Review of Particle Physics: C. Caso *et al.* (Particle Data Group), European Physical Journal **C3**, 1 (1998)

Z Boson – THIS IS PART 2 OF 2

To reduce the size of this section's PostScript file, we have divided it into two PostScript files. We present the following index:

PART 1

PART 2

AVERAGE PARTICLE MULTIPLICITIES IN HADRONIC Z DECAY

Summed over particle and antiparticle, when appropriate.

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

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

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

VALUE	DOCUMENT ID		TECN	COMMENT
9.79±0.28 OUR AVERAGE				
9.63±0.13±0.63	BARATE	97J	ALEP	E^{ee}_{cm}= 91.2 GeV
9.90±0.02±0.33	ACCIARRI	96	L3	E^{ee}_{cm}= 91.2 GeV
9.2 ±0.2 ±1.0	ADAM	96	DLPH	E^{ee}_{cm}= 91.2 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
9.18±0.03±0.73	ACCIARRI	94B	L3	Repl. by ACCIARRI 96

$\langle N_{\eta} \rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
0.93 ±0.01 ±0.09	ACCIARRI	96	L3	E^{ee}_{cm}= 91.2 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.91 ±0.02 ±0.11	ACCIARRI	94B	L3	Repl. by ACCIARRI 96
0.298±0.023±0.021	[103] BUSKULIC	92D	ALEP	E^{ee}_{cm}= 91.2 GeV

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

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

VALUE	DOCUMENT ID		TECN	COMMENT
1.30±0.12 OUR AVERAGE				
1.45±0.06±0.20	BUSKULIC	96H	ALEP	E^{ee}_{cm}= 91.2 GeV
1.21±0.04±0.15	ABREU	95L	DLPH	E^{ee}_{cm}= 91.2 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1.43±0.12±0.22	ABREU	93	DLPH	Repl. by ABREU 95L

$\langle N_{\omega} \rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
1.11±0.11 OUR AVERAGE				
1.17±0.09±0.15	ACCIARRI	97D	L3	E^{ee}_{cm}= 91.2 GeV
1.07±0.06±0.13	BUSKULIC	96H	ALEP	E^{ee}_{cm}= 91.2 GeV

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.25 ±0.04	[104] ACCIARRI	97D	L3	E^{ee}_{cm}= 91.2 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.068±0.018±0.016	[105] BUSKULIC	92D	ALEP	E^{ee}_{cm}= 91.2 GeV

[104] ACCIARRI 97D obtain this value averaging over the two decay channels $\eta' \rightarrow \pi^+ \pi^- \eta$ and $\eta' \rightarrow \rho^0 \gamma$.
[105] BUSKULIC 92D obtain this value for x> 0.1.

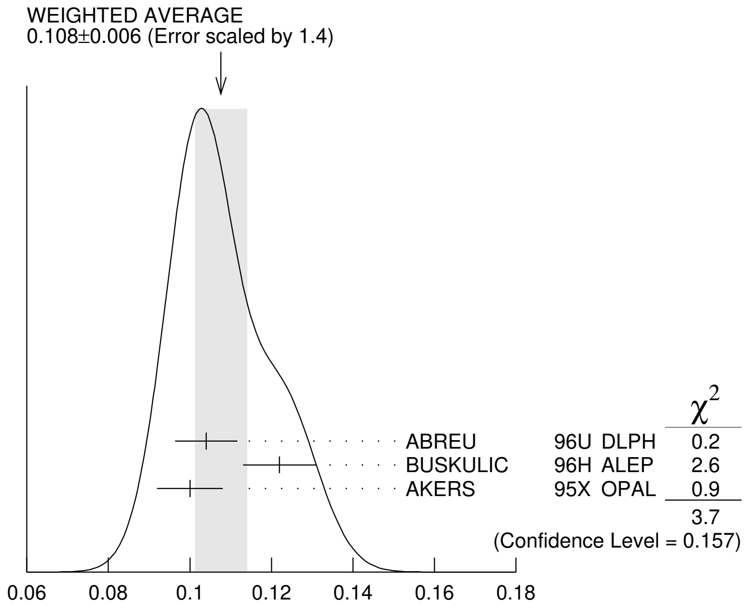
$\langle N_{f_0(980)} \rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.098±0.016	[106] ABREU	95L	DLPH	E^{ee}_{cm}= 91.2 GeV
0.10 ±0.03 ±0.019	[107] ABREU	93	DLPH	Repl. by ABREU 95L

[106] ABREU 95L obtain this value for 0.05 $<x<$ 0.6.
[107] ABREU 93 obtain this value for $x>$ 0.05.

$\langle N_{\phi} \rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
0.108±0.006 OUR AVERAGE	Error includes scale factor of 1.4. See the ideogram below.			
0.104±0.003±0.007	ABREU	96U	DLPH	E^{ee}_{cm}= 91.2 GeV
0.122±0.004±0.008	BUSKULIC	96H	ALEP	E^{ee}_{cm}= 91.2 GeV
0.100±0.004±0.007	AKERS	95X	OPAL	E^{ee}_{cm}= 91.2 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.086±0.015±0.010	ACTON	92O	OPAL	Repl. by AKERS 95X



$\langle N_{\phi} \rangle$

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

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.170±0.043	[108] ABREU	95L	DLPH	E^{ee}_{cm}= 91.2 GeV
0.11 ±0.04 ±0.03	[109] ABREU	93	DLPH	Repl. by ABREU 95L

[108] ABREU 95L obtain this value for $x>$ 0.05.
[109] ABREU 93 obtain this value for $x>$ 0.1.

$\langle N_{f'_2(1525)} \rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
0.020±0.005±0.006	ABREU	96C	DLPH	E^{ee}_{cm}= 91.2 GeV

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

VALUE	DOCUMENT ID		TECN	COMMENT
2.37±0.11 OUR AVERAGE				
2.26±0.01±0.18	ABREU	95F	DLPH	E^{ee}_{cm}= 91.2 GeV
2.42±0.13	AKERS	94P	OPAL	E^{ee}_{cm}= 91.2 GeV

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

VALUE	DOCUMENT ID		TECN	COMMENT
2.013±0.023 OUR AVERAGE				
2.024±0.006±0.042	ACCIARRI	97L	L3	E^{ee}_{cm}= 91.2 GeV
1.962±0.022±0.056	ABREU	95L	DLPH	E^{ee}_{cm}= 91.2 GeV
1.99 ±0.01 ±0.04	AKERS	95U	OPAL	E^{ee}_{cm}= 91.2 GeV
2.061±0.047	BUSKULIC	94K	ALEP	E^{ee}_{cm}= 91.2 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2.04 ±0.02 ±0.14	ACCIARRI	94B	L3	Repl. by ACCIARRI 97L
2.12 ±0.05 ±0.04	ABREU	92G	DLPH	Repl. by ABREU 95L

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.72 ±0.05 OUR AVERAGE				
0.712±0.031±0.059	ABREU	95L	DLPH	E^{ee}_{cm}= 91.2 GeV
0.72 ±0.02 ±0.08	ACTON	93	OPAL	E^{ee}_{cm}= 91.2 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1.33 ±0.11 ±0.24	ABREU	92G	DLPH	Repl. by ABREU 95L

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.752±0.025 OUR AVERAGE				
0.74 ±0.02 ±0.02	ACKERSTAFF	97S	OPAL	E^{ee}_{cm}= 91.2 GeV
0.77 ±0.02 ±0.07	ABREU	96U	DLPH	E^{ee}_{cm}= 91.2 GeV
0.83 ±0.01 ±0.09	BUSKULIC	96H	ALEP	E^{ee}_{cm}= 91.2 GeV
0.97 ±0.18 ±0.31	ABREU	93	DLPH	E^{ee}_{cm}= 91.2 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.74 ±0.03 ±0.03	AKERS	95X	OPAL	Repl. by ACKERSTAFF 97S

