



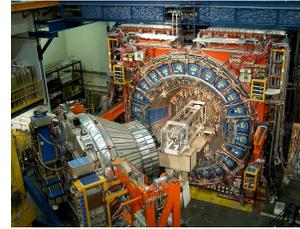
Non-SUSY Searches at the Tevatron

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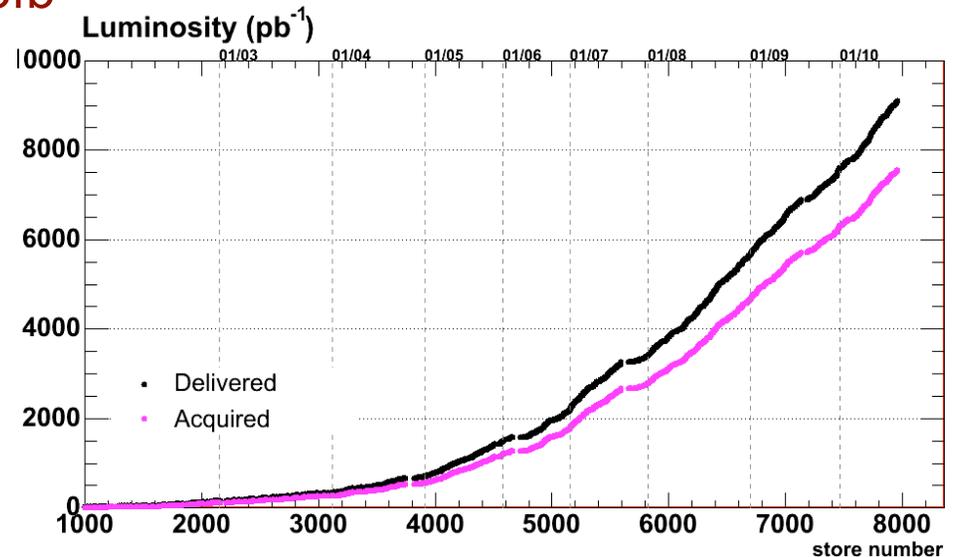
On behalf of the
CDF and DØ Collaborations

22nd Rencontres de Blois
July 17, 2010

Outline



- ▶ Tevatron experiments continue to search for new physics beyond the SM
 - ▶ More than 7 fb^{-1} of data collected per experiment and 9 fb^{-1} delivered mark reached!
 - ▶ Today's results show up to 5.8 fb^{-1}
- ▶ I will cover:
 - ▶ High mass resonances
 - ▶ Dimuon
 - ▶ Dielectron + Diphoton
 - ▶ Hadronic
 - ▶ Diboson
 - ▶ Leptoquark production
 - ▶ Hidden sector particles (show up as lepton-jets)

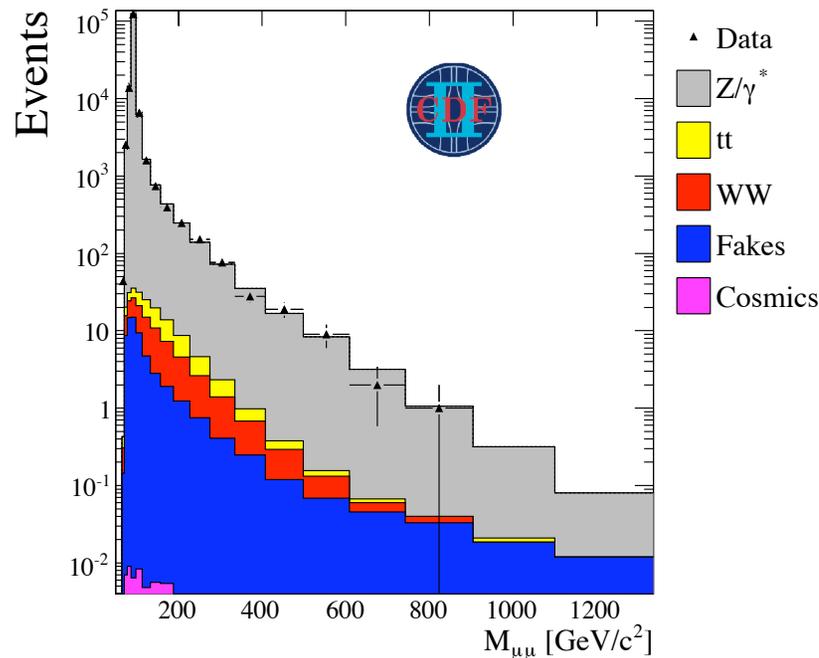


Dimuon Resonances

Search for excess in invariant mass spectrum

- ▶ Bump hunt
- ▶ Generic, powerful and track record for discovery in the past
- ▶ Predicted by several BSM models (e.g. Randall-Sundrum)

CDF Run II Preliminary 4.6 fb⁻¹

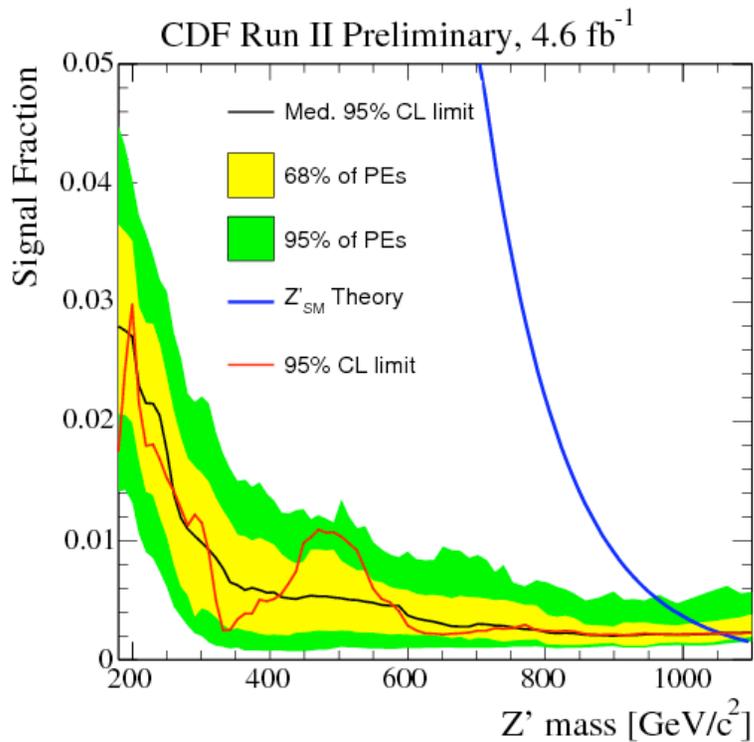


▶ Dimuon final state

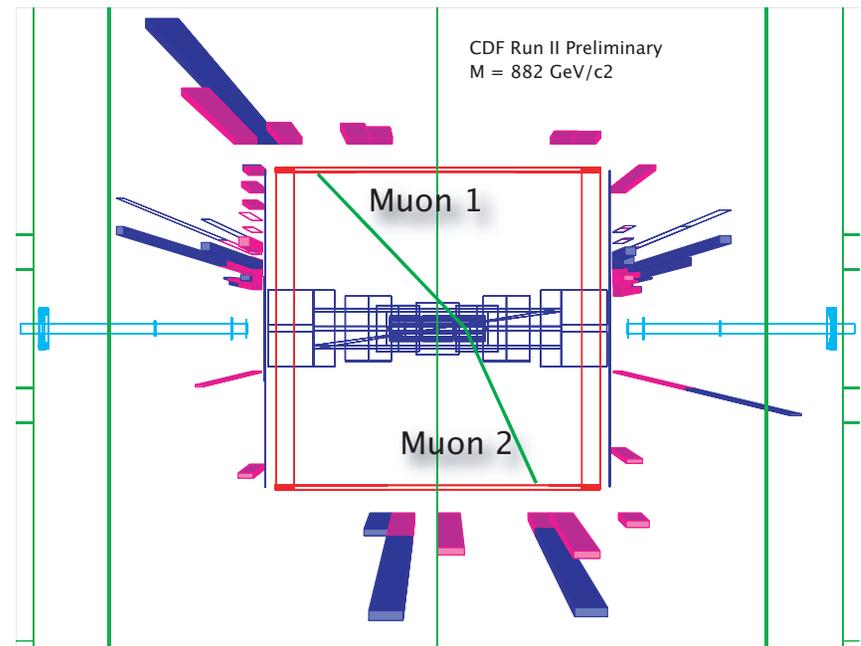
- ▶ Two opposite sign muons
- ▶ Search above 130 GeV
- ▶ Backgrounds include:
 - ▶ Drell-Yan, ttbar, WW, QCD fakes and cosmic ray muons

