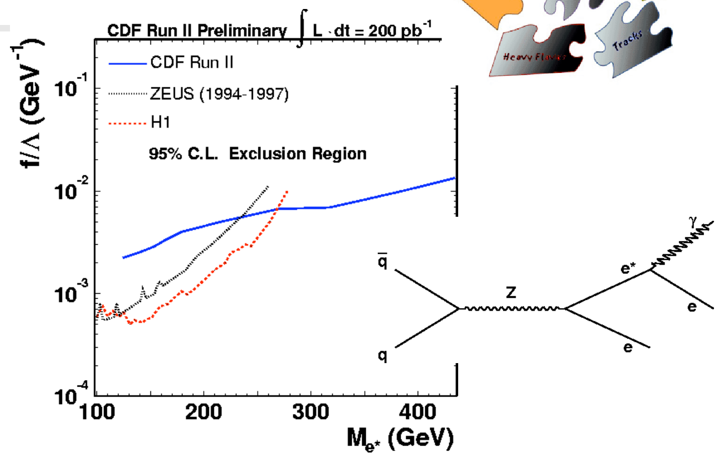


- Still searching for WZ, ZZ (SM WW 5.2 ± 0.4 pb)

$$\sigma(WZ) < 13.9 pb @ 95\% \ C.L.$$

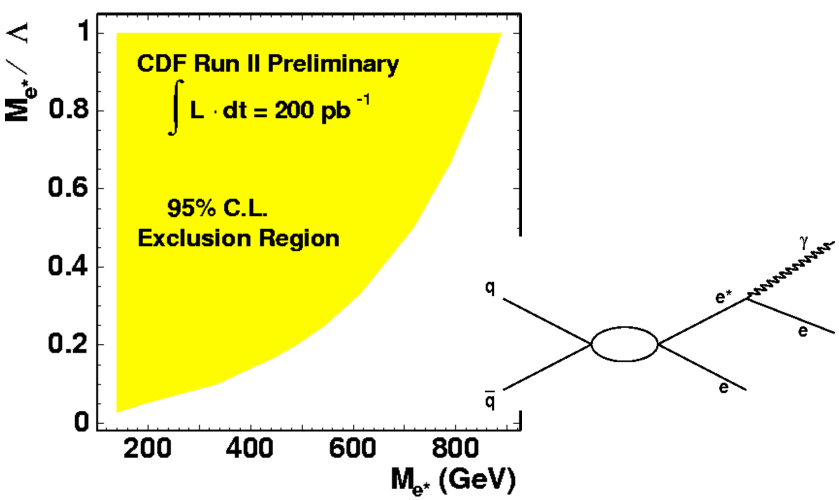
Excited electrons

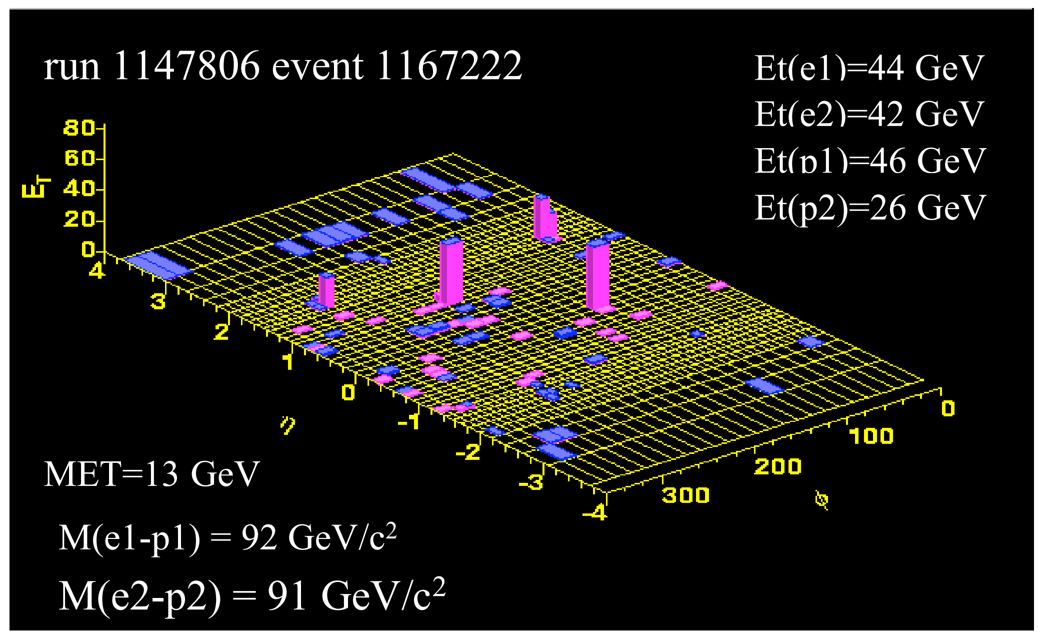
Observation of excited states of quarks and leptons might confirm the hypothesis that they are not elementary particles , but composite states



Select events with eeγ in the final state and look for resonance in M(eγ)

At Tevatron, e^* can be produced via contact interactions or gauge mediated interactions



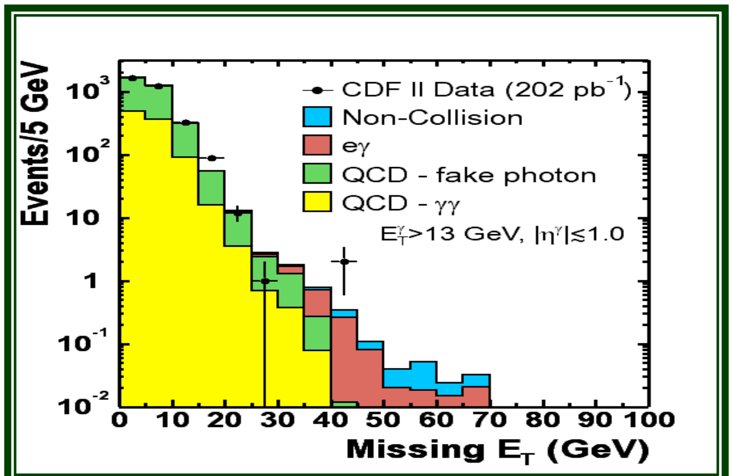


SUSY searches in diphoton + $\not{E}_T$

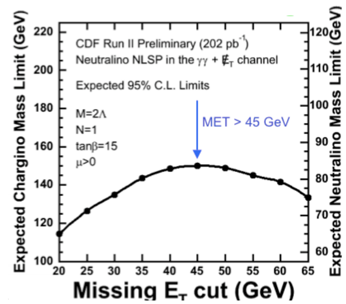
GMSB scenario
NLSP = $\tilde{\chi}^0_1 \to \gamma \tilde{G}$

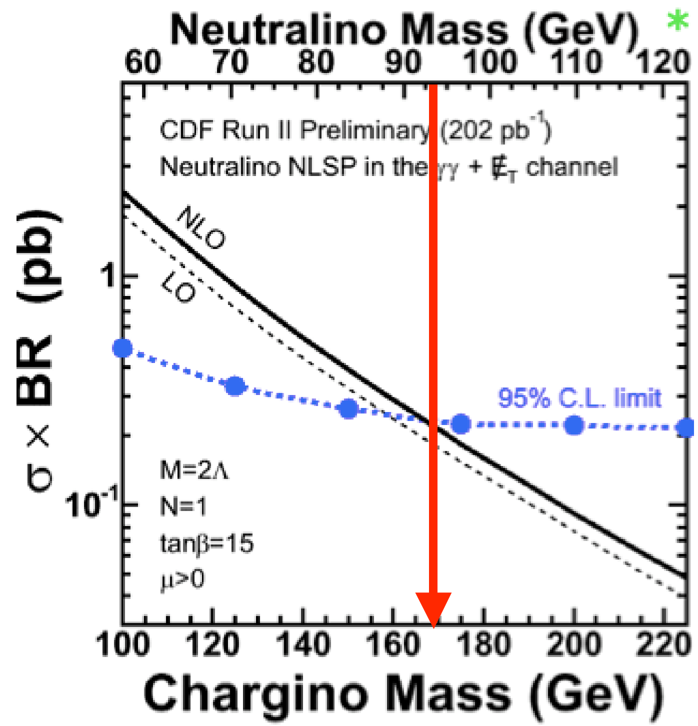
$p\bar{p} \to (X \to) \tilde{\chi}^0_1 \tilde{\chi}^0_1$ → $2\gamma + \not{E}_T$

Sample selection
- 2 central photons E_T > 13 GeV
- cosmic rays and beam halo rejection



For Missing Energy > 45 GeV
Expected: 0.60 ± 0.50
Observed : 0

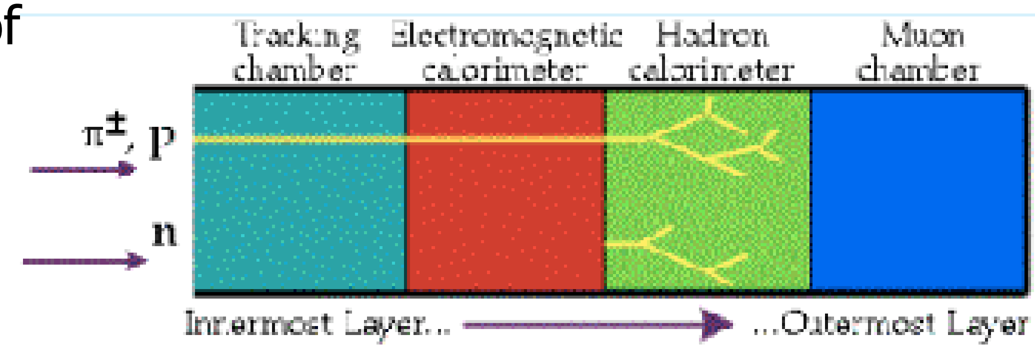


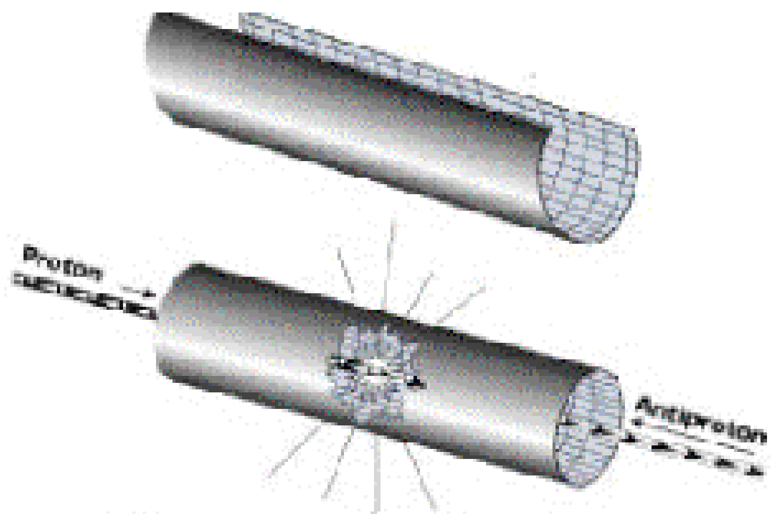


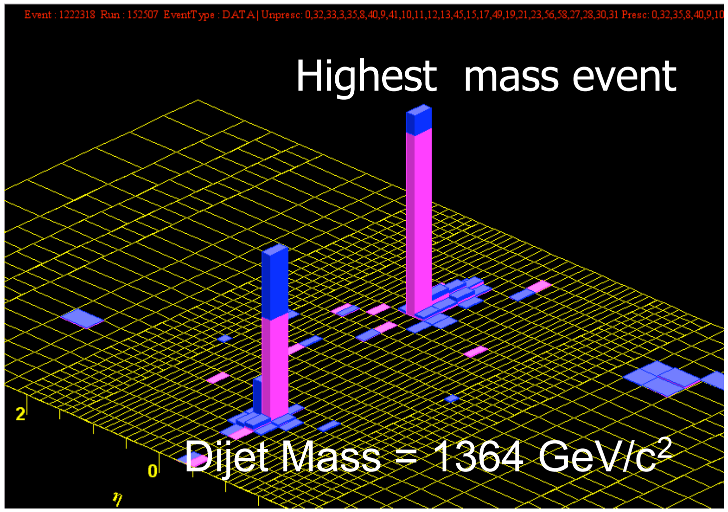
NLO Limit at 95% C.L.
$m(\tilde{\chi}_1^\pm) > 168\ \mathrm{GeV}/c^2$
$m(\tilde{\chi}_1^0) > 93\ \mathrm{GeV}/c^2$

Jets

- A quark or gluon flying out of the interaction point will generate lots of hadrons moving in the same general direction: a jet.







