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Combined fit to the Electroweak data and constraints on the Standard Model

- (Short) Introduction
- Inputs
- Results
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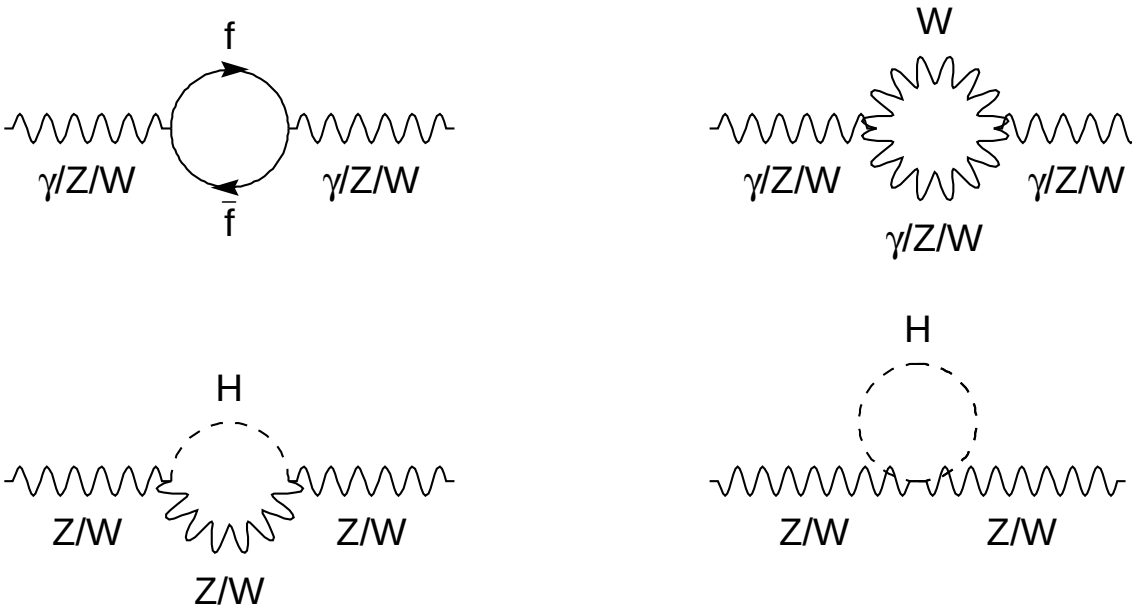
On behalf of the LEP/SLD collaborations and
the LEP Electroweak working group