▶ Data consistent with SM prediction

Dimuon Resonances Results



Mass Z'_{SM} > 1071 GeV

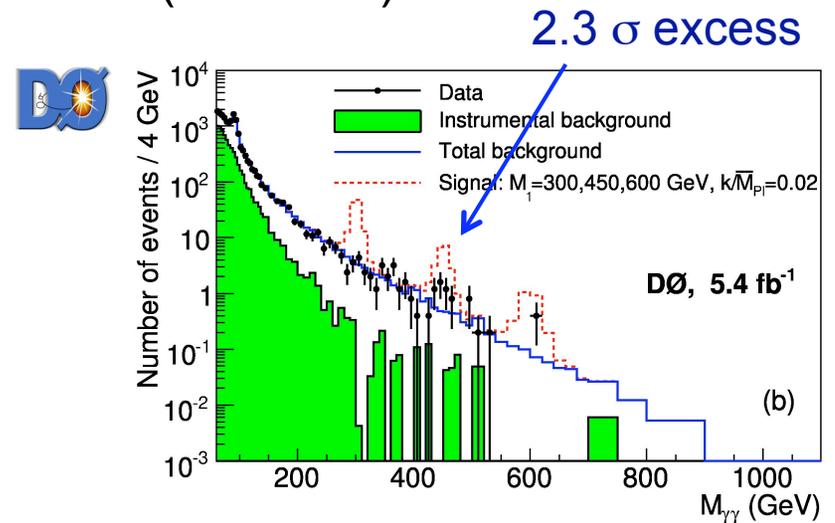
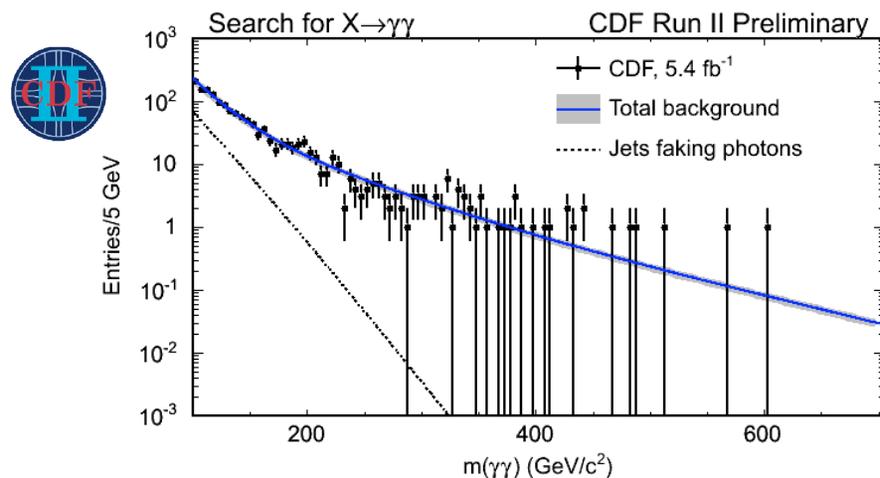
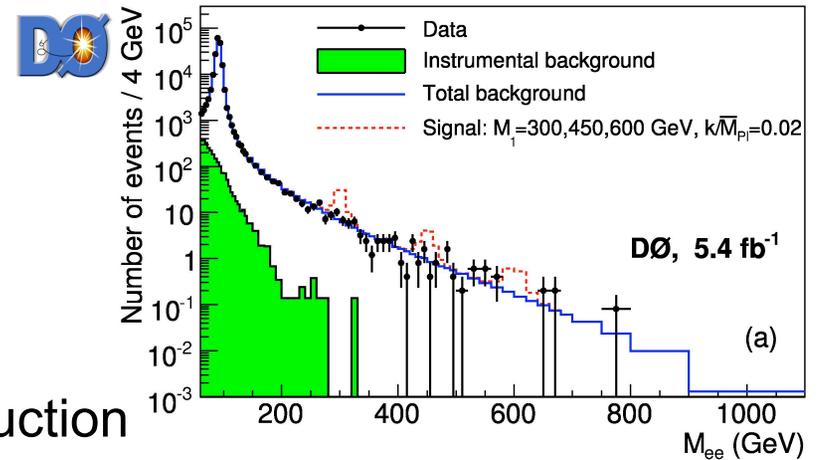


Highest dimuon mass = 882 GeV

Dielectron & Diphoton Resonances

Final state

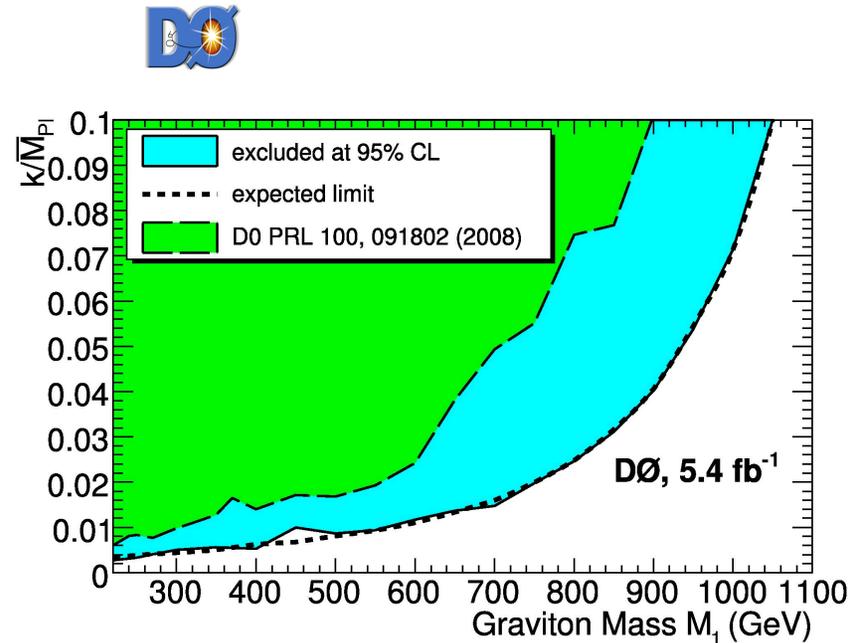
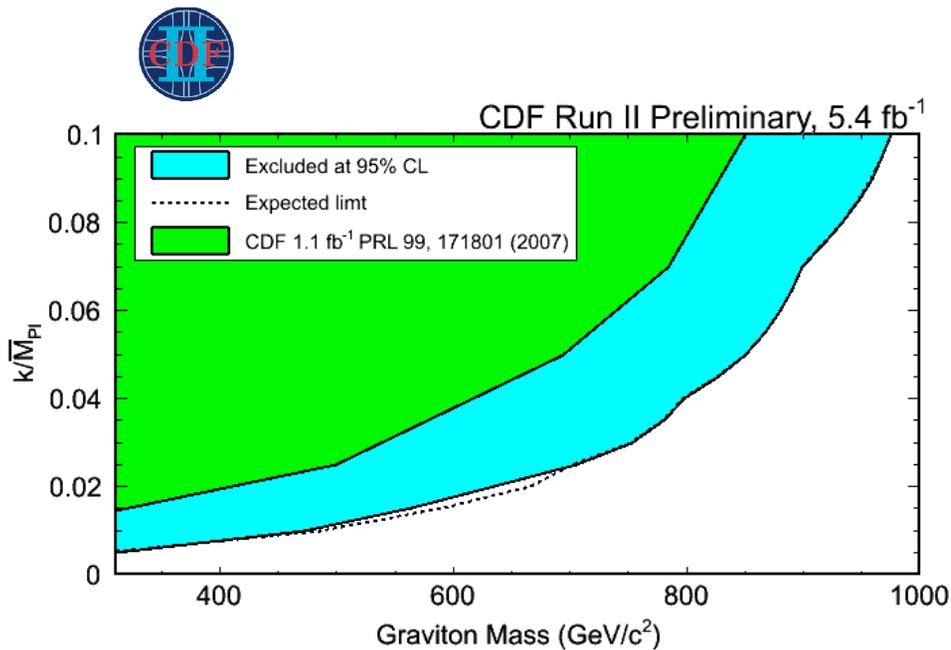
- ▶ CDF: diphotons
- ▶ DØ: diphotons + dielectrons
- ▶ Backgrounds:
 - ▶ dielectrons: Drell-Yan
 - ▶ diphotons: SM diphoton production
 - ▶ diphoton NLO calculation used (DIPHOX)



