

Search for Doubly Charged Higgs Pair Production in the Muon Decay Channel at DØ

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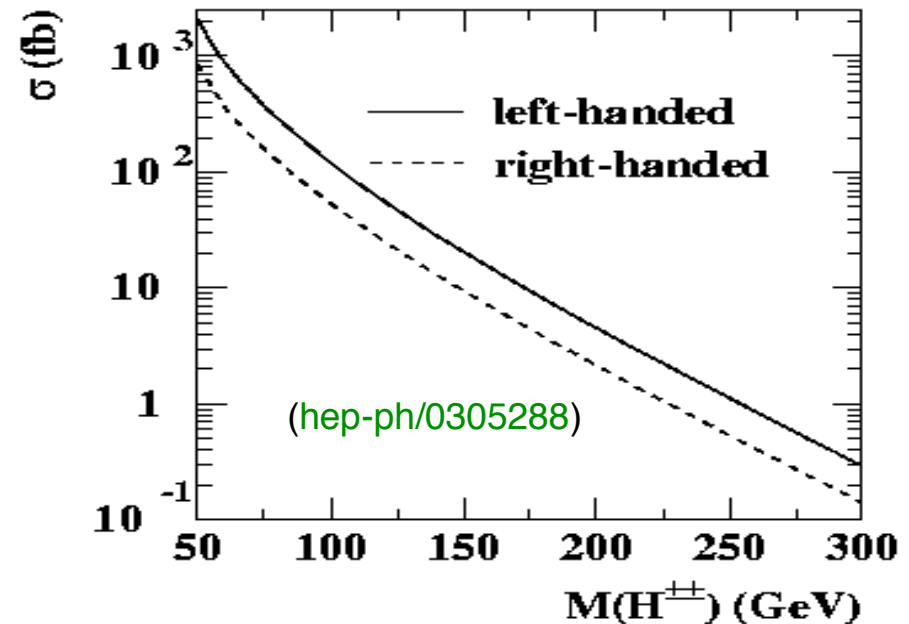
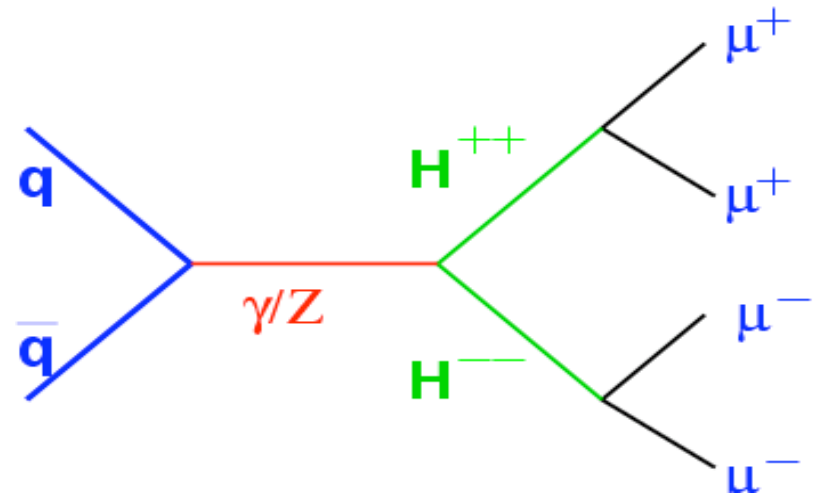