$\langle N_{K^*_2(1430)} \rangle$

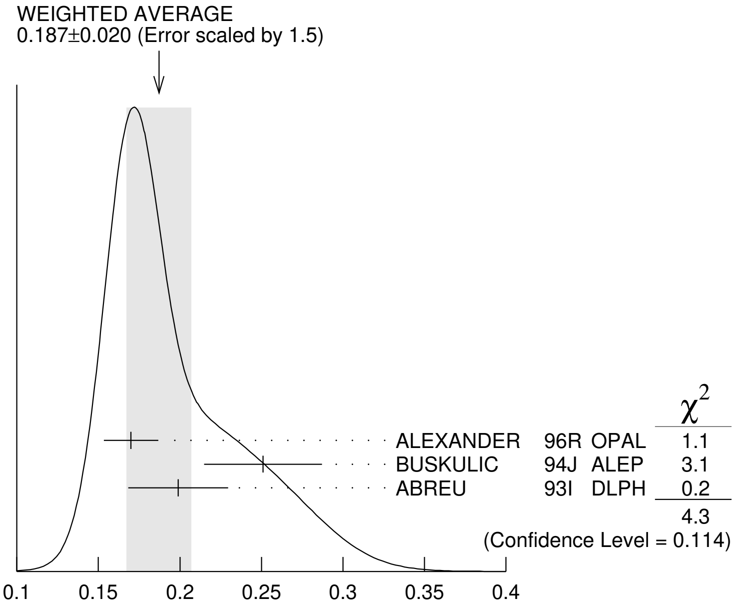
VALUE	DOCUMENT ID		TECN	COMMENT
0.079±0.026±0.031	ABREU	96U	DLPH	E^{ee}_{cm}= 91.2 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.19 ±0.04 ±0.06	[110] AKERS	95X	OPAL	E^{ee}_{cm}= 91.2 GeV

[110] AKERS 95X obtain this value for $x < 0.3$.

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

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
0.187±0.020 OUR AVERAGE	Error includes scale factor of 1.5. See the ideogram below.			
0.170±0.009±0.014	ALEXANDER	96R	OPAL	$E^{ee}_{\rm cm}$= 91.2 GeV
0.251±0.026±0.025	BUSKULIC	94J	ALEP	$E^{ee}_{\rm cm}$= 91.2 GeV
0.199±0.019±0.024	[111] ABREU	93I	DLPH	$E^{ee}_{\rm cm}$= 91.2 GeV

[111] See ABREU 95 (erratum).



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

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

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
0.462±0.026 OUR AVERAGE				
0.465±0.017±0.027	ALEXANDER	96R	OPAL	$E^{ee}_{\rm cm}$= 91.2 GeV
0.518±0.052±0.035	BUSKULIC	94J	ALEP	$E^{ee}_{\rm cm}$= 91.2 GeV
0.403±0.038±0.044	[112] ABREU	93I	DLPH	$E^{ee}_{\rm cm}$= 91.2 GeV

[112] See ABREU 95 (erratum).

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

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
0.131±0.010±0.018	ALEXANDER	96R	OPAL	$E^{ee}_{\rm cm}$= 91.2 GeV

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.183 ±0.008 OUR AVERAGE				
0.1854±0.0041±0.0091	[113] ACKERSTAFF	98E	OPAL	E^{ee}_{cm}= 91.2 GeV
0.187 ±0.015 ±0.013	BUSKULIC	94J	ALEP	E^{ee}_{cm}= 91.2 GeV
0.171 ±0.012 ±0.016	[114] ABREU	93I	DLPH	E^{ee}_{cm}= 91.2 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.183 ±0.009 ±0.011	[115] AKERS	95O	OPAL	Repl. by ACKERSTAFF 98E

[113] ACKERSTAFF 98E systematic error includes an uncertainty of ±0.0069 due to the branching ratios B($D^{*+} \rightarrow D^0 \pi^+$) = 0.683±0.014 and B($D^0 \rightarrow K^- \pi^+$) = 0.0383±0.0012.

[114] See ABREU 95 (erratum).

[115] AKERS 95O systematic error includes an uncertainty of ±0.008 due to the $D^{*\pm}$ and D^0 branching ratios [they use B($D^* \rightarrow D^0 \pi$) = 0.681 ± 0.016 and B($D^0 \rightarrow K \pi$) = 0.0401 ± 0.0014 to obtain this measurement].

$\langle N_{D_{s1}(2536)^+} \rangle$

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$2.9^{+0.7}_{-0.6}$±0.2	[116] ACKERSTAFF	97W	OPAL	E^{ee}_{cm}= 91.2 GeV

[116] ACKERSTAFF 97W obtain this value for $x>$ 0.6 and with the assumption that its decay width is saturated by the $D^* K$ final states.

$\langle N_{B^*} \rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
0.28 ±0.01 ±0.03	[117] ABREU	95R	DLPH	E^{ee}_{cm}= 91.2 GeV

[117] ABREU 95R quote this value for a flavor-averaged excited state.

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.0056±0.0003±0.0004	[118] ALEXANDER	96B	OPAL	E^{ee}_{cm}= 91.2 GeV

[118] ALEXANDER 96B identify $J/\psi(1S)$ from the decays into lepton pairs.

$\langle N_{\psi(2S)} \rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
0.0023±0.0004±0.0003	ALEXANDER	96B	OPAL	E^{ee}_{cm}= 91.2 GeV

$\langle N_p \rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
0.98±0.09 OUR AVERAGE				
1.07±0.01±0.14	ABREU	95F	DLPH	E^{ee}_{cm}= 91.2 GeV
0.92±0.11	AKERS	94P	OPAL	E^{ee}_{cm}= 91.2 GeV

$\langle N_{\Delta(1232)^{++}} \rangle$

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
0.087±0.033 OUR AVERAGE	Error includes scale factor of 2.4.			
0.079±0.009±0.011	ABREU	95W	DLPH	E^{ee}_{cm}= 91.2 GeV
0.22 ±0.04 ±0.04	ALEXANDER	95D	OPAL	E^{ee}_{cm}= 91.2 GeV

$\langle N_{\Lambda} \rangle$

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
0.372±0.007 OUR AVERAGE				
0.364±0.004±0.017	ACCIARRI	97L	L3	E^{ee}_{cm}= 91.2 GeV
0.374±0.002±0.010	ALEXANDER	97D	OPAL	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
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.37 ±0.01 ±0.04	ACCIARRI	94B	L3	Repl. by ACCIARRI 97L
0.351±0.019	ACTON	92J	OPAL	Repl. by ALEXANDER 97D

$\langle N_{\Lambda(1520)} \rangle$

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
0.0213±0.0021±0.0019	ALEXANDER	97D	OPAL	E^{ee}_{cm}= 91.2 GeV

$\langle N_{\Sigma^+} \rangle$

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
0.099±0.008±0.013	ALEXANDER	97E	OPAL	E^{ee}_{cm}= 91.2 GeV

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

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
0.083±0.006±0.009	ALEXANDER	97E	OPAL	E^{ee}_{cm}= 91.2 GeV

$\langle N_{\Sigma^+ + \Sigma^-} \rangle$

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
0.181±0.018 OUR AVERAGE				
0.182±0.010±0.016	[119] ALEXANDER	97E	OPAL	E^{ee}_{cm}= 91.2 GeV
0.170±0.014±0.061	ABREU	95O	DLPH	E^{ee}_{cm}= 91.2 GeV

[119] We have combined the values of $\langle N_{\Sigma^+} \rangle$ and $\langle N_{\Sigma^-} \rangle$ from ALEXANDER 97E adding the statistical and systematic errors of the two final states separately in quadrature. If isospin symmetry is assumed this value becomes 0.174 ± 0.010 ± 0.015.