Numbers & plots in `http://www.cern.ch/LEPEWWG`

EPS-HEP 2001, Budapest, July 12-18

(Short) Introduction

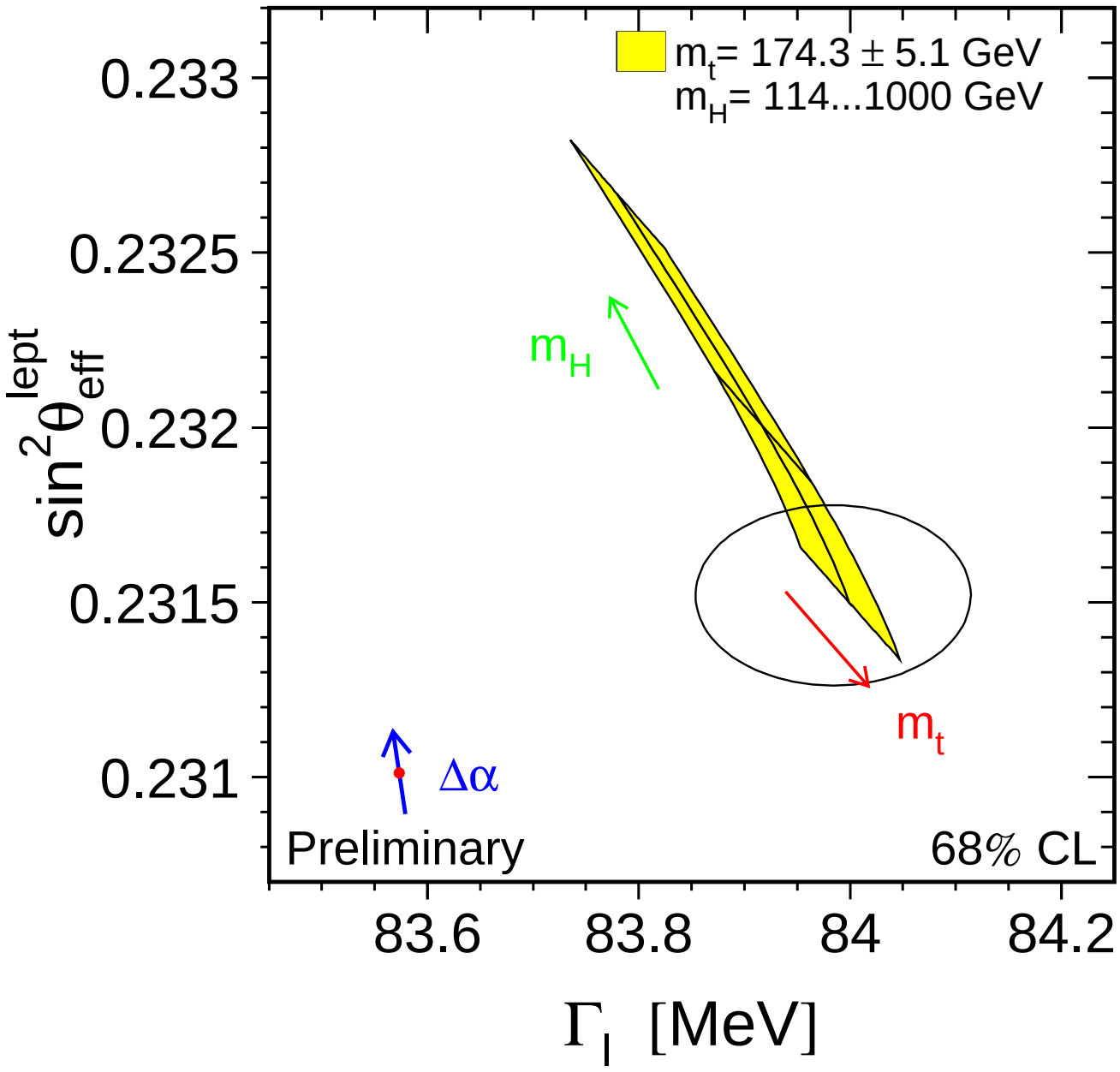
Precision Electroweak measurements test and constrain the Standard Model through the mechanism of radiative corrections.



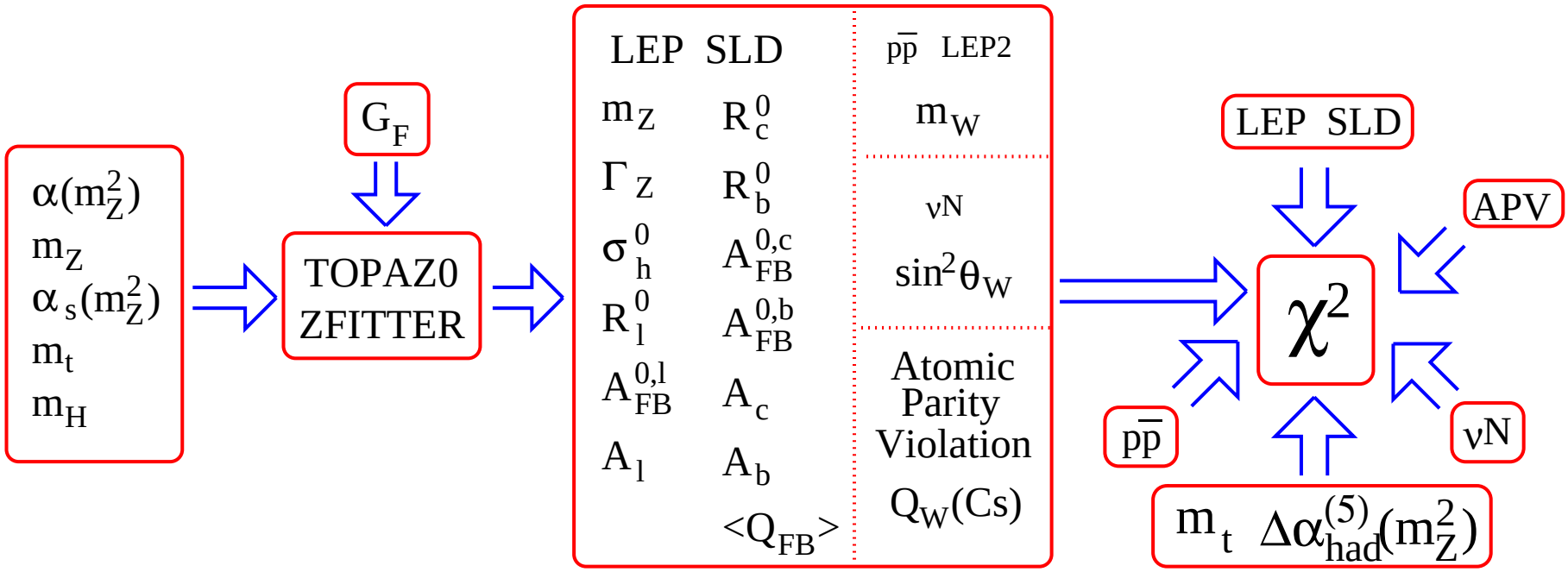
Boson and fermion loops in boson propagators

