Z

$J = 1$

MINIREVIEW GOES HERE

Z MASS

The fit is performed using the Z mass and width, the Z hadronic pole cross section, the ratios of hadronic to leptonic partial widths, and the Z pole forward-backward lepton asymmetries. We believe that this set is the most free of correlations. Common systematic errors are taken into account. For more details, see the the 'Note on the Z Boson.'

The Z-boson mass listed here corresponds to a Breit-Wigner resonance parameter. The value is 34 MeV greater than the real part of the position of the pole (in the energy plane) in the Z-boson propagator. Also the LEP experiments have generally assumed a fixed value of the γ − Z interferences term based on the standard model. Keeping this term as free parameter leads to a somewhat larger error on the fitted Z mass. See ADRIANI 93H for a detailed investigation of both these issues.

VALUE (GeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
91.187±0.007 OUR FIT					
91.188±0.007 OUR AVERAGE					
91.187±0.007±0.006	1.15M	[1] ABREU	94	DLPH	E^{ee}_{cm}= 88–94 GeV
91.195±0.006±0.007	1.2M	[1] ACCIARRI	94	L3	E^{ee}_{cm}= 88–94 GeV
91.182±0.007±0.006	1.33M	[1] AKERS	94	OPAL	E^{ee}_{cm}= 88–94 GeV
91.187±0.007±0.006	1.28M	[1] BUSKULIC	94	ALEP	E^{ee}_{cm}= 88–94 GeV
90.9 ±0.3 ±0.2	188	[2] ABE	89C	CDF	$E^{p\overline{p}}_{cm}$= 1800 GeV
91.14 ±0.12	480	[3] ABRAMS	89B	MRK2	E^{ee}_{cm}= 89–93 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
91.181±0.007±0.006	512k	[4] ACTON	93D	OPAL	Repl. by AKERS 94
91.195±0.009	460k	[5] ADRIANI	93F	L3	Repl. by ACCIARRI 94
91.160±0.010	463k	[6] ADRIANI	93H	L3	E^{ee}_{cm}= 88–94 GeV
91.187±0.009	520k	[7] BUSKULIC	93J	ALEP	Repl. by BUSKULIC 94
91.187±0.007	2.2M	[8] LEP	93	RVUE	E^{ee}_{cm}= 88–94 GeV
91.187±0.007	1.9M	[9] QUAST	93	RVUE	E^{ee}_{cm}= 88–94 GeV
91.74 ±0.28 ±0.93	156	[10] ALITTI	92B	UA2	$E^{p\overline{p}}_{cm}$= 630 GeV
91.177±0.006±0.02	550k	[11,12] BANERJEE	92	RVUE	E^{ee}_{cm}= 88–94 GeV
91.182±0.009±0.02	190k	[12] DECAMP	92B	ALEP	Repl. by LEP 93
91.175±0.021	650k	[13] LEP	92	RVUE	Repl. by LEP 93
91.177±0.010±0.02	150k	[12] ABREU	91F	DLPH	Repl. by ABREU 94
91.181±0.010±0.02	125k	[12] ADEVA	91E	L3	Repl. by LEP 93
91.161±0.009±0.02	184k	[12] ALEXANDER	91F	OPAL	Repl. by LEP 93
93.1 ±1.0 ±3.0	24	[14,15] ALBAJAR	89	UA1	$E^{p\overline{p}}_{cm}$= 546,630 GeV

[1] The second error of 6.3 MeV is due to a common LEP energy uncertainty.
[2] First error of ABE 89 is combination of statistical and systematic contributions; second is mass scale uncertainty.
[3] ABRAMS 89B uncertainty includes 35 MeV due to the absolute energy measurement.
[4] The systematic error in ACTON 93D is from the uncertainty in the LEP energy calibration.
[5] The error in ADEVA 91E includes 6 MeV due to the uncertainty in LEP energy calibration.
[6] ADRIANI 93H use the S-matrix approach to determine the pole position for the Z boson. Note the shift of this result with respect to the standard Breit-Wigner parametrization.
[7] BUSKULIC 93J supersedes DECAMP 92B. The error includes 6 MeV due to the uncertainty in LEP energy calibration.
[8] The LEP 93 error is due to the experiments is 4 MeV and the uncertainty due to the absolute LEP energy scale is 6 MeV.
[9] QUAST 93 is a combined analysis of LEP results as of Feb. 1993. A common systematic error of 6 MeV is taken into account.
[10] Enters fit through W/Z mass ratio below. The ALITTI 92B systematic error (±0.93) has two contributions: one (±0.92) cancels in m_W/m_Z and one (±0.12) is noncancelling. These were added in quadrature.
[11] BANERJEE 92 is a combined analysis of the four LEP experiments as of March 1991.
[12] The systematic error (0.02) is an error in common to the 4 LEP experiments.
[13] LEP 92 is combined analysis by the four LEP experiments as of December 1991. Systematic errors are included.
[14] Enters fit through Z-W mass difference below.
[15] ALBAJAR 89 result is from a total sample of 33 $Z \rightarrow e^+e^-$ events.

*CITATION: L. Montanet et al., Physical Review D50, 1173 (1994) and 1995 off-year partial update for the 1996 edition (URL: http://pdg.lbl.gov/)

Z WIDTH

VALUE (GeV)	EVTS	DOCUMENT ID		TECN	COMMENT
2.490±0.007 OUR FIT					
2.491±0.007 OUR AVERAGE					
2.483±0.011±0.0045	1.15M	[16] ABREU	94	DLPH	$E^{ee}_{\rm cm}$= 88–94 GeV
2.494±0.009±0.0045	1.2M	[16] ACCIARRI	94	L3	$E^{ee}_{\rm cm}$= 88–94 GeV
2.483±0.011±0.0045	1.33M	[16] AKERS	94	OPAL	$E^{ee}_{\rm cm}$= 88–94 GeV
2.501±0.011±0.0045	1.28M	[16] BUSKULIC	94	ALEP	$E^{ee}_{\rm cm}$= 88–94 GeV
3.8 ±0.8 ±1.0	188	ABE	89C	CDF	$E^{p\overline{p}}_{\rm cm}$= 1800 GeV
$2.42\ ^{+0.45}_{-0.35}$	480	[17] ABRAMS	89B	MRK2	$E^{ee}_{\rm cm}$= 89–93 GeV
$2.7\ ^{+1.2}_{-1.0}\ \pm1.3$	24	[18] ALBAJAR	89	UA1	$E^{p\overline{p}}_{\rm cm}$= 546,630 GeV
2.7 ±2.0 ±1.0	25	[19] ANSARI	87	UA2	$E^{p\overline{p}}_{\rm cm}$= 546,630 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
2.483±0.011±0.004	512k	[20] ACTON	93D	OPAL	Repl. by AKERS 94
2.490±0.011	460k	[21] ADRIANI	93F	L3	Repl. by ACCIARRI 94
2.492±0.012	463k	[22] ADRIANI	93H	L3	$E^{ee}_{\rm cm}$= 88–94 GeV
2.501±0.012	520k	[23] BUSKULIC	93J	ALEP	Repl. by BUSKULIC 94
2.490±0.007	1.9M	[24] QUAST	93	RVUE	$E^{ee}_{\rm cm}$= 88–94 GeV
2.481±0.010	550k	[25] BANERJEE	92	RVUE	$E^{ee}_{\rm cm}$= 88–94 GeV
2.484±0.017±0.005	190k	[26] DECAMP	92B	ALEP	Repl. by BUSKULIC 93J
2.487±0.010	650k	[27] LEP	92	RVUE	$E^{ee}_{\rm cm}$= 88–94 GeV
2.465±0.019±0.005	150k	[26] ABREU	91F	DLPH	Repl. by ABREU 94
2.501±0.017±0.005	125k	[26] ADEVA	91E	L3	Repl. by ADRIANI 93F
2.492±0.015±0.005	184k	[26] ALEXANDER	91F	OPAL	Repl. by ACTON 93D

[16] The second error of 4.5 MeV is due to a common LEP energy uncertainty.
[17] ABRAMS 89B uncertainty includes 50 MeV due to the miniSAM background subtraction error.
[18] ALBAJAR 89 result is from a total sample of 33 $Z \rightarrow e^+e^-$ events.
[19] Quoted values of ANSARI 87 are from direct fit. Ratio of Z and W production gives either $\Gamma(Z) < (1.09\pm0.07)\times\Gamma(W)$, CL = 90% or $\Gamma(Z) = (0.82^{+0.19}_{-0.14}\pm0.06)\times\Gamma(W)$. Assuming Standard-Model value $\Gamma(W)$ = 2.65 GeV then gives $\Gamma(Z) <$ 2.89 ± 0.19 or $= 2.17^{+0.50}_{-0.37} \pm 0.16$.
[20] The systematic error is from the uncertainty in the LEP energy calibration.
[21] The error in ADRIANI 93F includes 4 MeV due to the uncertainty in LEP energy calibration.
[22] ADRIANI 93H use the S-matrix approach to determine the pole position for the Z boson.
[23] The error in BUSKULIC 93J includes 4 MeV due to the uncertainty in LEP energy calibration.
[24] QUAST 93 is a combined analysis of LEP results as of Feb. 1993. A common systematic error of 4 MeV is taken into account.
[25] BANERJEE 92 is a combined analysis of the four LEP experiments as of March 1991.
[26] The systematic error (0.005) is an error in common to the 4 LEP experiments.
[27] LEP 92 is combined analysis by the four LEP experiments as of December 1991. Systematic errors are included.

Z DECAY MODES

	Mode		Fraction (Γ_i/Γ)	Confidence level
Γ_1	e^+e^-		(3.366±0.008) %	
Γ_2	$\mu^+\mu^-$		(3.367±0.013) %	
Γ_3	$\tau^+\tau^-$		(3.360±0.015) %	
Γ_4	$\ell^+\ell^-$	[a]	(3.367±0.006) %	
Γ_5	invisible		(20.01 ±0.16) %	
Γ_6	hadrons		(69.90 ±0.15) %	
Γ_7	$(u\overline{u}+c\overline{c})/2$		(9.7 ±1.8) %	
Γ_8	$(d\overline{d}+s\overline{s}+b\overline{b})/3$		(16.8 ±1.2) %	
Γ_9	$c\overline{c}$		(11.7 ±1.0) %	
Γ_{10}	$b\overline{b}$		(15.32 ±0.14) %	
Γ_{11}	$\pi^0\gamma$		$< 5.5 \times 10^{-5}$	95%
Γ_{12}	$\eta\gamma$		$< 5.1 \times 10^{-5}$	95%
Γ_{13}	$\omega\gamma$		$< 6.5 \times 10^{-4}$	95%
Γ_{14}	$\eta'(958)\gamma$		$< 4.2 \times 10^{-5}$	95%
Γ_{15}	$\gamma\gamma$		$< 5.5 \times 10^{-5}$	95%

Γ_{16}	$\gamma\gamma\gamma$			< 1.0	$\times 10^{-5}$	95%
Γ_{17}	$\pi^{\pm} W^{\mp}$		[b]	< 7	$\times 10^{-5}$	95%
Γ_{18}	$\rho^{\pm} W^{\mp}$		[b]	< 8.3	$\times 10^{-5}$	95%
Γ_{19}	$K^0 X$					
Γ_{20}	ηX					
Γ_{21}	$K^*(892)^+ X$					
Γ_{22}	$K^*(892)^0 X$					
Γ_{23}	ϕX					
Γ_{24}	ΛX					
Γ_{25}	$\Xi^- X$					
Γ_{26}	$\Sigma(1385)^{\pm} X$					
Γ_{27}	$\Xi(1530)^0 X$					
Γ_{28}	$\Omega^- X$					
Γ_{29}	$J/\psi(1S) X$			$(3.9 \pm 0.4) \times 10^{-3}$		
Γ_{30}	$\psi(2S) X$			$(1.6 \pm 0.8) \times 10^{-3}$		
Γ_{31}	$\chi_{c1}(1P) X$			$(6.0 \pm 1.9) \times 10^{-3}$		
Γ_{32}	$(D^0 / \overline{D}^0) X$			(20.7 ± 2.0) %		
Γ_{33}	$D^{\pm} X$			(12.2 ± 1.7) %		
Γ_{34}	$D^*(2010)^{\pm} X$		[b]	(11.4 ± 1.3) %		
Γ_{35}	$B X$					
Γ_{36}	$B^* X$					
Γ_{37}	$B^0_s X$			seen		
Γ_{38}	anomalous $\gamma +$ hadrons		[c]	< 3.2	$\times 10^{-3}$	95%
Γ_{39}	$e^+ e^- \gamma$		[c]	< 5.2	$\times 10^{-4}$	95%
Γ_{40}	$\mu^+ \mu^- \gamma$		[c]	< 5.6	$\times 10^{-4}$	95%
Γ_{41}	$\tau^+ \tau^- \gamma$		[c]	< 7.3	$\times 10^{-4}$	95%
Γ_{42}	$\ell^+ \ell^- \gamma\gamma$		[d]	< 6.8	$\times 10^{-6}$	95%
Γ_{43}	$q \overline{q} \gamma\gamma$		[d]	< 5.5	$\times 10^{-6}$	95%
Γ_{44}	$\nu \overline{\nu} \gamma\gamma$		[d]	< 3.1	$\times 10^{-6}$	95%
Γ_{45}	$e^{\pm} \mu^{\mp}$	LF	[b]	< 6	$\times 10^{-6}$	95%
Γ_{46}	$e^{\pm} \tau^{\mp}$	LF	[b]	< 1.3	$\times 10^{-5}$	95%
Γ_{47}	$\mu^{\pm} \tau^{\mp}$	LF	[b]	< 1.9	$\times 10^{-5}$	95%

[a] ℓ indicates each type of lepton (e, μ, and τ), not sum over them.

[b] The value is for the sum of the charge states indicated.

[c] See the Full Listings below for the γ energy range used in this measurement.

[d] For $m_{\gamma\gamma} = (60 \pm 5)$ GeV.

Z PARTIAL WIDTHS

$\Gamma(e^+ e^-)$ Γ_1

This parameter is not directly used in the overall fit but is derived using the fit results; see the 'Note on the Z Boson.'

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
83.83±0.30 OUR FIT					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
83.31±0.54	31.4k	ABREU	94	DLPH	E^{ee}_{cm}= 88–94 GeV
83.43±0.52	38k	ACCIARRI	94	L3	E^{ee}_{cm}= 88–94 GeV
83.63±0.53	42k	AKERS	94	OPAL	E^{ee}_{cm}= 88–94 GeV
84.61±0.49	45.8k	BUSKULIC	94	ALEP	E^{ee}_{cm}= 88–94 GeV
83.03±0.66	17k	ACTON	93D	OPAL	Repl. by AKERS 94
83.0 ±0.6	16k	ADRIANI	93M	L3	Repl. by ACCIARRI 94
84.43±0.60		BUSKULIC	93J	ALEP	Repl. by BUSKULIC 94
83.30±0.35	70k	[28] QUAST	93	RVUE	E^{ee}_{cm}= 88–94 GeV
82.6 ±0.7	16k	[29] BANERJEE	92	RVUE	E^{ee}_{cm}= 88–94 GeV
83.8 ±0.9	6947	DECAMP	92B	ALEP	Repl. by BUSKULIC 93J
83.20±0.55	19k	[30] LEP	92	RVUE	E^{ee}_{cm}= 88–94 GeV
82.4 ±1.1 ±0.5	2772	ABREU	91F	DLPH	Repl. by ABREU 94
83.3 ±1.1	4175	ADEVA	91E	L3	Repl. by ADRIANI 93M
82.9 ±1.0	5507	ALEXANDER	91F	OPAL	Repl. by ACTON 93D

[28] QUAST 93 is a combined analysis of LEP results as of Feb. 1993.
[29] BANERJEE 92 is a combined analysis of the four LEP experiments as of March 1991.
[30] LEP 92 is combined analysis by the four LEP experiments as of December 1991. Systematic errors are included.

$\Gamma(\mu^+\mu^-)$ — Γ_2

This parameter is not directly used in the overall fit but is derived using the fit results; see the 'Note on the Z Boson.'

