

$\Lambda_c(2593)^+$

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

Seen in $\Lambda_c^+ \pi^+ \pi^-$ but not in $\Lambda_c^+ \pi^0$, so this is indeed an excited Λ_c^+ rather than a Σ_c^+ . The $\Lambda_c^+ \pi^+ \pi^-$ mode is largely, and perhaps entirely, $\Sigma_c \pi$, which is just at threshold; thus (assuming, as has not yet been proven, that 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 $\Lambda(1405)$.

$\Lambda_c(2593)^+$ MASS

The mass is obtained from the $\Lambda_c(2593)^+ - \Lambda_c^+$ mass-difference measurements below.

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>
2593.9 ± 0.8 OUR FIT	

$\Lambda_c(2593)^+ - \Lambda_c^+$ MASS DIFFERENCE

<u>VALUE (MeV)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
308.9 ± 0.6 OUR FIT				Error includes scale factor of 1.1.
308.9 ± 0.6 OUR AVERAGE				Error includes scale factor of 1.1.
309.7 ± 0.9 ± 0.4	19	ALBRECHT	97 ARG	$e^+ e^- \approx 10$ GeV
309.2 ± 0.7 ± 0.3	14	¹ FRABETTI	96 E687	γ Be, $\bar{E}_\gamma \approx 220$ GeV
307.5 ± 0.4 ± 1.0	112	² EDWARDS	95 CLE2	$e^+ e^- \approx 10.5$ GeV

¹FRABETTI 96 claims a signal of 13.9 ± 4.5 events.

²EDWARDS 95 claims a signal of 112.5 ± 16.5 events in $\Lambda_c^+ \pi^+ \pi^-$.

$\Lambda_c(2593)^+$ WIDTH

<u>VALUE (MeV)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
3.6^{+2.0}_{-1.3} OUR AVERAGE				
2.9 ^{+2.9+1.8} _{-2.1-1.4}	19	ALBRECHT	97 ARG	$e^+ e^- \approx 10$ GeV
3.9 ^{+1.4+2.0} _{-1.2-1.0}	112	EDWARDS	95 CLE2	$e^+ e^- \approx 10.5$ GeV

$\Lambda_c(2593)^+$ 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^+ .

$\Lambda_c(2593)^+$ 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	γ 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	

$\Lambda_c(2593)^+$ REFERENCES

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.)