New Phenomena and Higgs Searches at DØ

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SuperSYmmetry

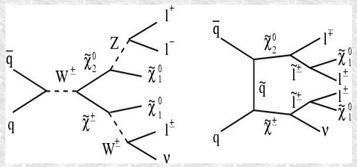
(spin1/2) quark , lepton ↔ (spin 0) *squark , slepton*

(spin1) gauge boson ↔ (spin ½) *chargino , neutralino , gluino*

Chargino (χ^+), *Neutralino* (χ^0) searches : looking for fermionic partners of Standard Model Gauge- & Higgs-Bosons

Preferred signature :
2 leptons + 1 track + Missing Et

Trilepton searches

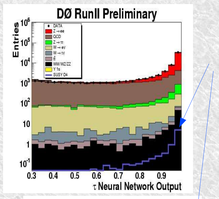


6 final states explored :
eμl, eel, μμl, μ⁺μ⁻l, μτl, eτl

Reconstruction

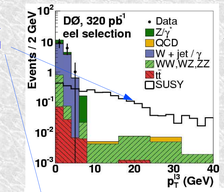
Signal selection

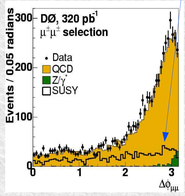
τ_h in the eτl channel



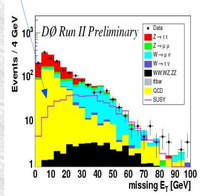
SUSY signal

Key 3rd track in the eel channel





Δφ(lepton,lepton) in the μ⁺μ⁻ channel

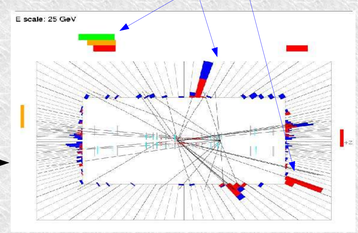


Missing Et in the μτl channel

Main common cuts :

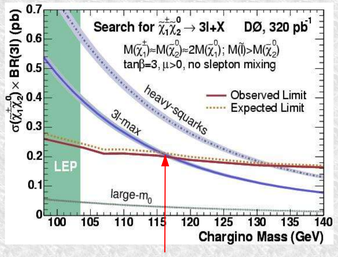
Δφ(lepton,lepton) < 2.7
Missing Et > 22 GeV
Jet Veto
p_T(3rd lepton) > 3 GeV/c
Met . P_T(3rd lepton)>150

Trilepton event ?



μ τ lepton

Result



Lower limit on *Chargino* mass

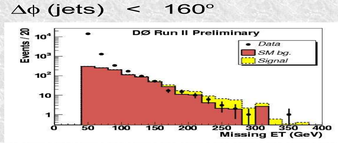
Chargino searches in other SUSY models

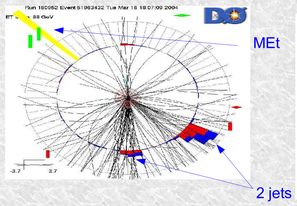
Model	Final State	Data	Hypothesis	Results
GMSB Neutrakino NLSP Prompt decays	γγ	263pb-1		195 < M(χ⁺)
RPV Sugra λ_{122} coupling	μμ l, eel eeτ	160pb-1	μ > 0 : μ < 0 :	165 < M(χ⁺) 160 < M(χ⁺)
AMSB	Stable Charginos	390pb-1	Chargino : stable : Higgsino-like : Gaugino-like :	140 < M(χ⁺) 174 < M(χ⁺)

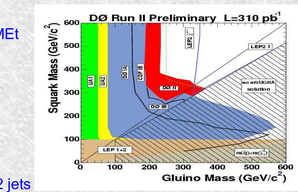
Squark, Gluino searches : looking for scalar/fermionic partner of Standard Model light quarks/gluon

Selections :	Expected background	Expected Signal	Events
Dijet	12.8 ± 5.4	7.6 ± 0.4	12
"Gluino" Jets > 4	7.1 ± 0.9	9.3 ± 0.5	10
3 jets	6.1 ± 3.1	9.6 ± 0.5	5

Dijet selection :
Missing Et > 40 GeV
$H_T = \Sigma P_T$(jets) > 40 GeV
Δφ (jets) < 160°





