τ – THIS IS PART 2 OF 4

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

PART 1

PART 2

PART 3

PART 4

τ BRANCHING FRACTIONS

Revised April 1998 by K.G. Hayes (Hillsdale College).

For the last six years, the rate of publication of new experimental results on the τ lepton has been high. The 30 new experimental papers listed in the τ References for this edition have produced significant changes in the τ Listings. The new results are made possible by the large τ data sets accumulated by the LEP experiments and by CLEO. Measurements of new τ-decay modes with small ($< 10^{-3}$) branching fractions have been published, and stringent upper limits on other new allowed τ decays have also been published. Significant improvements in branching fraction upper limits for forbidden τ decays have been made including the determination of upper limits for 12 new forbidden decay modes. The great majority of branching fraction upper limits for forbidden modes are now in the range of 10^{-5} to 10^{-6}.

Relatively precise branching fractions for 3-prong exclusive τ-decay modes containing charged kaons have finally been published [1]. This allows the determination of branching fractions for the decay modes $\tau^- \rightarrow \pi^-\pi^+\pi^-\nu_\tau$ and $\tau^- \rightarrow \pi^-\pi^+\pi^-\pi^0\nu_\tau$, the last exclusive τ-decay modes with large branching fractions to be measured. The new measurements have resulted in a 30% increase in the number of τ-decay modes in the Listings; 176 decay modes are listed in the current edition, although many are not mutually independent.

There have also been many new measurements of τ-decay parameters. For most parameters, the uncertainty on the world average has decreased by a factor of 2.5 or more. Finally, new experimental limits have been published for the various τ-dipole moments. However, there have been few new measurements of τ-decay modes with large branching fractions, and the world average values for most of these branching fractions have changed little since the last edition.

The constrained fit to τ branching fractions: The Lepton Summary Table and the List of τ-Decay Modes contain branching fractions for 105 conventional τ-decay modes and upper limits on the branching fractions for 22 other conventional τ-decay modes. Of the 105 modes with branching fractions, 76 are derived from a constrained fit to τ branching fraction data. The goal of the constrained fit is to make optimal use of the experimental data to determine τ branching fractions. For example, the new branching fractions for the decay modes $\tau^- \to \pi^-\pi^+\pi^-\nu_\tau$ and $\tau^- \to \pi^-\pi^+\pi^-\pi^0\nu_\tau$ are determined mostly from experimental measurements of the branching fractions for modes $\tau^- \to h^-h^-h^+\nu_\tau$ and $\tau^- \to h^-h^-h^+\pi^0\nu_\tau$ and the new measurements of exclusive branching fractions for 3-prong modes containing charged kaons and 0 or 1 π^0's.

Branching fractions from the constrained fit are derived from a set of basis modes. The basis modes form an exclusive set whose branching fractions are constrained to sum exactly to one. The list of 29 basis modes selected for the 1998 fit are listed in Table 1. The only change for the 1996 basis set is that the two modes $\tau \to h^-h^-h^+\nu_\tau$ (ex. K^0, ω) and $\tau \to h^-h^-h^+\pi^0\nu_\tau$ (ex. K^0, ω) have been replaced by the six new modes:

$\tau \to \pi^-\pi^+\pi^-\nu_\tau$ (ex. K^0, ω),
$\tau \to \pi^-\pi^+\pi^-\pi^0\nu_\tau$ (ex. K^0, ω),
$\tau \to K^-\pi^+\pi^-\nu_\tau$ (ex. K^0),
$\tau \to K^-\pi^+\pi^-\pi^0\nu_\tau$ (ex. K^0),
$\tau \to K^-K^+\pi^-\nu_\tau$, and
$\tau \to K^-K^+\pi^-\pi^0\nu_\tau$.

Table 1: Basis modes for the 1998 fit to τ branching fraction data.

$e^-\overline{\nu}_e\nu_\tau$	$K^-K^0\nu_\tau$
$\mu^-\overline{\nu}_\mu\nu_\tau$	$K^-K^0\pi^0\nu_\tau$
$\pi^-\nu_\tau$	$\pi^-\pi^+\pi^-\nu_\tau$ (ex. K^0,ω)
$\pi^-\pi^0\nu_\tau$	$\pi^-\pi^+\pi^-\pi^0\nu_\tau$ (ex. K^0,ω)
$\pi^-2\pi^0\nu_\tau$ (ex. K^0)	$K^-\pi^+\pi^-\nu_\tau$ (ex. K^0)
$\pi^-3\pi^0\nu_\tau$ (ex. K^0)	$K^-\pi^+\pi^-\pi^0\nu_\tau$ (ex. K^0)
$h^-4\pi^0\nu_\tau$ (ex. K^0)	$K^-K^+\pi^-\nu_\tau$
$K^-\nu_\tau$	$K^-K^+\pi^-\pi^0\nu_\tau$
$K^-\pi^0\nu_\tau$	$h^-h^-h^+2\pi^0\nu_\tau$ (ex. K^0,ω,η)
$K^-2\pi^0\nu_\tau$ (ex. K^0)	$h^-h^-h^+\geq 3\pi^0\nu_\tau$
$K^-3\pi^0\nu_\tau$ (ex. K^0)	$3h^-2h^+\nu_\tau$ (ex. K^0)
$\pi^-\overline{K}^0\nu_\tau$	$3h^-2h^+\pi^0\nu_\tau$ (ex. K^0)
$\pi^-\overline{K}^0\pi^0\nu_\tau$	$h^-\omega\nu_\tau$
$\pi^-K^0\overline{K}^0\nu_\tau$	$h^-\omega\pi^0\nu_\tau$
	$\pi^-\eta\pi^0\nu_\tau$

In selecting the basis modes, assumptions and choices must be made. Factors pertaining to the selection of the 1996 basis modes are described in the 1996 edition. Additional assumptions have been made in selecting the six new modes for the 1998 basis set. We assume the decays $\tau^-\to\pi^-K^+\pi^-\geq 0\pi^0\nu_\tau$ and $\tau^-\to\pi^+K^-K^-\geq 0\pi^0\nu_\tau$ have negligible branching fractions. This is consistent with Standard Model predictions for τ decay, although the experimental limits for these branching fractions are not very stringent. The 95% CL upper limits for these branching fractions in the current Listings are $\mathrm{B}(\tau^-\to\pi^-K^+\pi^-\geq 0\pi^0\nu_\tau) < 0.25\%$ and $\mathrm{B}(\pi^+K^-K^-\geq 0\pi^0\nu_\tau) < 0.09\%$, values not so different from measured branching fractions for allowed 3-prong modes containing charged kaons. Although our usual goal is to impose as few theoretical constraints as possible so that the world averages and fit results can be used to test the theoretical constraints (*i.e.*, we do not make use of the theoretical constraint from lepton universality on the ratio of the τ-leptonic branching fractions $\mathrm{B}(\tau^- \to \mu^-\overline{\nu}_\mu\nu_\tau)/\mathrm{B}(\tau^- \to e^-\overline{\nu}_e\nu_\tau) = 0.9728$), the experimental challenge to identify charged prongs in 3-prong τ decays is sufficiently difficult that experimenters have been forced to make these assumptions when measuring the branching fractions of the allowed decays.