QCD and Jet Physics

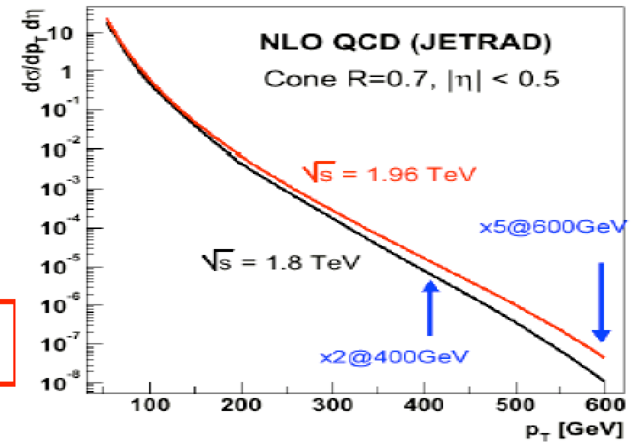
The Tevatron is a Jet Factory: all production processes are "QCD realated"

Optimal understanding is basic for all analyses:

-Main parameters (ex: gluon PDF's in high x)

-Non perturbative regime (ex: underlying event studies)

-Studies of specific processes where QCD is important

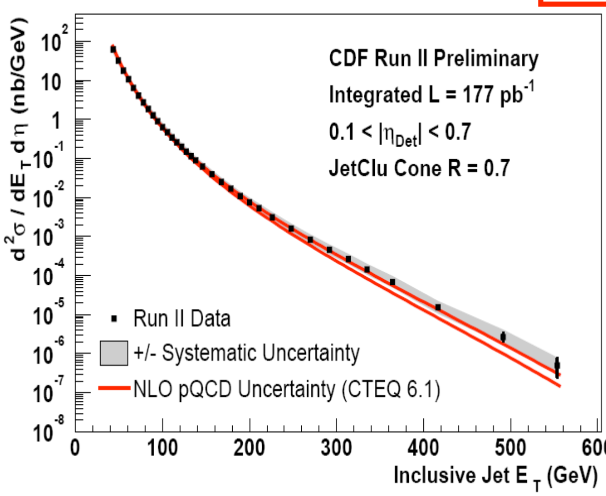


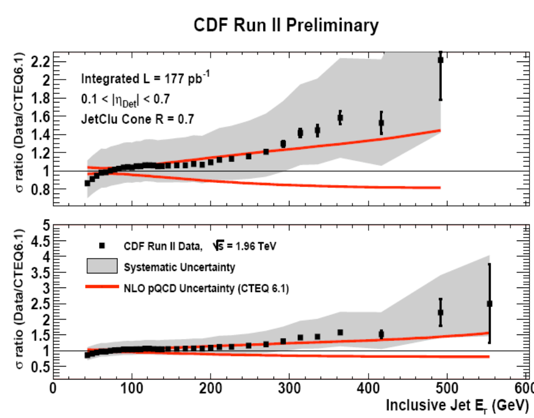
Probing higher energy scales:

Precise test of perturbative QCD at NLO

Look for deviations from SM predictions as a sign of new physics

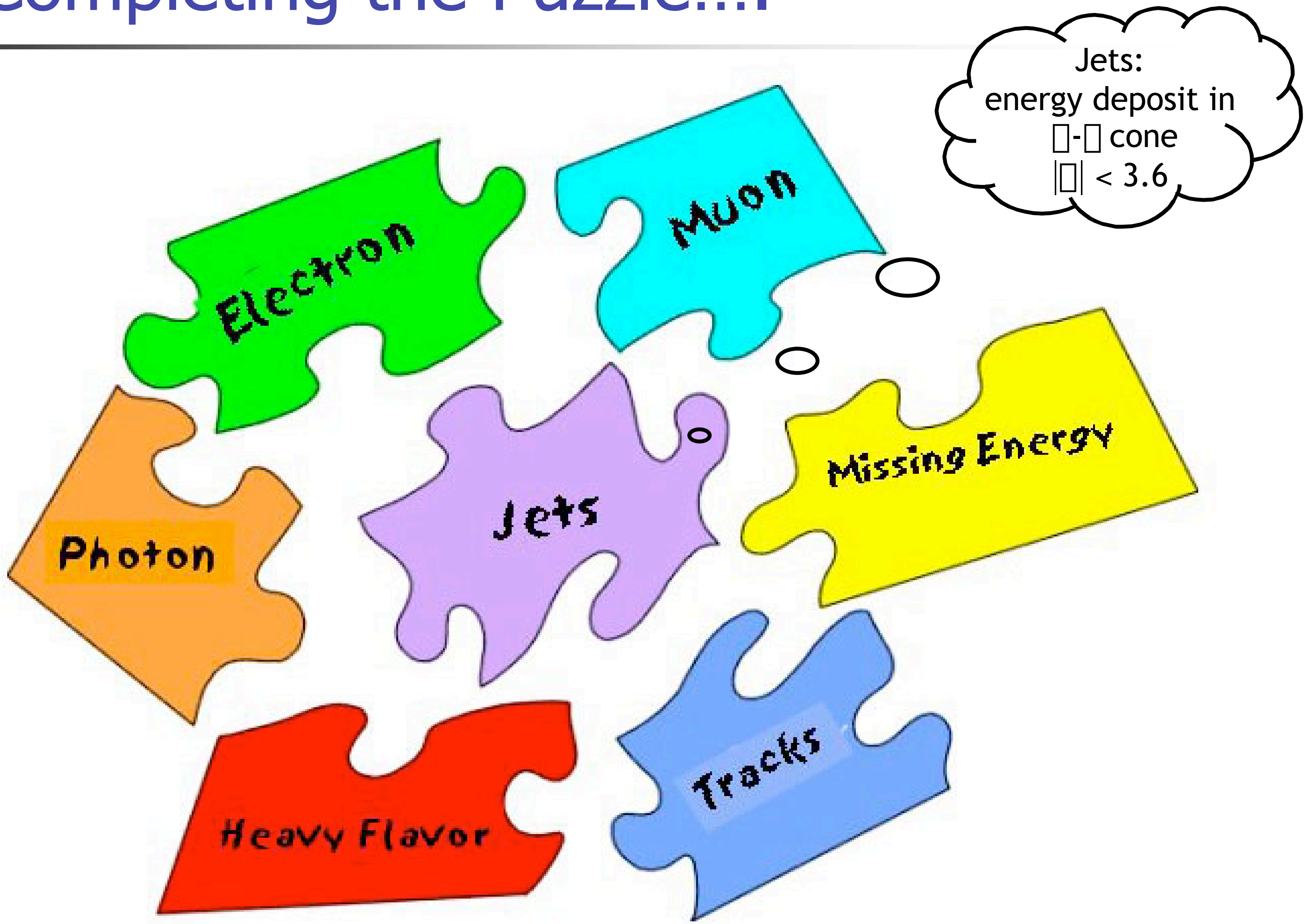
Increase in the kinematic range





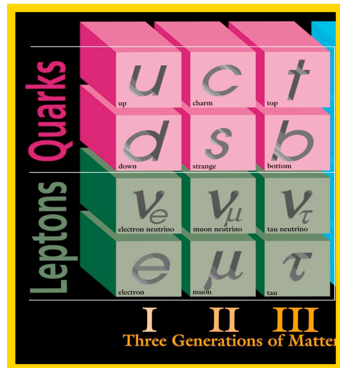
The error band shows the change in the cross section due to the 5% energy scale uncertainty

Completing the Puzzle….

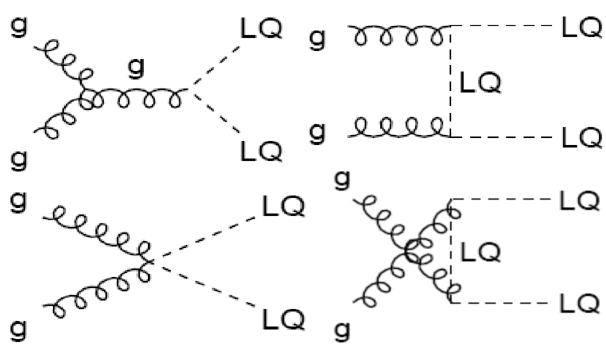


Leptoquarks

- **Leptoquarks (LQ)** are hypothetical particles which appear in many SM extensions to explain **symmetry between leptons and quarks**
  - SU(5) GUT model
  - superstring-inspired models
  - 'colour' SU(4) Pati-Salam model
  - composite models
  - technicolor



• LQs are **coupled to both leptons and quarks** and carry SU(3) color, fractional electric charge, baryon (B) and lepton (L) numbers



•LQs can have:

–spin 0 (scalar)

•couplings fixed, i.e., no free parameters

•Isotropic decay

–spin 1 (vector)

•anomalous magnetic (k_G) and electric quadrupole (λ_G) model-dependent couplings

–Yang-Mills coupling: $k_G = \lambda_G = 0$

–Minimal coupling: $K_G = 1, \lambda_G = 0$

–Decay amplitude proportional to $(1 + \cos\theta^*)^2$

- **Experimental evidence searched:**
  - indirectly: LQ-induced 4-fermion interactions
  - directly: production cross sections at collider experiments

Leptoquark Decay

Each generation can decay into 3 final states:

□ = Br(LQ□ lq)

Exclusive to the Tevatron

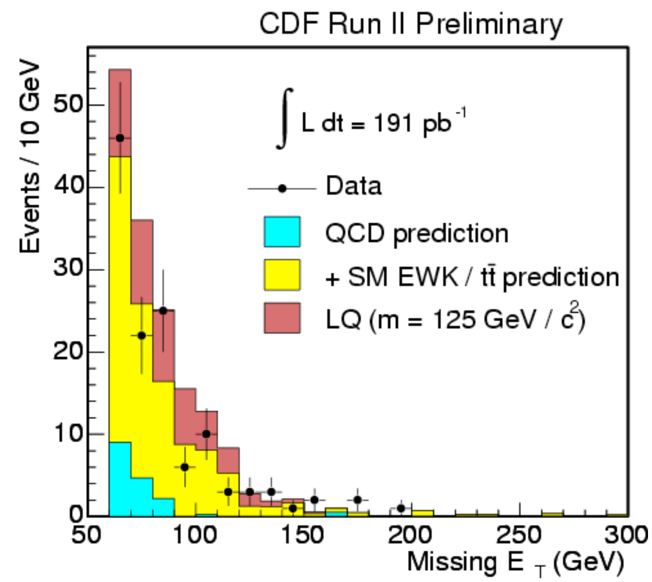
	1^{st} Generation	2^{nd} Generation	3^{rd} Generation
□ = 1	$LQ\,\overline{LQ}\rightarrow e^- e^+ q\bar{q}$	$LQ\,\overline{LQ}\rightarrow \mu^+\mu^- q\bar{q}$	$LQ\,\overline{LQ}\rightarrow \tau^+\tau^- q\bar{q}$
□ = 0.5	$LQ\,\overline{LQ}\rightarrow e^{\pm}\nu_e q_i q_j$	$LQ\,\overline{LQ}\rightarrow \mu^{\pm}\nu_\mu q_i q_j$	$LQ\,\overline{LQ}\rightarrow \tau^{\pm}\nu\, q_i q_j$
□ = 0	$LQ\,\overline{LQ}\rightarrow \nu_e \nu_e q\bar{q}$	$LQ\,\overline{LQ}\rightarrow \nu_\mu \nu_\mu q\bar{q}$	$LQ\,\overline{LQ}\rightarrow \nu_\tau \nu_\tau q\bar{q}$

LQ LQ □ llqq	2l+2j	BR = □^{2}
LQ LQ □ l□qq	l+MET+2j	BR = 2□(1-□)
LQ LQ □ □□qq	MET+2j	BR = (1-□)^2

LQ search in ννjj

β′ =BR(LQ→ νq) = 1

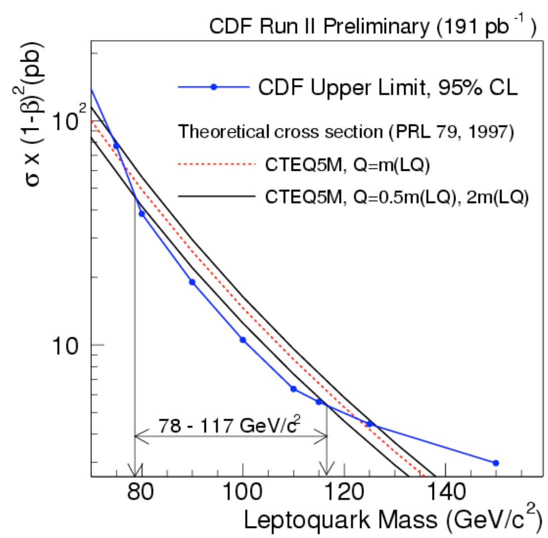
Signature: Large MET and 2 jets



Sample Composition:
- W/Z + jets
- top
- QCD fakes

Expected =118±14

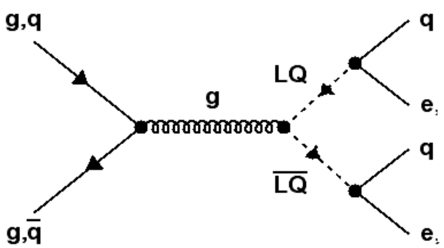
124 events seen after analysis cuts



M(LQ) > 117 GeV/c² @ 95 % C.L.