$$\frac{1}{\alpha(0)} \rightarrow \frac{1-\Delta\alpha}{\alpha(0)}$$

Electroweak corrections $= f(m_{\mathrm{t}}^2, \log m_{\mathrm{H}}, \ldots)$



Evidence of Electroweak corrections beyond the running of α.



NEW:

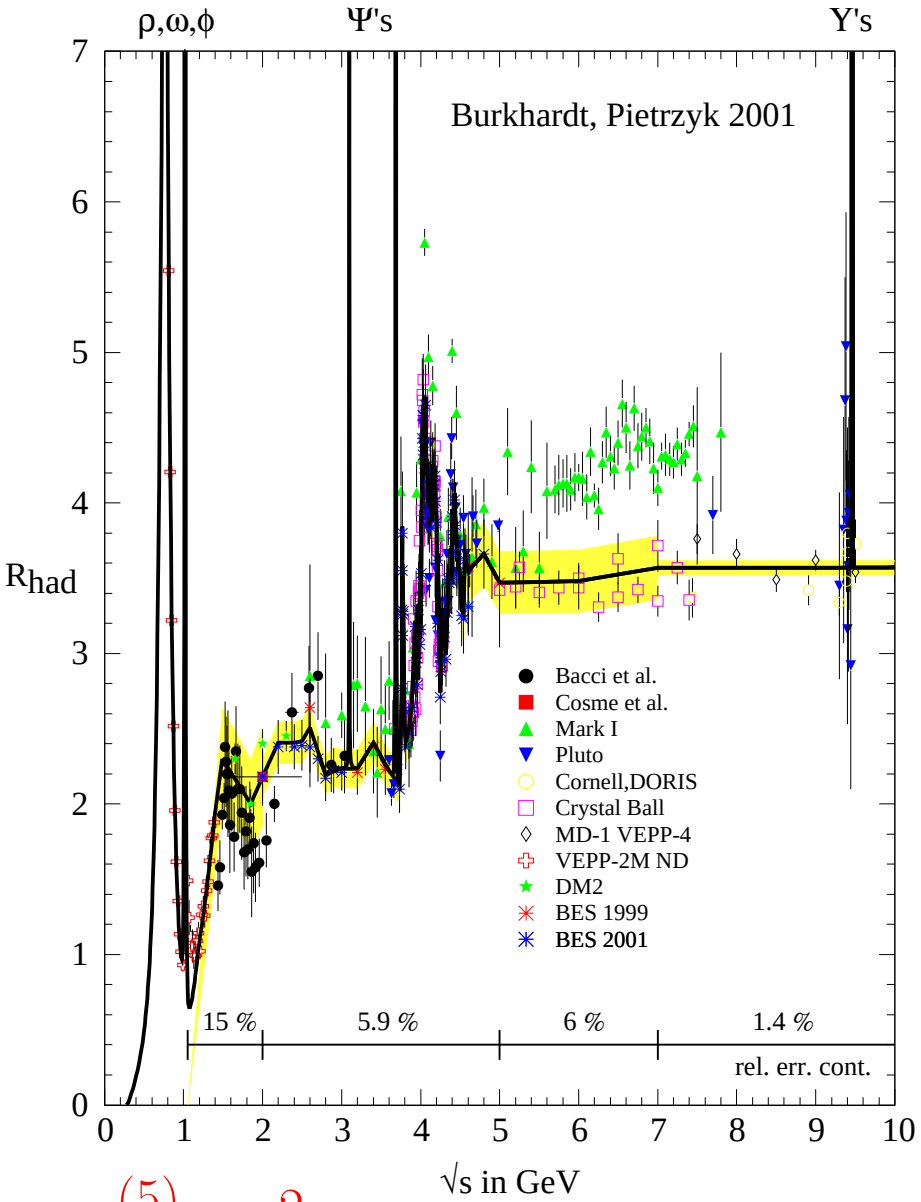
–Inclusion of Atomic Parity Violation

–Inclusion of Electroweak corrections on m_W

Inputs

$$\alpha(s) = \frac{\alpha(0)}{1 - \Delta\alpha_\ell(s) - \Delta\alpha_{\rm top}(s) - \Delta\alpha^{(5)}_{\rm had}(s)}$$