We also assume the branching fraction for the allowed decay $\tau^- \to K^-K^+K^- \geq 0\pi^0\nu_\tau$ is negligible. This decay has limited phase space, and the branching fraction is expected to be very small. The branching fraction upper limit for this decay in the current Listings is $\mathrm{B}(\tau^- \to K^-K^+K^- \geq 0\pi^0\nu_\tau) < 0.21\%$ at 95% CL, and the ALEPH Collaboration [1] has determined a much more stringent limit on the branching fraction $\mathrm{B}(\tau^- \to K^-K^+K^-\nu_\tau) < 0.019\%$ at 90% CL.

Recent measurements of several new decay modes having very small branching fractions have raised two other issues regarding the choice of basis modes. The ALEPH Collaboration has recently measured new branching fractions for 1-prong τ decays containing two neutral kaons [2]. The basis set has just one τ-decay mode containing two neutral kaons: $\tau^- \to \pi^-K^0\overline{K}^0\nu_\tau$. In calculating the contribution of this decay to other measured τ-decay modes, we assume the two neutral kaons decay independently:

$$\begin{aligned}\mathrm{B}(\tau^- \to \pi^-K^0_SK^0_S\nu_\tau) &= \mathrm{B}(\tau^- \to \pi^-K^0_LK^0_L\nu_\tau)\\ &= \tfrac{1}{4}\mathrm{B}(\pi^-K^0\overline{K}^0\nu_\tau).\\ \mathrm{B}(\tau^- \to \pi^-K^0_SK^0_L\nu_\tau) &= \tfrac{1}{2}\mathrm{B}(\pi^-K^0\overline{K}^0\nu_\tau).\end{aligned}$$

This assumption may be incorrect. For example, Bose-Einstein correlations between the two neutral kaons can in principle alter these branching fractions. The ratio of the ALEPH measurement of B $(\tau^- \to \pi^- K^0_S K^0_L \nu_\tau) = (0.101 \pm 0.023 \pm 0.013)\%$ to the average of the CLEO [3] and ALEPH [2] measurements of $\mathrm{B}(\tau^- \to \pi^- K^0_S K^0_S \nu_\tau) = (0.024 \pm 0.005)\%$ is not inconsistent with our assumed value for this ratio of 2. For the sake of simplicity, we retain in this edition the assumption of independent K^0 decay.

There are several newly measured modes with small branching fractions [4] which cannot be expressed in terms of the selected basis modes and are therefore left out of the fit:

$\mathrm{B}(K^0 h^+ h^- h^- \nu_\tau) = (2.3 \pm 2.0) \times 10^{-4}$,
$\mathrm{B}(\pi^- K^0_S K^0_L \pi^0 \nu_\tau) = (3.1 \pm 1.2) \times 10^{-4}$,
$\mathrm{B}(\tau^- \to \pi^- \overline{K}^0 \pi^0 \pi^0 \nu_\tau) = (6 \pm 4) \times 10^{-4}$,

plus the $\eta \to \gamma\gamma$ component of the branching fractions

$\mathrm{B}(\eta \pi^- \pi^+ \pi^- \nu_\tau) = (3.4 \pm 0.8) \times 10^{-4}$,
$\mathrm{B}(\eta \pi^- \pi^0 \pi^0 \nu_\tau) = (1.4 \pm 0.7) \times 10^{-4}$, and
$\mathrm{B}(\eta K^- \nu_\tau) = (2.7 \pm 0.6) \times 10^{-4}$.

The sum of these excluded branching fractions is $(0.15 \pm 0.05)\%$. This is near our goal of 0.1% for the internal consistency of the τ Listings for this edition, and thus for simplicity we do not include these small branching fraction decay modes in the basis set.

The only significant difference between the world average value and the constrained fit value for branching fractions in the 1996 edition was for the 1-prong and 3-prong topological branching fractions. The average values for the topological branching fractions were dominated by old measurements from the pre-LEP era. Some of these old experiments had significantly underestimated their experimental uncertainties, with the result that, in the period between 1986 and 1990, the uncertainty in the world averages for the 1-prong and 3-prong topological branching fractions were considerably smaller than the uncertainty in the world averages of the very well-measured leptonic branching fractions [5]. Also, several of these old topological branching fraction measurements made the largest contributions the the constrained χ^2 fit. These measurement are now very old and have been retired.

The constrained fit has a χ^2 of 94 for 113 degrees of freedom. The only basis mode branching fraction which shifted more than 1σ from its 1996 value is $\mathrm{B}(\tau^- \to \pi^- \nu_\tau)$ which changed from $(11.31 \pm 0.15)\%$ to $(11.08 \pm 0.11)\%$ due mainly to the new measurement of $\mathrm{B}(\tau^- \to h^- \nu_\tau)$ by the CLEO Collaboration [6]. The fit and average values for the topological branching fractions are consistent. Table 2 compares the current fit and average values for

$\mathrm{B}_1 \equiv \mathrm{B}(\text{particle}^- \geq 0 \text{ neutrals } \geq 0 K_L^0 \nu_\tau)$ and

$\mathrm{B}_3 \equiv \mathrm{B}(h^- h^- h^+ \geq 0 \text{ neutrals } \nu_\tau)$

with the values from the 1996 edition.

Table 2: Fit and average values for B_1 and B_3.

Branching fraction		1996 Fit	1998 Fit
B_1	Fit:	84.96 ± 0.17	84.71 ± 0.13
B_1	Ave:	85.91 ± 0.30	85.1 ± 0.4
B_3	Fit:	14.92 ± 0.17	15.18 ± 0.13
B_3	Ave:	14.01 ± 0.29	14.8 ± 0.4

Another measure of the overall consistency of the τ branching fraction data with the fit constraint is a comparison of the fit and average values for the leptonic branching fractions. Table 3 compares the current fit and average values for $\mathrm{B}_e \equiv \mathrm{B}(\tau^- \to e^- \overline{\nu}_e \nu_\tau)$ and $\mathrm{B}_\mu \equiv \mathrm{B}(\tau^- \to \mu^- \overline{\nu}_\mu \nu_\tau)$ with the values from the 1996 edition.

Table 3: Fit and average values for $\tau^- \to e^- \overline{\nu}_e \nu_\tau$ and $\tau^- \to \mu^- \overline{\nu}_\mu \nu_\tau$.

