# $\Lambda_c^+$

$I(J^P) = 0(\frac{1}{2}^+)$ Status: ****

$J$ has not actually been measured yet. Results of an analysis of $pK^-\pi^+$ decays (JEZABEK 92) are consistent with the expected $J = 1/2$. The quark content is $udc$.

We have omitted some results that have been superseded by later experiments. The omitted results may be found in earlier editions.

## $\Lambda_c^+$ MASS

Measurements with an error greater than 5 MeV or that are otherwise obsolete have been omitted.

The fit also includes $\Sigma_c$-$\Lambda_c^+$ and $\Lambda_c^{*+}$-$\Lambda_c^+$ mass-difference measurements.

| *VALUE* (MeV) | *EVTS* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| **2284.9±0.6 OUR FIT** | | | | | |
| **2284.9±0.6 OUR AVERAGE** | | | | | |
| 2284.7±0.6±0.7 | 1134 | AVERY | 91 | CLEO | Six modes |
| 2281.7±2.7±2.6 | 29 | ALVAREZ | 90B | NA14 | $pK^-\pi^+$ |
| 2285.8±0.6±1.2 | 101 | BARLAG | 89 | NA32 | $pK^-\pi^+$ |
| 2284.7±2.3±0.5 | 5 | AGUILAR-... | 88B | LEBC | $pK^-\pi^+$ |
| 2283.1±1.7±2.0 | 628 | ALBRECHT | 88C | ARG | $pK^-\pi^+$, $p\overline{K}^0$, $\Lambda 3\pi$ |
| 2286.2±1.7±0.7 | 97 | ANJOS | 88B | E691 | $pK^-\pi^+$ |
| 2281 ±3 | 2 | JONES | 87 | HBC | $pK^-\pi^+$ |
| 2283 ±3 | 3 | BOSETTI | 82 | HBC | $pK^-\pi^+$ |
| 2290 ±3 | 1 | CALICCHIO | 80 | HYBR | $pK^-\pi^+$ |

## $\Lambda_c^+$ MEAN LIFE

Measurements with an error $\geq 0.1 \times 10^{-12}$ s or with fewer than 20 events have been omitted.

| *VALUE* ($10^{-12}$ s) | *EVTS* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| **0.206±0.012 OUR AVERAGE** | | | | | |
| 0.215±0.016±0.008 | 1340 | FRABETTI | 93D | E687 | $\gamma$ Be, $\Lambda_c^+ \rightarrow pK^-\pi^+$ |
| 0.18 ±0.03 ±0.03 | 29 | ALVAREZ | 90 | NA14 | $\gamma$, $\Lambda_c^+ \rightarrow pK^-\pi^+$ |
| 0.20 ±0.03 ±0.03 | 90 | FRABETTI | 90 | E687 | $\gamma$ Be, $\Lambda_c^+ \rightarrow pK^-\pi^+$ |
| $0.196^{+0.023}_{-0.020}$ | 101 | BARLAG | 89 | NA32 | $pK^-\pi^+$ + c.c. |
| 0.22 ±0.03 ±0.02 | 97 | ANJOS | 88B | E691 | $pK^-\pi^+$ + c.c. |

# $\Lambda_c^+$ DECAY MODES

Nearly all branching fractions of the $\Lambda_c^+$ are measured relative to the $pK^-\pi^+$ mode, but there are no model-independent measurements of this branching fraction. We explain how we arrive at our value of $B(\Lambda_c^+ \rightarrow pK^-\pi^+)$ in a note attached to the "measurements" of $\Gamma(pK^-\pi^+)/\Gamma_{total}$, below. When this branching fractions is eventually well determined, all the other branching fractions will slide up or down proportionally as the true value differs from the value we use here.

| | Mode | | Fraction ($\Gamma_i/\Gamma$) | Scale factor/ Confidence level |
|---|---|---|---|---|
| | **Hadronic modes with a $p$ and one $\overline{K}$** | | | |
| $\Gamma_1$ | $p\overline{K}^0$ | | ( 2.5 ± 0.7 ) % | |
| $\Gamma_2$ | $pK^-\pi^+$ | [a] | ( 5.0 ± 1.3 ) % | |
| $\Gamma_3$ | $p\overline{K}^*(892)^0$ | [b] | ( 1.8 ± 0.6 ) % | |
| $\Gamma_4$ | $\Delta(1232)^{++}K^-$ | | ( 8 ± 5 ) $\times 10^{-3}$ | |
| $\Gamma_5$ | $\Lambda(1520)\pi^+$ | [b] | ( 4.5 $^{+\ 2.5}_{-\ 2.1}$ ) $\times 10^{-3}$ | |
| $\Gamma_6$ | $pK^-\pi^+$ nonresonant | | ( 2.8 ± 0.9 ) % | |
| $\Gamma_7$ | $p\overline{K}^0\eta$ | | ( 1.3 ± 0.4 ) % | |
| $\Gamma_8$ | $p\overline{K}^0\pi^+\pi^-$ | | ( 2.4 ± 1.1 ) % | |
| $\Gamma_9$ | $pK^-\pi^+\pi^0$ | | seen | |
| $\Gamma_{10}$ | $pK^*(892)^-\pi^+$ | [b] | ( 1.1 ± 0.6 ) % | |
| $\Gamma_{11}$ | $p(K^-\pi^+)_{\text{nonresonant}}\pi^0$ | | ( 3.6 ± 1.2 ) % | |
| $\Gamma_{12}$ | $\Delta(1232)\overline{K}^*(892)$ | | seen | |
| $\Gamma_{13}$ | $pK^-\pi^+\pi^+\pi^-$ | | ( 1.1 ± 0.8 ) $\times 10^{-3}$ | |
| $\Gamma_{14}$ | $pK^-\pi^+\pi^0\pi^0$ | | ( 8 ± 4 ) $\times 10^{-3}$ | |
| $\Gamma_{15}$ | $pK^-\pi^+\pi^0\pi^0\pi^0$ | | ( 5.0 ± 3.4 ) $\times 10^{-3}$ | |
| | **Hadronic modes with a $p$ and zero or two $K$'s** | | | |
| $\Gamma_{16}$ | $p\pi^+\pi^-$ | | ( 3.5 ± 2.0 ) $\times 10^{-3}$ | |
| $\Gamma_{17}$ | $pf_0(980)$ | [b] | ( 2.8 ± 1.9 ) $\times 10^{-3}$ | |
| $\Gamma_{18}$ | $p\pi^+\pi^+\pi^-\pi^-$ | | ( 1.8 ± 1.2 ) $\times 10^{-3}$ | |
| $\Gamma_{19}$ | $pK^+K^-$ | | ( 2.3 ± 0.9 ) $\times 10^{-3}$ | |
| $\Gamma_{20}$ | $p\phi$ | [b] | ( 1.2 ± 0.5 ) $\times 10^{-3}$ | |
| | **Hadronic modes with a hyperon** | | | |
| $\Gamma_{21}$ | $\Lambda\pi^+$ | | ( 9.0 ± 2.8 ) $\times 10^{-3}$ | |
| $\Gamma_{22}$ | $\Lambda\pi^+\pi^0$ | | ( 3.6 ± 1.3 ) % | |
| $\Gamma_{23}$ | $\Lambda\rho^+$ | | < 5 % | CL=95% |
| $\Gamma_{24}$ | $\Lambda\pi^+\pi^+\pi^-$ | | ( 3.3 ± 1.0 ) % | |
| $\Gamma_{25}$ | $\Lambda\pi^+\eta$ | | ( 1.7 ± 0.6 ) % | |
| $\Gamma_{26}$ | $\Sigma(1385)^+\eta$ | [b] | ( 8.5 ± 3.3 ) $\times 10^{-3}$ | |
| $\Gamma_{27}$ | $\Lambda K^+\overline{K}^0$ | | ( 6.0 ± 2.1 ) $\times 10^{-3}$ | |
| $\Gamma_{28}$ | $\Sigma^0\pi^+$ | | ( 9.9 ± 3.2 ) $\times 10^{-3}$ | |