Flavor independent

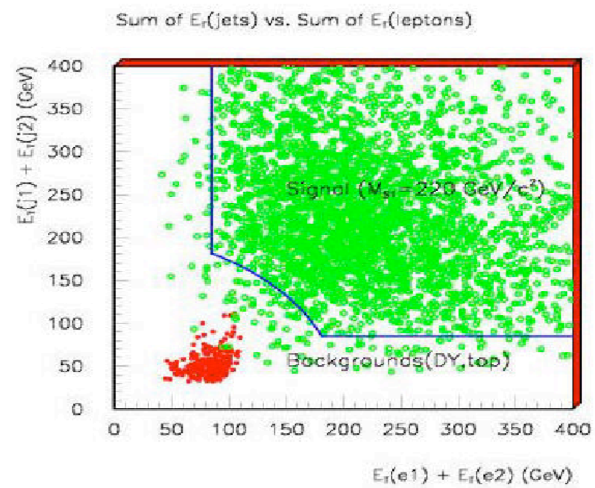
Search for Scalar LQ in dileptons + jets



Selection

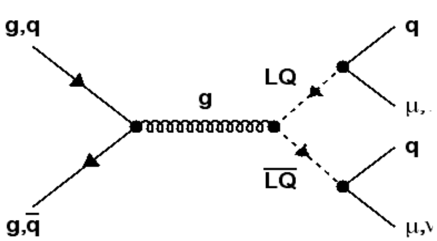
- ✓ 2 electrons (CC,CF) $E_T > 25$ GeV
- ✓ 2 jets, $E_T(j1) > 30$ GeV, $E_T(j2) > 15$ GeV
- ✓ Z Veto ($76 < M_{\mu\mu} < 110$) GeV
- ✓ Electrons/Jets: $E_T^{j1(e1)} + E_T^{j2(e2)} > 85$ GeV
- ✓ $((E_T(j_1) + E_T(j_2))^2 + (E_T(e_1) + E_T(e_2))^2)^{1/2} > 200$ GeV

SM background
- Drell-Yan+2jets
- Top (W e)
- QCD/Fakes

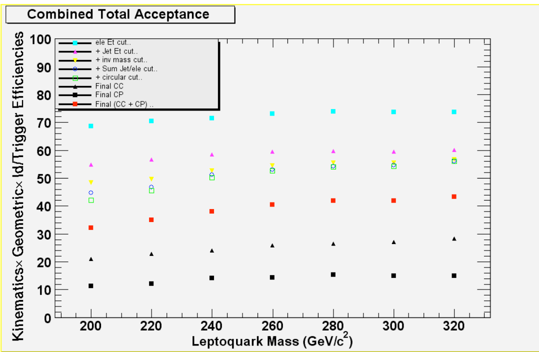


Selection

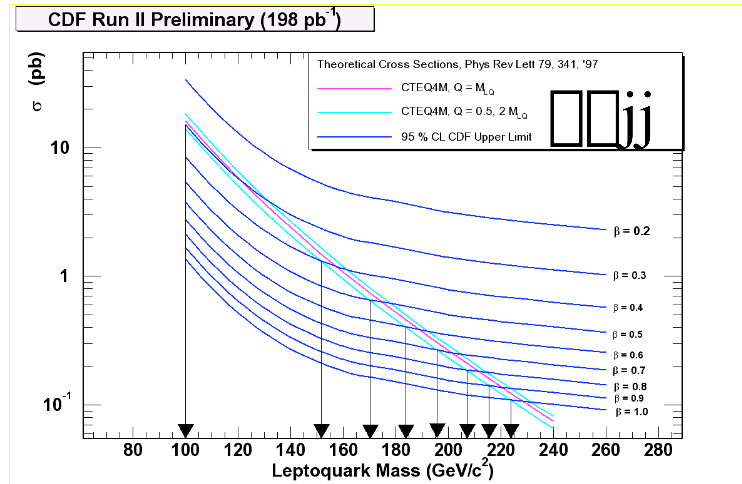
- 2 muons with $P_T > 25$ GeV
- 2 jets with $E_T(j1,j2) > 30,15$ GeV
- Dimuon Mass Veto:
  - $76 < M_{\mu\mu} < 110$, $M_{\mu\mu} < 15$ GeV
- $E_T(j_1) + E_T(j_2) > 85$ GeV and $P_T(\mu_1) + P_T(\mu_2) > 85$ GeV
- $((E_T(j_1) + E_T(j_2))^2 + (P_T(\mu_1) + P_T(\mu_2))^2)^{1/2} > 200$ GeV

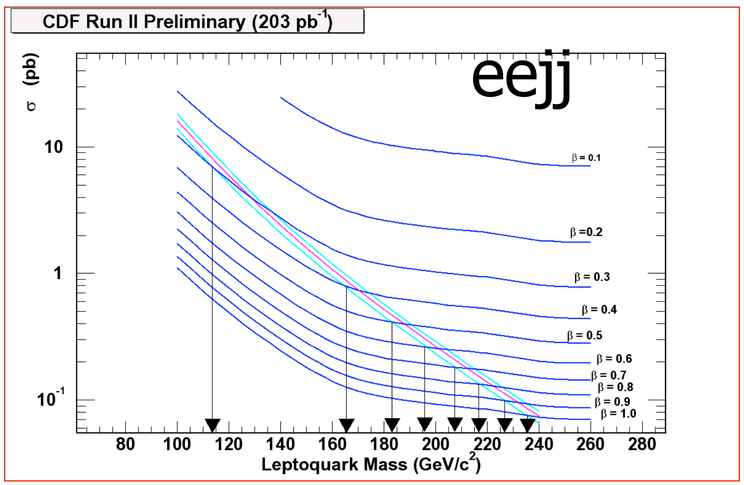


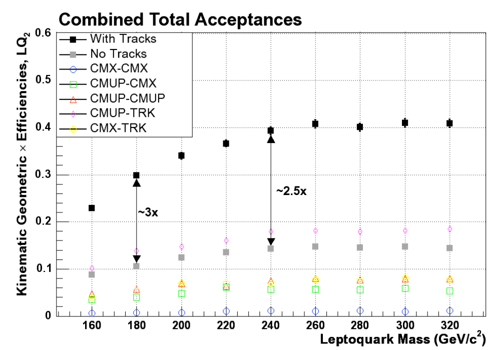
Scalar LQ in dileptons + jets



Exclude at 95% CL M_{LQ}<224 GeV/c^2 for β = 1.0

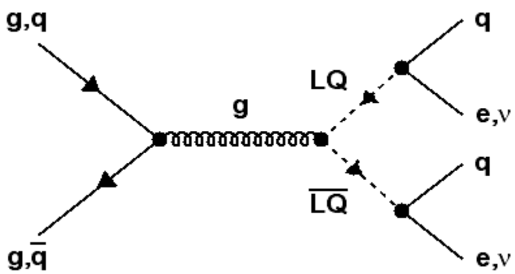






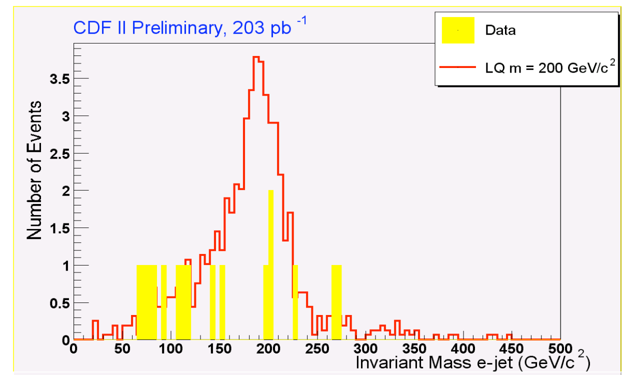
Exclude at 95% CL M_{LQ}<235 GeV/c^2 for β = 1.0

Search for Scalar LQ in lepton + MET + jets



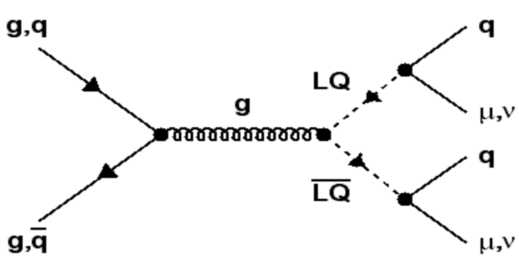
Selection

- 1central electrons with E_T > 25 GeV
- MET > 60 GeV
- Veto on 2nd electron, central loose or Plug
- 2 jets with E_T > 30 GeV
- □□ (MET-jet) > 10°
- E_T(j1) + E_T(j2) > 80 GeV
- M_T(e-□) > 120
- LQ mass combinations



SM background

- W +2jets
- Top (l + jets and dilepton)
- QCD/Fakes



Selection

Z veto (tight/loose pair)

No 2nd muon (CMUP, CMX, or stubless)