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
83.84±0.39 OUR FIT					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
84.15±0.77	45.6k	ABREU	94	DLPH	E^{ee}_{cm}= 88–94 GeV
83.20±0.79	34k	ACCIARRI	94	L3	E^{ee}_{cm}= 88–94 GeV
83.83±0.65	57k	AKERS	94	OPAL	E^{ee}_{cm}= 88–94 GeV
83.62±0.75	46.4k	BUSKULIC	94	ALEP	E^{ee}_{cm}= 88–94 GeV
84.43±0.92	23k	ACTON	93D	OPAL	Repl. by AKERS 94
82.8 ±1.0	14k	ADRIANI	93M	L3	Repl. by ACCIARRI 94
83.66±0.95		BUSKULIC	93J	ALEP	Repl. by BUSKULIC 94
83.82±0.52	70k	[31] QUAST	93	RVUE	E^{ee}_{cm}= 88–94 GeV
83.7 ±1.1	16k	[32] BANERJEE	92	RVUE	E^{ee}_{cm}= 88–94 GeV
81.4 ±1.4	6691	DECAMP	92B	ALEP	Repl. by BUSKULIC 93J
83.35±0.86	21k	[33] LEP	92	RVUE	E^{ee}_{cm}= 88–94 GeV
86.9 ±1.9 ±0.9	3428	ABREU	91F	DLPH	Repl. by ABREU 94
84.5 ±2.0	3245	ADEVA	91E	L3	Repl. by ADRIANI 93M
83.2 ±1.5	7240	ALEXANDER	91F	OPAL	Repl. by ACTON 93D

[31] QUAST 93 is a combined analysis of LEP results as of Feb. 1993.
[32] BANERJEE 92 is a combined analysis of the four LEP experiments as of March 1991.
[33] LEP 92 is combined analysis by the four LEP experiments as of December 1991. Systematic errors are included.

$\Gamma(\tau^+\tau^-)$ — Γ_3

This parameter is not directly used in the overall fit but is derived using the fit results; see the 'Note on the Z Boson.'

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
83.68±0.44 OUR FIT					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
83.55±0.91	25k	ABREU	94	DLPH	E^{ee}_{cm}= 88–94 GeV
84.04±0.94	25k	ACCIARRI	94	L3	E^{ee}_{cm}= 88–94 GeV
82.90±0.77	47k	AKERS	94	OPAL	E^{ee}_{cm}= 88–94 GeV
84.18±0.79	45.1k	BUSKULIC	94	ALEP	E^{ee}_{cm}= 88–94 GeV
82.2 ±1.1	18k	ACTON	93D	OPAL	Repl. by AKERS 94
84.6 ±1.2	10k	ADRIANI	93M	L3	Repl. by ACCIARRI 94
84.09±1.10		BUSKULIC	93J	ALEP	Repl. by BUSKULIC 94
83.54±0.62	50k	[34] QUAST	93	RVUE	E^{ee}_{cm}= 88–94 GeV
83.1 ±1.2	16k	[35] BANERJEE	92	RVUE	E^{ee}_{cm}= 88–94 GeV
82.4 ±1.6	6260	DECAMP	92B	ALEP	Repl. by BUSKULIC 93J
82.76±1.02	17k	[36] LEP	92	RVUE	E^{ee}_{cm}= 88–94 GeV
82.7 ±2.1 ±1.1	2345	ABREU	91F	DLPH	Repl. by ABREU 94
84.0 ±2.7	2540	ADEVA	91E	L3	Repl. by ADRIANI 93M
82.7 ±1.9	5559	ALEXANDER	91F	OPAL	Repl. by ACTON 93D

[34] QUAST 93 is a combined analysis of LEP results as of Feb. 1993.
[35] BANERJEE 92 is a combined analysis of the four LEP experiments as of March 1991.
[36] LEP 92 is combined analysis by the four LEP experiments as of December 1991. Systematic errors are included.

$\Gamma(\ell^+\ell^-)$ — Γ_4

In our fit $\Gamma(\ell^+\ell^-)$ is defined as the partial Z width for the decay into a pair of massless charged leptons. This parameter is not directly used in the 5-parameter fit assuming lepton universality but is derived using the fit results. See the 'Note on the Z Boson.'

VALUE (MeV)	*EVTS*	*DOCUMENT ID*	*TECN*	*COMMENT*
83.84±0.27 OUR FIT				
• • • We do not use the following data for averages, fits, limits, etc. • • •				

83.56±0.45	102k	ABREU	94	DLPH	E^{ee}_{cm}= 88–94 GeV
83.49±0.46	97k	ACCIARRI	94	L3	E^{ee}_{cm}= 88–94 GeV
83.55±0.44	146k	AKERS	94	OPAL	E^{ee}_{cm}= 88–94 GeV
84.40±0.43	137.3k	BUSKULIC	94	ALEP	E^{ee}_{cm}= 88–94 GeV
83.27±0.50	58k	ACTON	93D	OPAL	Repl. by AKERS 94
83.1 ±0.5	40k	ADRIANI	93F	L3	Repl. by ACCIARRI 94
84.22±0.48		BUSKULIC	93J	ALEP	Repl. by BUSKULIC 94
83.40±0.29	190k	[37] QUAST	93	RVUE	E^{ee}_{cm}= 88–94 GeV
83.0 ±0.4	50k	[38] BANERJEE	92	RVUE	E^{ee}_{cm}= 88–94 GeV
83.1 ±0.7	20k	DECAMP	92B	ALEP	Repl. by BUSKULIC 93J
83.24±0.42	57k	[39] LEP	92	RVUE	E^{ee}_{cm}= 88–94 GeV
83.4 ±0.8	10k	ABREU	91F	DLPH	Repl. by ABREU 94
83.6 ±0.8	10k	ADEVA	91E	L3	Repl. by ADRIANI 93F
83.0 ±0.7	18k	ALEXANDER	91F	OPAL	Repl. by ACTON 93D

[37] QUAST 93 is a combined analysis of LEP results as of Feb. 1993.
[38] BANERJEE 92 is a combined analysis of the four LEP experiments as of March 1991.
[39] LEP 92 is combined analysis by the four LEP experiments as of December 1991. Systematic errors are included.

Γ(invisible) Γ_5

We use only direct measurements of the invisible partial width to obtain the average value quoted below. The fit value is obtained as a difference between the total and the observed partial widths assuming lepton universality.

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
498.2± 4.2 OUR FIT					
517 ±22 OUR AVERAGE					
539 ±26 ±17	410	AKERS	95C	OPAL	E^{ee}_{cm}= 88–94 GeV
450 ±34 ±34	258	BUSKULIC	93L	ALEP	E^{ee}_{cm}= 88–94 GeV
540 ±80 ±40	52	ADEVA	92	L3	E^{ee}_{cm}= 88–94 GeV
524 ±40 ±20	172	[40] ADRIANI	92E	L3	E^{ee}_{cm} = 89–94 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
509.4± 7.0		ABREU	94	DLPH	E^{ee}_{cm}= 88–94 GeV
496.5± 7.9		ACCIARRI	94	L3	E^{ee}_{cm}= 88–94 GeV
490.3± 7.3		AKERS	94	OPAL	E^{ee}_{cm}= 88–94 GeV
501 ± 6		BUSKULIC	94	ALEP	E^{ee}_{cm}= 88–94 GeV
495 ±10		ACTON	93D	OPAL	Repl. by AKERS 94
494 ±10		ADRIANI	93M	L3	Repl. by ACCIARRI 94
498 ± 9		BUSKULIC	93J	ALEP	Repl. by BUSKULIC 94
499 ± 6		[41] QUAST	93	RVUE	E^{ee}_{cm}= 88–94 GeV
491 ±13		DECAMP	92B	ALEP	Repl. by BUSKULIC 93J
498 ± 8		[42] LEP	92	RVUE	E^{ee}_{cm}= 88–94 GeV
488 ±17		ABREU	91F	DLPH	Repl. by ABREU 94
508 ±17		ADEVA	91E	L3	Repl. by ADRIANI 93M
500 ±70 ±30	65	AKRAWY	91D	OPAL	Repl. by AKERS 95C
504 ±15		ALEXANDER	91F	OPAL	Repl. by ACTON 93D

[40] ADRIANI 92E improves but does not supersede ADEVA 92, obtained with 1990 data only.
[41] QUAST 93 is a combined analysis of LEP results as of Feb. 1993. Assumes lepton universality.
[42] LEP 92 is combined analysis by the four LEP experiments as of December 1991. Systematic errors are included. Assumes lepton universality.

Γ(hadrons) Γ_6

This parameter is not directly used in the 5-parameter fit assuming lepton universality, but is derived using the fit results. See the 'Note on the Z Boson.'

VALUE (MeV)	*EVTS*	*DOCUMENT ID*	*TECN*	*COMMENT*
1740.7± 5.9 OUR FIT				
• • • We do not use the following data for averages, fits, limits, etc. • • •				

1723 ±10	1.05M	ABREU	94	DLPH	$E^{ee}_{\rm cm}$= 88–94 GeV
1748 ±10	1.1M	ACCIARRI	94	L3	$E^{ee}_{\rm cm}$= 88–94 GeV
1741 ±10	1.2M	[43] AKERS	94	OPAL	$E^{ee}_{\rm cm}$= 88–94 GeV
1746 ±10	1.14M	BUSKULIC	94	ALEP	$E^{ee}_{\rm cm}$= 88–94 GeV
1738 ±12	454k	[44] ACTON	93D	OPAL	Repl. by AKERS 94
1747 ±11	420k	ADRIANI	93F	L3	Repl. by ACCIARRI 94
1751 ±11		BUSKULIC	93J	ALEP	Repl. by BUSKULIC 94
1741 ± 7	1.7M	[45] QUAST	93	RVUE	$E^{ee}_{\rm cm}$= 88–94 GeV
1734 ±10	500k	[46,47] BANERJEE	92	RVUE	$E^{ee}_{\rm cm}$= 88–94 GeV
1740 ±12	570k	[48] LEP	92	RVUE	Repl. by LEP 93
1726 ±19	124k	ABREU	91F	DLPH	Repl. by ABREU 94

[43] AKERS 94 assumes lepton universality. Without this assumption, it becomes 1742 ± 11 MeV.

[44] ACTON 93D assumes lepton universality. Without this assumption it becomes 1743 ± 15 MeV.

[45] QUAST 93 is a combined analysis of LEP results as of Feb. 1993. Assumes lepton universality.

[46] Assuming lepton universality. Without this assumption it becomes 1741 ± 15 MeV.

[47] BANERJEE 92 is a combined analysis of the four LEP experiments as of March 1991.

[48] LEP 92 is combined analysis by the four LEP experiments as of December 1991. Systematic errors are included. Assumes lepton universality.

Z BRANCHING RATIOS

$\Gamma(\text{hadrons})/\Gamma(e^+e^-)$ Γ_6/Γ_1

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
20.76± 0.08 OUR FIT					
20.74± 0.18	31.4k	ABREU	94	DLPH	$E^{ee}_{\rm cm}$= 88–94 GeV
20.96± 0.15	38k	ACCIARRI	94	L3	$E^{ee}_{\rm cm}$= 88–94 GeV
20.83± 0.16	42k	AKERS	94	OPAL	$E^{ee}_{\rm cm}$= 88–94 GeV
20.59± 0.15	45.8k	BUSKULIC	94	ALEP	$E^{ee}_{\rm cm}$= 88–94 GeV
$27.0\ ^{+11.7}_{-\ 8.8}$	12	[49] ABRAMS	89D	MRK2	$E^{ee}_{\rm cm}$= 89–93 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
20.99± 0.25	17k	ACTON	93D	OPAL	Repl. by AKERS 94
20.69± 0.21		BUSKULIC	93J	ALEP	Repl. by BUSKULIC 94
20.92± 0.12	70k	[50] QUAST	93	RVUE	$E^{ee}_{\rm cm}$= 88–94 GeV
20.91± 0.22	19k	[51] LEP	92	RVUE	$E^{ee}_{\rm cm}$= 88–94 GeV
21.19± 0.49±0.18	2772	[52] ABREU	91F	DLPH	Repl. by ABREU 94
21.01± 0.40±0.22	4175	[53] ADEVA	91E	L3	Repl. by ACCIARRI 94

[49] ABRAMS 89D have included both statistical and systematic uncertainties in their quoted errors.

[50] QUAST 93 is a combined analysis of LEP results as of Feb. 1993.

[51] LEP 92 is combined analysis by the four LEP experiments as of December 1991. Systematic errors are included.

[52] ABREU 91F report $\Gamma(ee)$ = 82.4 ± 1.1 ± 0.5 MeV and provided us with this branching ratio from the same data and analysis.

[53] ADEVA 91E report B(ee) = 3.33 ± 0.04% and $\Gamma(ee)$ = 83.3 ± 1.1 MeV and provided us with this branching ratio from the same data and analysis.

$\Gamma(\text{hadrons})/\Gamma(\mu^+\mu^-)$ Γ_6/Γ_2

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
20.76±0.07 OUR FIT					
20.78±0.09 OUR AVERAGE Error includes scale factor of 1.3. See the ideogram below.					
20.54±0.14	45.6k	ABREU	94	DLPH	$E^{ee}_{\rm cm}$= 88–94 GeV
21.02±0.16	34k	ACCIARRI	94	L3	$E^{ee}_{\rm cm}$= 88–94 GeV
20.78±0.11	57k	AKERS	94	OPAL	$E^{ee}_{\rm cm}$= 88–94 GeV
20.83±0.15	46.4k	BUSKULIC	94	ALEP	$E^{ee}_{\rm cm}$= 88–94 GeV
$18.9\ ^{+7.1}_{-5.3}$	13	[54] ABRAMS	89D	MRK2	$E^{ee}_{\rm cm}$= 89–93 GeV

• • • We do not use the following data for averages, fits, limits, etc. • • •

20.65±0.17	23k	ACTON	93D	OPAL	Repl. by AKERS 94
20.88±0.20		BUSKULIC	93J	ALEP	Repl. by BUSKULIC 94
20.79±0.10	70k	[55] QUAST	93	RVUE	E^{ee}_{cm}= 88–94 GeV
21.26±0.29	6691	DECAMP	92B	ALEP	Repl. by BUSKULIC 93J
20.88±0.18	21k	[56] LEP	92	RVUE	E^{ee}_{cm}= 88–94 GeV
19.89±0.40±0.19	2475	[57] ABREU	91	DLPH	Repl. by ABREU 94
20.08±0.36±0.16	3428	[58] ABREU	91F	DLPH	Repl. by ABREU 94
20.75±0.39±0.17	3245	[59] ADEVA	91E	L3	Repl. by ACCIARRI 94
20.92±0.31	7240	[60] ALEXANDER	91F	OPAL	Repl. by ACTON 93D

[54] ABRAMS 89D have included both statistical and systematic uncertainties in their quoted errors.

[55] QUAST 93 is a combined analysis of LEP results as of Feb. 1993.

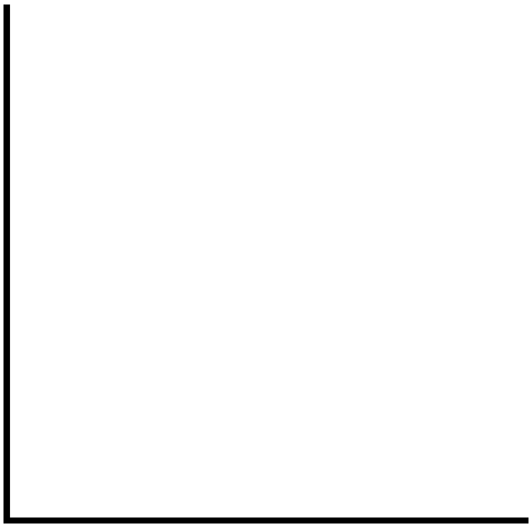
[56] LEP 92 is combined analysis by the four LEP experiments as of December 1991. Systematic errors are included.

[57] ABREU 91 also obtain $[\Gamma(e)\Gamma(\mu)]^{1/2} = 85.0 \pm 0.9 \pm 0.8$ MeV, assuming $m_Z = 91.181$ GeV and $\Gamma(Z) = 2.455$ GeV.

[58] ABREU 91F report $\Gamma(\mu\mu) = 86.9 \pm 1.9 \pm 0.9$ MeV and provided us with this branching ratio from the same data and analysis.