Branching fraction		1996 Fit	1998 Fit
B_e	Fit:	17.83 ± 0.08	17.81 ± 0.07
B_e	Ave:	17.80 ± 0.08	17.78 ± 0.08
B_μ	Fit:	17.35 ± 0.10	17.37 ± 0.09
B_μ	Ave:	17.30 ± 0.10	17.32 ± 0.09

Conclusions: Many new measurements of τ-lepton properties have been made in the last two years. Experimenters have exploited the availability of large data sets to measure τ-decay modes with either small branching fractions or low detection efficiencies. Charged particle identification in 3-prong decays has finally allowed the experimental determination of the branching fraction for the decay modes $\tau^- \to \pi^-\pi^+\pi^-\nu_\tau$ and $\tau^- \to \pi^-\pi^+\pi^-\pi^0\nu_\tau$, the last exclusive τ-decay modes with large branching fractions to be measured. The basis set of τ-decay modes used in the constrained fit to branching fractions has been expanded to include the new measurements of exclusive 3-prong decays with identified charged prongs and 0 or 1 π^0's. There is no significant evidence of any inconsistency in the branching fraction data used in the constrained fit or to calculate world average values.

References

1. ALEPH Collaboration, R. Barate *et al.*, Eur. Phys. J. **C1**, 65 (1998).
2. ALEPH Collaboration, R. Barate *et al.*, Eur. Phys. J. (to be published), CERN-PPE/97-167.
3. CLEO Collaboration, T.E. Coan *et al.*, Phys. Rev. **D53**, 6037 (1996).
4. See the τ Listings for references.
5. K.G. Hayes, Nucl. Phys. Proc. Suppl. **55C**, 23 (1997).
6. CLEO Collaboration, A. Anastassov *et al.*, Phys. Rev. **D55**, 2559 (1997).

τ^- BRANCHING RATIOS

Γ(particle$^-$ $\geq$ 0 neutrals $\geq 0K^0_L \nu_\tau$ ("1-prong"))/Γ_{total} $\qquad$ **Γ_1/Γ**

$\Gamma_1/\Gamma = (\Gamma_3+\Gamma_5+\Gamma_9+\Gamma_{10}+\Gamma_{13}+\Gamma_{15}+\Gamma_{19}+\Gamma_{20}+\Gamma_{23}+\Gamma_{24}+\Gamma_{26}+0.6569\Gamma_{32}+0.6569\Gamma_{34}+0.6569\Gamma_{36}+0.6569\Gamma_{38}+0.4316\Gamma_{41}+0.708\Gamma_{110}+0.09\Gamma_{125}+0.09\Gamma_{126})/\Gamma$

The charged particle here can be e, μ, or hadron. In many analyses, the sum of the topological branching fractions (1, 3, and 5 prongs) is constrained to be unity. Since the 5-prong fraction is very small, the measured 1-prong and 3-prong fractions are highly correlated and cannot be treated as independent quantities in our overall fit. We arbitrarily choose to use the 3-prong fraction in our fit, and leave the 1-prong fraction out. We do, however, use these 1-prong measurements in our average below. The measurements used only for the average are marked "avg," whereas "f&a" marks a result used for the fit and the average.

VALUE (%)		*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
84.71±0.13 OUR FIT Error includes scale factor of 1.2.						
85.1 ±0.4 OUR AVERAGE						
85.6 ±0.6 ±0.3	avg	3300	[19] ADEVA	91F	L3	E^{ee}_{cm}= 88.3–94.3 GeV
84.9 ±0.4 ±0.3	avg		BEHREND	89B	CELL	E^{ee}_{cm}= 14–47 GeV
84.7 ±0.8 ±0.6	avg		[20] AIHARA	87B	TPC	E^{ee}_{cm}= 29 GeV

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

86.4 $\pm$0.3 $\pm$0.3		ABACHI	89B	HRS	E^{ee}_{cm}= 29 GeV
87.1 $\pm$1.0 $\pm$0.7		[21] BURCHAT	87	MRK2	E^{ee}_{cm}= 29 GeV
87.2 $\pm$0.5 $\pm$0.8		SCHMIDKE	86	MRK2	E^{ee}_{cm}= 29 GeV
84.7 $\pm$1.1 $^{+1.6}_{-1.3}$	169	[22] ALTHOFF	85	TASS	E^{ee}_{cm}= 34.5 GeV
86.1 $\pm$0.5 $\pm$0.9		BARTEL	85F	JADE	E^{ee}_{cm}= 34.6 GeV
87.8 $\pm$1.3 $\pm$3.9		[23] BERGER	85	PLUT	E^{ee}_{cm}= 34.6 GeV
86.7 $\pm$0.3 $\pm$0.6		FERNANDEZ	85	MAC	E^{ee}_{cm}= 29 GeV

[19] Not independent of ADEVA 91F $\Gamma(h^- h^- h^+ \geq 0\text{neut.}\ \nu_\tau(\text{"3-prong"}))/\Gamma_{total}$ value.
[20] Not independent of AIHARA 87B $\Gamma(\mu^-\overline{\nu}_\mu\nu_\tau)/\Gamma_{total}$, $\Gamma(e^-\overline{\nu}_e\nu_\tau)/\Gamma_{total}$, and $\Gamma(h^- \geq 0\ \text{neutrals}\ \geq 0K^0_L\ \nu_\tau)/\Gamma_{total}$ values.
[21] Not independent of SCHMIDKE 86 value (also not independent of BURCHAT 87 value for $\Gamma(h^- h^- h^+ \geq 0\text{neut.}\ \nu_\tau(\text{"3-prong"}))/\Gamma_{total}$.
[22] Not independent of ALTHOFF 85 $\Gamma(\mu^-\overline{\nu}_\mu\nu_\tau)/\Gamma_{total}$, $\Gamma(e^-\overline{\nu}_e\nu_\tau)/\Gamma_{total}$, $\Gamma(h^- \geq 0\ \text{neutrals}\ \geq 0K^0_L\ \nu_\tau)/\Gamma_{total}$, and $\Gamma(h^- h^- h^+ \geq 0\text{neut.}\ \nu_\tau(\text{"3-prong"}))/\Gamma_{total}$ values.
[23] Not independent of (1-prong + $0\pi^0$) and (1-prong + $\geq 1\pi^0$) values.

$\Gamma(\text{particle}^- \geq 0\ \text{neutrals} \geq 0K^0\nu_\tau)/\Gamma_{total}$ Γ_2/Γ

$\Gamma_2/\Gamma = (\Gamma_3+\Gamma_5+\Gamma_9+\Gamma_{10}+\Gamma_{13}+\Gamma_{15}+\Gamma_{19}+\Gamma_{20}+\Gamma_{23}+\Gamma_{24}+\Gamma_{26}+\Gamma_{32}+\Gamma_{34}+\Gamma_{36}+\Gamma_{38}+\Gamma_{41}+0.708\Gamma_{110}+0.09\Gamma_{125}+0.09\Gamma_{126})/\Gamma$

VALUE (%)		*DOCUMENT ID*		*TECN*	*COMMENT*
85.30$\pm$0.13 OUR FIT	Error includes scale factor of 1.2.				
84.59$\pm$0.33 OUR AVERAGE					
84.48$\pm$0.27$\pm$0.23	avg	ACTON	92H	OPAL	1990–1991 LEP runs
85.45$^{+0.69}_{-0.73}$$\pm$0.65	f&a	DECAMP	92C	ALEP	1989–1990 LEP runs

$\Gamma(\mu^-\overline{\nu}_\mu\nu_\tau)/\Gamma_{total}$ Γ_3/Γ

Data marked "avg" are highly correlated with data appearing elsewhere in the Listings, and are therefore used for the average given below but not in the overall fits. "f&a" marks results used for the fit and the average.