$P_T(\mu)$ > 25 GeV

$\not{E}_T$ > 60 GeV

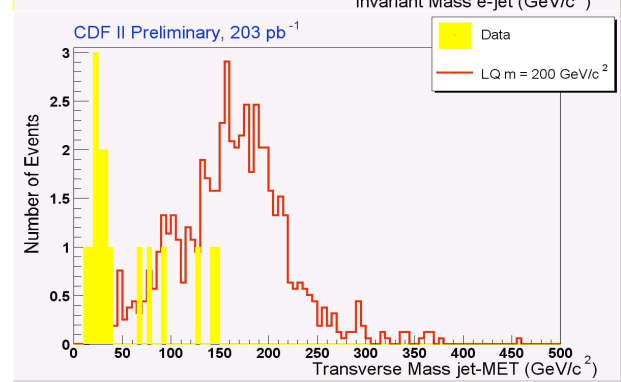
2 jets, @ E_T>30GeV

$\Delta\phi(\mu,\not{E}_T)$<175°, $\Delta\phi(\not{E}_T$,jets)>5°

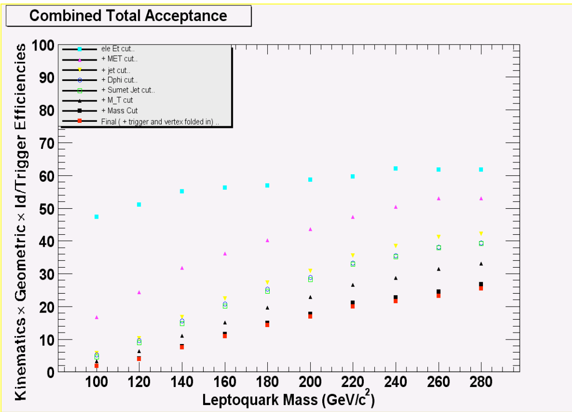
E_T(jet1)+E_T(jet2) > 80 GeV

$M_T(\not{E}_T$,Muon) > 120 GeV/c²

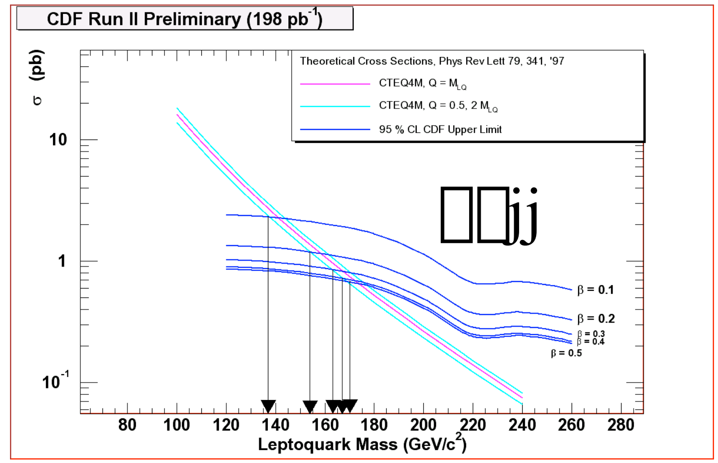
Mass Cut

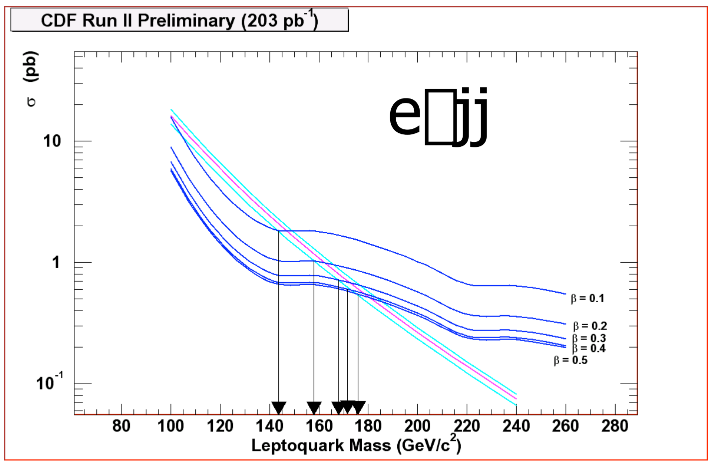


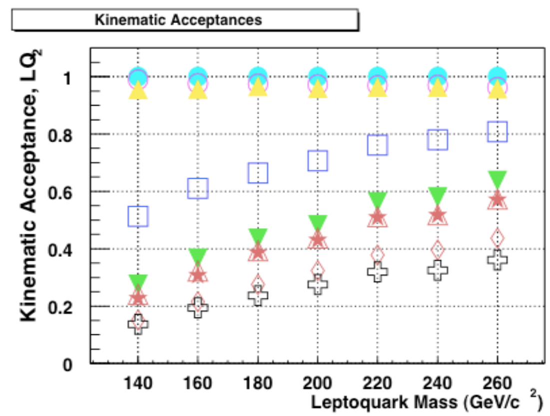
Scalar LQ in lepton + MET + jets



Exclude at 95% CL M_{LQ}<170 GeV/c^2 for β = 0.5







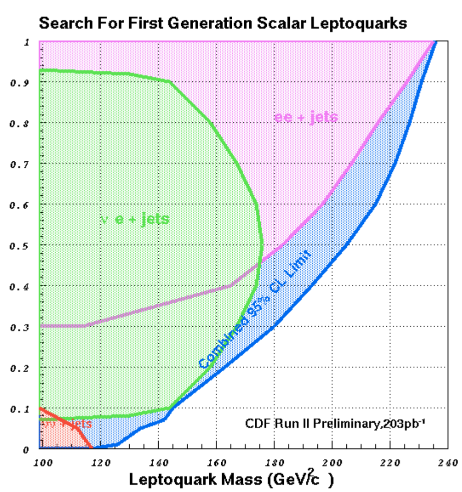
Exclude at 95% CL M_{LQ}<176 GeV/c^2 for β = 0.5

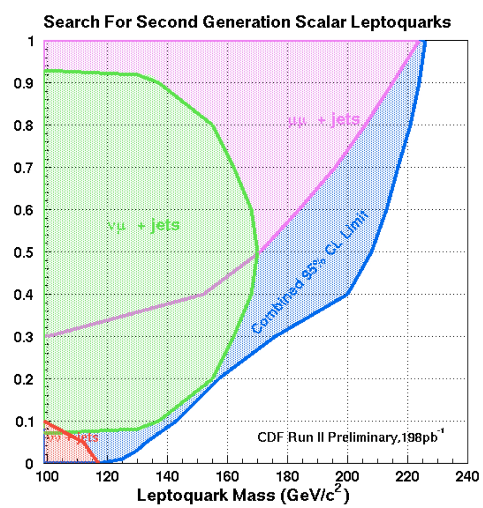
Final Combined Limits

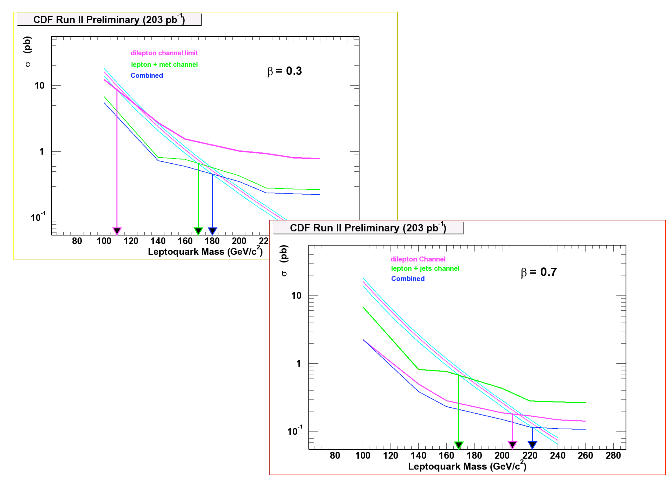
- Joint likelihood formed from the product of the individual channels likelihood.
- The searches in the dileptons and lepton + MET channels use common criteria and sometime apply the same kind of requirements (for example on the tight electron identification) so the uncertainties in the acceptances have been considered completely correlated (which gives the most conservative limit).
- When calculating the limit combination including also the □□jj channel the uncertainties in the acceptances have been considered uncorrelated.A correlation factor of 0.5 has also been considered (no difference)

$$□_{LIM} = N_{LIM}/(□_{average} □ ℒ)$$

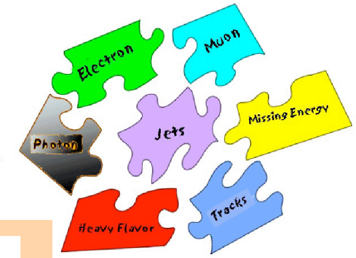
- $□_{average}$ = (□^{2}□(eejj) +2□(1-□)□(e□jj) +□^{2}□(ee as e□)) for the 2 channels case and
- $□_{average}$ = (□^{2}□(eejj) +2□(1-□)□(e□jj) +(1-□)^2□(□□jj) +□^{2}□(ee as e□)) for the three channels case.



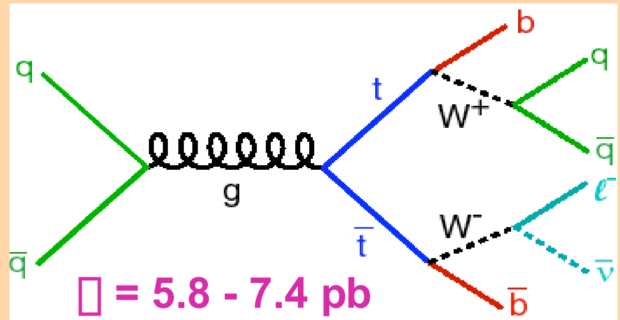


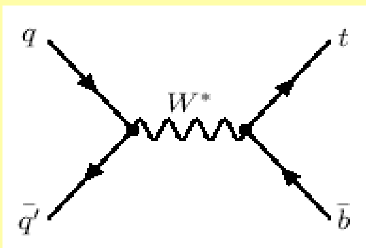


Top Quark



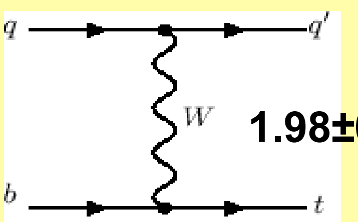
Pair production via strong interactions
- Central, spherical events
- Large transverse energy
- High P_T isolated leptons (tracks)
- Heavy-Flavored Jets



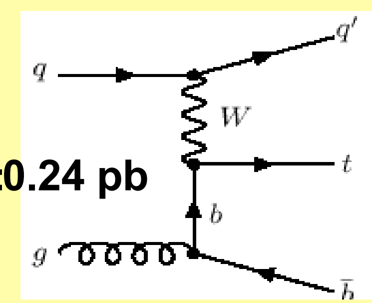


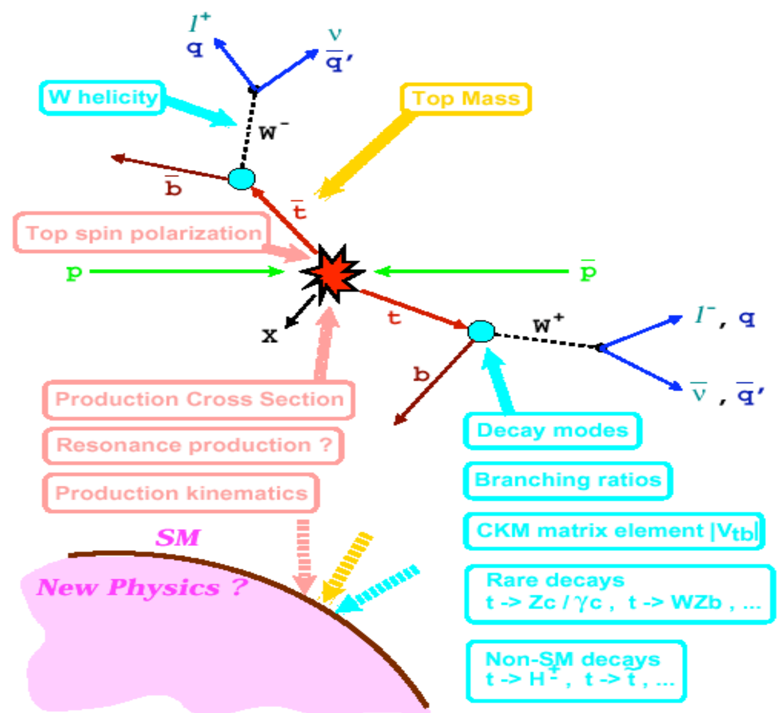
0.88±0.11 pb

EW single-top production,
x2 smaller rate, not (yet) seen



1.98±0.24 pb

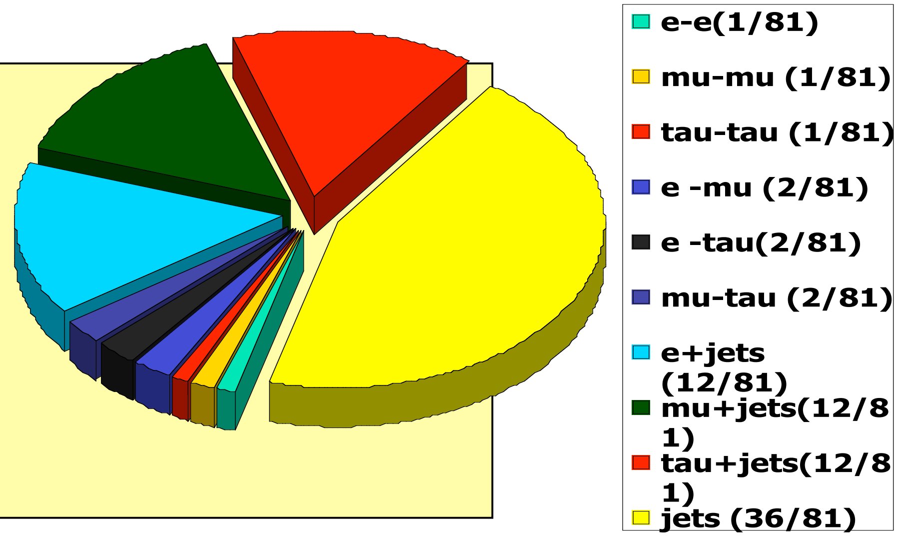


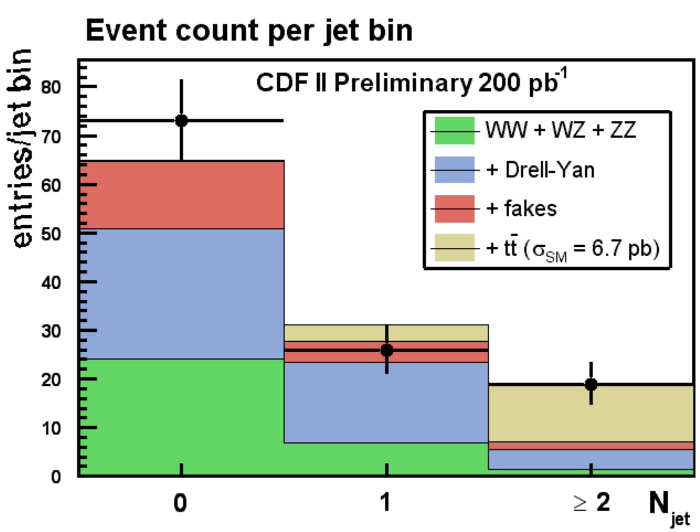


Top Data Samples

W's decay modes used
to classify the final states:
dileptons, lepton + jets, all-hadronic

