

# $\Sigma(1670)$ Bumps

$$I(J^P) = 1(?^?)$$

OMITTED FROM SUMMARY TABLE

Formation experiments are listed separately in the preceding entry.

Probably there are two states at the same mass with the same quantum numbers, one decaying to  $\Sigma\pi$  and  $\Lambda\pi$ , the other to  $\Lambda(1405)\pi$ . See the note in front of the preceding entry.

## $\Sigma(1670)$ MASS (PRODUCTION EXPERIMENTS)

<u>VALUE (MeV)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>
<b>≈ 1670 OUR ESTIMATE</b>					
1670 ± 4		<sup>1</sup> CARROLL 76	DPWA		Isospin-1 total $\sigma$
1675 ± 10		<sup>2</sup> HEPP 76	DBC	−	$K^- N$ 1.6–1.75 GeV/c
1665 ± 1		APSELL 74	HBC		$K^- p$ 2.87 GeV/c
1688 ± 2 or 1683 ± 5	1.2k	BERTHON 74	HBC	0	Quasi-2-body $\sigma$
1670 ± 6		AGUILAR-... 70B	HBC		$K^- p \rightarrow \Sigma\pi\pi$ 4 GeV
1668 ± 10		AGUILAR-... 70B	HBC		$K^- p \rightarrow \Sigma 3\pi$ 4 GeV
1660 ± 10		ALVAREZ 63	HBC	+	$K^- p$ 1.51 GeV/c
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●					
1668 ± 10	150	<sup>3</sup> FERRERSORIA81	OMEG	−	$\pi^- p$ 9,12 GeV/c
1655 to 1677		TIMMERMANS76	HBC	+	$K^- p$ 4.2 GeV/c
1665 ± 5		BUGG 68	CNTR		$K^- p, d$ total $\sigma$
1661 ± 9	70	PRIMER 68	HBC	+	See BARNES 69E
1685		ALEXANDER 62C	HBC	−0	$\pi^- p$ 2–2.2 GeV/c

## $\Sigma(1670)$ WIDTH (PRODUCTION EXPERIMENTS)

<u>VALUE (MeV)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>
67.0 ± 2.4		APSELL 74	HBC		$K^- p$ 2.87 GeV/c
110 ± 12		AGUILAR-... 70B	HBC		$K^- p \rightarrow \Sigma\pi\pi$ 4 GeV
135 <sup>+40</sup> <sub>−30</sub>		AGUILAR-... 70B	HBC		$K^- p \rightarrow \Sigma 3\pi$ 4 GeV
40 ± 10		ALVAREZ 63	HBC	+	
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●					
90 ± 20	150	<sup>3</sup> FERRERSORIA81	OMEG	−	$\pi^- p$ 9,12 GeV/c
52		<sup>1</sup> CARROLL 76	DPWA		Isospin-1 total $\sigma$
48 to 63		TIMMERMANS76	HBC	+	$K^- p$ 4.2 GeV/c
30 ± 15		BUGG 68	CNTR		
60 ± 20	70	PRIMER 68	HBC	+	See BARNES 69E
45		ALEXANDER 62C	HBC	−0	

## $\Sigma(1670)$ DECAY MODES (PRODUCTION EXPERIMENTS)

Mode
$\Gamma_1$ $N\bar{K}$
$\Gamma_2$ $\Lambda\pi$
$\Gamma_3$ $\Sigma\pi$
$\Gamma_4$ $\Lambda\pi\pi$
$\Gamma_5$ $\Sigma\pi\pi$
$\Gamma_6$ $\Sigma(1385)\pi$
$\Gamma_7$ $\Lambda(1405)\pi$

## $\Sigma(1670)$ BRANCHING RATIOS (PRODUCTION EXPERIMENTS)

$\Gamma(N\bar{K})/\Gamma(\Sigma\pi)$							$\Gamma_1/\Gamma_3$
<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>		
<0.03		TIMMERMANS76	HBC	+	$K^- p$ 4.2 GeV/c		
<0.10		BERTHON 74	HBC	0	Quasi-2-body $\sigma$		
<0.2		AGUILAR-... 70B	HBC				
<0.26		BARNES 69E	HBC	+	$K^- p$ 3.9–5 GeV/c		
0.025		BUGG 68	CNTR	0	Assuming $J = 3/2$		
<0.24	0	PRIMER 68	HBC	+	$K^- p$ 4.6–5 GeV/c		
<0.6		LONDON 66	HBC	+	$K^- p$ 2.25 GeV/c		
<0.19	0	ALVAREZ 63	HBC	+	$K^- p$ 1.15 GeV/c		
$\geq 0.5 \pm 0.25$		SMITH 63	HBC	-0			

$\Gamma(\Lambda\pi)/\Gamma(\Sigma\pi)$							$\Gamma_2/\Gamma_3$
<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>		
$0.76 \pm 0.09$		ESTES 74	HBC	0	$K^- p$ 2.1, 2.6 GeV/c		
$0.45 \pm 0.15$		BARNES 69E	HBC	+	$K^- p$ 3.9–5 GeV/c		
$0.15 \pm 0.07$		HUWE 69	HBC	+			
$0.11 \pm 0.06$	33	BUTTON-... 68	HBC	+	$K^- p$ 1.7 GeV/c		
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●							
$\leq 0.45 \pm 0.07$		TIMMERMANS76	HBC	+	$K^- p$ 4.2 GeV/c		
$0.55 \pm 0.11$		BERTHON 74	HBC	0	Quasi-2-body $\sigma$		
0	0	PRIMER 68	HBC	+	See BARNES 69E		
<0.6		LONDON 66	HBC	+	$K^- p$ 2.25 GeV/c		
1.2	130	ALVAREZ 63	HBC	+	$K^- p$ 1.15 GeV/c		
1.2		SMITH 63	HBC	-0			