Dielectron & Diphoton Resonances Results

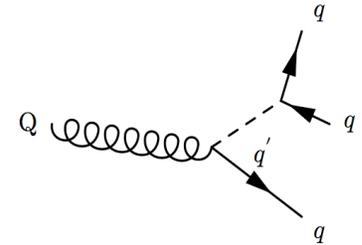
Limits set on RS Graviton mass and coupling parameters

- ▶ 95% C.L. lower limits for k/M_{Pl} between 0.01 - 0.1
 - ▶ CDF: 472 – 976 GeV
 - ▶ DØ: 560 – 1050 GeV



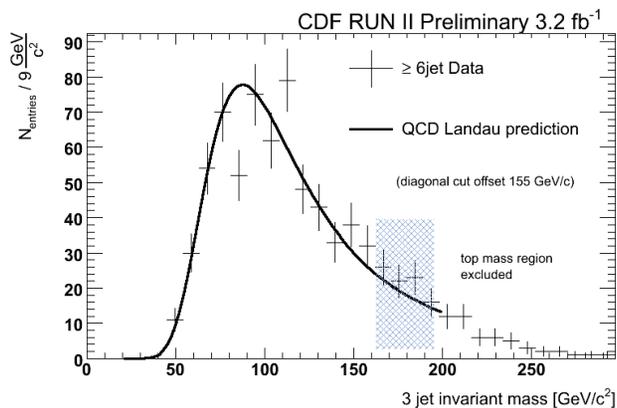
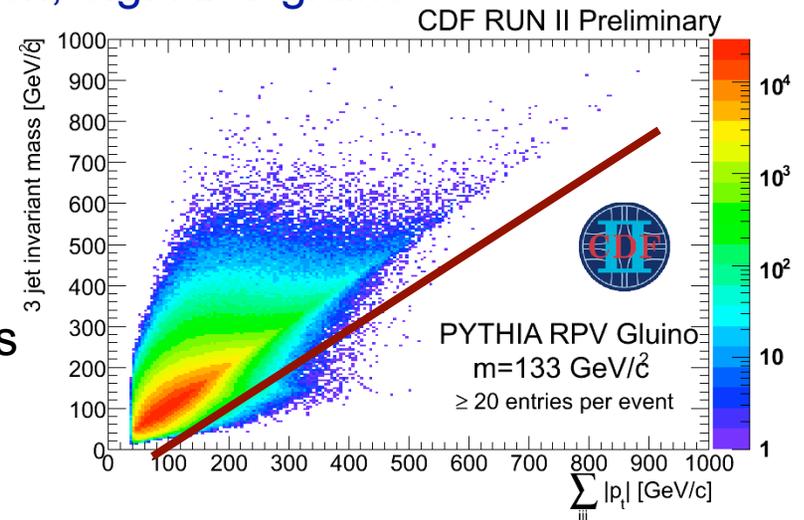
PRL 104, 241802 (2010)

Hadronic Resonance

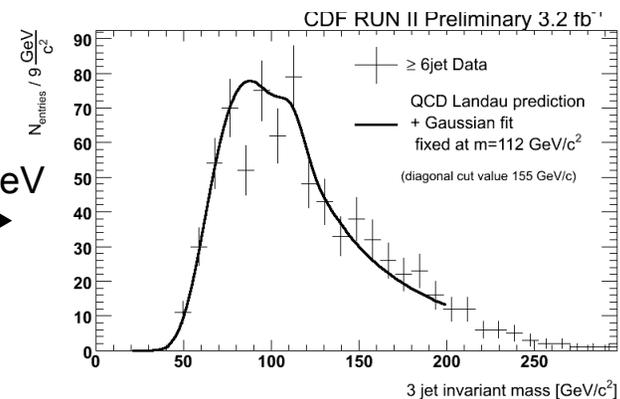
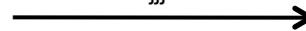


Look for new physics in multijets. Model independent search for:
 $pp \rightarrow QQ \rightarrow 3j+3j = 6j$, $Q = \text{Adjoint Majorana Fermion}$, e.g. RPV gluino

- ▶ **Final state: ≥ 6 jets (3jet resonance)**
 - ▶ Make use of kinematic features / correlations
 - ▶ Use an ensemble of jet combinations
 - ▶ **Background: QCD, Data-driven**
 - ▶ Use 5jet data to parameterize bkg in ≥ 6 jets
 - ▶ Fit M_{jjj} to a Landau distribution
 - ▶ Includes combinatorial confusion

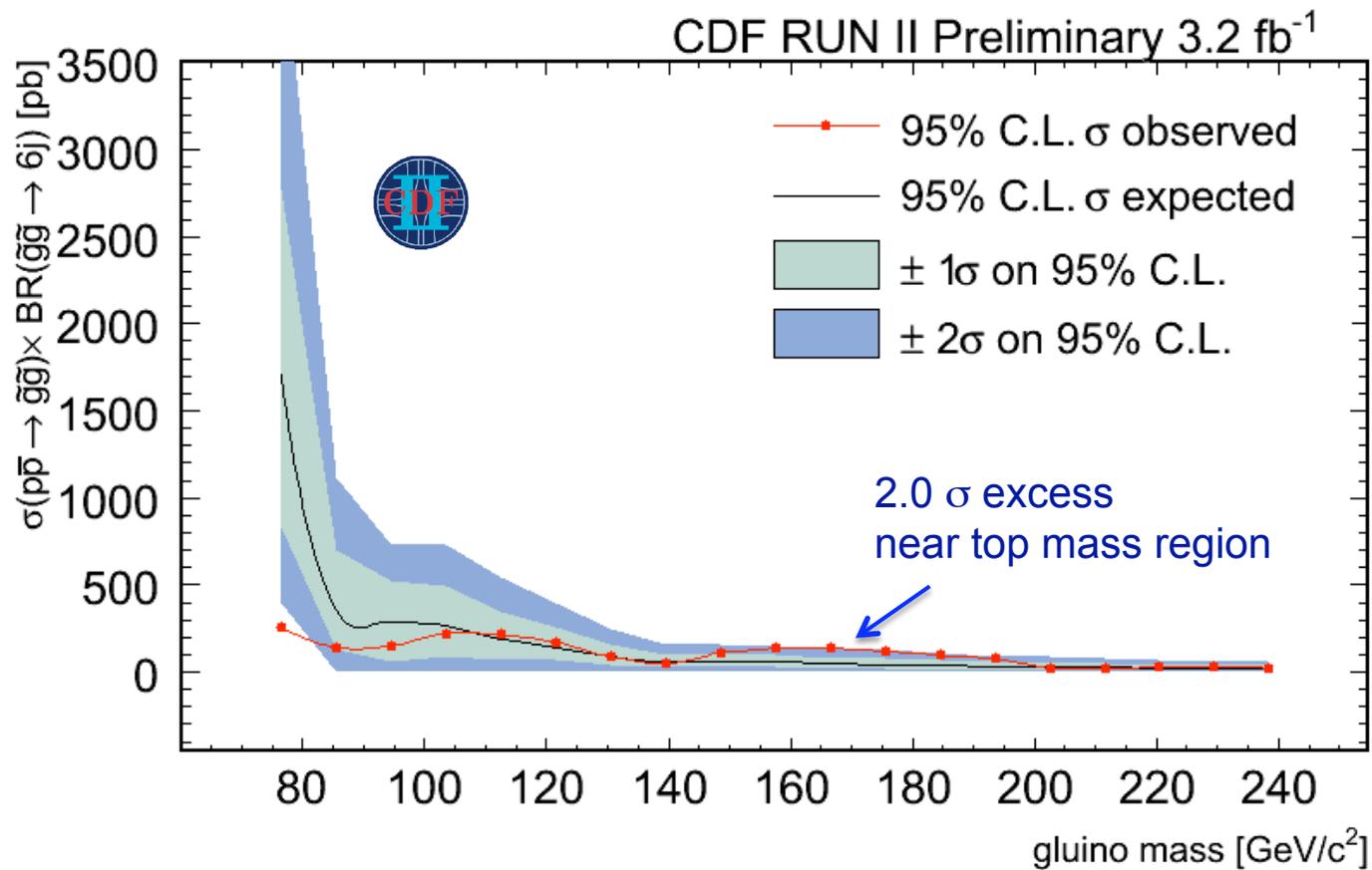


Bump hunt:
 Fit with Gaussian
 e.g. at $M_{jjj} = 112 \text{ GeV}$



Hadronic Resonance Results

New results: Limits set on $\sigma(\text{ppbar} \rightarrow \tilde{g}\tilde{g}) \times \text{BR}(\tilde{g}\tilde{g} \rightarrow 6j)$



