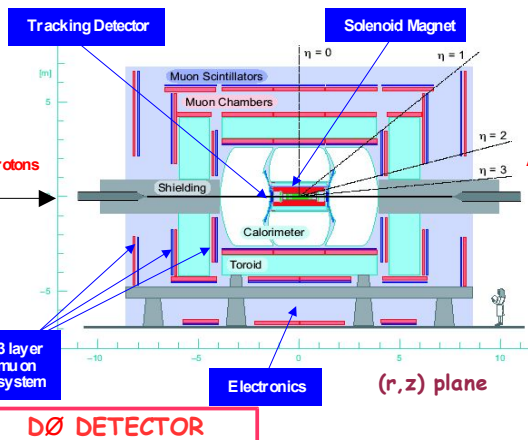


Search for a Doubly-Charged Higgs Boson in Muon Final States at DØ in Run II at $\sqrt{s} = 1.96$ TeV



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Total integrated luminosity used $L = (113 \pm 7) \text{ pb}^{-1}$



Submitted to Physics Review Letters, hep-ex/0404015

The first H^{++} search at hadron colliders. It extends the range of sensitivity for L-handed H^{++} decaying into muons

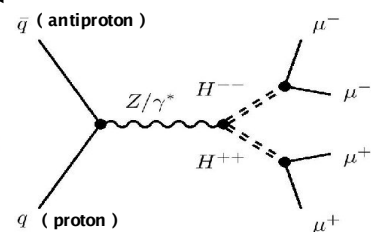
THEORY
 H^{++} appears in: Left-right symmetric, Little-Higgs and Higgs Triplet models.

complex $Y=|2|$ triplet Higgs representations

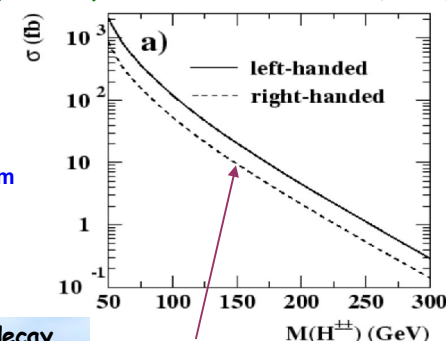
- * Smallness of left-neutrinos masses explained via seesaw mechanism
- * new phenomena: neutrinoless double β -decays, $\mu \rightarrow 3e$ and $\mu \rightarrow e\gamma$ decays, muonium-antimuonium conversions, etc.

Phenomenology of H^{++} is governed by its couplings:

- (1) trilinear couplings $W^+W^+ \rightarrow H^{++}$ are **not present**
- (2) **no** H^{++} decays to hadrons
- (3) $Z/\gamma \rightarrow H^+H^{++}$ are present
- (4) $H^{++} \rightarrow l^+l^+$ (lepton-number-violating)



NLO cross section for H^{++} production
M. Spira, Phys. Rev. D68, 117701, (2003)

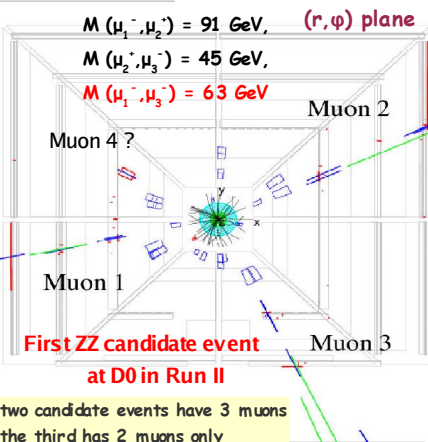


Same-sign lepton decay modes provide a clean experimental signature!

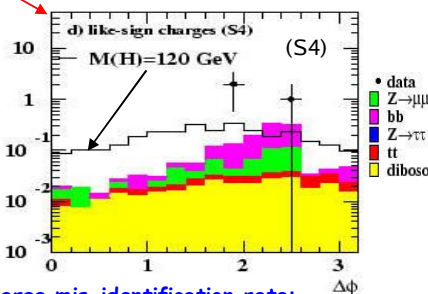
R-handed H^{++} cross section is smaller by a factor of ~ 2 due to a different coupling to Z.

