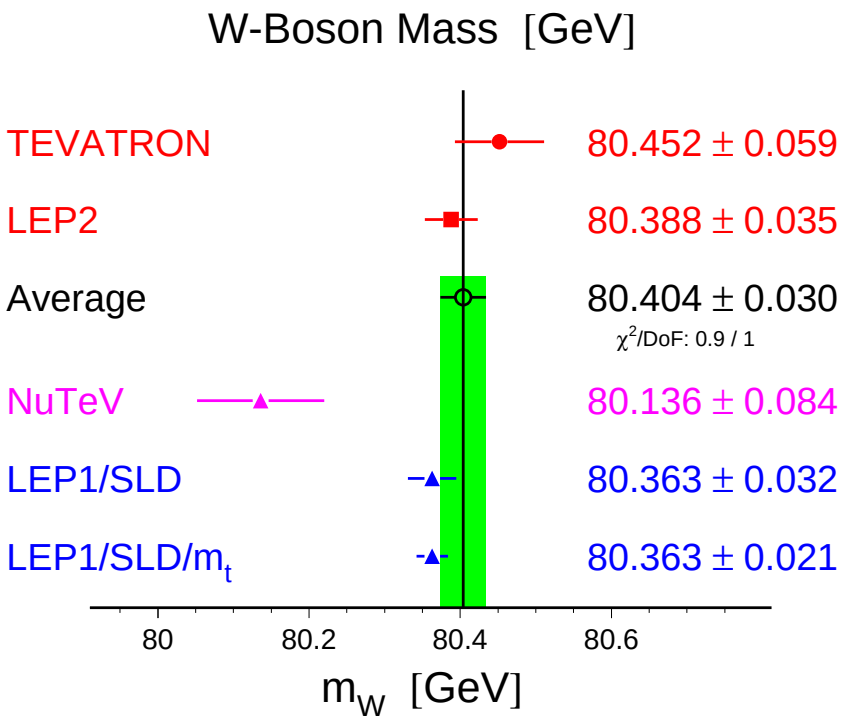
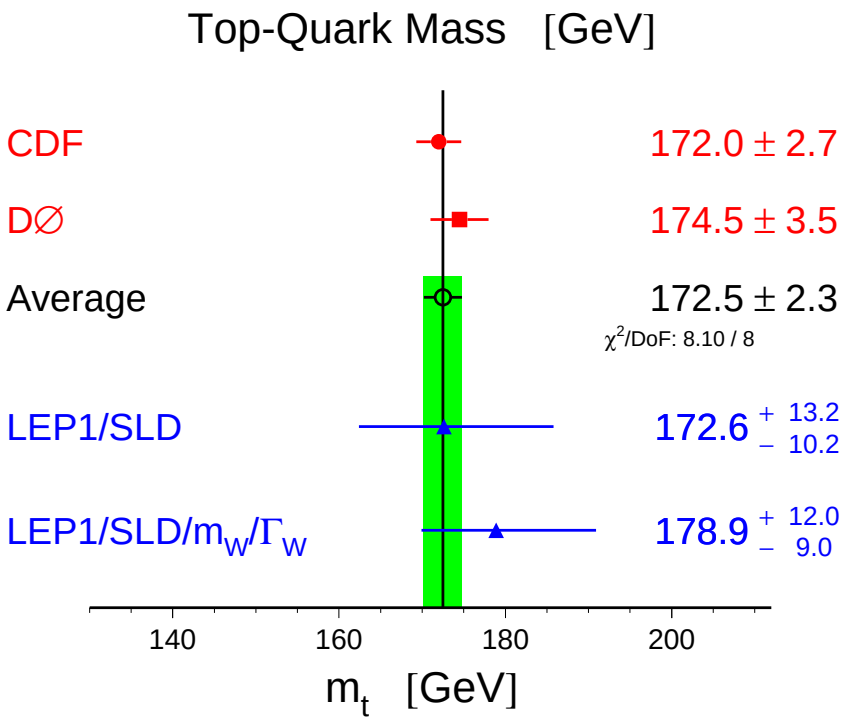
Indirect bound on m_h from M_W versus m_{top}