| | | | | | |
|---|---|---|---|---|---|
| $\Gamma_{29}$ | $\Sigma^+\pi^0$ | | ( 1.00± 0.34) % | | |
| $\Gamma_{30}$ | $\Sigma^+\eta$ | | ( 5.5 ± 2.3 ) $\times 10^{-3}$ | | |
| $\Gamma_{31}$ | $\Sigma^+\pi^+\pi^-$ | | ( 3.4 ± 1.0 ) % | | |
| $\Gamma_{32}$ | $\Sigma^+\rho^0$ | | < 1.4 | % | CL=95% |
| $\Gamma_{33}$ | $\Sigma^-\pi^+\pi^+$ | | ( 1.8 ± 0.8 ) % | | |
| $\Gamma_{34}$ | $\Sigma^0\pi^+\pi^0$ | | ( 1.8 ± 0.8 ) % | | |
| $\Gamma_{35}$ | $\Sigma^0\pi^+\pi^+\pi^-$ | | ( 1.1 ± 0.4 ) % | | |
| $\Gamma_{36}$ | $\Sigma^+\pi^+\pi^-\pi^0$ | | | | |
| $\Gamma_{37}$ | $\Sigma^+\omega$ | [b] | ( 2.7 ± 1.0 ) % | | |
| $\Gamma_{38}$ | $\Sigma^+\pi^+\pi^+\pi^-\pi^-$ | | ( 3.0 $^{+\ 4.1}_{-\ 2.1}$ ) $\times 10^{-3}$ | | |
| $\Gamma_{39}$ | $\Sigma^+K^+K^-$ | | ( 3.5 ± 1.2 ) $\times 10^{-3}$ | | |
| $\Gamma_{40}$ | $\Sigma^+\phi$ | [b] | ( 3.5 ± 1.7 ) $\times 10^{-3}$ | | |
| $\Gamma_{41}$ | $\Sigma^+K^+\pi^-$ | | ( 7 $^{+\ 6}_{-\ 4}$ ) $\times 10^{-3}$ | | |
| $\Gamma_{42}$ | $\Xi^0K^+$ | | ( 3.9 ± 1.4 ) $\times 10^{-3}$ | | |
| $\Gamma_{43}$ | $\Xi^-K^+\pi^+$ | | ( 4.9 ± 1.7 ) $\times 10^{-3}$ | | |
| $\Gamma_{44}$ | $\Xi(1530)^0K^+$ | [b] | ( 2.6 ± 1.0 ) $\times 10^{-3}$ | | |

**Semileptonic modes**

| | | | | | |
|---|---|---|---|---|---|
| $\Gamma_{45}$ | $\Lambda\ell^+\nu_\ell$ | [c] | ( 2.0 ± 0.6 ) % | | |
| $\Gamma_{46}$ | $\Lambda e^+\nu_e$ | | ( 2.1 ± 0.6 ) % | | |
| $\Gamma_{47}$ | $\Lambda\mu^+\nu_\mu$ | | ( 2.0 ± 0.7 ) % | | |
| $\Gamma_{48}$ | $e^+$ anything | | ( 4.5 ± 1.7 ) % | | |
| $\Gamma_{49}$ | $p\,e^+$ anything | | ( 1.8 ± 0.9 ) % | | |
| $\Gamma_{50}$ | $\Lambda\,e^+$ anything | | | | |
| $\Gamma_{51}$ | $\Lambda\mu^+$ anything | | | | |
| $\Gamma_{52}$ | $\Lambda\ell^+\nu_\ell$ anything | | | | |

**Inclusive modes**

| | | | | | |
|---|---|---|---|---|---|
| $\Gamma_{53}$ | $p$ anything | | (50 ±16 ) % | | |
| $\Gamma_{54}$ | $p$ anything (no $\Lambda$) | | (12 ±19 ) % | | |
| $\Gamma_{55}$ | $p$ hadrons | | | | |
| $\Gamma_{56}$ | $n$ anything | | (50 ±16 ) % | | |
| $\Gamma_{57}$ | $n$ anything (no $\Lambda$) | | (29 ±17 ) % | | |
| $\Gamma_{58}$ | $\Lambda$ anything | | (35 ±11 ) % | | S=1.4 |
| $\Gamma_{59}$ | $\Sigma^\pm$ anything | [d] | (10 ± 5 ) % | | |

**$\Delta C = 1$ weak neutral current ($C1$) modes, or Lepton number ($L$) violating modes**

| | | | | | | |
|---|---|---|---|---|---|---|
| $\Gamma_{60}$ | $p\mu^+\mu^-$ | $C1$ | < 3.4 | $\times 10^{-4}$ | CL=90% |
| $\Gamma_{61}$ | $\Sigma^-\mu^+\mu^+$ | $L$ | < 7.0 | $\times 10^{-4}$ | CL=90% |

[a] See the note at the beginning of this list of decay modes.

[b] This branching fraction includes all the decay modes of the final-state resonance.

[*c*] $\ell$ indicates $e$ or $\mu$ mode, not sum over modes.

[*d*] The value is for the sum of the charge states of particle/antiparticle states indicated.

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## $\Lambda_c^+$ BRANCHING RATIOS

Most of the modes are measured relative to the $pK^-\pi^+$ mode. A few obsolete results have been omitted.

### Hadronic modes with a $p$ and one $\overline{K}$

**$\Gamma(p\overline{K}^0)/\Gamma(pK^-\pi^+)$** **$\Gamma_1/\Gamma_2$**

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.49±0.07 OUR AVERAGE** | | | | | |
| 0.44±0.07±0.05 | 133 | AVERY | 91 | CLEO | $e^+e^-$ 10.5 GeV |
| 0.55±0.17±0.14 | 45 | ANJOS | 90 | E691 | $\gamma$ Be 70–260 GeV |
| 0.62±0.15±0.03 | 73 | ALBRECHT | 88C | ARG | $e^+e^-$ 10 GeV |

**$\Gamma(pK^-\pi^+)/\Gamma_{total}$** **$\Gamma_2/\Gamma$**

Most $\Lambda_c^+$ branching fractions are measured relative to the decay mode $\Lambda_c^+ \to pK^-\pi^+$. However, there are no model-independent measurements of the absolute branching fraction for $\Lambda_c^+ \to pK^-\pi^+$. Here, we describe the measurements that have been used to extract B($\Lambda_c^+ \to pK^-\pi^+$), the model-dependence of the results, and the method we have used to average the results.

