

1

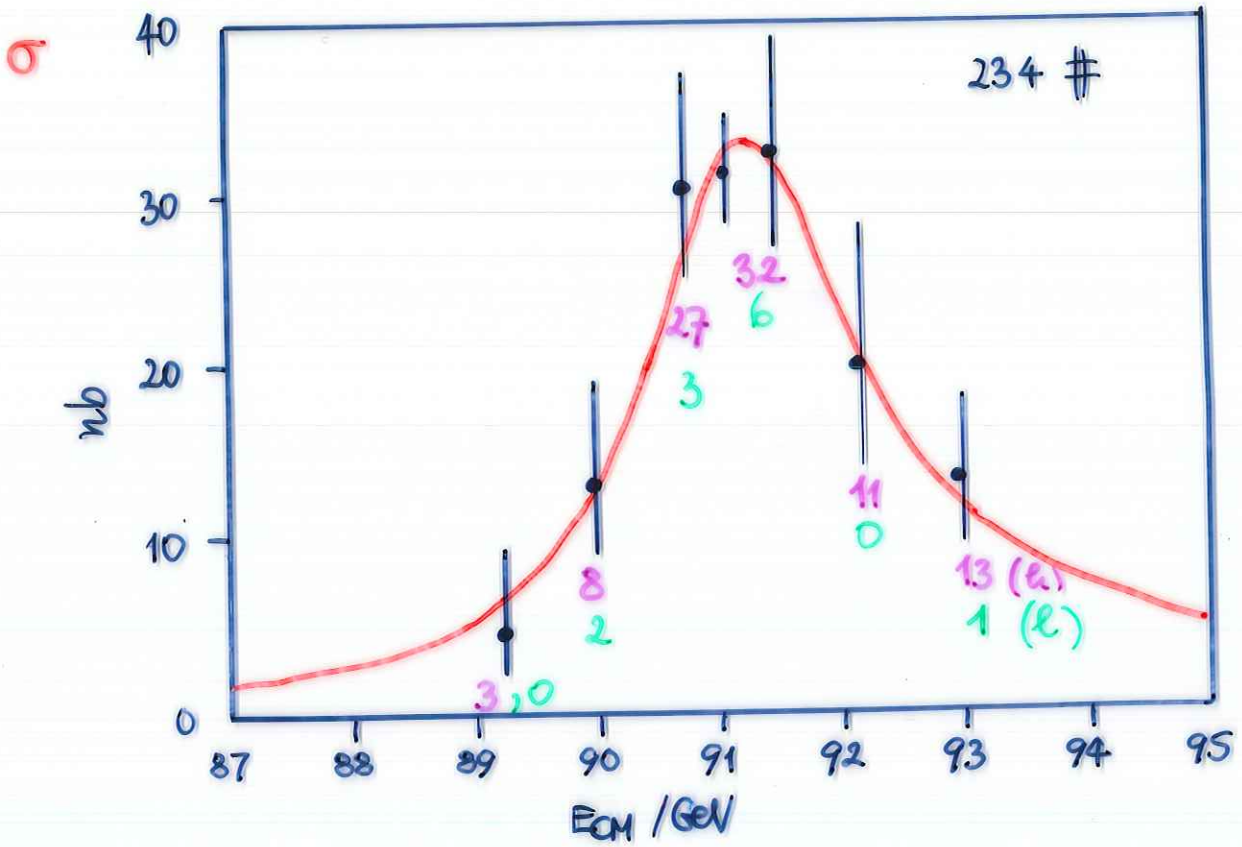
MEASUREMENT OF ELECTROWEAK
PARAMETERS FROM W'S & Z'S
1989

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SEPT. 26 1989

1. COLLIDER RESULTS : UA1, UA2, CDF
2. e^+e^- : SLC & LEP
3. SUMMARY ON WHAT WE KNOW :
 $\sin^2\theta$, M_W , M_Z , Γ_Z , N_f
4. THE TOP QUARK MASS