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

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
0.070±0.011 OUR AVERAGE				
0.071±0.012±0.013	ALEXANDER	97E	OPAL	E^{ee}_{cm}= 91.2 GeV
0.070±0.010±0.010	ADAM	96B	DLPH	E^{ee}_{cm}= 91.2 GeV

$\langle N_{(\Sigma^+ + \Sigma^- + \Sigma^0)/3} \rangle$

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
0.084±0.005±0.008	ALEXANDER	97E	OPAL	E^{ee}_{cm}= 91.2 GeV

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.0239±0.0009±0.0012	ALEXANDER	97D	OPAL	E^{ee}_{cm}= 91.2 GeV

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.0240±0.0010±0.0014	ALEXANDER	97D	OPAL	E^{ee}_{cm}= 91.2 GeV

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.046 ±0.004 OUR AVERAGE	Error includes scale factor of 1.6.			
0.0479±0.0013±0.0026	ALEXANDER	97D	OPAL	E^{ee}_{cm}= 91.2 GeV
0.0382±0.0028±0.0045	ABREU	95O	DLPH	E^{ee}_{cm}= 91.2 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.0380±0.0062	ACTON	92J	OPAL	Repl. by ALEXANDER 97D

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.0258±0.0009 OUR AVERAGE				
0.0259±0.0004±0.0009	ALEXANDER	97D	OPAL	E^{ee}_{cm}= 91.2 GeV
0.0250±0.0009±0.0021	ABREU	95O	DLPH	E^{ee}_{cm}= 91.2 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.020 ±0.004 ±0.003	ABREU	92G	DLPH	Repl. by ABREU 95O
0.0206±0.0021	ACTON	92J	OPAL	Repl. by ALEXANDER 97D

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.0053±0.0013 OUR AVERAGE	Error includes scale factor of 3.2.			
0.0068±0.0005±0.0004	ALEXANDER	97D	OPAL	E^{ee}_{cm}= 91.2 GeV
0.0041±0.0004±0.0004	ABREU	95O	DLPH	E^{ee}_{cm}= 91.2 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.0063±0.0014	ACTON	92J	OPAL	Repl. by ALEXANDER 97D

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.00164±0.00028 OUR AVERAGE				
0.0018 ±0.0003 ±0.0002	ALEXANDER	97D	OPAL	E^{ee}_{cm}= 91.2 GeV
0.0014 ±0.0002 ±0.0004	ADAM	96B	DLPH	E^{ee}_{cm}= 91.2 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.0050 ±0.0015	ACTON	92J	OPAL	Repl. by ALEXANDER 97D

$\langle N_{\Lambda_c^+} \rangle$

VALUE	DOCUMENT ID		TECN	COMMENT
0.078±0.012±0.012	ALEXANDER	96R	OPAL	E^{ee}_{cm}= 91.2 GeV

$\langle N_{charged} \rangle$

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
21.00±0.13 OUR AVERAGE				
21.05±0.20	AKERS	95Z	OPAL	E^{ee}_{cm}= 91.2 GeV
20.91±0.03±0.22	BUSKULIC	95R	ALEP	E^{ee}_{cm}= 91.2 GeV
21.40±0.43	ACTON	92B	OPAL	E^{ee}_{cm}= 91.2 GeV
20.71±0.04±0.77	ABREU	91H	DLPH	E^{ee}_{cm}= 91.2 GeV
20.7 ±0.7	ADEVA	91I	L3	E^{ee}_{cm}= 91.2 GeV
20.1 ±1.0 ±0.9	ABRAMS	90	MRK2	E^{ee}_{cm}= 91.1 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
20.85±0.02±0.24	DECAMP	91K	ALEP	Repl. by BUSKULIC 95R

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*
41.54±0.14 OUR FIT					
41.49±0.10 OUR AVERAGE					
41.23±0.20	1.05M	ABREU	94	DLPH	E^{ee}_{cm}= 88–94 GeV
41.39±0.26	1.09M	ACCIARRI	94	L3	E^{ee}_{cm}= 88–94 GeV
41.70±0.23	1.19M	AKERS	94	OPAL	E^{ee}_{cm}= 88–94 GeV
41.60±0.16	1.27M	BUSKULIC	94	ALEP	E^{ee}_{cm}= 88–94 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
42 ±4	450	ABRAMS	89B	MRK2	E^{ee}_{cm}= 89.2–93.0 GeV

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_V^μ compared to g_V^e and g_V^τ 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_V^e. Since

g_V^μ is obtained using the relation $A_{FB}^\mu = 0.75 \times A_e \times A_\mu$, a large value of g_V^e leads to a SMALL value of g_V^μ. 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_V^e

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
−0.0383±0.0008 OUR FIT					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
-0.0414 ± 0.0020		[120] ABE	95J	SLD	E_{cm}^{ee}= 91.31 GeV
$-0.0364^{+0.0096}_{-0.0082}$	38k	[121] ACCIARRI	94	L3	E_{cm}^{ee}= 88–94 GeV
-0.036 ± 0.005	45.8k	[122] BUSKULIC	94	ALEP	E_{cm}^{ee}= 88–94 GeV
$-0.040^{+0.013}_{-0.011}$		[123] ADRIANI	93M	L3	Repl. by ACCIARRI 94
$-0.034^{+0.006}_{-0.005}$		[121] BUSKULIC	93J	ALEP	Repl. by BUSKULIC 94

[120] ABE 95J obtain this result combining polarized Bhabha results with the A_{LR} measurement of ABE 94C. The Bhabha results alone give $-0.0507 \pm 0.0096 \pm 0.0020$.
[121] The τ polarization result has been included.
[122] BUSKULIC 94 use the added constraint of τ polarization.
[123] ADRIANI 93M use their measurement of the τ polarization in addition to forward-backward lepton asymmetries.

g_V^μ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
−0.0274±0.0047 OUR FIT					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$-0.0402^{+0.0153}_{-0.0211}$	34k	[124] ACCIARRI	94	L3	E_{cm}^{ee}= 88–94 GeV
-0.034 ± 0.013	46.4k	[125] BUSKULIC	94	ALEP	E_{cm}^{ee}= 88–94 GeV
$-0.048^{+0.021}_{-0.033}$		[126] ADRIANI	93M	L3	Repl. by ACCIARRI 94
$-0.019^{+0.018}_{-0.019}$		[124] BUSKULIC	93J	ALEP	Repl. by BUSKULIC 94

[124] The τ polarization result has been included.
[125] BUSKULIC 94 use the added constraint of τ polarization.
[126] ADRIANI 93M use their measurement of the τ polarization in addition to forward-backward lepton asymmetries.

g_V^τ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
−0.0378±0.0020 OUR FIT					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
-0.0384 ± 0.0078	25k	[127] ACCIARRI	94	L3	E_{cm}^{ee}= 88–94 GeV
-0.038 ± 0.005	45.1k	[128] BUSKULIC	94	ALEP	E_{cm}^{ee}= 88–94 GeV
-0.037 ± 0.008	7441	[129] ADRIANI	93M	L3	Repl. by ACCIARRI 94
-0.039 ± 0.006		[127] BUSKULIC	93J	ALEP	Repl. by BUSKULIC 94

[127] The τ polarization result has been included.
[128] BUSKULIC 94 use the added constraint of τ polarization.
[129] ADRIANI 93M use their measurement of the τ polarization in addition to forward-backward lepton asymmetries.

g_V^{ℓ}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
−0.0377±0.0007 OUR FIT					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
−0.039 ±0.004	50.3k	[130] ABREU	94	DLPH	E^{ee}_{cm}= 88–94 GeV
$-0.0378^{+0.0045}_{-0.0042}$	97k	[131] ACCIARRI	94	L3	E^{ee}_{cm}= 88–94 GeV
−0.034 ±0.004	146k	[130] AKERS	94	OPAL	E^{ee}_{cm}= 88–94 GeV
−0.038 ±0.004	137.3k	[130] BUSKULIC	94	ALEP	E^{ee}_{cm}= 88–94 GeV
−0.027 ±0.008	58k	[130] ACTON	93D	OPAL	Repl. by AKERS 94
$-0.040^{+0.006}_{-0.005}$		[131] ADRIANI	93M	L3	Repl. by ACCIARRI 94
$-0.034^{+0.004}_{-0.003}$		[131] BUSKULIC	93J	ALEP	Repl. by BUSKULIC 94

[130] Using forward-backward lepton asymmetries.
[131] The τ polarization result has been included.

