

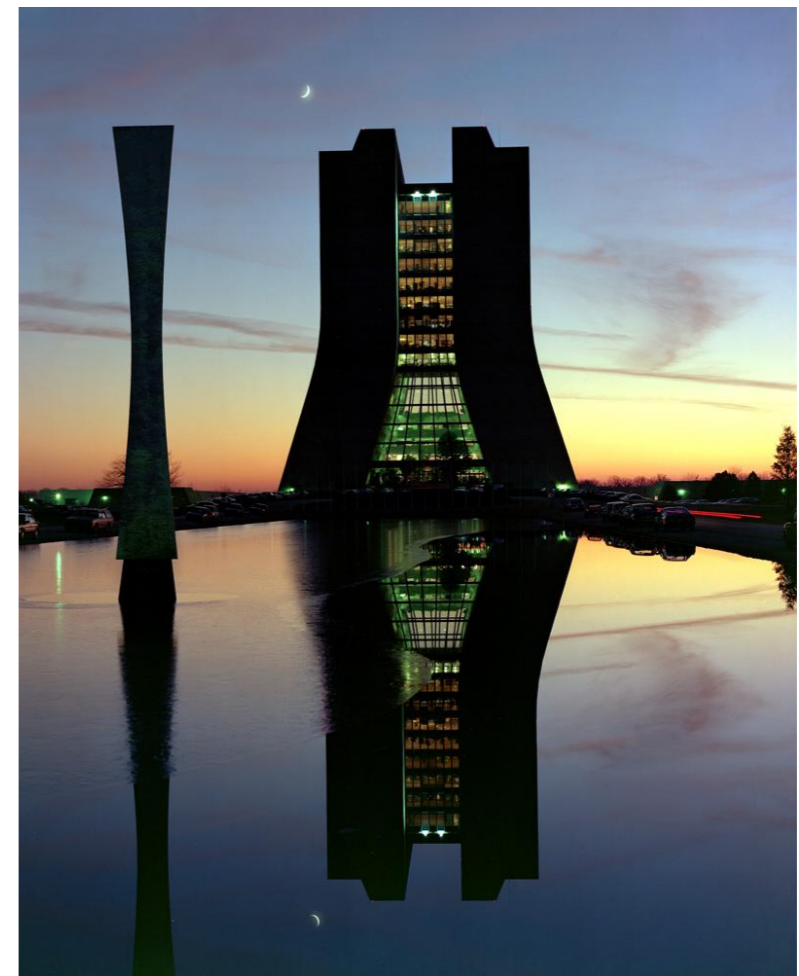
Searches for New Physics With Leptons at the Tevatron

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On behalf of the

CDF and D0 Collaborations



Imperial College
London

Overview

Leptons – clear signatures at hadron colliders
-> triggers and event selection

Neutralinos and Charginos

Stops

New resonances

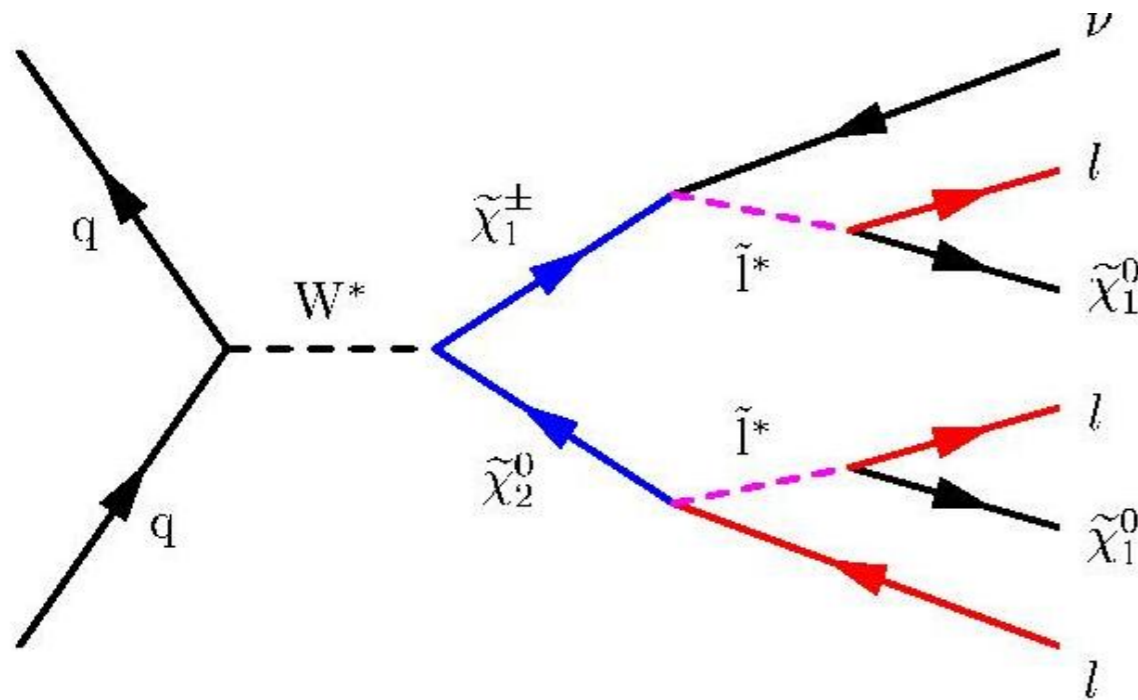
W' , Z' , and Gravitons

Heavy or composite fermions



Neutralinos and Charginos

Direct EWK production – jet free



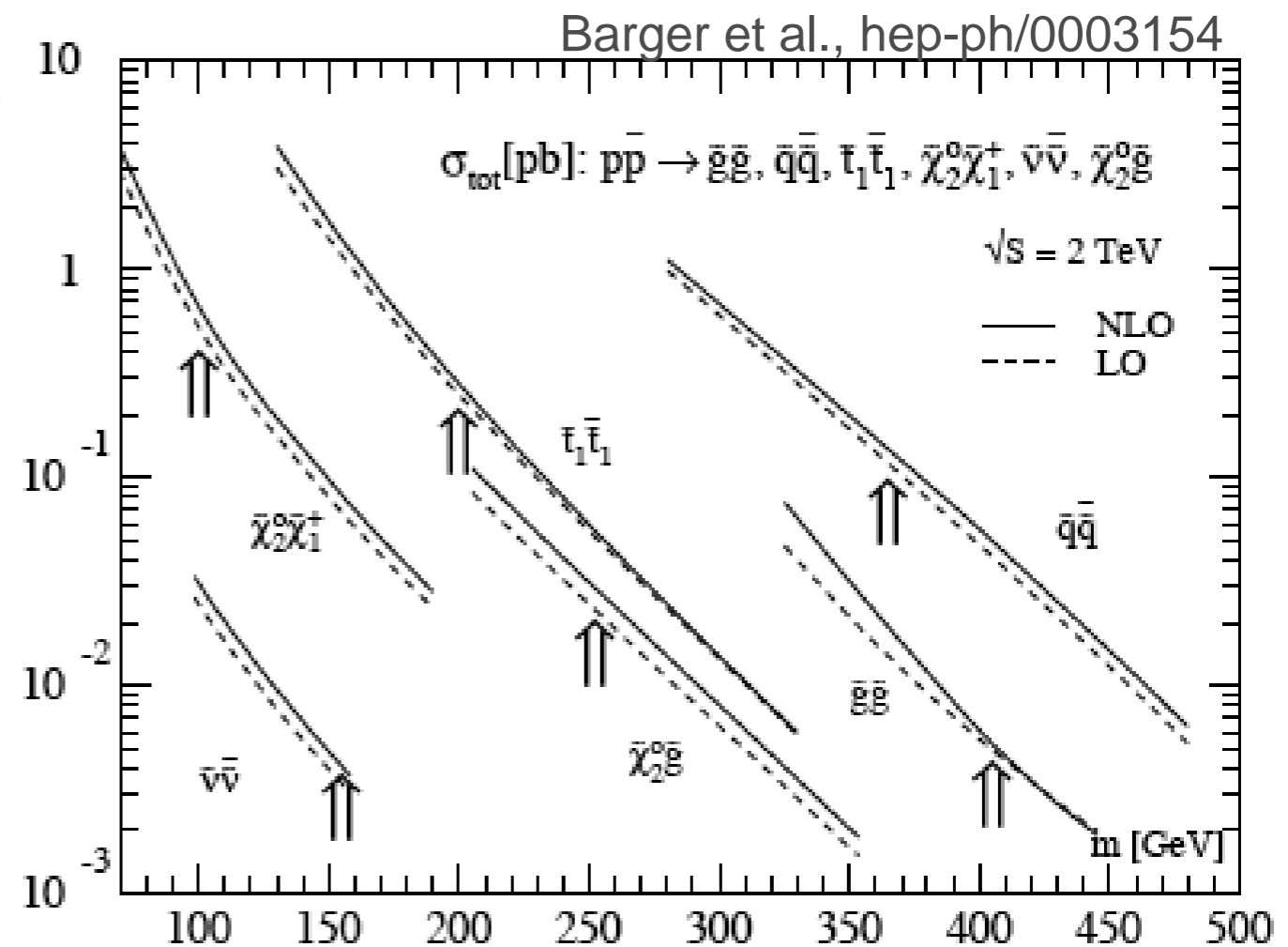
Spectacular 3 lepton signature

Low cross section

Leptons can be soft

“Golden signature”

SUSY – squarks and gluinos typically heavy





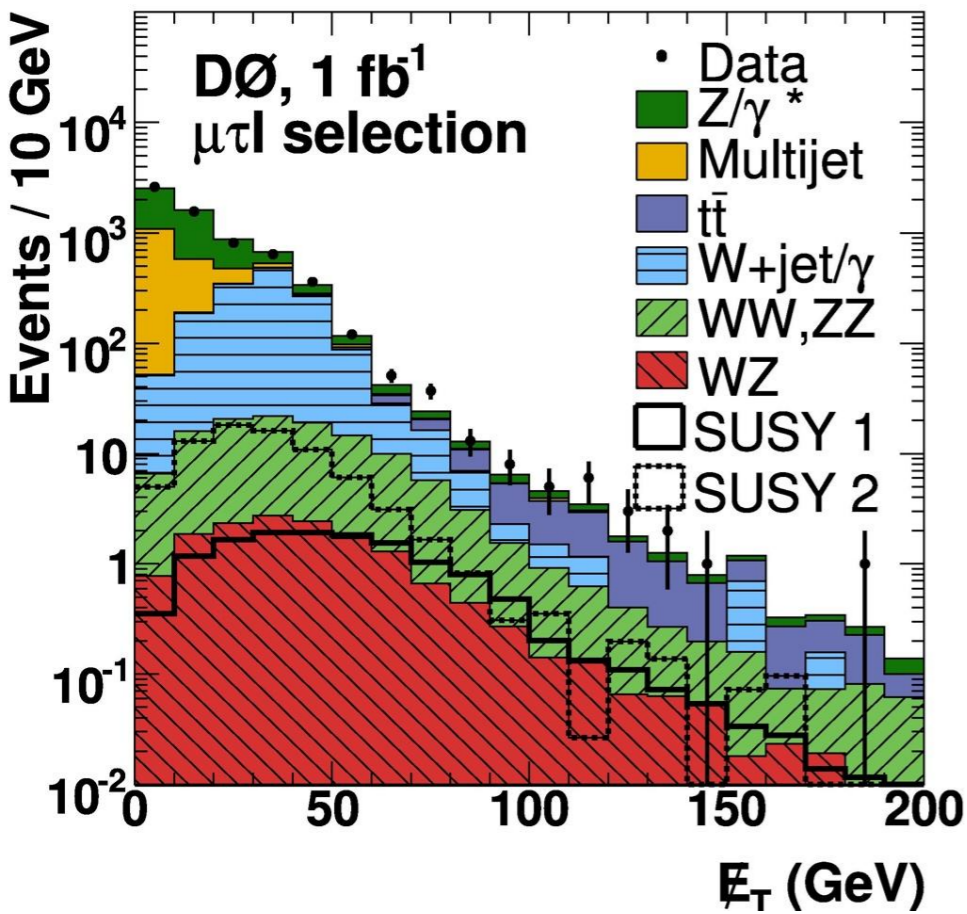
Trileptons

PLB 680, 24 (2009)