$\Delta\alpha_\ell(s)$ and $\Delta\alpha_{\rm top}(s)$ are calculable, $\Delta\alpha^{(5)}_{\rm had}(s)$ has QCD uncertainties.
Determine it from measurements of $R_{\rm had} = \frac{\sigma(e^+e^-\to{\rm hadrons})}{\sigma(e^+e^-\to\mu^+\mu^-)}$ (BES updates)



$$\Delta\alpha^{(5)}_{\rm had}(m_{\rm Z}^2) = 0.02761 \pm 0.00036$$

Previous value, Eidelman, Jegerlehner ZP **C67** (1995) 585:

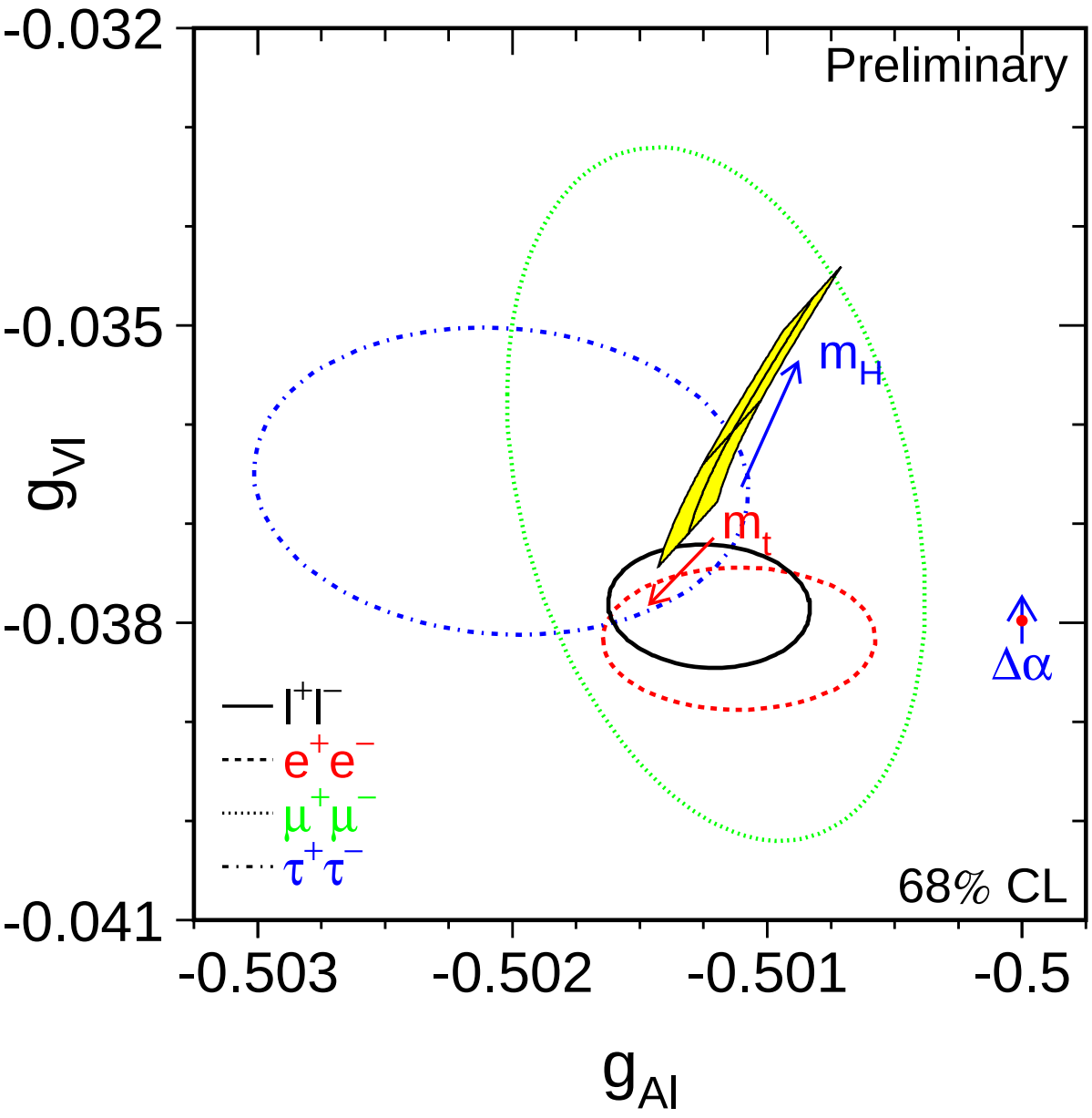
$$\Delta\alpha^{(5)}_{\rm had}(m_{\rm Z}^2) = 0.02804 \pm 0.00065$$

