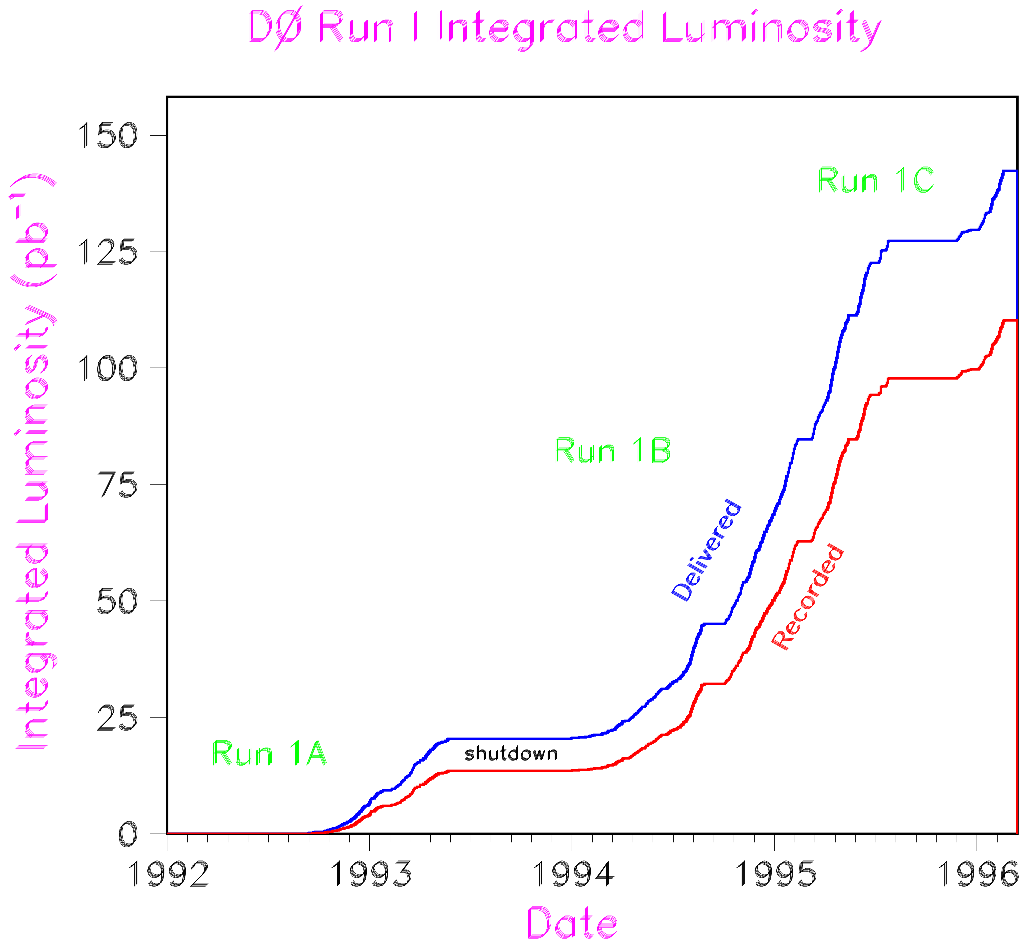
DØ Results on *W* Boson Properties

Kathleen Streets

New York University

Hadron Collider Physics 97
Stony Brook
5 June 1997

- **W and Z Production**
- **W Mass**



⇒ 1992-1993: **Run 1A,** $\mathcal{L} \approx 15\ pb^{-1}$

⇒ 1994-1995: **Run 1B,** $\mathcal{L} \approx 89\ pb^{-1}$

Inclusive W and Z Production

$$\Longrightarrow \quad p\bar{p} \rightarrow W + X \qquad p\bar{p} \rightarrow Z + X$$

$\Longrightarrow$ **detect W and Z via their leptonic decays**

$\star$ **cleaner signature & lower background**

- $W \rightarrow e\nu, \mu\nu, \tau\nu$
- $Z \rightarrow ee, \mu\mu$

For the e and μ channels, trigger on events with:

$\Rightarrow$ **high p_T lepton + large $\not\!\!E_T$ (W)**

$\Rightarrow$ **2 high p_T leptons (Z)**

Analyses:

$\star$ $\sigma\cdot$ **BR $\rightarrow$ provides fundamental test of SM**

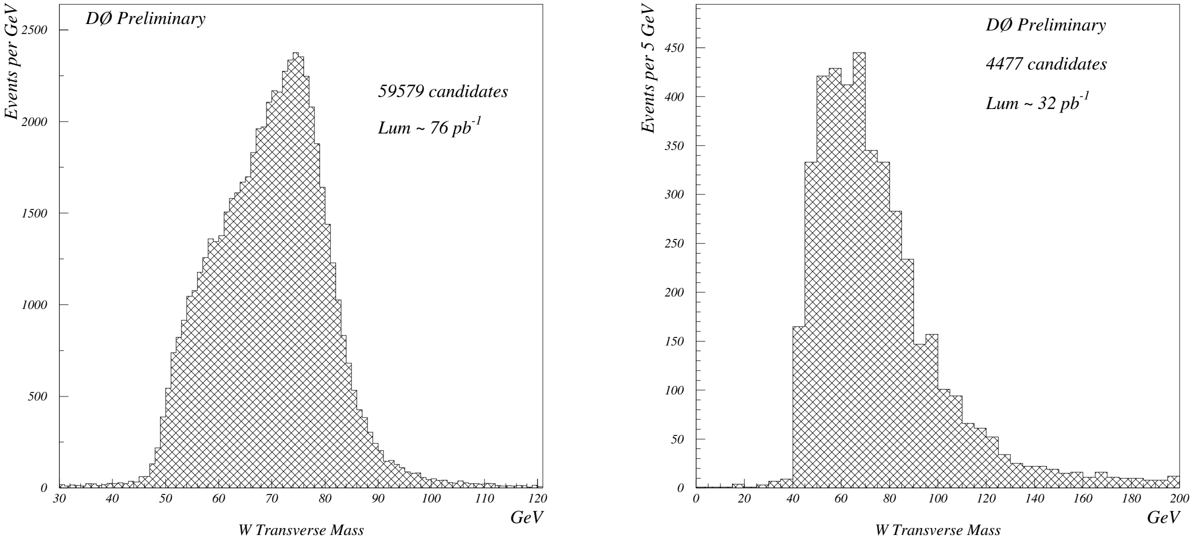
$\star$ Γ_W $\rightarrow$ **limit on unknown decays of W**