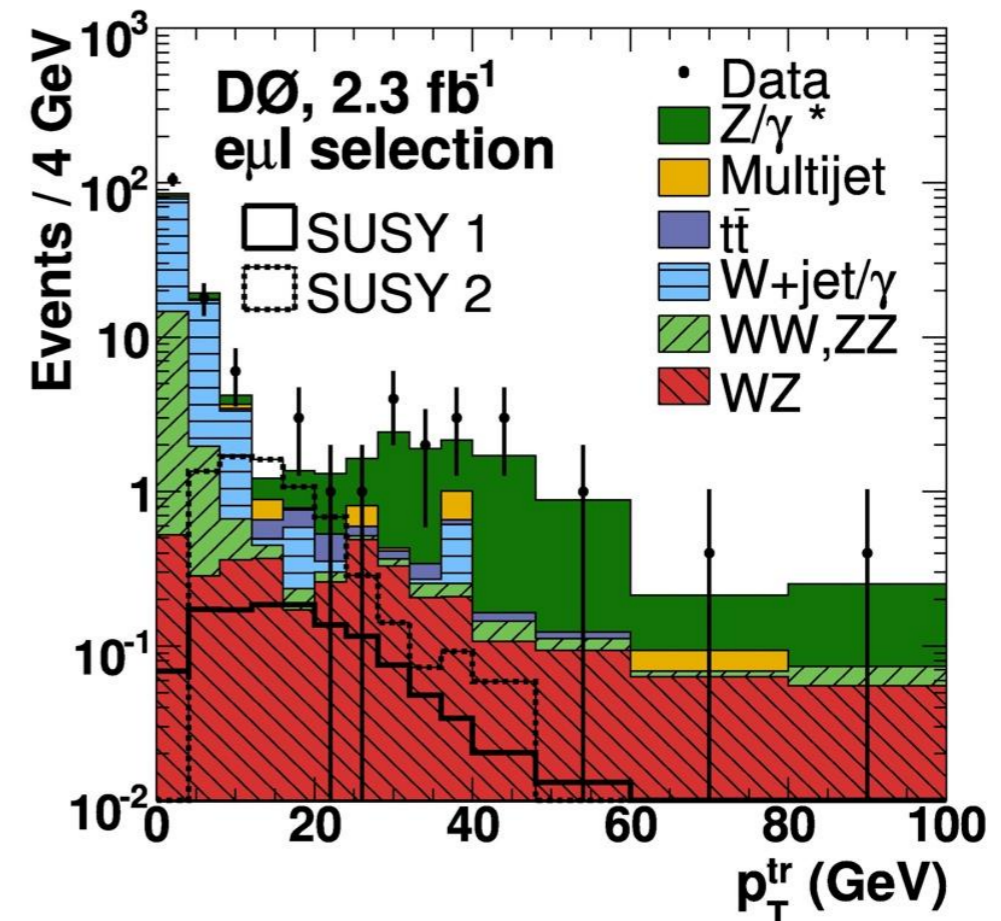
Final states with 3 leptons

eel , $\mu\mu l$, $e\mu l$, $\mu\tau l/\mu\tau\tau$

Optimised for 2 mSUGRA reference models



SUSY1	Data	Bgd	Sig Eff /%
μμl	4	1.2±0.2	2.8±0.1
eel	2	1.8±0.2	2.1±0.1
eμl	2	0.8±0.2	1.3±0.1
SUSY2			
μμl	4	2.0±0.3	5.0±0.1
eel	0	0.8±0.1	3.6±0.1
eμl	0	0.5±0.1	2.1±0.1
tau			
μτl	0	0.8±0.1	1.2±0.1
μττ	1	0.8±0.1	1.3±0.1

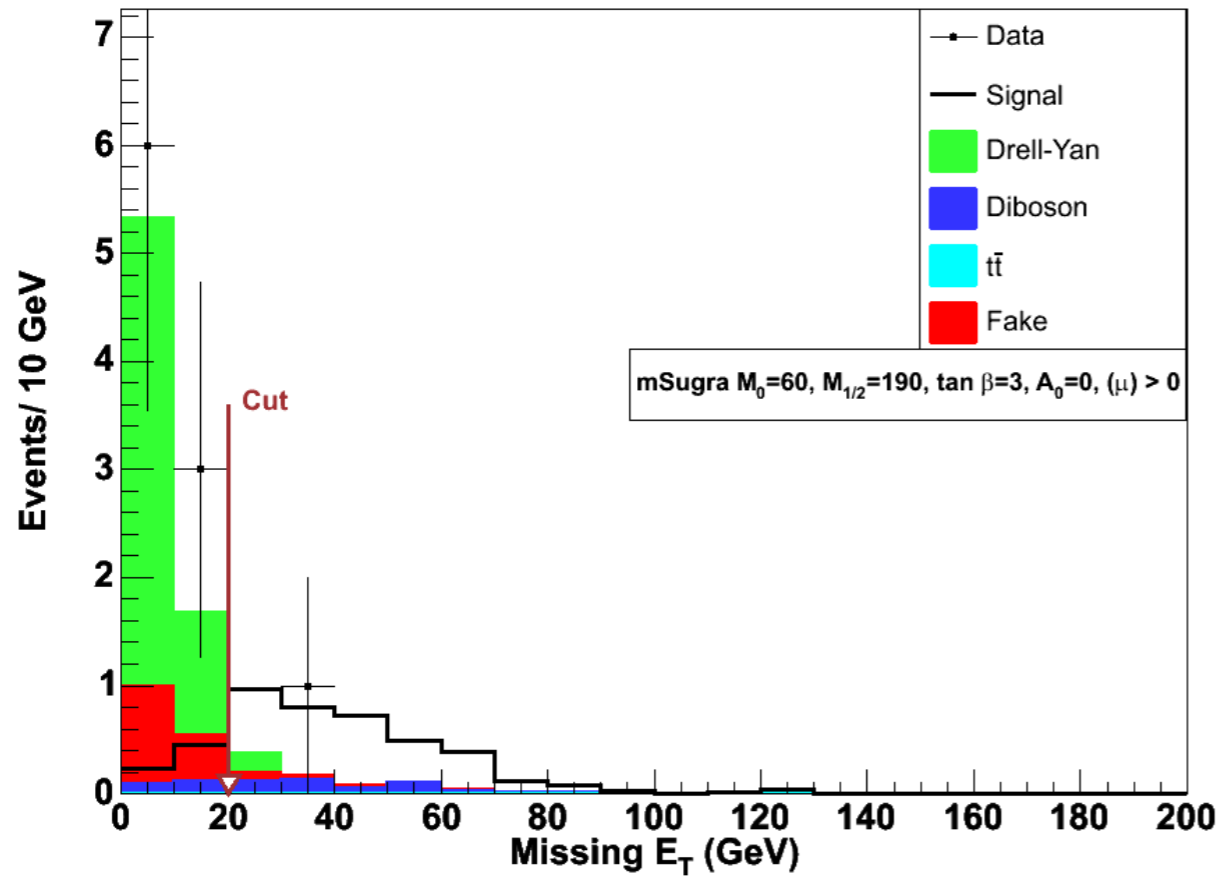




Trileptons

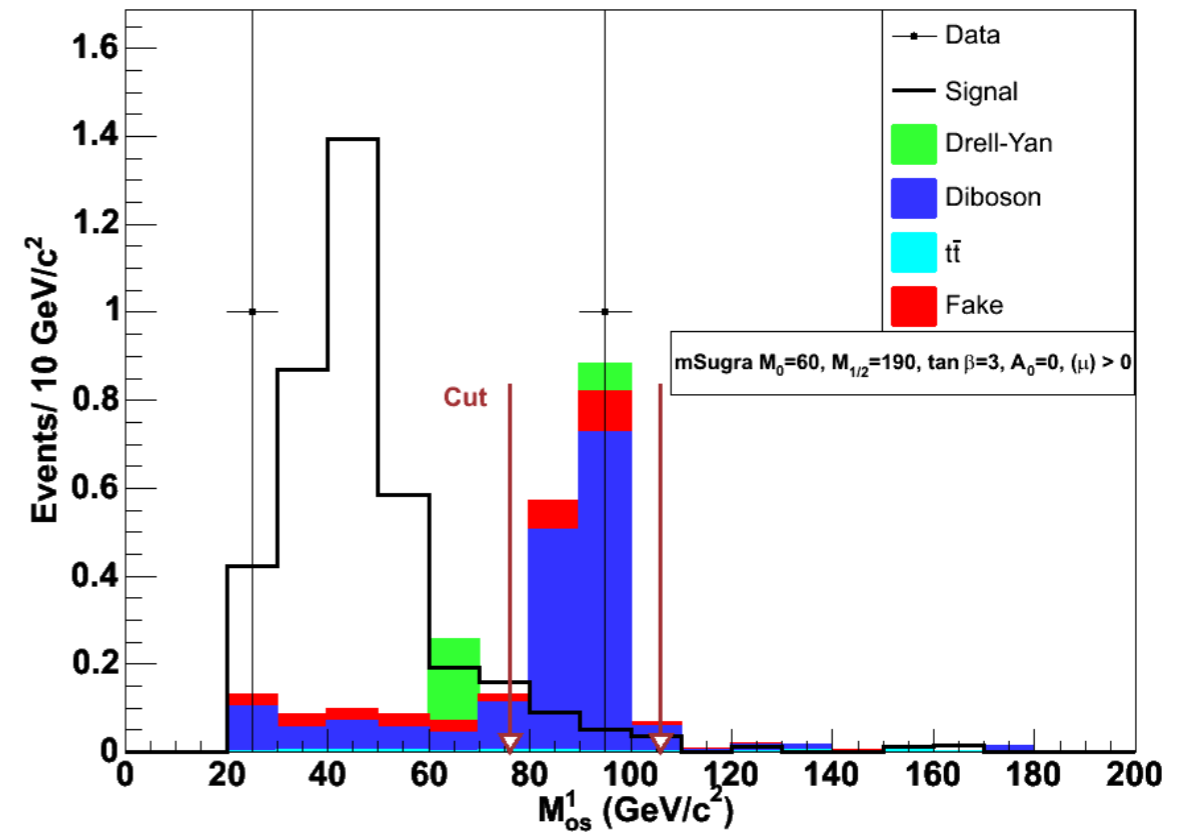
Similar analysis at CDF

Search for $\tilde{\chi}_2^0 \tilde{\chi}_1^\pm$, CDF Run II Preliminary, 3.2 fb^{-1}