B(t Wb) = 100%





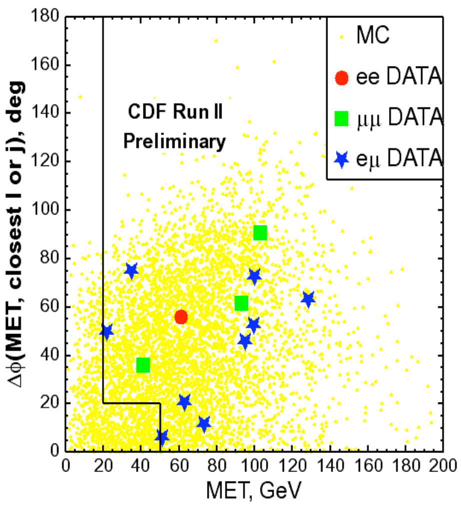
Samples are defined by counting leptons and jets

Cross section results validate
top-enriched samples

can also point toward new physics

Top Decaying to Dileptons

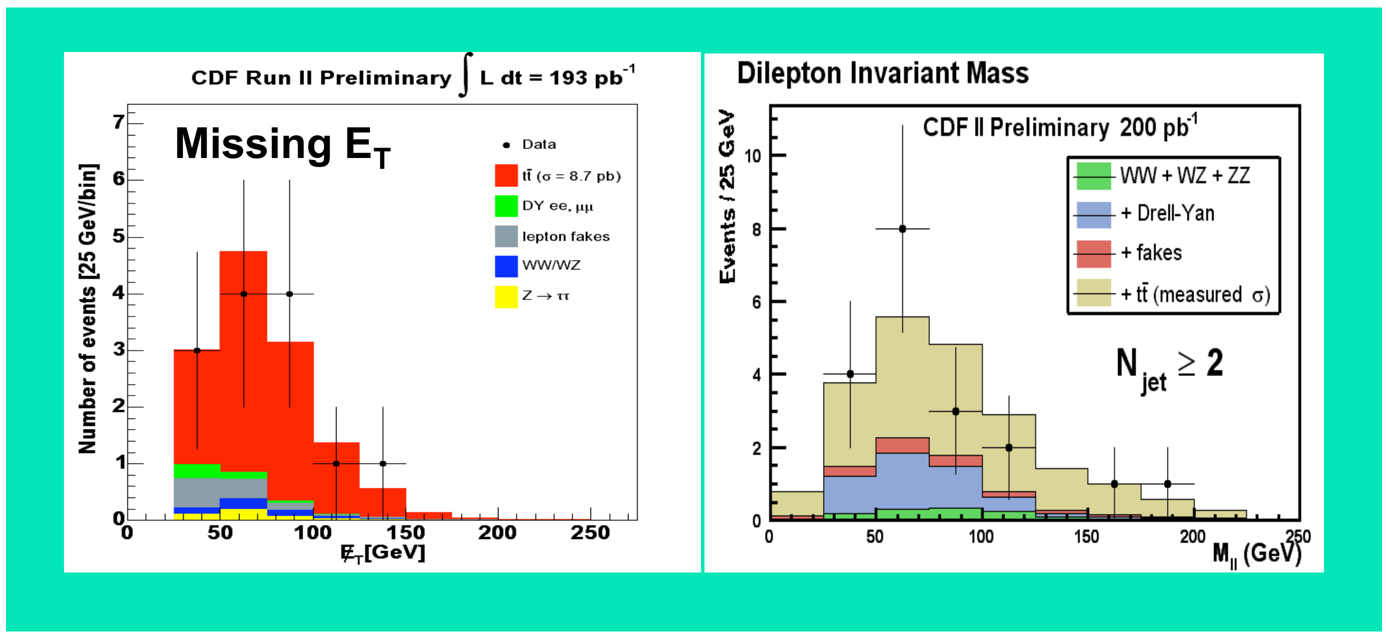
Small sample but very clean for top signal: 2 leptons, 2 jets and $\not{E}_T$



Tight e/μ selection complemented by e/μ + track selection

Lepton + track sample has looser ID requirements for second lepton
It is sensitive to τ lepton final state

Interesting place to follow up on Run I anomalies

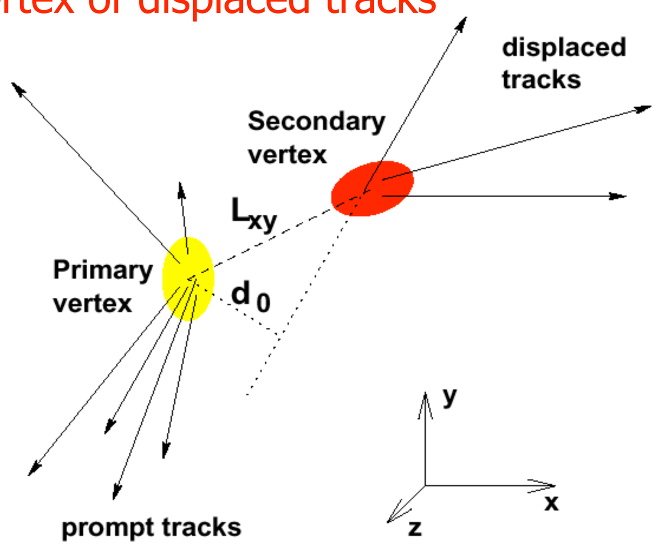


Heavy Flavor jets: tagging tools

B hadrons in top signal events

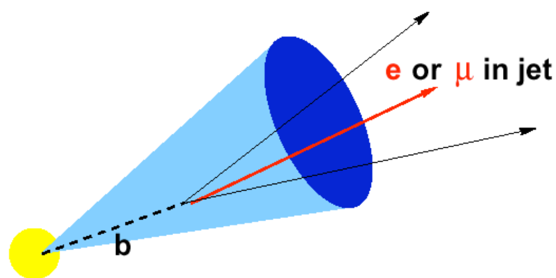
are long-lived and massive

Vertex of displaced tracks



may decay semileptonically

Identify low-pt muon from decay

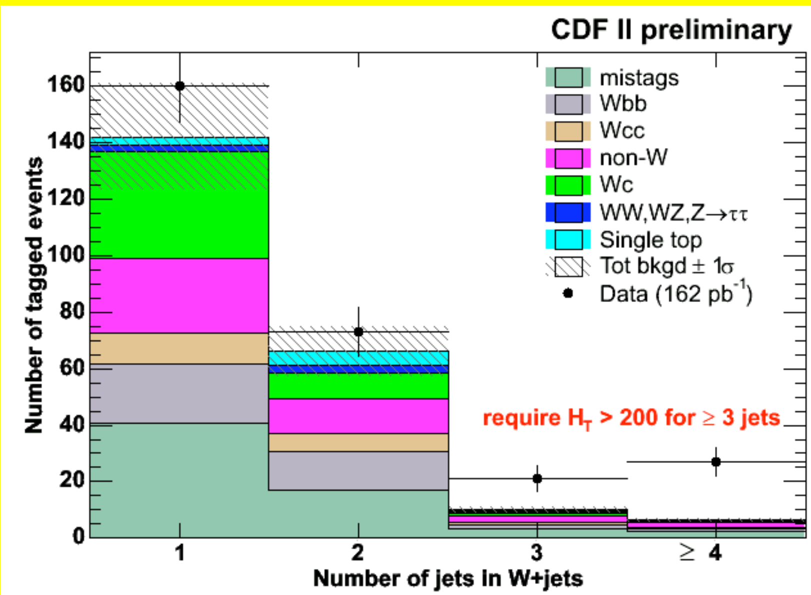


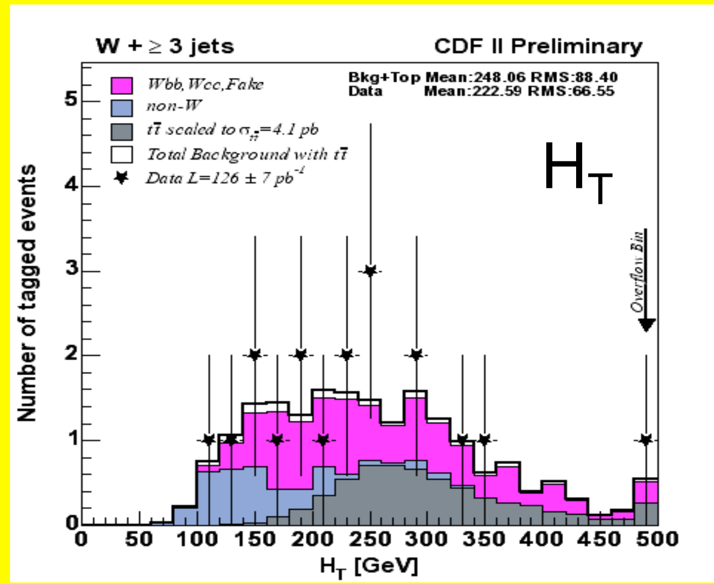
- $b \to \ell \nu c$ (BR ~ 20%)
- $b \to c \to \ell \nu s$ (BR ~ 20%)

55%	**Top Event Tag Efficiency**	**15%**
0.5%	**False Tag Rate (QCD jets)**	**3.6%**

Top Results Using Tagging

Counting experiments with vertex tag and soft muon tag in 3,4-jet bins

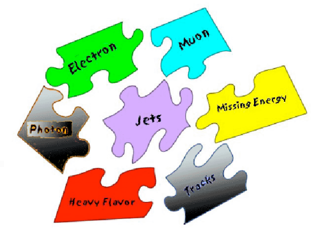




Backgrounds estimate in the lepton + jets sample carried on:

- using data as much as possible (non-W QCD, fake tags)
- using MC calculations for diboson and W + heavy flavor

An Alternative Approach: NN results

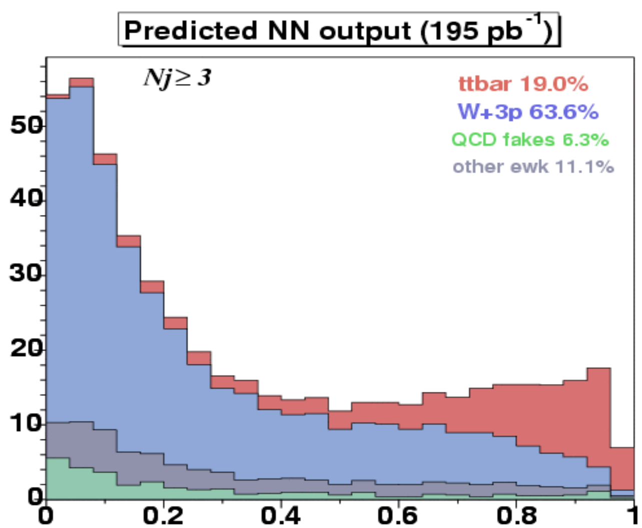


ttbar and W+jets kinematics differ modestly, but do so in several different variables.