Diboson Resonances

Search for Gauge-Boson-like objects.

Predicted by many BSM models: e.g. Extra dimensions, technicolor.



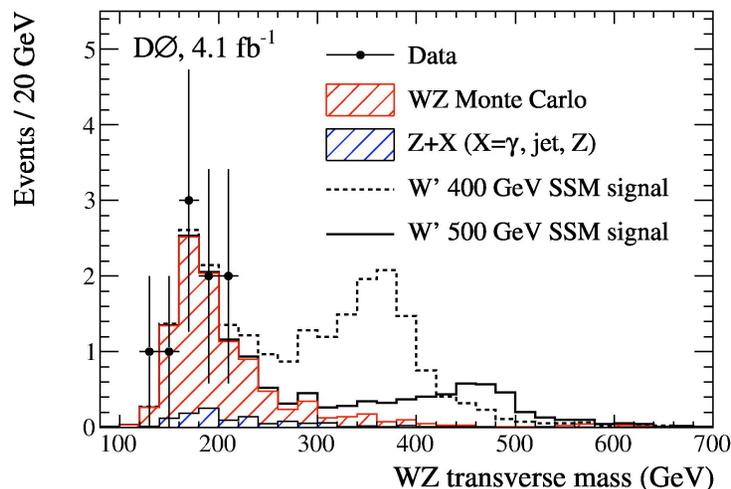
WZ final state

- ▶ trileptons + MET
- ▶ Require presence of Z
- ▶ Z-leptons and 3rd lepton well separated in ΔR

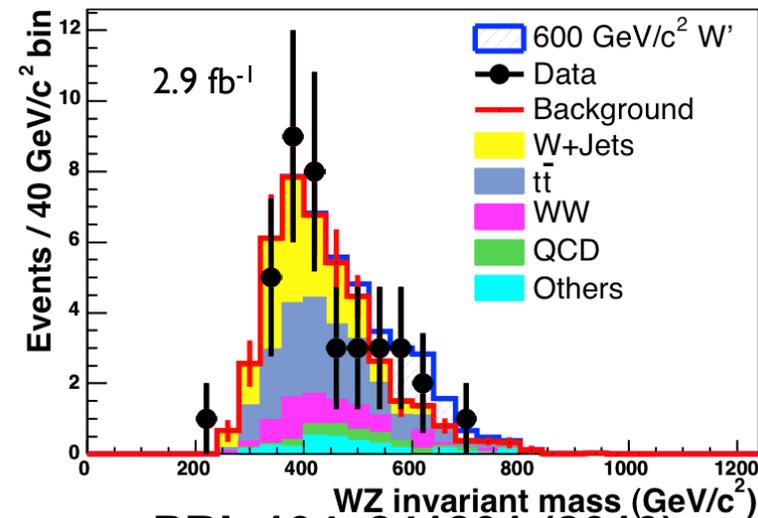


WW/WZ final state

- ▶ e+2jets+MET
- ▶ e and MET combined to form W
- ▶ Dijets consistent with W (65-95 GeV) or Z (75-105 GeV)



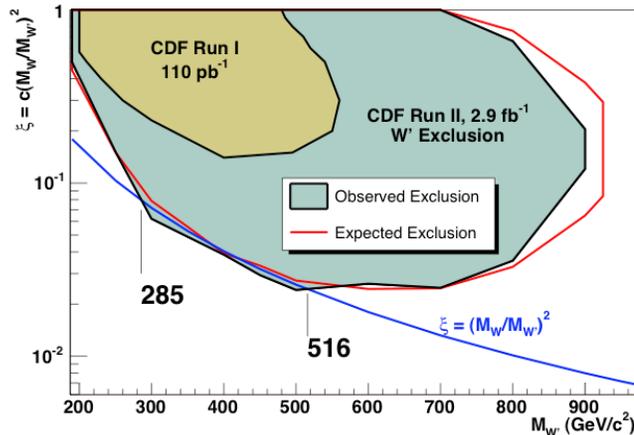
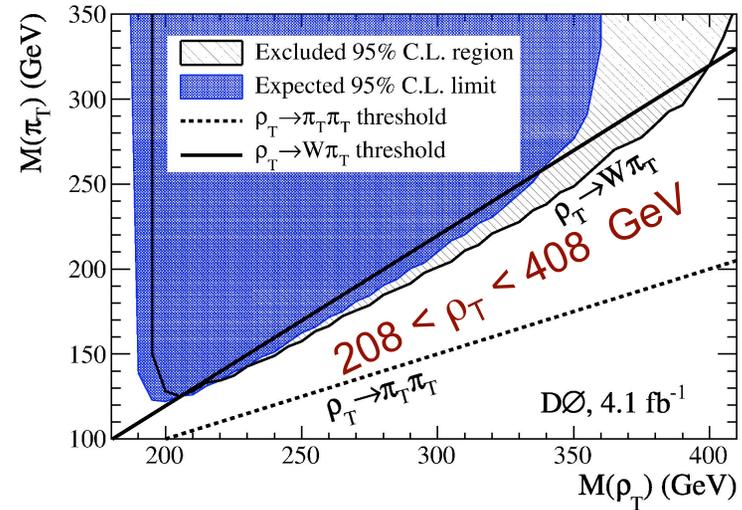
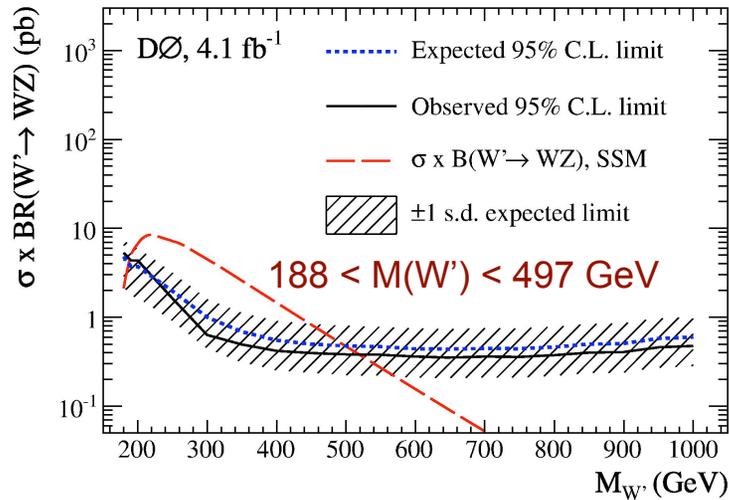
PRL 104, 061801 (2010)