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 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.

g_A^{e}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
−0.5007±0.0009 OUR FIT					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
−0.4977±0.0045		[132] ABE	95J	SLD	E^{ee}_{cm}= 91.31 GeV
−0.4998±0.0016	38k	[133] ACCIARRI	94	L3	E^{ee}_{cm}= 88–94 GeV
−0.503 ±0.002	45.8k	BUSKULIC	94	ALEP	E^{ee}_{cm}= 88–94 GeV
−0.4980±0.0021		[133] ADRIANI	93M	L3	Repl. by ACCIARRI 94
−0.5029±0.0018		[133] BUSKULIC	93J	ALEP	Repl. by BUSKULIC 94

[132] ABE 95J obtain this result combining polarized Bhabha results with the A_{LR} measurement of ABE 94C. The Bhabha results alone give −0.4968 ± 0.0039 ± 0.0027.
[133] The τ-polarization constraint has been included.

g_A^{μ}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
−0.5015±0.0012 OUR FIT					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$-0.4987^{+0.0030}_{-0.0026}$	34k	[134] ACCIARRI	94	L3	E^{ee}_{cm}= 88–94 GeV
−0.501 ±0.002	46.4k	BUSKULIC	94	ALEP	E^{ee}_{cm}= 88–94 GeV
$-0.4968^{+0.0050}_{-0.0037}$		[134] ADRIANI	93M	L3	Repl. by ACCIARRI 94
−0.5014±0.0029		[134] BUSKULIC	93J	ALEP	Repl. by BUSKULIC 94

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

g_A^τ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
−0.5009±0.0013 OUR FIT					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
−0.5014±0.0029	25k	[135] ACCIARRI	94	L3	$E_{\rm cm}^{ee}$= 88–94 GeV
−0.502 ±0.003	45.1k	BUSKULIC	94	ALEP	$E_{\rm cm}^{ee}$= 88–94 GeV
−0.5032±0.0038	7441	[135] ADRIANI	93M	L3	Repl. by ACCIARRI 94
−0.5016±0.0033		[135] BUSKULIC	93J	ALEP	Repl. by BUSKULIC 94

[135] 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	[136] 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	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		[136] ADRIANI	93M	L3	Repl. by ACCIARRI 94
−0.5022±0.0015		[136] BUSKULIC	93J	ALEP	Repl. by BUSKULIC 94

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

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	[137] VILAIN	94	CHM2	From $\nu_\mu e$ and $\nu_e e$ scattering

[137] 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	[138] VILAIN	94	CHM2	From $\nu_\mu e$ scattering

[138] 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

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

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
0.1519±0.0034 OUR AVERAGE					
0.162 ±0.041 ±0.014	89838	[139] ABE	97	SLD	E^{ee}_{cm}= 91.27 GeV
0.1543±0.0039	93644	[140] ABE	97E	SLD	E^{ee}_{cm}= 91.27 GeV
0.152 ±0.012		[141] ABE	97N	SLD	E^{ee}_{cm}= 91.27 GeV
0.129 ±0.014 ±0.005	89075	[142] ALEXANDER	96U	OPAL	E^{ee}_{cm}= 88–94 GeV
0.202 ±0.038 ±0.008		[143] ABE	95J	SLD	E^{ee}_{cm}= 91.31 GeV
0.136 ±0.027 ±0.003		[144] ABREU	95I	DLPH	E^{ee}_{cm}= 88–94 GeV
0.129 ±0.016 ±0.005	33000	[145] BUSKULIC	95Q	ALEP	E^{ee}_{cm}= 88–94 GeV
0.157 ±0.020 ±0.005	86000	[144] ACCIARRI	94E	L3	E^{ee}_{cm}= 88–94 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.122 ±0.030 ±0.012	30663	[144] AKERS	95	OPAL	Repl. by ALEXANDER 96U
0.1656±0.0071±0.0028	49392	[146] ABE	94C	SLD	Repl. by ABE 97E
0.097 ±0.044 ±0.004	10224	[147] ABE	93	SLD	Repl. by ABE 97E
0.120 ±0.026		[144] BUSKULIC	93P	ALEP	Repl. by BUSKULIC 95Q

[139] ABE 97 obtain this result from a measurement of the observed left-right charge asymmetry, $A_Q^{\rm obs}$ = 0.225 ± 0.056 ± 0.019, in hadronic Z decays. If they combine this value of $A_Q^{\rm obs}$ with their earlier measurement of $A_{LR}^{\rm obs}$ they determine A_e to be 0.1574 ± 0.0197 ± 0.0067 independent of the beam polarization.

[140] ABE 97E measure the left-right asymmetry in hadronic Z production. This value (statistical and systematic errors added in quadrature) leads to $\sin^2\theta_W^{\rm eff}$ = 0.23060 ± 0.00050.

[141] ABE 97N obtain this direct measurement using the lef-right cross section asymmetry and the left-right forward-backward asymmetry in leptonic decays of the Z boson obtained with a polarized electron beam.

[142] ALEXANDER 96U measure the τ-lepton polarization and the forward-backward polarization asymmetry.

[143] ABE 95J obtain this result from polarized Bhabha scattering.

[144] Derived from the measurement of forward-backward τ polarization asymmetry.

[145] BUSKULIC 95Q obtain this result fitting the τ polarization as a function of the polar τ production angle.

[146] ABE 94C measured the left-right asymmetry in Z production. This value leads to $\sin^2\theta_W$ = 0.2292 ± 0.0009 ± 0.0004.

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

A_μ

This quantity is directly extracted from a measurement of the left-right forward-backward asymmetry in $\mu^+\mu^-$ production at SLC using a polarized electron beam. This double asymmetry eliminates the dependence on the Z-e-e coupling parameter A_e.

VALUE	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
0.102±0.034	3788	[148] ABE	97N	SLD	E^{ee}_{cm}= 91.27 GeV

[148] ABE 97N obtain this direct measurement using the lef-right cross section asymmetry and the left-right forward-backward asymmetry in $\mu^+\mu^-$ decays of the Z boson obtained with a polarized electron beam.

A_τ

The LEP Collaborations derive this quantity from the measurement of the average τ polarization in $Z \rightarrow \tau^+\tau^-$. The SLD Collaboration directly extracts this quantity from its measured left-right forward-backward asymmetry in $Z \rightarrow \tau^+\tau^-$ produced using a polarized e^- beam. This double asymmetry eliminates the dependence on the Z-e-e coupling parameter A_e.

VALUE	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
0.143±0.008 OUR AVERAGE					
0.195±0.034		[149] ABE	97N	SLD	E^{ee}_{cm}= 91.27 GeV
0.134±0.009±0.010	89075	[150] ALEXANDER	96U	OPAL	E^{ee}_{cm}= 88–94 GeV
0.148±0.017±0.014		ABREU	95I	DLPH	E^{ee}_{cm}= 88–94 GeV
0.136±0.012±0.009	33000	[151] BUSKULIC	95Q	ALEP	E^{ee}_{cm}= 88–94 GeV
0.150±0.013±0.009	86000	ACCIARRI	94E	L3	E^{ee}_{cm}= 88–94 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.153±0.019±0.013	30663	AKERS	95	OPAL	Repl. by ALEXANDER 96U
0.132±0.033	10732	ADRIANI	93M	L3	Repl. by ACCIARRI 94E
0.143±0.023		BUSKULIC	93P	ALEP	Repl. by BUSKULIC 95Q
0.24 ±0.07	2021	ABREU	92N	DLPH	Repl. by ABREU 95I

[149] ABE 97N obtain this direct measurement using the left-right cross section asymmetry and the left-right forward-backward asymmetry in $\tau^+\tau^-$ decays of the Z boson obtained with a polarized electron beam.

[150] ALEXANDER 96U measure the τ-lepton polarization and the forward-backward polarization asymmetry.

[151] BUSKULIC 95Q obtain this result fitting the τ polarization as a function of the polar τ production angle.

A_c

This quantity is directly extracted from a measurement of the left-right forward-backward asymmetry in $c\overline{c}$ production at SLC using polarized electron beam. This double asymmetry eliminates the dependence on the Z-e-e coupling parameter A_e.