[59] ADEVA 91E report $B(\mu\mu) = 3.38 \pm 0.08\%$ and $\Gamma(\mu\mu) = 84.5 \pm 2.0$ MeV and provided us with this branching ratio from the same data and analysis.

[60] ALEXANDER 91F report $\Gamma(\mu\mu) = 83.2 \pm 1.5$ MeV and provided us with this branching ratio from the same data and analysis.



$\Gamma\left(\text{hadrons}\right)/\Gamma\left(\mu^+\mu^-\right)$

$\Gamma(\text{hadrons})/\Gamma(\tau^+\tau^-)$ $\qquad\Gamma_6/\Gamma_3$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
20.80±0.08 OUR FIT					
20.81±0.08 OUR AVERAGE					
20.68±0.18	25k	ABREU	94	DLPH	E^{ee}_{cm}= 88–94 GeV
20.80±0.20	25k	ACCIARRI	94	L3	E^{ee}_{cm}= 88–94 GeV
21.01±0.15	47k	AKERS	94	OPAL	E^{ee}_{cm}= 88–94 GeV
20.70±0.16	45.1k	BUSKULIC	94	ALEP	E^{ee}_{cm}= 88–94 GeV
$15.2\ ^{+4.8}_{-3.9}$	21	[61] ABRAMS	89D	MRK2	E^{ee}_{cm}= 89–93 GeV

• • • We do not use the following data for averages, fits, limits, etc. • • •

21.22±0.25	18k	ACTON	93D	OPAL	Repl. by AKERS 94
20.77±0.23		BUSKULIC	93J	ALEP	Repl. by BUSKULIC 94
20.86±0.13	50k	[62] QUAST	93	RVUE	E^{ee}_{cm}= 88–94 GeV
21.00±0.36	6260	DECAMP	92B	ALEP	Repl. by BUSKULIC 93J
21.02±0.23	17k	[63] LEP	92	RVUE	E^{ee}_{cm}= 88–94 GeV
21.14±0.49±0.27	2345	[64] ABREU	91F	DLPH	Repl. by ABREU 94
20.83±0.43±0.43	2540	[65] ADEVA	91E	L3	Repl. by ACCIARRI 94
21.05±0.44	5559	[66] ALEXANDER	91F	OPAL	Repl. by ACTON 93D

[61] ABRAMS 89D have included both statistical and systematic uncertainties in their quoted errors.

[62] QUAST 93 is a combined analysis of LEP results as of Feb. 1993.

[63] LEP 92 is combined analysis by the four LEP experiments as of December 1991. Systematic errors are included.

[64] ABREU 91F report $\Gamma(\tau\tau)$ = 82.7 ± 2.1 ± 1.1 MeV and provided us with this branching ratio from the same data and analysis.

[65] ADEVA 91E report B($\tau\tau$) = 3.36 ± 0.11% and $\Gamma(\tau\tau)$ = 84.0 ± 2.7 MeV and provided us with this branching ratio from the same data and analysis.

[66] ALEXANDER 91F report $\Gamma(\tau\tau)$ = 82.7 ± 1.9 MeV and provided us with this branching ratio from the same data and analysis.

$\Gamma(\text{hadrons})/\Gamma(\ell^+\ell^-)$ Γ_6/Γ_4

ℓ indicates each type of lepton (e, μ, and τ), not sum over them.

Our fit result is obtained requiring lepton universality.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
20.76 ±0.05 OUR FIT					
20.77 ±0.07 OUR AVERAGE		Error includes scale factor of 1.4. See the ideogram below.			
20.62 ±0.10	102k	ABREU	94	DLPH	E^{ee}_{cm}= 88–94 GeV
20.93 ±0.10	97k	ACCIARRI	94	L3	E^{ee}_{cm}= 88–94 GeV
20.835±0.086	146k	AKERS	94	OPAL	E^{ee}_{cm}= 88–94 GeV
20.69 ±0.09	137.3k	BUSKULIC	94	ALEP	E^{ee}_{cm}= 88–94 GeV
18.9 $^{+3.6}_{-3.2}$	46	ABRAMS	89B	MRK2	E^{ee}_{cm}= 89–93 GeV

• • • We do not use the following data for averages, fits, limits, etc. • • •

20.88 ±0.13	58k	ACTON	93D	OPAL	Repl. by AKERS 94
21.00 ±0.15	40k	ADRIANI	93M	L3	Repl. by ACCIARRI 94
20.78 ±0.13		BUSKULIC	93J	ALEP	Repl. by BUSKULIC 94
20.87 ±0.07	190k	[67] QUAST	93	RVUE	E^{ee}_{cm}= 88–94 GeV
20.90 ±0.15	50k	[68] BANERJEE	92	RVUE	E^{ee}_{cm}= 88–94 GeV
21.00 ±0.20	20k	DECAMP	92B	ALEP	Repl. by BUSKULIC 93J
20.89 ±0.13	57k	[69] LEP	92	RVUE	E^{ee}_{cm}= 88–94 GeV
20.70 ±0.25 ±0.14	10k	ABREU	91F	DLPH	Repl. by ABREU 94
20.84 ±0.29	10k	ADEVA	91E	L3	Repl. by ADRIANI 93M
20.95 ±0.22	18k	ALEXANDER	91F	OPAL	Repl. by ACTON 93D

[67] QUAST 93 is a combined analysis of LEP results as of Feb. 1993. Assumes lepton universality.

[68] BANERJEE 92 is a combined analysis of the four LEP experiments as of March 1991.

[69] LEP 92 is combined analysis by the four LEP experiments as of December 1991. Systematic errors are included.

$\Gamma(\text{hadrons})/\Gamma(\ell^+\ell^-)$

$\Gamma(\text{hadrons})/\Gamma_{\text{total}}$ — Γ_6/Γ

This parameter is not directly used in the overall fit but is derived using the fit results; see the 'Note on the Z Boson.'

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.6990±0.0015 OUR FIT				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.6983±0.0023	1.14M	BUSKULIC 94	ALEP	E^{ee}_{cm}= 88–94 GeV
0.6993±0.0031	570k	[70] LEP 92	RVUE	E^{ee}_{cm}= 88–94 GeV

[70] LEP 92 is combined analysis by the four LEP experiments as of December 1991. Systematic errors are included. Assumes lepton universality.

$\Gamma(e^+e^-)/\Gamma_{\text{total}}$ — Γ_1/Γ

This parameter is not directly used in the overall fit but is derived using the fit results; see the 'Note on the Z Boson.'

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.03366±0.00008 OUR FIT				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.03383±0.00013	45.8k	BUSKULIC 94	ALEP	E^{ee}_{cm}= 88–94 GeV
0.03345±0.00020	19k	[71] LEP 92	RVUE	E^{ee}_{cm}= 88–94 GeV

[71] LEP 92 is combined analysis by the four LEP experiments as of December 1991. Systematic errors are included.

$\Gamma(\mu^+\mu^-)/\Gamma_{\text{total}}$ — Γ_2/Γ

This parameter is not directly used in the overall fit but is derived using the fit results; see the 'Note on the Z Boson.'

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.03367±0.00013 OUR FIT				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.03344±0.00026	46.4k	BUSKULIC 94	ALEP	E^{ee}_{cm}= 88–94 GeV
0.03351±0.00034	21k	[72] LEP 92	RVUE	E^{ee}_{cm}= 88–94 GeV

[72] LEP 92 is combined analysis by the four LEP experiments as of December 1991. Systematic errors are included.

$\Gamma(\tau^+\tau^-)/\Gamma_{\text{total}}$ — Γ_3/Γ

This parameter is not directly used in the overall fit but is derived using the fit results; see the 'Note on the Z Boson.'

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.03360±0.00015 OUR FIT				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.03366±0.00028	45.1k	BUSKULIC 94	ALEP	E^{ee}_{cm}= 88–94 GeV
0.03328±0.00040	17k	[73] LEP 92	RVUE	E^{ee}_{cm}= 88–94 GeV

[73] LEP 92 is combined analysis by the four LEP experiments as of December 1991. Systematic errors are included.

$\Gamma(\ell^+\ell^-)/\Gamma_{total}$ — Γ_4/Γ

ℓ indicates each type of lepton (e, μ, and τ), not sum over them.

Our fit result assumes lepton universality.

This parameter is not directly used in the overall fit but is derived using the fit results; see the 'Note on the Z Boson.'

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.03367±0.00006 OUR FIT					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.03375±0.00009	137.3k	BUSKULIC	94	ALEP	E^{ee}_{cm}= 88–94 GeV
0.03347±0.00013	57k	[74] LEP	92	RVUE	E^{ee}_{cm}= 88–94 GeV

[74] LEP 92 is combined analysis by the four LEP experiments as of December 1991. Systematic errors are included.

$\Gamma(\text{invisible})/\Gamma_{total}$ — Γ_5/Γ

See the data, the note, and the fit result for the partial width, Γ_5, above.

VALUE	DOCUMENT ID
0.2001±0.0016 OUR FIT	

$\Gamma(\mu^+\mu^-)/\Gamma(e^+e^-)$ — Γ_2/Γ_1

This parameter is not directly used in the overall fit but is derived using the fit results; see the 'Note on the Z Boson.'

VALUE	DOCUMENT ID
1.000±0.005 OUR FIT	

$\Gamma(\tau^+\tau^-)/\Gamma(e^+e^-)$ — Γ_3/Γ_1

This parameter is not directly used in the overall fit but is derived using the fit results; see the 'Note on the Z Boson.'

VALUE	DOCUMENT ID
0.998±0.005 OUR FIT	

$\Gamma((u\overline{u}+c\overline{c})/2)/\Gamma(\text{hadrons})$ — Γ_7/Γ_6

This quantity is the branching ratio of $Z \rightarrow$ "up-type" quarks to $Z \rightarrow$ hadrons.

VALUE	DOCUMENT ID		TECN	COMMENT
0.139±0.026	[75] ACTON	93F	OPAL	E^{ee}_{cm}= 88–94 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.191±0.031±0.040	[76] ALEXANDER	91E	OPAL	Repl. by ACTON 93F

[75] ACTON 93F use the LEP 92 value of Γ(hadrons) = 1740 ± 12 MeV.
[76] ALEXANDER 91E result is from analysis of final state photons.

$\Gamma((d\overline{d}+s\overline{s}+b\overline{b})/3)/\Gamma(\text{hadrons})$ — Γ_8/Γ_6

This quantity is the branching ratio of $Z \rightarrow$ "down-type" quarks to $Z \rightarrow$ hadrons.

VALUE	DOCUMENT ID		TECN	COMMENT
0.241±0.017	[77] ACTON	93F	OPAL	E^{ee}_{cm}= 88–94 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.206±0.021±0.028	[78] ALEXANDER	91E	OPAL	Repl. by ACTON 93F

[77] ACTON 93F use the LEP 92 value of Γ(hadrons) = 1740 ± 12 MeV.
[78] ALEXANDER 91E result is from analysis of final state photons.

$\Gamma(c\overline{c})/\Gamma(\text{hadrons})$ — Γ_9/Γ_6

Our average consists of a simple weighted average assuming no common errors.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.168±0.014 OUR AVERAGE					
0.165±0.005±0.020		[79] BUSKULIC	94G	ALEP	E^{ee}_{cm}= 88–94 GeV
0.187±0.031±0.023		[80] ABREU	93I	DLPH	E^{ee}_{cm}= 88–94 GeV
0.151±0.008±0.041		[81] ABREU	92O	DLPH	E^{ee}_{cm}= 88–94 GeV
0.186±0.035±0.020	115	[82] ALEXANDER	91B	OPAL	E^{ee}_{cm}= 88–95 GeV
0.162±0.030±0.050	381	[83] ABREU	90H	DLPH	E^{ee}_{cm}= 91 GeV
$0.148\pm0.044^{+0.045}_{-0.038}$	1383	[84] DECAMP	90L	ALEP	E^{ee}_{cm}= 88–94 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.223±0.032±0.059		[85] AKRAWY	91E	OPAL	E^{ee}_{cm}= 88–95 GeV

[79] BUSKULIC 94G perform a simultaneous fit to the p and p_T spectra of both single and dilepton events.
[80] ABREU 93I assume that the D_s and charmed baryons are equally produced at LEP and CLEO (10 GeV) energies.
[81] ABREU 92O use the neural network techinque to tag heavy flavour events among a sample of 123k selected hadronic events. The systematic error consists of three parts:

due to Monte Carlo (MC) parametrization (0.023), choice of MC model (0.033) and detector effects (0.009) added in quadrature.

[82] ALEXANDER 91B (OPAL) obtains the result from an analysis of the $D^{*\pm}$ momentum distribution (c production is tagged via $D^{*\pm}$ production). ALEXANDER 91B include all errors due to their experiment in the first quoted error and all others in the second (±0.020).

[83] ABREU 90H use CLEO probability for $c\overline{c} \rightarrow D^*(2010)^{\pm} X$ with $D^*(2010)^{\pm} \rightarrow D^0 \pi^{\pm}$. Systematic error includes ±0.026 due to uncertainties in branching ratios.

[84] DECAMP 90L find $B(c \rightarrow e)\Gamma(c\overline{c})/\Gamma(\text{hadrons}) = 0.0133 \pm 0.0040^{+0.0038}_{-0.0031}$. Assumes $B(c \rightarrow e) = 0.090 \pm 0.013$. Systematic error includes about ±0.025 due to uncertainties in branching ratios.

[85] AKRAWY 91E (OPAL) performs a fit to the p and p_T spectra of muon candidates, used to tag heavy flavor semileptonic decays. AKRAWY 91E systematic error includes the uncertainty from semileptonic branching ratios (±0.025) plus other systematics (±0.053).

$\Gamma(b\overline{b})/\Gamma(\text{hadrons})$ — Γ_{10}/Γ_6

Following the procedure of the joint LEP effort to extract $\Gamma(b\overline{b})/\Gamma(\text{hadrons})$ (see the 'Note on the Z Boson'), we have divided the measurements into 3 classes, based on lepton tagging, event shapes, and lifetime tagging. For each group, the systematic errors are split into those specific to an experiment (uncorrelated systematics) and those in common between the results (common systematics). For the overall average, the results from the three tagging techniques are assumed to be entirely uncorrelated.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.2191±0.0020 OUR EVALUATION					
0.2171±0.0021±0.0021		[86] AKERS	95B	OPAL	E^{ee}_{cm}= 88–94 GeV
0.219 ±0.006 ±0.005		[87] BUSKULIC	94G	ALEP	E^{ee}_{cm}= 88–94 GeV
0.222 ±0.003 ±0.007		[88] ADRIANI	93E	L3	E^{ee}_{cm}= 88–94 GeV
0.2187±0.0022±0.0031		[89] BUSKULIC	93M	ALEP	E^{ee}_{cm} = 91.3 GeV
0.228 ±0.005 ±0.005		[90] BUSKULIC	93N	ALEP	E^{ee}_{cm}= 88–94 GeV
0.232 ±0.005 ±0.017		[91] ABREU	92O	DLPH	E^{ee}_{cm}= 88–94 GeV
0.221 ±0.004 ±0.013	3893	[92] ADEVA	91C	L3	E^{ee}_{cm}= 88–95 GeV
0.251 ±0.049 ±0.030	32	[93] JACOBSEN	91	MRK2	E^{ee}_{cm}= 91 GeV
$0.23\ ^{+0.10}_{-0.08}\ ^{+0.05}_{-0.04}$	15	[94] KRAL	90	MRK2	E^{ee}_{cm}= 89–93 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.218 ±0.006 ±0.010		[95] AKERS	94D	OPAL	Repl. by AKERS 95B
0.220 ±0.002 ±0.013	11893	[96] ACTON	93I	OPAL	Repl. by AKERS 95B
0.222 ±0.007 ±0.008		[97] ACTON	93M	OPAL	Repl. by AKERS 95B
0.222 ±0.011 ±0.007		[98] AKERS	93B	OPAL	Repl. by AKERS 95B
$0.222\ ^{+0.033}_{-0.031}\ \pm0.017$		[99] ABREU	92	DLPH	E^{ee}_{cm}= 88–94 GeV
0.219 ±0.014 ±0.019		[100] ABREU	92K	DLPH	E^{ee}_{cm}= 88–94 GeV
0.226 ±0.008 ±0.018	1180	[101] ACTON	92I	OPAL	Repl. by ACTON 93I
0.193 ±0.006 ±0.024	1494	[102] AKRAWY	91E	OPAL	Repl. by ACTON 93I
0.204 ±0.014 ±0.024	171	[103] ADEVA	90E	L3	Repl. by ADRIANI 93E
0.215 ±0.017 ±0.024	1383	[104] DECAMP	90L	ALEP	E^{ee}_{cm}= 88–94 GeV

[86] AKERS 95B select events based on the lepton and/or vertex tag independently in each hemisphere. Comparing the numbers of single- and double-tagged events, they determine the b-tagging efficiency directly from data.