With perturbative QCD and BES data, Martin *et al* PL **B492** (2000) 69:

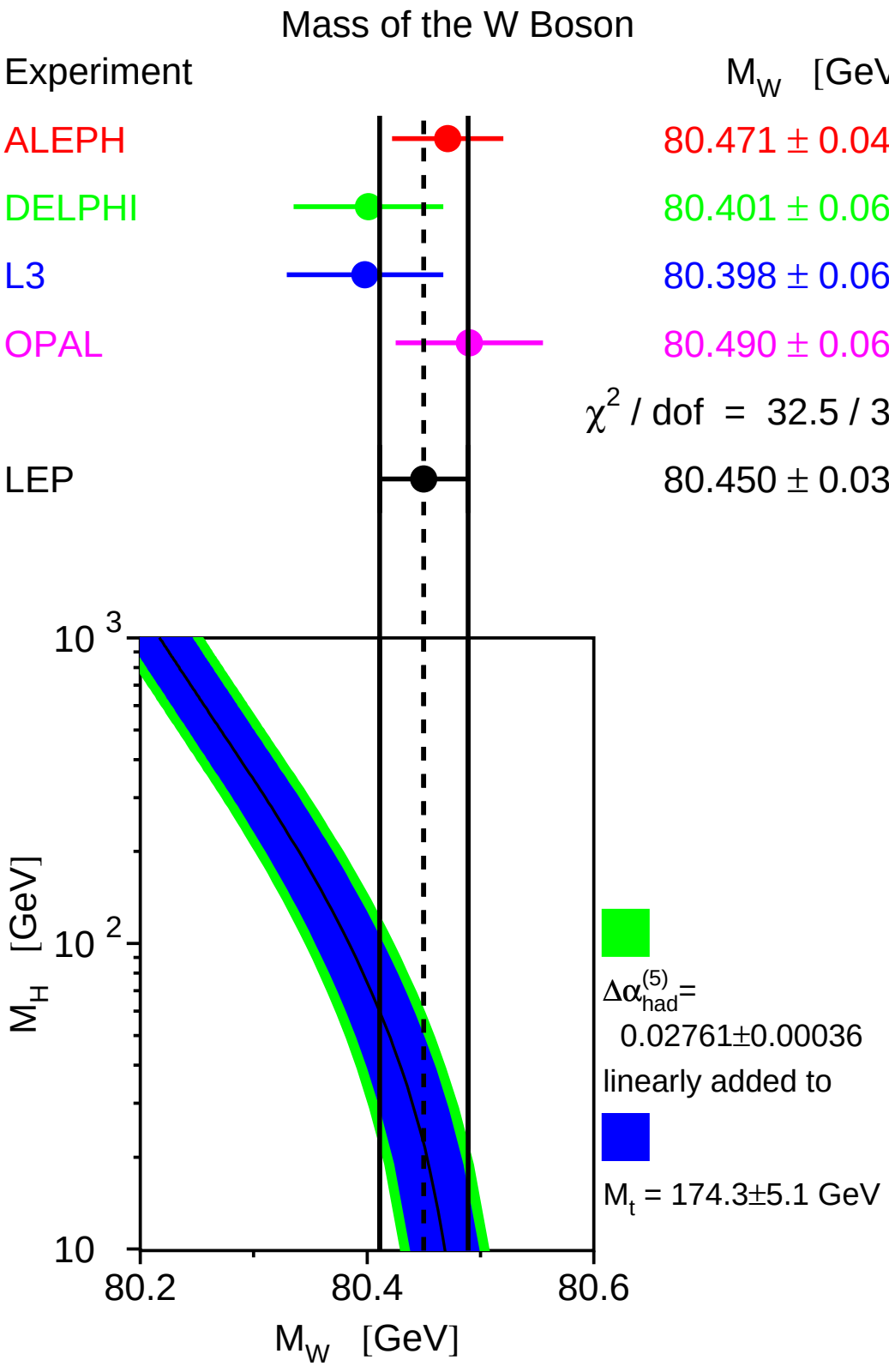
$$\Delta\alpha^{(5)}_{\rm had}(m_{\rm Z}^2) = 0.02378 \pm 0.00020$$