- From $e^+e^- \to W^+W^-$ and LEPII
- from $p\bar{p} \to t\bar{t} + X$ at Tevatron
- from $p\bar{p} \to W + X$ at Tevatron

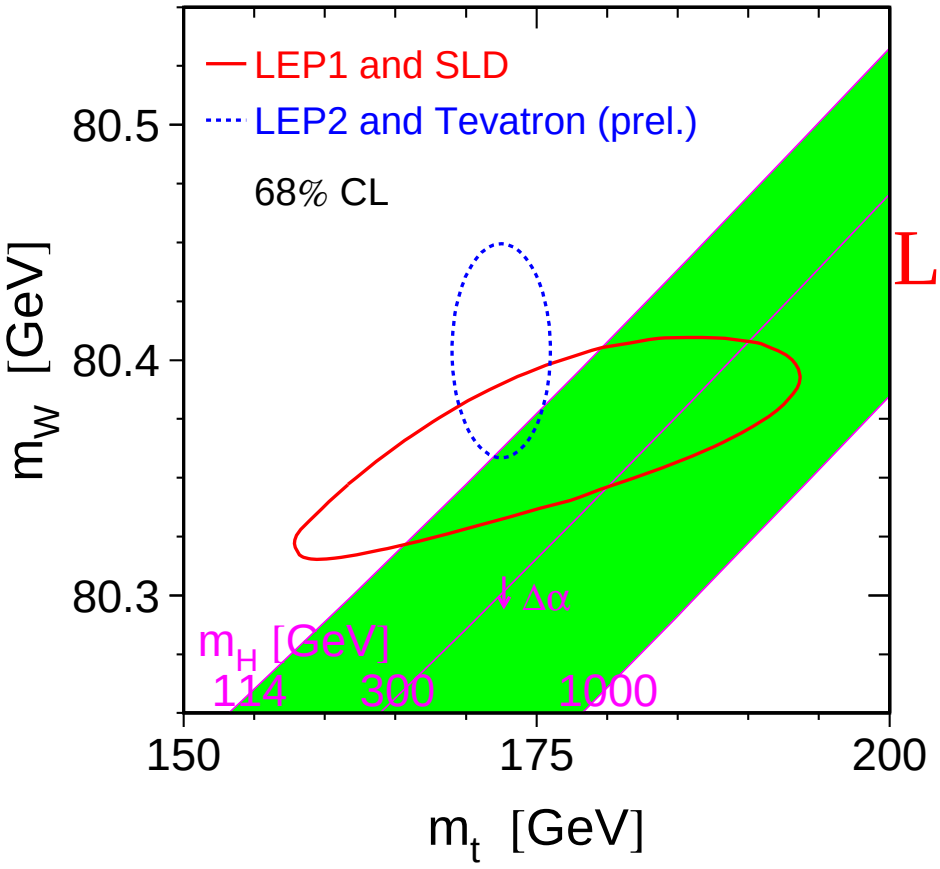




Indirect bound on m_h from M_W versus m_{top}

At one loop

$$M_W^2 \left(1 - \frac{M_W^2}{M_Z^2}\right) = \frac{\pi\alpha}{\sqrt{2}G_F} \frac{1}{1 - \Delta r(m_{top}, m_h)}$$