[87] BUSKULIC 94G perform a simultaneous fit to the p and p_T spectra of both single and dilepton events.

[88] ADRIANI 93E use a multidimensional analysis based on a neural network approach.

[89] BUSKULIC 93M use a method which tags the $Z \rightarrow b\overline{b}$ decays through the lifetime of the produced heavy hadrons. The systematic error includes a contribution of ±0.0016 due to the uncertainty of the charm partial width (for compatibility, we quote the result obtained with the Standard Model prediction $\Gamma(c\overline{c})/\Gamma(\text{hadrons}) = 0.171$).

[90] BUSKULIC 93N use event shape and high p_T lepton discriminators applied to both hemispheres.

[91] ABREU 92O use the neural network technique to tag heavy flavour events among a sample of 123k selected hadronic events. The systematic error consists of three parts: due to Monte Carlo (MC) parametrization (0.010), choice of MC model (0.008), and detector effects (0.011) added in quadrature.

[92] ADEVA 91C report $\Gamma(b\overline{b}) = 385 \pm 7 \pm 11 \pm 19$ MeV; we use their $\Gamma(\text{hadrons}) = 1742 \pm 19$ MeV to obtain the branching ratio. The systematic error includes the semileptonic branching ratio uncertainty (±0.011) plus other systematics (±0.006).

[93] JACOBSEN 91 tagged $b\overline{b}$ events by requiring coincidence of ≥ 3 tracks with significant impact parameters using vertex detector. Systematic error includes lifetime and decay uncertainties (±0.014).

[94] KRAL 90 used isolated leptons and found $\Gamma(b\overline{b})/\Gamma(\text{total}) = 0.17^{+0.07}_{-0.06}{}^{+0.04}_{-0.03}$.

[95] AKERS 94D perform an analysis based on a "mixed tag" method (impact parameter and lepton tagging). The systematic error includes a contribution (±0.007) due to the $\Gamma(c\overline{c})/\Gamma(\text{hadrons})$ uncertainty.

[96] ACTON 93I use both electrons and muons to tag B semileptonic decays. The systematic error includes components due to b and c quark fragmentation uncertainties, decay branching ratios, and $\Gamma(c\overline{c})/\Gamma(\text{hadrons})$.

[97] ACTON 93M tagged $Z \rightarrow b\overline{b}$ events using the impact parameter technique.

[98] AKERS 93B use a simultaneous fit to single and dilepton events (electrons and muons) to tag $Z \rightarrow b\overline{b}$.

[99] ABREU 92 result is from an indirect technique. They measure the lifetime τ_B, but use a world average of τ_B independent of $\Gamma(b\overline{b})$ and compare to their $\Gamma(b\overline{b})$ dependent lifetime from a hadron sample.

[100] ABREU 92K use boosted−sphericity technique to tag and enrich the b-$\overline{b}$ content with a sample of 50k hadronic events. Most of the systematic error is from hadronization uncertainty.

[101] ACTON 92I use high p ($>$ 4 GeV), high p_T ($>$ 0.8 GeV) electrons to tag $Z \rightarrow b\overline{b}$ events.

[102] For AKRAWY 91E, the systematic error includes the uncertainty from semileptonic branching ratios (±0.021) plus other systematics (±0.011).

[103] ADEVA 90E used isolated muons and found $\text{B}(B \rightarrow \mu)\Gamma(b\overline{b}) = 41.7 \pm 2.9 \pm 3.0$ MeV. The systematic error of ±0.024 above includes 0.02 due to uncertainty in $\text{B}(B \rightarrow \mu)$ added in quadrature to ±0.014 systematic.

[104] DECAMP 90L find $\text{B}(b \rightarrow e)\Gamma(b\overline{b})/\Gamma(\text{hadrons}) = 0.0219 \pm 0.0017 \pm 0.0010$. They assume $\text{B}(b \rightarrow e) = 0.102 \pm 0.007 \pm 0.007$. The quoted systematic error is dominated by that from the semileptonic branching ratio.

$\Gamma(\pi^0\gamma)/\Gamma_{\text{total}}$ Γ_{11}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<5.5 \times 10^{-5}$	95	[105] ABREU	94B	DLPH	E^{ee}_{cm}= 88–94 GeV
$<1.2 \times 10^{-4}$	95	[106] ADRIANI	92B	L3	E^{ee}_{cm}= 88–94 GeV
$<2.1 \times 10^{-4}$	95	DECAMP	92	ALEP	E^{ee}_{cm}= 88–94 GeV
$<1.4 \times 10^{-4}$	95	AKRAWY	91F	OPAL	E^{ee}_{cm}= 88–94 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<1.3 \times 10^{-4}$	95	BARDADIN-...	92	RVUE	E^{ee}_{cm}= 88–94 GeV
$<1.5 \times 10^{-4}$	95	ABREU	91E	DLPH	Repl. by ABREU 94B
$<2.9 \times 10^{-4}$	95	ADEVA	90K	L3	Repl. by ADRIANI 92B
$<3.9 \times 10^{-4}$	95	AKRAWY	90F	OPAL	Repl. by AKRAWY 91F
$<4.9 \times 10^{-4}$	95	DECAMP	90J	ALEP	Repl. by DECAMP 92

[105] ABREU 94B supersedes ABREU 91E.

[106] This limit is for both decay modes $Z^0 \rightarrow \pi^0\gamma/\gamma\gamma$ which are indistinguishable in ADRIANI 92B.

$\Gamma(\eta\gamma)/\Gamma_{\text{total}}$ Γ_{12}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<8.0 \times 10^{-5}$	95	[107] ABREU	94B	DLPH	E^{ee}_{cm}= 88–94 GeV
$<1.8 \times 10^{-4}$	95	ADRIANI	92B	L3	E^{ee}_{cm}= 88–94 GeV
$<5.1 \times 10^{-5}$	95	DECAMP	92	ALEP	E^{ee}_{cm}= 88–94 GeV
$<2.0 \times 10^{-4}$	95	AKRAWY	91F	OPAL	E^{ee}_{cm}= 88–94 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<1.9 \times 10^{-4}$	95	BARDADIN-...	92	RVUE	E^{ee}_{cm}= 88–94 GeV
$<2.8 \times 10^{-4}$	95	ABREU	91E	DLPH	Repl. by ABREU 94B
$<4.1 \times 10^{-4}$	95	ADEVA	90K	L3	Repl. by ADRIANI 92B
$<5.8 \times 10^{-4}$	95	AKRAWY	90F	OPAL	Repl. by AKRAWY 91F
$<4.6 \times 10^{-4}$	95	DECAMP	90J	ALEP	Repl. by DECAMP 92

[107] ABREU 94B supersedes ABREU 91E.

$\Gamma(\omega\gamma)/\Gamma_{\text{total}}$ Γ_{13}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<6.5 \times 10^{-4}$	95	ABREU	94B	DLPH	E^{ee}_{cm}= 88–94 GeV

$\Gamma(\eta'(958)\gamma)/\Gamma_{\text{total}}$ Γ_{14}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<4.2 \times 10^{-5}$	95	DECAMP	92	ALEP	E^{ee}_{cm}= 88–94 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<2.2 \times 10^{-4}$	95	DECAMP	90J	ALEP	Repl. by DECAMP 92

$\Gamma(\gamma\gamma)/\Gamma_{\rm total}$ Γ_{15}/Γ

This decay would violate the Landau-Yang theorem.

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<5.5 × 10^{-5}	95	ABREU 94B	DLPH	$E^{ee}_{\rm cm}$= 88–94 GeV
<1.2 × 10^{-4}	95	[108] ADRIANI 92B	L3	$E^{ee}_{\rm cm}$= 88–94 GeV
<1.4 × 10^{-4}	95	AKRAWY 91F	OPAL	$E^{ee}_{\rm cm}$= 88–94 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<2.9 × 10^{-4}	95	ADEVA 90K	L3	Repl. by ADRIANI 92B
<3.7 × 10^{-4}	95	AKRAWY 90F	OPAL	Repl. by AKRAWY 91F

[108] This limit is for both decay modes $Z^0 \to \pi^0\gamma/\gamma\gamma$ which are indistinguishable in ADRIANI 92B.

$\Gamma(\gamma\gamma\gamma)/\Gamma_{\rm total}$ Γ_{16}/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<1.0 × 10^{-5}	95	[109] ACCIARRI 95C	L3	$E^{ee}_{\rm cm}$= 88–94 GeV
<1.7 × 10^{-5}	95	[109] ABREU 94B	DLPH	$E^{ee}_{\rm cm}$= 88–94 GeV
<6.6 × 10^{-5}	95	AKRAWY 91F	OPAL	$E^{ee}_{\rm cm}$= 88–94 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<3.3 × 10^{-5}	95	ADRIANI 92B	L3	Repl. by ACCIARRI 95C
<2.4 × 10^{-5}	95	BARDADIN-... 92	RVUE	$E^{ee}_{\rm cm}$= 88–94 GeV
<1.4 × 10^{-4}	95	ABREU 91E	DLPH	Repl. by ABREU 94B
<1.2 × 10^{-4}	95	ADEVA 90K	L3	Repl. by ADRIANI 92B
<2.8 × 10^{-4}	95	AKRAWY 90F	OPAL	Repl. by AKRAWY 91F

[109] Limit derived in the context of composite Z model.

$\Gamma(\pi^\pm W^\mp)/\Gamma_{\rm total}$ Γ_{17}/Γ

The value is for the sum of the charge states indicated.

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<7 × 10^{-5}	95	DECAMP 92	ALEP	$E^{ee}_{\rm cm}$= 88–94 GeV

$\Gamma(\rho^\pm W^\mp)/\Gamma_{\rm total}$ Γ_{18}/Γ

The value is for the sum of the charge states indicated.

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<8.3 × 10^{-5}	95	DECAMP 92	ALEP	$E^{ee}_{\rm cm}$= 88–94 GeV

$\Gamma(J/\psi(1S)X)/\Gamma_{\rm total}$ Γ_{29}/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT
3.9 ±0.4 OUR AVERAGE				
3.73±0.39±0.36	153	[110] ABREU 94P	DLPH	$E^{ee}_{\rm cm}$= 88–94 GeV
3.6 ±0.5 ±0.4	121	[110] ADRIANI 93J	L3	$E^{ee}_{\rm cm}$= 88–94 GeV
5.3 ±0.9 ±0.5		[111] ALEXANDER 91G	OPAL	$E^{ee}_{\rm cm}$= 88–94 GeV

[110] Combining $\mu^+\mu^-$ and e^+e^- channels and taking into account the common systematic errors.

[111] ALEXANDER 91G use B($J/\psi(1S) \to \ell^+\ell^-$) = (6.9 ± 0.9)%. We have rescaled their value, 4.5 ± 0.8 ± 0.7, using the MARK III branching ratio of (5.91 ± 0.23)%.

$\Gamma(\psi(2S)X)/\Gamma_{\rm total}$ Γ_{30}/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT
1.60±0.73±0.33	5.4	[112] ABREU 94P	DLPH	$E^{ee}_{\rm cm}$= 88–94 GeV

[112] ABREU 94P measure this branching ratio via the decay channel $\psi(2S) \to J/\psi\pi^+\pi^-$, with $J/\psi \to \mu^+\mu^-$.

$\Gamma(\chi_{c1}(1P)X)/\Gamma_{\rm total}$ Γ_{31}/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT
6.0±1.9 OUR AVERAGE				
$5.0\pm2.1^{+1.5}_{-0.9}$	6.4	[113] ABREU 94P	DLPH	$E^{ee}_{\rm cm}$= 88–94 GeV
7.5±2.9±0.6	19	[113] ADRIANI 93J	L3	$E^{ee}_{\rm cm}$= 88–94 GeV

[113] This branching ratio is measured via the decay channel $\chi_{c1} \to J/\psi + \gamma$, with $J/\psi \to \mu^+\mu^-$.

$\Gamma((D^0/\overline{D}^0)X)/\Gamma(\text{hadrons})$ Γ_{32}/Γ_6

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.296±0.019±0.021	369	[114] ABREU 93I	DLPH	$E^{ee}_{\rm cm}$= 88–94 GeV

[114] The $(D^0/\overline{D}^0)$ states in ABREU 93I are detected by the $K\pi$ decay mode. This is a corrected result (see the erratum of ABREU 93I).

$\Gamma(D^{\pm}X)/\Gamma(\text{hadrons})$ Γ_{33}/Γ_6

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.174±0.016±0.018	539	[115] ABREU 93I	DLPH	E^{ee}_{cm}= 88–94 GeV

[115] The $D^{\pm}$ states in ABREU 93I are detected by the $K\pi\pi$ decay mode. This is a corrected result (see the erratum of ABREU 93I).

$\Gamma(D^*(2010)^{\pm}X)/\Gamma(\text{hadrons})$ Γ_{34}/Γ_6

The value is for the sum of the charge states indicated.

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.163±0.019 OUR AVERAGE	Error includes scale factor of 1.3.			
0.155±0.010±0.013	358	[116] ABREU 93I	DLPH	E^{ee}_{cm}= 88–94 GeV
0.21 ±0.04	362	[117] DECAMP 91J	ALEP	E^{ee}_{cm}= 88–94 GeV

[116] $D^*(2010)^{\pm}$ in ABREU 93I are reconstructed from $D^0\pi^{\pm}$, with $D^0 \to K^-\pi^+$. The new CLEO II measurement of B($D^{*\pm} \to D^0\pi^{\pm}$) = (68.1 ± 1.6) % is used. This is a corrected result (see the erratum of ABREU 93I).

[117] DECAMP 91J report B($D^*(2010)^+ \to D^0\pi^+$) B($D^0 \to K^-\pi^+$) $\Gamma(D^*(2010)^{\pm}X)$ / Γ(hadrons) = $(5.11 \pm 0.34) \times 10^{-3}$. They obtained above number assuming B($D^0 \to K^-\pi^+$) = (3.62 ± 0.34 ± 0.44)% and B($D^*(2010)^+ \to D^0\pi^+$) = (55 ± 4)%. We have rescaled their original result of 0.26 ± 0.05 taking into account the new CLEO II branching ratio B($D^*(2010)^+ \to D^0\pi^+$) = (68.1 ± 1.6)%.

$\Gamma(B^0_sX)/\Gamma(\text{hadrons})$ Γ_{37}/Γ_6

VALUE	DOCUMENT ID	TECN	COMMENT
seen	[118] ABREU 92M	DLPH	E^{ee}_{cm}= 88–94 GeV

[118] ABREU 92M reported value is $\Gamma(B^0_sX)$*B($B^0_s \to D_s\mu\nu_\mu X$) *B($D_s \to \phi\pi$)/Γ(hadrons) = $(18 \pm 8) \times 10^{-5}$.

$\Gamma(B^*X)/[\Gamma(BX)+\Gamma(B^*X)]$ $\Gamma_{36}/(\Gamma_{35}+\Gamma_{36})$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.76±0.08±0.06	1378	[119] ACCIARRI 95B	L3	E^{ee}_{cm}= 88–94 GeV

[119] ACCIARRI 95B give this ratio assuming a b-baryon fraction of 0.094. This measurement represents an average for a mixture of the states B_d, B_u, and B_s.

$\Gamma(\text{anomalous }\gamma+\text{hadrons})/\Gamma_{\text{total}}$ Γ_{38}/Γ

Limits on additional sources of prompt photons beyond expectations for final-state bremsstrahlung.