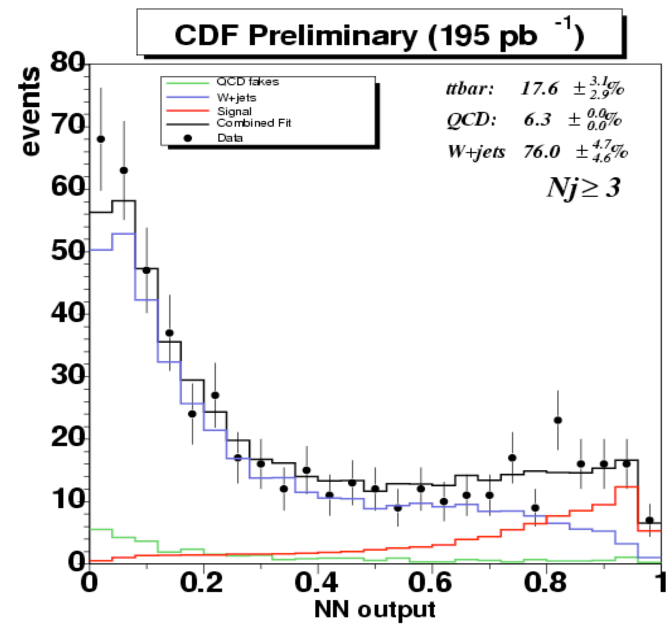
→ Develop a neural net to use this information optimally.

Statistical and systematic uncertainties improved compared to single-variable fit.

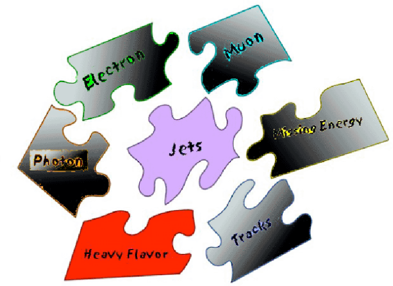
No b tagging information is used



Good separation between signal and background



The Challenge: Hadronic top



Signature: six jets, 2 tagged
Large QCD background

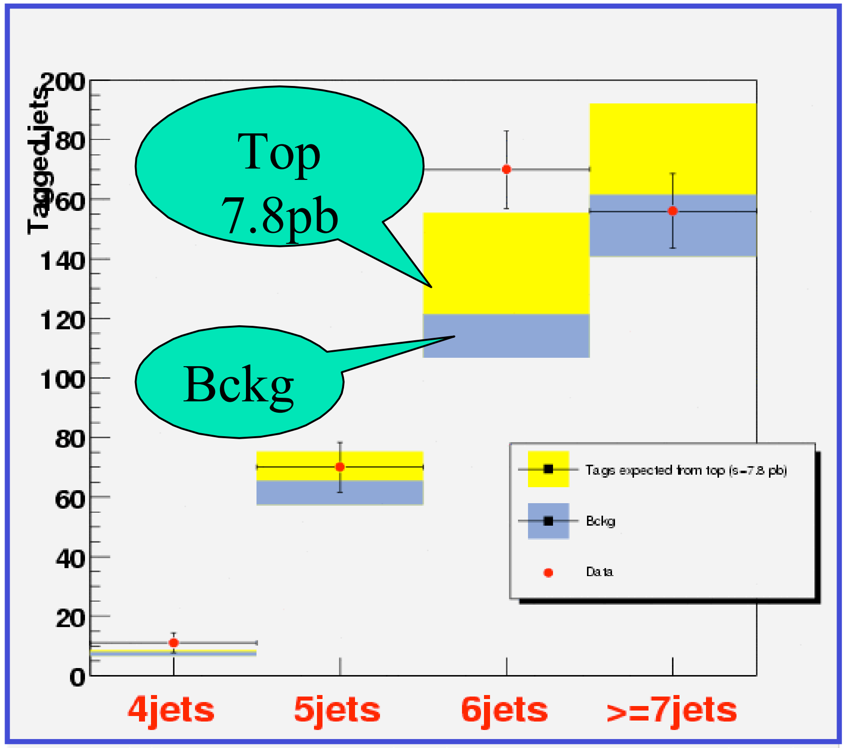
Kinematical selection of the sample complemented by b-tagging of at least one jet

Cross Section is a function of the number of observed tagged jets

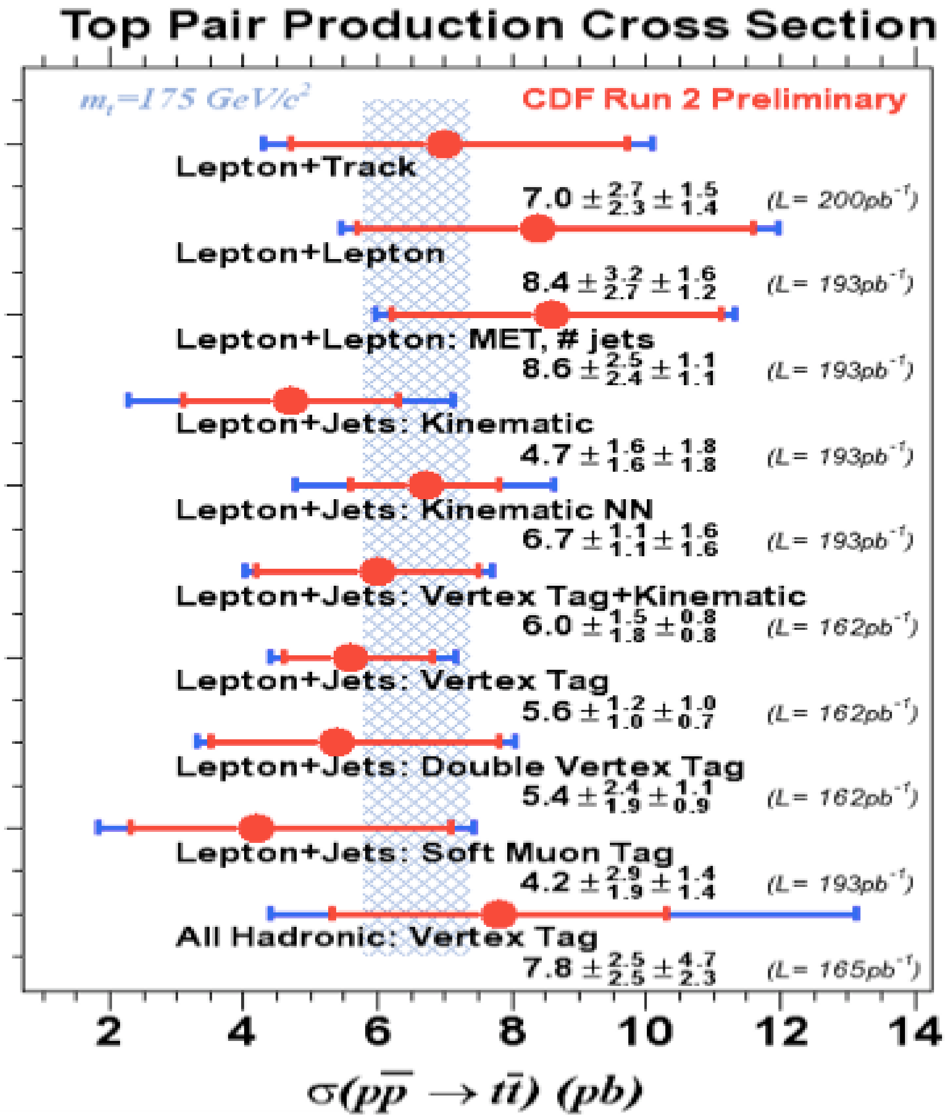
$$\sigma_{t\bar{t}} = \frac{ObservedTags - ExpectedTags}{\varepsilon_k \varepsilon_{tag}^{ave} L} \pm \delta$$

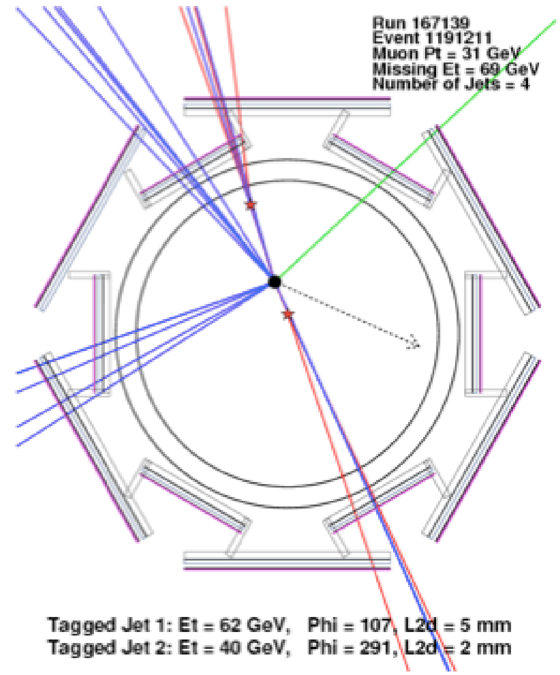
Kinematics

b-tag



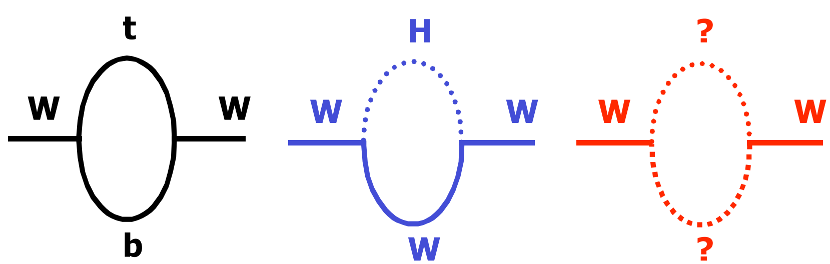
CDF Top Cross Section Summary



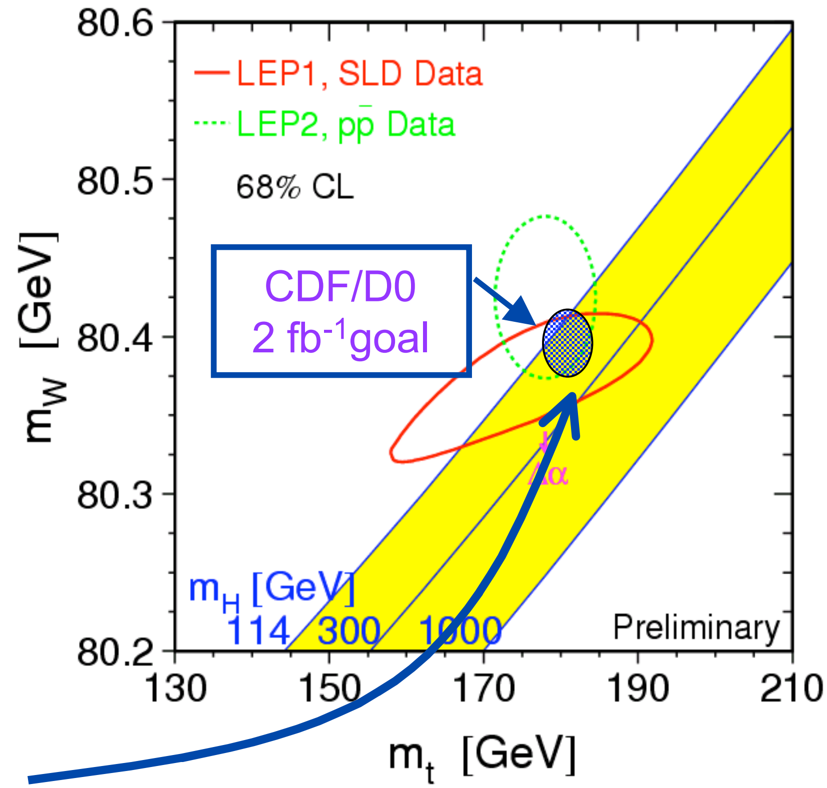


Top Quark Mass Measurement

- The Top Quark Mass is a fundamental parameter of the Standard Model
  - Only fermion with mass near electroweak scale
- Correlated to other SM parameters via electroweak corrections

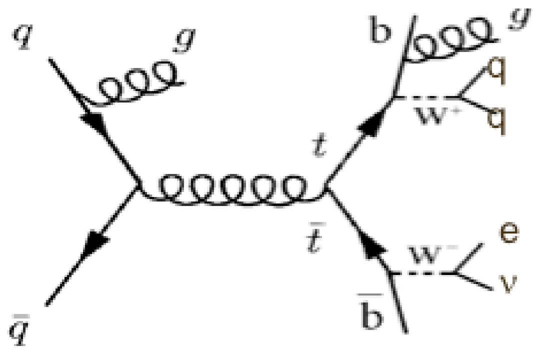


□ M_W □ M_T^2 □ M_W □ ln M_H New Physics



- **Precise measurement provides stringent SM test**
  - **Constrains the mass of the Higgs Boson**