$\star$ g_τ^W/g_e^W $\rightarrow$ **measure of lepton universality**

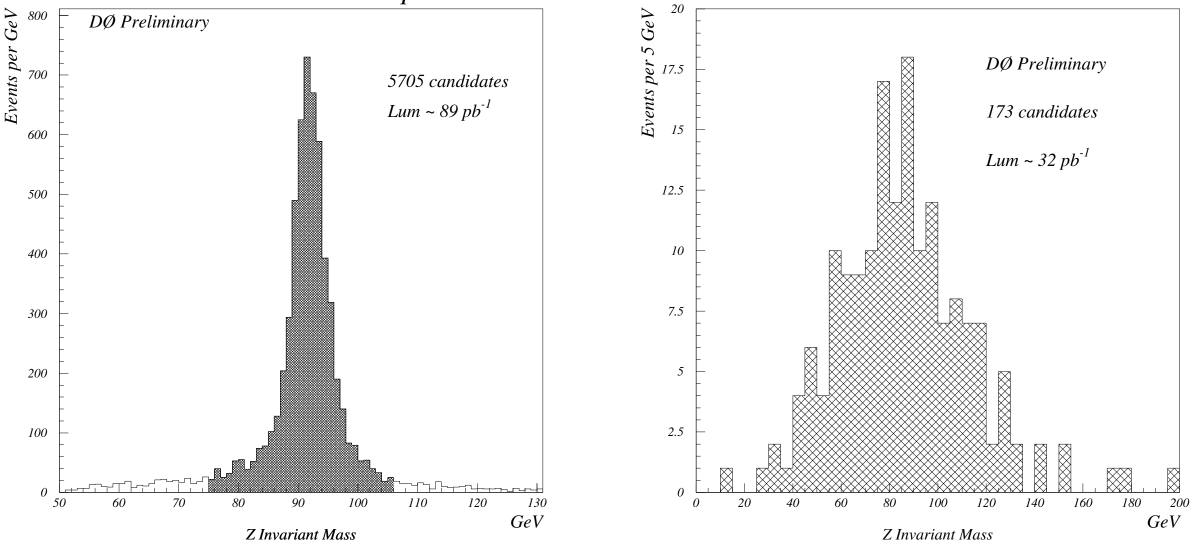
W and *Z* Production Cross Sections

Run 1B, preliminary

Run 1b W → eν Sample



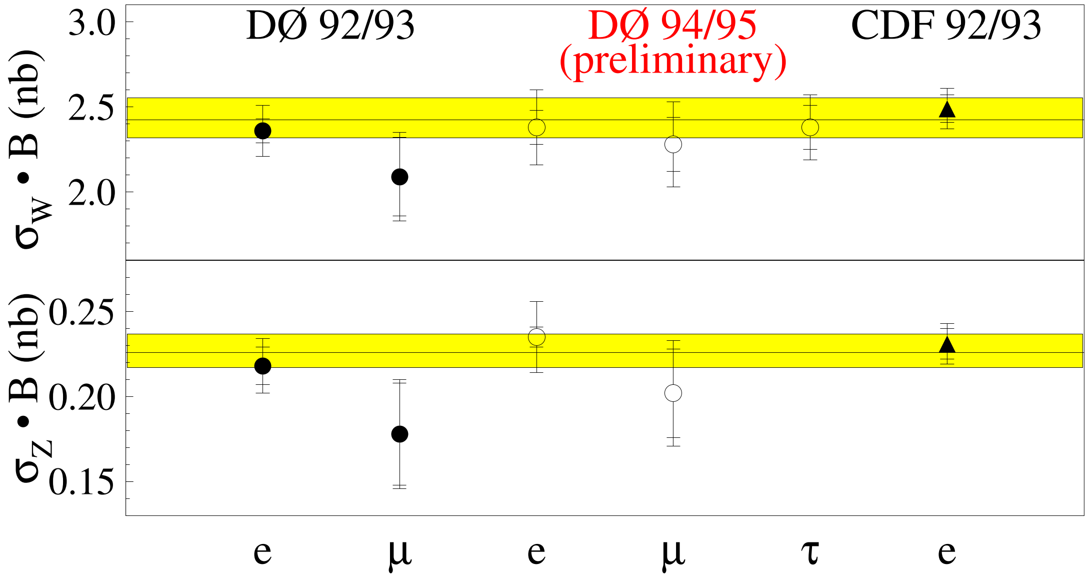
Run 1b Z → ee Sample



Final Event Selection:

- $p_T(e) > 25$ **GeV**, $p_T(\mu, \mu_2) > 20(15)$ **GeV**
- $\not{E}_T > 25, 20$ **for** $W \to e, \mu$ **events**
- $75 < M(ee) < 105\ \mathrm{GeV/c^2}$

W and Z Production Cross Sections



Theoretical Prediction at $\mathcal{O}(\alpha_s^2) \Rightarrow$

- **Hamberg, van Neerven & Matsuura, NP B359, 313; van Neerven & Zijlstra, NP B382, 11**
- **uses CTEQ2M pdf**
- **error dominated by pdf uncertainties**

$\sigma_W \cdot B(W \to e\nu)$	=	2.38	±0.01	±0.09	±0.20 nb
$\sigma_W \cdot B(W \to \mu\nu)$	=	2.32	±0.04	±0.16	±0.19 nb
$\sigma_Z \cdot B(Z \to ee)$	=	0.235	±0.003	±0.005	±0.020 nb
$\sigma_Z \cdot B(Z \to \mu\mu)$	=	0.202	±0.016	±0.020	±0.017 nb
			(± stat)	(± syst)	(± lum)