ARGUS (ALBRECHT 88C) and CLEO (CRAWFORD 92) measure B($\overline{B} \to \Lambda_c^+ X$) × B($\Lambda_c^+ \to pK^-\pi^+$) to be (0.30±0.12±0.06)% and (0.273±0.051±0.039)%. Under the assumptions that decays of $\overline{B}$ mesons to baryons are dominated by $\overline{B} \to \Lambda_c^+ X$ and that $\Lambda_c^+ X$ final states other than $\Lambda_c^+ \overline{N} X$ can be neglected, they also measure B($\overline{B} \to \Lambda_c^+ X$) to be (6.8 ± 0.5 ± 0.3)% (ALBRECHT 92O) and (6.4 ± 0.8 ± 0.8)% (CRAWFORD 92). Combining these results, we get B($\Lambda_c^+ \to pK^-\pi^+$) = (4.14 ± 0.91)%. However, the assumption that $\overline{B}$ decay modes to baryons other than $\Lambda_c^+ \overline{N} X$ is not on solid ground experimentally or theoretically. Therefore, the branching fraction for $\Lambda_c^+ \to pK^-\pi^+$ given above may be low by some undetermined amount.

The second type of model-dependent determination of B($\Lambda_c^+ \to pK^-\pi^+$) is based on measurements by ARGUS (ALBRECHT 91G) and CLEO (BERGFELD 94) of $\sigma(e^+e^- \to \Lambda_c^+ X) \cdot$ B($\Lambda_c^+ \to \Lambda\ell\nu_\ell$) = (4.15 ± 1.03 ± 1.18) pb and (4.77 ± 0.25 ± 0.66) pb. ARGUS (ALBRECHT 96E) and CLEO (AVERY 91) have also measured $\sigma(e^+e^- \to \Lambda_c^+ X) \cdot$ B($\Lambda_c^+ \to pK^-\pi^+$). The weighted average is (11.2 ± 1.3) pb. From these measurements, we extract $R \equiv$ B($\Lambda_c^+ \to pK^-\pi^+$) / B($\Lambda_c^+ \to \Lambda\ell^+\nu_\ell$) = 2.40±0.43. We estimate the $\Lambda_c^+ \to pK^-\pi^+$ branching fraction from the equation

$$\text{B}(\Lambda_c^+ \to pK^-\pi^+) = R\, f\, F\, \frac{\Gamma(D \to X\ell\nu_\ell)}{1+|V_{cd}/V_{cs}|^2} \cdot \tau(\Lambda_c^+),$$

where $f = B(\Lambda_c^+ \to \Lambda \ell \nu_\ell)/ B(\Lambda_c^+ \to X_s \ell \nu_\ell)$ and $F = \Gamma(\Lambda_c^+ \to X_s \ell \nu_\ell)/ \Gamma(D^0 \to X_s \ell \nu_\ell)$. When we use $1+|V_{cd}/V_{cs}|^2 = 1.05$ and the world averages $\Gamma(D \to X \ell \nu_\ell) = (0.163 \pm 0.006) \times 10^{12}$ s$^{-1}$ and $\tau(\Lambda_c^+) = (0.206 \pm 0.012) \times 10^{-12}$ s, we calculate $B(\Lambda_c^+ \to p K^- \pi^+) = (7.7 \pm 1.5)\% \cdot fF$. Theoretical estimates for $f$ and $F$ are near 1.0 with significant uncertainties.

So, we have two results with significant model-dependence: from $\overline{B}$ decays, $B(\Lambda_c^+ \to p K^- \pi^+) = (4.14 \pm 0.91)\%$ and from semileptonic $\Lambda_c^+$ decays, $B(\Lambda_c^+ \to p K^- \pi^+) = (7.7 \pm 1.5)\% \cdot fF$. If we set $fF = 1.0$ in the second result, and assign an uncertainty of 30% to each result to account for the unknown model-dependence, we get the consistent results $B(\Lambda_c^+ \to p K^- \pi^+) = (4.14 \pm 0.91 \pm 1.24)\%$ and $B(\Lambda_c^+ \to p K^- \pi^+) = (7.7 \pm 1.5 \pm 2.3)\%$. The weighted average of these two results is $B(\Lambda_c^+ \to p K^- \pi^+) = (5.0 \pm 1.3)\%$, where the uncertainty contains both the experimental uncertainty and the 30% estimate of model dependence in each result.

This procedure is clearly rather arbitrary, but so is any other procedure until good measurements of the absolute branching fraction are made. Therefore, by the powers invested in us by the Particle Data Group, we have assigned the value $(5.0 \pm 1.3)\%$ to the $\Lambda_c^+ \to p K^- \pi^+$ branching fraction (given as PDG 97 below).

| *VALUE* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **0.050±0.013** | PDG | 97 | | See note above |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.041±0.010 | [1,2] ALBRECHT | 92O | ARG | $e^+ e^-$ ≈ $\Upsilon(4S)$ |
| 0.044±0.012 | [1,3] CRAWFORD | 92 | CLEO | $e^+ e^-$ 10.5 GeV |

[1] To extract $\Gamma(p K^- \pi^+)/\Gamma_{total}$, we use $B(\overline{B} \to \Lambda_c^+ X) \cdot B(\Lambda_c^+ \to p K^- \pi^+) = (0.28 \pm 0.06)\%$, which is the average of measurements from ARGUS (ALBRECHT 88C) and CLEO (CRAWFORD 92).

[2] ALBRECHT 92O measures $B(\overline{B} \to \Lambda_c^+ X) = (6.8 \pm 0.5 \pm 0.3)\%$.

[3] CRAWFORD 92 measures $B(\overline{B} \to \Lambda_c^+ X) = (6.4 \pm 0.8 \pm 0.8)\%$.

## $\Gamma(p\overline{K}^*(892)^0)/\Gamma(pK^-\pi^+)$ $\Gamma_3/\Gamma_2$

Unseen decay modes of the $\overline{K}^*(892)^0$ are included.

| *VALUE* | *EVTS* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| **$0.36^{+0.06}_{-0.07}$ OUR AVERAGE** | | | | | |
| $0.35^{+0.06}_{-0.07} \pm 0.03$ | 39 | BOZEK | 93 | NA32 | $\pi^-$ Cu 230 GeV |
| 0.42±0.24 | 12 | BASILE | 81B | CNTR | $pp \to \Lambda_c^+ e^- X$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 0.35±0.11 | | BARLAG | 90D | NA32 | See BOZEK 93 |

## $\Gamma(\Delta(1232)^{++} K^-)/\Gamma(pK^-\pi^+)$ $\Gamma_4/\Gamma_2$

| *VALUE* | *EVTS* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| **0.16±0.10 OUR AVERAGE** Error includes scale factor of 1.5. | | | | | |
| $0.12^{+0.04}_{-0.05} \pm 0.05$ | 14 | BOZEK | 93 | NA32 | $\pi^-$ Cu 230 GeV |
| 0.40±0.17 | 17 | BASILE | 81B | CNTR | $pp \to \Lambda_c^+ e^- X$ |

### $\Gamma(\Lambda(1520)\pi^+)/\Gamma(pK^-\pi^+)$ $\Gamma_5/\Gamma_2$

Unseen decay modes of the $\Lambda(1520)$ are included.