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
0.59±0.19 OUR AVERAGE				
0.37±0.23±0.21	[152] ABE	95L	SLD	E^{ee}_{cm}= 91.26 GeV
0.73±0.22±0.10	[153] ABE,K	95	SLD	E^{ee}_{cm}= 91.26 GeV

[152] ABE 95L tag b and c quarks through their semileptonic decays into electrons and muons. A maximum likelihood fit is performed to extract A_b and A_c.

[153] ABE,K 95 tag $Z \rightarrow c\overline{c}$ events using D^{*+} and D^+ meson production. To take care of the $b\overline{b}$ contamination in their analysis they use A^D_b= 0.64 ± 0.11 (which is A_b from

D^*/D tagging). This is obtained by starting with a Standard Model value of 0.935, assigning it an estimated error of ± 0.105 to cover LEP and SLD measurements, and finally taking into account B-$\overline{B}$ mixing ($1-2\chi_{\mathrm{mix}} = 0.72 \pm 0.09$). Combining with ABE 95L they quote 0.59 ± 0.19.

A_b

This quantity is directly extracted from a measurement of the left-right forward-backward asymmetry in $b\overline{b}$ production at SLC using polarized electron beam. This double asymmetry eliminates the dependence on the Z-e-e coupling parameter A_e.

VALUE	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
0.89±0.11 OUR AVERAGE					
$0.87 \pm 0.11 \pm 0.09$	4032	[154] ABE	95K	SLD	E^{ee}_{cm}= 91.26 GeV
$0.91 \pm 0.14 \pm 0.07$		[155] ABE	95L	SLD	E^{ee}_{cm}= 91.26 GeV

[154] ABE 95K obtain an enriched sample of $b\overline{b}$ events tagging with the impact parameter. A momentum-weighted charge sum is used to identify the charge of the underlying b quark.

[155] ABE 95L tag b and c quarks through their semileptonic decays into electrons and muons. A maximum likelihood fit is performed to extract A_b and A_c. Combining with ABE 95K, they quote $0.89 \pm 0.09 \pm 0.06$.

TRANSVERSE SPIN CORRELATIONS IN $Z \to \tau^+\tau^-$

The correlations between the transverse spin components of $\tau^+\tau^-$ produced in Z decays may be expressed in terms of the vector and axial-vector couplings:

$$C_{TT} = \frac{|g_A^\tau|^2 - |g_V^\tau|^2}{|g_A^\tau|^2 + |g_V^\tau|^2}$$

$$C_{TN} = -2\frac{|g_A^\tau||g_V^\tau|}{|g_A^\tau|^2 + |g_V^\tau|^2}\sin(\Phi_{g_V^\tau} - \Phi_{g_A^\tau})$$

C_{TT} refers to the transverse-transverse (within the collision plane) spin correlation and C_{TN} refers to the transverse-normal (to the collision plane) spin correlation.

The longitudinal τ polarization P_τ ($= -A_\tau$) is given by:

$$P_\tau = -2\frac{|g_A^\tau||g_V^\tau|}{|g_A^\tau|^2 + |g_V^\tau|^2}\cos(\Phi_{g_V^\tau} - \Phi_{g_A^\tau})$$

Here Φ is the phase and the phase difference $\Phi_{g_V^\tau} - \Phi_{g_A^\tau}$ can be obtained using both the measurements of C_{TN} and P_τ.

C_{TT}

VALUE	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
1.01±0.12 OUR AVERAGE					
$0.87 \pm 0.20 ^{+0.10}_{-0.12}$	9.1K	ABREU	97G	DLPH	E^{ee}_{cm}= 91.2 GeV
$1.06 \pm 0.13 \pm 0.05$	120K	BARATE	97D	ALEP	E^{ee}_{cm}= 91.2 GeV

C_{TN}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.08±0.13±0.04	120K	[156] BARATE	97D	ALEP	E^{ee}_{cm}= 91.2 GeV

[156] BARATE 97D combine their value of C_{TN} with the world average $P_\tau = -0.140 \pm 0.007$ to obtain $\tan(\Phi_{g^\tau_V} - \Phi_{g^\tau_A}) = -0.57 \pm 0.97$.

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

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 $e^+ e^- \rightarrow \mu^+ \mu^-$

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. • • •					
9 ±30	−2	20	[157] ABREU	95M	DLPH
7 ±26	−10	40	[157] ABREU	95M	DLPH
−11 ±33	−25	57	[157] ABREU	95M	DLPH
−62 ±17	−45	69	[157] ABREU	95M	DLPH
−56 ±10	−58	79	[157] ABREU	95M	DLPH
−13 ± 5	−23	87.5	[157] ABREU	95M	DLPH
$-29.0 \, {}^{+\,5.0}_{-\,4.8} \pm 0.5$	−32.1	56.9	[158] ABE	90I	VNS
− 9.9 ± 1.5 ±0.5	−9.2	35	HEGNER	90	JADE
0.05± 0.22	0.026	91.14	[159] ABRAMS	89D	MRK2
−43.4 ±17.0	−24.9	52.0	[160] BACALA	89	AMY
−11.0 ±16.5	−29.4	55.0	[160] BACALA	89	AMY
−30.0 ±12.4	−31.2	56.0	[160] BACALA	89	AMY
−46.2 ±14.9	−33.0	57.0	[160] BACALA	89	AMY
−29 ±13	−25.9	53.3	ADACHI	88C	TOPZ

$+5.3 \pm 5.0 \pm 0.5$	-1.2	14.0	ADEVA	88	MRKJ
$-10.4 \pm 1.3 \pm 0.5$	-8.6	34.8	ADEVA	88	MRKJ
$-12.3 \pm 5.3 \pm 0.5$	-10.7	38.3	ADEVA	88	MRKJ
$-15.6 \pm 3.0 \pm 0.5$	-14.9	43.8	ADEVA	88	MRKJ
-1.0 ± 6.0	-1.2	13.9	BRAUNSCH...	88D	TASS
$-9.1 \pm 2.3 \pm 0.5$	-8.6	34.5	BRAUNSCH...	88D	TASS
$-10.6 {}^{+2.2}_{-2.3} \pm 0.5$	-8.9	35.0	BRAUNSCH...	88D	TASS
$-17.6 {}^{+4.4}_{-4.3} \pm 0.5$	-15.2	43.6	BRAUNSCH...	88D	TASS
$-4.8 \pm 6.5 \pm 1.0$	-11.5	39	BEHREND	87C	CELL
$-18.8 \pm 4.5 \pm 1.0$	-15.5	44	BEHREND	87C	CELL
$+2.7 \pm 4.9$	-1.2	13.9	BARTEL	86C	JADE
$-11.1 \pm 1.8 \pm 1.0$	-8.6	34.4	BARTEL	86C	JADE
$-17.3 \pm 4.8 \pm 1.0$	-13.7	41.5	BARTEL	86C	JADE
$-22.8 \pm 5.1 \pm 1.0$	-16.6	44.8	BARTEL	86C	JADE
$-6.3 \pm 0.8 \pm 0.2$	-6.3	29	ASH	85	MAC
$-4.9 \pm 1.5 \pm 0.5$	-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

[157] ABREU 95M perform this measurement using radiative muon-pair events associated with high-energy isolated photons.
[158] ABE 90I measurements in the range $50 \leq \sqrt{s} \leq 60.8$ GeV.
[159] ABRAMS 89D asymmetry includes both 9 $\mu^+\mu^-$ and 15 $\tau^+\tau^-$ events.
[160] BACALA 89 systematic error is about 5%.