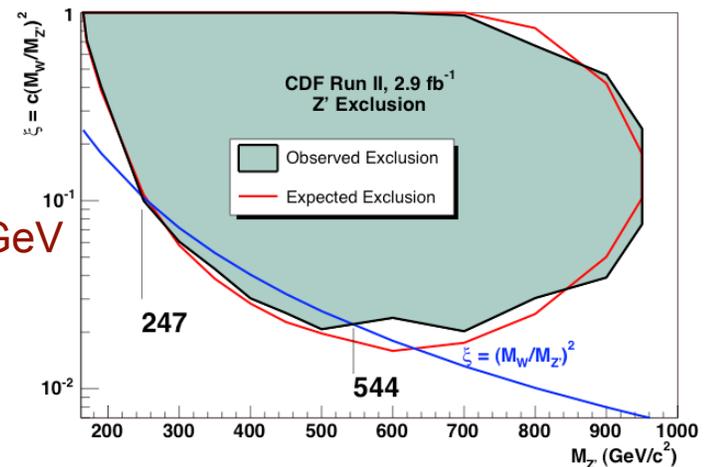
PRL 104, 241801 (2010)

Diboson Resonances Results

95% CL limits on W' , Z' , RS Graviton and technicolor production and gauge coupling strengths



Also limit on $M(G^*) < 607 \text{ GeV}$ for $k/M_{Pl} = 0.1$



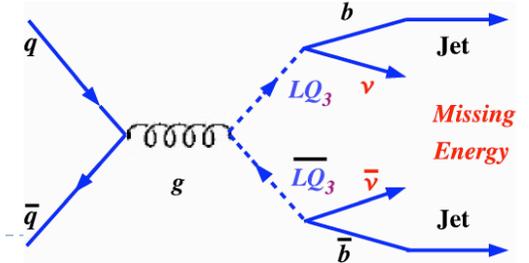
$$g \cos \theta_W \rightarrow \xi \times g \cos \theta_W$$

$$\xi = C \times (m_W/m_V)^2$$

July 17, 2010

Rencontres de Blois - E. Halkiadakis

Leptoquarks

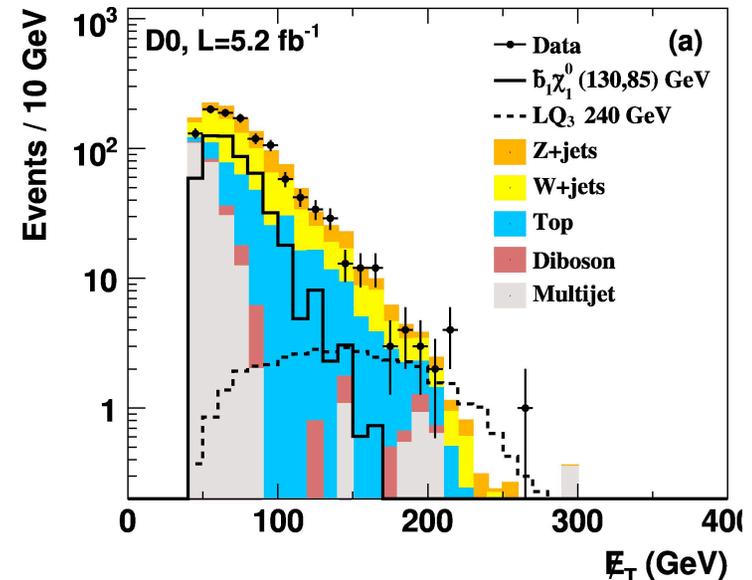
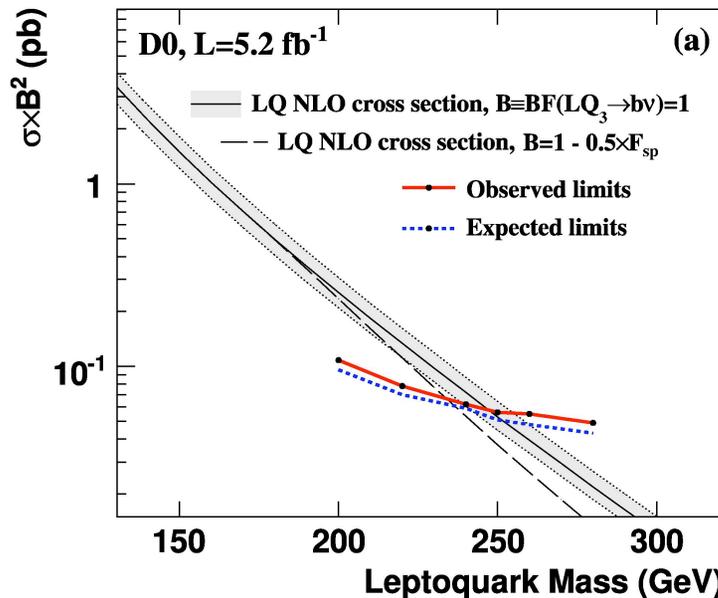


Hypothesized fundamental particles with both lepton and baryon quantum numbers

2b-jet + MET final state



- ▶ Large angle between b-jets and MET
- ▶ No asymmetry between MET and HT
- ▶ Cut on $X_{jj} = (p_T^{\text{jet1}} + p_T^{\text{jet2}}) / HT$ to discriminate against top



95% C.L. upper limits set on

Third generation LQ

▶ $m_{LQ} > 247 \text{ GeV}$

Submitted to PLB

Also set limits on scalar bottom quarks
(See SUSY searches talk by J. Parsons)

Lepton-Jets

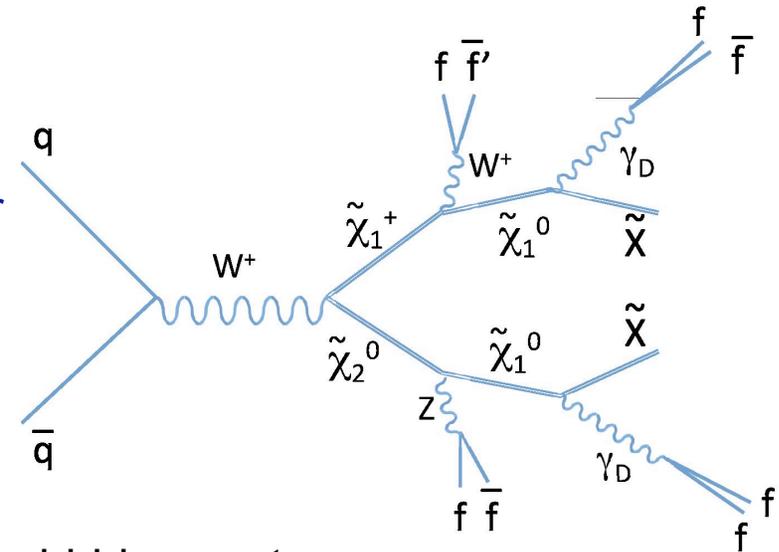
▶ Hidden valley models give rise to hidden sector

- ▶ Weakly couple to SM particles
- ▶ New physics could escape detection
- ▶ Source of dark matter?

See M. Strassler
talk on Monday

▶ Could SUSY also be hidden?

- ▶ In RPV conserving SUSY LSP can decay to hidden sector
 - ▶ Can produce two or more dark photons in each event



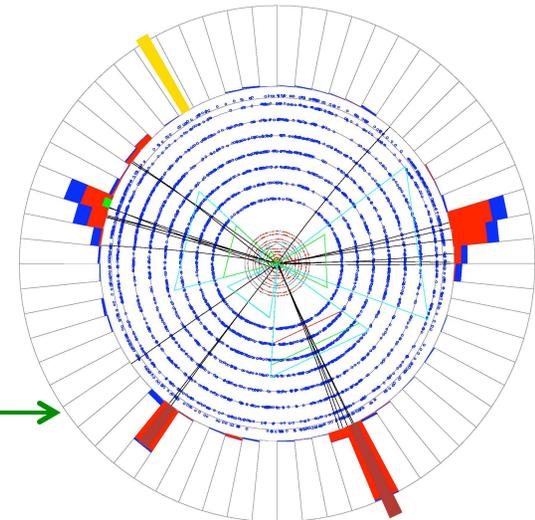
Run 248074 Evt 24810582 Wed Dec 17 03:49:03 2008