To minimize the effect of experiments with large systematic errors, we exclude experiments which together would contribute 5% of the weight in the average.

VALUE (%)		*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
17.37$\pm$0.09 OUR FIT						
17.32$\pm$0.09 OUR AVERAGE						
17.37$\pm$0.08$\pm$0.18	avg		[24] ANASTASSOV	97	CLEO	E^{ee}_{cm}= 10.6 GeV
17.31$\pm$0.11$\pm$0.05	f&a	20.7k	BUSKULIC	96C	ALEP	1991–1993 LEP runs
17.02$\pm$0.19$\pm$0.24	f&a	6586	ABREU	95T	DLPH	1991–1992 LEP runs
17.36$\pm$0.27	f&a	7941	AKERS	95I	OPAL	1990–1992 LEP runs
17.6 $\pm$0.4 $\pm$0.4	f&a	2148	ADRIANI	93M	L3	E^{ee}_{cm}= 88–94 GeV
17.4 $\pm$0.3 $\pm$0.5	avg		[25] ALBRECHT	93G	ARG	E^{ee}_{cm}= 9.4–10.6 GeV
17.35$\pm$0.41$\pm$0.37	f&a		DECAMP	92C	ALEP	1989–1990 LEP runs
17.7 $\pm$0.8 $\pm$0.4	f&a	568	BEHREND	90	CELL	E^{ee}_{cm}= 35 GeV
17.4 $\pm$1.0	f&a	2197	ADEVA	88	MRKJ	E^{ee}_{cm}= 14–16 GeV

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

17.7 ±1.2 ±0.7			AIHARA	87B	TPC	E^{ee}_{cm}= 29 GeV
18.3 ±0.9 ±0.8			BURCHAT	87	MRK2	E^{ee}_{cm}= 29 GeV
18.6 ±0.8 ±0.7	558	[26]	BARTEL	86D	JADE	E^{ee}_{cm}= 34.6 GeV
12.9 ±1.7 $^{+0.7}_{-0.5}$			ALTHOFF	85	TASS	E^{ee}_{cm}= 34.5 GeV
18.0 ±0.9 ±0.5	473	[26]	ASH	85B	MAC	E^{ee}_{cm}= 29 GeV
18.0 ±1.0 ±0.6		[27]	BALTRUSAIT...	85	MRK3	E^{ee}_{cm}= 3.77 GeV
19.4 ±1.6 ±1.7	153		BERGER	85	PLUT	E^{ee}_{cm}= 34.6 GeV
17.6 ±2.6 ±2.1	47		BEHREND	83C	CELL	E^{ee}_{cm}= 34 GeV
17.8 ±2.0 ±1.8			BERGER	81B	PLUT	E^{ee}_{cm}= 9–32 GeV

[24] This ANASTASSOV 97 result is not independent of $\Gamma(\mu^-\overline{\nu}_\mu\nu_\tau)/\Gamma(e^-\overline{\nu}_e\nu_\tau)$ and $\Gamma(e^-\overline{\nu}_e\nu_\tau)/\Gamma_{total}$ values.

[25] Not independent of ALBRECHT 92D $\Gamma(\mu^-\overline{\nu}_\mu\nu_\tau)/\Gamma(e^-\overline{\nu}_e\nu_\tau)$ and ALBRECHT 93G $\Gamma(\mu^-\overline{\nu}_\mu\nu_\tau)\times\Gamma(e^-\overline{\nu}_e\nu_\tau)/\Gamma^2_{total}$ values.

[26] Modified using $B(e^-\overline{\nu}_e\nu_\tau)$/B("1 prong") and B("1 prong") ,= 0.855.

[27] Error correlated with BALTRUSAITIS 85 $e\nu\overline{\nu}$ value.

$\Gamma(\mu^-\overline{\nu}_\mu\nu_\tau)/\Gamma(\text{particle}^- \geq 0\text{ neutrals} \geq 0K^0_L\nu_\tau(\text{"1-prong"}))$ Γ_3/Γ_1

$\Gamma_3/\Gamma_1 = \Gamma_3/(\Gamma_3+\Gamma_5+\Gamma_9+\Gamma_{10}+\Gamma_{13}+\Gamma_{15}+\Gamma_{19}+\Gamma_{20}+\Gamma_{23}+\Gamma_{24}+\Gamma_{26}+ 0.6569\Gamma_{32}+0.6569\Gamma_{34}+0.6569\Gamma_{36}+0.6569\Gamma_{38}+0.4316\Gamma_{41}+0.708\Gamma_{110}+0.09\Gamma_{125}+ 0.09\Gamma_{126})$

VALUE	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
0.2051±0.0010 OUR FIT	Error includes scale factor of 1.1.				
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.217 ±0.009 ±0.008		BARTEL	86D	JADE	E^{ee}_{cm}= 34.6 GeV
0.211 ±0.010 ±0.006	390	ASH	85B	MAC	E^{ee}_{cm}= 29 GeV

$\Gamma(\mu^-\overline{\nu}_\mu\nu_\tau\gamma)/\Gamma_{total}$ Γ_4/Γ

VALUE (%)	*EVTS*		*DOCUMENT ID*		*TECN*	*COMMENT*
0.30±0.04±0.05	116	[28]	ALEXANDER	96S	OPAL	1991–1994 LEP runs
• • • We do not use the following data for averages, fits, limits, etc. • • •						
0.23±0.10	10	[29]	WU	90	MRK2	E^{ee}_{cm}= 29 GeV

[28] ALEXANDER 96S impose requirements on detected γ's corresponding to a τ-rest-frame energy cutoff E_γ >20 MeV.

[29] WU 90 reports $\Gamma(\mu^-\overline{\nu}_\mu\nu_\tau\gamma)/\Gamma(\mu^-\overline{\nu}_\mu\nu_\tau) = 0.013 \pm 0.006$, which is converted to $\Gamma(\mu^-\overline{\nu}_\mu\nu_\tau\gamma)/\Gamma_{total}$ using $\Gamma(\mu^-\overline{\nu}_\mu\nu_\tau\gamma)/\Gamma_{total}$ = 17.35%. Requirements on detected γ's correspond to a τ rest frame energy cutoff E_γ > 37 MeV.

$\Gamma(e^- \overline{\nu}_e \nu_\tau)/\Gamma_{total}$ Γ_5/Γ

Data marked "avg" are highly correlated with data appearing elsewhere in the Listings, and are therefore used for the average given below but not in the overall fits. "f&a" marks results used for the fit and the average.

To minimize the effect of experiments with large systematic errors, we exclude experiments which together would contribute 5% of the weight in the average.