Event Selection: $S1 \rightarrow S2 \rightarrow S3 \rightarrow S4$

Run 175670 Event 49640736



two candidate events have 3 muons the third has 2 muons only



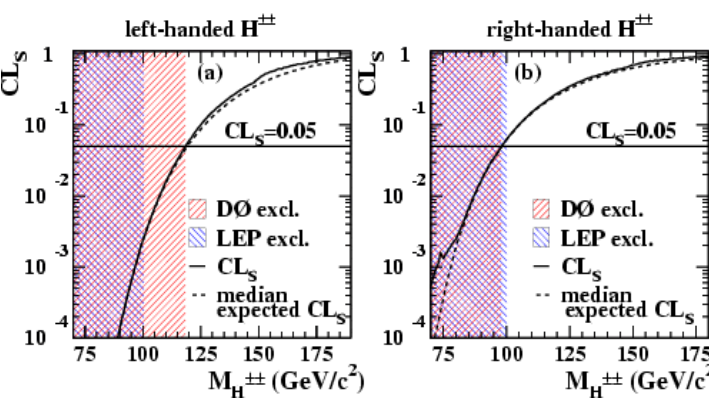
Charge mis-identification rate:
- 0.45 events (expected)
- one data event might qualify as charged mis-identified

LIMIT CALCULATION

MCLIMIT program

T. Junk, NIM A434, 435, (1999)

- mass distribution of signal, background and signal mass resolution considered
- modified frequentist approach
- Confidence Level for signal: $CL_S = CL_{S+B} / CL_B$
- signal plus bkgd is excluded at 95% CL if $CL_S < 0.05$
- systematic uncertainty taken into account

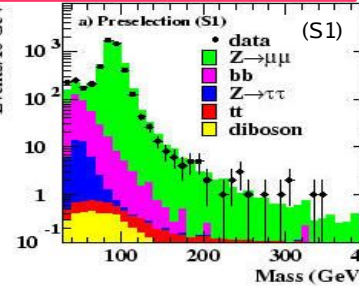


LEP limits are improved by ~ 18 GeV for L-handed H^{++}

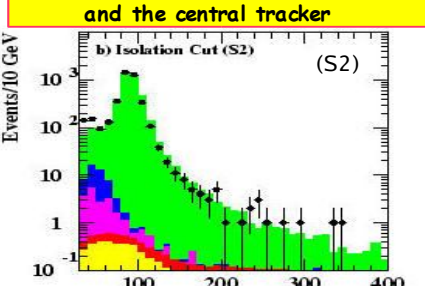
FINAL RESULTS

$M(\text{L-handed } H^{++}) > 118.4 \text{ GeV}/c^2$
 $M(\text{R-handed } H^{++}) > 98.2 \text{ GeV}/c^2$
assuming 100% BR into muons

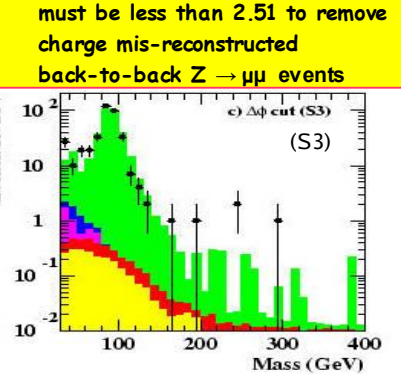
(S1) two muons with $p_T > 15 \text{ GeV}$



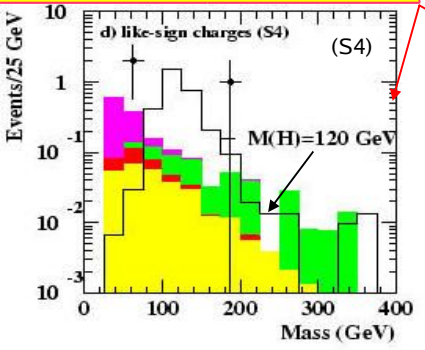
(S2) tracks are isolated in calorimeter and the central tracker



(S3) azimuthal angle phi between muons must be less than 2.51 to remove charge mis-reconstructed back-to-back Z to mu mu events



(S4) two muons must be same-charged



Same-charged di-muon events after S4 :

Data	MC background (sum)	Semi-leptonic b-decays with muons	$Z \rightarrow \mu\mu$	Top pairs	Dibosons
3	1.5 ± 0.4	0.8 ± 0.4	0.3 ± 0.1	0.11	0.28