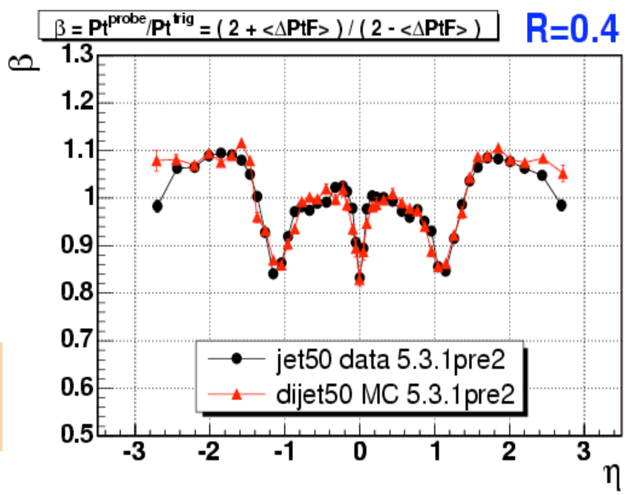
Top Mass Measurement Challenges



- Why so challenging?
  not just a calculation of M(W+b) !!!
  - missing neutrino
  - confusion in ID (additional jet from ISR/FSR, b-tag: not 100%)
  - jet energy scale

Link observables to parton-level energies

- Accurate detector simulation vital to precision physics measurements
- Large systematic uncertainty from energy scale

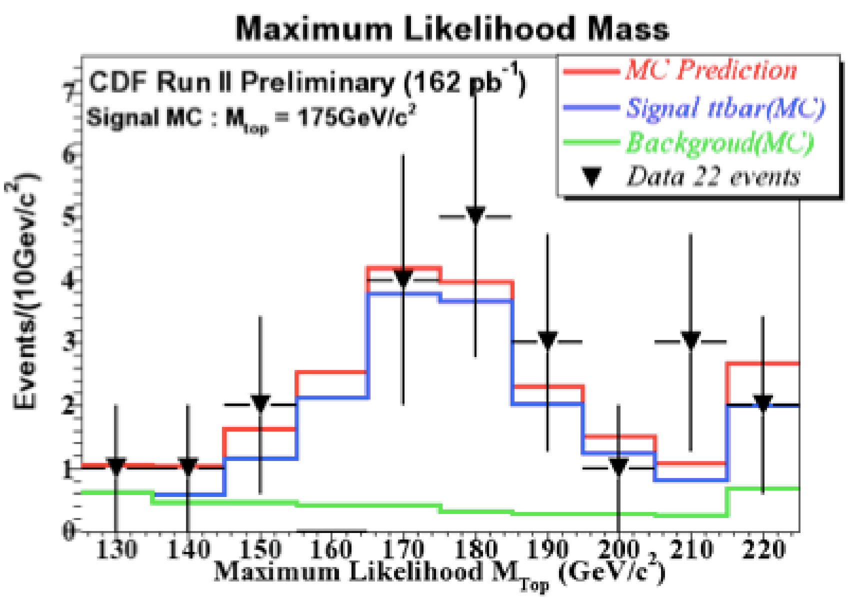


Method: reconstruct Mtop with 2 constraints, $M(W^+)=M(W^-)$, $M(t)=M(\bar{t})$

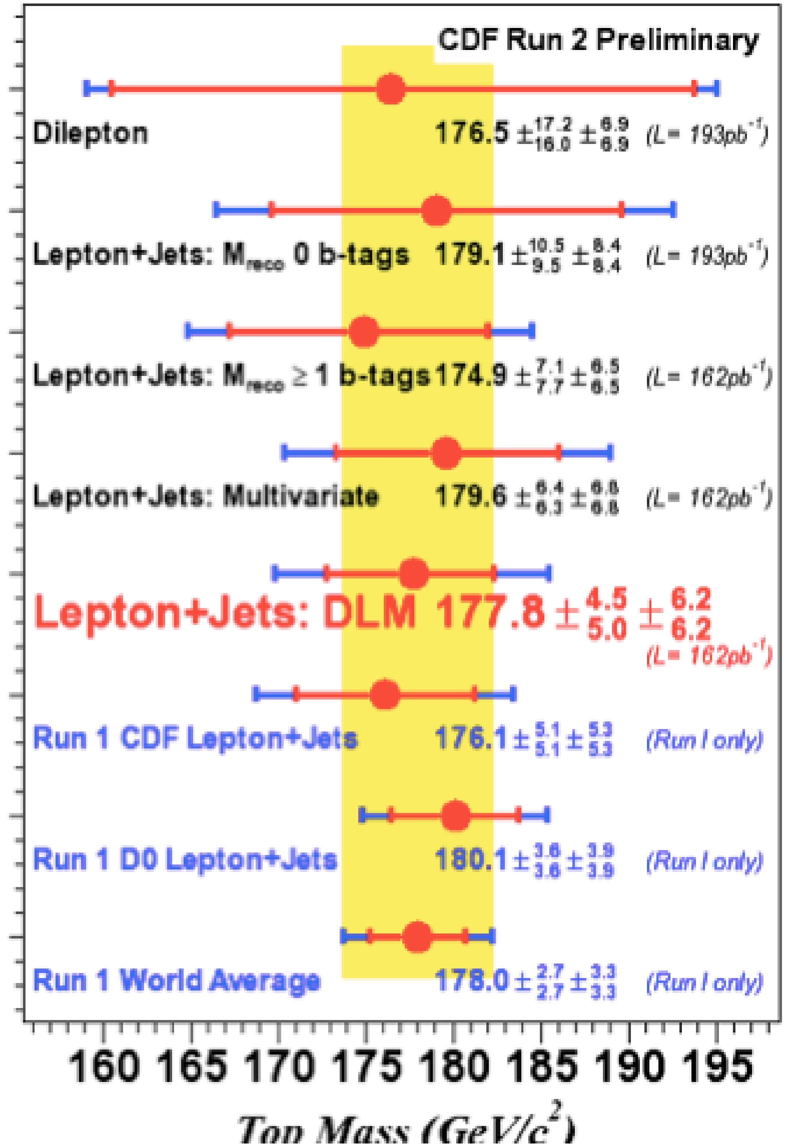
data is fitted to most likely mass template from Top MC

- Take the best combination over all 12 combinations
- Use all combinations(12) weighted by the diff. cross section (full kinematic info): dependence on $t\bar{t}$ event kinematics?

Top Mass Measurements

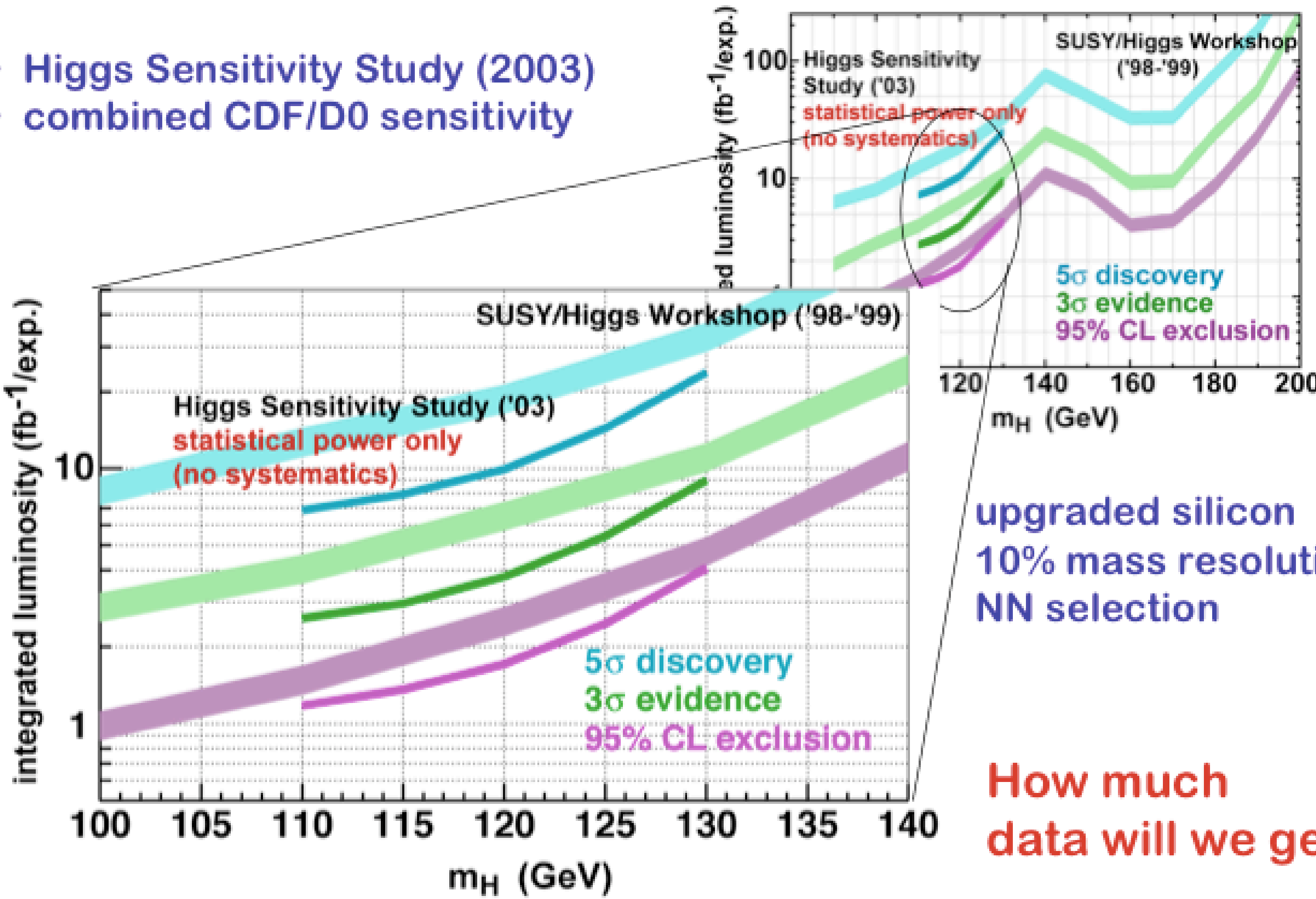


- Prospect: $\delta m_{top} \approx$ 2-3 GeV with 2fb^{-1}
  - improved jet energy scale
  - Accurate detector simulation (jets)
  - γ+jet Et, Z+jet balance, W mass from top
  - Z→bb mass for b-jets



The Search for the Higgs Boson

- Higgs Sensitivity Study (2003)
- combined CDF/D0 sensitivity

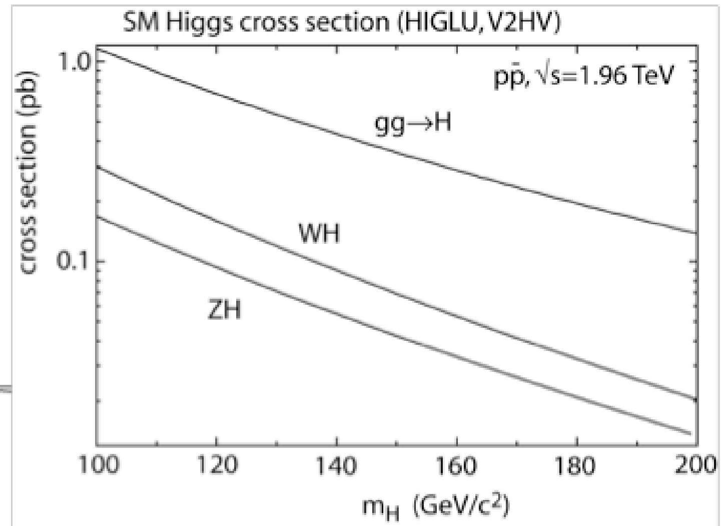


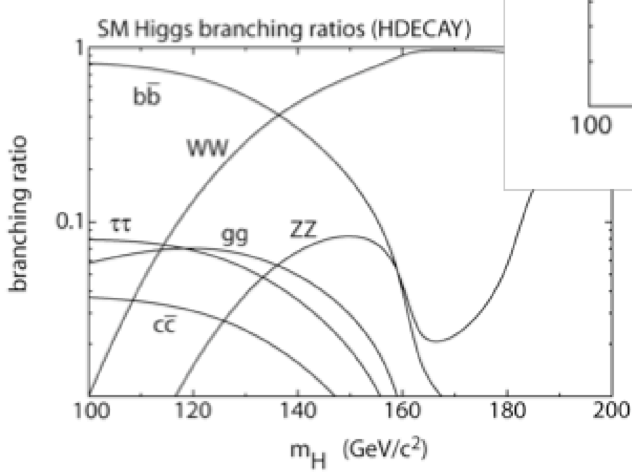
upgraded silicon
10% mass resolution
NN selection

How much
data will we get?