Inputs

Standard Model predictions from:
$m_{\rm t} = 174.3 \pm 5.1$, $m_{\rm H} = [114.1, 1000]$

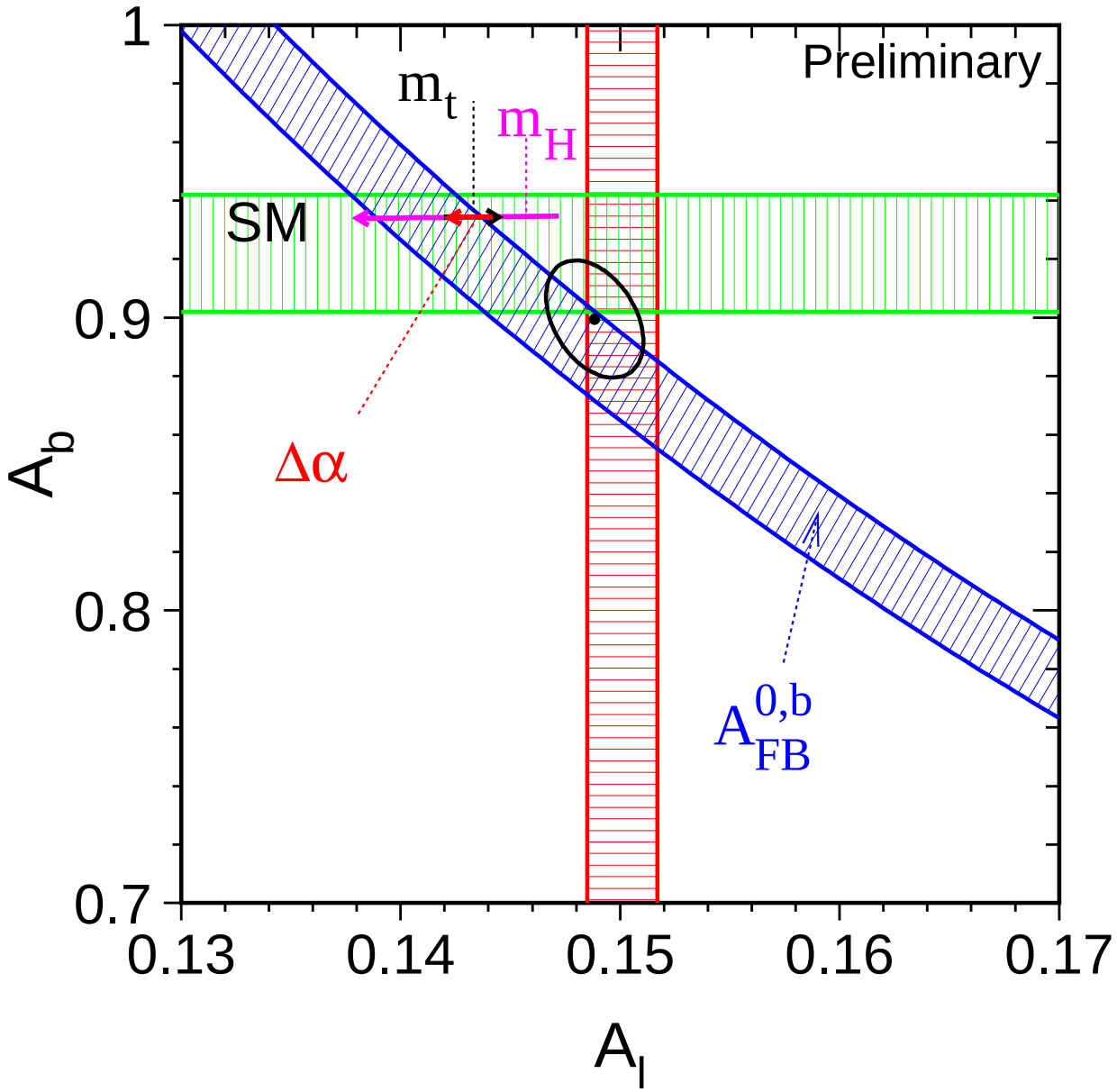