PRL101:251801,2008
CDF-Note 9817

Search for $\tilde{\chi}_2^0 \tilde{\chi}_1^\pm$, CDF Run II Preliminary, 3.2 fb^{-1}



Classify events according to lepton quality

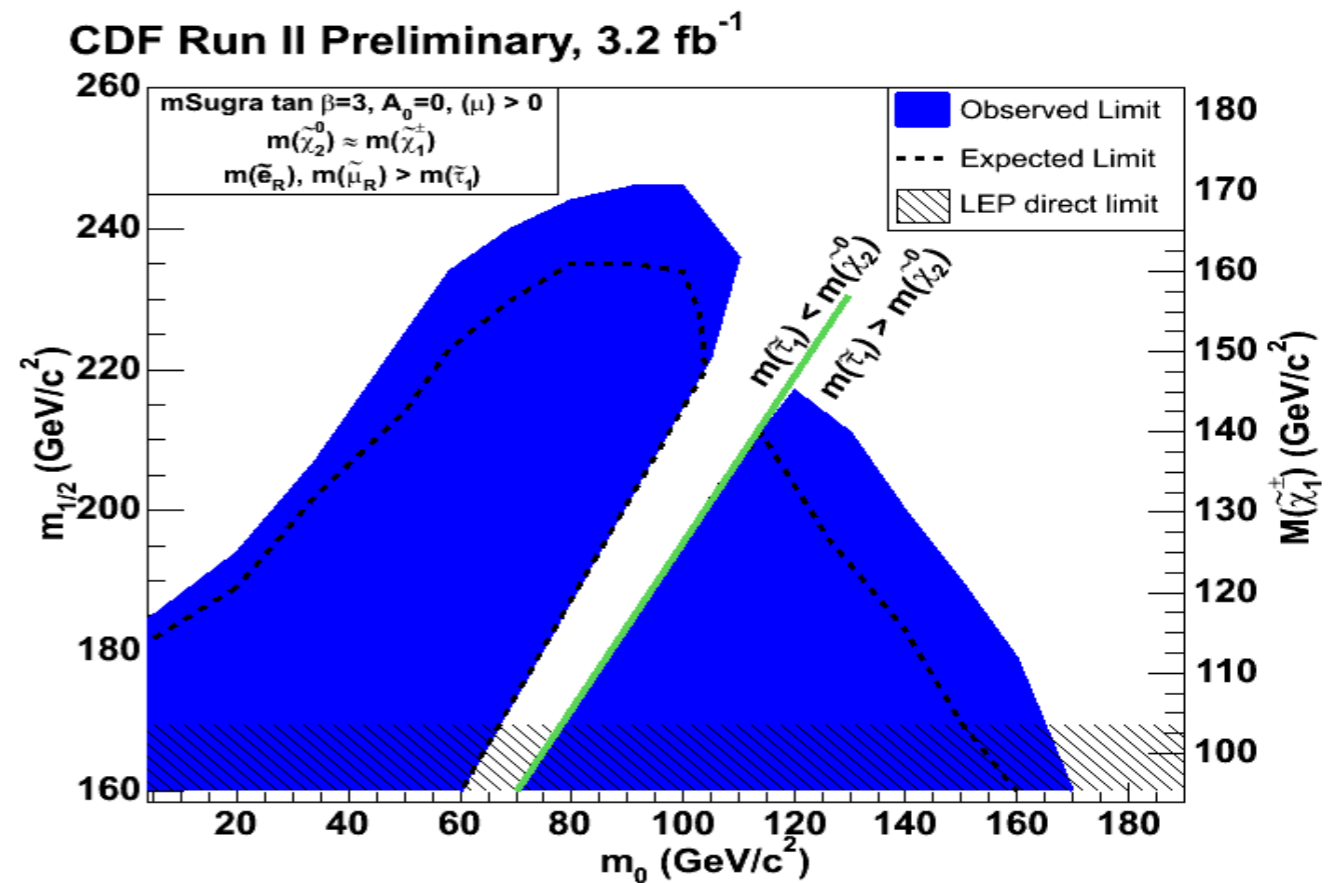
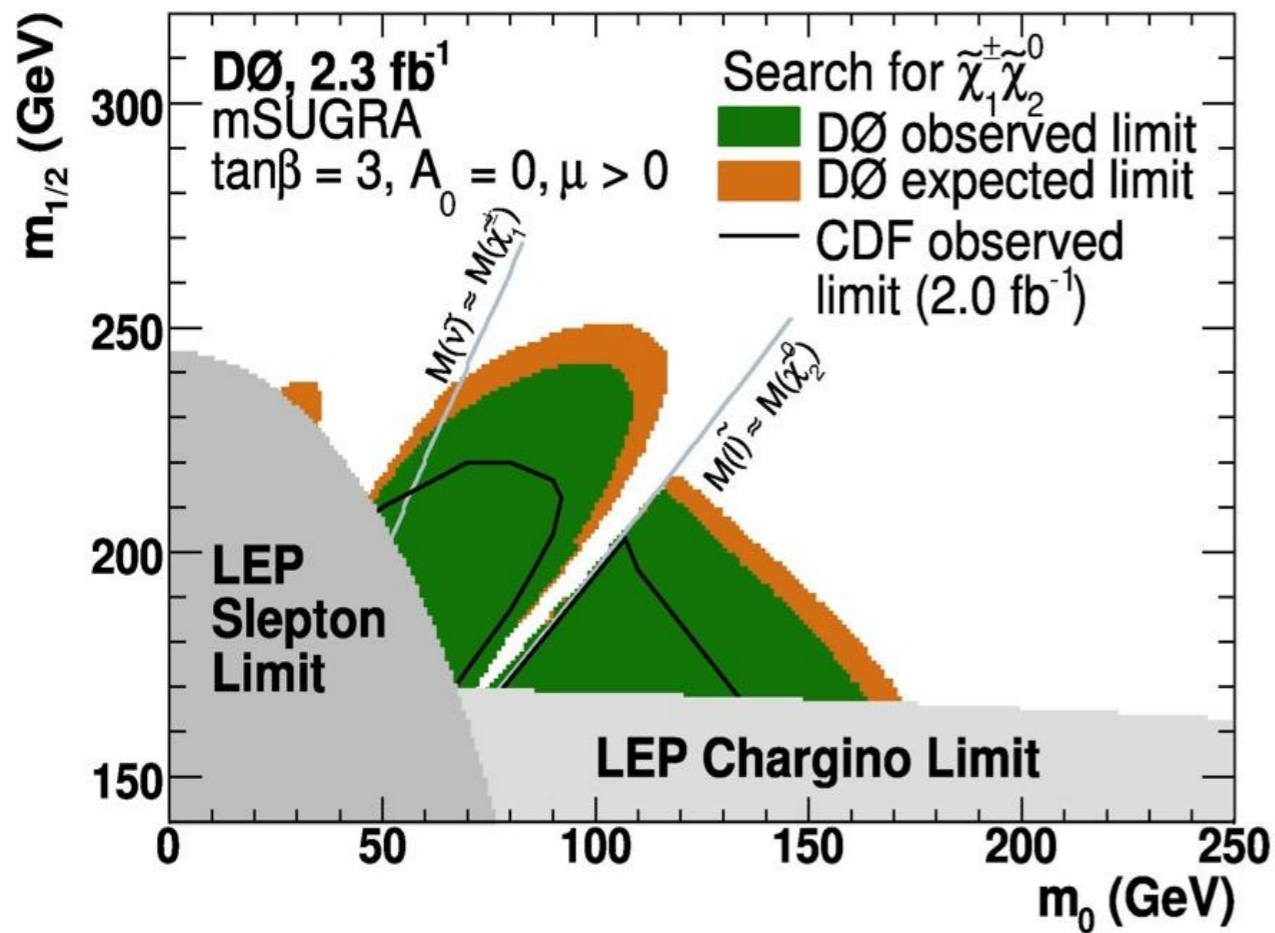
	Data	Background	Signal
trilepton	1	1.47 ± 0.21	7.38 ± 0.68
Dilepton+track	6	9.38 ± 1.44	11.21 ± 1.12



Trileptons



No significant excesses observed



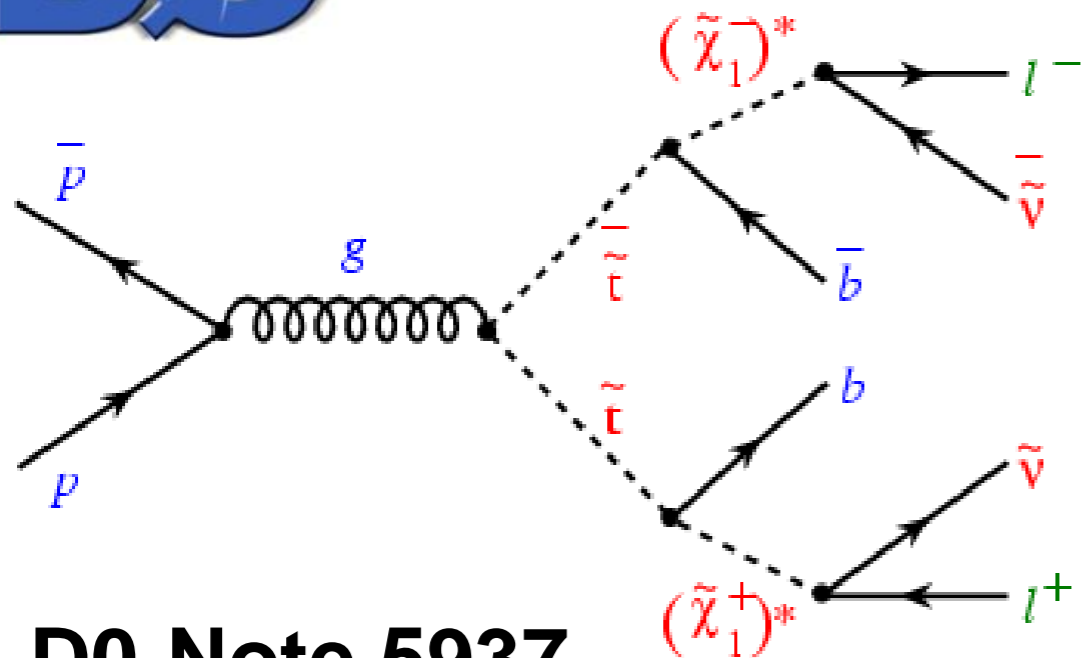
Interpret results in mSUGRA

Stop Searches

Stop potentially lighter than top



arXiv:0912.1308



Assume chargino light

neutralino LSP

Look for stop mimicking
top production

$$\tilde{t} \rightarrow b \tilde{\chi}_1^\pm \rightarrow b \tilde{\chi}_1^0 l^\pm \nu$$