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<3.2 x 10⁻³	95	[120] AKRAWY 90J	OPAL	E^{ee}_{cm}= 88–95 GeV

[120] AKRAWY 90J report $\Gamma(\gamma X) <$ 8.2 MeV at 95%CL. They assume a three-body $\gamma q\overline{q}$ distribution and use E(γ) > 10 GeV.

$\Gamma(e^+e^-\gamma)/\Gamma_{\text{total}}$ Γ_{39}/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<5.2 \times 10^{-4}$	95	[121] ACTON 91B	OPAL	E^{ee}_{cm}= 91.1 GeV

[121] ACTON 91B looked for isolated photons with E>2% of beam energy (> 0.9 GeV).

$\Gamma(\mu^+\mu^-\gamma)/\Gamma_{\text{total}}$ Γ_{40}/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<5.6 \times 10^{-4}$	95	[122] ACTON 91B	OPAL	E^{ee}_{cm}= 91.1 GeV

[122] ACTON 91B looked for isolated photons with E>2% of beam energy (> 0.9 GeV).

$\Gamma(\tau^+\tau^-\gamma)/\Gamma_{\text{total}}$ Γ_{41}/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<7.3 \times 10^{-4}$	95	[123] ACTON 91B	OPAL	E^{ee}_{cm}= 91.1 GeV

[123] ACTON 91B looked for isolated photons with E>2% of beam energy (> 0.9 GeV).

$\Gamma(\ell^+\ell^-\gamma\gamma)/\Gamma_{\text{total}}$ Γ_{42}/Γ

The value is the sum over $\ell = e, \mu, \tau$.

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<6.8 \times 10^{-6}$	95	[124] ACTON 93E	OPAL	E^{ee}_{cm}= 88–94 GeV

[124] For $m_{\gamma\gamma}$ = 60 ± 5 GeV.

$\Gamma(q\overline{q}\gamma\gamma)/\Gamma_{total}$ — Γ_{43}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<5.5 × 10^{-6}	95	[125] ACTON	93E	OPAL	E^{ee}_{cm}= 88–94 GeV

[125] For $m_{\gamma\gamma}$ = 60 ± 5 GeV.

$\Gamma(\nu\overline{\nu}\gamma\gamma)/\Gamma_{total}$ — Γ_{44}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<3.1 × 10^{-6}	95	[126] ACTON	93E	OPAL	E^{ee}_{cm}= 88–94 GeV

[126] For $m_{\gamma\gamma}$ = 60 ± 5 GeV.

$\Gamma(e^{\pm}\mu^{\mp})/\Gamma(e^{+}e^{-})$ — Γ_{45}/Γ_{1}

Test of lepton family number conservation. The value is for the sum of the charge states indicated.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.07	90	ALBAJAR	89	UA1	$E^{p\overline{p}}_{cm}$= 546,630 GeV

$\Gamma(e^{\pm}\mu^{\mp})/\Gamma_{total}$ — Γ_{45}/Γ

Test of lepton family number conservation. The value is for the sum of the charge states indicated.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<3.2 × 10^{-5}	95	ABREU	93B	DLPH	E^{ee}_{cm}= 88–94 GeV
<0.6 × 10^{-5}	95	ADRIANI	93I	L3	E^{ee}_{cm}= 88–94 GeV
<2.6 × 10^{-5}	95	DECAMP	92	ALEP	E^{ee}_{cm}= 88–94 GeV
<4.6 × 10^{-5}	95	AKRAWY	91B	OPAL	E^{ee}_{cm}= 88–94 GeV

$\Gamma(e^{\pm}\tau^{\mp})/\Gamma_{total}$ — Γ_{46}/Γ

Test of lepton family number conservation. The value is for the sum of the charge states indicated.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<1.1 × 10^{-4}	95	ABREU	93B	DLPH	E^{ee}_{cm}= 88–94 GeV
<1.3 × 10^{-5}	95	ADRIANI	93I	L3	E^{ee}_{cm}= 88–94 GeV
<1.2 × 10^{-4}	95	DECAMP	92	ALEP	E^{ee}_{cm}= 88–94 GeV
<7.2 × 10^{-5}	95	AKRAWY	91B	OPAL	E^{ee}_{cm}= 88–94 GeV

$\Gamma(\mu^{\pm}\tau^{\mp})/\Gamma_{total}$ — Γ_{47}/Γ

Test of lepton family number conservation. The value is for the sum of the charge states indicated.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<1.4 × 10^{-4}	95	ABREU	93B	DLPH	E^{ee}_{cm}= 88–94 GeV
<1.9 × 10^{-5}	95	ADRIANI	93I	L3	E^{ee}_{cm}= 88–94 GeV
<1.0 × 10^{-4}	95	DECAMP	92	ALEP	E^{ee}_{cm}= 88–94 GeV
<3.5 × 10^{-4}	95	AKRAWY	91B	OPAL	E^{ee}_{cm}= 88–94 GeV

AVERAGE PARTICLE MULTIPLICITIES IN HADRONIC *Z* DECAY

Summed over particle and antiparticle, when appropriate.

$\langle N_{\pi^0}\rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
9.18±0.03±0.73	ACCIARRI	94B	L3	E^{ee}_{cm}= 91.2 GeV

$\langle N_{\pi^\pm}\rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
17.05±0.43	AKERS	94P	OPAL	E^{ee}_{cm}= 91.2 GeV

$\langle N_{K^\pm}\rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
2.42±0.13	AKERS	94P	OPAL	E^{ee}_{cm}= 91.2 GeV

$\langle N_{K^0}\rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
2.080±0.035 OUR AVERAGE				
2.04 ±0.02 ±0.14	ACCIARRI	94B	L3	E^{ee}_{cm}= 91.2 GeV
2.061±0.047	BUSKULIC	94K	ALEP	E^{ee}_{cm}= 91.2 GeV
2.12 ±0.05 ±0.04	ABREU	92G	DLPH	E^{ee}_{cm}= 91.2 GeV
2.10 ±0.14	ALEXANDER	91C	OPAL	E^{ee}_{cm}= 91.2 GeV

$\langle N_{K^*(892)^\pm} \rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
0.77±0.17 OUR AVERAGE Error includes scale factor of 2.2.				
0.72±0.02±0.08	ACTON	93	OPAL	E^{ee}_{cm}= 91.2 GeV
1.33±0.11±0.24	ABREU	92G	DLPH	E^{ee}_{cm}= 91.2 GeV

$\langle N_{K^*(892)^0} \rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
0.77±0.09 OUR AVERAGE				
0.97±0.18±0.31	ABREU	93	DLPH	E^{ee}_{cm}= 91.2 GeV
0.76±0.07±0.06	ACTON	92O	OPAL	E^{ee}_{cm}= 91.2 GeV

$\langle N_{\eta} \rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
0.91 ±0.02 ±0.11	ACCIARRI	94B	L3	E^{ee}_{cm}= 91.2 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.298±0.023±0.021	[127] BUSKULIC	92D	ALEP	E^{ee}_{cm}= 91.2 GeV

[127] BUSKULIC 92D obtain this value for $x > 0.1$.

$\langle N_{\rho^0} \rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
1.43±0.12±0.22	ABREU	93	DLPH	E^{ee}_{cm}= 91.2 GeV

$\langle N_{f_0(975)} \rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.10±0.03±0.019	[128] ABREU	93	DLPH	E^{ee}_{cm}= 91.2 GeV

[128] ABREU 93 obtain this value for $x > 0.05$.

$\langle N_{\eta'} \rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.068±0.018±0.016	[129] BUSKULIC	92D	ALEP	E^{ee}_{cm}= 91.2 GeV

[129] BUSKULIC 92D obtain this value for $x > 0.1$.

$\langle N_{p} \rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
0.92±0.11	AKERS	94P	OPAL	E^{ee}_{cm}= 91.2 GeV

$\langle N_{\phi} \rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
0.086±0.015±0.010	ACTON	92O	OPAL	E^{ee}_{cm}= 91.2 GeV

$\langle N_{f_2(1270)} \rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.11±0.04±0.03	[130] ABREU	93	DLPH	E^{ee}_{cm}= 91.2 GeV

[130] ABREU 93 obtain this value for $x > 0.1$.

$\langle N_{\Lambda} \rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
0.367±0.010 OUR AVERAGE				
0.37 ±0.01 ±0.04	ACCIARRI	94B	L3	E^{ee}_{cm}= 91.2 GeV
0.386±0.016	BUSKULIC	94K	ALEP	E^{ee}_{cm}= 91.2 GeV
0.357±0.003±0.017	ABREU	93L	DLPH	E^{ee}_{cm}= 91.2 GeV
0.351±0.019	ACTON	92J	OPAL	E^{ee}_{cm}= 91.2 GeV

$\langle N_{\Xi^-} \rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
0.0205±0.0019 OUR AVERAGE				
0.020 ±0.004 ±0.003	ABREU	92G	DLPH	E^{ee}_{cm}= 91.2 GeV
0.0206±0.0021	ACTON	92J	OPAL	E^{ee}_{cm}= 91.2 GeV

$\langle N_{\Sigma(1385)^\pm} \rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
0.0380±0.0062	ACTON	92J	OPAL	E^{ee}_{cm}= 91.2 GeV

$\langle N_{\Xi(1530)^0} \rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
0.0063±0.0014	ACTON	92J	OPAL	E^{ee}_{cm}= 91.2 GeV

$\langle N_{\Omega^-} \rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
0.0050±0.0015	ACTON	92J	OPAL	E^{ee}_{cm}= 91.2 GeV

$\langle N_{D^0} \rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
0.46 ±0.06 OUR AVERAGE	Error includes scale factor of 1.3.			
0.518±0.052±0.035	BUSKULIC	94J	ALEP	E^{ee}_{cm}= 91.2 GeV
0.403±0.038±0.044	[131] ABREU	93I	DLPH	E^{ee}_{cm}= 91.2 GeV

[131] See ABREU 95 (erratum).

$\langle N_{D^\pm} \rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
0.221±0.026 OUR AVERAGE	Error includes scale factor of 1.1.			
0.251±0.026±0.025	BUSKULIC	94J	ALEP	E^{ee}_{cm}= 91.2 GeV
0.199±0.019±0.024	[132] ABREU	93I	DLPH	E^{ee}_{cm}= 91.2 GeV

[132] See ABREU 95 (erratum).

$\langle N_{D^*(2010)^\pm} \rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
0.184±0.014 OUR AVERAGE				
0.187±0.015±0.013	BUSKULIC	94J	ALEP	E^{ee}_{cm}= 91.2 GeV
0.171±0.012±0.016	[133] ABREU	93I	DLPH	E^{ee}_{cm}= 91.2 GeV
0.245±0.051	ALEXANDER	91B	OPAL	E^{ee}_{cm}= 91.2 GeV

[133] See ABREU 95 (erratum).

$\langle N_{J/\psi(1S)} \rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
0.0075±0.0015	[134] ALEXANDER	91G	OPAL	E^{ee}_{cm}= 91.2 GeV

[134] ALEXANDER 91G use B($J/\psi(1S) \rightarrow \ell^+ \ell^-$) = (6.9 ± 0.9)%. We have rescaled their value, 0.0064 ± 0.0016, using the MARK III branching ratio of (5.91 ± 0.23)% and our current values for Γ_{total} and $\Gamma_{hadrons}$.

$\langle N_{charged} \rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
21.4±0.43	ACTON	92B	OPAL	E^{ee}_{cm}= 91.2 GeV

Z HADRONIC POLE CROSS SECTION

This quantity is defined as

$$\sigma_h^0 = \frac{12\pi}{M_Z^2} \frac{\Gamma(e^+e^-)\,\Gamma(\text{hadrons})}{\Gamma_Z^2}$$

It is one of the parameters used in the Z lineshape fit. (See the 'Note on the Z Boson.')

VALUE (nb)	EVTS	DOCUMENT ID		TECN	COMMENT
41.55±0.14 OUR FIT					
41.49±0.10 OUR AVERAGE					
41.23±0.20	1.15M	ABREU	94	DLPH	E^{ee}_{cm}= 88–94 GeV
41.39±0.26	1.2M	ACCIARRI	94	L3	E^{ee}_{cm}= 88–94 GeV
41.70±0.23	1.2M	AKERS	94	OPAL	E^{ee}_{cm}= 88–94 GeV
41.60±0.16	1.28M	BUSKULIC	94	ALEP	E^{ee}_{cm}= 88–94 GeV
42 ±4	450	ABRAMS	89B	MRK2	E^{ee}_{cm}= 89.2–93.0 GeV

• • • We do not use the following data for averages, fits, limits, etc. • • •

41.45±0.31	512k	ACTON	93D	OPAL	Repl. by AKERS 94
41.34±0.28	460k	ADRIANI	93M	L3	Repl. by ACCIARRI 94
41.60±0.27	520k	BUSKULIC	93J	ALEP	Repl. by BUSKULIC 94
41.33±0.23	650k	[135] LEP	92	RVUE	E^{ee}_{cm}= 88–94 GeV
41.84±0.45	150k	ABREU	91F	DLPH	Repl. by ABREU 94

[135] LEP 92 is a combined analysis by the four LEP experiments as of Dec 1991.

Z VECTOR COUPLINGS TO CHARGED LEPTONS

These quantities are the effective vector couplings of the Z to charged leptons. Their magnitude is derived from a measurement of the Z lineshape and the forward-backward lepton asymmetries as a function of energy around the Z mass. The relative sign among the vector to axial-vector couplings is obtained from a measurement of the Z asymmetry parameters, A_e and A_τ, or ν_e scattering. The fit values quoted below correspond to global nine- or five-parameter fits to lineshape, lepton forward-backward asymmetry, and A_e and A_τ measurements. See "Note on the Z boson" for details.

Within the current data set, the reason for the smallness of g^μ_V compared to g^e_V and g^τ_V is due to the large value of A_e which is heavily weighted by the SLD result. This large value of A_e leads to a large value of g^e_V. Since g^μ_V is obtained using the relation $A^\mu_{FB} = 0.75 \times A_e \times A_\mu$, a large value of g^e_V leads to a SMALL value of g^μ_V. Concerning the τ, its g_V gets mainly determined directly from A_τ which is obtained from a measurement of the τ polarization (see "Note on the Z boson").

g^e_V

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
$\mathbf{-0.0398^{+0.0024}_{-0.0023}}$ **OUR FIT**					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$-0.0364^{+0.0096}_{-0.0082}$	38k	[136] ACCIARRI	94	L3	E^{ee}_{cm}= 88–94 GeV
-0.036 ± 0.005	45.8k	[137] BUSKULIC	94	ALEP	E^{ee}_{cm}= 88–94 GeV
$-0.040\ ^{+0.013}_{-0.011}$		[138] ADRIANI	93M	L3	Repl. by ACCIARRI 94
$-0.034\ ^{+0.006}_{-0.005}$		[136] BUSKULIC	93J	ALEP	Repl. by BUSKULIC 94
-0.035 ± 0.005	70k	[139] QUAST	93	RVUE	E^{ee}_{cm}= 88–94 GeV
$-0.006\ ^{+0.003}_{-0.004}$	16k	[140] BANERJEE	92	RVUE	E^{ee}_{cm}= 88–94 GeV
$-0.045\ ^{+0.013}_{-0.011}$	6947	[141] DECAMP	92B	ALEP	Repl. by BUSKULIC 93J
$-0.035\ ^{+0.013}_{-0.014}$	6947	[142] DECAMP	92B	ALEP	Repl. by BUSKULIC 93J

[136] The τ polarization result has been included.
[137] BUSKULIC 94 use the added constraint of τ polarization.
[138] ADRIANI 93M use their measurement of the τ polarization in addition to forward-backward lepton asymmetries.
[139] QUAST 93 is a combined analysis of LEP results as of Feb. 1993. QUAST 93 use also the average LEP values for τ polarization and the forward–backward τ polarisation asymmetry.
[140] BANERJEE 92 is a combined analysis of the four LEP experiments as of March 1991. Only forward-backward lepton asymmetries are used.
[141] DECAMP 92B use their measurement of the τ polarization in addition to the forward-backward lepton asymmetries.
[142] Using only forward-backward lepton asymmetries.

g^μ_V

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
$\mathbf{-0.0273^{+0.0056}_{-0.0058}}$ **OUR FIT**				