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

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
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$-32.8 {}^{+6.4}_{-6.2} \pm 1.5$	-32.1	56.9	[161] ABE	90I	VNS
$-8.1 \pm 2.0 \pm 0.6$	-9.2	35	HEGNER	90	JADE
-18.4 ± 19.2	-24.9	52.0	[162] BACALA	89	AMY
-17.7 ± 26.1	-29.4	55.0	[162] BACALA	89	AMY
-45.9 ± 16.6	-31.2	56.0	[162] BACALA	89	AMY
-49.5 ± 18.0	-33.0	57.0	[162] BACALA	89	AMY
-20 ± 14	-25.9	53.3	ADACHI	88C	TOPZ
$-10.6 \pm 3.1 \pm 1.5$	-8.5	34.7	ADEVA	88	MRKJ

$-8.5 \pm 6.6 \pm 1.5$	-15.4	43.8	ADEVA	88	MRKJ
$-6.0 \pm 2.5 \pm 1.0$	8.8	34.6	BARTEL	85F	JADE
$-11.8 \pm 4.6 \pm 1.0$	14.8	43.0	BARTEL	85F	JADE
$-5.5 \pm 1.2 \pm 0.5$	-0.063	29.0	FERNANDEZ	85	MAC
-4.2 ± 2.0	0.057	29	LEVI	83	MRK2
-10.3 ± 5.2	-9.2	34.2	BEHREND	82	CELL
-0.4 ± 6.6	-9.1	34.2	BRANDELIK	82C	TASS

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

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

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

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

ASYMMETRY (%)	*STD. MODEL*	$\sqrt{s}$ *(GeV)*	*DOCUMENT ID*		*TECN*
4.0±7.3 OUR EVALUATION					
4.0 ± 6.7 ± 2.8	6	91.2	[163] ACKERSTAFF	97T	OPAL

[163] ACKERSTAFF 97T measure the forward-backward asymmetry of various fast hadrons made of light quarks. Then using SU(2) isospin symmetry and flavor independence for down and strange quarks authors solve for the different quark types.

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

The s-quark asymmetry is derived from measurements of the forward-backward asymmetry of fast hadrons containing an s quark.

ASYMMETRY (%)	*STD. MODEL*	$\sqrt{s}$ *(GeV)*	*DOCUMENT ID*		*TECN*
9.9±3.1 OUR AVERAGE	Error includes scale factor of 1.2.				
6.8±3.5±1.1	10	91.2	[164] ACKERSTAFF	97T	OPAL
13.1±3.5±1.3		91.2	[165] ABREU	95G	DLPH

[164] ACKERSTAFF 97T measure the forward-backward asymmetry of various fast hadrons made of light quarks. Then using SU(2) isospin symmetry and flavor independence for down and strange quarks authors solve for the different quark types. The value reported here corresponds then to the forward-backward asymmetry for "down-type" quarks.

[165] ABREU 95G require the presence of a high-momentum charged kaon or Λ^0 to tag the s quark. An unresolved s- and d-quark asymmetry of $(11.2 \pm 3.1 \pm 5.4)\%$ is obtained by tagging the presence of a high-energy neutron or neutral kaon in the hadron calorimeter.

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

OUR FIT, which is obtained by a simultaneous fit to several c- and b-quark measurements as explained in the "Note on the Z boson," refers to the Z pole asymmetry. As a cross check we have also performed a weighted average of the "near peak" measurements taking into account the various common systematic errors. We have assumed that the smallest common systematic error is fully correlated. Applying to this combined "peak" measurement QCD, QED, and energy-dependence corrections, our weighted average gives a pole asymmetry of $(7.20 \pm 0.64)\%$.

ASYMMETRY (%)	*STD. MODEL*	$\sqrt{s}$ (GeV)	*DOCUMENT ID*		*TECN*
7.32± 0.58 OUR FIT					
6.3 ± 1.2 ±0.6		91.22	[166] ALEXANDER	97C	OPAL
6.00± 0.67±0.52		91.24	[167] ALEXANDER	96	OPAL
7.7 ± 2.9 ±1.2		91.27	[168] ABREU	95E	DLPH
8.3 ± 2.2 ±1.6		91.27	[169] ABREU	95K	DLPH
6.99± 2.05±1.02		91.24	[170] BUSKULIC	95I	ALEP
9.9 ± 2.0 ±1.7		91.24	[171] BUSKULIC	94G	ALEP
8.3 ± 3.8 ±2.7	5.6	91.24	[172] ADRIANI	92D	L3
• • • We do not use the following data for averages, fits, limits, etc. • • •					
3.9 ± 5.1 ±0.9		89.45	[166] ALEXANDER	97C	OPAL
15.8 ± 4.1 ±1.1		93.00	[166] ALEXANDER	97C	OPAL
−7.5 ± 3.4 ±0.6	−3.5	89.52	[167] ALEXANDER	96	OPAL
14.1 ± 2.8 ±0.9	12.0	92.94	[167] ALEXANDER	96	OPAL
6.8 ± 4.2 ±0.9		91.25	[173] BUSKULIC	94J	ALEP
1.4 ± 3.0 ±2.0	5.6	91.24	[174] ACTON	93K	OPAL
3.8 ± 4.4 ±1.0	5.4	91.28	[175] 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

[166] ALEXANDER 97C identify the b and c events using a D/D^* tag.
[167] ALEXANDER 96 tag heavy flavors using one or two identified leptons. This allows the simultaneous fitting of the b and c quark forward-backward asymmetries as well as the average B^0-$\overline{B}^0$ mixing.
[168] ABREU 95E require the presence of a $D^{*\pm}$ to identify c and b quarks.
[169] ABREU 95K identify c and b quarks using both electron and muon semileptonic decays.
[170] BUSKULIC 95I require the presence of a high momentum $D^{*\pm}$ to have an enriched sample of $Z \rightarrow c\overline{c}$ events.
[171] BUSKULIC 94G perform a simultaneous fit to the p and p_T spectra of both single and dilepton events.
[172] ADRIANI 92D use both electron and muon semileptonic decays.
[173] BUSKULIC 94J Identify the b and c decays using D^*. Replaced by BUSKULIC 95I.
[174] ACTON 93K use the lepton tagging technique. Replaced by ALEXANDER 96.
[175] AKERS 93D identify the b and c decays using D^*. Replaced by ALEXANDER 97C.

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

OUR FIT, which is obtained by a simultaneous fit to several c- and b-quark measurements as explained in the "Note on the Z boson," refers to the Z pole asymmetry. As a cross check we have also performed a weighted average of the "near peak" measurements taking into account the various common systematic errors. We have assumed that the smallest common systematic error is fully correlated. Applying to this combined "peak" measurement QCD, QED, and energy-dependence corrections, our weighted average gives a pole asymmetry of (10.07 ± 0.32)%. For the jet-charge measurements (where the QCD corrections are already included since they represent an inherent part of the analysis), we subtract the QCD correction before combining.

ASYMMETRY (%)	*STD. MODEL*	$\sqrt{s}$ (GeV)	*DOCUMENT ID*		*TECN*
10.02± 0.28 OUR FIT					
9.94± 0.52± 0.44		91.21	[176] ACKERSTAFF	97P	OPAL
9.4 ± 2.7 ± 2.2		91.22	[177] ALEXANDER	97C	OPAL
9.06± 0.51± 0.23		91.24	[178] ALEXANDER	96	OPAL
9.65± 0.44± 0.26		91.21	[179] BUSKULIC	96Q	ALEP
5.9 ± 6.2 ± 2.4		91.27	[180] ABREU	95E	DLPH
10.4 ± 1.3 ± 0.5		91.27	[181] ABREU	95K	DLPH
11.5 ± 1.7 ± 1.0		91.27	[182] ABREU	95K	DLPH
8.7 ± 1.1 ± 0.4		91.3	[183] ACCIARRI	94D	L3
9.92± 0.84± 0.46		91.19	[184] BUSKULIC	94I	ALEP
• • • We do not use the following data for averages, fits, limits, etc. • • •					
4.1 ± 2.1 ± 0.2		89.44	[176] ACKERSTAFF	97P	OPAL
14.5 ± 1.7 ± 0.7		92.91	[176] ACKERSTAFF	97P	OPAL
− 8.6 ±10.8 ± 2.9		89.45	[177] ALEXANDER	97C	OPAL
− 2.1 ± 9.0 ± 2.6		93.00	[177] ALEXANDER	97C	OPAL
5.5 ± 2.4 ± 0.3	5.5	89.52	[178] ALEXANDER	96	OPAL
11.7 ± 2.0 ± 0.3	11.4	92.94	[178] ALEXANDER	96	OPAL
− 3.4 ±11.2 ± 0.7		88.38	[179] BUSKULIC	96Q	ALEP
5.3 ± 2.0 ± 0.2		89.38	[179] BUSKULIC	96Q	ALEP
8.9 ± 5.9 ± 0.4		90.21	[179] BUSKULIC	96Q	ALEP
3.8 ± 5.1 ± 0.2		92.05	[179] BUSKULIC	96Q	ALEP
10.3 ± 1.6 ± 0.4		92.94	[179] BUSKULIC	96Q	ALEP
8.8 ± 7.5 ± 0.5		93.90	[179] BUSKULIC	96Q	ALEP
6.2 ± 3.4 ± 0.2		89.52	[185] AKERS	95S	OPAL
9.63± 0.67± 0.38		91.25	[185] AKERS	95S	OPAL
17.2 ± 2.8 ± 0.7		92.94	[185] AKERS	95S	OPAL
8.7 ± 1.4 ± 0.2		91.24	[186] BUSKULIC	94G	ALEP
7.1 ± 5.4 ± 0.7	5.2	89.66	[187] ACTON	93K	OPAL
9.2 ± 1.8 ± 0.8	8.5	91.24	[187] ACTON	93K	OPAL