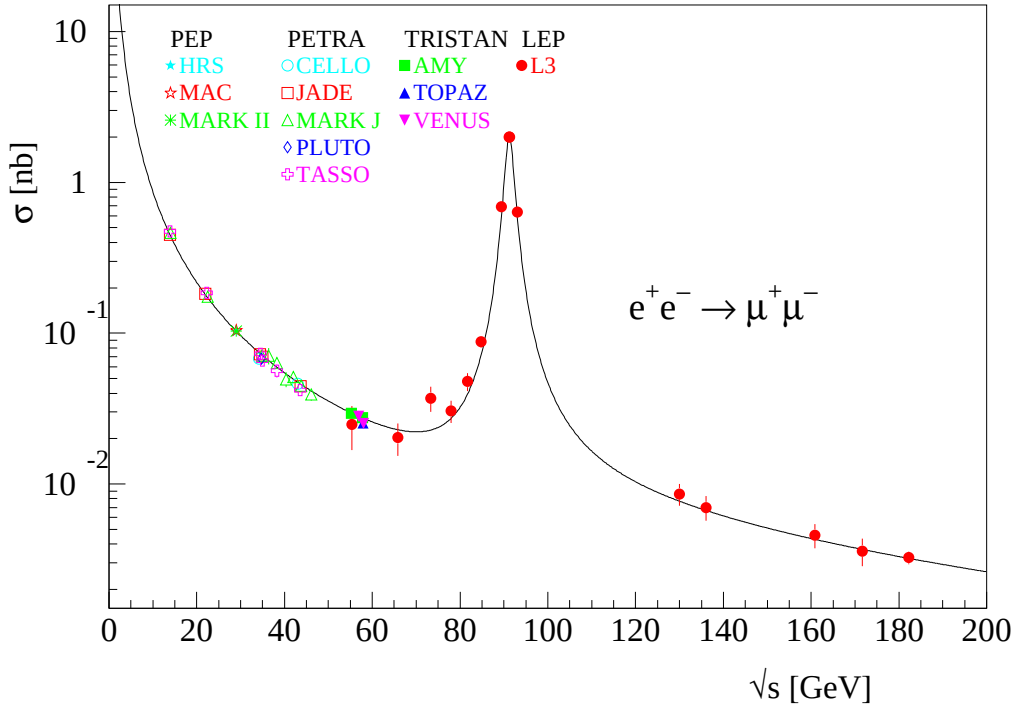
Light higgs favoured

$e^+e^- \to f\bar{f}$: Total cross section

$$\mathcal{L} = -e\,Q_f\,\bar{f}\gamma^\mu\,A_\mu\,f - \frac{g}{2\cos\theta_W}\,\bar{f}\,\gamma_\mu(g_V^d + g_A^f\gamma^5)f\,Z^\mu$$

$$\sigma = \frac{4\pi\alpha^2 N_c}{3s}Q_f^2 + \frac{N_c G_F^2 M_Z^4 s}{6\pi[(s-M_Z^2)^2+\Gamma_Z^2 M_Z^2]}({g_V^e}^2 + {g_A^e}^2)({g_V^f}^2 + {g_A^f}^2)$$

$$+\frac{4N_c\alpha G_F M_Z^2(s-M_Z^2)}{3\sqrt{2}[(s-M_Z^2)^2+\Gamma_Z^2 M_Z^2]}Q_f g_V^e g_V^f$$