The Search for the Higgs Boson

- gg→H dominates but dijet background too big…
- bb and WW decay modes are best!



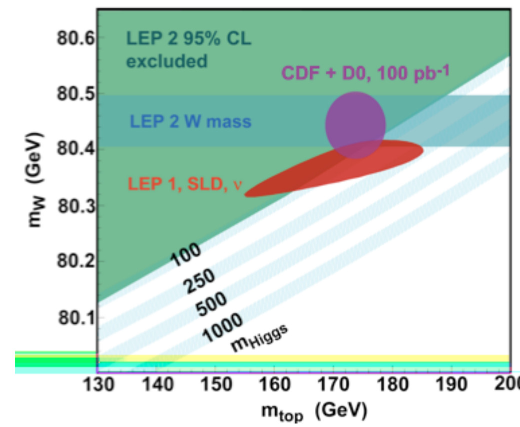


WH+ZH ~300 fb at 115 GeV

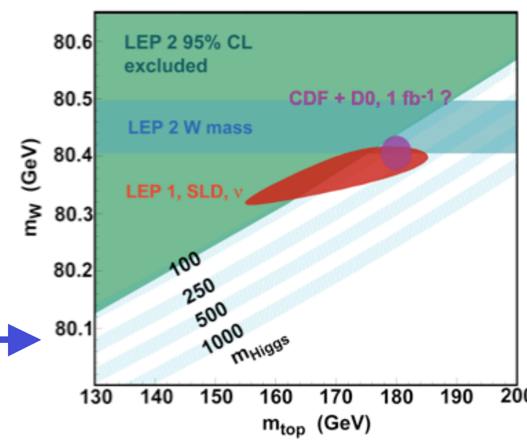
typical efficiencies ~ 2%

A daunting proposition!

Indirect Searches



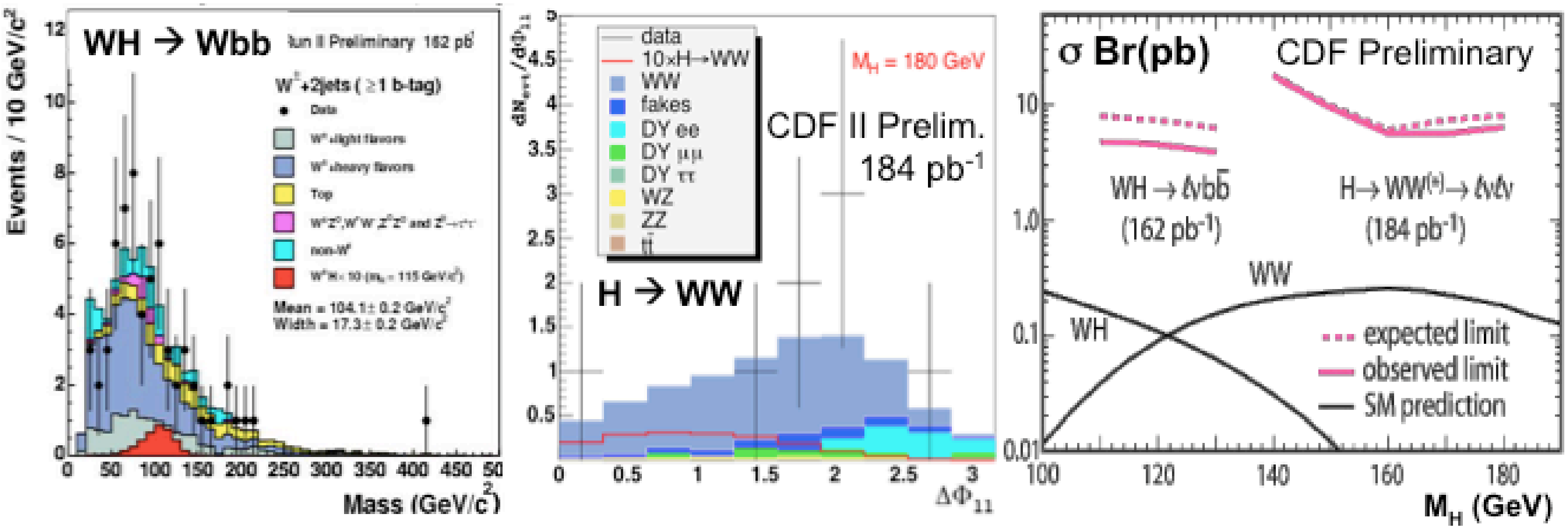
↓ ?



Evidence for New Physics! →

SM Higgs searches

M_H < 130 GeV: W,Z + H (→ bb), M_H > 130 GeV: H → WW



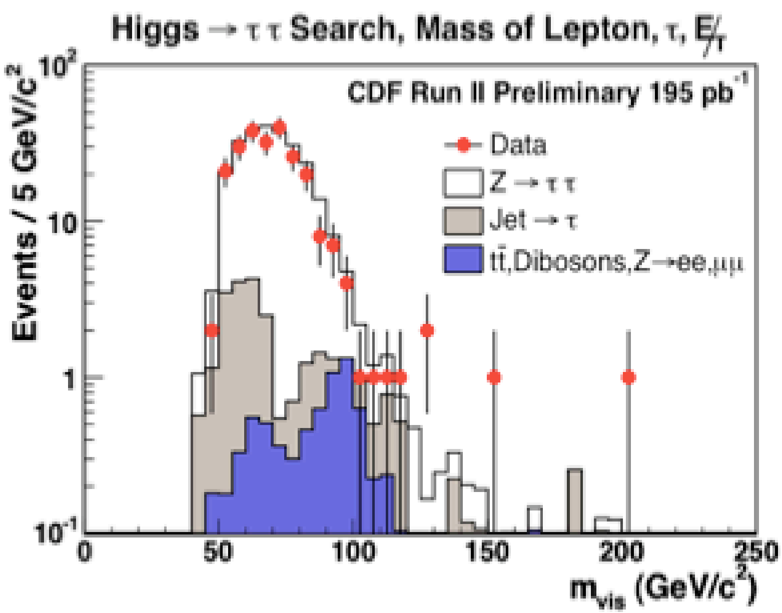
- SM: Limits already exceeding Run I results.
  Sensitivity beyond LEP exclusion starts at ~2 fb^{-1}.
- New Physics: Interesting sensitivity to other new physics sooner?
- Improvements expected from
  - Better *b* tagging, topological (spin 0) information, more channels(ZH), better mass resolution (Z → bb sample)

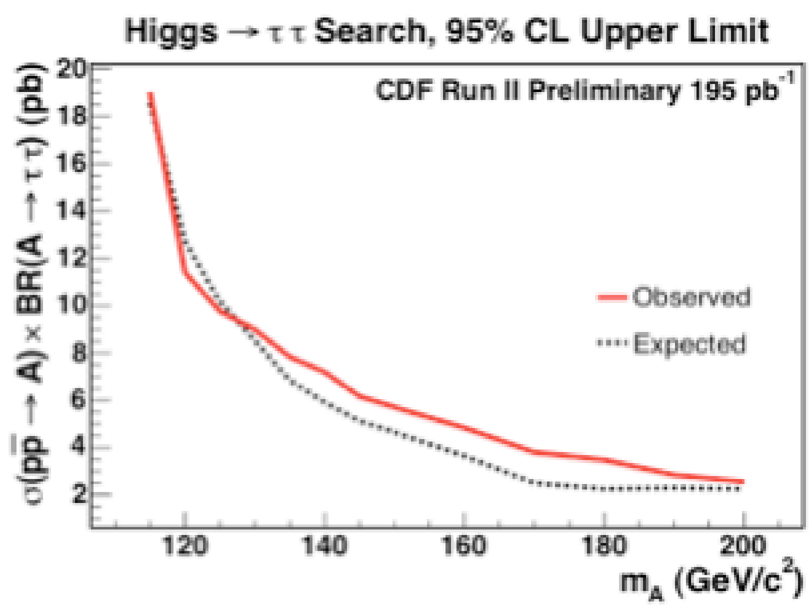
MSSM Higgs

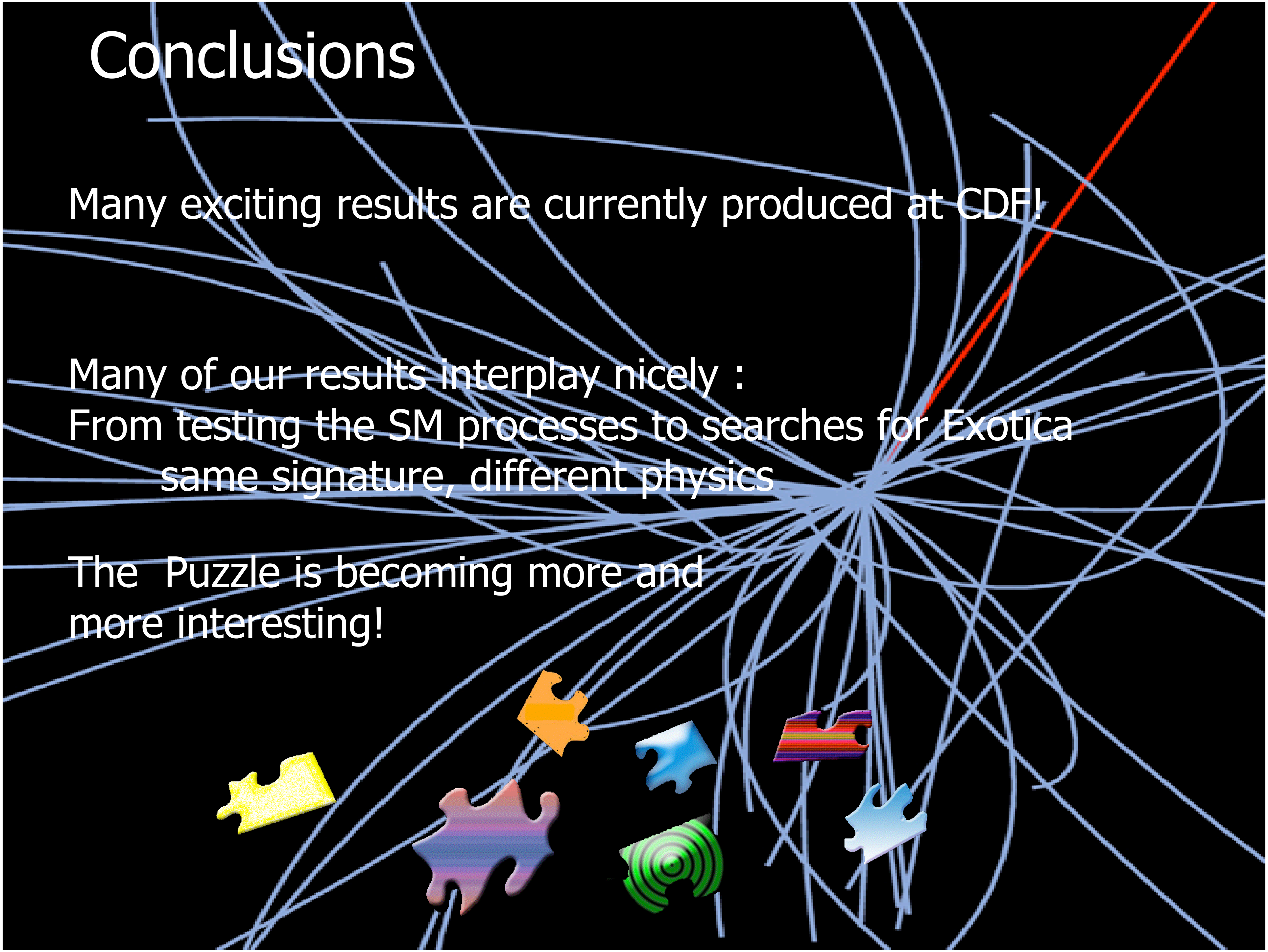
at high tanβ:

- enhanced x-sections
- heavy flavor (b, τ) preferred

ϕ (from gg or qq) or $b\bar{b}\phi$ production with $\phi \rightarrow \tau\tau$






Conclusions
Many exciting results are currently produced at CDF!
Many of our results interplay nicely :
From testing the SM processes to searches for Exotica
same signature, different physics
The Puzzle is becoming more and
more interesting!