13.1 ± 4.7 ± 1.3	10.8	92.75	[187] ACTON	93K	OPAL
13.9 ± 9.7 ± 4.9	9.4	91.28	[188] AKERS	93D	OPAL
16.1 ± 6.0 ± 2.1		91.2	[189] ABREU	92H	DLPH
8.6 ± 1.5 ± 0.7	8.2	91.24	[190] ADRIANI	92D	L3
2.5 ± 5.1 ± 0.7	5.3	89.67	[191] ADRIANI	92D	L3
9.7 ± 1.7 ± 0.7	8.2	91.24	[191] ADRIANI	92D	L3
6.2 ± 4.2 ± 0.7	10.8	92.81	[191] ADRIANI	92D	L3
$-71 \pm 34 {}^{+7}_{-8}$	−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

[176] ACKERSTAFF 97P tag b quarks using lifetime. The quark charge is measured using both jet charge and vertex charge, a weighted sum of the charges of tracks in a jet which contains a tagged secondary vertex.

[177] ALEXANDER 97C identify the b and c events using a D/D^* tag.

[178] ALEXANDER 96 tag heavy flavors using one or two identified leptons. This allows the simultaneous fitting of the b and c quark forward-backward asymmetries as well as the average B^0-$\overline{B}^0$ mixing.

[179] BUSKULIC 96Q tag b-quark flavor and charge using high transverse momentum leptons. The asymmetry value at the Z peak is obtained using a charm charge asymmetry of 6.17%.

[180] ABREU 95E require the presence of a $D^{*\pm}$ to identify c and b quarks.

[181] ABREU 95K identify c and b quarks using both electron and muon semileptonic decays. The systematic error includes an uncertainty of ±0.3 due to the mixing correction ($\chi = 0.115 \pm 0.011$).

[182] ABREU 95K tag b quarks using lifetime; the quark charge is identified using jet charge. The systematic error includes an uncertainty of ±0.3 due to the mixing correction ($\chi = 0.115 \pm 0.011$).

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

[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] AKERS 95S tag b quarks using lifetime; the quark charge is measured using jet charge. These asymmetry values are obtained using $R_b = \Gamma(b\overline{b})/\Gamma(\text{hadrons}) = 0.216$. For a value of R_b different from this by an amount ΔR_b, the change in the asymmetry values is given by $-K\Delta R_b$, where K = 0.082, 0.471, and 0.855 for $\sqrt{s}$ values of 89.52, 91.25, and 92.94 GeV respectively. Replaced by ACKERSTAFF 97P.

[186] BUSKULIC 94G perform a simultaneous fit to the p and p_T spectra of both single and dilepton events. Replaced by BUSKULIC 96Q.

[187] ACTON 93K use the lepton tagging technique. The systematic error includes the uncertainty on the mixing parameter. Replaced by ALEXANDER 96.

[188] AKERS 93D identify the b and c decays using D^*. Replaced by ALEXANDER 97C.

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

[190] 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.

[191] 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 $e^+e^- \to q\overline{q}$

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. • • •					
$-$ 0.76$\pm$0.12$\pm$0.15		91.2	[192] ABREU	92I	DLPH
4.0 $\pm$0.4 $\pm$0.63	4.0	91.3	[193] ACTON	92L	OPAL
9.1 $\pm$1.4 $\pm$1.6	9.0	57.9	ADACHI	91	TOPZ
$-$ 0.84$\pm$0.15$\pm$0.04		91	DECAMP	91B	ALEP
8.3 $\pm$2.9 $\pm$1.9	8.7	56.6	STUART	90	AMY
11.4 $\pm$2.2 $\pm$2.1	8.7	57.6	ABE	89L	VNS
6.0 $\pm$1.3	5.0	34.8	GREENSHAW	89	JADE
8.2 $\pm$2.9	8.5	43.6	GREENSHAW	89	JADE

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

[193] ACTON 92L use the weight function method on 259k selected $Z \to$ 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 $\sin^2\theta_W^{\mathrm{eff}}$ to be 0.2321 $\pm$ 0.0017 $\pm$ 0.0028.

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

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

Z REFERENCES

ABE	98D	PRL 80 660	K. Abe+	(SLD Collab.)
ACKERSTAFF	98E	EPJ C1 439	K. Ackerstaff+	(OPAL Collab.)
ABE	97	PRL 78 17	+Abe, Abt, Akagi, Allen+	(SLD Collab.)
ABE	97E	PRL 78 2075	+Abe, Abt, Akagi, Allen+	(SLD Collab.)
ABE	97N	PRL 79 804	K. Abe+	(SLD Collab.)
ABREU	97C	ZPHY C73 243	+Adam, Adye, Ajinenko+	(DELPHI Collab.)
ABREU	97G	PL B404 194	P. Abreu+	(DELPHI Collab.)
ACCIARRI	97D	PL B393 465	+Adriani, Aguilar-Benitez, Ahlen+	(L3 Collab.)
ACCIARRI	97J	PL B407 351	M. Acciarri+	(L3 Collab.)
ACCIARRI	97K	PL B407 361	M. Acciarri+	(L3 Collab.)
ACCIARRI	97L	PL B407 389	M. Acciarri+	(L3 Collab.)
ACCIARRI	97R	PL B413 167	M. Acciarri+	(L3 Collab.)
ACKERSTAFF	97C	PL B391 221	+Alexander, Allison, Altekamp, Ametewee+	(OPAL Collab.)
ACKERSTAFF	97K	ZPHY C74 1	K. Ackerstaff+	(OPAL Collab.)
ACKERSTAFF	97M	ZPHY C74 413	K. Ackerstaff+	(OPAL Collab.)
ACKERSTAFF	97P	ZPHY C75 385	K. Ackerstaff+	(OPAL Collab.)
ACKERSTAFF	97S	PL B412 210	K. Ackerstaff+	(OPAL Collab.)
ACKERSTAFF	97T	ZPHY C76 387	K. Ackerstaff+	(OPAL Collab.)
ACKERSTAFF	97W	ZPHY C76 425	K. Ackerstaff+	(OPAL Collab.)
ALEXANDER	97C	ZPHY C73 379	+Allison, Altekamp, Ametewee+	(OPAL Collab.)
ALEXANDER	97D	ZPHY C73 569	+Allison, Altekamp, Ametewee+	(OPAL Collab.)
ALEXANDER	97E	ZPHY C73 587	+Allison, Altekamp, Ametewee+	(OPAL Collab.)
BARATE	97D	PL B405 191	R. Barate+	(ALEPH Collab.)
BARATE	97E	PL B401 150	R. Barate+	(ALEPH Collab.)