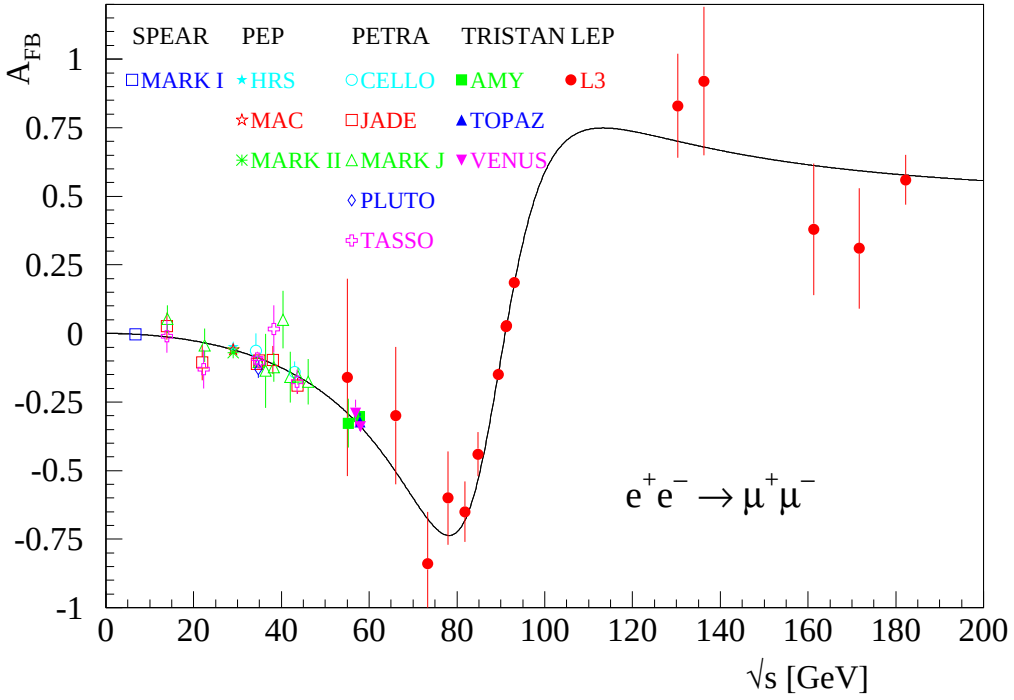


$e^+e^- \to f\bar{f}$: Forward-Backward asymmetry

$$\frac{d\sigma}{d\cos\theta} = \frac{N_c\pi\alpha^2}{2s}Q_f^2(1+\cos^2\theta) - \frac{N_c\alpha G_F M_Z^2(s-M_Z^2)Q_f}{2\sqrt{2}[(s-M_Z^2)^2+\Gamma_Z^2M_Z^2]}\left[g_V^e g_V^f(1+\cos^2\theta)+2g_A^e g_A^f\cos\theta\right]$$

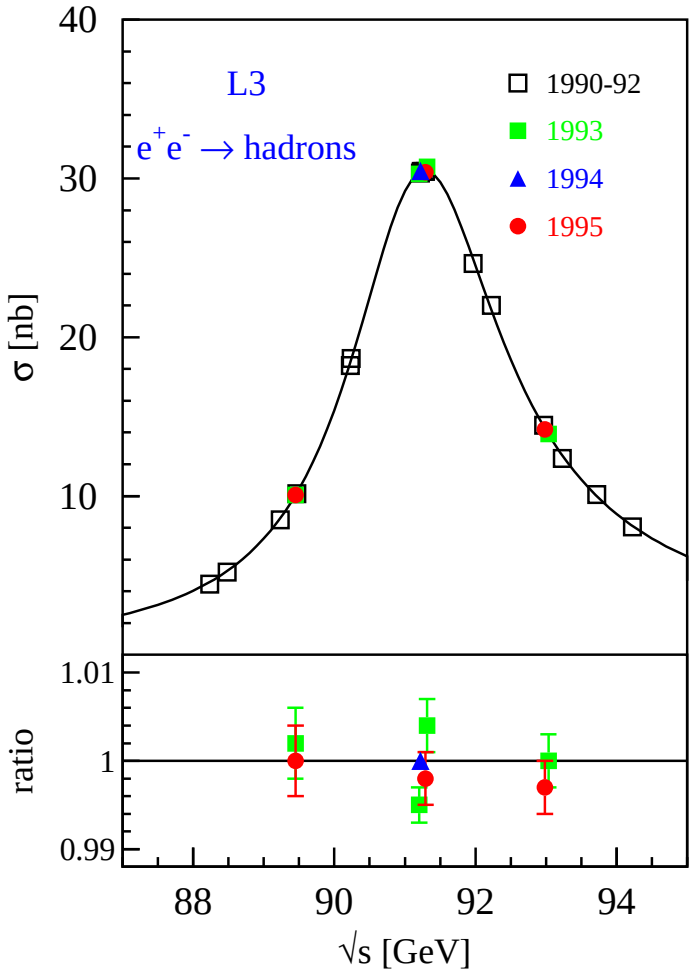
$$+\frac{G_F^2M_Z^4 s}{16\pi[(s-M_Z^2)^2+\Gamma_Z^2M_Z^2]}({g_V^e}^2+{g_A^e}^2)({g_V^f}^2+{g_A^f}^2)(1+\cos^2\theta)+2g_V^e g_A^e g_V^f g_A^f\cos\theta\Bigg\}$$

$$A_{FB} = \frac{\int_0^1 \frac{d\sigma}{d\cos\theta} - \int_{-1}^0 \frac{d\sigma}{d\cos\theta}}{\int_{-1}^1 \frac{d\sigma}{d\cos\theta}}$$