D0-Note 5937

Assume chargino heavy

sneutrino LSP

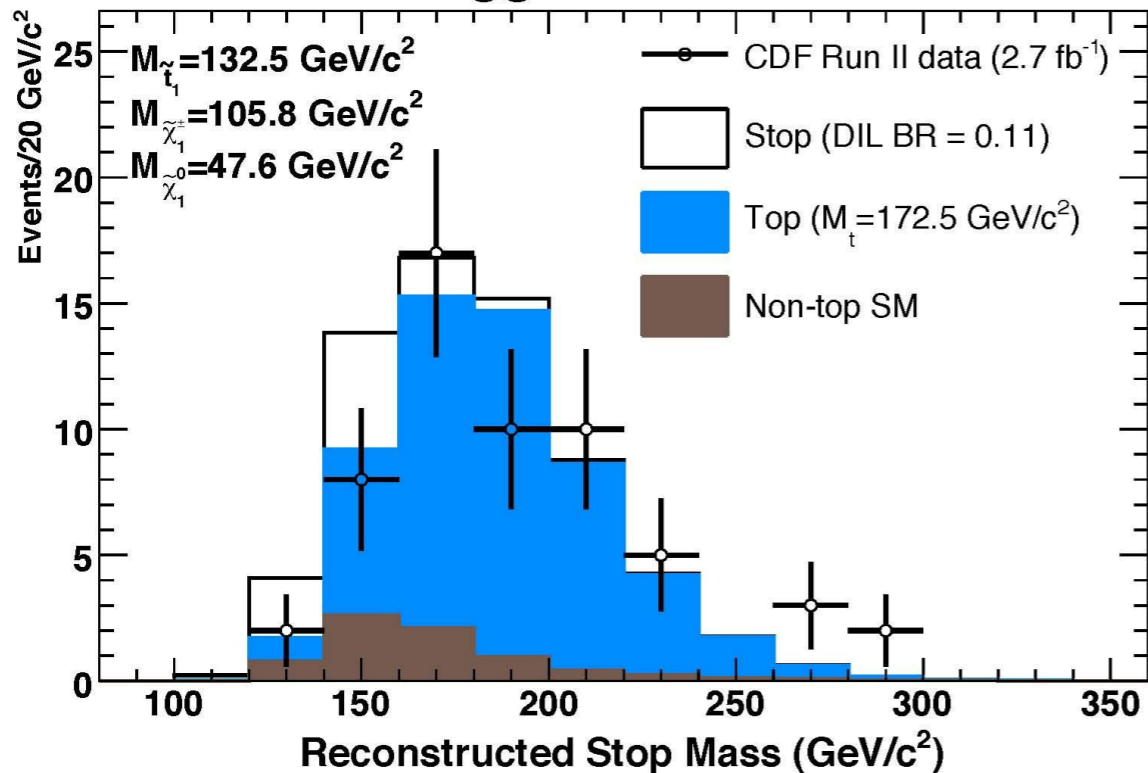
$e\mu + (bb) + \text{MET}$ signature

$l^+l^- + \text{jets} > 1 + \text{MET}$ signature
With and without b-tags



Stop Searches

B-Tagged Channel

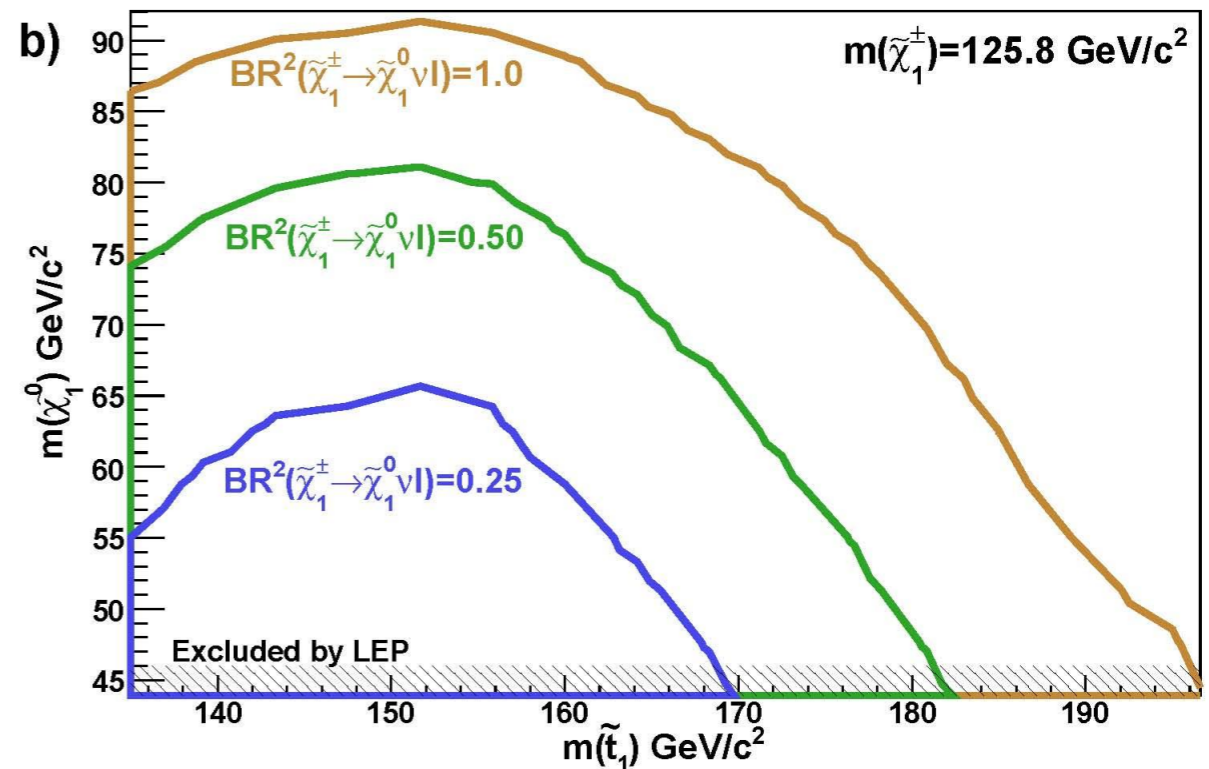
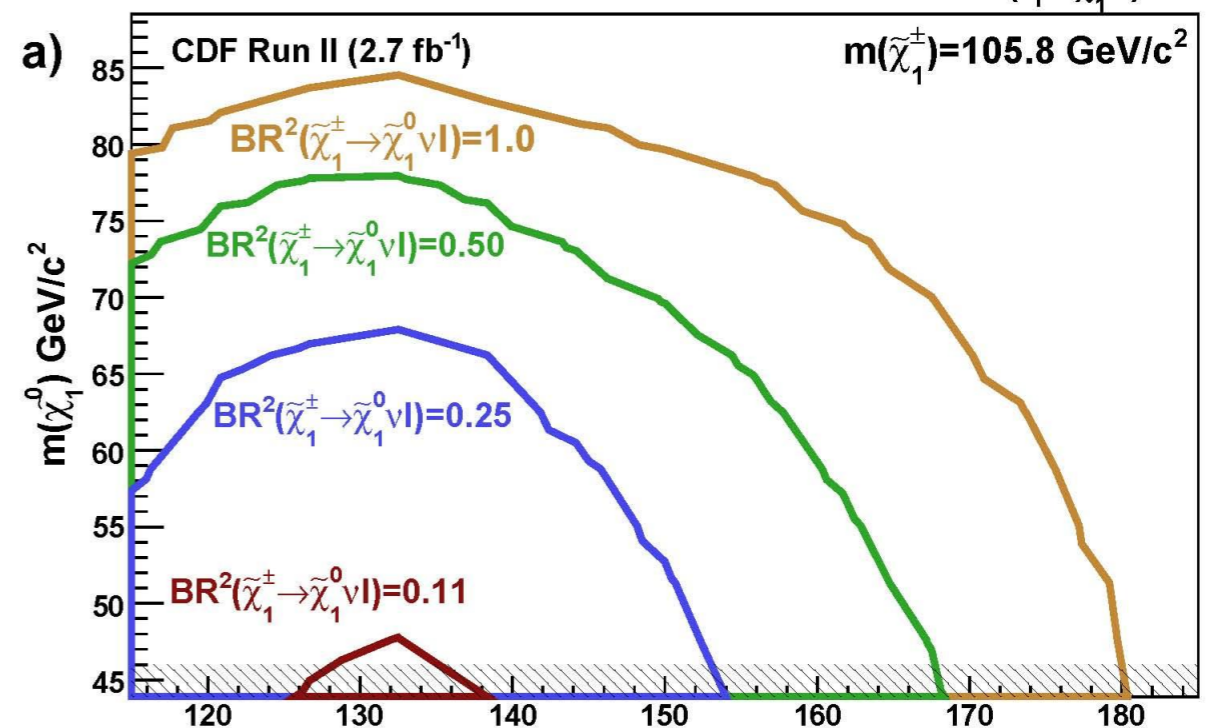