ET scale: 52 GeV

▶ Final state

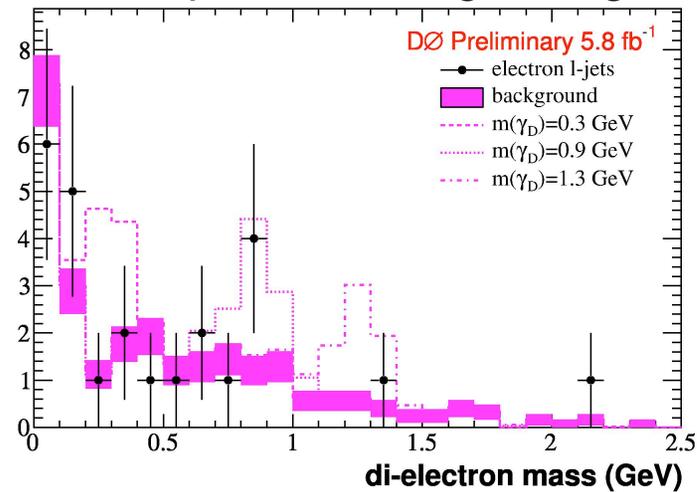
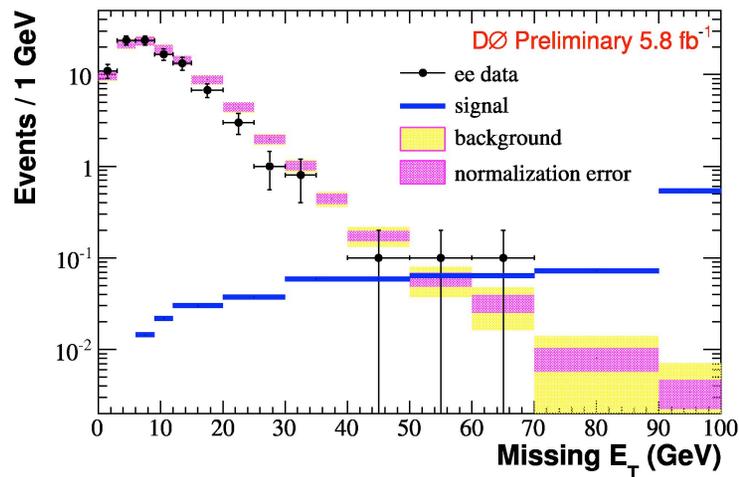
- ▶ At least two isolated lepton-jets
 - ▶ Electron or muon plus opposite charge partner track in cone 0.2
- ▶ Plus large MET

Two electron-jet candidate event →

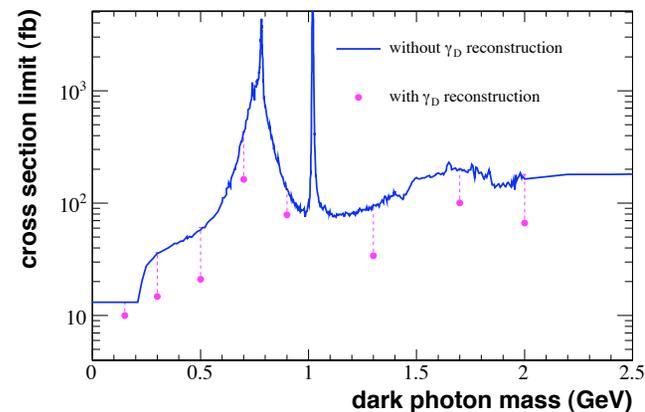


Lepton-Jets Results

- ▶ **Backgrounds:** multijets and conversions
 - ▶ Use low MET, non-isolated region to extrapolate into signal region



- ▶ **Consistent with SM prediction**
- ▶ **Limits set on SUSY production cross sections of chargino neutralino pairs where SUSY LSP decays into hidden sector**



Thanks to
S. Thomas

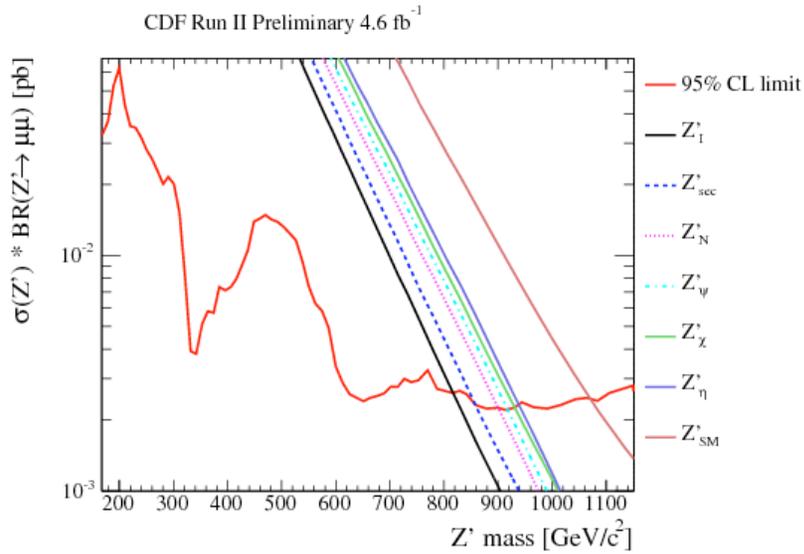
Conclusions

- ▶ Tevatron experiments continue to search for evidence of physics beyond the SM
 - ▶ Rich program of BSM searches
- ▶ Continuously updating results with more data
 - ▶ Analyses performed with up to 5.8 fb^{-1}
 - ▶ More data in the can
 - 9 fb^{-1} delivered and counting
 - ▶ $11\text{-}12 \text{ fb}^{-1}$ expected to be delivered by the end of Run II
 - ▶ No evidence of new physics yet
 - ▶ Keep looking until either we find something or LHC takes over

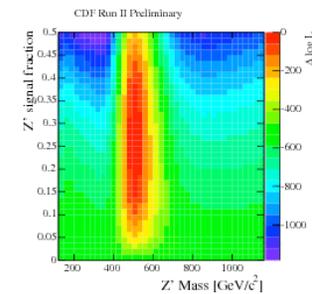
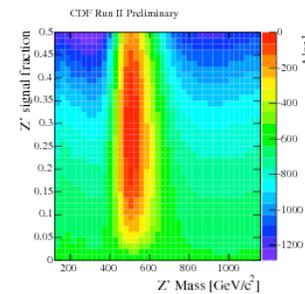
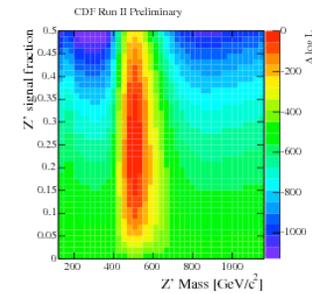
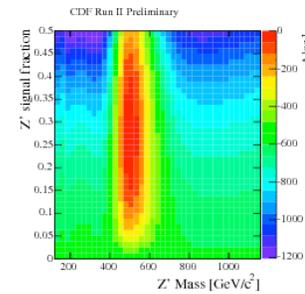
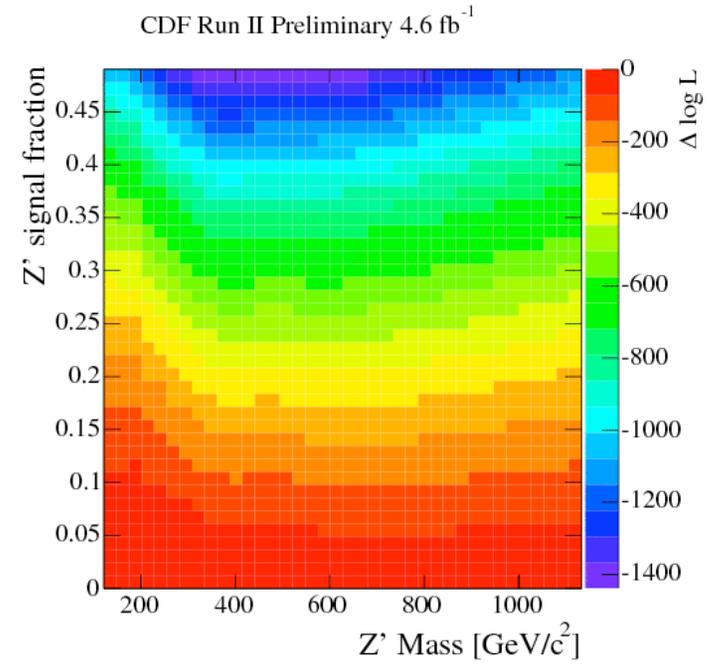