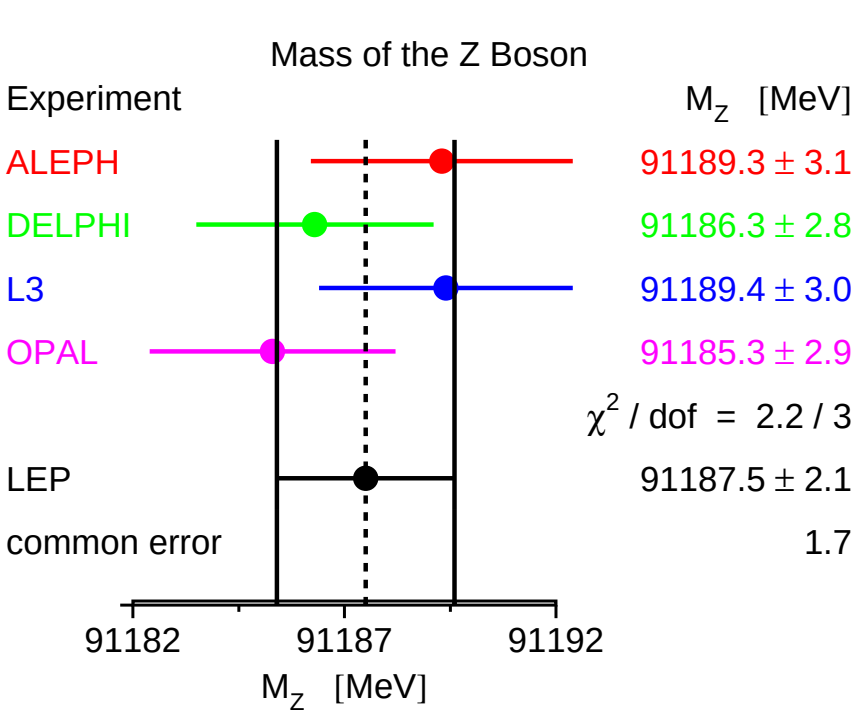
$e^+e^- \to f\bar{f}$ at $\sqrt{s} \sim M_Z$