VALUE (%)		EVTS	DOCUMENT ID		TECN	COMMENT
17.81±0.07 OUR FIT						
17.78±0.08 OUR AVERAGE						
17.76±0.06±0.17	f&a		ANASTASSOV	97	CLEO	E^{ee}_{cm}= 10.6 GeV
17.78±0.10±0.09	f&a	25.3k	ALEXANDER	96D	OPAL	1991–1994 LEP runs
17.79±0.12±0.06	f&a	20.6k	BUSKULIC	96C	ALEP	1991–1993 LEP runs
17.51±0.23±0.31	f&a	5059	ABREU	95T	DLPH	1991–1992 LEP runs
17.9 ±0.4 ±0.4	f&a	2892	ADRIANI	93M	L3	E^{ee}_{cm}= 88–94 GeV
17.5 ±0.3 ±0.5	avg		[30] ALBRECHT	93G	ARG	E^{ee}_{cm}= 9.4–10.6 GeV
19.1 ±0.4 ±0.6	avg	2960	[31] AMMAR	92	CLEO	E^{ee}_{cm}= 10.5–10.9 GeV
18.09±0.45±0.45	f&a		DECAMP	92C	ALEP	1989–1990 LEP runs
17.0 ±0.5 ±0.6	f&a	1.7k	ABACHI	90	HRS	E^{ee}_{cm}= 29 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •						
17.97±0.14±0.23		3970	AKERIB	92	CLEO	Repl. by ANASTASSOV 97
18.4 ±0.8 ±0.4		644	BEHREND	90	CELL	E^{ee}_{cm}= 35 GeV
16.3 ±0.3 ±3.2			JANSSEN	89	CBAL	E^{ee}_{cm}= 9.4–10.6 GeV
18.4 ±1.2 ±1.0			AIHARA	87B	TPC	E^{ee}_{cm}= 29 GeV
19.1 ±0.8 ±1.1			BURCHAT	87	MRK2	E^{ee}_{cm}= 29 GeV
16.8 ±0.7 ±0.9		515	[31] BARTEL	86D	JADE	E^{ee}_{cm}= 34.6 GeV
20.4 ±3.0 $^{+1.4}_{-0.9}$			ALTHOFF	85	TASS	E^{ee}_{cm}= 34.5 GeV
17.8 ±0.9 ±0.6		390	[31] ASH	85B	MAC	E^{ee}_{cm}= 29 GeV
18.2 ±0.7 ±0.5			[32] BALTRUSAIT...	85	MRK3	E^{ee}_{cm}= 3.77 GeV
13.0 ±1.9 ±2.9			BERGER	85	PLUT	E^{ee}_{cm}= 34.6 GeV
18.3 ±2.4 ±1.9		60	BEHREND	83C	CELL	E^{ee}_{cm}= 34 GeV
16.0 ±1.3		459	[33] BACINO	78B	DLCO	E^{ee}_{cm}= 3.1–7.4 GeV

[30] Not independent of ALBRECHT 92D $\Gamma(\mu^- \overline{\nu}_\mu \nu_\tau)/\Gamma(e^- \overline{\nu}_e \nu_\tau)$ and ALBRECHT 93G $\Gamma(\mu^- \overline{\nu}_\mu \nu_\tau) \times \Gamma(e^- \overline{\nu}_e \nu_\tau)/\Gamma^2_{total}$ values.

[31] Modified using B($e^- \overline{\nu}_e \nu_\tau$)/B("1 prong") and B("1 prong") ,= 0.855.

[32] Error correlated with BALTRUSAITIS 85 $\Gamma(\mu^- \overline{\nu}_\mu \nu_\tau)/\Gamma_{total}$.

[33] BACINO 78B value comes from fit to events with $e^\pm$ and one other nonelectron charged prong.

$\Gamma(e^- \overline{\nu}_e \nu_\tau)/\Gamma(\text{particle}^- \geq 0 \text{ neutrals} \geq 0 K^0_L \nu_\tau (\text{"1-prong"}))$ Γ_5/Γ_1

$\Gamma_5/\Gamma_1 = \Gamma_5/(\Gamma_3+\Gamma_5+\Gamma_9+\Gamma_{10}+\Gamma_{13}+\Gamma_{15}+\Gamma_{19}+\Gamma_{20}+\Gamma_{23}+\Gamma_{24}+\Gamma_{26}+0.6569\Gamma_{32}+0.6569\Gamma_{34}+0.6569\Gamma_{36}+0.6569\Gamma_{38}+0.4316\Gamma_{41}+0.708\Gamma_{110}+0.09\Gamma_{125}+0.09\Gamma_{126})$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.2102±0.0009 OUR FIT	Error includes scale factor of 1.1.				
0.2231±0.0044±0.0073	2856	AMMAR	92	CLEO	E^{ee}_{cm}= 10.5–10.9 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					

0.196 ±0.008 ±0.010		BARTEL	86D	JADE	E^{ee}_{cm}= 34.6 GeV
0.208 ±0.010 ±0.007	390	ASH	85B	MAC	E^{ee}_{cm}= 29 GeV

$\Gamma(\mu^-\overline{\nu}_\mu\nu_\tau) \times \Gamma(e^-\overline{\nu}_e\nu_\tau)/\Gamma^2_{total}$ — $\Gamma_3\Gamma_5/\Gamma^2$

VALUE	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
0.03094±0.00021 OUR FIT	Error includes scale factor of 1.1.				
0.0306 ±0.0005 ±0.0013	3230	ALBRECHT	93G	ARG	E^{ee}_{cm}= 9.4–10.6 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.0288 ±0.0017 ±0.0019		ASH	85B	MAC	E^{ee}_{cm}= 29 GeV

$\Gamma(\mu^-\overline{\nu}_\mu\nu_\tau)/\Gamma(e^-\overline{\nu}_e\nu_\tau)$ — Γ_3/Γ_5

Predicted to be 1 for sequential lepton, 1/2 for para-electron, and 2 for para-muon. Para-electron also ruled out by HEILE 78.

Data marked "avg" are highly correlated with data appearing elsewhere in the Listings, and are therefore used for the average given below but not in the overall fits. "f&a" marks results used for the fit and the average.

VALUE		*DOCUMENT ID*		*TECN*	*COMMENT*
0.976 ±0.006 OUR FIT					
0.978 ±0.011 OUR AVERAGE					
0.9777±0.0063±0.0087	f&a	ANASTASSOV	97	CLEO	E^{ee}_{cm}= 10.6 GeV
0.997 ±0.035 ±0.040	f&a	ALBRECHT	92D	ARG	E^{ee}_{cm}= 9.4–10.6 GeV

$\Gamma(h^- \geq 0\,\text{neutrals} \geq 0K^0_L\,\nu_\tau)/\Gamma_{total}$ — Γ_6/Γ

$\Gamma_6/\Gamma = (\Gamma_9+\Gamma_{10}+\Gamma_{13}+\Gamma_{15}+\Gamma_{19}+\Gamma_{20}+\Gamma_{23}+\Gamma_{24}+\Gamma_{26}+0.6569\Gamma_{32}+0.6569\Gamma_{34}+0.6569\Gamma_{36}+0.6569\Gamma_{38}+0.4316\Gamma_{41}+0.708\Gamma_{110}+0.09\Gamma_{125}+0.09\Gamma_{126})/\Gamma$

VALUE (%)		*DOCUMENT ID*		*TECN*	*COMMENT*
49.52±0.16 OUR FIT	Error includes scale factor of 1.2.				
48.6 ±1.2 ±0.9	**avg**	[34] AIHARA	87B	TPC	E^{ee}_{cm}= 29 GeV

[34] Not independent of AIHARA 87B $e\nu\overline{\nu}$, $\mu\nu\overline{\nu}$, and $\pi^+2\pi^-(\geq 0\pi^0)\nu$ values.