Backup

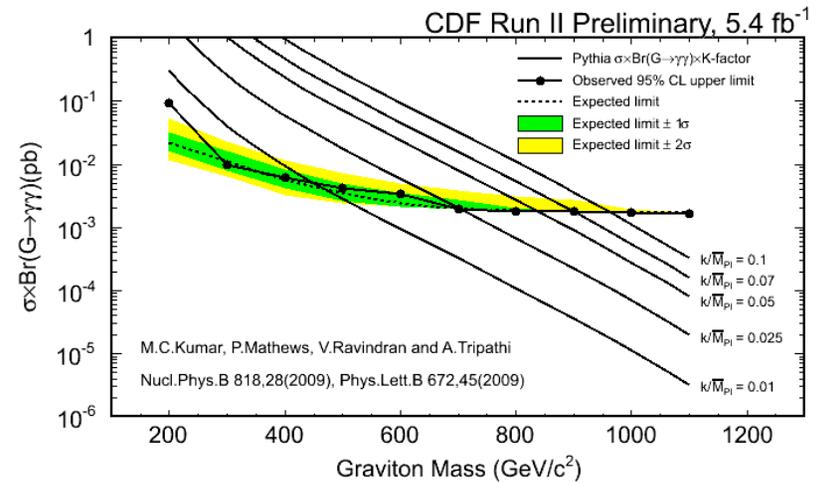
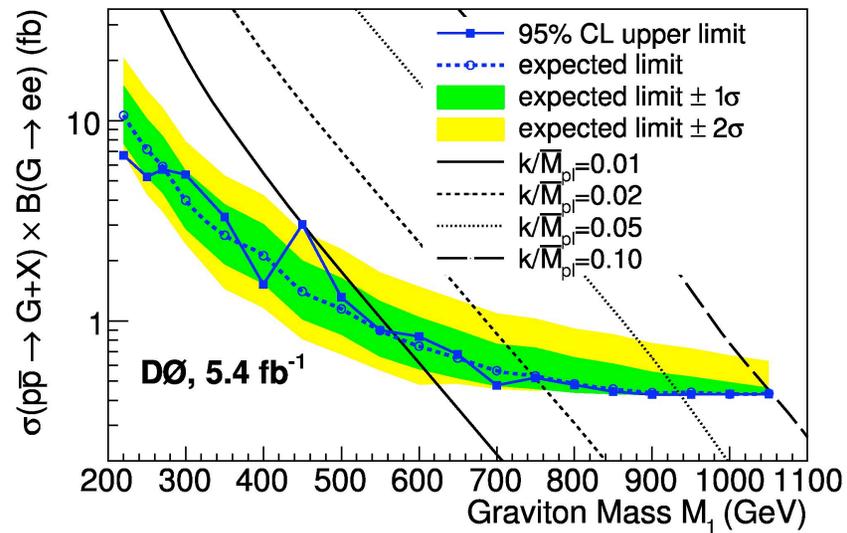
Dimuon



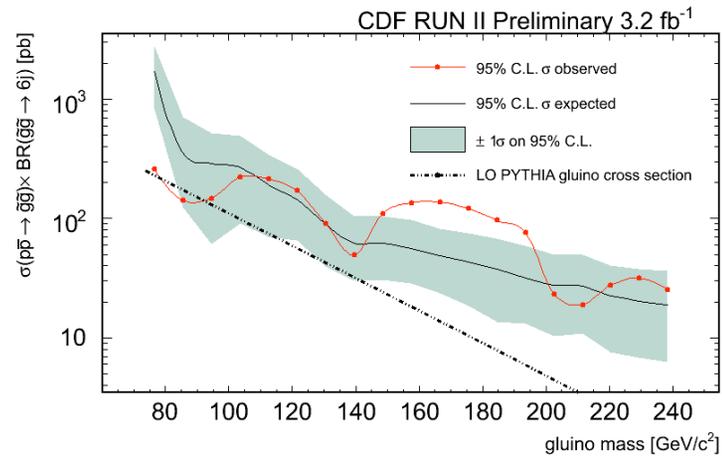
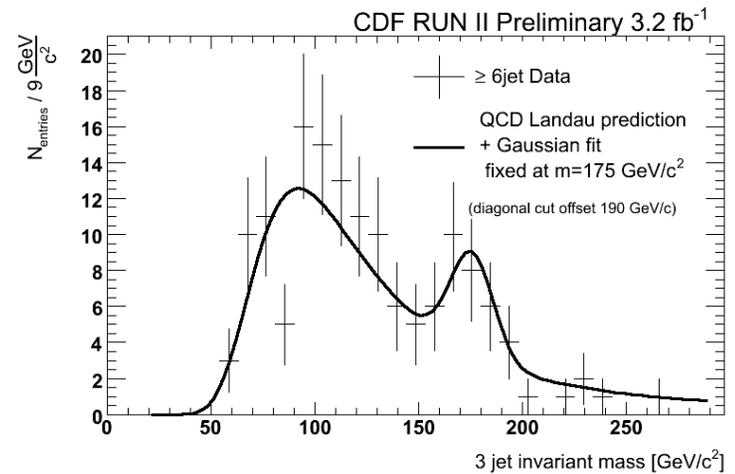
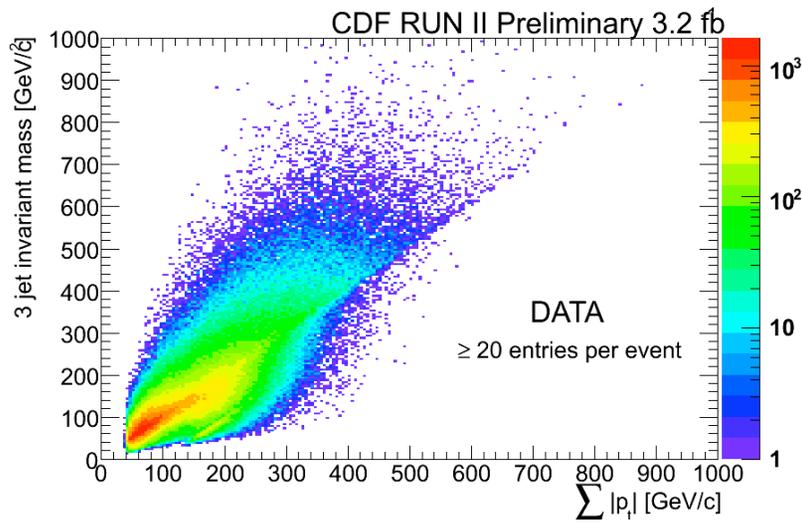
Model	Mass Limit (GeV/c ²)
Z'_1	817
Z'_{sec}	858
Z'_N	900
Z'_ψ	917
Z'_χ	930
Z'_η	938
Z'_{SM}	1071



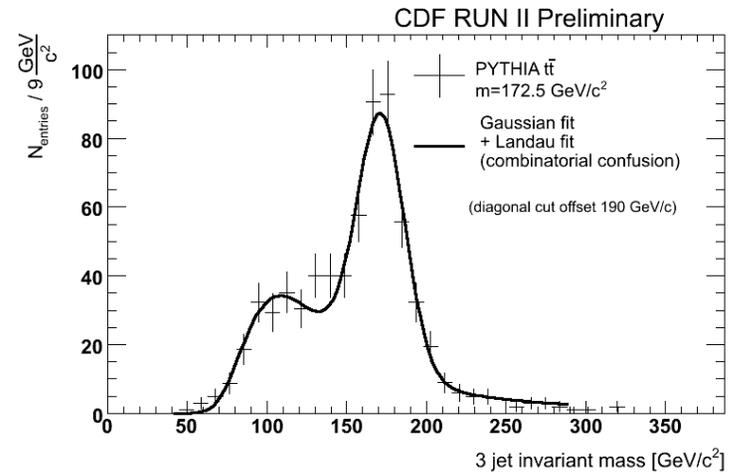
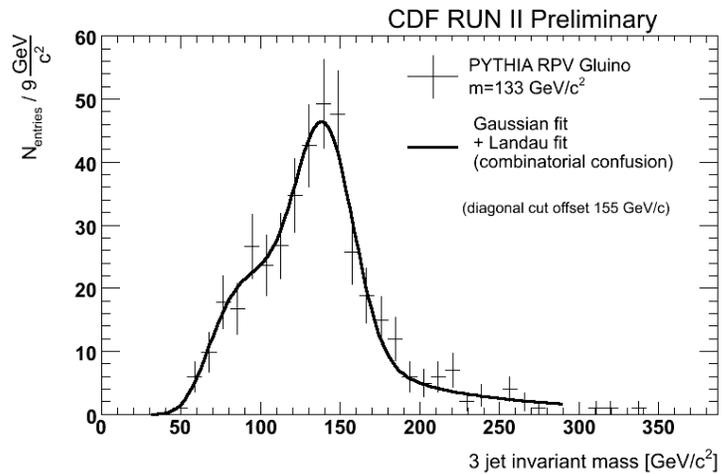
Dielectron and Diphoton