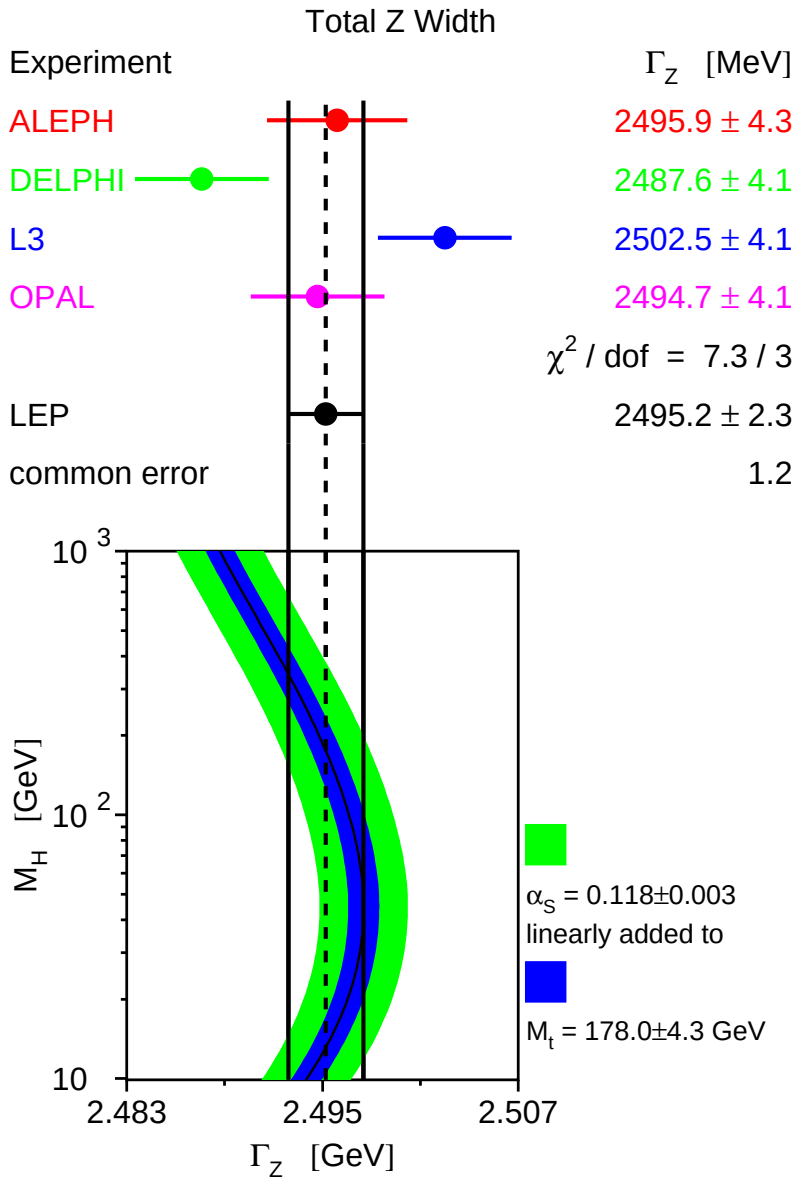
- LEP (CERN) produced 2×10^7 unpolarized Z's
- SLD (SLAC) produced 2×10^5 Z's with $P_e \sim 75\%$



$\Rightarrow M_Z$ and Γ_Z

$e^+e^- \to f\bar{f}$ at $\sqrt{s} \sim M_Z$





$e^+e^- \to f\bar{f}$ at $\sqrt{s} \sim M_Z$

- The decay width into the different fermions:

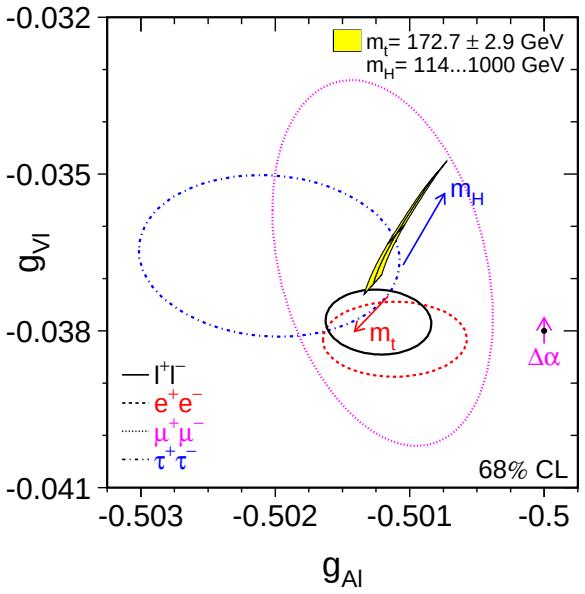
$$\Gamma(Z \to \bar{f} f) = \frac{G_F M_Z^3}{6\sqrt{2}\pi} N_C^f ({g_V^f}^2 + {g_A^f}^2)$$