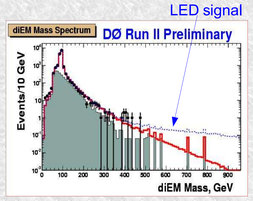


Large Extra Dimensions

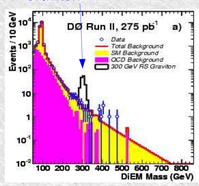
Standard Model particles : confined to 3D membrane
→ "Revealed" at high energies
→ Gravity : "diluted" in other dimensions; Planck scale reflects this dilution

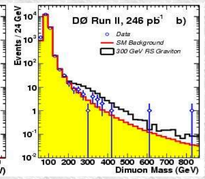
Signature : 2 very high Pt leptons, photons via *graviton* exchange

LED signal

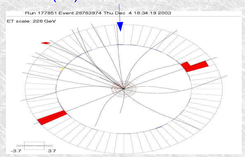


Randall-Sundrum Graviton





LED candidate ?
M(ee) = 475 GeV/c²



→ Combined with RunI limit :
Lower 95% CL limit on the fundamental Planck scale : 1.43 TeV

Leptoquarks :

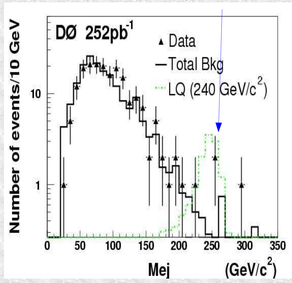
6 quarks, 6 leptons → 6 parent *leptoquarks* ?

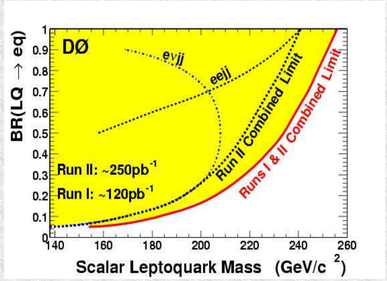
LQ LQ → q l q l
jet jet (e,μ) (e,μ)
jet jet (e,μ) ν

jj ee analysis :
$S_T = \Sigma P_T$(jets,leptons) > 450 GeV
Z veto

jj e MEt analysis :
Missing Et > 30 GeV
$S_T = \Sigma P_T$(jets,lepton,MEt) > 330 GeV
Transverse Mass (lepton,MEt) > 130 GeV

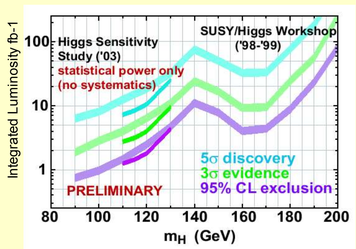
Leptoquark signal



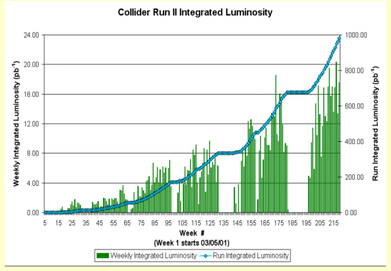


Higgs Searches

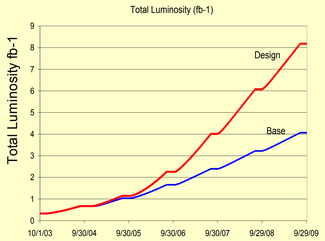
The Higgs mechanism can give masses to the fermions and explain the electroweak symmetry breaking in the standard model.



Amount of luminosity needed for discovery or exclusion, based on the mass of the Higgs boson.



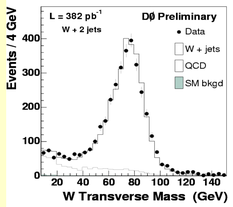
Current Run II Integrated Luminosity delivered by the Tevatron, so far we have taken about 1 pb⁻¹ of data.



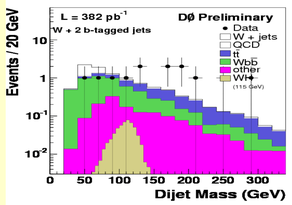
The base line is the minimum amuont of luminosity expected to be delivered by the Tevatron. We expect to have up to 8 fb⁻¹ by the end of 2009.

