The global fit

to Electroweak data

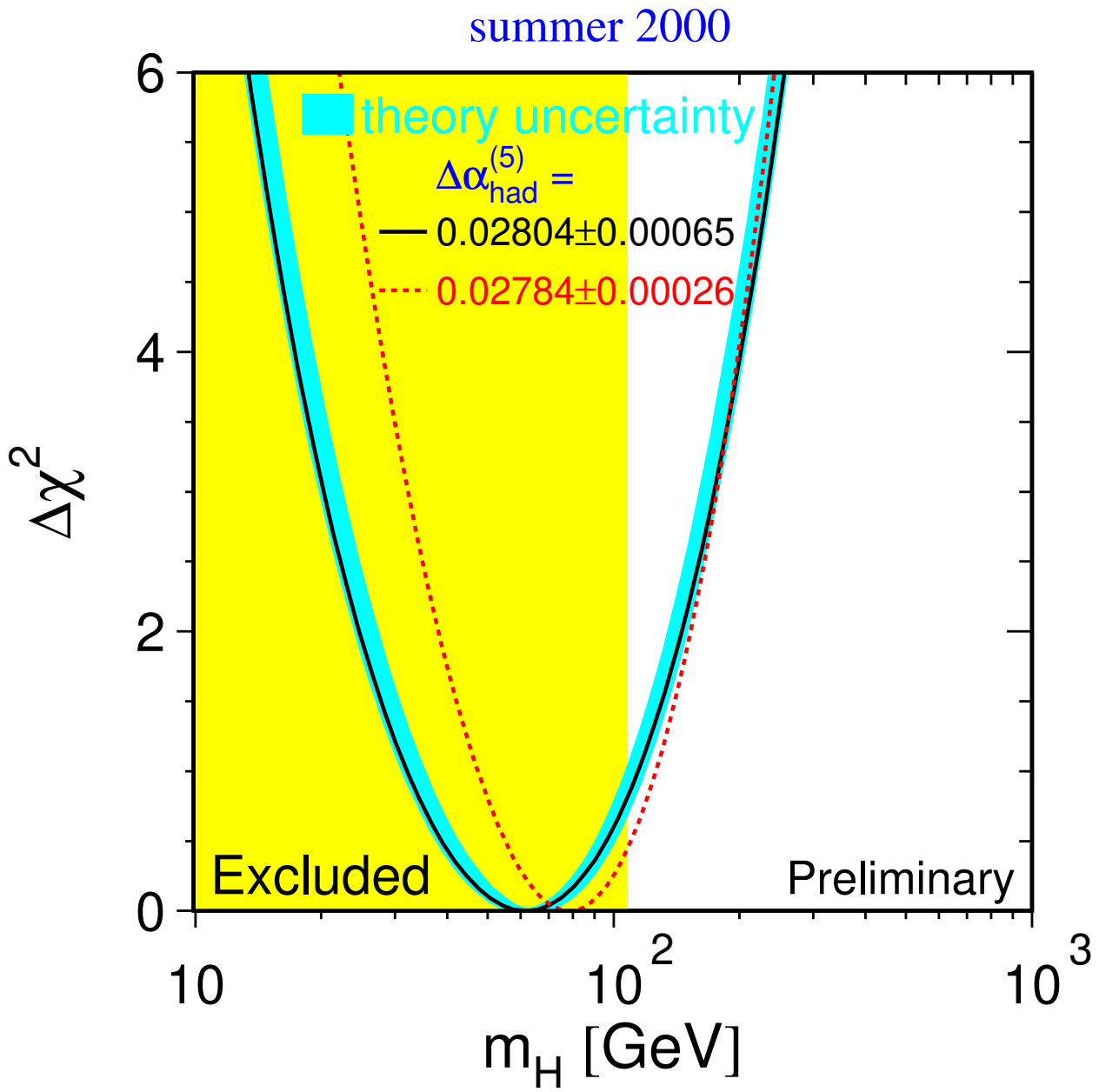
Bolek Pietrzyk

LAPP Annecy-le-Vieux

FRANCE

ICHEP 2000, Osaka, July 28, 2000

log m_H - blue band plot



$m_H = 62^{+53}_{-30}$ GeV

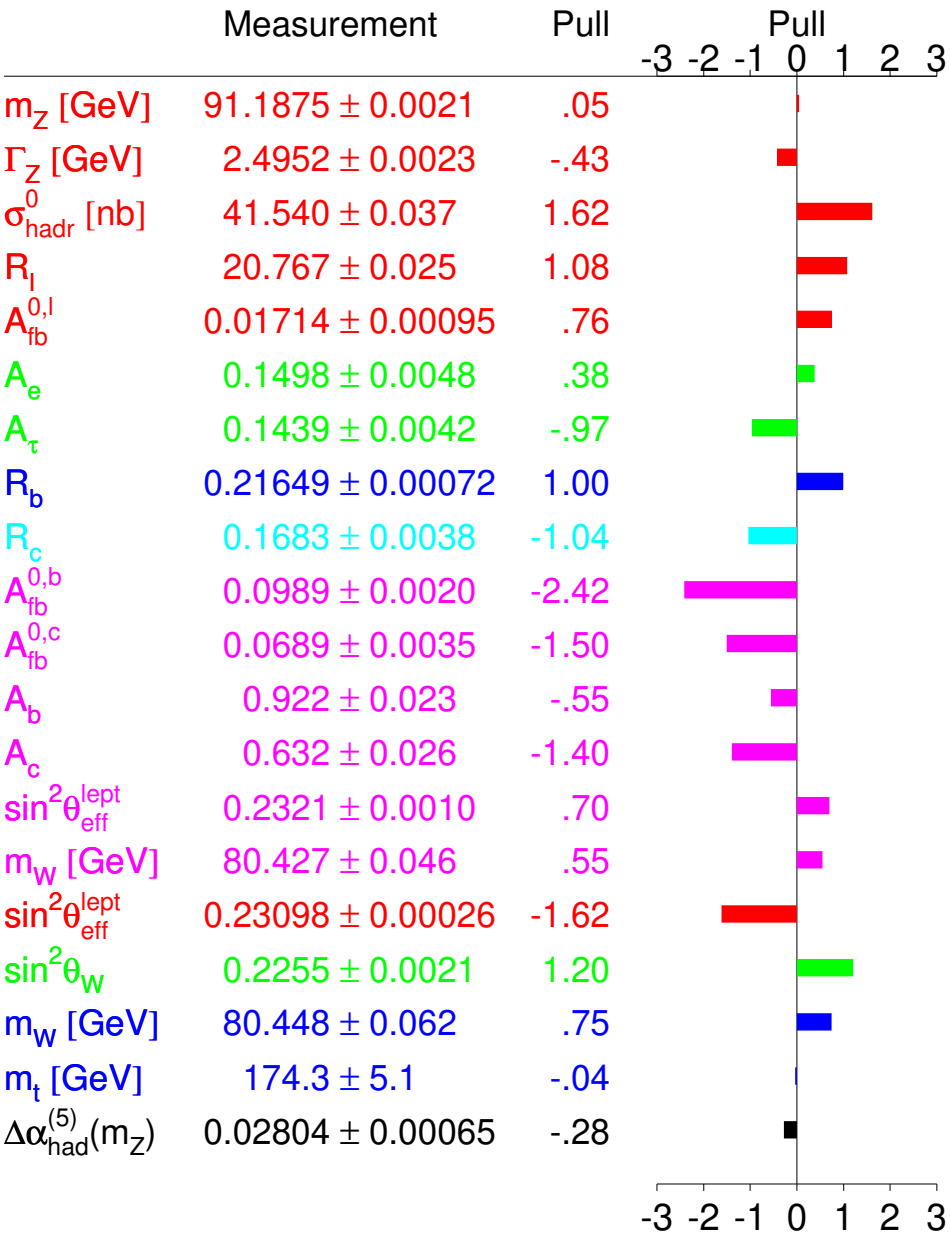
The one-sided 95%CL (90% two-sided) upper limit on m_H is
. 170 GeV

was $66.5\pm^{+60}_{-33}$ GeV in Moriond (spring 2000)