Introduction

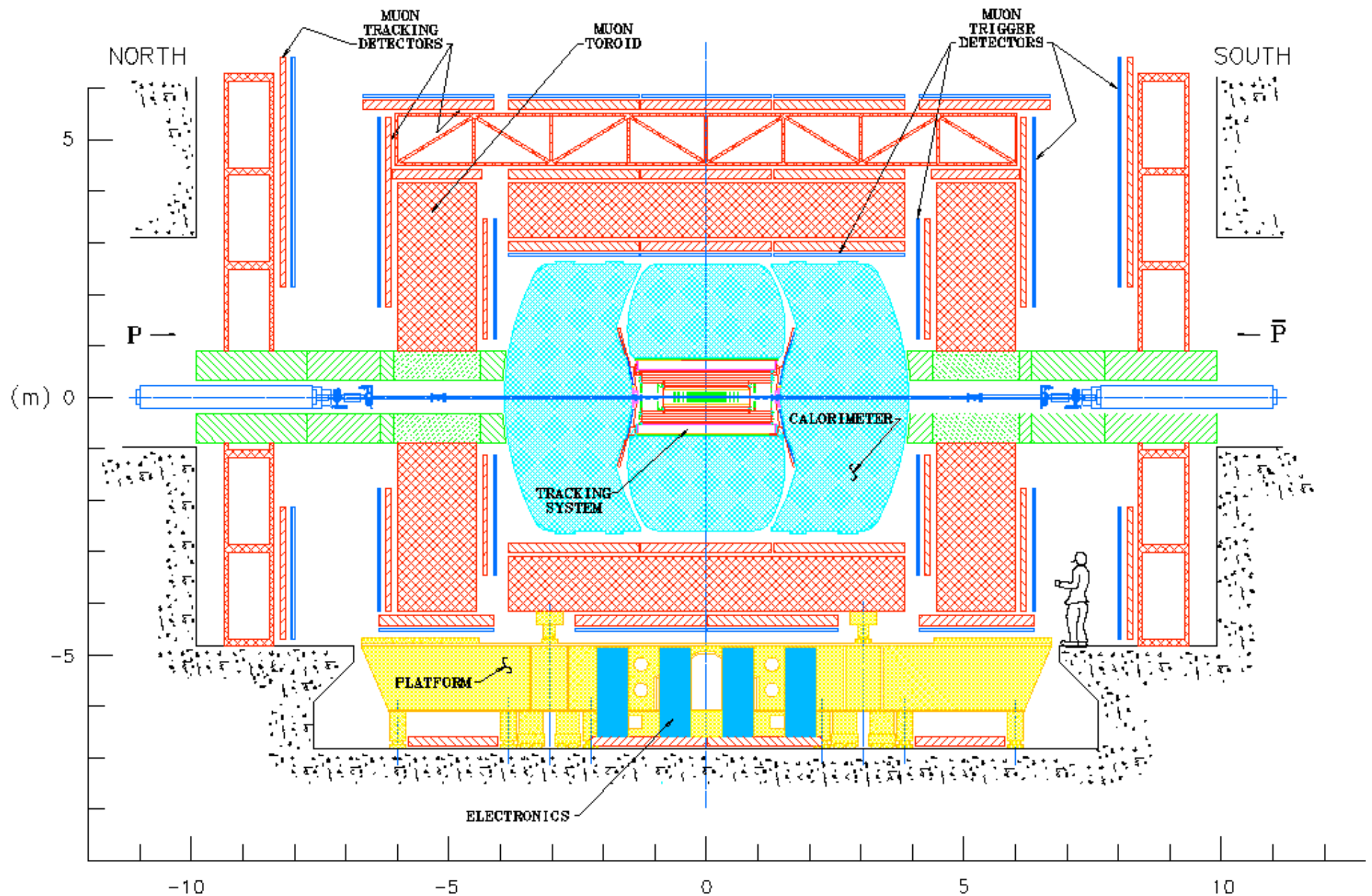
- Many models **beyond SM** predict doubly Charged Higgs bosons
- Some predict dominant decays to four leptons → **Clean signal** for Hadron colliders
- Searches performed at **LEP** set limit **> 100 GeV** (95% CL)
- Present first (published) **Tevatron** result