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| $0.09^{+0.04}_{-0.03}\pm0.02$ | 12 | BOZEK | 93 | NA32 | $\pi^-$ Cu 230 GeV |

### $\Gamma(pK^-\pi^+ \text{nonresonant})/\Gamma(pK^-\pi^+)$ $\Gamma_6/\Gamma_2$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| $0.56^{+0.07}_{-0.09}\pm0.05$ | 71 | BOZEK | 93 | NA32 | $\pi^-$ Cu 230 GeV |

### $\Gamma(p\overline{K}^0\eta)/\Gamma(pK^-\pi^+)$ $\Gamma_7/\Gamma_2$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| $0.25\pm0.04\pm0.04$ | 57 | AMMAR | 95 | CLEO | $e^+e^- \approx \Upsilon(4S)$ |

### $\Gamma(p\overline{K}^0\pi^+\pi^-)/\Gamma(pK^-\pi^+)$ $\Gamma_8/\Gamma_2$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **$0.49\pm0.17$ OUR AVERAGE** | Error includes scale factor of 1.4. | | | | |
| $0.43\pm0.12\pm0.04$ | 83 | AVERY | 91 | CLEO | $e^+e^-$ 10.5 GeV |
| $0.98\pm0.36\pm0.08$ | 12 | BARLAG | 90D | NA32 | $\pi^-$ 230 GeV |

### $\Gamma(pK^-\pi^+\pi^0)/\Gamma_{\text{total}}$ $\Gamma_9/\Gamma$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **seen** | 44 | AMENDOLIA | 87 | SPEC | $\gamma$ Ge-Si |

### $\Gamma(pK^*(892)^-\pi^+)/\Gamma(p\overline{K}^0\pi^+\pi^-)$ $\Gamma_{10}/\Gamma_8$

Unseen decay modes of the $K^*(892)^-$ are included.

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **$0.44\pm0.14$** | 17 | ALEEV | 94 | BIS2 | $nN$ 20–70 GeV |

### $\Gamma(p(K^-\pi^+)_{\text{nonresonant}}\pi^0)/\Gamma(pK^-\pi^+)$ $\Gamma_{11}/\Gamma_2$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **$0.73\pm0.12\pm0.05$** | 67 | BOZEK | 93 | NA32 | $\pi^-$ Cu 230 GeV |

### $\Gamma(\Delta(1232)\overline{K}^*(892))/\Gamma_{\text{total}}$ $\Gamma_{12}/\Gamma$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **seen** | 35 | AMENDOLIA | 87 | SPEC | $\gamma$ Ge-Si |

### $\Gamma(pK^-\pi^+\pi^+\pi^-)/\Gamma(pK^-\pi^+)$ $\Gamma_{13}/\Gamma_2$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **$0.022\pm0.015$** | BARLAG | 90D | NA32 | $\pi^-$ 230 GeV |

### $\Gamma(pK^-\pi^+\pi^0\pi^0)/\Gamma(pK^-\pi^+)$ $\Gamma_{14}/\Gamma_2$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **$0.16\pm0.07\pm0.03$** | 15 | BOZEK | 93 | NA32 | $\pi^-$ Cu 230 GeV |

### $\Gamma(pK^-\pi^+\pi^0\pi^0\pi^0)/\Gamma(pK^-\pi^+)$ $\Gamma_{15}/\Gamma_2$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **$0.10\pm0.06\pm0.02$** | 8 | BOZEK | 93 | NA32 | $\pi^-$ Cu 230 GeV |

## Hadronic modes with a $p$ and 0 or 2 $K$'s

### $\Gamma(p\pi^+\pi^-)/\Gamma(pK^-\pi^+)$ $\Gamma_{16}/\Gamma_2$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.069±0.036** | BARLAG | 90D | NA32 | $\pi^-$ 230 GeV |

### $\Gamma(pf_0(980))/\Gamma(pK^-\pi^+)$ $\Gamma_{17}/\Gamma_2$

Unseen decay modes of the $f_0(980)$ are included.

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.055±0.036** | BARLAG | 90D | NA32 | $\pi^-$ 230 GeV |

### $\Gamma(p\pi^+\pi^+\pi^-\pi^-)/\Gamma(pK^-\pi^+)$ $\Gamma_{18}/\Gamma_2$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.036±0.023** | BARLAG | 90D | NA32 | $\pi^-$ 230 GeV |

### $\Gamma(pK^+K^-)/\Gamma(pK^-\pi^+)$ $\Gamma_{19}/\Gamma_2$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.046±0.012 OUR AVERAGE** | | Error includes scale factor of 1.2. | | | |
| 0.039±0.009±0.007 | 214 | ALEXANDER | 96C | CLEO | $e^+e^- \approx \Upsilon(4S)$ |
| 0.096±0.029±0.010 | 30 | FRABETTI | 93H | E687 | $\gamma$ Be, $\overline{E}_\gamma$ 220 GeV |
| 0.048±0.027 | | BARLAG | 90D | NA32 | $\pi^-$ 230 GeV |

### $\Gamma(p\phi)/\Gamma(pK^-\pi^+)$ $\Gamma_{20}/\Gamma_2$

Unseen decay modes of the $\phi$ are included.

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.024±0.006±0.003** | 54 | ALEXANDER | 96C | CLEO | $e^+e^- \approx \Upsilon(4S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 0.040±0.027 | | BARLAG | 90D | NA32 | $\pi^-$ 230 GeV |

### $\Gamma(p\phi)/\Gamma(pK^+K^-)$ $\Gamma_{20}/\Gamma_{19}$

Unseen decay modes of the $\phi$ are included.

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| <0.58 | 90 | FRABETTI | 93H | E687 | $\gamma$ Be, $\overline{E}_\gamma$ 220 GeV |

## Hadronic modes with a hyperon

### $\Gamma(\Lambda\pi^+)/\Gamma(pK^-\pi^+)$ $\Gamma_{21}/\Gamma_2$

| VALUE | CL% | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|---|
| **0.180±0.032 OUR AVERAGE** | | | | | | |
| 0.18 ±0.03 ±0.04 | | | ALBRECHT | 92 | ARG | $e^+e^- \approx 10.4$ GeV |
| 0.18 ±0.03 ±0.03 | | 87 | AVERY | 91 | CLEO | $e^+e^-$ 10.5 GeV |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | | |
| <0.33 | 90 | | ANJOS | 90 | E691 | $\gamma$ Be 70–260 GeV |
| <0.16 | 90 | | ALBRECHT | 88C | ARG | $e^+e^-$ 10 GeV |

### $\Gamma(\Lambda\pi^+\pi^0)/\Gamma(pK^-\pi^+)$ $\Gamma_{22}/\Gamma_2$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.73±0.09±0.16** | 464 | AVERY | 94 | CLEO | $e^+e^- \approx \Upsilon(3S), \Upsilon(4S)$ |

### $\Gamma(\Lambda\rho^+)/\Gamma(pK^-\pi^+)$ $\Gamma_{23}/\Gamma_2$

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **<0.95** | 95 | AVERY | 94 | CLEO | $e^+e^- \approx \Upsilon(3S), \Upsilon(4S)$ |

### $\Gamma(\Lambda\pi^+\pi^+\pi^-)/\Gamma_{total}$ $\Gamma_{24}/\Gamma$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| $0.028 \pm 0.007 \pm 0.011$ | 70 | [4] BOWCOCK | 85 | CLEO | $e^+e^-$ 10.5 GeV |

[4] See BOWCOCK 85 for assumptions made on charm production and $\Lambda_c$ production from charm to get this result.