ZFITTER and THOPAZ0 programs are used

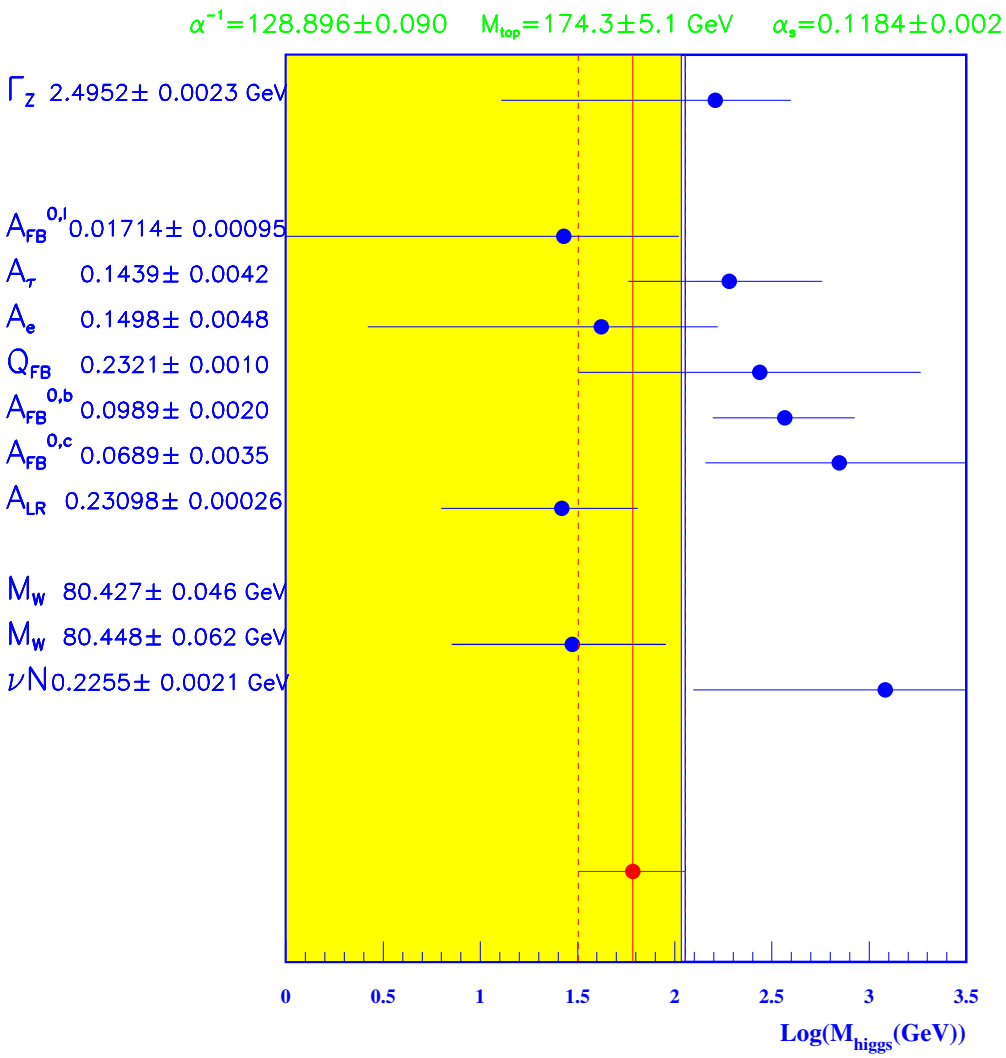
fits of LEP EWWG: pulls

Osaka 2000



χ^2/d.o.f. = 21/15 12% probability

log m_H for different measurements

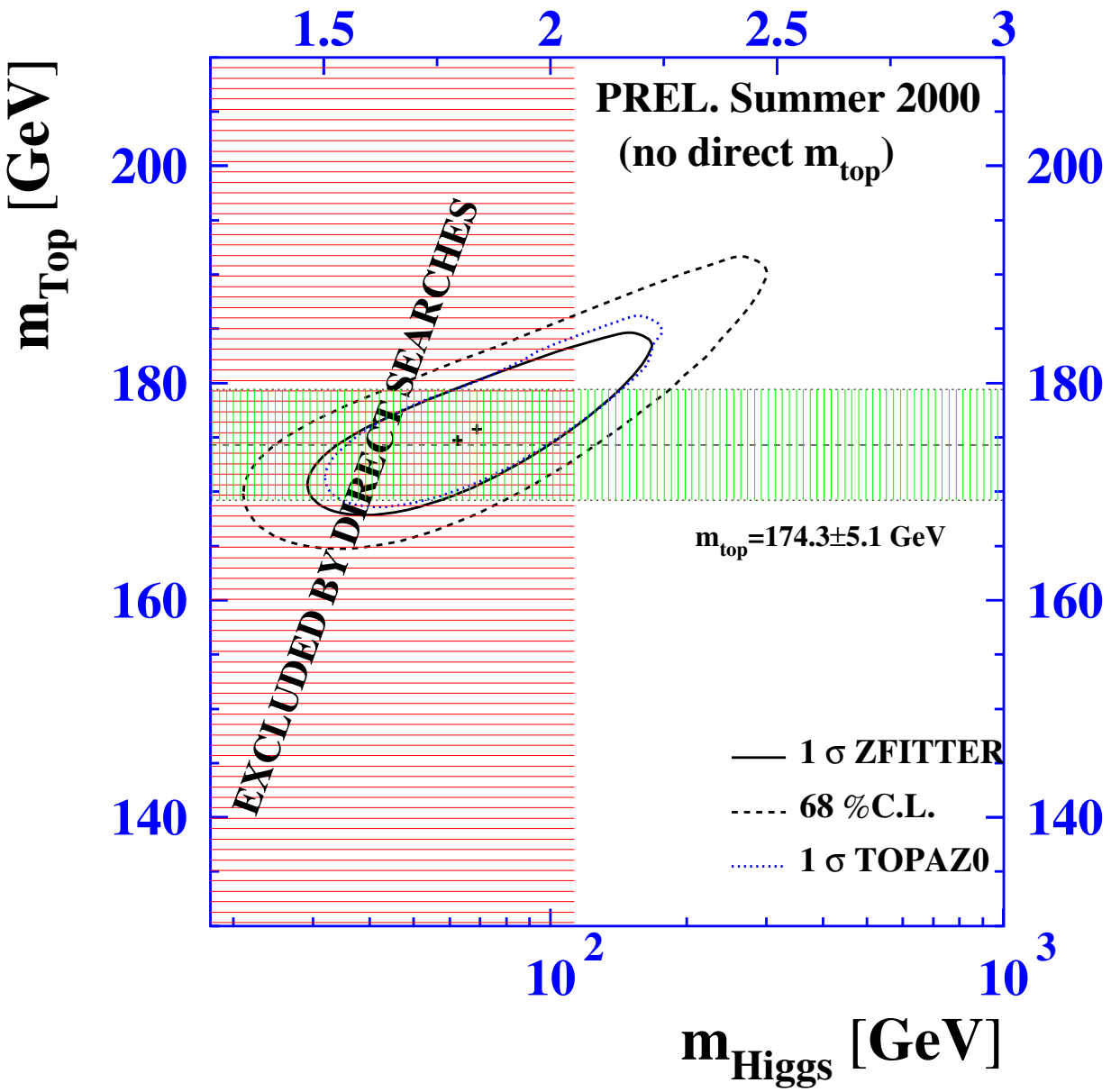


three measurements : $A_{FB}^{0,l}$, A_{LR} and m_W give central value of m_H of about 30 GeV