Production and Decay

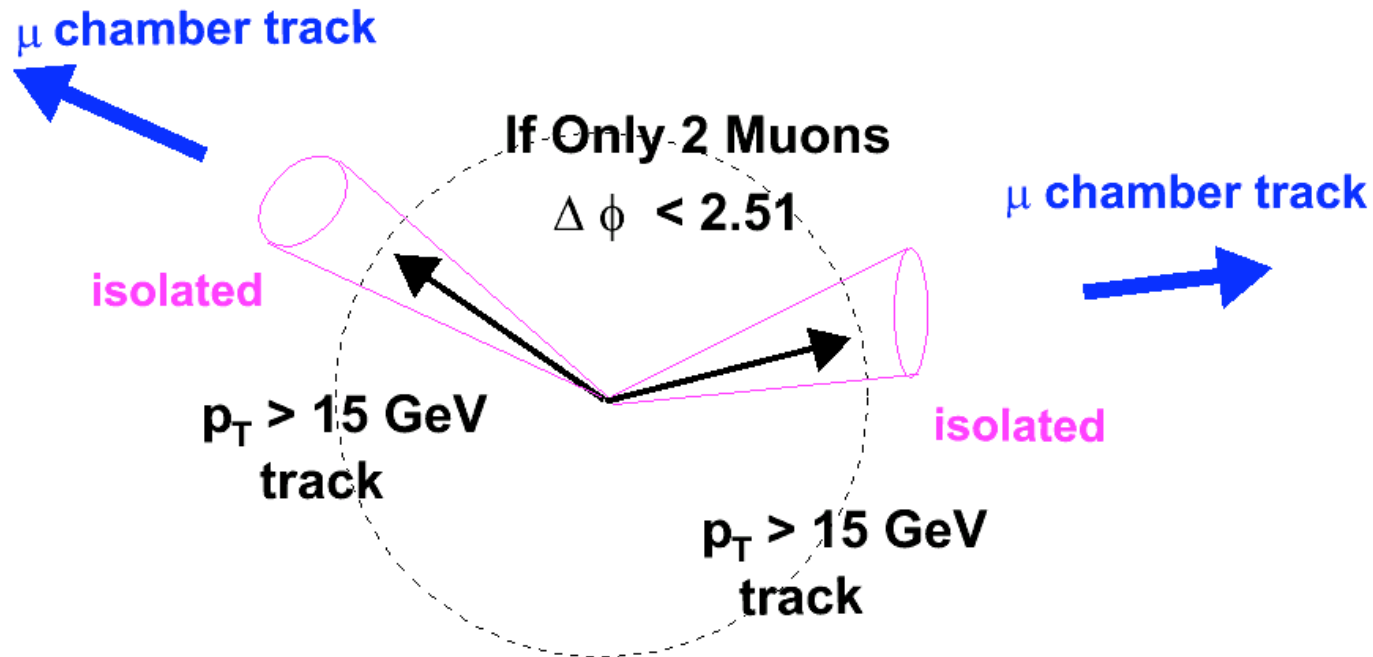
- Produce via Z/γ^* exchange
- Different **couplings** to Z for LH and RH Higgs
- Assume (100%) decay to muons
- Some low E limits on Yukawa coupling to muons (~ 0.1)



DØ Detector



Event Selection



2+ Muons

At least two with same sign

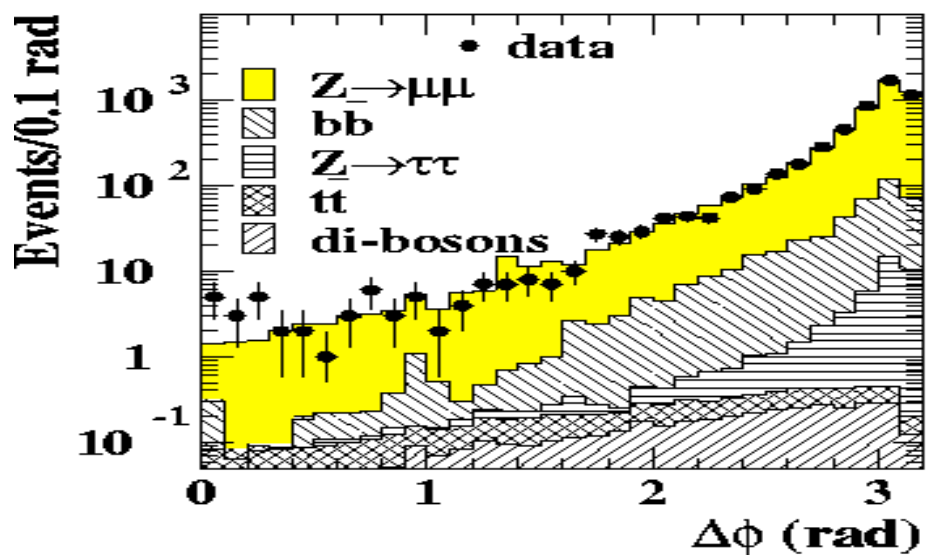
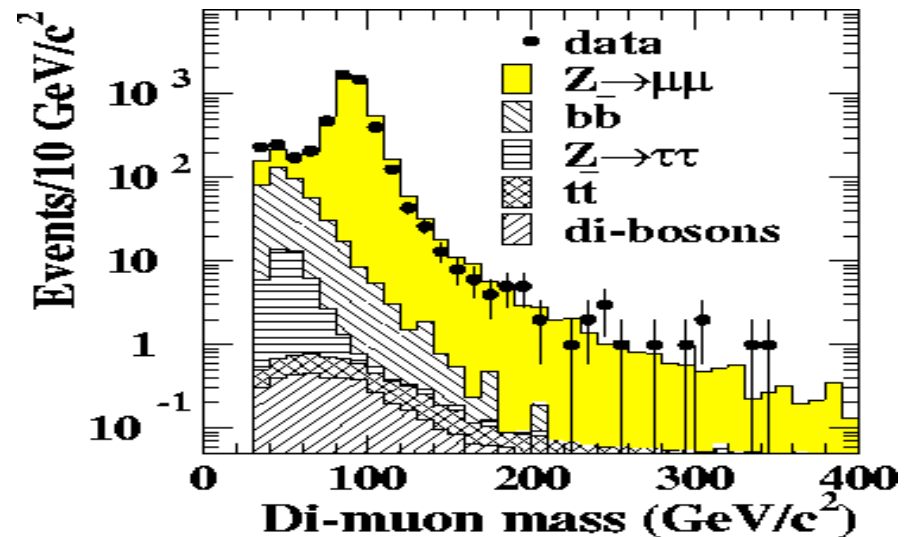
Fire di-muon trigger