	SM Total	Data
b-tagged	56.4 ± 7.2	57
No-tags	65.9 ± 9.8	65

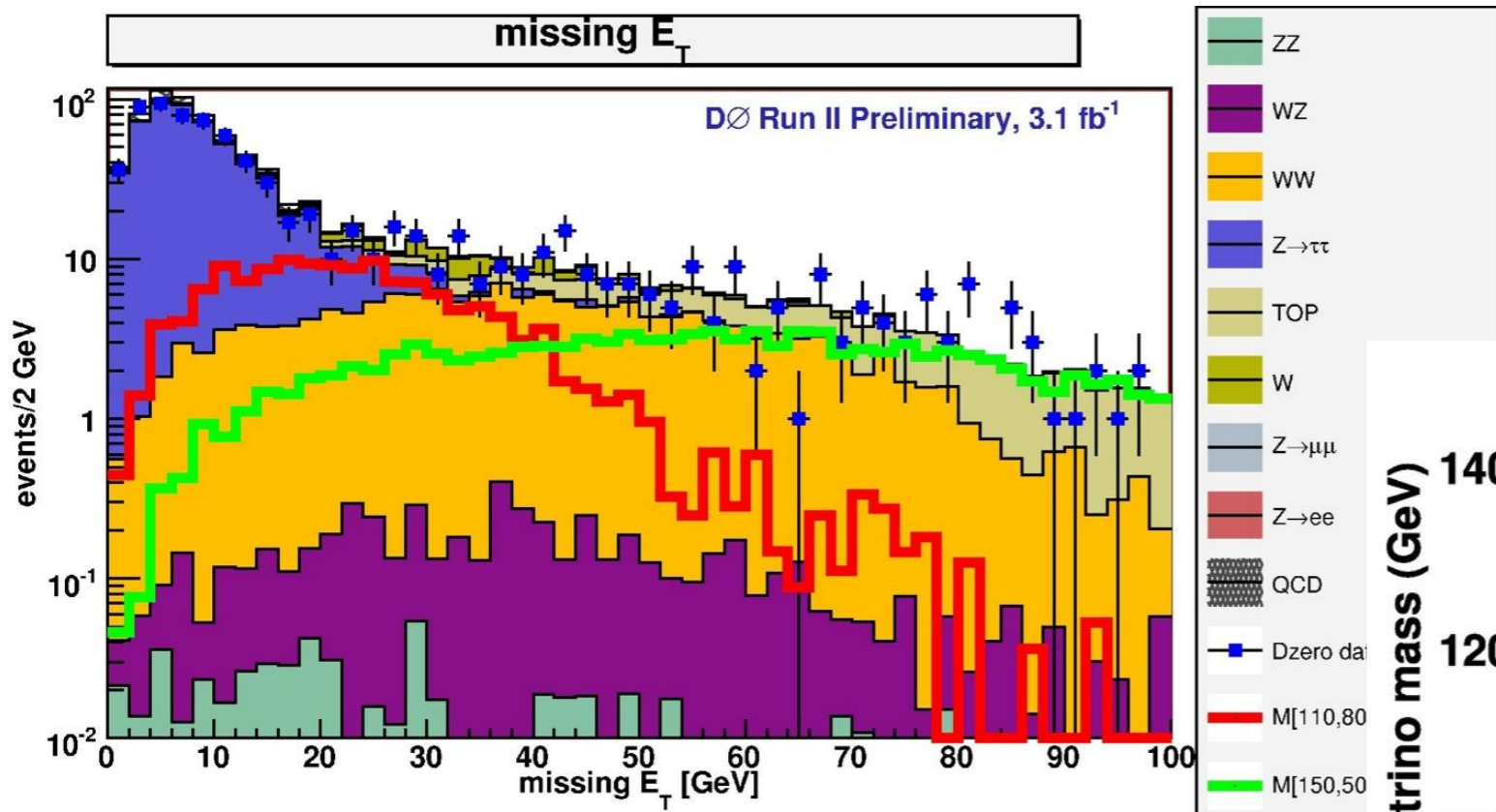
$128 < m_{\text{stop}} < 135$
Excluded at 95%CL

Observed 95% CL

$BR(\tilde{t}_1 \rightarrow \tilde{\chi}_1^\pm b) = 1$

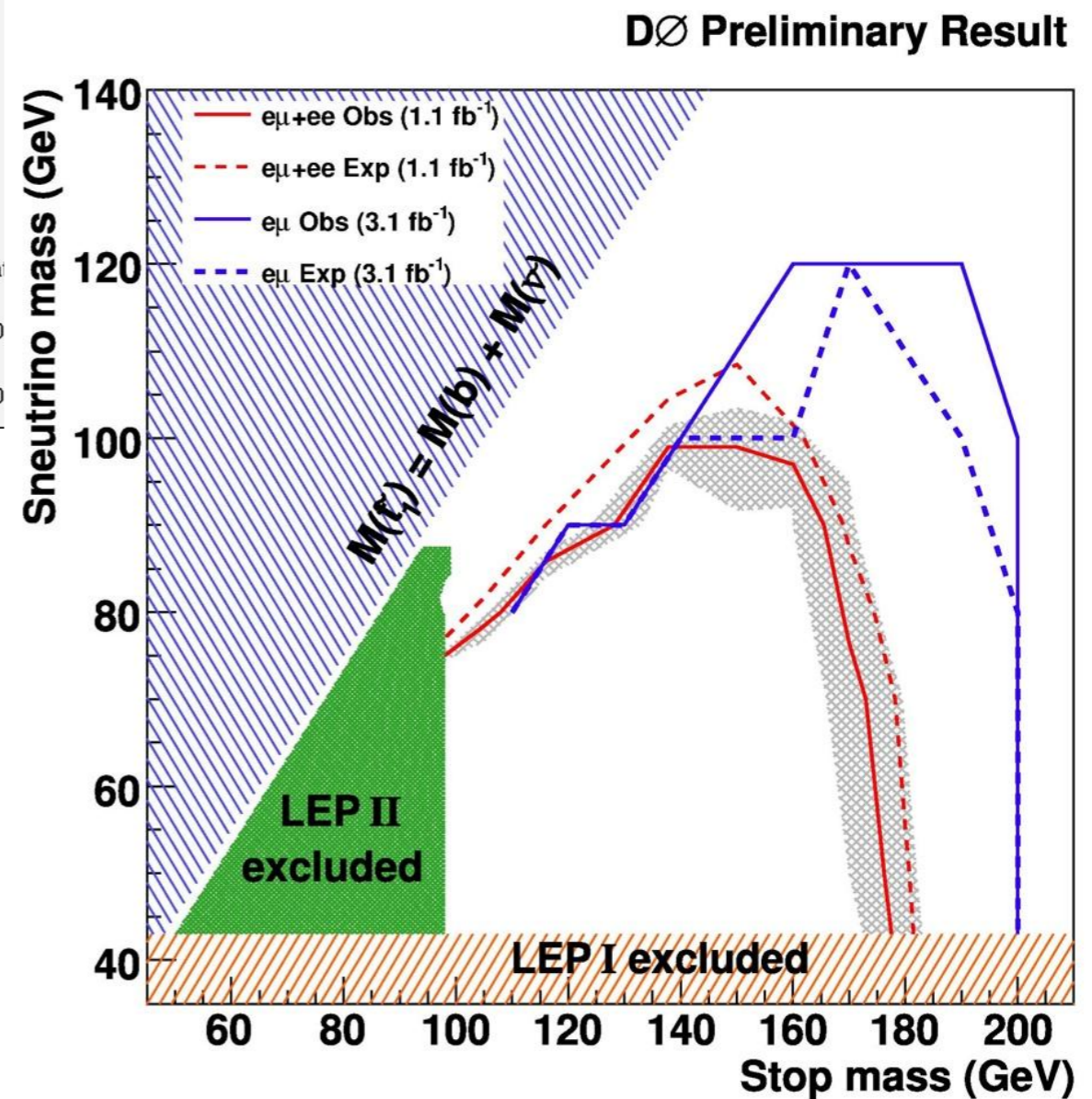


Stop Searches



Signal	$M_{\text{stop}} / \text{GeV}$	$M_{\text{sneutrino}} / \text{GeV}$
Soft	110	80
Hard	150	50

Background	Data	Signal (soft)	Signal (hard)
303 +16 -20	288	122 +14 -16	89 +11 -13



Set limits using 2D bins

S_T (leptons + MET) vs H_T (jets)

RS Gravitons

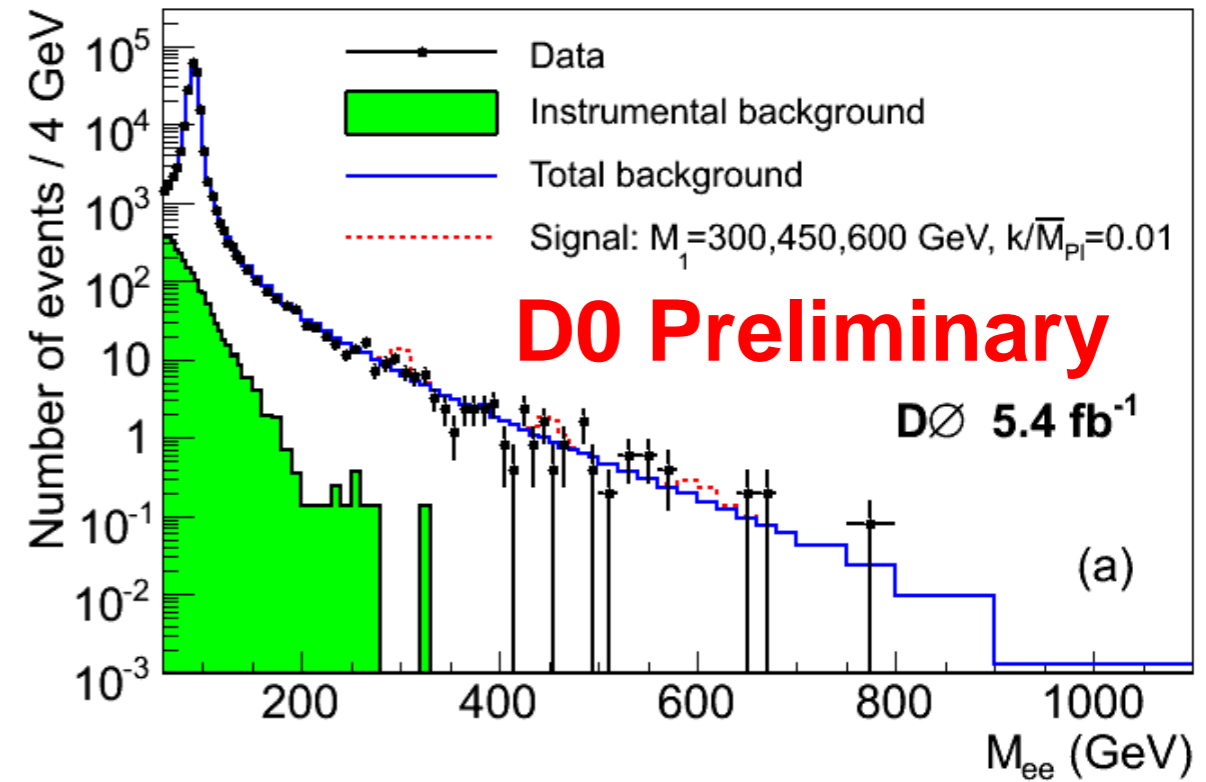
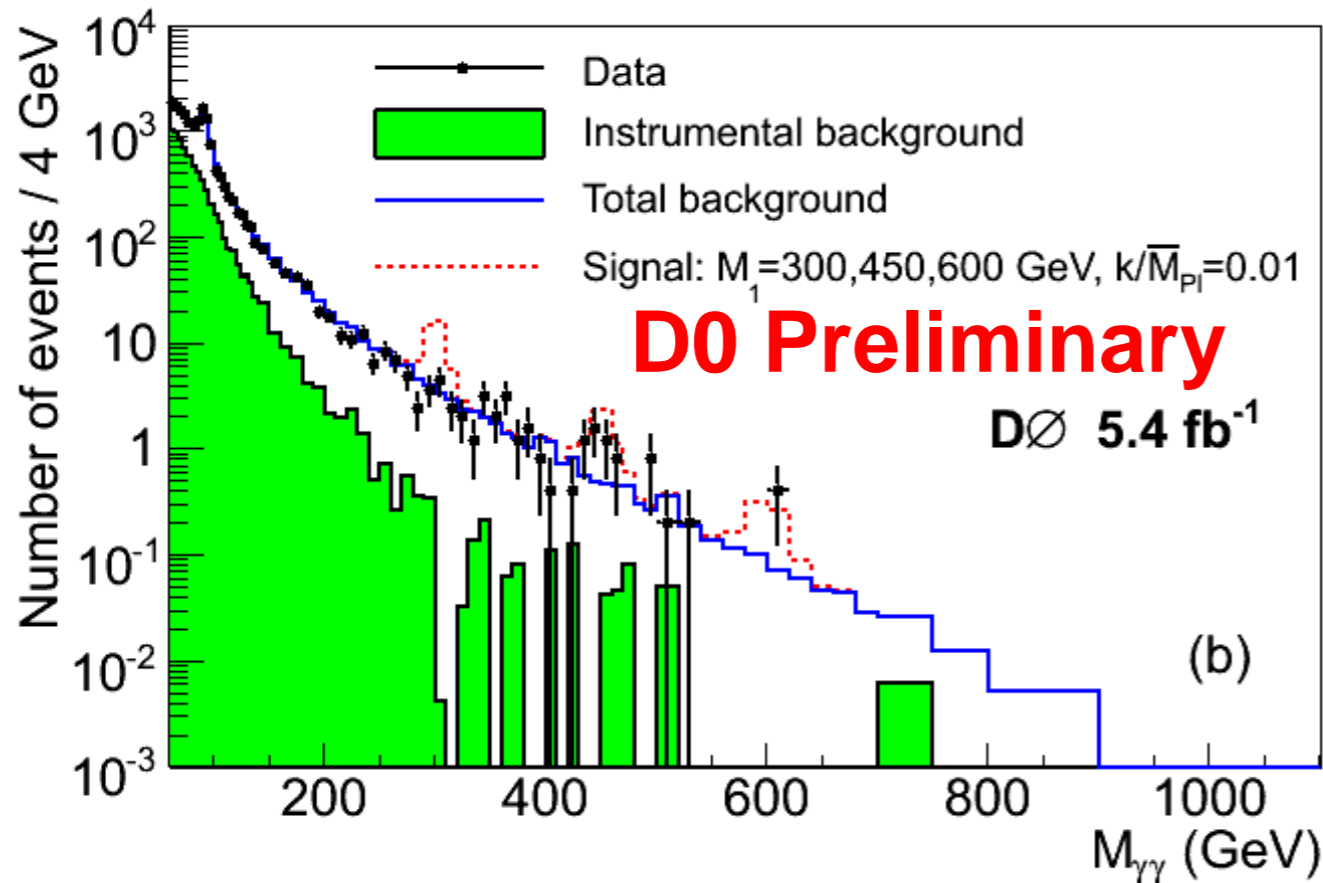