$\Gamma(h^- \geq 0K^0_L\,\nu_\tau)/\Gamma_{total}$ — Γ_7/Γ

$\Gamma_7/\Gamma = (\Gamma_9+\Gamma_{10}+\frac{1}{2}\Gamma_{32}+\frac{1}{2}\Gamma_{34}+\frac{1}{4}\Gamma_{41})/\Gamma$

Data marked "avg" are highly correlated with data appearing elsewhere in the Listings, and are therefore used for the average given below but not in the overall fits. "f&a" marks results used for the fit and the average.

VALUE (%)		*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
12.32±0.12 OUR FIT	Error includes scale factor of 1.5.					
12.42±0.14 OUR AVERAGE						
12.44±0.11±0.11	f&a	15k	[35] BUSKULIC	96	ALEP	1991–1993 LEP run
12.47±0.26±0.43	f&a	2967	[36] ACCIARRI	95	L3	1992 LEP run
12.4 ±0.7 ±0.7	f&a	283	[37] ABREU	92N	DLPH	1990 LEP run
11.7 ±0.6 ±0.8	avg		[38] ALBRECHT	92D	ARG	E^{ee}_{cm}= 9.4–10.6 GeV
12.98±0.44±0.33	f&a		[39] DECAMP	92C	ALEP	1989–1990 LEP runs
12.1 ±0.7 ±0.5	f&a	309	ALEXANDER	91D	OPAL	1990 LEP run
12.3 ±0.9 ±0.5	f&a	1338	BEHREND	90	CELL	E^{ee}_{cm}= 35 GeV
11.3 ±0.5 ±0.8	avg	798	[40] FORD	87	MAC	E^{ee}_{cm}= 29 GeV
12.3 ±0.6 ±1.1	avg	328	[41] BARTEL	86D	JADE	E^{ee}_{cm}= 34.6 GeV

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

11.1 ±1.1 ±1.4		[42] BURCHAT	87	MRK2	E^{ee}_{cm}= 29 GeV
13.0 ±2.0 ±4.0		BERGER	85	PLUT	E^{ee}_{cm}= 34.6 GeV
11.2 ±1.7 ±1.2	34	[43] BEHREND	83C	CELL	E^{ee}_{cm}= 34 GeV

[35] BUSKULIC 96 quote 11.78 ± 0.11 ± 0.13 We add 0.66 to undo their correction for unseen K^0_L and modify the systematic error accordingly.

[36] ACCIARRI 95 with 0.65% added to remove their correction for $\pi^- K^0_L$ backgrounds.

[37] ABREU 92N with 0.5% added to remove their correction for $K^*(892)^-$ backgrounds.

[38] Not independent of ALBRECHT 92D $\Gamma(\mu^-\overline{\nu}_\mu\nu_\tau)/\Gamma(e^-\overline{\nu}_e\nu_\tau)$, $\Gamma(\mu^-\overline{\nu}_\mu\nu_\tau) \times \Gamma(e^-\overline{\nu}_e\nu_\tau)$, and $\Gamma(h^- \geq 0K^0_L\nu_\tau)/\Gamma(e^-\overline{\nu}_e\nu_\tau)$ values.

[39] DECAMP 92C quote $B(h^- \geq 0K^0_L \geq 0\,(K^0_S \rightarrow \pi^+\pi^-)\,\nu_\tau) = 13.32 \pm 0.44 \pm 0.33$. We subtract 0.35 to correct for their inclusion of the K^0_S decays.

[40] FORD 87 result for $B(\pi^-\nu_\tau)$ with 0.67% added to remove their K^- correction and adjusted for 1992 B("1 prong").

[41] BARTEL 86D result for $B(\pi^-\nu_\tau)$ with 0.59% added to remove their K^- correction and adjusted for 1992 B("1 prong").

[42] BURCHAT 87 with 1.1% added to remove their correction for K^- and $K^*(892)^-$ backgrounds.

[43] BEHREND 83C quote $B(\pi^-\nu_\tau) = 9.9 \pm 1.7 \pm 1.3$ after subtracting 1.3 ± 0.5 to correct for $B(K^-\nu_\tau)$.

$\Gamma(h^- \geq 0K^0_L\,\nu_\tau)/\Gamma(\text{particle}^- \geq 0\text{ neutrals} \geq 0K^0_L\nu_\tau\,(\text{"1-prong"}))$ Γ_7/Γ_1

$\Gamma_7/\Gamma_1 = (\Gamma_9+\Gamma_{10}+\frac{1}{2}\Gamma_{32}+\frac{1}{2}\Gamma_{34}+\frac{1}{4}\Gamma_{41})/(\Gamma_3+\Gamma_5+\Gamma_9+\Gamma_{10}+\Gamma_{13}+\Gamma_{15}+\Gamma_{19}+\Gamma_{20}+\Gamma_{23}+\Gamma_{24}+\Gamma_{26}+0.6569\Gamma_{32}+0.6569\Gamma_{34}+0.6569\Gamma_{36}+0.6569\Gamma_{38}+0.4316\Gamma_{41}+0.708\Gamma_{110}+0.09\Gamma_{125}+0.09\Gamma_{126})$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.1455±0.0014 OUR FIT Error includes scale factor of 1.4.					
0.135 ±0.009 OUR AVERAGE					
0.131 ±0.006 ±0.009	798	[44] FORD	87	MAC	E^{ee}_{cm}= 29 GeV
0.143 ±0.007 ±0.013	328	[45] BARTEL	86D	JADE	E^{ee}_{cm}= 34.6 GeV

[44] FORD 87 result divided by 0.865, their assumed value for B("1 prong").

[45] BARTEL 86D result with 0.6% added to remove their K^- correction and then divided by 0.866, their assumed value for B("1 prong").

$\Gamma(h^- \geq 0K^0_L\,\nu_\tau)/\Gamma(e^-\overline{\nu}_e\nu_\tau)$ Γ_7/Γ_5

$\Gamma_7/\Gamma_5 = (\Gamma_9+\Gamma_{10}+\frac{1}{2}\Gamma_{32}+\frac{1}{2}\Gamma_{34}+\frac{1}{4}\Gamma_{41})/\Gamma_5$

VALUE	DOCUMENT ID		TECN	COMMENT
0.692±0.008 OUR FIT Error includes scale factor of 1.4.				
0.678±0.037±0.044	ALBRECHT	92D	ARG	E^{ee}_{cm}= 9.4–10.6 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.647±0.039±0.061	[46] BARTEL	86D	JADE	E^{ee}_{cm}= 34.6 GeV

[46] Combined result of BARTEL 86D $e\nu\overline{\nu}$, $\mu\nu\overline{\nu}$, and $\pi^-\nu$ assuming $B(\mu\nu\overline{\nu})/B(e\nu\overline{\nu}) = 0.973$.

