

$\Lambda_c(2595)^+$ $I(J^P) = 0(\frac{1}{2}^-)$ Status: ***

The $\Lambda_c^+ \pi^+ \pi^-$ mode is largely, and perhaps entirely, $\Sigma_c \pi$, which is just at threshold; since the Σ_c has $J^P = 1/2^+$, the J^P here is almost certainly $1/2^-$. This result is in accord with the theoretical expectation that this is the charm counterpart of the strange $\Lambda(1405)$.

$\Lambda_c(2595)^+$ MASS

The mass is obtained from the $\Lambda_c(2595)^+ - \Lambda_c^+$ mass-difference measurements below.

| <u>VALUE (MeV)</u> | <u>DOCUMENT ID</u> |
|-------------------------------|--------------------|
| 2592.25 ± 0.28 OUR FIT | |

$\Lambda_c(2595)^+ - \Lambda_c^+$ MASS DIFFERENCE

| <u>VALUE (MeV)</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|-------------|-----------------------|-------------|---|
| 305.79 ± 0.24 OUR FIT | | | | |
| 305.79 ± 0.14 ± 0.20 | 3.5k | AALTONEN | 11H CDF | $p\bar{p}$ at 1.96 TeV |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | |
| 305.6 ± 0.3 | | ¹ BLECHMAN | 03 | Threshold shift |
| 309.7 ± 0.9 ± 0.4 | 19 | ALBRECHT | 97 ARG | $e^+ e^- \approx 10$ GeV |
| 309.2 ± 0.7 ± 0.3 | 14 ± 4.5 | FRABETTI | 96 E687 | γ Be, $\bar{E}_\gamma \approx 220$ GeV |
| 307.5 ± 0.4 ± 1.0 | 112 ± 17 | EDWARDS | 95 CLE2 | $e^+ e^- \approx 10.5$ GeV |

¹ BLECHMAN 03 finds that a more sophisticated treatment than a simple Breit-Wigner for the proximity of the threshold of the dominant decay, $\Sigma_c(2455)\pi$, lowers the $\Lambda_c(2595)^+ - \Lambda_c^+$ mass difference by 2 or 3 MeV. The analysis of AALTONEN 11H bears this out.

$\Lambda_c(2595)^+$ WIDTH

| <u>VALUE (MeV)</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|-------------|-----------------------|-------------|----------------------------|
| 2.59 ± 0.30 ± 0.47 | 3.5k | ² AALTONEN | 11H CDF | $p\bar{p}$ at 1.96 TeV |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | |
| 2.9 ^{+2.9} _{-2.1} ^{+1.8} _{-1.4} | 19 | ALBRECHT | 97 ARG | $e^+ e^- \approx 10$ GeV |
| 3.9 ^{+1.4} _{-1.2} ^{+2.0} _{-1.0} | 112 ± 17 | EDWARDS | 95 CLE2 | $e^+ e^- \approx 10.5$ GeV |

² AALTONEN 11H treats the three charged modes $\Lambda_c(2595)^+ \rightarrow \Sigma_c(2455)^{++} \pi^-$, $\Sigma_c(2455)^+ \pi^0$, $\Sigma_c(2455)^0 \pi^+$ separately in terms of a common coupling constant h_2 and obtains $h_2^2 = 0.36 \pm 0.08$. From this the width is determined.

$\Lambda_c(2595)^+$ DECAY MODES

$\Lambda_c^+ \pi \pi$ and its submode $\Sigma_c(2455)\pi$ — the latter just barely — are the only strong decays allowed to an excited Λ_c^+ having this mass; and the submode seems to dominate.

| Mode | Fraction (Γ_i/Γ) |
|---|--------------------------------|
| Γ_1 $\Lambda_c^+ \pi^+ \pi^-$ | [a] $\approx 67\%$ |
| Γ_2 $\Sigma_c(2455)^{++} \pi^-$ | $24 \pm 7\%$ |
| Γ_3 $\Sigma_c(2455)^0 \pi^+$ | $24 \pm 7\%$ |
| Γ_4 $\Lambda_c^+ \pi^+ \pi^-$ 3-body | $18 \pm 10\%$ |
| Γ_5 $\Lambda_c^+ \pi^0$ | [b] not seen |
| Γ_6 $\Lambda_c^+ \gamma$ | not seen |

[a] Assuming isospin conservation, so that the other third is $\Lambda_c^+ \pi^0 \pi^0$.