Timing cuts remove cosmics

3 candidate Events in 113pb^{-1}

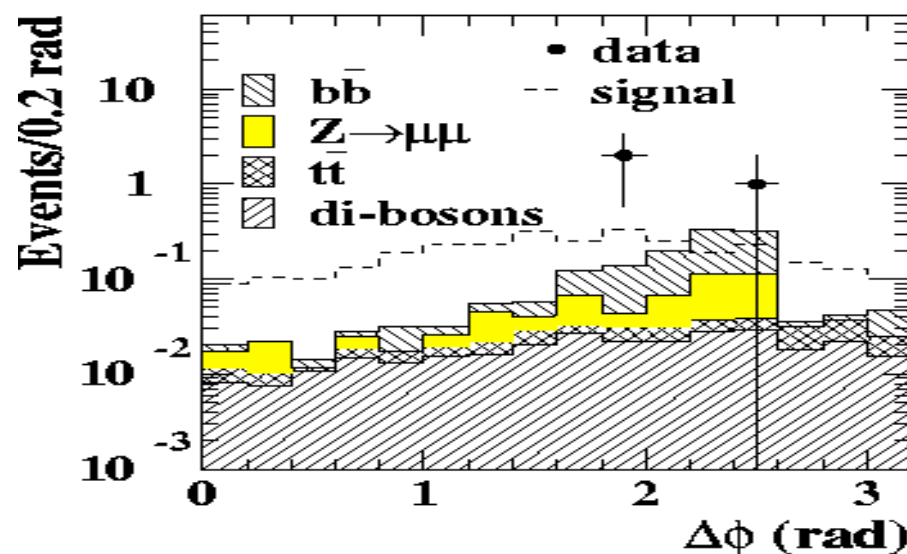
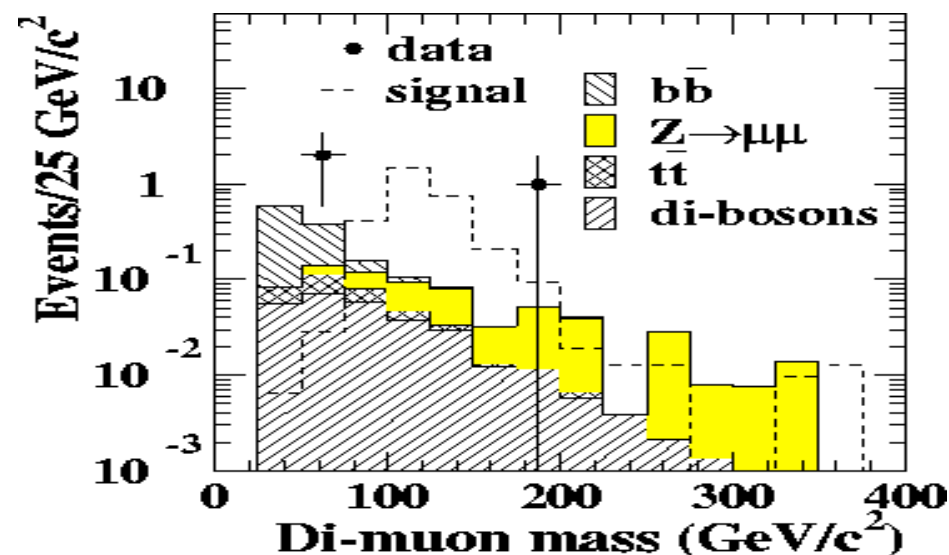
Efficiencies