Warped extra dimensions

Predicts KK-gravitons

Lightest $M_1 \sim \text{TeV}$

avoids fine-tuning



e^+e^- and $\gamma\gamma$ final states

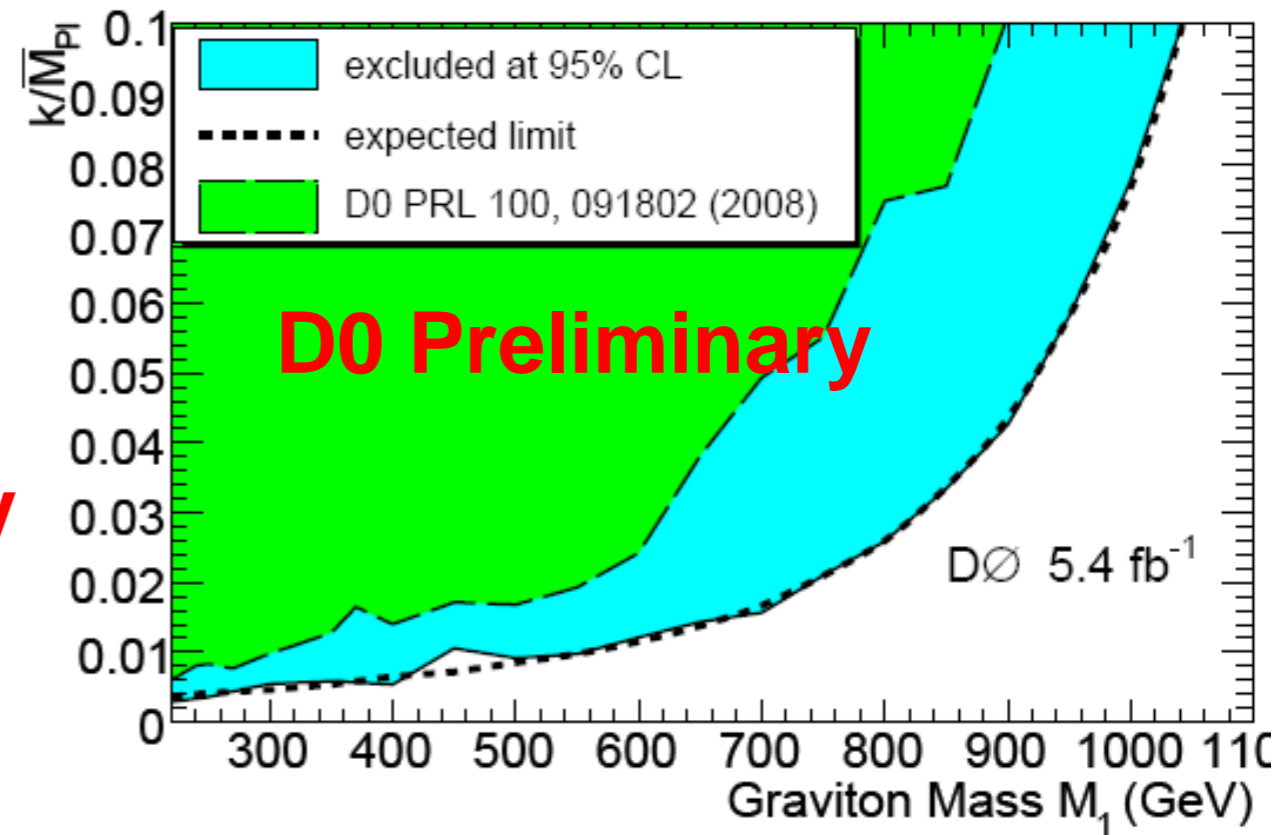
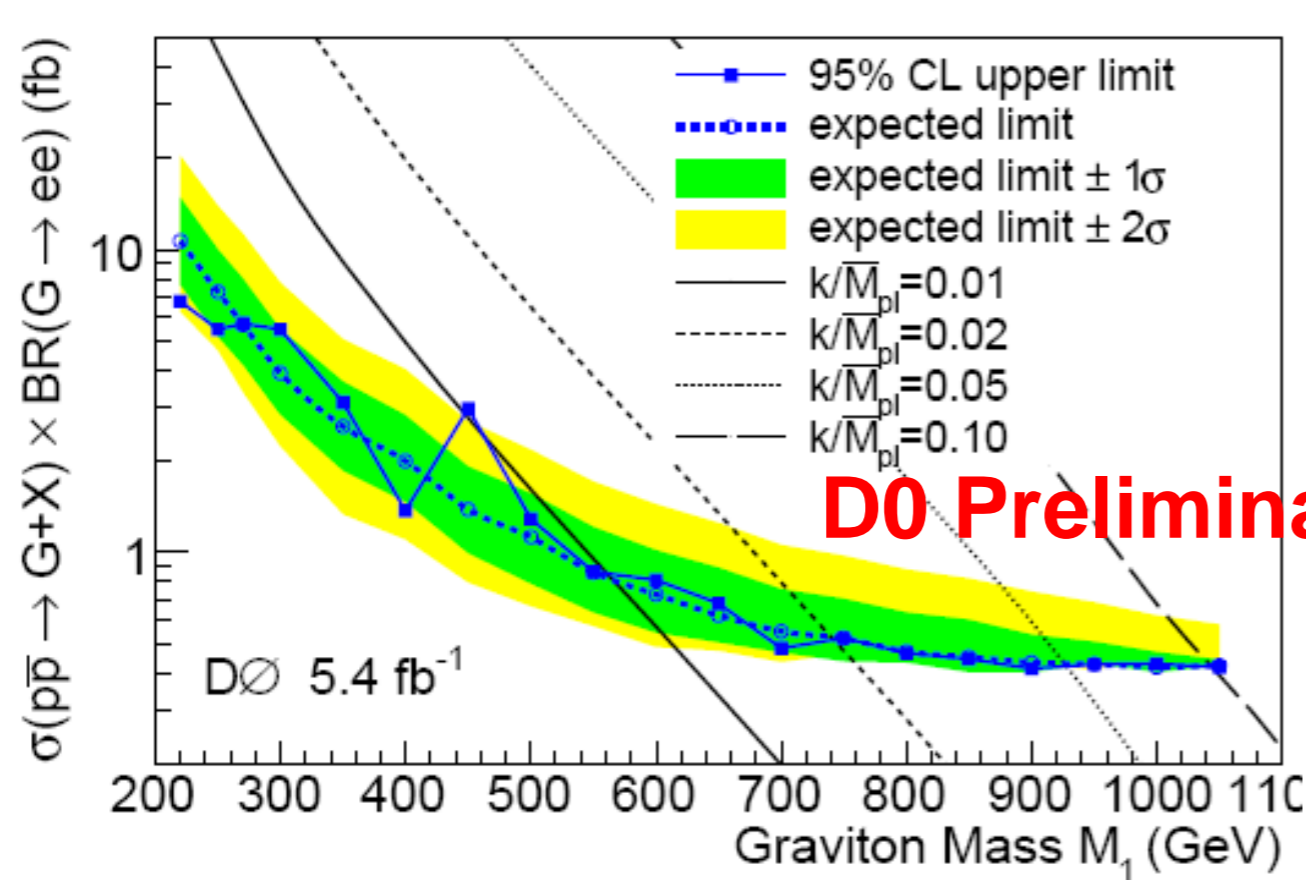
Dominant backgrounds