• • • We do not use the following data for averages, fits, limits, etc. • • •

$-0.0402^{+0.0153}_{-0.0211}$	34k	[143] ACCIARRI 94	L3	$E^{ee}_{\rm cm}$= 88–94 GeV
-0.034 ± 0.013	46.4k	[144] BUSKULIC 94	ALEP	$E^{ee}_{\rm cm}$= 88–94 GeV
$-0.048\ ^{+0.021}_{-0.033}$		[145] ADRIANI 93M	L3	Repl. by ACCIARRI 94
$-0.019\ ^{+0.018}_{-0.019}$		[143] BUSKULIC 93J	ALEP	Repl. by BUSKULIC 94
-0.029 ± 0.010	70k	[146] QUAST 93	RVUE	$E^{ee}_{\rm cm}$= 88–94 GeV
$-0.191\ ^{+0.088}_{-0.081}$	16k	[147] BANERJEE 92	RVUE	$E^{ee}_{\rm cm}$= 88–94 GeV
$-0.018\ ^{+0.023}_{-0.026}$	6691	[148] DECAMP 92B	ALEP	Repl. by BUSKULIC 93J
$-0.023\ ^{+0.029}_{-0.037}$	6691	[149] DECAMP 92B	ALEP	Repl. by BUSKULIC 93J

[143] The τ polarization result has been included.
[144] BUSKULIC 94 use the added constraint of τ polarization.
[145] ADRIANI 93M use their measurement of the τ polarization in addition to forward-backward lepton asymmetries.
[146] QUAST 93 is a combined analysis of LEP results as of Feb. 1993. QUAST 93 use also the average LEP values for τ polarization and the forward–backward τ polarisation asymmetry.
[147] BANERJEE 92 is a combined analysis of the four LEP experiments as of March 1991. Only forward-backward lepton asymmetries are used.
[148] DECAMP 92B use their measurement of the τ polarization in addition to the forward-backward lepton asymmetries.
[149] Using only forward-backward lepton asymmetries.

g^{τ}_{V}

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
-0.0389 ± 0.0043 OUR FIT				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
-0.0384 ± 0.0078	25k	[150] ACCIARRI 94	L3	$E^{ee}_{\rm cm}$= 88–94 GeV
-0.038 ± 0.005	45.1k	[151] BUSKULIC 94	ALEP	$E^{ee}_{\rm cm}$= 88–94 GeV
-0.037 ± 0.008	7441	[152] ADRIANI 93M	L3	Repl. by ACCIARRI 94
-0.039 ± 0.006		[150] BUSKULIC 93J	ALEP	Repl. by BUSKULIC 94
-0.039 ± 0.004	50k	[153] QUAST 93	RVUE	$E^{ee}_{\rm cm}$= 88–94 GeV
$-0.287\ ^{+0.127}_{-0.077}$	16k	[154] BANERJEE 92	RVUE	$E^{ee}_{\rm cm}$= 88–94 GeV
$-0.045\ ^{+0.010}_{-0.011}$	6260	[155] DECAMP 92B	ALEP	Repl. by BUSKULIC 93J
$-0.104\ ^{+0.040}_{-0.066}$	6260	[156] DECAMP 92B	ALEP	Repl. by BUSKULIC 93J

[150] The τ polarization result has been included.
[151] BUSKULIC 94 use the added constraint of τ polarization.
[152] ADRIANI 93M use their measurement of the τ polarization in addition to forward-backward lepton asymmetries.
[153] QUAST 93 is a combined analysis of LEP results as of Feb. 1993. QUAST 93 use also the average LEP values for τ polarization and the forward–backward τ polarisation asymmetry.
[154] BANERJEE 92 is a combined analysis of the four LEP experiments as of March 1991. Only forward-backward lepton asymmetries are used.
[155] DECAMP 92B use their measurement of the τ polarization in addition to the forward-backward lepton asymmetries.
[156] Using only forward-backward lepton asymmetries.

g^{ℓ}_{V}

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
-0.0377 ± 0.0016 OUR FIT				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
-0.039 ± 0.004	50.3k	[157] ABREU 94	DLPH	$E^{ee}_{\rm cm}$= 88–94 GeV
$-0.0378^{+0.0045}_{-0.0042}$	97k	[158] ACCIARRI 94	L3	$E^{ee}_{\rm cm}$= 88–94 GeV
-0.034 ± 0.004	146k	[157] AKERS 94	OPAL	$E^{ee}_{\rm cm}$= 88–94 GeV
-0.038 ± 0.004	137.3k	[157] BUSKULIC 94	ALEP	$E^{ee}_{\rm cm}$= 88–94 GeV
-0.027 ± 0.008	58k	[157] ACTON 93D	OPAL	Repl. by AKERS 94
$-0.040\ ^{+0.006}_{-0.005}$		[158] ADRIANI 93M	L3	Repl. by ACCIARRI 94
$-0.034\ ^{+0.004}_{-0.003}$		[158] BUSKULIC 93J	ALEP	Repl. by BUSKULIC 94
-0.0355 ± 0.0025	190k	[159] QUAST 93	RVUE	$E^{ee}_{\rm cm}$= 88–94 GeV

$-0.034\ {}^{+0.009}_{-0.007}$	50k	[160] BANERJEE	92	RVUE	$E^{ee}_{\rm cm}$= 88–94 GeV
$-0.041\ {}^{+0.007}_{-0.006}$	20k	[158] DECAMP	92B	ALEP	Repl. by BUSKULIC 93J
$-0.042\ {}^{+0.009}_{-0.007}$	20k	[157] DECAMP	92B	ALEP	Repl. by BUSKULIC 93J
$-0.034\ \pm0.006$	57k	[161] LEP	92	RVUE	$E^{ee}_{\rm cm}$= 88–94 GeV
$-0.017\ \pm0.029$	9k	[157] ABREU	91F	DLPH	Repl. by ABREU 94
$-0.046\ {}^{+0.015}_{-0.012}$	10k	[157] ADEVA	91E	L3	Repl. by ADRIANI 93M
$-0.024\ \pm0.015$	18k	[157] ALEXANDER	91F	OPAL	Repl. by AKERS 94

[157] Using forward-backward lepton asymmetries.

[158] The τ polarization result has been included.

[159] QUAST 93 is a combined analysis of LEP results as of Feb. 1993. QUAST 93 use also the average LEP values for τ polarization and the forward–backward τ polarisation asymmetry. Assumes lepton universality.

[160] BANERJEE 92 is a combined analysis of the four LEP experiments as of March 1991. Forward-backward lepton asymmetries are used.

[161] LEP 92 is a combined analysis of the four LEP experiments as of December 1991. Forward-backward lepton asymmetries are used.

Z AXIAL-VECTOR COUPLINGS TO CHARGED LEPTONS

These quantities are the effective axial-vector couplings of the Z to charged leptons. Their magnitude is derived from a measurement of the Z line-shape and the forward-backward lepton asymmetries as a function of energy around the Z mass. The relative sign among the vector to axial-vector couplings is obtained from a measurement of the Z asymmetry parameters, A_e and A_τ, or ν_e scattering. The fit values quoted below correspond to global nine- or five-parameter fits to lineshape, lepton forward-backward asymmetry, and A_e and A_τ measurements. See "Note on the Z boson" for details.

g^e_A

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
−0.5007±0.0009 OUR FIT					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
−0.4998±0.0016	38k	[162] ACCIARRI	94	L3	$E^{ee}_{\rm cm}$= 88–94 GeV
−0.503 ±0.002	45.8k	[162] BUSKULIC	94	ALEP	$E^{ee}_{\rm cm}$= 88–94 GeV
−0.4980±0.0021		[162] ADRIANI	93M	L3	Repl. by ACCIARRI 94
−0.5029±0.0018		[162] BUSKULIC	93J	ALEP	Repl. by BUSKULIC 94

[162] The τ-polarization constraint has been included.

g^μ_A

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
−0.5015±0.0009 OUR FIT					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$-0.4987{}^{+0.0030}_{-0.0026}$	34k	[163] ACCIARRI	94	L3	$E^{ee}_{\rm cm}$= 88–94 GeV
−0.501 ±0.002	46.4k	[163] BUSKULIC	94	ALEP	$E^{ee}_{\rm cm}$= 88–94 GeV
$-0.4968{}^{+0.0050}_{-0.0037}$		[163] ADRIANI	93M	L3	Repl. by ACCIARRI 94
−0.5014±0.0029		[163] BUSKULIC	93J	ALEP	Repl. by BUSKULIC 94

[163] The τ-polarization constraint has been included.

g^τ_A

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
−0.5005±0.0010 OUR FIT					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
−0.5014±0.0029	25k	[164] ACCIARRI	94	L3	$E^{ee}_{\rm cm}$= 88–94 GeV
−0.502 ±0.003	45.1k	[164] BUSKULIC	94	ALEP	$E^{ee}_{\rm cm}$= 88–94 GeV
−0.5032±0.0038	7441	[164] ADRIANI	93M	L3	Repl. by ACCIARRI 94
−0.5016±0.0033		[164] BUSKULIC	93J	ALEP	Repl. by BUSKULIC 94

[164] The τ-polarization constraint has been included.

g_A^ℓ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
−0.5008±0.0008 OUR FIT					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
−0.4999±0.0014	71k	ABREU	94	DLPH	$E_{\rm cm}^{ee}$= 88–94 GeV
−0.4998±0.0014	97k	[165] ACCIARRI	94	L3	$E_{\rm cm}^{ee}$= 88–94 GeV
−0.500 ±0.001	146k	AKERS	94	OPAL	$E_{\rm cm}^{ee}$= 88–94 GeV
−0.502 ±0.001	137k	[165] BUSKULIC	94	ALEP	$E_{\rm cm}^{ee}$= 88–94 GeV
−0.4998±0.0016	58k	ACTON	93D	OPAL	Repl. by AKERS 94
−0.4986±0.0015		[165] ADRIANI	93M	L3	Repl. by ACCIARRI 94
−0.5022±0.0015		[165] BUSKULIC	93J	ALEP	Repl. by BUSKULIC 94
−0.499 ±0.001	57k	[166] LEP	92	RVUE	$E_{\rm cm}^{ee}$= 88–94 GeV
−0.501 ±0.003	9k	ABREU	91F	DLPH	Repl. by ABREU 94

[165] The τ-polarization constraint has been included.
[166] LEP 92 is a combined analysis of the four LEP experiments as of December 1991.

Z COUPLINGS TO NEUTRAL LEPTONS

These quantities are the effective couplings of the Z to neutral leptons. $\nu_e\,e$ and $\nu_\mu\,e$ scattering results are combined with g_A^e and g_V^e measurements at the Z mass to obtain g^{ν_e} and g^{ν_μ} following NOVIKOV 93C.

g^{ν_e}

VALUE	DOCUMENT ID		TECN	COMMENT
0.528±0.085	[167] VILAIN	94	CHM2	From $\nu_\mu\,e$ and $\nu_e\,e$ scattering

[167] VILAIN 94 derive this value from their value of g^{ν_μ} and their ratio $g^{\nu_e}/g^{\nu_\mu} = 1.05^{+0.15}_{-0.18}$.

g^{ν_μ}

VALUE	DOCUMENT ID		TECN	COMMENT
0.502±0.017	[168] VILAIN	94	CHM2	From $\nu_\mu\,e$ scattering

[168] VILAIN 94 derive this value from their measurement of the couplings $g_A^{e\nu_\mu} = -0.503 \pm 0.017$ and $g_V^{e\nu_\mu} = -0.035 \pm 0.017$ obtained from $\nu_\mu\,e$ scattering. We have re-evaluated this value using the current PDG values for g_A^e and g_V^e.

Z ASYMMETRY PARAMETERS

For each fermion-antifermion pair coupling to the Z these quantities are defined as

$$A_f = \frac{2g_V^f g_A^f}{(g_V^f)^2 + (g_A^f)^2}$$

where g_V^f and g_A^f are the effective vector and axial-vector couplings. For their relation to the various lepton asymmetries see the 'Note on the Z Boson.'

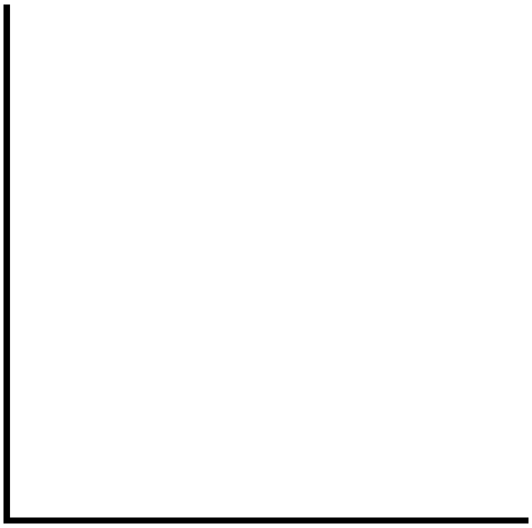
A_e

Using polarized beams, this quantity can also be measured as $(\sigma_L - \sigma_R)/(\sigma_L + \sigma_R)$, where σ_L and σ_R are the e^+e^- production cross sections for Z bosons produced with left-handed and right-handed electrons respectively.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.158 ±0.008 OUR AVERAGE	Error includes scale factor of 1.3. See the ideogram below.				
0.122 ±0.030 ±0.012	30663	[169] AKERS	95	OPAL	$E_{\rm cm}^{ee}$= 88–94 GeV
0.1656±0.0071±0.0028	49392	[170] ABE	94C	SLD	$E_{\rm cm}^{ee}$= 91.26 GeV
0.157 ±0.020 ±0.005	86000	[169] ACCIARRI	94E	L3	$E_{\rm cm}^{ee}$= 88–94 GeV
0.097 ±0.044 ±0.004	10224	[171] ABE	93	SLD	$E_{\rm cm}^{ee}$= 91.26 GeV
0.120 ±0.026		[169] BUSKULIC	93P	ALEP	$E_{\rm cm}^{ee}$= 88–94 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.29 ±0.13	3245	[169] ALEXANDER	91D	OPAL	Repl. by AKERS 95

[169] Derived from the measurement of forward-backward τ polarization asymmetry.
[170] ABE 94C measured the left-right asymmetry in Z production. This value leads to $\sin^2\theta_W = 0.2292 \pm 0.0009 \pm 0.0004$.

[171] ABE 93 measured the left-right asymmetry in Z production.



A_e

A_τ

This quantity is derived from the measurement of the average τ polarization.

VALUE	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
0.151±0.011 OUR AVERAGE					
0.153±0.019±0.013	30663	AKERS	95	OPAL	$E^{ee}_{\rm cm}$= 88–94 GeV
0.150±0.013±0.009	86000	ACCIARRI	94E	L3	$E^{ee}_{\rm cm}$= 88–94 GeV
0.143±0.023		BUSKULIC	93P	ALEP	$E^{ee}_{\rm cm}$= 88–94 GeV
0.24 ±0.07	2021	ABREU	92N	DLPH	$E^{ee}_{\rm cm}$= 88–94 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.132±0.033	10732	ADRIANI	93M	L3	Repl. by ACCIARRI 94E
0.01 ±0.09	3245	ALEXANDER	91D	OPAL	Repl. by AKERS 95

$A^{(0,e)}_{FB}$ CHARGE ASYMMETRY IN $e^+e^- \rightarrow e^+e^-$ (including radiative corrections)

For the Z peak, we report the pole asymmetry defined by $(3/4)A^2_e$ as determined by the nine-parameter fit to cross-section and lepton forward-backward asymmetry data. For details see the "Note on the Z boson."

ASYMMETRY (%)	*STD. MODEL*	$\sqrt{s}$ *(GeV)*	*DOCUMENT ID*		*TECN*
1.51±0.40 OUR FIT					
1.5 ±0.4 OUR AVERAGE					
2.5 ±0.9		91.2	ABREU	94	DLPH
1.04±0.92		91.2	ACCIARRI	94	L3
0.62±0.80		91.2	AKERS	94	OPAL
1.85±0.66		91.2	BUSKULIC	94	ALEP

$A^{(0,\mu)}_{FB}$ CHARGE ASYMMETRY IN $e^+e^- \rightarrow \mu^+\mu^-$ (including radiative corrections)

For the Z peak, we report the pole asymmetry defined by $(3/4)A_e A_\mu$ as determined by the nine-parameter fit to cross-section and lepton forward-backward asymmetry data. For details see the "Note on the Z boson."