### $\Gamma(\Lambda\pi^+\pi^+\pi^-)/\Gamma(pK^-\pi^+)$ $\Gamma_{24}/\Gamma_2$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.66±0.11 OUR AVERAGE** | | | | | |
| $0.65 \pm 0.11 \pm 0.12$ | 289 | AVERY | 91 | CLEO | $e^+e^-$ 10.5 GeV |
| $0.82 \pm 0.29 \pm 0.27$ | 44 | ANJOS | 90 | E691 | $\gamma$ Be 70–260 GeV |
| $0.94 \pm 0.41 \pm 0.13$ | 10 | BARLAG | 90D | NA32 | $\pi^-$ 230 GeV |
| $0.61 \pm 0.16 \pm 0.04$ | 105 | ALBRECHT | 88C | ARG | $e^+e^-$ 10 GeV |

### $\Gamma(p\overline{K}^0\pi^+\pi^-)/\Gamma(\Lambda\pi^+\pi^+\pi^-)$ $\Gamma_8/\Gamma_{24}$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| $4.3 \pm 1.2$ | 130 | ALEEV | 84 | BIS2 | $n$C 40–70 GeV |

### $\Gamma(\Lambda\pi^+\eta)/\Gamma(pK^-\pi^+)$ $\Gamma_{25}/\Gamma_2$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.35±0.05±0.06** | 116 | AMMAR | 95 | CLEO | $e^+e^- \approx \Upsilon(4S)$ |

### $\Gamma(\Sigma(1385)^+\eta)/\Gamma(pK^-\pi^+)$ $\Gamma_{26}/\Gamma_2$

Unseen decay modes of the $\Sigma(1385)^+$ are included.

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.17±0.04±0.03** | 54 | AMMAR | 95 | CLEO | $e^+e^- \approx \Upsilon(4S)$ |

### $\Gamma(\Lambda K^+\overline{K}^0)/\Gamma(pK^-\pi^+)$ $\Gamma_{27}/\Gamma_2$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.12 ±0.02 ±0.02** | 59 | AMMAR | 95 | CLEO | $e^+e^- \approx \Upsilon(4S)$ |

### $\Gamma(\Sigma^0\pi^+)/\Gamma(pK^-\pi^+)$ $\Gamma_{28}/\Gamma_2$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.20±0.04 OUR AVERAGE** | | | | | |
| $0.21 \pm 0.02 \pm 0.04$ | 196 | AVERY | 94 | CLEO | $e^+e^- \approx \Upsilon(3S), \Upsilon(4S)$ |
| $0.17 \pm 0.06 \pm 0.04$ | | ALBRECHT | 92 | ARG | $e^+e^- \approx 10.4$ GeV |

### $\Gamma(\Sigma^+\pi^0)/\Gamma(pK^-\pi^+)$ $\Gamma_{29}/\Gamma_2$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.20±0.03±0.03** | 93 | KUBOTA | 93 | CLEO | $e^+e^- \approx \Upsilon(4S)$ |

### $\Gamma(\Sigma^+\eta)/\Gamma(pK^-\pi^+)$ $\Gamma_{30}/\Gamma_2$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.11±0.03±0.02** | 26 | AMMAR | 95 | CLEO | $e^+e^- \approx \Upsilon(4S)$ |

### $\Gamma(\Sigma^+\pi^+\pi^-)/\Gamma(pK^-\pi^+)$ $\Gamma_{31}/\Gamma_2$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.68±0.09 OUR AVERAGE** | | | | | |
| 0.74±0.07±0.09 | 487 | KUBOTA | 93 | CLEO | $e^+e^- \approx \Upsilon(4S)$ |
| $0.54^{+0.18}_{-0.15}$ | 11 | BARLAG | 92 | NA32 | $\pi^-$ Cu 230 GeV |

### $\Gamma(\Sigma^+\rho^0)/\Gamma(pK^-\pi^+)$ $\Gamma_{32}/\Gamma_2$

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **<0.27** | 95 | KUBOTA | 93 | CLEO | $e^+e^- \approx \Upsilon(4S)$ |

### $\Gamma(\Sigma^-\pi^+\pi^+)/\Gamma(\Sigma^+\pi^+\pi^-)$ $\Gamma_{33}/\Gamma_{31}$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.53±0.15±0.07** | 56 | FRABETTI | 94E | E687 | $\gamma$ Be, $\overline{E}_\gamma$ 220 GeV |

### $\Gamma(\Sigma^0\pi^+\pi^0)/\Gamma(pK^-\pi^+)$ $\Gamma_{34}/\Gamma_2$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.36±0.09±0.10** | 117 | AVERY | 94 | CLEO | $e^+e^- \approx \Upsilon(3S), \Upsilon(4S)$ |

### $\Gamma(\Sigma^0\pi^+\pi^+\pi^-)/\Gamma(pK^-\pi^+)$ $\Gamma_{35}/\Gamma_2$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.21±0.05±0.05** | 90 | AVERY | 94 | CLEO | $e^+e^- \approx \Upsilon(3S), \Upsilon(4S)$ |

### $\Gamma(\Sigma^+\omega)/\Gamma(pK^-\pi^+)$ $\Gamma_{37}/\Gamma_2$

Unseen decay modes of the $\omega$ are included.

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.54±0.13±0.06** | 107 | KUBOTA | 93 | CLEO | $e^+e^- \approx \Upsilon(4S)$ |

### $\Gamma(\Sigma^+\pi^+\pi^+\pi^-\pi^-)/\Gamma(pK^-\pi^+)$ $\Gamma_{38}/\Gamma_2$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| $\mathbf{0.06^{+0.08}_{-0.04}}$ | 1 | BARLAG | 92 | NA32 | $\pi^-$ Cu 230 GeV |

### $\Gamma(\Sigma^+K^+K^-)/\Gamma(pK^-\pi^+)$ $\Gamma_{39}/\Gamma_2$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.070±0.011±0.011** | 59 | AVERY | 93 | CLEO | $e^+e^- \approx 10.5$ GeV |

### $\Gamma(\Sigma^+\phi)/\Gamma(pK^-\pi^+)$ $\Gamma_{40}/\Gamma_2$

Unseen decay modes of the $\phi$ are included.