Drell Yan and SM $\gamma\gamma$



RS Gravitons

No significant excess observed



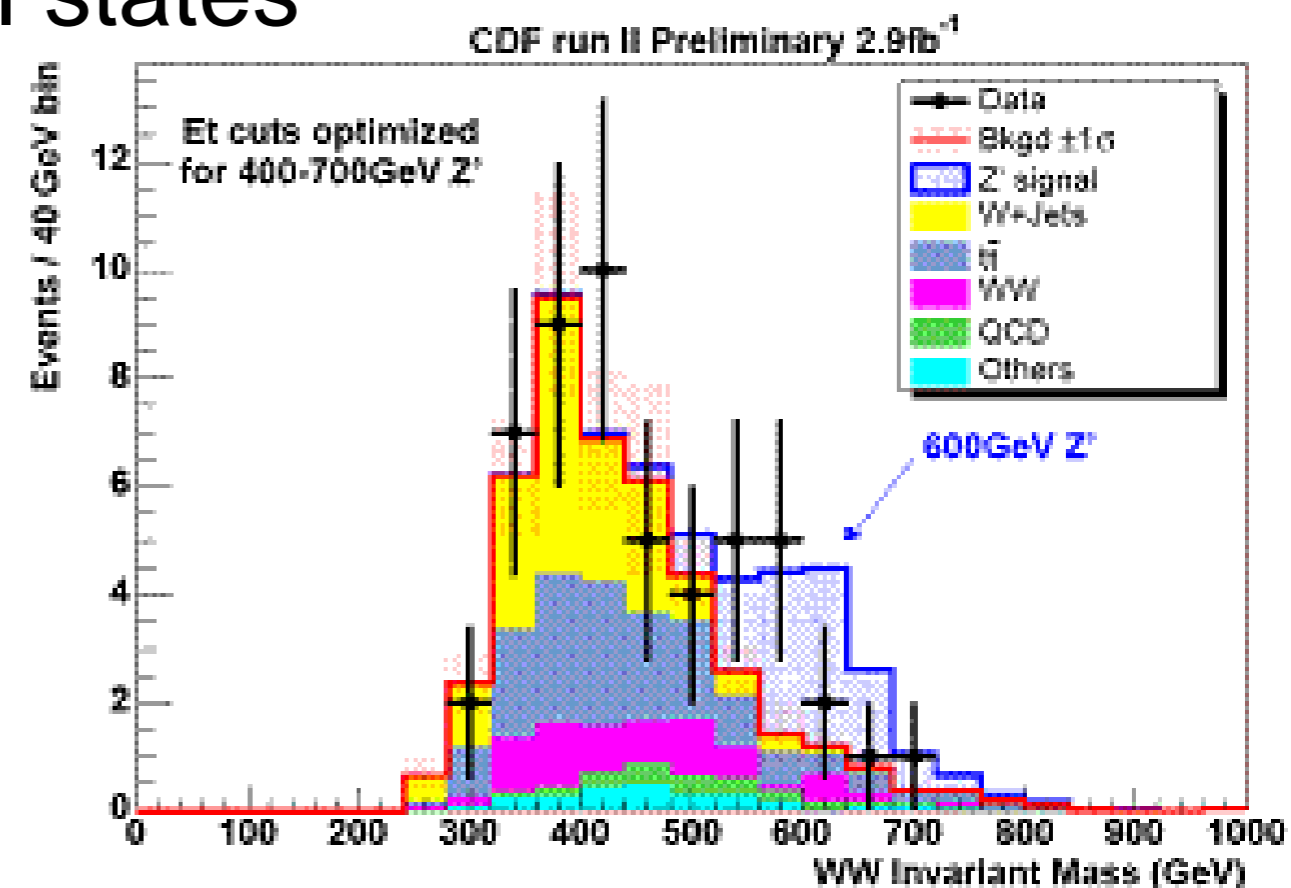
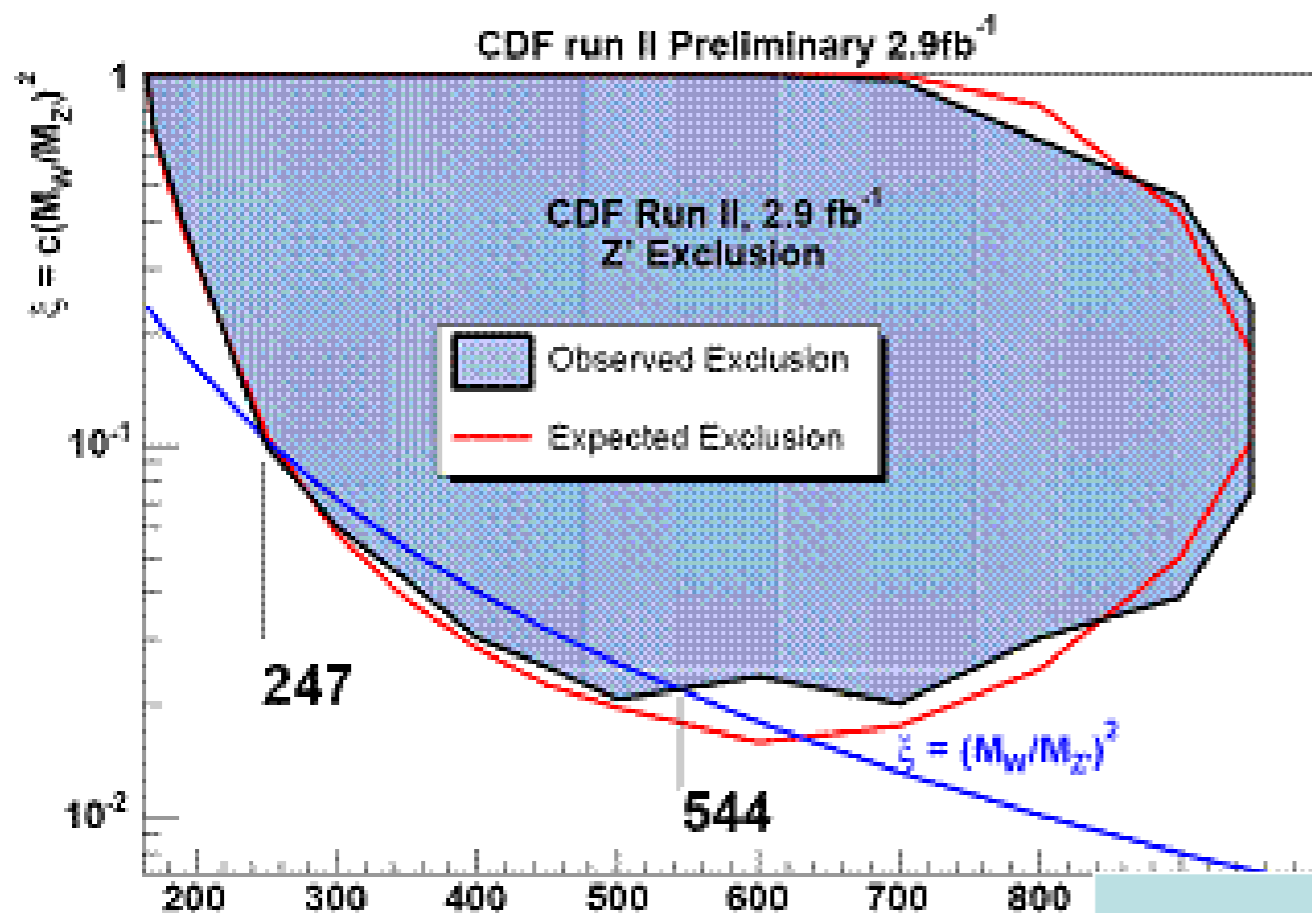
$M_1 > 440 \rightarrow 1040 \text{ GeV}$
 $k/\bar{M}_{Pl} 0.01 \rightarrow 0.1$



Diboson Resonances

Search in WW and WZ final states

e + MET + 2(3) jets



Optimise ET cuts for G, W', Z'

CDF-Note 9730

	Graviton	Z'	W'
Expected exclusion	< 632 GeV	257 – 630 GeV	381 – 420 GeV
Observed exclusion	< 606 GeV	247 – 545 GeV	284 – 515 GeV

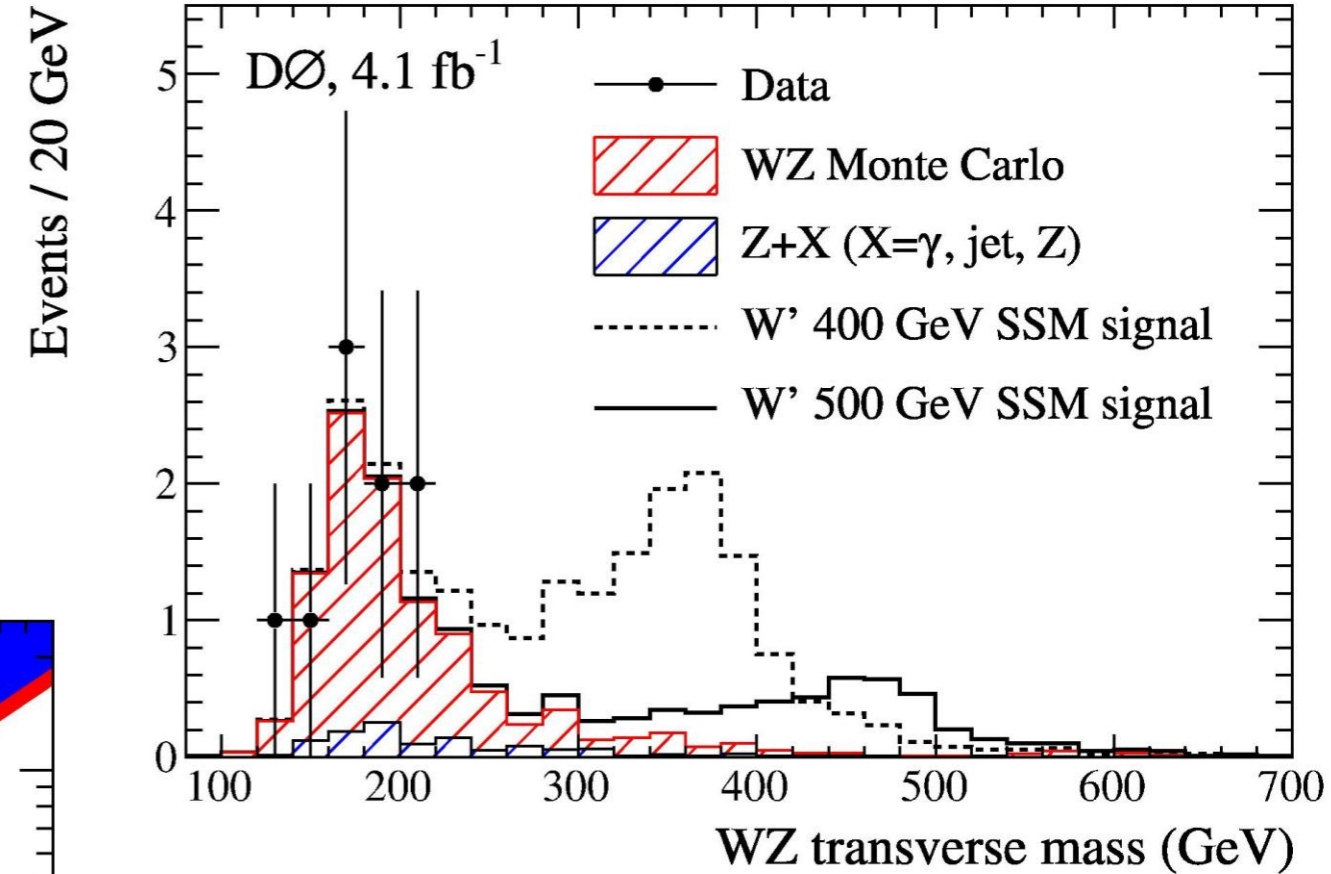
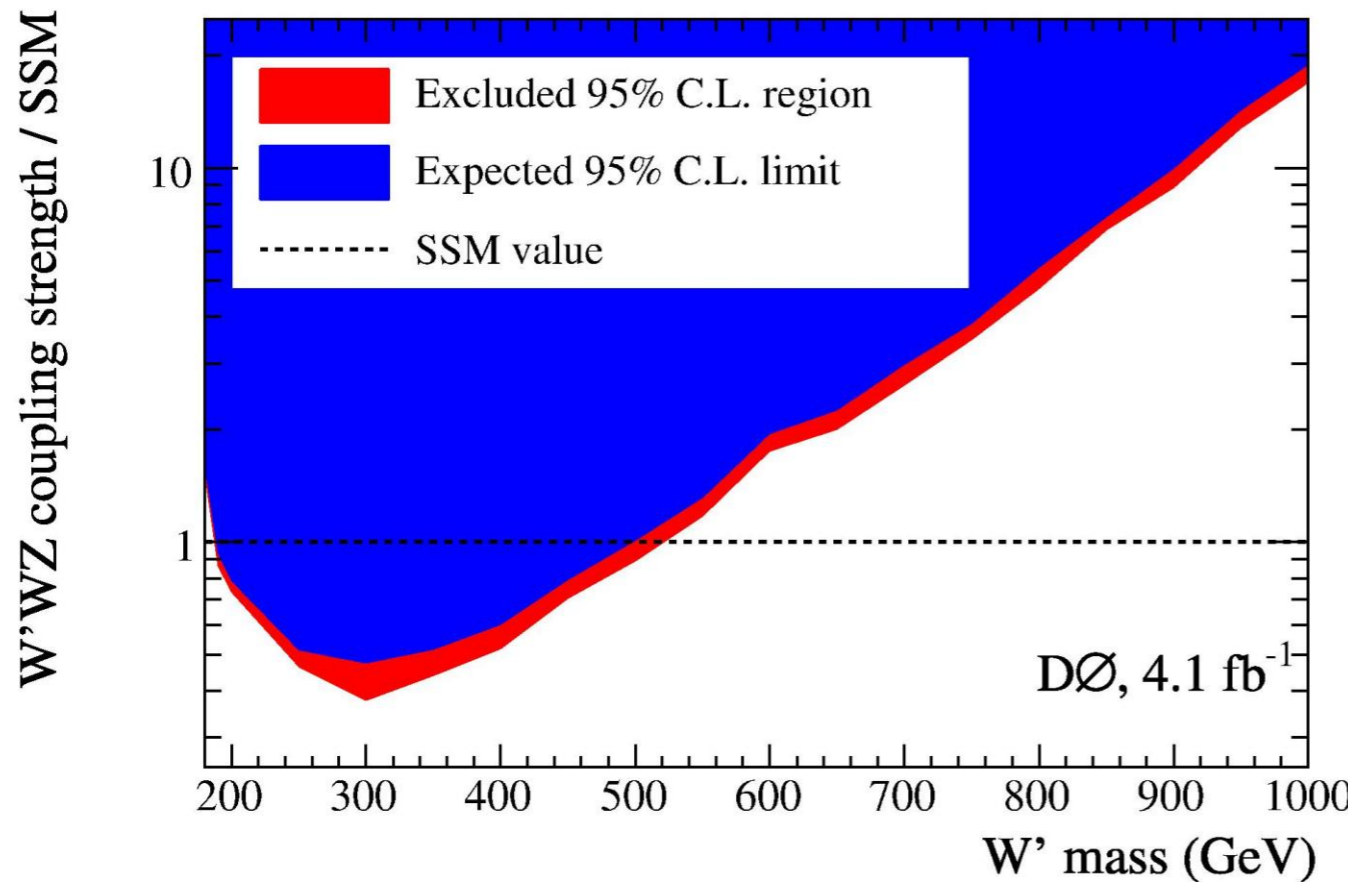
Diboson Resonances