2. SLC and LEP

MARK 2



$$m_Z = 91.17 \pm .18 \text{ GeV}$$

$$\Gamma_Z = 1.95 \pm .40 \text{ GeV}$$

$$N_\gamma = 3.0 \pm 0.9$$

$$N_\gamma < 4.4 \text{ at } 95\% \text{ C.L.}$$

SLAC

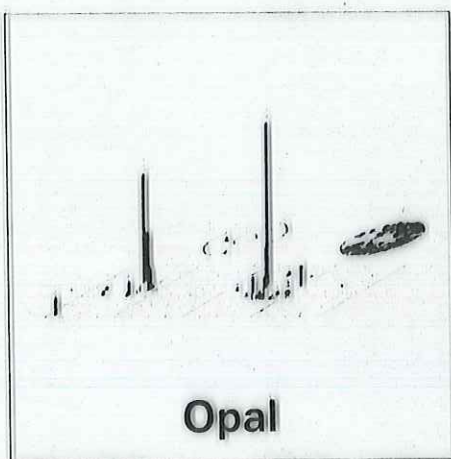
MADRID : $Z \rightarrow q\bar{q}$ 310 (23)
 $\mu^+\mu^-$ 9 (7)
 e^+e^- 13 (11) } no change for m_Z, Γ_Z

$$\mathcal{L} = 10 \text{ nb}^{-1} \rightarrow 13 \text{ nb}^{-1}$$

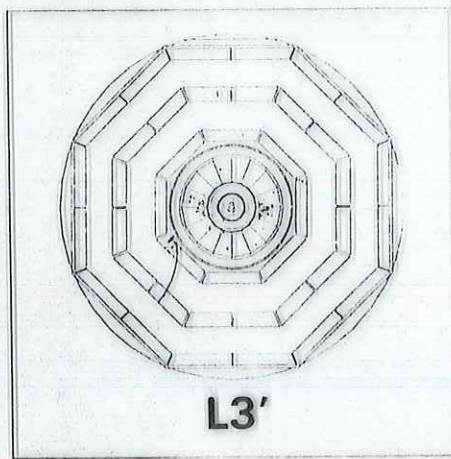
SLAC MADRID

1ST LEP events

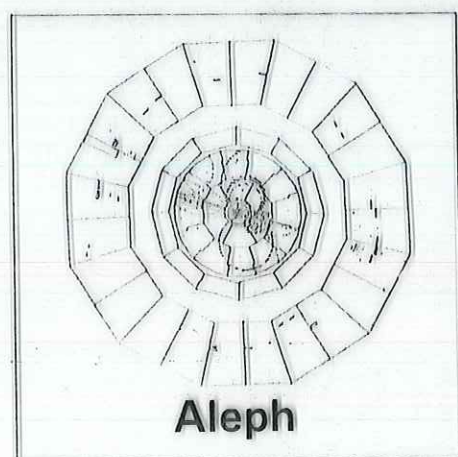
Initial Zs in LEP, as seen by the four detectors.



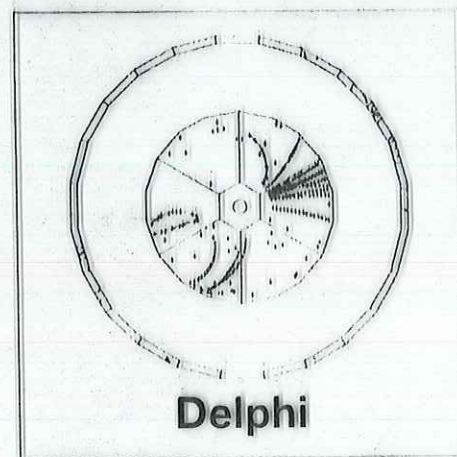
Opal



L3'



Aleph



Delphi

ALEPH

$Z \rightarrow q\bar{q}$	12
$Z \rightarrow e^+e^-$ large δ	2
$Z \rightarrow \tau^+\tau^-$	1
BHABHA	11

} 15 hrs

DELPHI

5 Z 's
1 BHABHA

L3

≥ 1 # (cf. fig.)

OPAL

$Z \rightarrow q\bar{q}$	18
$Z \rightarrow e^+e^-$	2
$Z \rightarrow \tau^+\tau^-$	1
BHABHA	25

NO $Z \rightarrow p^+p^-$
(STAT. ALLOWED).

e^+e^- BELOW LEP/SLC:

$$R = \frac{\sigma(e^+e^- \rightarrow X_Z)}{\sigma(e^+e^- \rightarrow \mu^+\mu^-)}$$

1) BELOW TRISTAN ($< 30 \text{ GeV}/\text{beam}$) PETRA/PEP:

$$M_Z \in [88, 89.4] \text{ GeV}$$

2) TRISTAN

$$M_Z = 88.9 \pm 1.2 \text{ GeV}$$



2σ , not yet significant.