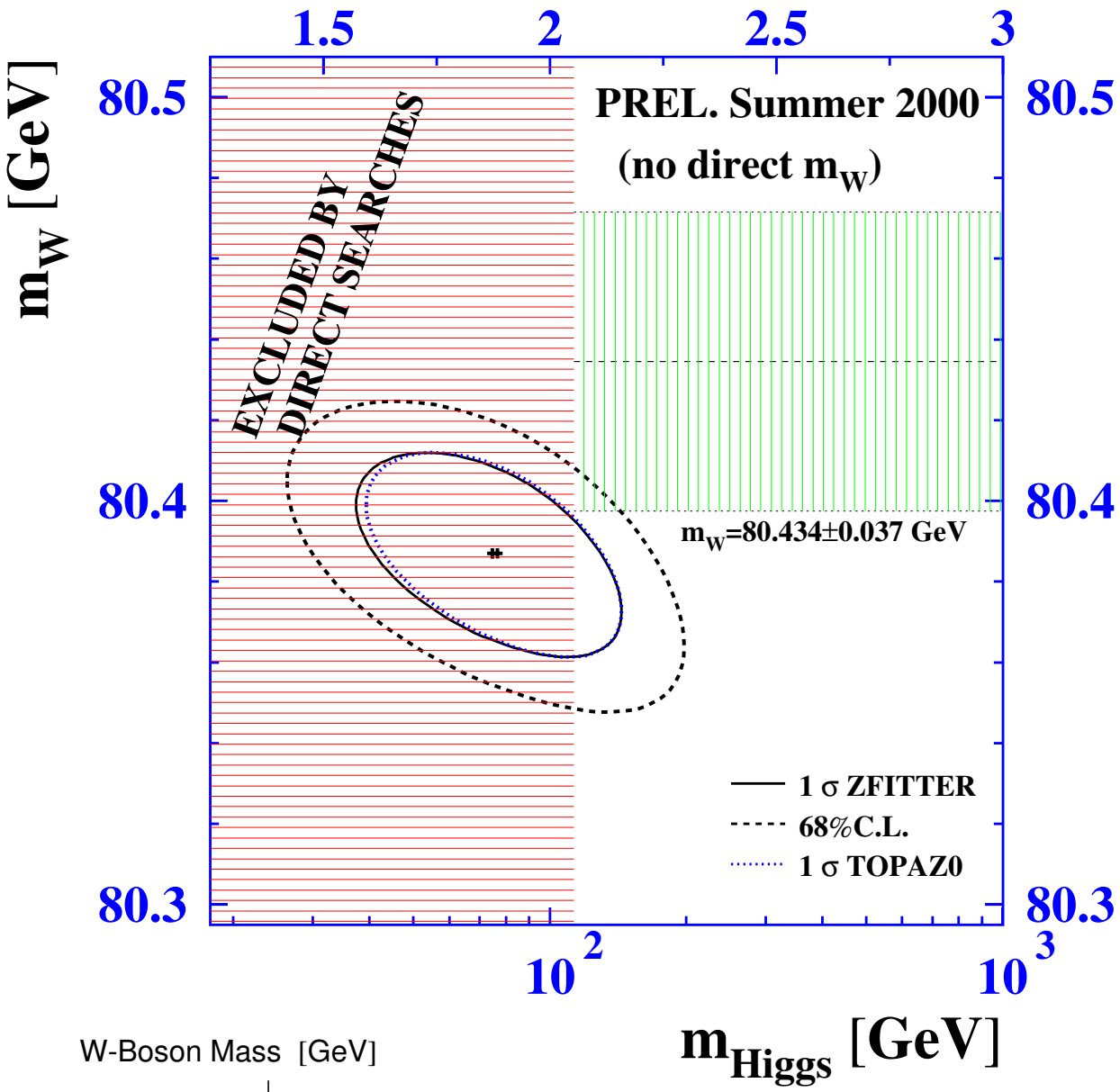
numerical results

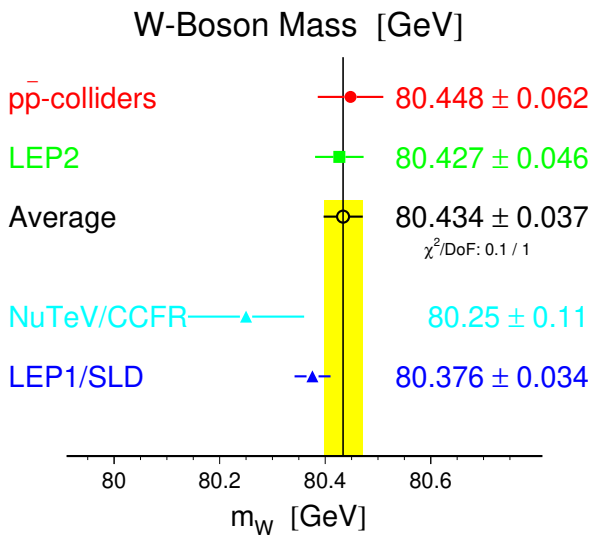
	LEP including LEP-II $m_{\rm W}$	all data except $m_{\rm W}$ and $m_{\rm t}$	all data except $m_{\rm W}$	all data
$m_{\rm t}$ [GeV]	178^{+13}_{-10}	169^{+10}_{-8}	173.2 ± 4.6	174.5 ± 4.3
$m_{\rm H}$ [GeV]	135^{+262}_{-83}	59^{+84}_{-29}	75^{+69}_{-37}	62^{+53}_{-30}
$\log(m_{\rm H}/{\rm GeV})$	$2.13^{+0.47}_{-0.41}$	$1.77^{+0.39}_{-0.29}$	$1.88^{+0.28}_{-0.30}$	$1.79^{+0.27}_{-0.28}$
$\alpha_s(m_{\rm Z}^2)$	0.120 ± 0.003	0.119 ± 0.003	0.119 ± 0.003	0.118 ± 0.003
χ^2/d.o.f.	$13/9$	$20/12$	$20/13$	$21/15$
$\sin^2\theta_{\rm eff}^{\rm lept}$	0.23167 ± 0.00020	0.23147 ± 0.00017	0.23147 ± 0.00017	0.23140 ± 0.00016
$1 - m_{\rm W}^2/m_{\rm Z}^2$	0.2229 ± 0.0006	0.2231 ± 0.0007	0.2229 ± 0.0005	0.2226 ± 0.0004
$m_{\rm W}$ [GeV]	80.383 ± 0.029	80.376 ± 0.034	80.387 ± 0.025	80.402 ± 0.020