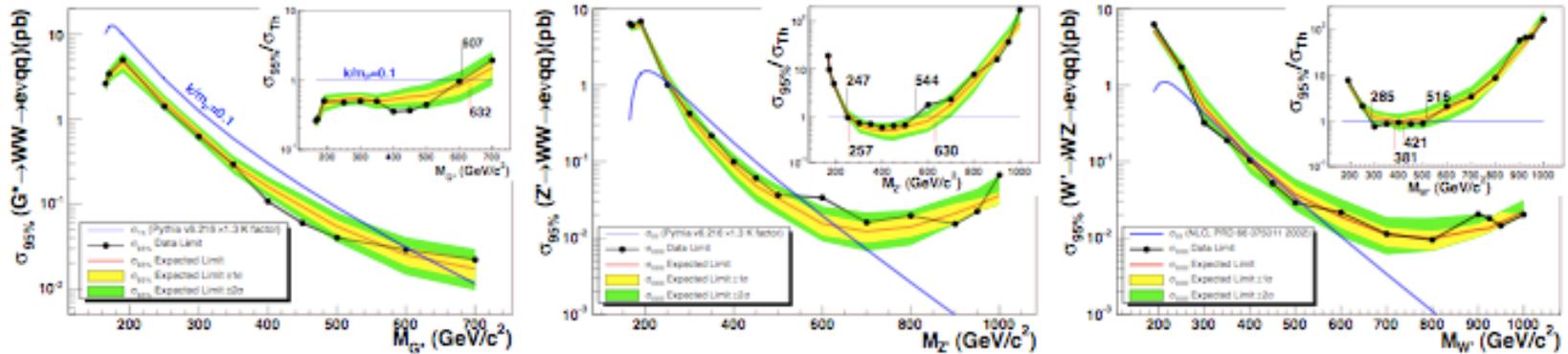
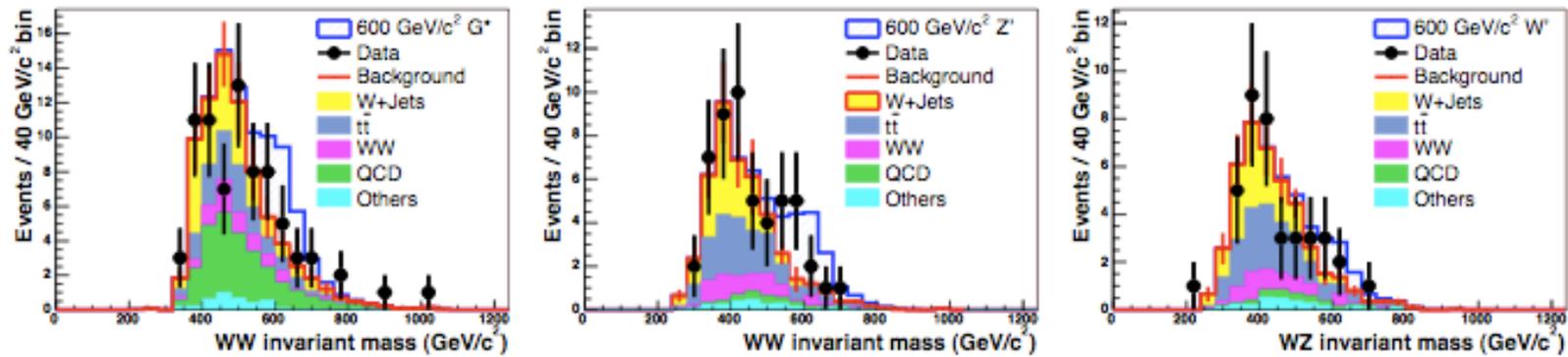
Hadronic



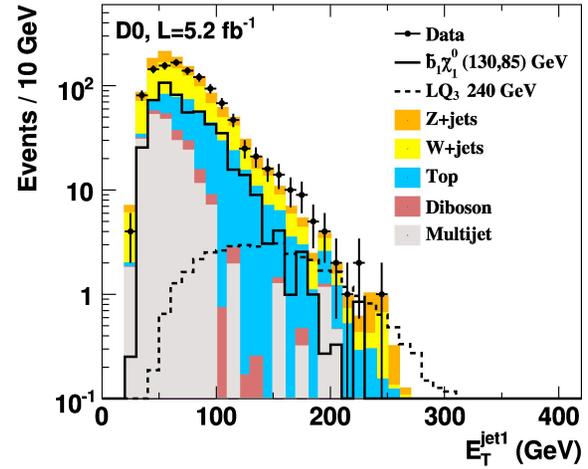
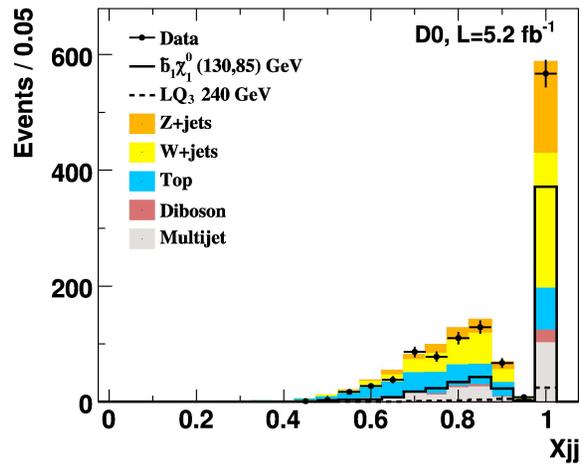
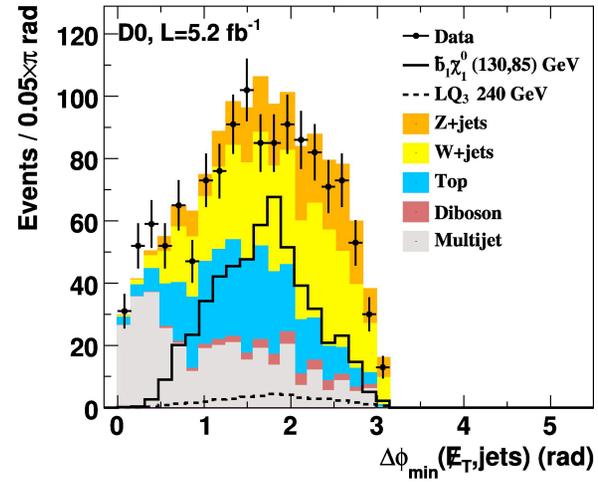
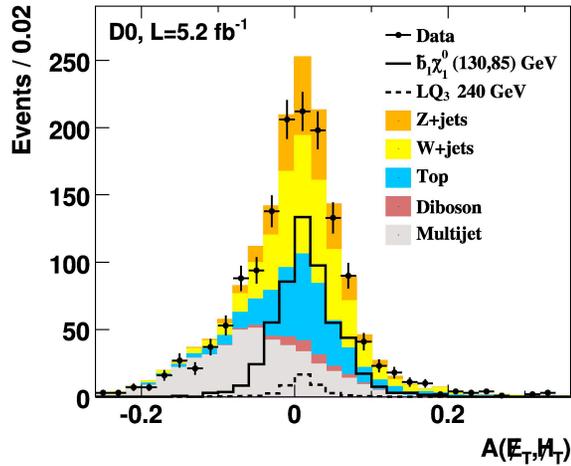
Hadronic



Diboson



Leptoquarks



Lepton-Jets