Search in WH→eν+bb̄ channel

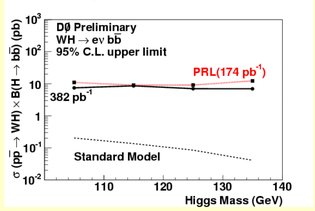
After gluon fusion, the next largest Higgs production cross section is the creation of the Higgs boson in association with the W boson. The signal is one high pT isolated electron, two b jets, and large missing transverse energy.



The transverse mass of the W boson before requiring jet b tagging.



Dijet mas of two b-tagged jets with the largest contributon from Wbb and top. Also shown is the expected Higgs signal of m_H = 115 GeV.

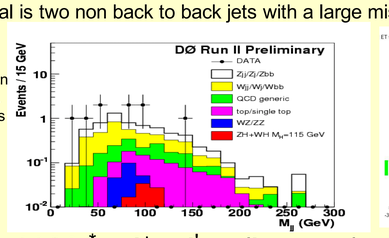


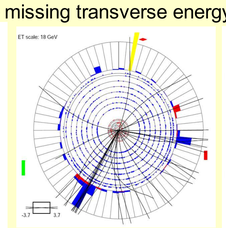
The production cross section times branching ratio is less than 7-9 pb for a Higgs mass range of 105 to135 GeV.

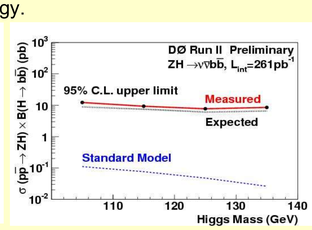
Search in ZH→ν ν + b b̄

The large branching ratio of Z boson to two neutrinos makes this channel one of the most sensitive ways to search for the Higgs boson. The signal is two non back to back jets with a large missing transverse energy.

The invariant mass distribution of the two jets after b-tagging. The largest background is jets being produced with the Z boson.



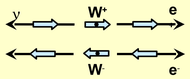


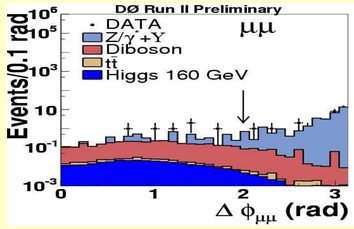


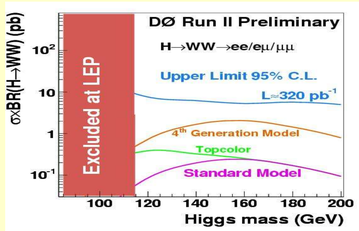
Search in H→WW*→l⁺ ν l⁻ ν (l = e,u) decays

Three decay channels are investigated e⁺e⁻, e±u±, u⁺u⁻. The signal is two leptons plus a large missing transverse momentum.

The $\Delta\varphi_{ll}$ is an important cut for discriminating the Higgs signal from the background, since the Higgs is a spin 0 particle. The largest background after this cut is SM WW production.

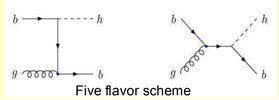


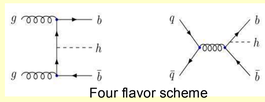


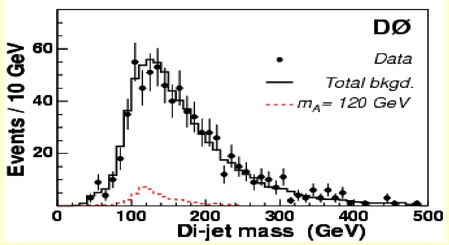
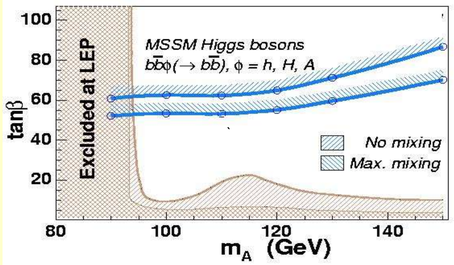


Search for Super Symmetric Higgs in hb / hbb

This analysis is sensitive to tan β of 50 - 100 and the signal is 3 or more b-tagged jets in 260 pb⁻¹ of data. Backgrounds are Z+jets->bb+jets, Zb, and tt.







Invariant mass of the 2 leading b-tagged jets in 3 or more b-tagged events. h,H, and A masses cannot be distinguished due to b jet resolution.