$\Gamma(h^- \nu_\tau)/\Gamma_{total}$ $\Gamma_8/\Gamma = (\Gamma_9+\Gamma_{10})/\Gamma$

Data marked "avg" are highly correlated with data appearing elsewhere in the Listings, and are therefore used for the average given below but not in the overall fits. "f&a" marks results used for the fit and the average.

VALUE (%)		DOCUMENT ID	TECN	COMMENT
11.79±0.12 OUR FIT Error includes scale factor of 1.5.				
11.65±0.21 OUR AVERAGE Error includes scale factor of 1.9.				
11.98±0.13±0.16	f&a	ACKERSTAFF 98M	OPAL	1991–1995 LEP runs
11.52±0.05±0.12	f&a	ANASTASSOV 97	CLEO	E^{ee}_{cm}= 10.6 GeV

$\Gamma(h^- \nu_\tau)/\Gamma(e^- \overline{\nu}_e \nu_\tau)$ $\Gamma_8/\Gamma_5 = (\Gamma_9+\Gamma_{10})/\Gamma_5$

Data marked "avg" are highly correlated with data appearing elsewhere in the Listings, and are therefore used for the average given below but not in the overall fits. "f&a" marks results used for the fit and the average.

VALUE		DOCUMENT ID	TECN	COMMENT
0.662 ±0.008 OUR FIT Error includes scale factor of 1.4.				
0.6484±0.0041±0.0060	**avg**	[47] ANASTASSOV 97	CLEO	E^{ee}_{cm}= 10.6 GeV

[47] Not independent of ANASTASSOV 97 $\Gamma(h^- \nu_\tau)/\Gamma_{total}$ value.

$\Gamma(\pi^- \nu_\tau)/\Gamma_{total}$ Γ_9/Γ

Data marked "avg" are highly correlated with data appearing elsewhere in the Listings, and are therefore used for the average given below but not in the overall fits. "f&a" marks results used for the fit and the average.

VALUE (%)		EVTS	DOCUMENT ID	TECN	COMMENT
11.08±0.13 OUR FIT Error includes scale factor of 1.4.					
11.07±0.18 OUR AVERAGE					
11.06±0.11±0.14	avg		[48] BUSKULIC 96	ALEP	LEP 1991–1993 data
11.7 ±0.4 ±1.8	f&a	1138	BLOCKER 82D	MRK2	E^{ee}_{cm}= 3.5–6.7 GeV

[48] Not independent of BUSKULIC 96 B($h^- \nu_\tau$) and B($K^- \nu_\tau$) values.

$\Gamma(K^- \nu_\tau)/\Gamma_{total}$ Γ_{10}/Γ

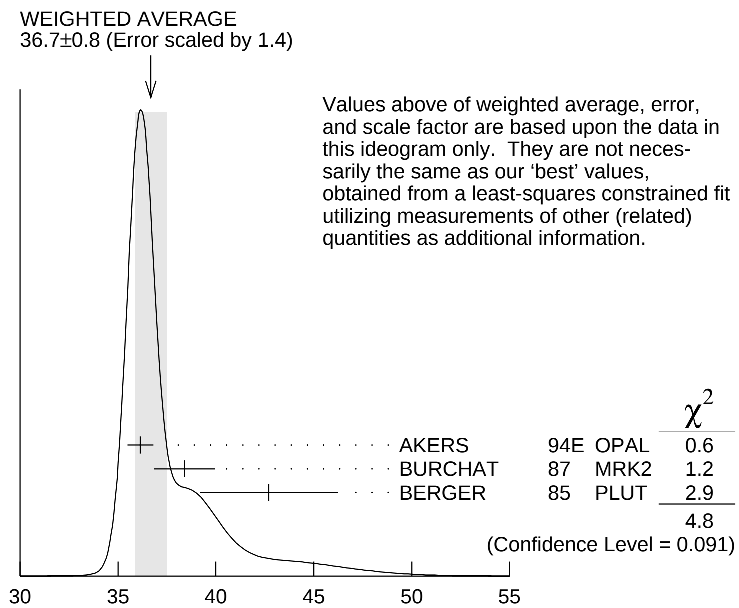
VALUE (%)	EVTS	DOCUMENT ID	TECN	COMMENT
0.71±0.05 OUR FIT				
0.71±0.05 OUR AVERAGE				
0.72±0.04±0.04	728	BUSKULIC 96	ALEP	LEP 1991–1993 data
0.85±0.18	27	ABREU 94K	DLPH	LEP 1992 Z data
0.66±0.07±0.09	99	BATTLE 94	CLEO	$E^{ee}_{cm} \approx$ 10.6 GeV
0.59±0.18	16	MILLS 84	DLCO	E^{ee}_{cm}= 29 GeV
1.3 ±0.5	15	BLOCKER 82B	MRK2	E^{ee}_{cm}= 3.9–6.7 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.64±0.05±0.05	336	BUSKULIC 94E	ALEP	Repl. by BUSKULIC 96

$\Gamma(h^- \geq 1\,\text{neutrals}\,\nu_\tau)/\Gamma_{\text{total}}$ $\qquad\Gamma_{11}/\Gamma$

$\Gamma_{11}/\Gamma = (\Gamma_{13}+\Gamma_{15}+\Gamma_{19}+\Gamma_{20}+\Gamma_{23}+\Gamma_{24}+\Gamma_{26}+0.157\Gamma_{32}+0.157\Gamma_{34}+0.157\Gamma_{36}+0.157\Gamma_{38}+0.0246\Gamma_{41}+0.708\Gamma_{110}+0.09\Gamma_{125}+0.09\Gamma_{126})/\Gamma$

VALUE (%)	*DOCUMENT ID*		*TECN*	*COMMENT*
36.91±0.17 OUR FIT	Error includes scale factor of 1.2.			
36.7 ±0.8 OUR AVERAGE	Error includes scale factor of 1.4. See the ideogram below.			
36.14±0.33±0.58	AKERS	94E	OPAL	1991–1992 LEP runs
38.4 ±1.2 ±1.0	[49] BURCHAT	87	MRK2	E^{ee}_{cm}= 29 GeV
42.7 ±2.0 ±2.9	BERGER	85	PLUT	E^{ee}_{cm}= 34.6 GeV

[49] BURCHAT 87 quote for B($\pi^\pm \geq 1$ neutral ν_τ) = $0.378 \pm 0.012 \pm 0.010$. We add 0.006 to account for contribution from ($K^{*-}\nu_\tau$) which they fixed at BR = 0.013.