- **Acceptance** from Pythia + GEANT based simulation (**75%**)
- **ID** and **trigger** Efficiencies from $Z \rightarrow \mu\mu$ data (**tag and probe**)
- Total efficiency is $47.5 \pm 2.5\%$



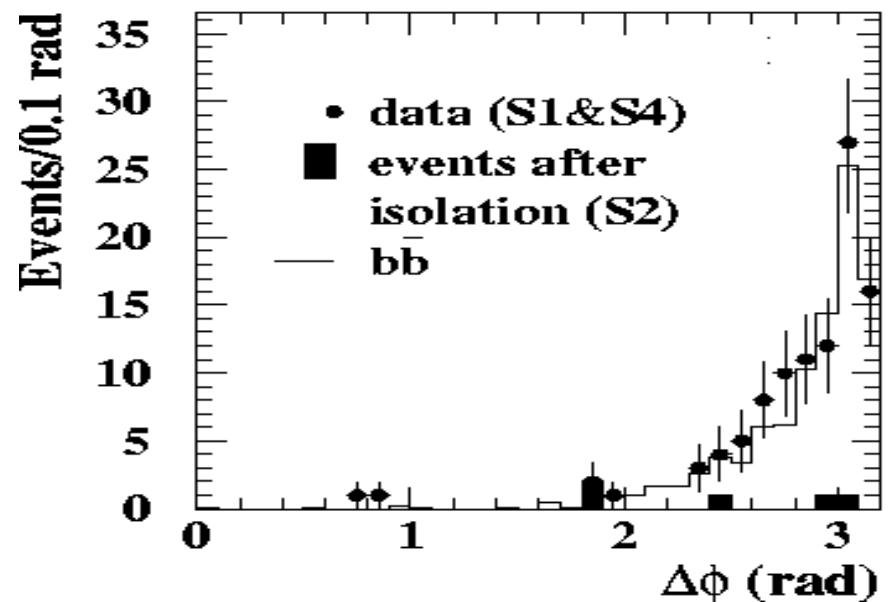
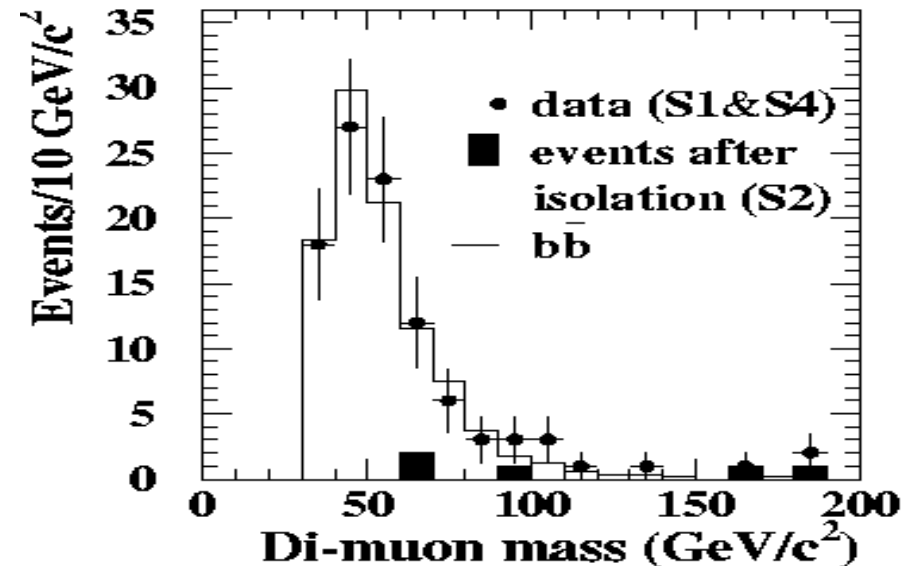
Backgrounds

- Evaluate all with MC
- Dominant from bb (like sign from mixing) 0.8 ± 0.4
- Also contributions from $Z \rightarrow \mu\mu$ with charge mis-ID (0.3 ± 0.1), di-boson & tt 0.39 ± 0.03
- Total background expected 1.5 ± 0.4



BB Backgrounds

- Estimate using **Pythia** + **GEANT** based MC
- **Normalise** using cross section from DØ Run I
- Large uncertainty (40%) on this
- Loosen cuts to **enhance $b\bar{b}$** and **compare**