⋆ **Final Results Soon!**

Cross Section Ratio ⇒ Γ_W

→ **Take ratio - many errors cancel**

$$R = \frac{\sigma_W \cdot B(W \rightarrow l\nu)}{\sigma_Z \cdot B(Z \rightarrow ll)} = 10.32 \pm 0.43$$

→ **Use theoretical calculation of σ_W/σ_Z and LEP measurement of B$(Z \rightarrow ll)$ to obtain B$(W \rightarrow l\nu)$**

$$B(W \rightarrow l\nu) = B(Z \rightarrow ll)\ \frac{\sigma_Z}{\sigma_W}\ R = (10.43 \pm 0.44)\%$$

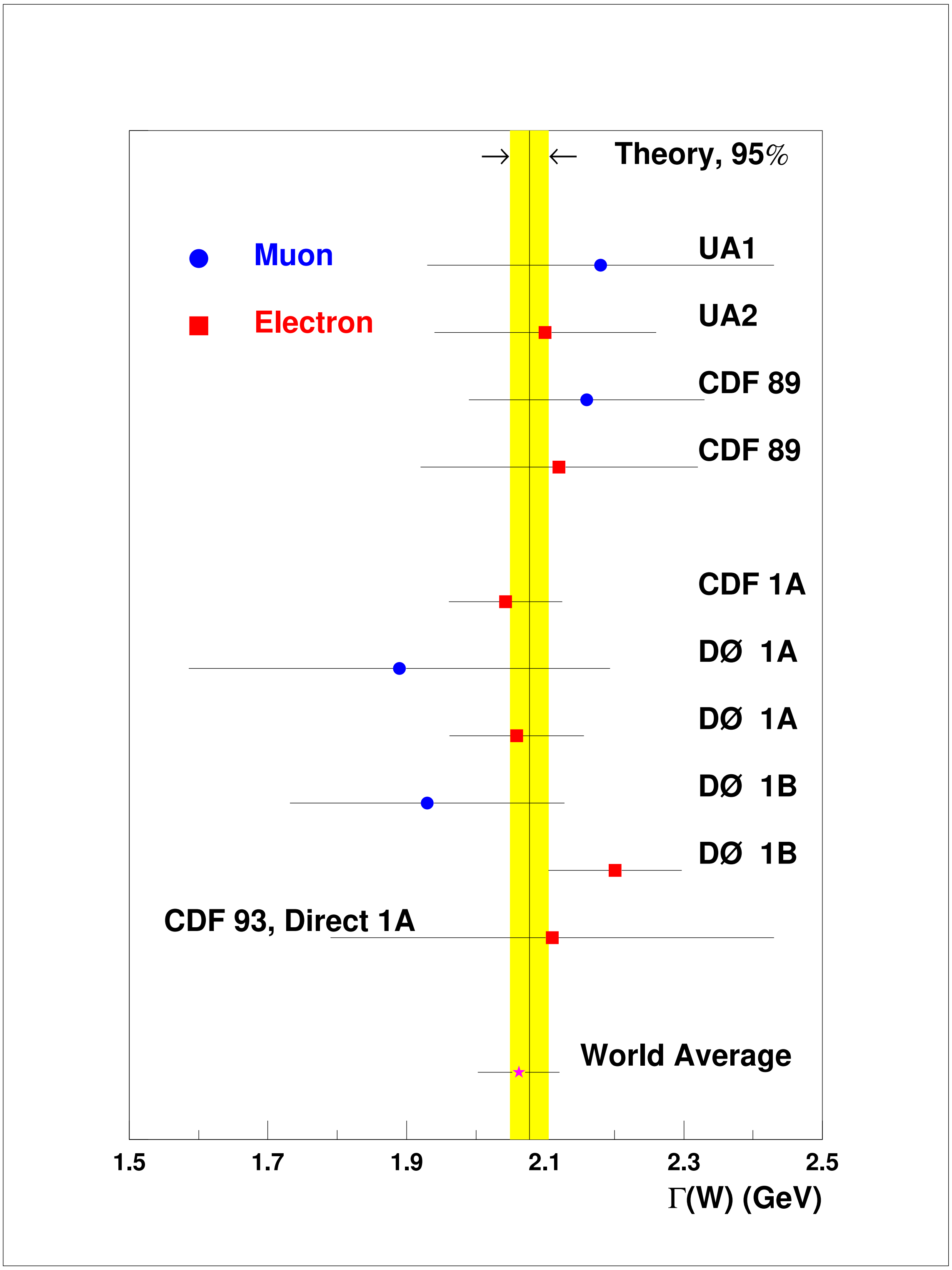
→ **Use theoretical calculation of $\Gamma(W \rightarrow l\nu)$ to obtain Γ_W (Run 1B, preliminary)**