Internal consistency in the leptonic sector
LOW $m_{\rm H}$ are favoured



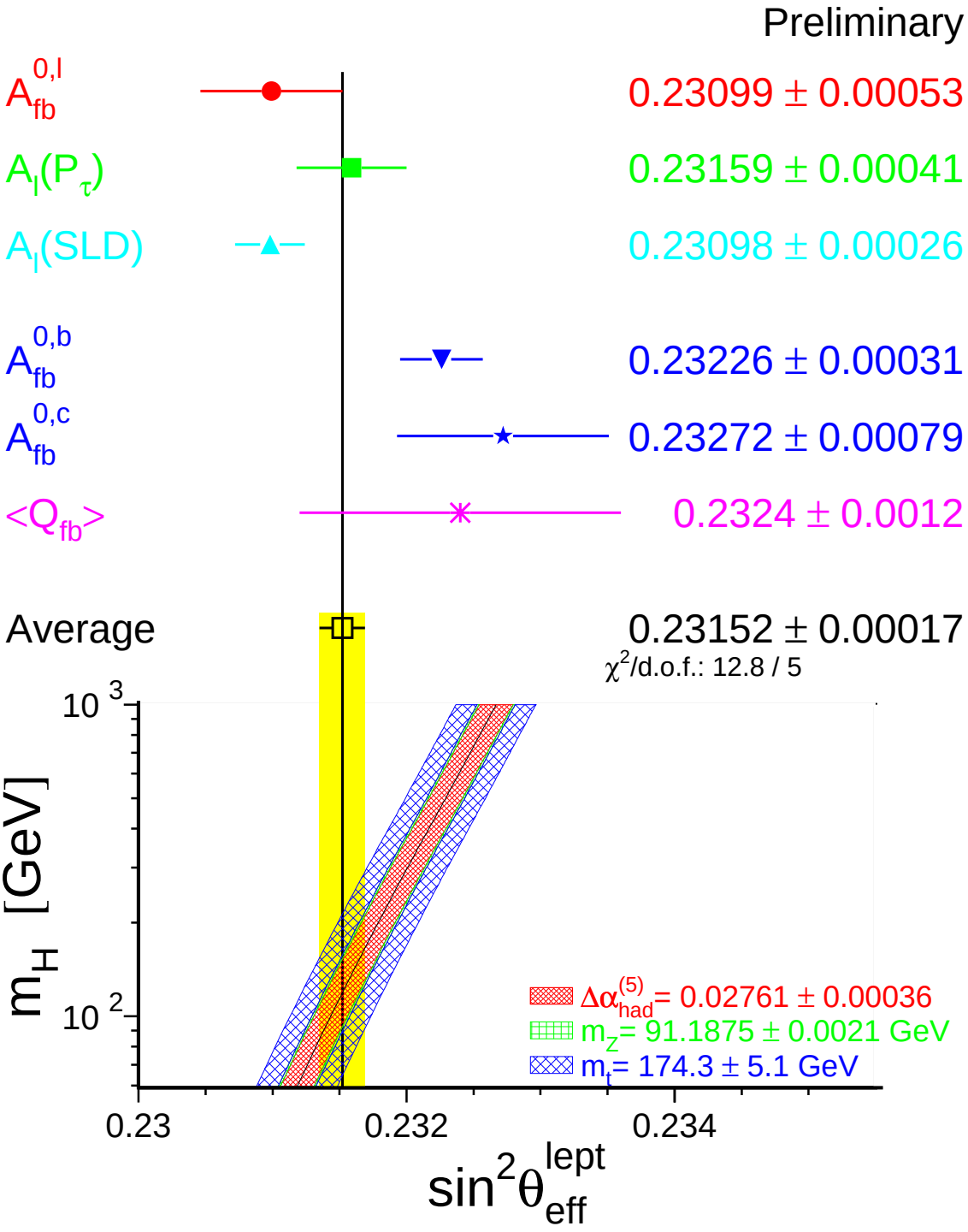
Other observables also prefer **LOW** m_{H}