m_t vs m_H

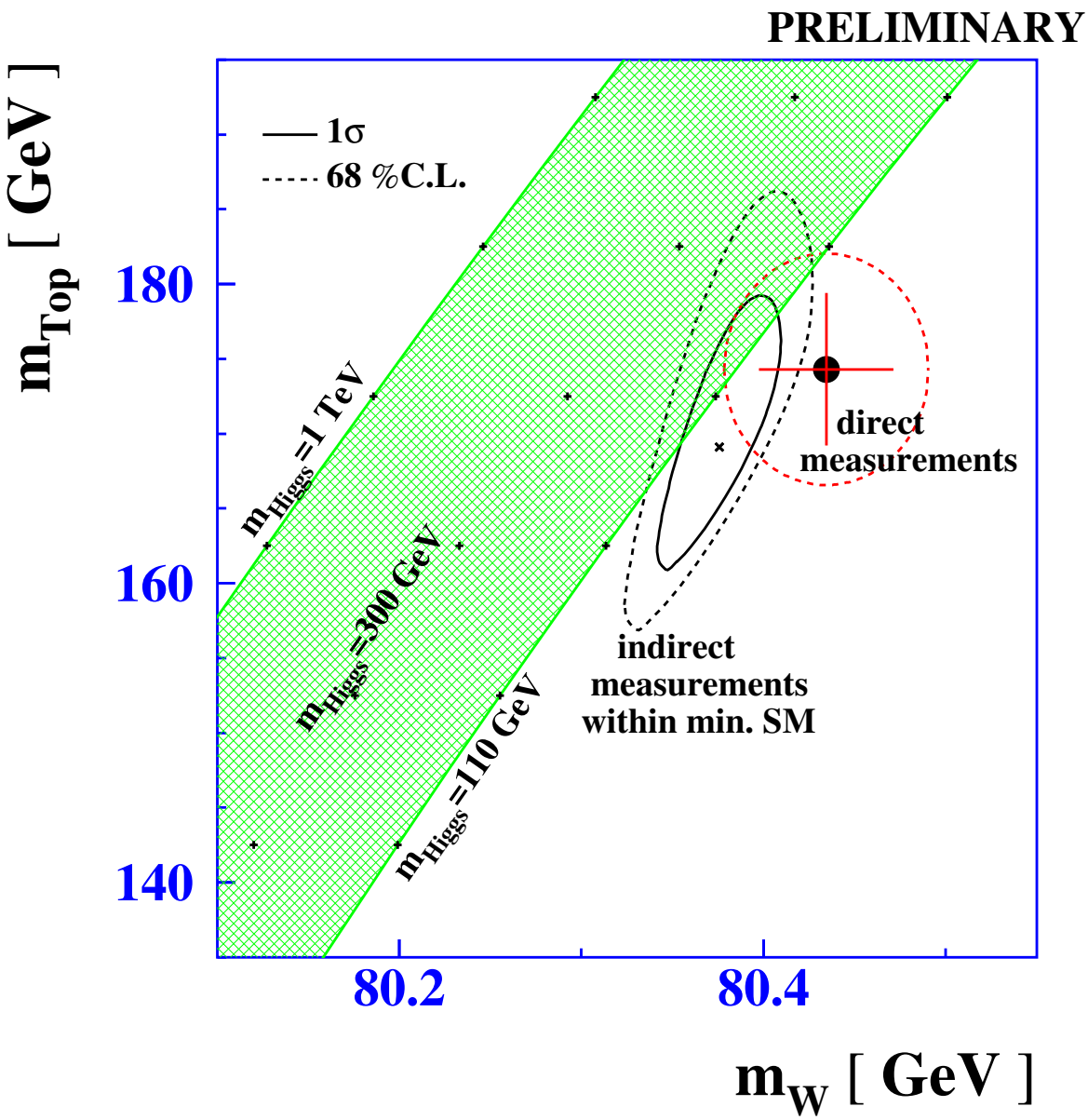

1.5
2
2.5
3
PREL. Summer 2000
(no direct m_top)
200
180
160
140
m_Top [GeV]
EXCLUDED BY DIRECT SEARCHES
m_top=174.3±5.1 GeV
1 σ ZFITTER
68 %C.L.
1 σ TOPAZ0
10^2
10^3
m_Higgs [GeV]

m_W vs m_H

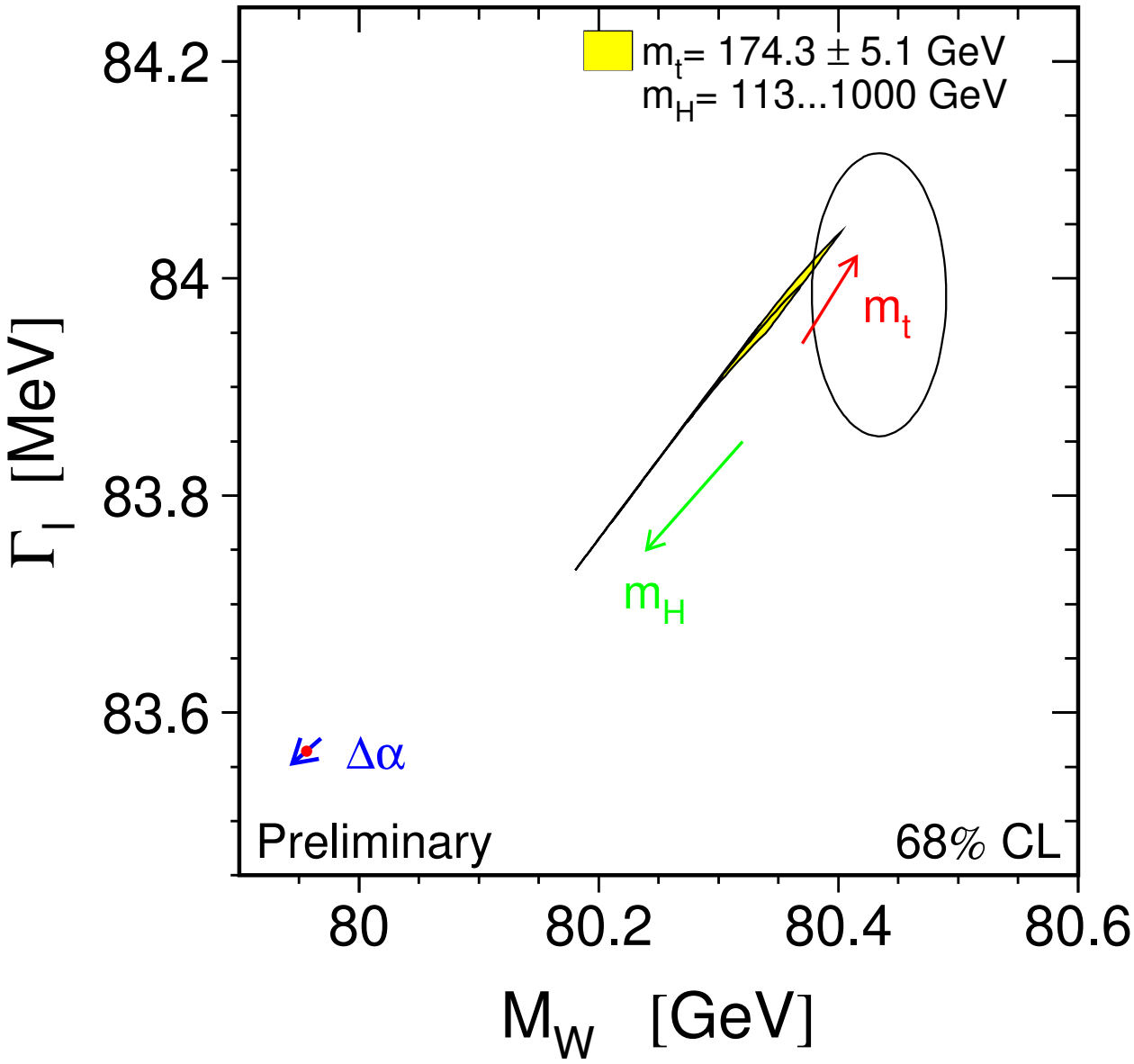

1.5
2
2.5
3
80.5
80.4
80.3
m_W [GeV]
PREL. Summer 2000
(no direct m_W)
EXCLUDED BY DIRECT SEARCHES
m_W=80.434±0.037 GeV
1 σ ZFITTER
68%C.L.
1 σ TOPAZ0
10^2
10^3
m_{Higgs} [GeV]