ASYMMETRY (%)	*STD. MODEL*	$\sqrt{s}$ (GeV)	*DOCUMENT ID*		*TECN*
1.33± 0.26 OUR FIT					
1.34± 0.24 OUR AVERAGE					
1.4 ± 0.5		91.2	ABREU	94	DLPH
1.79± 0.61		91.2	ACCIARRI	94	L3
0.99± 0.42		91.2	AKERS	94	OPAL
1.46± 0.48		91.2	BUSKULIC	94	ALEP
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$-29.0\ ^{+5.0}_{-4.8}\ \pm0.5$	−32.1	56.9	[172] ABE	90I	VNS
18 ± 8	+1	91.28	ADEVA	90D	L3
− 9.9 ± 1.5 ±0.5	−9.2	35	HEGNER	90	JADE
0.05± 0.22	0.026	91.14	[173] ABRAMS	89D	MRK2
−43.4 ±17.0	−24.9	52.0	[174] BACALA	89	AMY
−11.0 ±16.5	−29.4	55.0	[174] BACALA	89	AMY
−30.0 ±12.4	−31.2	56.0	[174] BACALA	89	AMY
−46.2 ±14.9	−33.0	57.0	[174] BACALA	89	AMY
−29 ±13	−25.9	53.3	ADACHI	88C	TOPZ
+ 5.3 ± 5.0 ±0.5	−1.2	14.0	ADEVA	88	MRKJ
−10.4 ± 1.3 ±0.5	−8.6	34.8	ADEVA	88	MRKJ
−12.3 ± 5.3 ±0.5	−10.7	38.3	ADEVA	88	MRKJ
−15.6 ± 3.0 ±0.5	−14.9	43.8	ADEVA	88	MRKJ
− 1.0 ± 6.0	−1.2	13.9	BRAUNSCH...	88D	TASS
− 9.1 ± 2.3 ±0.5	−8.6	34.5	BRAUNSCH...	88D	TASS
$-10.6\ ^{+2.2}_{-2.3}\ \pm0.5$	−8.9	35.0	BRAUNSCH...	88D	TASS
$-17.6\ ^{+4.4}_{-4.3}\ \pm0.5$	−15.2	43.6	BRAUNSCH...	88D	TASS
− 4.8 ± 6.5 ±1.0	−11.5	39	BEHREND	87C	CELL
−18.8 ± 4.5 ±1.0	−15.5	44	BEHREND	87C	CELL
+ 2.7 ± 4.9	−1.2	13.9	BARTEL	86C	JADE
−11.1 ± 1.8 ±1.0	−8.6	34.4	BARTEL	86C	JADE
−17.3 ± 4.8 ±1.0	−13.7	41.5	BARTEL	86C	JADE
−22.8 ± 5.1 ±1.0	−16.6	44.8	BARTEL	86C	JADE
− 6.3 ± 0.8 ±0.2	−6.3	29	ASH	85	MAC
− 4.9 ± 1.5 ±0.5	−5.9	29	DERRICK	85	HRS
− 7.1 ± 1.7	−5.7	29	LEVI	83	MRK2
−16.1 ± 3.2	−9.2	34.2	BRANDELIK	82C	TASS

[172] ABE 90I measurements in the range 50 $\leq \sqrt{s} \leq$ 60.8 GeV.
[173] ABRAMS 89D asymmetry includes both 9 $\mu^+\mu^-$ and 15 $\tau^+\tau^-$ events.
[174] BACALA 89 systematic error is about 5%.

$A_{FB}^{(0,\tau)}$ CHARGE ASYMMETRY IN $e^+e^- \rightarrow \tau^+\tau^-$ (including radiative corrections)

For the Z peak, we report the pole asymmetry defined by $(3/4)A_e A_\tau$ as determined by the nine-parameter fit to cross-section and lepton forward-backward asymmetry data. For details see the "Note on the Z boson."

ASYMMETRY (%)	*STD. MODEL*	$\sqrt{s}$ (GeV)	*DOCUMENT ID*		*TECN*
2.12± 0.32 OUR FIT					
2.13± 0.31 OUR AVERAGE					
2.2 ± 0.7		91.2	ABREU	94	DLPH
2.65± 0.88		91.2	ACCIARRI	94	L3
2.05± 0.52		91.2	AKERS	94	OPAL
1.97± 0.56		91.2	BUSKULIC	94	ALEP

*CITATION: L. Montanet et al., Physical Review D50, 1173 (1994) and 1995 off-year partial update for the 1996 edition (URL: http://pdg.lbl.gov/)

• • • We do not use the following data for averages, fits, limits, etc. • • •

$-32.8\ {}^{+\ 6.4}_{-\ 6.2}\ \pm1.5$	-32.1	56.9	[175]	ABE	90I	VNS
$-\ 8.1\ \pm\ 2.0\ \pm0.6$	-9.2	35		HEGNER	90	JADE
$-18.4\ \pm19.2$	-24.9	52.0	[176]	BACALA	89	AMY
$-17.7\ \pm26.1$	-29.4	55.0	[176]	BACALA	89	AMY
$-45.9\ \pm16.6$	-31.2	56.0	[176]	BACALA	89	AMY
$-49.5\ \pm18.0$	-33.0	57.0	[176]	BACALA	89	AMY
$-20\ \ \pm14$	-25.9	53.3		ADACHI	88C	TOPZ
$-10.6\ \pm\ 3.1\ \pm1.5$	-8.5	34.7		ADEVA	88	MRKJ
$-\ 8.5\ \pm\ 6.6\ \pm1.5$	-15.4	43.8		ADEVA	88	MRKJ
$-\ 6.0\ \pm\ 2.5\ \pm1.0$	8.8	34.6		BARTEL	85F	JADE
$-11.8\ \pm\ 4.6\ \pm1.0$	14.8	43.0		BARTEL	85F	JADE
$-\ 5.5\ \pm\ 1.2\ \pm0.5$	-0.063	29.0		FERNANDEZ	85	MAC
$-\ 4.2\ \pm\ 2.0$	0.057	29		LEVI	83	MRK2
$-10.3\ \pm\ 5.2$	-9.2	34.2		BEHREND	82	CELL
$-\ 0.4\ \pm\ 6.6$	-9.1	34.2		BRANDELIK	82C	TASS

[175] ABE 90I measurements in the range $50 \leq \sqrt{s} \leq 60.8$ GeV.
[176] BACALA 89 systematic error is about 5%.

$A_{FB}^{(0,\ell)}$ CHARGE ASYMMETRY IN $e^+e^- \to \ell^+\ell^-$ (including radiative corrections)

For the Z peak, we report the pole asymmetry defined by $(3/4)A_\ell^2$ as determined by the five-parameter fit to cross-section and lepton forward-backward asymmetry data assuming lepton universality. For details see the "Note on the Z boson."

ASYMMETRY (%)	STD. MODEL	$\sqrt{s}$ (GeV)	DOCUMENT ID		TECN
1.59±0.18 OUR FIT					
1.60±0.18 OUR AVERAGE					
1.77±0.37		91.2	ABREU	94	DLPH
1.84±0.45		91.2	ACCIARRI	94	L3
1.28±0.30		91.2	AKERS	94	OPAL
1.71±0.33		91.2	BUSKULIC	94	ALEP

$A_{FB}^{(0,c)}$ CHARGE ASYMMETRY IN $e^+e^- \to c\bar{c}$

OUR ESTIMATE refers to the Z pole asymmetry. This is obtained by appropriately combining the "near peak" measurements for which the various systematic errors are split into uncorrelated and correlated parts (model dependence, semileptonic branching ratios, fragmentation, $\Gamma(c\bar{c})/\Gamma(b\bar{b})$, and D^* branching ratio). We finally apply to this combined "peak" measurement QCD, QED, and energy-dependence corrections.

ASYMMETRY (%)	STD. MODEL	$\sqrt{s}$ (GeV)		DOCUMENT ID		TECN
7.5± 1.5 OUR ESTIMATE						
9.9± 2.0±1.7		91.24	[177]	BUSKULIC	94G	ALEP
6.8± 4.2±0.9		91.25	[178]	BUSKULIC	94J	ALEP
1.4± 3.0±2.0	5.6	91.24	[179]	ACTON	93K	OPAL
5.2± 2.8±1.2	5.4	91.28	[178]	AKERS	93D	OPAL
8.3± 3.8±2.7	5.6	91.24	[180]	ADRIANI	92D	L3
6.4± 3.9±3.0		91.2	[181]	DECAMP	91E	ALEP
• • • We do not use the following data for averages, fits, limits, etc. • • •						
−14 ±14 ±3	−2	89.75	[178]	AKERS	93D	OPAL
18 ±12 ±3	12	92.64	[178]	AKERS	93D	OPAL
−12.9± 7.8±5.5	−13.6	35		BEHREND	90D	CELL
7.7±13.4±5.0	−22.1	43		BEHREND	90D	CELL
−12.8± 4.4±4.1	−13.6	35		ELSEN	90	JADE
−10.9±12.9±4.6	−23.2	44		ELSEN	90	JADE
−14.9± 6.7	−13.3	35		OULD-SAADA	89	JADE

[177] BUSKULIC 94G perform a simultaneous fit to the p and p_T spectra of both single and dilepton events.
[178] Identifying the b and c decays using D^*.
[179] ACTON 93K use the lepton tagging technique.
[180] ADRIANI 92D use both electron and muon semileptonic decays.
[181] DECAMP 91E use the lepton-tagging technique.

$A_{FB}^{(0,b)}$ CHARGE ASYMMETRY IN $e^+e^- \rightarrow b\overline{b}$

OUR ESTIMATE refers to the Z pole asymmetry. This is obtained by appropriately combining the "near peak" measurements for which the various systematic errors are split into uncorrelated and correlated parts (model dependence, semileptonic branching ratios, fragmentation, $\Gamma(c\overline{c})/\Gamma(b\overline{b})$, mixing, and $c\overline{c}$ asymmetry). We finally apply to this combined "peak" measurement QCD, QED, and energy-dependence corrections. For the jet-charge measurements (where the QCD corrections are already included since they represent an inherent part of the analysis) we subtact a ZFITTER QCD correction before combining.

ASYMMETRY (%)	STD. MODEL	$\sqrt{s}$ (GeV)	DOCUMENT ID		TECN
9.9 ± 0.6 OUR ESTIMATE					
8.7 ± 1.1 ± 0.4		91.3	[182] ACCIARRI	94D	L3
8.7 ± 1.4 ± 0.2		91.24	[183] BUSKULIC	94G	ALEP
9.92 ± 0.84 ± 0.46		91.19	[184] BUSKULIC	94I	ALEP
9.2 ± 1.8 ± 0.8	8.5	91.24	[185] ACTON	93K	OPAL
13.9 ± 9.7 ± 4.9	9.4	91.28	[186] AKERS	93D	OPAL
16.1 ± 6.0 ± 2.1		91.2	[187] ABREU	92H	DLPH
12.6 ± 2.8 ± 1.2		91.2	[188] DECAMP	91E	ALEP
• • • We do not use the following data for averages, fits, limits, etc. • • •					
3.8 ± 6.7 ± 0.5		88.24	[189] BUSKULIC	94G	ALEP
−1.7 ± 7.6 ± 0.3		89.24	[189] BUSKULIC	94G	ALEP
4.5 ± 6.0 ± 0.5		90.24	[189] BUSKULIC	94G	ALEP
7.0 ± 5.5 ± 0.7		92.24	[189] BUSKULIC	94G	ALEP
12.1 ± 6.9 ± 1.1		93.24	[189] BUSKULIC	94G	ALEP
14.5 ± 8.1 ± 1.3		94.24	[189] BUSKULIC	94G	ALEP
7.1 ± 5.4 ± 0.7	5.2	89.66	[185] ACTON	93K	OPAL
13.1 ± 4.7 ± 1.3	10.8	92.75	[185] ACTON	93K	OPAL
9.3 ± 1.1		91.2	[190] QUAST	93	RVUE
8.6 ± 1.5 ± 0.7	8.2	91.24	[191] ADRIANI	92D	L3
2.5 ± 5.1 ± 0.7	5.3	89.67	[192] ADRIANI	92D	L3
9.7 ± 1.7 ± 0.7	8.2	91.24	[192] ADRIANI	92D	L3
6.2 ± 4.2 ± 0.7	10.8	92.81	[192] ADRIANI	92D	L3
9.7 ± 5.7 ± 1.4	9.	91	AKRAWY	91E	OPAL
$-71 \pm 34 {}^{+7}_{-8}$	−58	58.3	SHIMONAKA	91	TOPZ
−22.2 ± 7.7 ± 3.5	−26.0	35	BEHREND	90D	CELL
−49.1 ± 16.0 ± 5.0	−39.7	43	BEHREND	90D	CELL
−28 ± 11	−23	35	BRAUNSCH...	90	TASS
−16.6 ± 7.7 ± 4.8	−24.3	35	ELSEN	90	JADE
−33.6 ± 22.2 ± 5.2	−39.9	44	ELSEN	90	JADE
3.4 ± 7.0 ± 3.5	−16.0	29.0	BAND	89	MAC
−72 ± 28 ± 13	−56	55.2	SAGAWA	89	AMY

[182] ACCIARRI 94D use both electron and muon semileptonic decays.

[183] BUSKULIC 94G perform a simultaneous fit to the p and p_T spectra of both single and dilepton events.

[184] BUSKULIC 94I use the lifetime tag method to obtain a high purity sample of $Z \rightarrow b\overline{b}$ events and the hemisphere charge technique to obtain the jet charge.

[185] ACTON 93K use the lepton tagging technique. The systematic error includes the uncertainty on the mixing parameter.

[186] AKERS 93D identify the b and c decays using D^*.

[187] B tagging via its semimuonic decay. Experimental value corrected using average LEP B^0-$\overline{B}^0$ mixing parameter $\chi = 0.143 \pm 0.023$.

[188] DECAMP 91E use the lepton-tagging technique.

[189] BUSKULIC 94G perform a high p_T lepton analysis using single- and double-tagged events.

[190] QUAST 93 is a combined analysis of LEP results as of Feb. 1993.

[191] ADRIANI 92D use both electron and muon semileptonic decays. For this measurement ADRIANI 92D average over all $\sqrt{s}$ values to obtain a single result.

[192] ADRIANI 92D use both electron and muon semileptonic decays. The quoted systematic error is common to all measurements. The peak value is superseded by ACCIARRI 94D.

CHARGE ASYMMETRY IN $e^+e^- \rightarrow q\overline{q}$

Summed over five lighter flavors.

Experimental and Standard Model values are somewhat event-selection dependent. Standard Model expectations contain some assumptions on B^0-$\overline{B}^0$ mixing and on other electroweak parameters.

ASYMMETRY (%)	STD. MODEL	$\sqrt{s}$ (GeV)	DOCUMENT ID		TECN
• • • We do not use the following data for averages, fits, limits, etc. • • •					
3.93±0.65		91.2	[193] QUAST	93	RVUE
− 0.76±0.12±0.15		91.2	[194] ABREU	92I	DLPH
4.0 ±0.4 ±0.63	4.0	91.3	[195] ACTON	92L	OPAL
9.1 ±1.4 ±1.6	9.0	57.9	ADACHI	91	TOPZ
− 0.84±0.15±0.04		91	DECAMP	91B	ALEP
8.3 ±2.9 ±1.9	8.7	56.6	STUART	90	AMY
11.4 ±2.2 ±2.1	8.7	57.6	ABE	89L	VNS
6.0 ±1.3	5.0	34.8	GREENSHAW	89	JADE
8.2 ±2.9	8.5	43.6	GREENSHAW	89	JADE

[193] QUAST 93 is a combined analysis of LEP results as of Feb. 1993.

[194] ABREU 92I has 0.14 systematic error due to uncertainty of quark fragmentation.