Standard Model predictions from:
$m_{\rm t} = 174.3 \pm 5.1$, $m_{\rm H} = [114.1, 1000]$



The heavy quark favour **HIGH** $m_{\rm H}$

Inputs

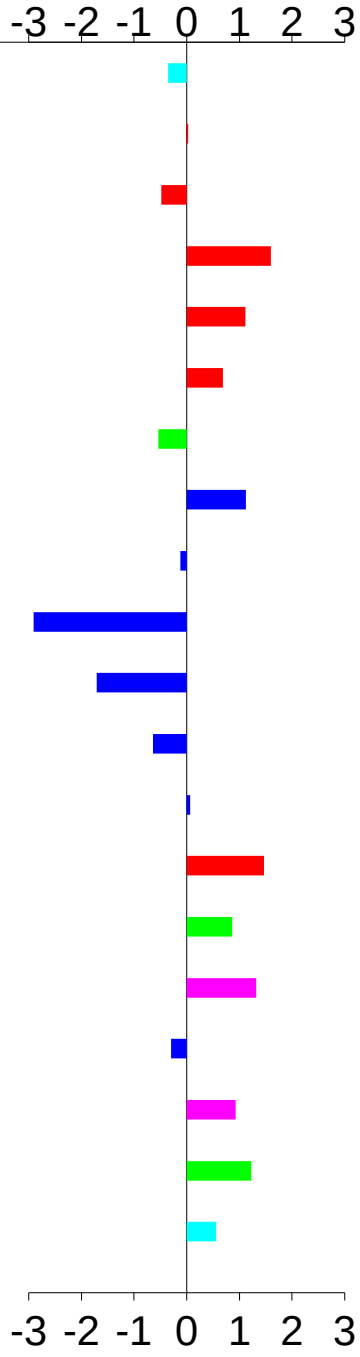


$$\chi^2(\text{leptons})/d.o.f. = 1.6/2\ (44.3\%)$$
$$\chi^2(\text{hadrons})/d.o.f. = 0.3/2\ (84.6\%)$$
$$\chi^2(\text{total})/d.o.f. = 12.8/5\ (2.5\%)$$

Difference of 3.3σ between hadrons and leptons

Summer 2001

	Measurement	Pull
$\Delta\alpha^{(5)}_{had}(m_Z)$	0.02761 ± 0.00036	-.35
m_Z [GeV]	91.1875 ± 0.0021	.03
Γ_Z [GeV]	2.4952 ± 0.0023	-.48
σ^0_{had} [nb]	41.540 ± 0.037	1.60
R_l	20.767 ± 0.025	1.11
$A^{0,l}_{fb}$	0.01714 ± 0.00095	.69
$A_l(P_\tau)$	0.1465 ± 0.0033	-.54
R_b	0.21646 ± 0.00065	1.12
R_c	0.1719 ± 0.0031	-.12
$A^{0,b}_{fb}$	0.0990 ± 0.0017	-2.90
$A^{0,c}_{fb}$	0.0685 ± 0.0034	-1.71
A_b	0.922 ± 0.020	-.64
A_c	0.670 ± 0.026	.06
A_l(SLD)	0.1513 ± 0.0021	1.47
$\sin^2\theta^{lept}_{eff}(Q_{fb})$	0.2324 ± 0.0012	.86
$m^{(LEP)}_W$ [GeV]	80.450 ± 0.039	1.32
m_t [GeV]	174.3 ± 5.1	-.30
$m^{(TEV)}_W$ [GeV]	80.454 ± 0.060	.93
$\sin^2\theta_W(\nu N)$	0.2255 ± 0.0021	1.22
$Q_W(Cs)$	-72.50 ± 0.70	.56



$$\text{Pull} = \frac{\mathcal{O}_{\text{meas}} - \mathcal{O}_{\text{fit}}}{\sigma\mathcal{O}_{\text{meas}}}$$

$$\chi^2/d.o.f. = 22.9/15 \quad \mathcal{P}(\chi^2) = 8.6\%$$