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.069±0.023±0.016** | 26 | AVERY | 93 | CLEO | $e^+e^- \approx 10.5$ GeV |

### $\Gamma(\Sigma^+K^+\pi^-)/\Gamma(pK^-\pi^+)$ $\Gamma_{41}/\Gamma_2$

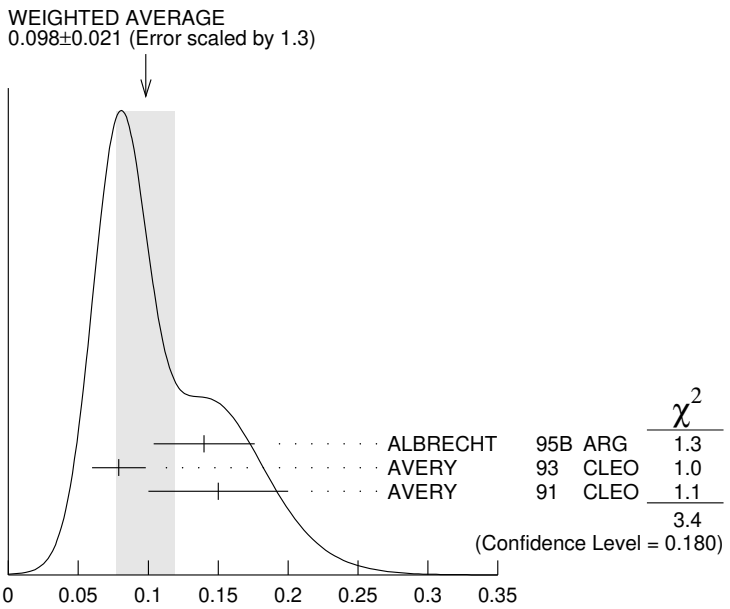
| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| $\mathbf{0.13^{+0.12}_{-0.07}}$ | 2 | BARLAG | 92 | NA32 | $\pi^-$ Cu 230 GeV |

### $\Gamma(\Xi^0 K^+)/\Gamma(pK^-\pi^+)$ $\Gamma_{42}/\Gamma_2$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.078±0.013±0.013** | 56 | AVERY | 93 | CLEO | $e^+e^-\approx 10.5$ GeV |

### $\Gamma(\Xi^- K^+\pi^+)/\Gamma(pK^-\pi^+)$ $\Gamma_{43}/\Gamma_2$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.098±0.021 OUR AVERAGE** | | Error includes scale factor of 1.3. See the ideogram below. | | | |
| 0.14 ±0.03 ±0.02 | 34 | ALBRECHT | 95B | ARG | $e^+e^-\approx 10.4$ GeV |
| 0.079±0.013±0.014 | 60 | AVERY | 93 | CLEO | $e^+e^-\approx 10.5$ GeV |
| 0.15 ±0.04 ±0.03 | 30 | AVERY | 91 | CLEO | $e^+e^-$ 10.5 GeV |




$\Gamma(\Xi^- K^+\pi^+)/\Gamma(pK^-\pi^+)$

### $\Gamma(\Xi(1530)^0 K^+)/\Gamma(pK^-\pi^+)$ $\Gamma_{44}/\Gamma_2$

Unseen decay modes of the $\Xi(1530)^0$ are included.

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.052±0.014 OUR AVERAGE** | | | | | |
| 0.05 ±0.02 ±0.01 | 11 | ALBRECHT | 95B | ARG | $e^+e^-\approx 10.4$ GeV |
| 0.053±0.016±0.010 | 24 | AVERY | 93 | CLEO | $e^+e^-\approx 10.5$ GeV |

## Semileptonic modes

### $\Gamma(\Lambda\ell^+\nu_\ell)/\Gamma(pK^-\pi^+)$ $\Gamma_{45}/\Gamma_2$

| VALUE | DOCUMENT ID | | COMMENT |
|---|---|---|---|
| **0.41±0.05 OUR AVERAGE** | | | |
| 0.42±0.07 | PDG | 97 | Our $\Gamma(\Lambda e^+\nu_e)/\Gamma(pK^-\pi^+)$ |
| 0.39±0.08 | PDG | 97 | Our $\Gamma(\Lambda\mu^+\nu_\mu)/\Gamma(pK^-\pi^+)$ |

### $\Gamma(\Lambda e^+ \nu_e)/\Gamma(p K^- \pi^+)$ $\Gamma_{46}/\Gamma_2$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.42±0.07 OUR AVERAGE** | | | | |
| 0.43±0.08 | [5,6] BERGFELD | 94 | CLEO | $e^+e^- \approx \Upsilon(4S)$ |
| 0.38±0.14 | [6,7] ALBRECHT | 91G | ARG | $e^+e^- \approx 10.4$ GeV |

[5] BERGFELD 94 measures $\sigma(e^+e^- \to \Lambda_c^+ X)\cdot B(\Lambda_c^+ \to \Lambda e^+ \nu_e) = (4.87 \pm 0.28 \pm 0.69)$ pb.

[6] To extract $\Gamma(\Lambda_c^+ \to \Lambda e^+ \nu_e)/\Gamma(\Lambda_c^+ \to p K^- \pi^+)$, we use $\sigma(e^+e^- \to \Lambda_c^+ X)\cdot B(\Lambda_c \to p K^- \pi^+) = (11.2 \pm 1.3)$ pb, which is the weighted average of measurements from ARGUS (ALBRECHT 96E) and CLEO (AVERY 91).

[7] ALBRECHT 91G measures $\sigma(e^+e^- \to \Lambda_c^+ X)\cdot B(\Lambda_c^+ \to \Lambda e^+ \nu_e) = (4.20 \pm 1.28 \pm 0.71)$ pb.

### $\Gamma(\Lambda \mu^+ \nu_\mu)/\Gamma(p K^- \pi^+)$ $\Gamma_{47}/\Gamma_2$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.39±0.08 OUR AVERAGE** | | | | |
| 0.40±0.09 | [8,9] BERGFELD | 94 | CLEO | $e^+e^- \approx \Upsilon(4S)$ |
| 0.35±0.20 | [9,10] ALBRECHT | 91G | ARG | $e^+e^- \approx 10.4$ GeV |

[8] BERGFELD 94 measures $\sigma(e^+e^- \to \Lambda_c^+ X)\cdot B(\Lambda_c^+ \to \Lambda \mu^+ \nu_\mu) = (4.43 \pm 0.51 \pm 0.64)$ pb.

[9] To extract $\Gamma(\Lambda_c^+ \to \Lambda \mu^+ \nu_\mu)/\Gamma(\Lambda_c^+ \to p K^- \pi^+)$, we use $\sigma(e^+e^- \to \Lambda_c^+ X)\cdot B(\Lambda_c \to p K^- \pi^+) = (11.2 \pm 1.3)$ pb, which is the weighted average of measurements from ARGUS (ALBRECHT 96E) and CLEO (AVERY 91).

[10] ALBRECHT 91G measures $\sigma(e^+e^- \to \Lambda_c^+ X)\cdot B(\Lambda_c^+ \to \Lambda \mu^+ \nu_\mu) = (3.91 \pm 2.02 \pm 0.90)$ pb.

### $\Gamma(e^+ \text{anything})/\Gamma_{\text{total}}$ $\Gamma_{48}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.045±0.017** | VELLA | 82 | MRK2 | $e^+e^-$ 4.5–6.8 GeV |

### $\Gamma(p e^+ \text{anything})/\Gamma_{\text{total}}$ $\Gamma_{49}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.018±0.009** | [11] VELLA | 82 | MRK2 | $e^+e^-$ 4.5–6.8 GeV |

[11] VELLA 82 includes protons from $\Lambda$ decay.