Dominant Sources of Uncertainty

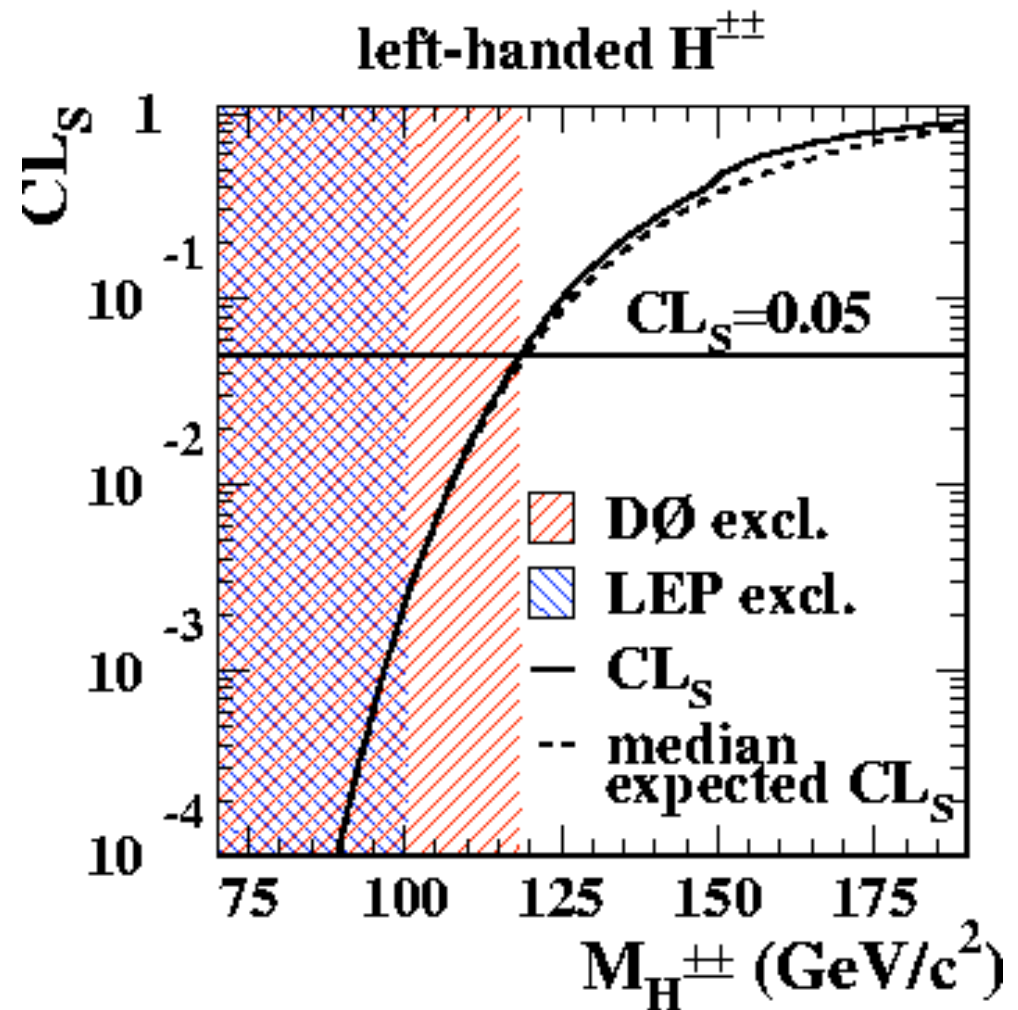
- Dominant uncertainty from the Monte Carlo (27%) due to uncertainty in bb cross section and limited stats
- Uncertainty on NLO $H^{\pm\pm}$ production 10%
- Uncertainty on Luminosity 6.5%
- Uncertainty on Efficiency 5% (muon ID)
- Inclusion of these reduces limit by ~ 1 GeV

Limit Setting

- Use **MCLIMIT** program
- Calculate conf level for bkgd (CL_B) and for signal + bkgd (CL_{S+B}) as functions of mass
- conf level for signal

$$CL_S = CL_{S+B} / CL_B$$

- Limits **118.4** and **98.2** GeV for LH and RH



Conclusions

- $DØ$ has performed a search for doubly charged higgs bosons in the muon channel using 113 pb^{-1}
- The number of candidates is consistent with no signal
- Can set limits of 118.4 and 98.2 GeV for LH and RH $H^{\pm\pm}$ respectively
- Compare to LEP result (100.4 and 100.1 GeV)