W-Boson Mass [GeV]
pp̄-colliders
80.448 ± 0.062
LEP2
80.427 ± 0.046
Average
80.434 ± 0.037
χ²/DoF: 0.1 / 1
NuTeV/CCFR
80.25 ± 0.11
LEP1/SLD
80.376 ± 0.034
80
80.2
80.4
80.6
m_W [GeV]

no m_t, no m_W in the fit input



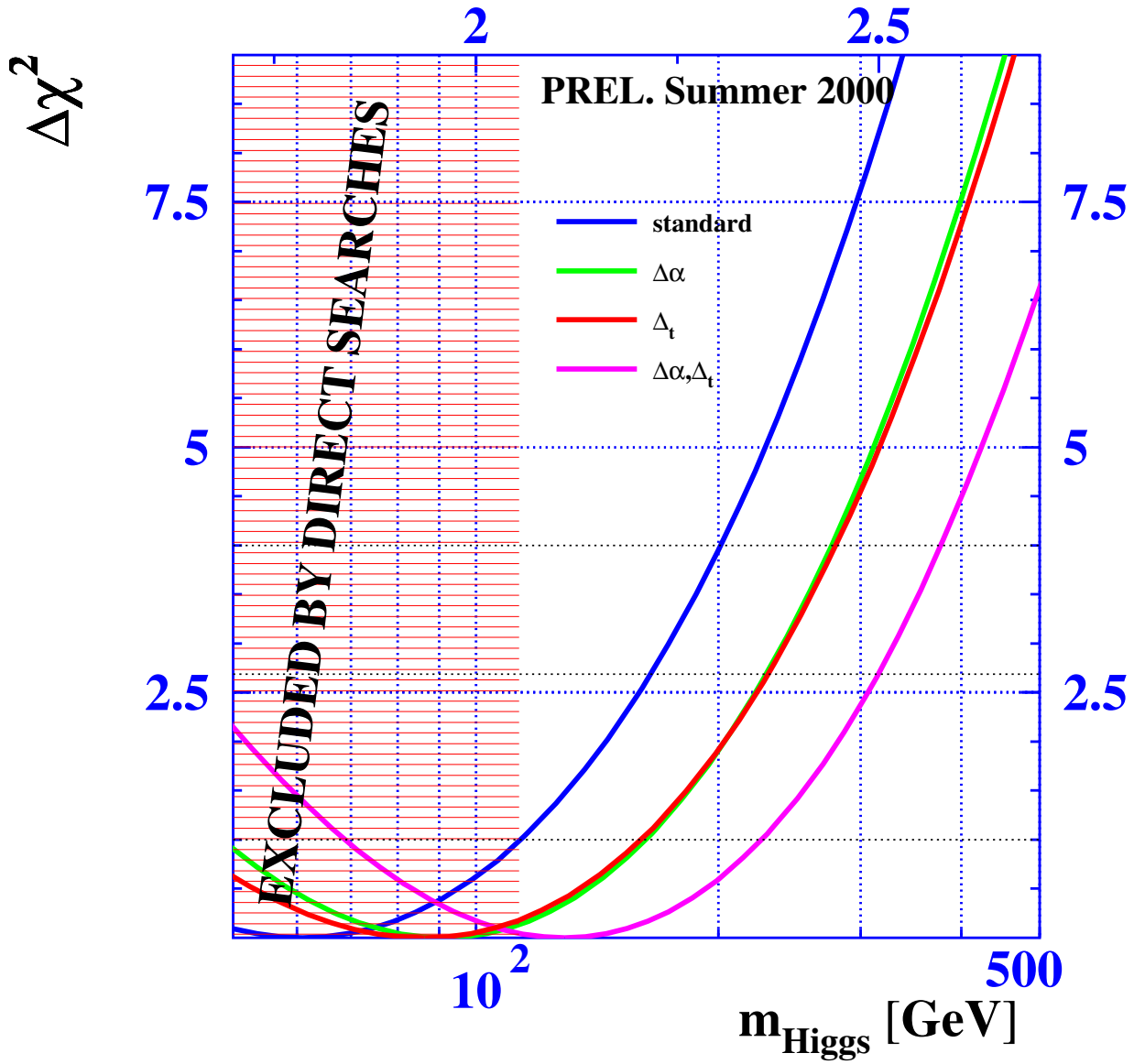
EW radiative corrections



$$\Delta r = \Delta\alpha + \Delta r_w(m_t, m_H, \ldots.)$$

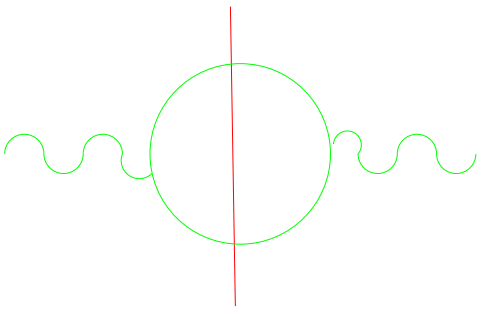
Sensitivity to $\Delta\alpha$ and Δ m_t

repeat the fit by changing the input value of
α^{-1} by 0.09 (1σ)
m_t by 5.1 GeV (1σ)
both



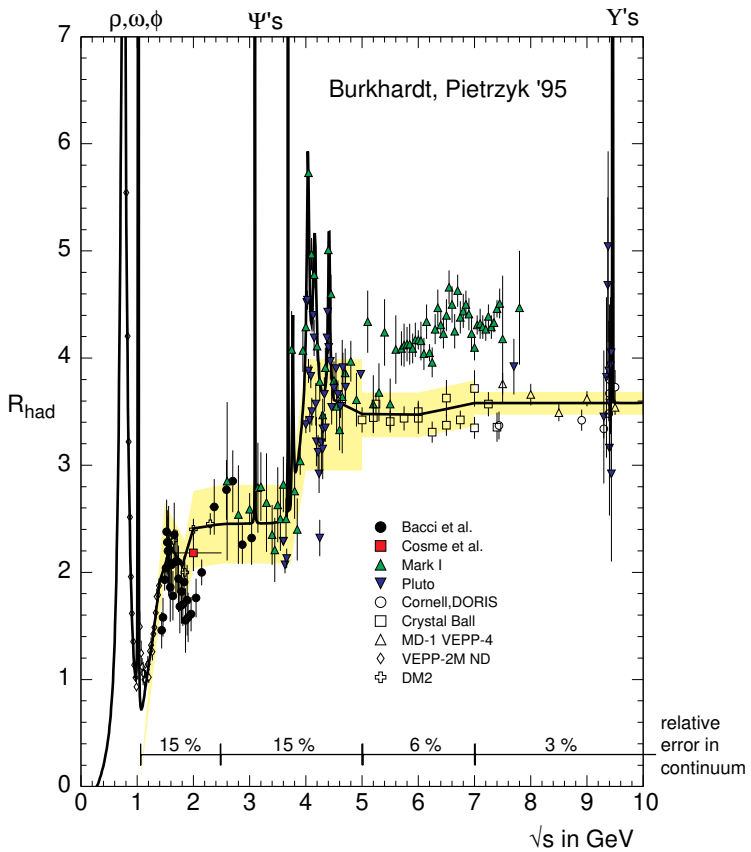
$$\Delta r = \Delta\alpha + \Delta_{weak}(m_t, m_H)$$