### $\Gamma(\Lambda e^+ \text{anything})/\Gamma_{\text{total}}$ $\Gamma_{50}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.011±0.008 | [12] VELLA | 82 | MRK2 | $e^+e^-$ 4.5–6.8 GeV |

[12] VELLA 82 includes $\Lambda$'s from $\Sigma^0$ decay.

## Inclusive modes

### $\Gamma(p \text{ anything})/\Gamma_{\text{total}}$ $\Gamma_{53}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.50±0.08±0.14** | [13] CRAWFORD | 92 | CLEO | $e^+e^-$ 10.5 GeV |

[13] This CRAWFORD 92 value includes protons from $\Lambda$ decay. The value is model dependent, but account is taken of this in the systematic error.

### $\Gamma(p \text{ anything (no } \Lambda))/\Gamma_{total}$ $\Gamma_{54}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.12±0.10±0.16** | CRAWFORD | 92 | CLEO | $e^+e^-$ 10.5 GeV |

### $\Gamma(n \text{ anything})/\Gamma_{total}$ $\Gamma_{56}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.50±0.08±0.14** | [14] CRAWFORD | 92 | CLEO | $e^+e^-$ 10.5 GeV |

[14] This CRAWFORD 92 value includes neutrons from $\Lambda$ decay. The value is model dependent, but account is taken of this in the systematic error.

### $\Gamma(n \text{ anything (no } \Lambda))/\Gamma_{total}$ $\Gamma_{57}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.29±0.09±0.15** | CRAWFORD | 92 | CLEO | $e^+e^-$ 10.5 GeV |

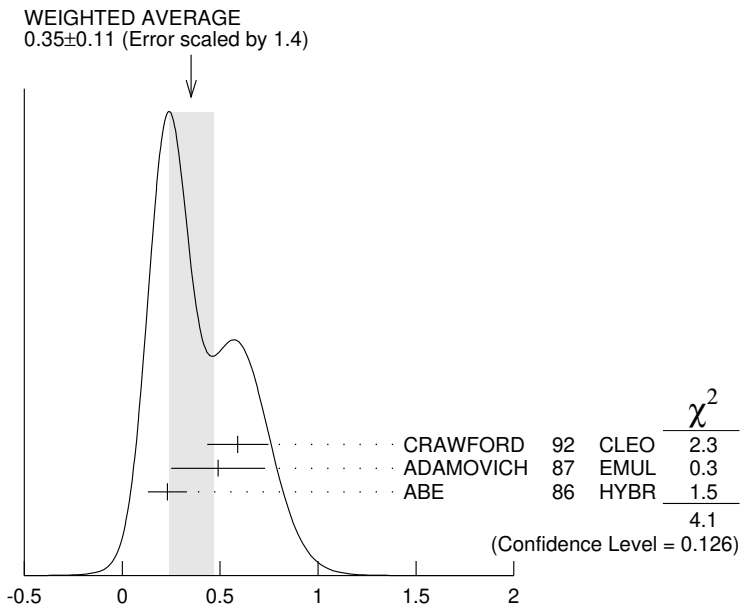
### $\Gamma(p \text{ hadrons})/\Gamma_{total}$ $\Gamma_{55}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.41±0.24 | ADAMOVICH | 87 | EMUL | $\gamma$ A 20–70 GeV/$c$ |

### $\Gamma(\Lambda \text{ anything})/\Gamma_{total}$ $\Gamma_{58}/\Gamma$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.35±0.11 OUR AVERAGE** Error includes scale factor of 1.4. See the ideogram below. | | | | | |
| 0.59±0.10±0.12 | | CRAWFORD | 92 | CLEO | $e^+e^-$ 10.5 GeV |
| 0.49±0.24 | | ADAMOVICH | 87 | EMUL | $\gamma$ A 20–70 GeV/$c$ |
| 0.23±0.10 | 8 | [15] ABE | 86 | HYBR | 20 GeV $\gamma p$ |

[15] ABE 86 includes $\Lambda$'s from $\Sigma^0$ decay.




$\Gamma(\Lambda \text{ anything})/\Gamma_{total}$

### $\Gamma(\Sigma^{\pm}\text{anything})/\Gamma_{\text{total}}$ $\Gamma_{59}/\Gamma$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.1 ±0.05** | 5 | ABE | 86 | HYBR | 20 GeV $\gamma p$ |

## Rare or forbidden modes

### $\Gamma(p\mu^+\mu^-)/\Gamma_{\text{total}}$ $\Gamma_{60}/\Gamma$

A test for the $\Delta C$=1 weak neutral current. Allowed by higher-order electroweak interactions.

| VALUE | CL% | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|---|
| **$<3.4\times10^{-4}$** | 90 | 0 | KODAMA | 95 | E653 | $\pi^-$ emulsion 600 GeV |

### $\Gamma(\Sigma^-\mu^+\mu^+)/\Gamma_{\text{total}}$ $\Gamma_{61}/\Gamma$

A test of lepton-number conservation.

| VALUE | CL% | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|---|
| **$<7.0\times10^{-4}$** | 90 | 0 | KODAMA | 95 | E653 | $\pi^-$ emulsion 600 GeV |

# $\Lambda_c^+$ DECAY PARAMETERS

See the "Note on Baryon Decay Parameters" in the neutron Listings.

### $\alpha$ FOR $\Lambda_c^+ \to \Lambda\pi^+$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **−0.98±0.19 OUR AVERAGE** | | | | | |
| $-0.94\pm0.21\pm0.12$ | 414 | [16] BISHAI | 95 | CLEO | $e^+e^-\approx\Upsilon(4S)$ |
| $-0.96\pm0.42$ | | ALBRECHT | 92 | ARG | $e^+e^-\approx10.4$ GeV |
| $-1.1\ \pm0.4$ | 86 | AVERY | 90B | CLEO | $e^+e^-\approx10.6$ GeV |

[16] BISHAI 95 actually gives $\alpha=-0.94^{+0.21+0.12}_{-0.06-0.06}$, chopping the errors at the physical limit −1.0. However, for $\alpha\approx-1.0$, some experiments should *get* unphysical values ($\alpha<-1.0$), and for averaging with other measurements such values (or errors that extend below −1.0) should *not* be chopped.

### $\alpha$ FOR $\Lambda_c^+ \to \Sigma^+\pi^0$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **−0.45±0.31±0.06** | 89 | BISHAI | 95 | CLEO | $e^+e^-\approx\Upsilon(4S)$ |

### $\alpha$ FOR $\Lambda_c^+ \to \Lambda\ell^+\nu_\ell$

The experiments don't cover the complete (or same incomplete) $M(\Lambda\ell^+)$ range, but we average them together anyway.

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **$-0.82^{+0.11}_{-0.07}$ OUR AVERAGE** | | | | | |
| $-0.82^{+0.09+0.06}_{-0.06-0.03}$ | 700 | [17] CRAWFORD | 95 | CLEO | $e^+e^-\approx\Upsilon(4S)$ |
| $-0.91\pm0.42\pm0.25$ | | [18] ALBRECHT | 94B | ARG | $e^+e^-\approx10$ GeV |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| $-0.89^{+0.17+0.09}_{-0.11-0.05}$ | 350 | [19] BERGFELD | 94 | CLEO | See CRAWFORD 95 |

[17] CRAWFORD 95 measures the form-factor ratio $R\equiv f_2/f_1$ for $\Lambda_c^+\to\Lambda e^+\nu_e$ events to be $-0.25\pm0.14\pm0.08$ and from this calculates $\alpha$, averaged over $q^2$, to be the above.