[195] ACTON 92L use the weight function method on 259k selected $Z \rightarrow$ hadrons events. The systematic error includes a contribution of 0.2 due to B^0-$\overline{B}^0$ mixing effect, 0.4 due to Monte Carlo (MC) fragmentation uncertainties and 0.3 due to MC statistics. ACTON 92L derive a value of $\sin^2\theta_W^{\rm eff}$ to be 0.2321 ± 0.0017 ± 0.0028.

CHARGE ASYMMETRY IN $p\overline{p} \rightarrow Z \rightarrow e^+e^-$

ASYMMETRY (%)	STD. MODEL	$\sqrt{s}$ (GeV)	DOCUMENT ID		TECN
• • • We do not use the following data for averages, fits, limits, etc. • • •					
5.2±5.9±0.4		91	ABE	91E	CDF

Z REFERENCES

ABREU	95	ZPHY C65 709 erratum	+Adam, Adye, Agasi+	(DELPHI Collab.)
ACCIARRI	95B	PL B345 589	+Adam, Adriani+	(L3 Collab.)
ACCIARRI	95C	PL B345 609	+Adam, Adriani+	(L3 Collab.)
AKERS	95	ZPHY C65 1	+Alexander, Allison+	(OPAL Collab.)
AKERS	95B	ZPHY C65 17	+Alexander, Allison+	(OPAL Collab.)
AKERS	95C	ZPHY C65 47	+Alexander, Allison+	(OPAL Collab.)
ABE	94C	PRL 73 25	+Abt, Ash, Aston, Bacchetta, Baird+	(SLD Collab.)
ABREU	94	NP B418 403	+Adam, Adye, Agasi+	(DELPHI Collab.)
ABREU	94B	PL B327 386	+Adam, Adye, Agasi+	(DELPHI Collab.)
ABREU	94P	PL B341 109	+Adam, Adye, Agasi, Ajinenko+	(DELPHI Collab.)
ACCIARRI	94	ZPHY C62 551	+Adam, Adriani, Aguilar-Benitez+	(L3 Collab.)
ACCIARRI	94B	PL B328 223	+Adam, Adriani, Aguilar-Benitez+	(L3 Collab.)
ACCIARRI	94D	PL B335 542	+Adam, Adriani, Aguilar-Benitez, Ahlen+	(L3 Collab.)
ACCIARRI	94E	PL B341 245	+Adam, Adriani+	(L3 Collab.)
AKERS	94	ZPHY C61 19	+Alexander, Allison+	(OPAL Collab.)
AKERS	94D	ZPHY C61 357	+Alexander, Allison+	(OPAL Collab.)
AKERS	94P	ZPHY C63 181	+Alexander, Allison+	(OPAL Collab.)
BUSKULIC	94	ZPHY C62 539	+Casper, De Bonis, Decamp, Ghez, Goy+	(ALEPH Collab.)
BUSKULIC	94G	ZPHY C62 179	+Casper, DeBonis, Decamp, Ghez+	(ALEPH Collab.)
BUSKULIC	94I	PL B335 99	+Casper, DeBonis+	(ALEPH Collab.)
BUSKULIC	94J	ZPHY C62 1	+DeBonis, Decamp+	(ALEPH Collab.)
BUSKULIC	94K	ZPHY C64 361	+Debonis, Decamp+	(ALEPH Collab.)
VILAIN	94	PL B320 203	+Wilquet, Beyer+	(CHARM II Collab.)
ABE	93	PRL 70 2515	+Abt, Acton+	(SLD Collab.)
ABREU	93	PL B298 236	+Adam, Adye, Agasi+	(DELPHI Collab.)
ABREU	93B	PL B298 247	+Adam, Adye, Agasi+	(DELPHI Collab.)
ABREU	93I	ZPHY C59 533	+Adam, Adye, Agasi+	(DELPHI Collab.)
Also	95	ZPHY C65 709 erratum	Abreu, Adam, Adye, Agasi+	(DELPHI Collab.)
ABREU	93L	PL B318 249	+Adam, Adami, Adye+	(DELPHI Collab.)
ACTON	93	PL B305 407	+Alexander, Allison+	(OPAL Collab.)
ACTON	93D	ZPHY C58 219	+Alexander, Allison+	(OPAL Collab.)
ACTON	93E	PL B311 391	+Akers, Alexander+	(OPAL Collab.)
ACTON	93F	ZPHY C58 405	+Alexander, Allison+	(OPAL Collab.)
ACTON	93I	ZPHY C58 523	+Alexander, Allison+	(OPAL Collab.)
ACTON	93K	ZPHY C60 19	+Akers, Alexander+	(OPAL Collab.)
ACTON	93M	ZPHY C60 579	+Akers, Alexander+	(OPAL Collab.)
ADRIANI	93E	PL B307 237	+Aguilar-Benitez, Ahlen+	(L3 Collab.)
ADRIANI	93F	PL B309 451	+Aguilar-Benitez, Ahlen+	(L3 Collab.)
ADRIANI	93H	PL B315 494	+Aguilar-Benitez, Ahlen+	(L3 Collab.)
ADRIANI	93I	PL B316 427	+Aguilar-Benitez, Ahlen+	(L3 Collab.)
ADRIANI	93J	PL B317 467	+Aguilar-Benitez, Ahlen, Alcaraz+	(L3 Collab.)
ADRIANI	93M	PRPL 236 1	+Aguilar-Benitez, Ahlen, Alcaraz, Aloisio+	(L3 Collab.)
Also	92H	PL B294 466	Adriani, Aguilar-Benitez, Ahlen, Alcaraz+	(L3 Collab.)
AKERS	93B	ZPHY C60 199	+Alexander, Allison, Anderson, Arcelli+	(OPAL Collab.)
AKERS	93D	ZPHY C60 601	+Alexander, Allison+	(OPAL Collab.)
BUSKULIC	93J	ZPHY C60 71	+Decamp, Goy, Lees, Minard+	(ALEPH Collab.)

BUSKULIC	93L	PL B313 520	+De Bonis, Decamp+	(ALEPH Collab.)
BUSKULIC	93M	PL B313 535	+De Bonis, Decamp+	(ALEPH Collab.)
BUSKULIC	93N	PL B313 549	+De Bonis, Decamp+	(ALEPH Collab.)
BUSKULIC	93P	ZPHY C59 369	+Decamp, Goy+	(ALEPH Collab.)
LEP	93	PL B307 187	+LEP Energy Group, LEP Collabs	(LEP Collabs.)
NOVIKOV	93C	PL B298 453	+Okun, Vysotsky	(ITEP)
QUAST	93	MPL A8 675		(DESY)
ABREU	92	ZPHY C53 567	+Adam, Adami, Adye+	(DELPHI Collab.)
ABREU	92G	PL B275 231	+Adam, Adami, Adye+	(DELPHI Collab.)
ABREU	92H	PL B276 536	+Adam, Adami, Adye+	(DELPHI Collab.)
ABREU	92I	PL B277 371	+Adam, Adami, Adye+	(DELPHI Collab.)
ABREU	92K	PL B281 383	+Adam, Adami, Adye+	(DELPHI Collab.)
ABREU	92M	PL B289 199	+Adam, Adye, Agasi, Alekseev+	(DELPHI Collab.)
ABREU	92N	ZPHY C55 555	+Adam, Adye, Agasi+	(DELPHI Collab.)
ABREU	92O	PL B295 383	+Adam, Adami, Adye+	(DELPHI Collab.)
ACTON	92B	ZPHY C53 539	+Alexander, Allisson, Allport+	(OPAL Collab.)
ACTON	92I	ZPHY C55 191	+Alexander, Allison, Allport+	(OPAL Collab.)
ACTON	92J	PL B291 503	+Alexander, Allison, Allport+	(OPAL Collab.)
ACTON	92L	PL B294 436	+Alexander, Allison, Allport+	(OPAL Collab.)
ACTON	92O	ZPHY C56 521	+Alexander, Allison+	(OPAL Collab.)
ADEVA	92	PL B275 209	+Adriani, Aguilar-Benitez+	(L3 Collab.)
ADRIANI	92B	PL B288 404	+Aguilar-Benitez, Ahlen, Akbari, Alcaraz+	(L3 Collab.)
ADRIANI	92D	PL B292 454	+Aguilar-Benitez, Ahlen, Akbari+	(L3 Collab.)
ADRIANI	92E	PL B292 463	+Aguilar-Benitez, Ahlen, Akbari, Alcaraz+	(L3 Collab.)
ALITTI	92B	PL B276 354	+Ambrosini, Ansari, Autiero, Bareyre+	(UA2 Collab.)
BANERJEE	92	IJMP A7 1853	+Ganguli, Gurtu	(TATA)
BARDADIN-...	92	ZPHY C55 163	Bardadin-Otwinowska	(CLER)
BUSKULIC	92D	PL B292 210	+Decamp, Goy, Lees+	(ALEPH Collab.)
DECAMP	92	PRPL 216 253	+Deschizeaux, Goy, Lees, Minard+	(ALEPH Collab.)
DECAMP	92B	ZPHY C53 1	+Deschizeaux, Goy, Lees, Minard+	(ALEPH Collab.)
LEP	92	PL B276 247	+ALEPH, DELPHI, L3, OPAL	(LEP Collabs.)
ABE	91E	PRL 67 1502	+Amidei, Apollinari+	(CDF Collab.)
ABREU	91	PL B260 240	+Adam, Adami+	(DELPHI Collab.)
ABREU	91E	PL B268 296	+Adam, Adami, Adye, Akesson+	(DELPHI Collab.)
ABREU	91F	NP B367 511	+Adam, Adami, Adye, Akesson+	(DELPHI Collab.)
ACTON	91B	PL B273 338	+Alexander, Allison, Allport, Anderson+	(OPAL Collab.)
ADACHI	91	PL B255 613	+Anazawa, Doser, Enomoto+	(TOPAZ Collab.)
ADEVA	91C	PL B261 177	+Adriani, Aguilar-Benitez, Akbari+	(L3 Collab.)
ADEVA	91E	ZPHY C51 179	+Adriani, Aguilar-Benitez, Akbari, Alcaraz+	(L3 Collab.)
AKRAWY	91B	PL B254 293	+Alexander, Allison+	(OPAL Collab.)
AKRAWY	91D	ZPHY C50 373	+Alexander, Allison, Allport, Anderson+	(OPAL Collab.)
AKRAWY	91E	PL B263 311	+Alexander, Allison+	(OPAL Collab.)
AKRAWY	91F	PL B257 531	+Alexander, Allison, Allport, Anderson+	(OPAL Collab.)
ALEXANDER	91B	PL B262 341	+Allison, Allport, Anderson, Arcelli+	(OPAL Collab.)
ALEXANDER	91C	PL B264 467		(OPAL Collab.)
ALEXANDER	91D	PL B266 201	+Allison, Allport, Anderson+	(OPAL Collab.)
ALEXANDER	91E	PL B264 219	+Allison, Allport+	(OPAL Collab.)
ALEXANDER	91F	ZPHY C52 175	+Allison, Allport, Anderson, Arcelli+	(OPAL Collab.)
ALEXANDER	91G	PL B266 485	+Allison, Allport+	(OPAL Collab.)
DECAMP	91B	PL B259 377	+Deschizeaux, Goy+	(ALEPH Collab.)
DECAMP	91E	PL B263 325	+Deschizeaux, Goy+	(ALEPH Collab.)
DECAMP	91J	PL B266 218	+Deschizeaux, Goy, Lees+	(ALEPH Collab.)
JACOBSEN	91	PRL 67 3347	+Koetke, Adolphsen, Fujino+	(Mark II Collab.)
SHIMONAKA	91	PL B268 457	+Fujii, Miyamoto+	(TOPAZ Collab.)
ABE	90I	ZPHY C48 13	+Amako, Arai, Asano, Chiba+	(VENUS Collab.)
ABREU	90H	PL B252 140	+Adam, Adami, Adye+	(DELPHI Collab.)
ADEVA	90D	PL B238 122	+Adriani, Aguilar-Benitez, Akbari+	(L3 Collab.)
ADEVA	90E	PL B241 416	+Adriani, Aguilar-Benitez, Akbari+	(L3 Collab.)
ADEVA	90K	PL B250 199	+Adriani, Aguilar-Benitez, Akbari, Alcarez+	(L3 Collab.)
AKRAWY	90F	PL B241 133	+Alexander, Allison, Allport+	(OPAL Collab.)
AKRAWY	90J	PL B246 285	+Alexander, Allison, Allport, Anderson+	(OPAL Collab.)
BEHREND	90D	ZPHY C47 333	+Criegee, Field, Franke, Jung+	(CELLO Collab.)
BRAUNSCH...	90	ZPHY C48 433	Braunschweig, Gerhards, Kirschfink+	(TASSO Collab.)
DECAMP	90J	PL B241 635	+Deschizeaux, Goy, Lees+	(ALEPH Collab.)
DECAMP	90L	PL B244 551	+Deschizeaux, Goy+	(ALEPH Collab.)
ELSEN	90	ZPHY C46 349	+Allison, Ambrus, Barlow, Bartel+	(JADE Collab.)
HEGNER	90	ZPHY C46 547	+Naroska, Schroth, Allison+	(JADE Collab.)
KRAL	90	PRL 64 1211	+Abrams, Adolphsen, Averill, Ballam+	(Mark II Collab.)
STUART	90	PRL 64 983	+Breedon, Kim, Ko, Lander, Maeshima+	(AMY Collab.)
ABE	89	PRL 62 613	+Amidei, Apollinari, Ascori, Atac+	(CDF Collab.)
ABE	89C	PRL 63 720	+Amidei, Apollinari, Atac, Auchincloss+	(CDF Collab.)
ABE	89L	PL B232 425	+Amako, Arai, Asano, Chiba+	(VENUS Collab.)
ABRAMS	89B	PRL 63 2173	+Adolphsen, Averill, Ballam, Barish+	(Mark II Collab.)
ABRAMS	89D	PRL 63 2780	+Adolphsen, Averill, Ballam, Barish+	(Mark II Collab.)
ALBAJAR	89	ZPHY C44 15	+Albrow, Allkofer, Arnison, Astbury+	(UA1 Collab.)
BACALA	89	PL B218 112	+Malchow, Sparks, Imlay, Kirk+	(AMY Collab.)
BAND	89	PL B218 369	+Camporesi, Chadwick, Delfino, Desangro+	(MAC Collab.)
GREENSHAW	89	ZPHY C42 1	+Warming, Allison, Ambrus, Barlow+	(JADE Collab.)
OULD-SAADA	89	ZPHY C44 567	+Allison, Ambrus, Barlow, Bartel+	(JADE Collab.)
SAGAWA	89	PRL 63 2341	+Lim, Abe, Fujii, Higashi+	(AMY Collab.)
ADACHI	88C	PL B208 319	+Aihara, Dijkstra, Enomoto, Fujii+	(TOPAZ Collab.)
ADEVA	88	PR D38 2665	+Anderhub, Ansari, Becker+	(Mark-J Collab.)
BRAUNSCH...	88D	ZPHY C40 163	Braunschweig, Gerhards, Kirschfink+	(TASSO Collab.)
ANSARI	87	PL B186 440	+Bagnaia, Banner, Battiston+	(UA2 Collab.)
BEHREND	87C	PL B191 209	+Buerger, Criegee, Dainton+	(CELLO Collab.)
BARTEL	86C	ZPHY C30 371	+Becker, Cords, Felst, Haidt+	(JADE Collab.)
Also	85B	ZPHY C26 507	Bartel, Becker, Bowdery, Cords+	(JADE Collab.)
Also	82	PL 108B 140	Bartel, Cords, Dittmann, Eichler+	(JADE Collab.)
ASH	85	PRL 55 1831	+Band, Blume, Camporesi+	(MAC Collab.)
BARTEL	85F	PL 161B 188	+Becker, Cords, Felst+	(JADE Collab.)
DERRICK	85	PR D31 2352	+Fernandez, Fries, Hyman+	(HRS Collab.)
FERNANDEZ	85	PRL 54 1624	+Ford, Qi, Read+	(MAC Collab.)
LEVI	83	PRL 51 1941	+Blocker, Strait+	(Mark II Collab.)
BEHREND	82	PL 114B 282	+Chen, Fenner, Field+	(CELLO Collab.)
BRANDELIK	82C	PL 110B 173	+Braunschweig, Gather	(TASSO Collab.)