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



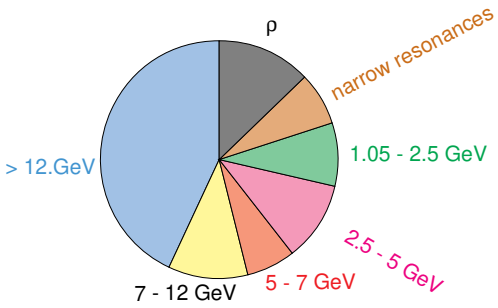
$$\text{Re}\,\Pi_{\gamma\gamma}(s) = \frac{\alpha\, s}{3\pi}\; P\int_{4m_\pi^2}^{\infty} \frac{R_{had}(s')}{s'(s'-s)} ds'$$

$\Delta\alpha^{(5)}_{had}(s)$ was evaluated (using exp. data) by
S. Eidelmann and F. Jegerleher, Z. Phys. C67(1995)419
H. Burkhardt and B. Pietrzyk, Phys. Lett. B356(1995)398

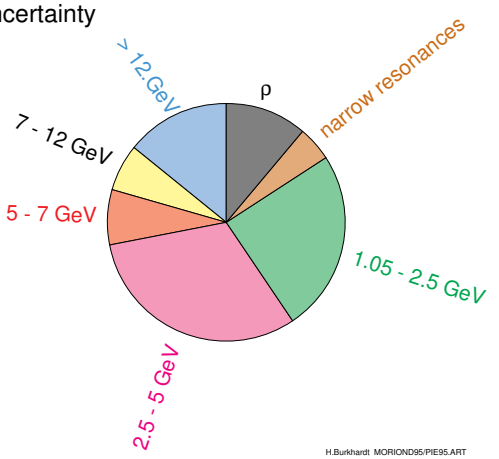


Burkhardt, Pietrzyk '95

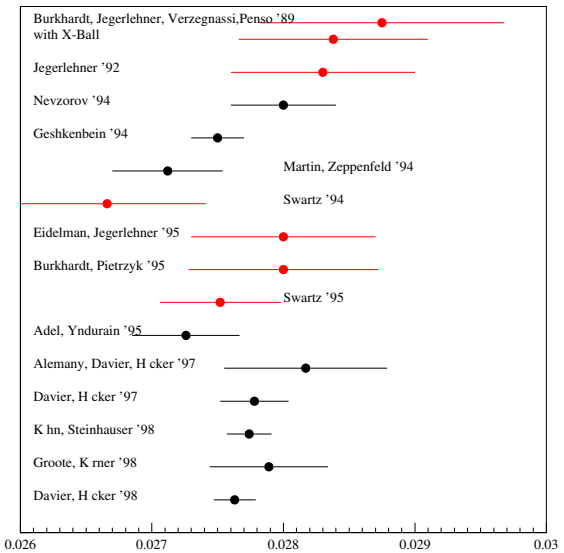
relative contributions to $\Delta\alpha_{had}(M_Z)$



in uncertainty

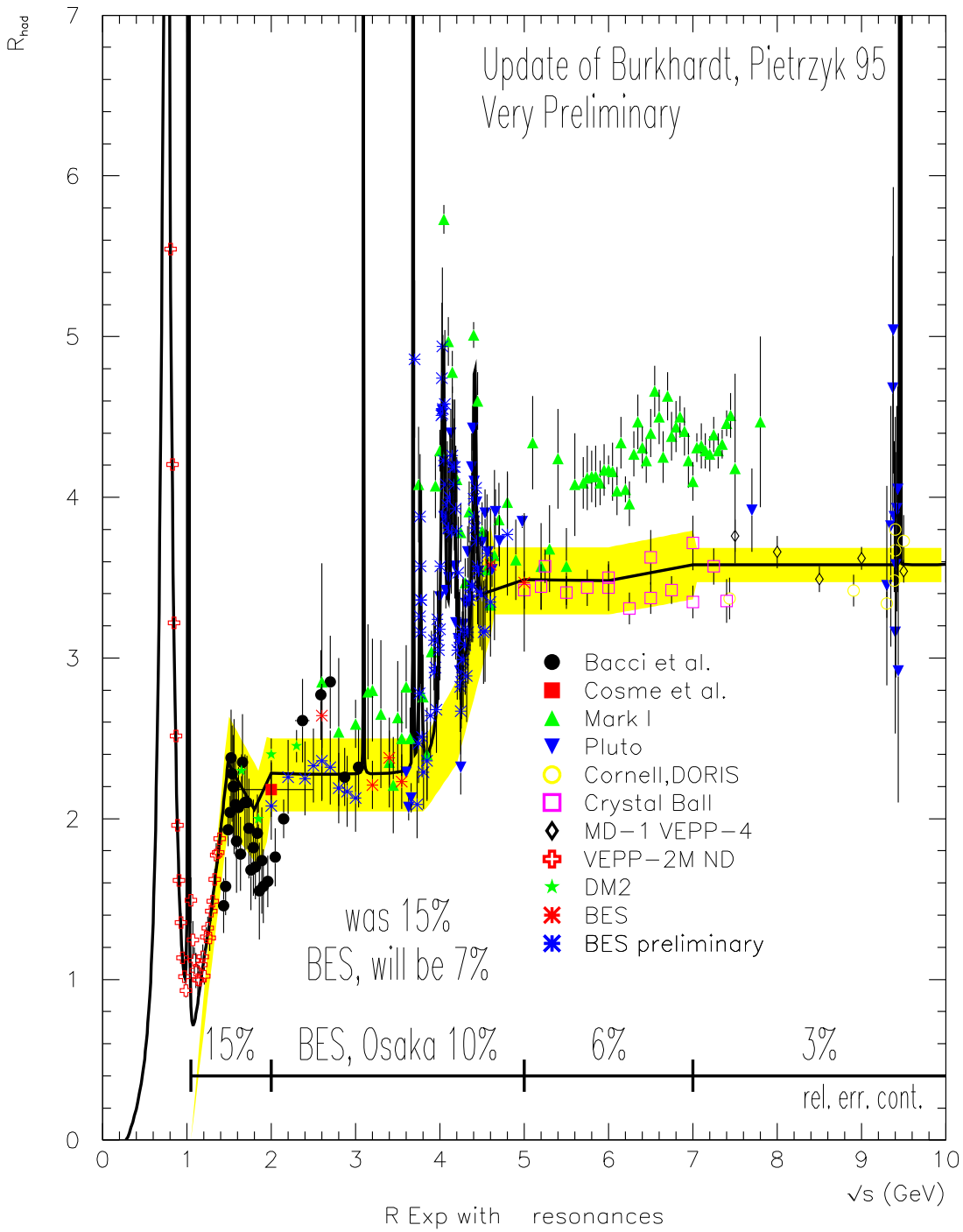


from Burkhardt,Pietrzyk, Phys.Lett.B356(1995)398
new publications added up to Oct.1998