[18] ALBRECHT 94B uses $\Lambda e^+$ and $\Lambda \mu^+$ events in the mass range $1.85 < M(\Lambda \ell^+) < 2.20$ GeV.
[19] BERGFELD 94 uses $\Lambda e^+$ events.

## $\Lambda_c^+$ REFERENCES

We have omitted some papers that have been superseded by later experiments. The omitted papers may be found in our 1992 edition (Physical Review **D45**, 1 June, Part II) or in earlier editions.


| | | | | |
|---|---|---|---|---|
| PDG | 97 | Unofficial 1997 WWW edition | | |
| ALBRECHT | 96E | PRPL 276 223 | +Andam, Binder, Bockmann+ | (ARGUS Collab.) |
| ALEXANDER | 96C | PR D53 R1013 | +Bebek, Berger+ | (CLEO Collab.) |
| ALBRECHT | 95B | PL B342 397 | +Hamacher, Hofmann+ | (ARGUS Collab.) |
| AMMAR | 95 | PRL 74 3534 | +Baringer, Bean, Besson+ | (CLEO Collab.) |
| BISHAI | 95 | PL B350 256 | +Fast, Gerndt, Hinson+ | (CLEO Collab.) |
| CRAWFORD | 95 | PRL 75 624 | +Daubenmier, Fulton+ | (CLEO Collab.) |
| KODAMA | 95 | PL B345 85 | +Ushida, Mokhtarani+ | (FNAL E653 Collab.) |
| ALBRECHT | 94B | PL B326 320 | +Ehrlichmann, Hamacher+ | (ARGUS Collab.) |
| ALEEV | 94 | PAN 57 1370 | +Balandin+ | (Serpukhov BIS-2 Collab.) |
| | | Translated from YF 57 1443. | | |
| AVERY | 94 | PL B325 257 | +Freyberger, Rodriguez+ | (CLEO Collab.) |
| BERGFELD | 94 | PL B323 219 | +Eisenstein, Gollin, Ong+ | (CLEO Collab.) |
| FRABETTI | 94E | PL B328 193 | +Cheung, Cumalat+ | (FNAL E687 Collab.) |
| AVERY | 93 | PRL 71 2391 | +Freyberger, Rodriguez+ | (CLEO Collab.) |
| BOZEK | 93 | PL B312 247 | +Barlag, Becker, Boehringer+ | (CERN NA32 Collab.) |
| FRABETTI | 93D | PRL 70 1755 | +Cheung, Cumalat+ | (FNAL E687 Collab.) |
| FRABETTI | 93H | PL B314 477 | +Cheung, Cumalat+ | (FNAL E687 Collab.) |
| KUBOTA | 93 | PRL 71 3255 | +Lattery, Nelson, Patton+ | (CLEO Collab.) |
| ALBRECHT | 92 | PL B274 239 | +Ehrlichmann, Hamacher, Krueger+ | (ARGUS Collab.) |
| ALBRECHT | 92O | ZPHY C56 1 | +Cronstroem, Ehrlichmann+ | (ARGUS Collab.) |
| BARLAG | 92 | PL B283 465 | +Becker, Bozek, Boehringer+ | (ACCMOR Collab.) |
| CRAWFORD | 92 | PR D45 752 | +Fulton, Jensen, Johnson+ | (CLEO Collab.) |
| JEZABEK | 92 | PL B286 175 | +Rybicki, Rylko | (CRAC) |
| ALBRECHT | 91G | PL B269 234 | +Ehrlichmann, Hamacher+ | (ARGUS Collab.) |
| AVERY | 91 | PR D43 3599 | +Besson, Garren, Yelton+ | (CLEO Collab.) |
| ALVAREZ | 90 | ZPHY C47 539 | +Barate, Bloch, Bonamy+ | (CERN NA14/2 Collab.) |
| ALVAREZ | 90B | PL B246 256 | +Barate, Bloch, Bonamy+ | (CERN NA14/2 Collab.) |
| ANJOS | 90 | PR D41 801 | +Appel, Bean+ | (FNAL E691 Collab.) |
| AVERY | 90B | PRL 65 2842 | +Besson, Garren, Yelton, Kinoshita+ | (CLEO Collab.) |
| BARLAG | 90D | ZPHY C48 29 | +Becker, Boehringer, Bosman+ | (ACCMOR Collab.) |
| FRABETTI | 90 | PL B251 639 | +Bogart, Cheung, Coteus+ | (FNAL E687 Collab.) |
| BARLAG | 89 | PL B218 374 | +Becker, Boehringer, Bosman+ | (ACCMOR Collab.) |
| AGUILAR-... | 88B | ZPHY C40 321 | Aguilar-Benitez, Allison, Bailly+ | (LEBC-EHS Collab.) |
| Also | 87 | PL B189 254 | Aguilar-Benitez, Allison, Bailly+ | (LEBC-EHS Collab.) |
| Also | 87B | PL B199 462 | Aguilar-Benitez, Allison, Bailly+ | (LEBC-EHS Collab.) |
| Also | 88 | SJNP 48 833 | Begalli, Otter, Schulte, Gensch+ | (LEBC-EHS Collab.) |
| | | Translated from YAF 48 1310. | | |
| ALBRECHT | 88C | PL B207 109 | + | (ARGUS Collab.) |
| ANJOS | 88B | PRL 60 1379 | +Appel+ | (FNAL E691 Collab.) |
| ADAMOVICH | 87 | EPL 4 887 | +Alexandrov, Bolta+ | (Photon Emulsion Collab.) |
| Also | 87 | SJNP 46 447 | Viaggi, Gessaroli+ | (Photon Emulsion Collab.) |
| | | Translated from YAF 46 799. | | |
| AMENDOLIA | 87 | ZPHY C36 513 | +Bagliesi, Batignani, Beck+ | (CERN NA1 Collab.) |
| JONES | 87 | ZPHY C36 593 | +Jones, Kennedy, O'Neale+ | (CERN WA21 Collab.) |
| ABE | 86 | PR D33 1 | + | (SLAC Hybrid Facility Photon Collab.) |
| BOWCOCK | 85 | PRL 55 923 | +Giles, Hassard, Kinoshita+ | (CLEO Collab.) |
| ALEEV | 84 | ZPHY C23 333 | +Arefiev, Balandin, Berdyshev+ | (BIS-2 Collab.) |
| BOSETTI | 82 | PL 109B 234 | +Graessler+ | (AACH3, BONN, CERN, MPIM, OXF) |
| VELLA | 82 | PRL 48 1515 | +Trilling, Abrams, Alam+ | (SLAC, LBL, UCB) |
| BASILE | 81B | NC 62A 14 | +Romeo+ | (CERN, BGNA, PGIA, FRAS) |
| CALICCHIO | 80 | PL 93B 521 | + | (BARI, BIRM, BRUX, CERN, EPOL, RHEL+) |