[b] A test that the isospin is indeed 0, so that the particle is indeed a Λ_c^+ .

$\Lambda_c(2595)^+$ BRANCHING RATIOS

$\Gamma(\Sigma_c(2455)^{++} \pi^-) / \Gamma(\Lambda_c^+ \pi^+ \pi^-)$ Γ_2/Γ_1

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---|-------------|------|----------------------------|
| 0.36 ± 0.10 OUR AVERAGE | | | |
| $0.37 \pm 0.12 \pm 0.13$ | ALBRECHT 97 | ARG | $e^+ e^- \approx 10$ GeV |
| $0.36 \pm 0.09 \pm 0.09$ | EDWARDS 95 | CLE2 | $e^+ e^- \approx 10.5$ GeV |

$\Gamma(\Sigma_c(2455)^0 \pi^+) / \Gamma(\Lambda_c^+ \pi^+ \pi^-)$ Γ_3/Γ_1

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---|-------------|------|----------------------------|
| 0.37 ± 0.10 OUR AVERAGE | | | |
| $0.29 \pm 0.10 \pm 0.11$ | ALBRECHT 97 | ARG | $e^+ e^- \approx 10$ GeV |
| $0.42 \pm 0.09 \pm 0.09$ | EDWARDS 95 | CLE2 | $e^+ e^- \approx 10.5$ GeV |

$[\Gamma(\Sigma_c(2455)^{++} \pi^-) + \Gamma(\Sigma_c(2455)^0 \pi^+)] / \Gamma(\Lambda_c^+ \pi^+ \pi^-)$ $(\Gamma_2 + \Gamma_3)/\Gamma_1$

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|-----|--------------------------|------|--|
| $0.66^{+0.13}_{-0.16} \pm 0.07$ | | ALBRECHT 97 | ARG | $e^+ e^- \approx 10$ GeV |
| > 0.51 | 90 | ³ FRABETTI 96 | E687 | $\gamma \text{Be}, \bar{E}_\gamma \approx 220$ GeV |

³ The results of FRABETTI 96 are consistent with this ratio being 100%.

$\Gamma(\Lambda_c^+ \pi^0) / \Gamma(\Lambda_c^+ \pi^+ \pi^-)$ Γ_5/Γ_1

$\Lambda_c^+ \pi^0$ decay is forbidden by isospin conservation if this state is in fact a Λ_c .

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------------------------------|-----|-------------|------|----------------------------|
| < 3.53 | 90 | EDWARDS 95 | CLE2 | $e^+ e^- \approx 10.5$ GeV |

| $\Gamma(\Lambda_c^+ \gamma) / \Gamma(\Lambda_c^+ \pi^+ \pi^-)$ | | | | | Γ_6 / Γ_1 |
|--|------------|--------------------|-------------|----------------|----------------------------|
| <u>VALUE</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> | |
| <0.98 | 90 | EDWARDS | 95 | CLE2 | $e^+ e^- \approx 10.5$ GeV |

$\Lambda_c(2595)^+$ REFERENCES

| | | | | |
|----------|-----|---------------|-----------------------------|---------------------|
| AALTONEN | 11H | PR D84 012003 | T. Aaltonen <i>et al.</i> | (CDF Collab.) |
| BLECHMAN | 03 | PR D67 074033 | A.E. Blechman <i>et al.</i> | (JHU, FLOR) |
| ALBRECHT | 97 | PL B402 207 | H. Albrecht <i>et al.</i> | (ARGUS Collab.) |
| FRABETTI | 96 | PL B365 461 | P.L. Frabetti <i>et al.</i> | (FNAL E687 Collab.) |
| EDWARDS | 95 | PRL 74 3331 | K.W. Edwards <i>et al.</i> | (CLEO Collab.) |