... and now BES results come

α_{QED} with new BES measurements



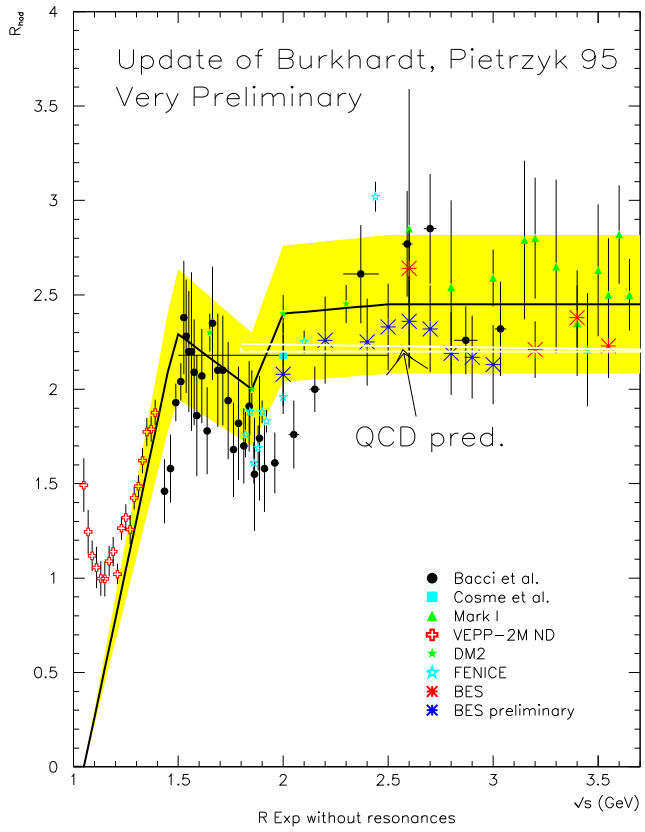
$\Delta\alpha^{(5)}_{had}(s) = 0.02755 \pm 0.00046 \leftarrow$ very preliminary

was 0.0280 ± 0.0007, central value changed by 0.7σ

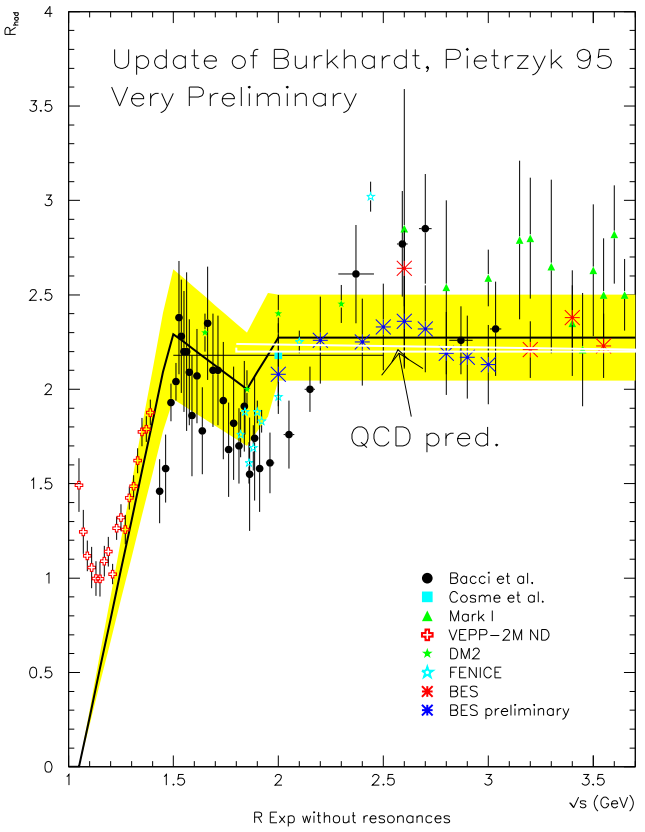
$\rightarrow \alpha^{-1} = 128.945 \pm 0.060$