$$M_Z = 91.17 \pm .18 \text{ SLC}$$

3. SUMMARY ON WHAT WE KNOW:

$$M_{W,Z}, \Gamma_Z, N_f, \sin^2\theta$$

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• BEST MEASUREMENTS •

$$\left. \begin{array}{l} M_Z \\ \Gamma_Z \end{array} \right\} \leftarrow \text{MARK II} \quad \text{SLC}$$

$$M_W \leftarrow \text{CDF (UA2)} \quad \text{TEVATRON}$$

GOOD LIMITS ON N_f (m_t of below)

$$\sin^2\theta_W \leftarrow \text{DIS AT CERN \& FNAL} \\ \text{(CHARM II)} \text{ (COLLIDER)}$$

$$M_Z = 91.17 \pm .18 \text{ GeV} \\ \uparrow 180 \text{ MeV !}$$

$$M_W = 80.0 \pm .2 \pm .6 \text{ GeV}$$

$$\sin^2\theta = .234 \pm .004 \pm .005 \\ \uparrow !$$

$$N_f < 3.9 \quad 95\% \text{ CL}$$

$$\text{(WATCH: } \Delta M_Z \\ = M_Z^{\text{Tristram}} - M_Z^{\text{SLC}} \text{)}$$

4. THE MASS OF THE TOP QUARK

i) direct exclusions:

UA1 $m_t > 45 \text{ GeV}$

UA2 $m_t > 67 \text{ GeV}$

CDF $m_t > 77 \text{ GeV}$ (or $m_t < 33 \text{ GeV}$) 95% CL.

TRISTAN $m_t > 33 \text{ GeV}$

SLC $m_t > 40.7 \text{ GeV}$

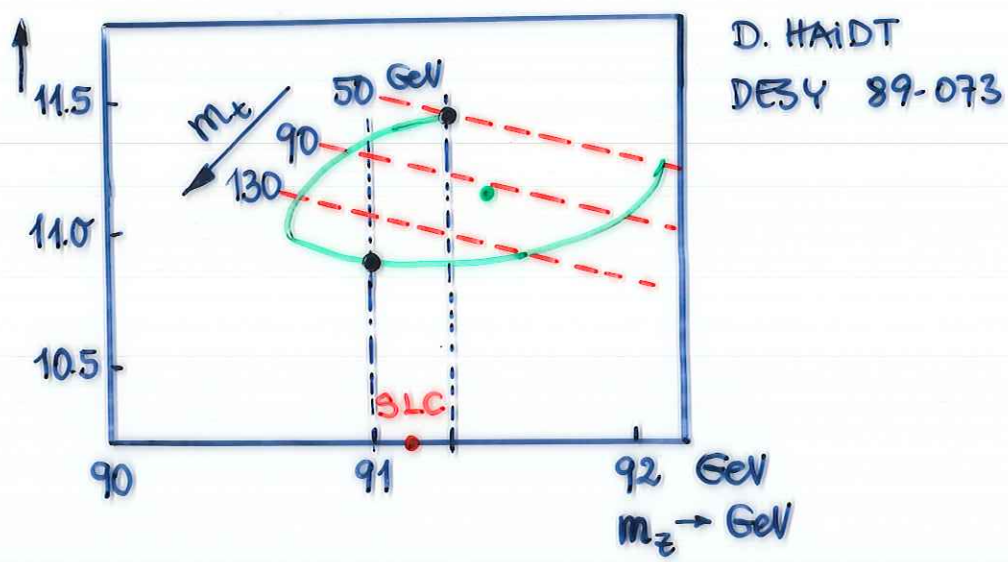
ii) FIT FROM ALL ELECTROWEAK DATA : SM : $SU_{2L} \times U_1$

$$M_W = \frac{37.281 \text{ GeV}}{\sin^2 \theta_W} \sqrt{1 - \Delta r(\alpha, G_F; m_t; m_H; \dots)}$$

↑ ↑ ↓

$= 1 - \frac{M_H^2}{M_Z^2}$

$$m_t \pm \delta m_t$$



LANGACKER: $m_t = 140 \pm 50$ GeV 1σ
 J. ELLIS et al: $m_t = 130 \pm 50$ GeV 1σ
 ↑ includes SLC result.

iii) OTHER HEAVY PARTICLES:

- b' : UA1 $m_{b'} > 41$ GeV
- UA2 $m_{b'} > 53$ GeV 35% CL
- SLC $m_{b'} > 45$ GeV ($b' \rightarrow b\gamma$)

- L^0 : SLC $m_{L^0} > 40$ GeV >50% CL