$$\Gamma_W = \frac{\Gamma(W \rightarrow l\nu)}{B(W \rightarrow l\nu)} = 2.159 \pm 0.092 \text{ GeV}$$

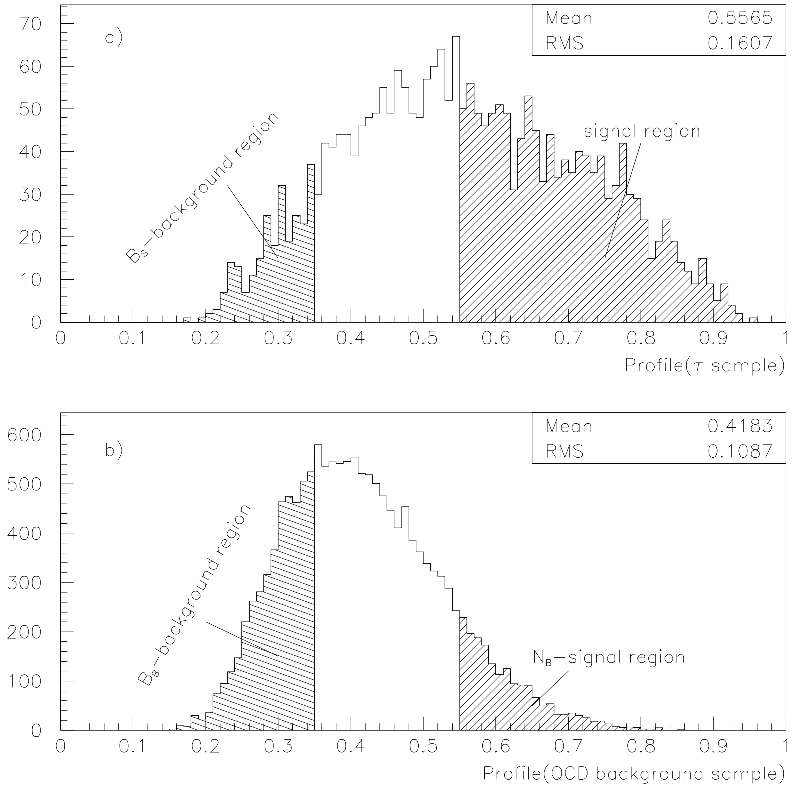
⇒ **Comparison of published world average ($\Gamma_W = 2.062$) with SM prediction ($\Gamma_W = 2.077 \pm 0.014$ GeV) gives limit on unknown decay modes of W ⇒**

95% CL upper limit of $\Delta\Gamma < 109$ MeV on unexpected decays of the W

Γ_W


Theory, 95%
● Muon
■ Electron
UA1
UA2
CDF 89
CDF 89
CDF 1A
DØ 1A
DØ 1A
DØ 1B
DØ 1B
CDF 93, Direct 1A
World Average
1.5
1.7
1.9
2.1
2.3
2.5
Γ(W) (GeV)

$W \rightarrow \tau\nu$ Data Sample



τ Candidate Selection

- **Use hadronic decay of the tau: isolated, narrow jet**
- E_T**(jet)**> 25 **GeV** ($|\eta| < 0.9$), $\not{E}_T > 25$ **GeV**
- **no opposite jet**
- **Isolation: Jet cone** $R = 0.7$, **Jet width:** $rms_{jet} < 0.25$
- **Estimate signal and bkgnd. from profile distribution**
  Profile=(sum of highest two tower E_T**)/(cluster** E_T**)**
  Require Profile > 0.55**(final sample)**

$W \rightarrow \tau\nu$