Eq. (26.35). (Also, the expression for M_Z is divided by $\sqrt{\rho_0}$; the M_W formula is unchanged.) There is now enough data to determine ρ_0, $\sin^2\theta_W$, m_t, and α_s simultaneously. In particular, R_b and the CDF events yield m_t independent of ρ_0, the asymmetries yield $\widehat{s}^{\,2}_Z$, R gives α_s, and M_Z and the widths constrain ρ_0. From the global fit (including CDF),

$$\rho_0 = 1.0004 \pm 0.0022 \pm 0.002 \tag{26.41}$$

$$\widehat{s}^{\,2}_Z = 0.2318 \pm 0.0005 \tag{26.42}$$

$$\alpha_s = 0.120 \pm 0.007 \tag{26.43}$$

$$m_t = 170^{+16}_{-15} \,, \tag{26.44}$$

where the second error on ρ_0 is from M_H (the other parameters are insensitive to M_H). This is in remarkable agreement with the Standard Model expectation $\rho_0 = 1$, and constrains any higher-dimensional Higgs representation to have vacuum expectation values of less than a few percent of those of the doublets. The allowed regions in the $\rho_0 - \widehat{s}^{\,2}_Z$ plane are shown in Fig. 26.2.

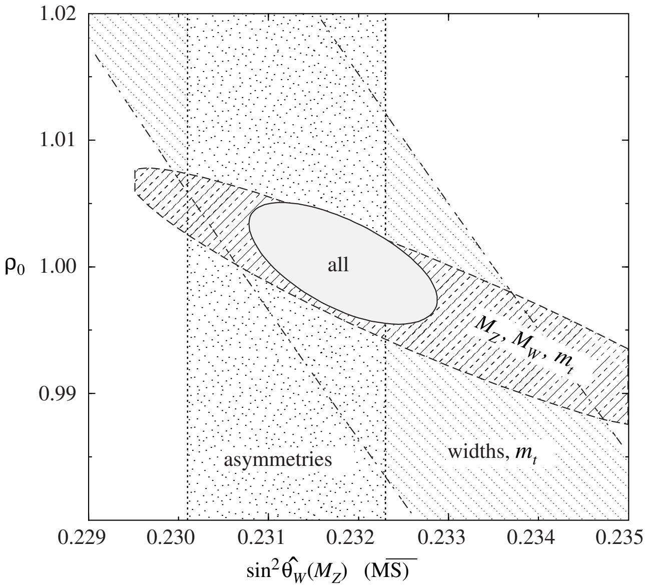

Figure 26.2: The allowed regions in $\sin^2\widehat{\theta}_W - \rho_0$ at 90% CL. m_t is a free parameter and $M_H = 300$ GeV is assumed. (Varying M_H in the range 60–1000 GeV moves the contour down or up by 0.002.)

Most of the parameters relevant to ν-hadron, νe, e-hadron, and e^+e^- processes are determined uniquely and precisely from the data in "model independent" fits (*i.e.*, fits which allow for an arbitrary electroweak gauge theory). The values for the parameters defined in Eqs. (26.12)–(26.14) are given in Table 26.6 along with the predictions of the Standard Model. The agreement is excellent. The low-energy e^+e^- results are difficult to present in a model-independent way because Z-propagator effects are non-negligible at TRISTAN, PETRA, and PEP energies. However, assuming e-μ-τ universality, the lepton asymmetries imply [33] $4(g^e_A)^2 = 0.99 \pm 0.05$, in good agreement with the Standard Model prediction $\simeq 1$. The much more precisely measured Z-pole parameters in Table 26.3 are in excellent agreement with the Standard Model.

Table 26.6: Values of the model-independent neutral-current parameters, compared with the Standard Model prediction using $M_Z = 91.187$ GeV for $m_t = 169^{+16}_{-18}$ GeV and $M_H = 300$ GeV. There is a second $g^{\nu e}_{V,A}$ solution, given approximately by $g^{\nu e}_V \leftrightarrow g^{\nu e}_A$, which is eliminated by e^+e^- data under the assumption that the neutral current is dominated by the exchange of a single Z. θ_i, $i = L$ or R, is defined as $\tan^{-1}[\epsilon_i(u)/\epsilon_i(d)]$.

Quantity	Experimental Value	Standard Model Prediction		Correlation
$\epsilon_L(u)$	0.332 ± 0.016	0.345 ± 0.001		
$\epsilon_L(d)$	-0.438 ± 0.012	-0.429 ± 0.001		non-
$\epsilon_R(u)$	-0.178 ± 0.013	-0.155		Gaussian
$\epsilon_R(d)$	$-0.026\ ^{+0.075}_{-0.048}$	0.078		
g^2_L	0.3017 ± 0.0033	0.303 ± 0.001		
g^2_R	0.0326 ± 0.0033	0.030		small
θ_L	2.50 ± 0.035	2.46		
θ_R	$4.58\ ^{+0.46}_{-0.28}$	5.18		
$g^{\nu e}_A$	-0.506 ± 0.015	-0.506 ± 0.001		-0.04
$g^{\nu e}_V$	-0.039 ± 0.017	-0.037 ± 0.001		
C_{1u}	-0.214 ± 0.046	-0.189 ± 0.001	-0.995	-0.79
C_{1d}	0.359 ± 0.041	0.341 ± 0.002		0.79
$C_{2u} - \frac{1}{2}C_{2d}$	-0.04 ± 0.13	-0.051 ± 0.002		

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