W' decaying into WZ

Predicted in many theories

3 leptons + MET



No evidence of resonant WZ production

Exclude $188 < M_{W'} < 520$ (SSM)
 $208 < M_{\rho_T} < 408$ (LSTC)

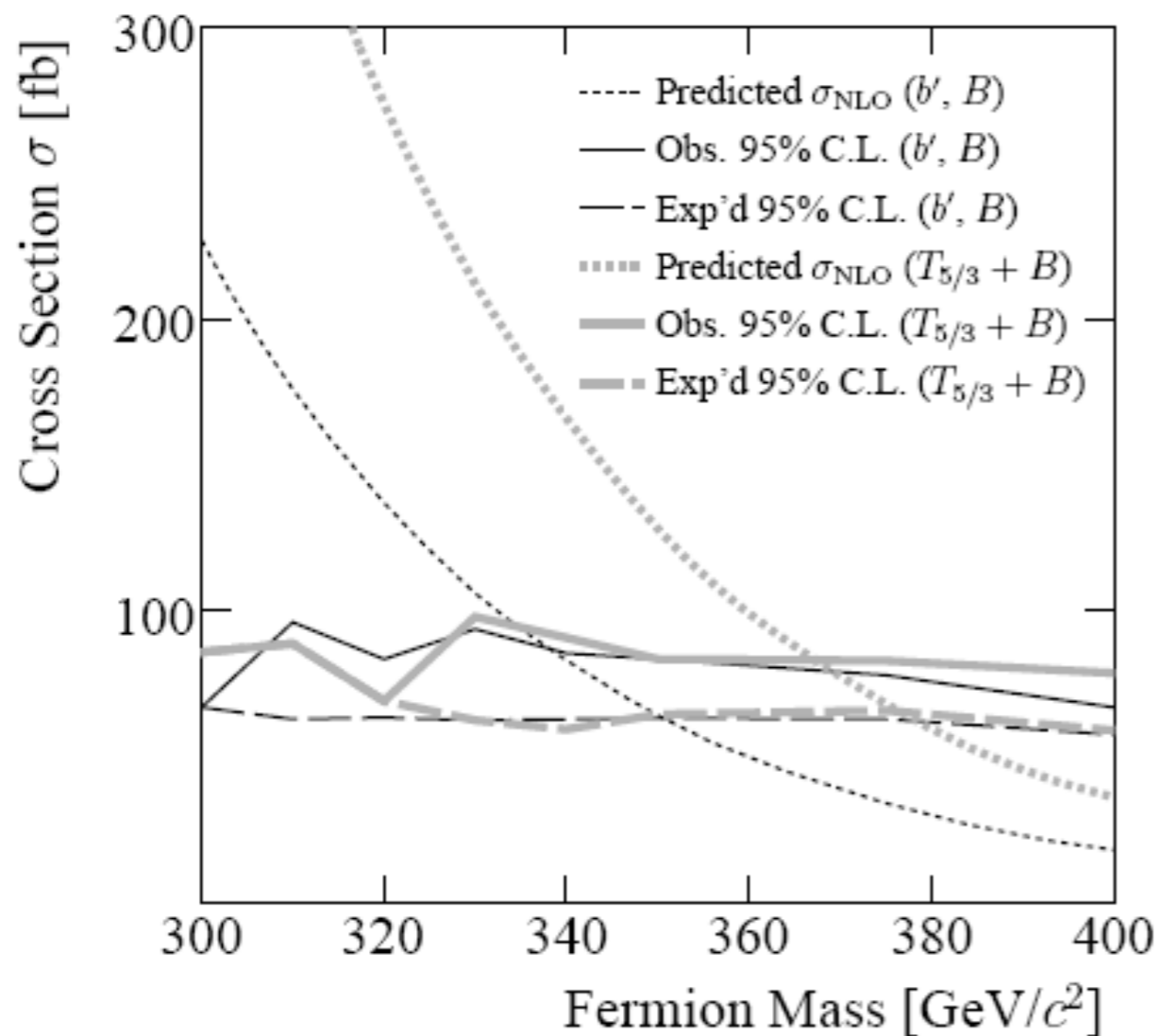
PRL 104, 061801 (2010)



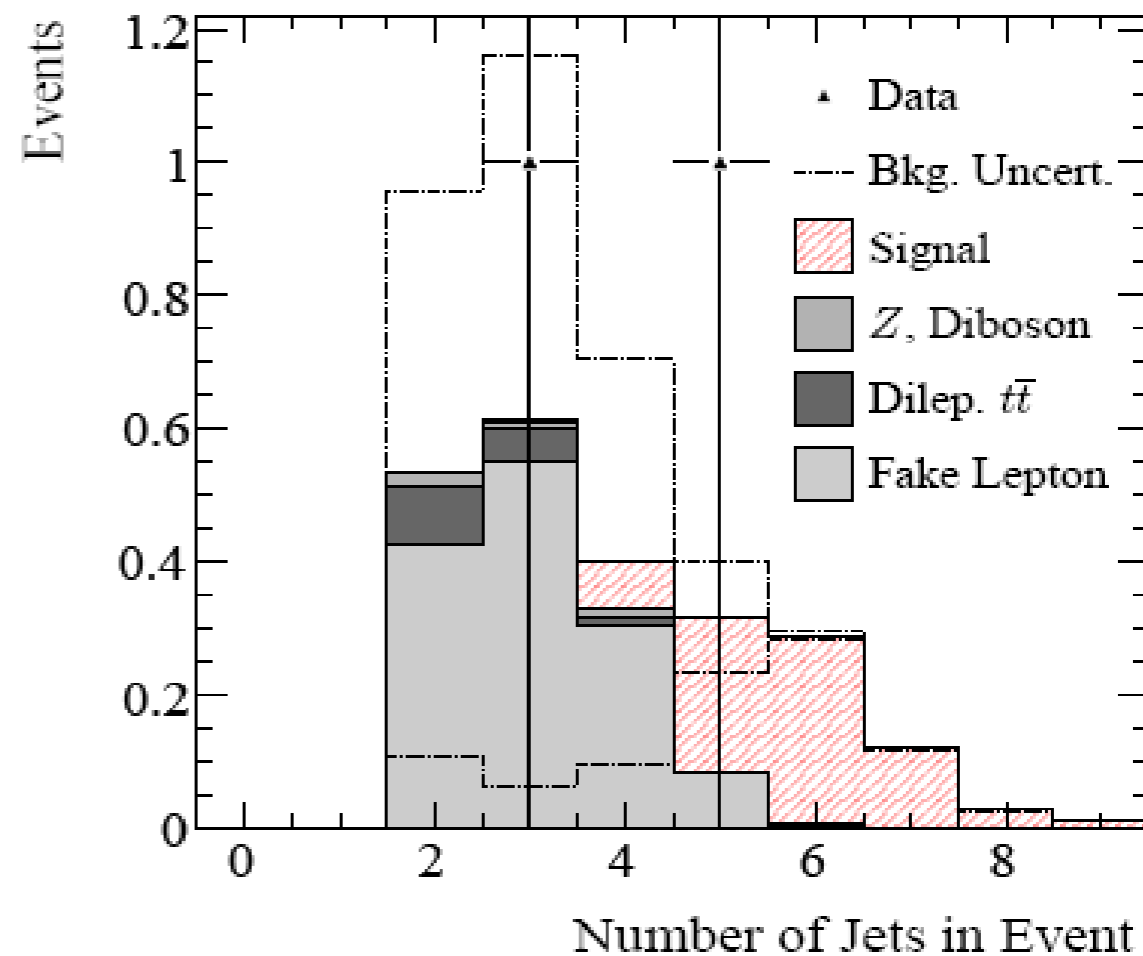
Heavy Fermions

Search for 4th gen b' or composite B and $T_{5/3}$

$Q \rightarrow tW, \bar{Q} \rightarrow \bar{t}W^+$ $l^\pm l^\pm + bj + MET$



arXiv:0912.1057



Data: 2 events, Bgd: 1.6 ± 1.4

$M_{b'}, M_B > 338 \text{ GeV}$

$M_{T_{5/3}} > 365 \text{ GeV}$

Submitted to PRL

Just a sampling of NP Searches at Tevatron

LHC era approaches rapidly!

However – Tevatron still has work to do
Potential for discovery still there

