$\Gamma(\text{invisible})/\Gamma_{\text{total}}$ — 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 $Z \to$ "up-type" quarks to $Z \to$ 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 $Z \to$ "down-type" quarks to $Z \to$ 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
0.171±0.020 OUR AVERAGE					
0.187±0.031±0.023		[79] ABREU	93I	DLPH	E^{ee}_{cm} = 88–94 GeV
0.151±0.008±0.041		[80] ABREU	92O	DLPH	E^{ee}_{cm}= 88–94 GeV
0.186±0.035±0.020	115	[81] ALEXANDER	91B	OPAL	E^{ee}_{cm}= 88–95 GeV
0.162±0.030±0.050	381	[82] ABREU	90H	DLPH	E^{ee}_{cm}= 91 GeV
$0.148\pm0.044^{+0.045}_{-0.038}$	1383	[83] 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		[84] AKRAWY	91E	OPAL	E^{ee}_{cm}= 88–95 GeV

[79] ABREU 93I assume that the D_s and charmed baryons are equally produced at LEP and CLEO (10 GeV) energies.
[80] 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.
[81] 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).
[82] ABREU 90H use CLEO probability for $c\overline{c} \to D^*(2010)^{\pm}X$ with $D^*(2010)^{\pm} \to D^0\pi^{\pm}$. Systematic error includes ±0.026 due to uncertainties in branching ratios.
[83] DECAMP 90L find $B(c \to e)\Gamma(c\overline{c})/\Gamma(\text{hadrons}) = 0.0133 \pm 0.0040^{+0.0038}_{-0.0031}$. Assumes $B(c \to e) = 0.090 \pm 0.013$. Systematic error includes about ±0.025 due to uncertainties in branching ratios.
[84] 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
0.2210±0.0029 OUR EVALUATION					
0.218 ±0.006 ±0.010		[85] AKERS	94D	OPAL	E^{ee}_{cm}= 88–94 GeV
0.220 ±0.002 ±0.013	11893	[86] ACTON	93I	OPAL	E^{ee}_{cm} = 88–94 GeV
0.222 ±0.007 ±0.008		[87] ACTON	93M	OPAL	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
0.215 ±0.017 ±0.024	1383	[94] DECAMP	90L	ALEP	E^{ee}_{cm}= 88–94 GeV
$0.23\ ^{+0.10}_{-0.08}\ ^{+0.05}_{-0.04}$	15	[95] KRAL	90	MRK2	E^{ee}_{cm}= 89–93 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.222 ±0.011 ±0.007		[96] AKERS	93B	OPAL	E^{ee}_{cm} = 88–94 GeV
$0.222\ ^{+0.033}_{-0.031}$ ±0.017		[97] ABREU	92	DLPH	E^{ee}_{cm}= 88–94 GeV
0.219 ±0.014 ±0.019		[98] ABREU	92K	DLPH	E^{ee}_{cm}= 88–94 GeV
0.226 ±0.008 ±0.018	1180	[99] ACTON	92I	OPAL	Repl. by ACTON 93I
0.193 ±0.006 ±0.024	1494	[100] AKRAWY	91E	OPAL	Repl. by ACTON 93I
0.204 ±0.014 ±0.024	171	[101] ADEVA	90E	L3	Repl. by ADRIANI 93E

[85] 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.
[86] 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 $\Gamma(c\overline{c})/\Gamma(\text{hadrons})$.
[87] ACTON 93M tagged $Z \to b\overline{b}$ events using the impact parameter technique.
[88] ADRIANI 93E use a multidimensional analysis based on a neural network approach.
[89] BUSKULIC 93M use a method which tags the $Z \to b\overline{b}$ 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 Γ(hadrons) = 1742 ± 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] DECAMP 90L find $B(b \to e)\Gamma(b\overline{b})/\Gamma(\text{hadrons}) = 0.0219 \pm 0.0017 \pm 0.0010$. They assume $B(b \to e) = 0.102 \pm 0.007 \pm 0.007$. The quoted systematic error is dominated by that from the semileptonic branching ratio.
[95] KRAL 90 used isolated leptons and found $\Gamma(b\overline{b})/\Gamma(\text{total}) = 0.17^{+0.07}_{-0.06}{}^{+0.04}_{-0.03}$.
[96] AKERS 93B use a simultaneous fit to single and dilepton events (electrons and muons) to tag $Z \to b\overline{b}$.
[97] 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.
[98] 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.
[99] ACTON 92I use high p (> 4 GeV), high p_T (> 0.8 GeV) electrons to tag $Z \to b\overline{b}$ events.
[100] For AKRAWY 91E, the systematic error includes the uncertainty from semileptonic branching ratios (±0.021) plus other systematics (±0.011).
[101] ADEVA 90E used isolated muons and found $B(B \to \mu)\Gamma(b\overline{b}) = 41.7 \pm 2.9 \pm 3.0$ MeV. The systematic error of ±0.024 above includes 0.02 due to uncertainty in $B(B \to \mu)$ added in quadrature to ±0.014 systematic.

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<5.5 \times 10^{-5}$	95	[102] ABREU	94B	DLPH	E^{ee}_{cm}= 88–94 GeV
$<1.2 \times 10^{-4}$	95	[103] 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	E^{ee}_{cm}= 88–95 GeV
$<4.9 \times 10^{-4}$	95	DECAMP	90J	ALEP	E^{ee}_{cm}= 88–95 GeV

[102] ABREU 94B supersedes ABREU 91E.
[103] This limit is for both decay modes $Z^0 \to \pi^0\gamma/\gamma\gamma$ 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	[104] 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	E^{ee}_{cm}= 88–95 GeV
$<4.6 \times 10^{-4}$	95	DECAMP	90J	ALEP	E^{ee}_{cm}= 88–95 GeV

[104] 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