BARATE	97F	PL B401 163	R. Barate+	(ALEPH Collab.)
BARATE	97J	ZPHY C74 451	R. Barate+	(ALEPH Collab.)
ABE	96E	PR D53 1023	+Abt, Ahn, Akagi, Allen+	(SLD Collab.)
ABREU	96	ZPHY C70 531	+Adam, Adye+	(DELPHI Collab.)
ABREU	96C	PL B379 309	+Adam, Adye+	(DELPHI Collab.)
ABREU	96R	ZPHY C72 31	+Adam, Adye+	(DELPHI Collab.)
ABREU	96S	PL B389 405	+Adam, Adye, Ajinenko+	(DELPHI Collab.)
ABREU	96U	ZPHY C73 61	+Adam, Adye, Agasi, Ajinenko+	(DELPHI Collab.)
ACCIARRI	96	PL B371 126	+Adam, Adriani+	(L3 Collab.)
ACCIARRI	96B	PL B370 195	+Adam, Adriani+	(L3 Collab.)
ADAM	96	ZPHY C69 561	+Adye, Agasi, Ajinenko+	(DELPHI Collab.)
ADAM	96B	ZPHY C70 371	+Adye, Agasi+	(DELPHI Collab.)
ALEXANDER	96	ZPHY C70 357	+Allison, Altekamp+	(OPAL Collab.)
ALEXANDER	96B	ZPHY C70 197	+Allison, Altekamp+	(OPAL Collab.)
ALEXANDER	96F	PL B370 185	+Allison, Altekamp+	(OPAL Collab.)
ALEXANDER	96N	PL B384 343	+Allison, Altekamp, Ametewee+	(OPAL Collab.)
ALEXANDER	96R	ZPHY C72 1	+Allison, Altekamp+	(OPAL Collab.)
ALEXANDER	96U	ZPHY C72 365	+Allison, Altekamp, Ametewee+	(OPAL Collab.)
ALEXANDER	96X	PL B376 232	G. Alexander+	(OPAL Collab.)
BUSKULIC	96D	ZPHY C69 393	+Casper, De Bonis, Decamp+	(ALEPH Collab.)
BUSKULIC	96H	ZPHY C69 379	+Casper, De Bonis+	(ALEPH Collab.)
BUSKULIC	96Q	PL B384 414	+De Bonis, Decamp, Ghez+	(ALEPH Collab.)
ABE	95J	PRL 74 2880	+Abt, Ahn, Akagi+	(SLD Collab.)
ABE	95K	PRL 74 2890	+Abt, Ahn, Akagi+	(SLD Collab.)
ABE	95L	PRL 74 2895	+Abt, Ahn, Akagi+	(SLD Collab.)
ABE,K	95	PRL 75 3609	K. Abe, Abt, Ahn, Akagi+	(SLD Collab.)
ABREU	95	ZPHY C65 709 erratum	+Adam, Adye, Agasi+	(DELPHI Collab.)
ABREU	95D	ZPHY C66 323	+Adam, Adye, Agasi+	(DELPHI Collab.)
ABREU	95E	ZPHY C66 341	+Adam, Adye, Agasi+	(DELPHI Collab.)
ABREU	95F	NP B444 3	+Adam, Adye, Agasi+	(DELPHI Collab.)
ABREU	95G	ZPHY C67 1	+Adam, Adye, Agasi+	(DELPHI Collab.)
ABREU	95I	ZPHY C67 183	+Adam, Adye, Agasi+	(DELPHI Collab.)
ABREU	95J	ZPHY C65 555	+Adam, Adye, Agasi+	(DELPHI Collab.)
ABREU	95K	ZPHY C65 569	+Adam, Adye, Agasi+	(DELPHI Collab.)
ABREU	95L	ZPHY C65 587	+Adam, Adye, Agasi+	(DELPHI Collab.)
ABREU	95M	ZPHY C65 603	+Adam, Adye, Agasi, Ajinenko+	(DELPHI Collab.)
ABREU	95O	ZPHY C67 543	+Adam, Adye, Agasi+	(DELPHI Collab.)
ABREU	95R	ZPHY C68 353	+Adam, Adye, Agasi+	(DELPHI Collab.)
ABREU	95W	PL B361 207	+Adam, Adye, Agasi+	(DELPHI Collab.)
ABREU	95X	ZPHY C69 1	+Adam, Adye, Agasi+	(DELPHI Collab.)
ACCIARRI	95B	PL B345 589	+Adam, Adriani, Aguilar-Benitez+	(L3 Collab.)
ACCIARRI	95C	PL B345 609	+Adam, Adriani, Aguilar-Benitez+	(L3 Collab.)
ACCIARRI	95G	PL B353 136	+Adam, Adriani, Aguilar-Benitez, Ahlen+	(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.)
AKERS	95O	ZPHY C67 27	+Alexander, Allison+	(OPAL Collab.)
AKERS	95S	ZPHY C67 365	+Alexander, Allison+	(OPAL Collab.)
AKERS	95U	ZPHY C67 389	+Alexander, Allison+	(OPAL Collab.)
AKERS	95W	ZPHY C67 555	+Alexander, Allison+	(OPAL Collab.)
AKERS	95X	ZPHY C68 1	+Alexander, Allison+	(OPAL Collab.)
AKERS	95Z	ZPHY C68 203	+Alexander, Allison+	(OPAL Collab.)
ALEXANDER	95D	PL B358 162	+Allison, Altekamp+	(OPAL Collab.)
BUSKULIC	95I	PL B352 479	+Casper, De Bonis+	(ALEPH Collab.)
BUSKULIC	95Q	ZPHY C69 183	+Casper, De Bonis+	(ALEPH Collab.)
BUSKULIC	95R	ZPHY C69 15	+Casper, De Bonis, Decamp+	(ALEPH Collab.)
MIYABAYASHI	95	PL B347 171	+Adachi, Fujii+	(TOPAZ 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	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, De Bonis, Decamp, Ghez+	(ALEPH Collab.)
BUSKULIC	94I	PL B335 99	+Casper, De Bonis+	(ALEPH Collab.)

BUSKULIC	94J	ZPHY C62 1	+De Bonis, Decamp+	(ALEPH Collab.)
BUSKULIC	94K	ZPHY C64 361	+De Bonis, 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	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	93K	ZPHY C60 19	+Akers, Alexander+	(OPAL Collab.)
ADRIANI	93	PL B301 136	+Aguilar-Benitez, Ahlen+	(L3 Collab.)
ADRIANI	93E	PL B307 237	+Aguilar-Benitez, Ahlen+	(L3 Collab.)
ADRIANI	93F	PL B309 451	+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.)
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	93N	PL B313 549	+De Bonis, Decamp+	(ALEPH Collab.)
BUSKULIC	93P	ZPHY C59 369	+Decamp, Goy+	(ALEPH Collab.)
NOVIKOV	93C	PL B298 453	+Okun, Vysotsky	(ITEP)
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	92J	PL B291 503	+Alexander, Allison, Allport+	(OPAL Collab.)
ACTON	92L	PL B294 436	+Alexander, Allison, Allport+	(OPAL Collab.)
ACTON	92N	PL B295 357	+Alexander, Allison, Allport, Anderson+	(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.)
BUSKULIC	92D	PL B292 210	+Decamp, Goy, Lees+	(ALEPH Collab.)
BUSKULIC	92E	PL B294 145	+Decamp, Goy, Lees, Minard+	(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	91H	ZPHY C50 185	+Adam, Adami, Adye+	(DELPHI Collab.)
ACTON	91B	PL B273 338	+Alexander, Allison, Allport, Anderson+	(OPAL Collab.)
ADACHI	91	PL B255 613	+Anazawa, Doser, Enomoto+	(TOPAZ Collab.)
ADEVA	91I	PL B259 199	+Adriani, Aguilar-Benitez, Akbari+	(L3 Collab.)
AKRAWY	91F	PL B257 531	+Alexander, Allison, Allport, Anderson+	(OPAL Collab.)
DECAMP	91B	PL B259 377	+Deschizeaux, Goy+	(ALEPH Collab.)
DECAMP	91J	PL B266 218	+Deschizeaux, Goy, Lees+	(ALEPH Collab.)
DECAMP	91K	PL B273 181	+Deschizeaux, Goy, Lees, Minard+	(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.)
ABRAMS	90	PRL 64 1334	+Adolphsen, Averill, Ballam+	(Mark II Collab.)
ADACHI	90F	PL B234 525	+Doser, Enomoto, Fujii+	(TOPAZ 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.)
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.)