α_{QED} - comparison of 95 and Osaka analysis
low energy region

95 analysis

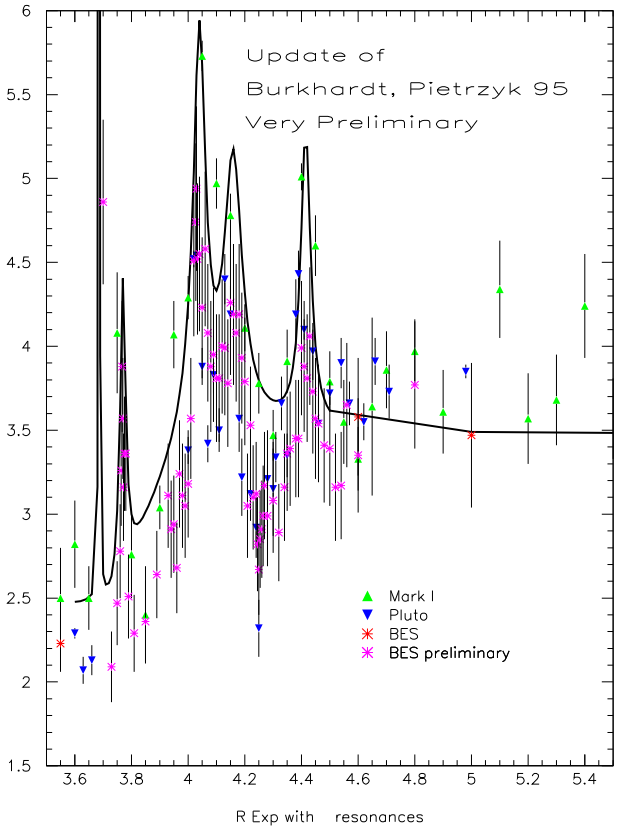


Osaka analysis

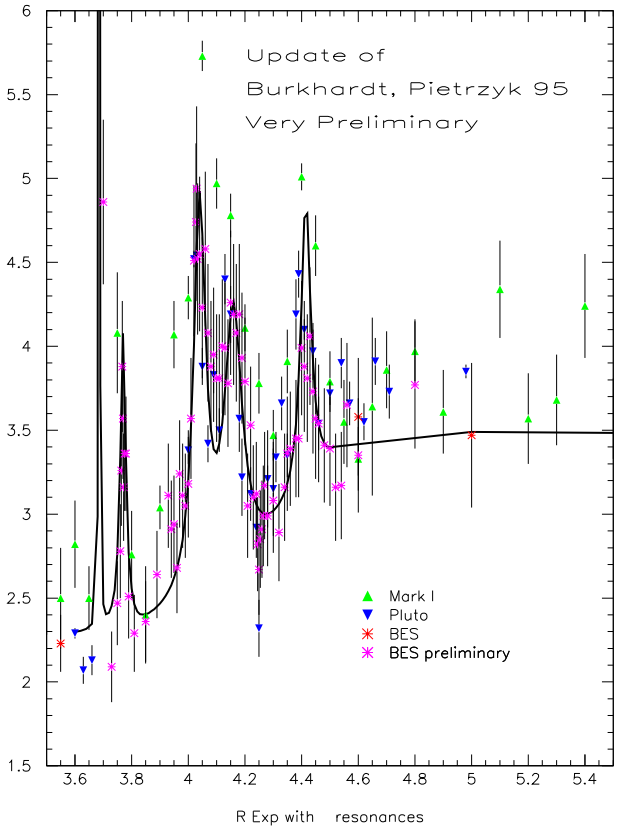


α_{QED} - comparison of 95 and Osaka analysis charmonium region

95 analysis

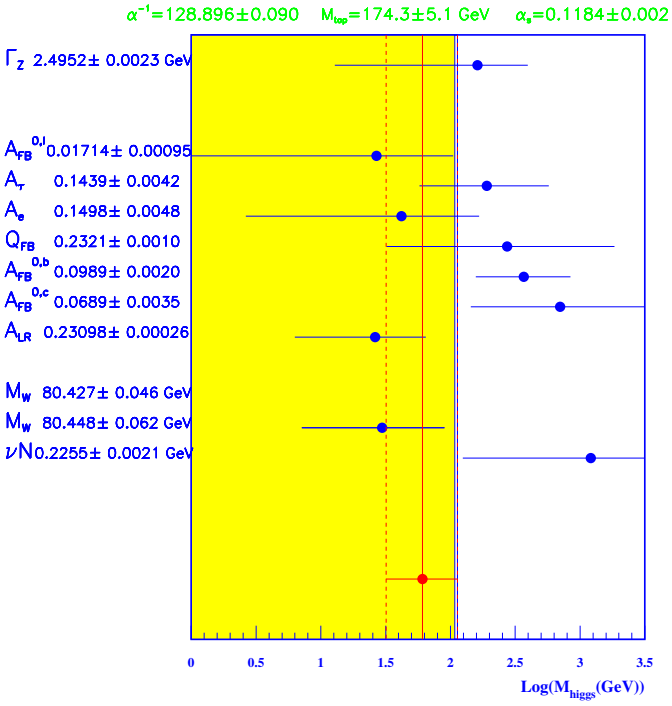


Osaka analysis

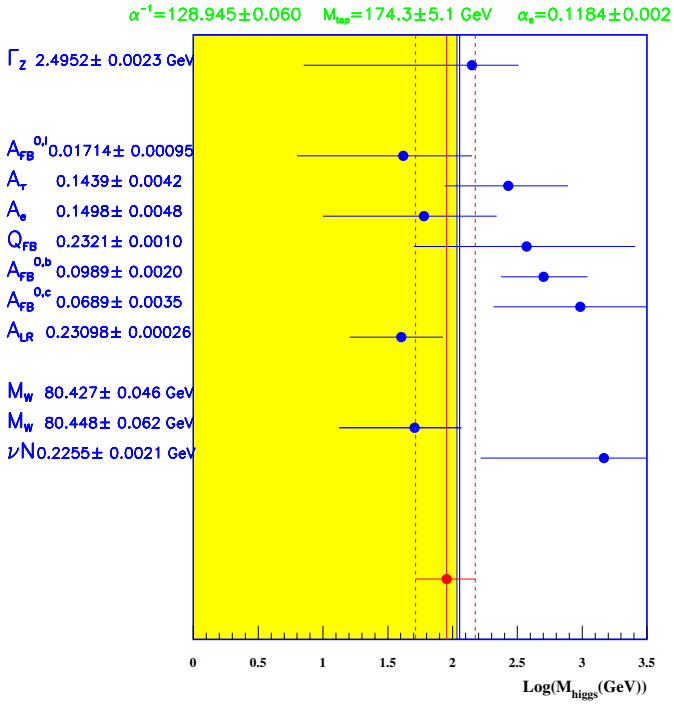


comparison log m_H fits

before BES

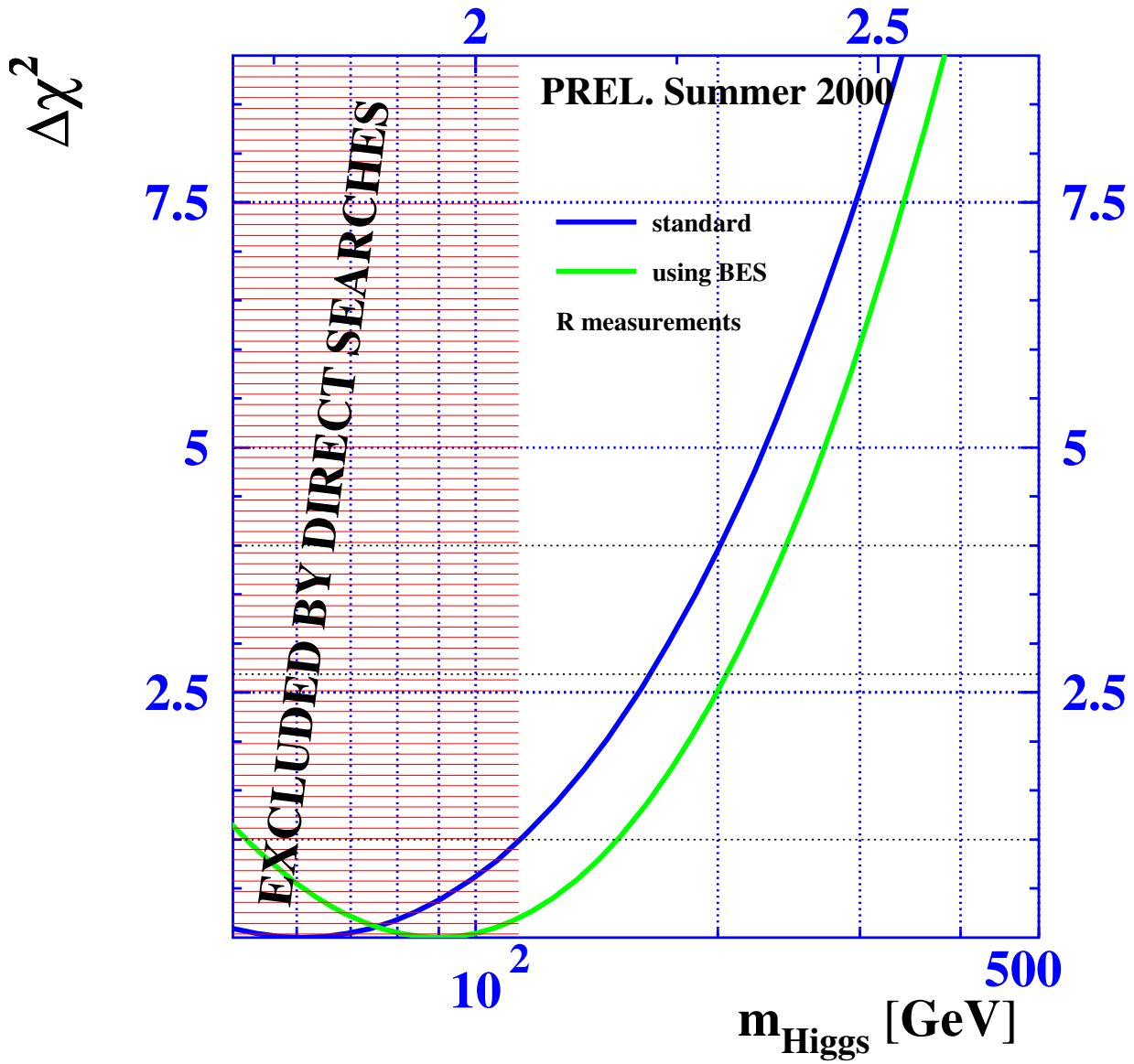


with BES results



with BES results, three measurements $A_{FB}^{0,l}$, A_{LR} and m_W, give higher central values of m_H (40 - 50 GeV)

log m_H - consequence of BES R measurements



minimum moves to 90 GeV, upper limit moves to 210 GeV

↑ very preliminary ↑

Conclusions, comments

- Standard Model is still in a good shape
- Standard Model is consistent
  - indirect $m_t = 169^{+10}_{-8}$ GeV, direct $m_t = 174.3 \pm 5.1$ GeV
  - indirect $m_W = 80.376 \pm 0.034$ GeV,
    direct $m_W = 80.434 \pm 0.037$ GeV
- most significant changes :
  - BES R measurements, not yet included in the official fit results
  - m_W from LEP
  - Z lineshape now final, but preliminary numbers were already very good
- data prefer low Higgs mass

  official fit results $\rightarrow$ $m_H = 62^{+53}_{-30}$ GeV, $m_H < 170$ GeV
- using BES R measurements, data still prefer low m_H, but less low

thanks to
Gunter Quast with his ZF package
Zhengguo Zhao and his BES team
LEPP EWWG with Martin Gruenewald and Bob Clare
LEP Collaborations