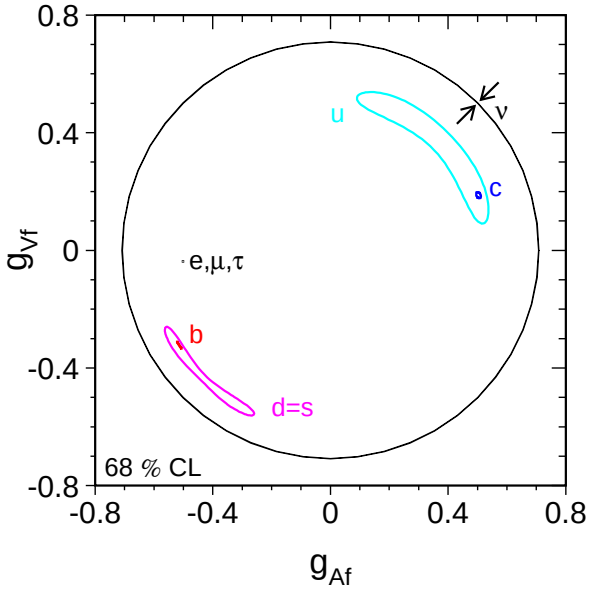
- The forward-backward asymmetry

$$A_{FB}(M_Z) = 3 \frac{g_V^f g_A^f}{({g_V^f}^2 + {g_A^f}^2)} \frac{g_V^e g_A^e}{({g_V^e}^2 + {g_A^e}^2)}$$

$\Rightarrow$ Good determination of couplings

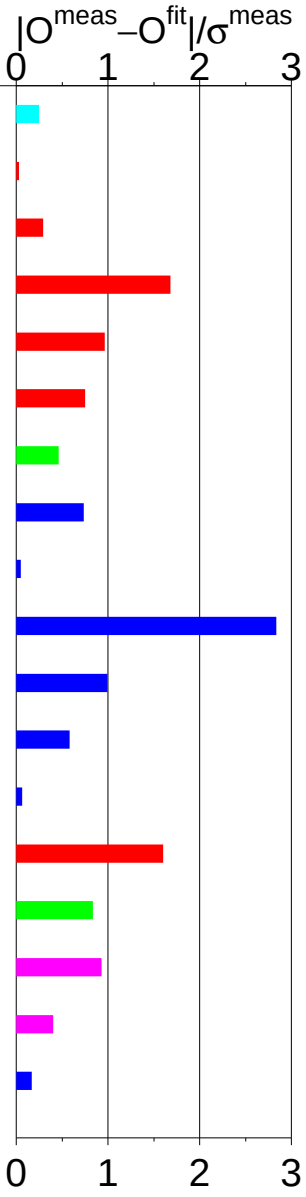
$$g_V^f = T_3^f - 2Q_f \sin^2\theta_w$$
$$g_A^f = T_3^f$$





Precision Electroweak Observations

	Measurement	Fit
$\Delta\alpha^{(5)}_{had}(m_Z)$	0.02758 ± 0.00035	0.02767
m_Z [GeV]	91.1875 ± 0.0021	91.1874
Γ_Z [GeV]	2.4952 ± 0.0023	2.4959
σ^0_{had} [nb]	41.540 ± 0.037	41.478
R_l	20.767 ± 0.025	20.743
$A^{0,l}_{fb}$	0.01714 ± 0.00095	0.01643
$A_l(P_\tau)$	0.1465 ± 0.0032	0.1480
R_b	0.21629 ± 0.00066	0.21581
R_c	0.1721 ± 0.0030	0.1722
$A^{0,b}_{fb}$	0.0992 ± 0.0016	0.1037
$A^{0,c}_{fb}$	0.0707 ± 0.0035	0.0742
A_b	0.923 ± 0.020	0.935
A_c	0.670 ± 0.027	0.668
A_l(SLD)	0.1513 ± 0.0021	0.1480
$\sin^2\theta^{lept}_{eff}(Q_{fb})$	0.2324 ± 0.0012	0.2314
m_W [GeV]	80.404 ± 0.030	80.376
Γ_W [GeV]	2.115 ± 0.058	2.092
m_t [GeV]	172.5 ± 2.3	172.9



Tested with 1% precision, but. . .

Light Higgs Required !!!