$\Gamma(h^- \geq 1\,\text{neutrals}\,\nu_\tau)/\Gamma_{\text{total}}$ (%)

$\Gamma(h^-\pi^0\nu_\tau)/\Gamma_{\text{total}}$ $\qquad\Gamma_{12}/\Gamma = (\Gamma_{13}+\Gamma_{15})/\Gamma$

VALUE (%)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
25.84±0.14 OUR FIT	Error includes scale factor of 1.1.				
25.69±0.22 OUR AVERAGE	Error includes scale factor of 1.5. See the ideogram below.				
25.89±0.17±0.29		ACKERSTAFF	98M	OPAL	1991–1995 LEP runs
25.76±0.15±0.13	31k	BUSKULIC	96	ALEP	LEP 1991–1993 data
25.05±0.35±0.50	6613	ACCIARRI	95	L3	1992 LEP run
25.87±0.12±0.42	51k	[50] ARTUSO	94	CLEO	E^{ee}_{cm}= 10.6 GeV
23.1 ±0.4 ±0.9	1249	[51] ALBRECHT	92Q	ARG	E^{ee}_{cm}= 10 GeV

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

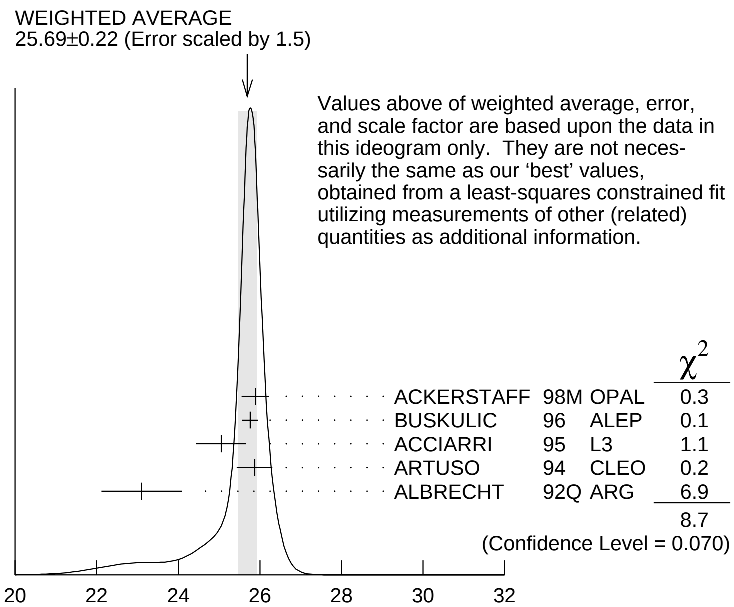
25.98±0.36±0.52		[52] AKERS	94E	OPAL	Repl. by ACKERSTAFF 98M
22.9 ±0.8 ±1.3	283	[53] ABREU	92N	DLPH	E^{ee}_{cm}= 88.2–94.2 GeV
25.02±0.64±0.88	1849	DECAMP	92C	ALEP	1989–1990 LEP runs
22.0 ±0.8 ±1.9	779	ANTREASYAN	91	CBAL	E^{ee}_{cm}= 9.4–10.6 GeV
22.6 ±1.5 ±0.7	1101	BEHREND	90	CELL	E^{ee}_{cm}= 35 GeV
23.1 ±1.9 ±1.6		BEHREND	84	CELL	E^{ee}_{cm}= 14,22 GeV

[50] ARTUSO 94 reports the combined result from three independent methods, one of which (23% of the $\tau^- \to h^- \pi^0 \nu_\tau$) is normalized to the inclusive one-prong branching fraction, taken as 0.854 ± 0.004. Renormalization to the present value causes negligible change.

[51] ALBRECHT 92Q with 0.5% added to remove their correction for $\tau^- \to K^*(892)^- \nu_\tau$ background.

[52] AKERS 94E quote $(26.25 \pm 0.36 \pm 0.52) \times 10^{-2}$; we subtract 0.27% from their number to correct for $\tau^- \to h^- K^0_L \nu_\tau$.

[53] ABREU 92N with 0.5% added to remove their correction for $K^*(892)^-$ backgrounds.



$\Gamma\left(h^- \pi^0 \nu_\tau\right)/\Gamma_{total}$ (%)

$\Gamma\left(\pi^- \pi^0 \nu_\tau\right)/\Gamma_{total}$ $\qquad$ Γ_{13}/Γ

Data marked "avg" are highly correlated with data appearing elsewhere in the Listings, and are therefore used for the average given below but not in the overall fits. "f&a" marks results used for the fit and the average.

VALUE (%)		EVTS	DOCUMENT ID	TECN	COMMENT
25.32±0.15 OUR FIT Error includes scale factor of 1.1.					
25.31±0.18 OUR AVERAGE					
25.30±0.15±0.13	avg		[54] BUSKULIC	96 ALEP	LEP 1991–1993 data
25.36±0.44	avg		[55] ARTUSO	94 CLEO	E^{ee}_{cm}= 10.6 GeV

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

21.5 ± 0.4 ± 1.9	4400	[56,57] ALBRECHT	88L	ARG	E^{ee}_{cm}= 10 GeV
23.0 ± 1.3 ± 1.7	582	ADLER	87B	MRK3	E^{ee}_{cm}= 3.77 GeV
25.8 ± 1.7 ± 2.5		[58] BURCHAT	87	MRK2	E^{ee}_{cm}= 29 GeV
22.3 ± 0.6 ± 1.4	629	[57] YELTON	86	MRK2	E^{ee}_{cm}= 29 GeV

[54] Not independent of BUSKULIC 96 B($h^- \pi^0 \nu_\tau$) and B($K^- \pi^0 \nu_\tau$) values.

[55] Not independent of ARTUSO 94 B($h^- \pi^0 \nu_\tau$) and BATTLE 94 B($K^- \pi^0 \nu_\tau$) values.

[56] The authors divide by ($\Gamma_3 + \Gamma_5 + \Gamma_9 + \Gamma_{10}$)/Γ = 0.467 to obtain this result.

[57] Experiment had no hadron identification. Kaon corrections were made, but insufficient information is given to permit their removal.

[58] BURCHAT 87 value is not independent of YELTON 86 value. Nonresonant decays included.

$\Gamma(\pi^- \pi^0 \text{non-}\rho(770) \nu_\tau)/\Gamma_{total}$ Γ_{14}/Γ

VALUE (%)	*DOCUMENT ID*		*TECN*	*COMMENT*
0.3 ±0.1 ±0.3	[59] BEHREND	84	CELL	E^{ee}_{cm}= 14,22 GeV

[59] BEHREND 84 assume a flat nonresonant mass distribution down to the $\rho(770)$ mass, using events with mass above 1300 to set the level.

$\Gamma(K^- \pi^0 \nu_\tau)/\Gamma_{total}$ Γ_{15}/Γ

VALUE (%)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
0.52±0.05 OUR FIT					
0.52±0.06 OUR AVERAGE					
0.52±0.04±0.05	395	BUSKULIC	96	ALEP	LEP 1991–1993 data
0.51±0.10±0.07	37	BATTLE	94	CLEO	$E^{ee}_{cm} \approx$ 10.6 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.53±0.05±0.07	220	BUSKULIC	94E	ALEP	Repl. by BUSKULIC 96