$\Gamma(\Lambda\pi\pi)/\Gamma(\Sigma\pi)$						$\Gamma_4/\Gamma_3$
<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>	
<0.6		LONDON	66	HBC	+	$K^- p$ 2.25 GeV/c
0.56	90	ALVAREZ	63	HBC	+	$K^- p$ 1.15 GeV/c
0.17		SMITH	63	HBC	-0	

$\Gamma(\Sigma\pi\pi)/\Gamma(\Sigma\pi)$						$\Gamma_5/\Gamma_3$
<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>	
largest at small angles		ESTES	74	HBC	0	$K^- p$ 2.1,2.6 GeV/c
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<0.2		<sup>2</sup> HEPP	76	DBC	-	$K^- N$ 1.6-1.75 GeV/c
0.56	180	ALVAREZ	63	HBC	+	$K^- p$ 1.15 GeV/c

$\Gamma(\Lambda(1405)\pi)/\Gamma(\Sigma\pi)$						$\Gamma_7/\Gamma_3$
<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>	
$1.8 \pm 0.3$ to $0.02 \pm 0.07$		<sup>3,4</sup> TIMMERMANS76		HBC	+	$K^- p$ 4.2 GeV/c
largest at small angles		ESTES	74	HBC	$\pm$	$K^- p$ 2.1,2.6 GeV/c
$3.0 \pm 1.6$	50	LONDON	66	HBC	+	$K^- p$ 2.25 GeV/c
• • • We do not use the following data for averages, fits, limits, etc. • • •						
$0.58 \pm 0.20$	17	PRIMER	68	HBC	+	See BARNES 69E

$\Gamma(\Sigma\pi)/\Gamma(\Sigma\pi\pi)$						$\Gamma_3/\Gamma_5$
<u>VALUE</u>		<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>	
varies with prod. angle		<sup>5</sup> APSELL	74	HBC	+	$K^- p$ 2.87 GeV/c
$1.39 \pm 0.16$		BERTHON	74	HBC	0	Quasi-2-body $\sigma$
2.5 to 0.24		<sup>4</sup> EBERHARD	69	HBC		$K^- p$ 2.6 GeV/c
<0.4		BIRMINGHAM	66	HBC	+	$K^- p$ 3.5 GeV/c
$0.30 \pm 0.15$		LONDON	66	HBC	+	$K^- p$ 2.25 GeV/c

$\Gamma(\Lambda(1405)\pi)/\Gamma(\Sigma\pi\pi)$						$\Gamma_7/\Gamma_5$
<u>VALUE</u>		<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>	
$0.97 \pm 0.08$		TIMMERMANS76		HBC		$K^- p$ 4.2 GeV/c
$1.00 \pm 0.02$		APSELL	74	HBC		$K^- p$ 2.87 GeV/c
$0.90^{+0.10}_{-0.16}$		EBERHARD	65	HBC	+	$K^- p$ 2.45 GeV/c

$\Gamma(\Lambda(1405)\pi)/\Gamma(\Sigma(1385)\pi)$						$\Gamma_7/\Gamma_6$
<u>VALUE</u>		<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>	
<0.8		EBERHARD	65	HBC	+	$K^- p$ 2.45 GeV/c

$\Gamma(\Lambda\pi\pi)/\Gamma(\Sigma\pi\pi)$	$\Gamma_4/\Gamma_5$			
<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>
$0.35 \pm 0.2$	BIRMINGHAM 66	HBC	+	$K^- p$ 3.5 GeV/c

  

$\Gamma(\Lambda\pi)/\Gamma(\Sigma\pi\pi)$	$\Gamma_2/\Gamma_5$			
<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>
$< 0.2$	BIRMINGHAM 66	HBC	+	$K^- p$ 3.5 GeV/c

  

$\Gamma(\Lambda\pi)/[\Gamma(\Lambda\pi) + \Gamma(\Sigma\pi)]$	$\Gamma_2/(\Gamma_2 + \Gamma_3)$			
<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>
$< 0.6$	AGUILAR-... 70B	HBC		

  

$\Gamma(\Sigma(1385)\pi)/\Gamma(\Sigma\pi)$	$\Gamma_6/\Gamma_3$			
<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>
$\leq 0.21 \pm 0.05$	TIMMERMANS76	HBC		$K^- p$ 4.2 GeV/c

### $\Sigma(1670)$ QUANTUM NUMBERS (PRODUCTION EXPERIMENTS)

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>
$J^P = 3/2^-$	400	BUTTON-...	68	HBC	$\pm \Sigma^0 \pi$
$J^P = 3/2^-$		EBERHARD	67	HBC	$+$ $\Lambda(1405)\pi$
$J^P = 3/2^+$		LEVEQUE	65	HBC	$\Lambda(1405)\pi$

### $\Sigma(1670)$ FOOTNOTES

- <sup>1</sup> Total cross-section bump with  $(J+1/2) \Gamma_{el} / \Gamma_{total} = 0.23$ .
- <sup>2</sup> Enhancements in  $\Sigma\pi$  and  $\Sigma\pi\pi$  cross sections.
- <sup>3</sup> Backward production in the  $\Lambda\pi^- K^+$  final state.
- <sup>4</sup> Depending on production angle.
- <sup>5</sup> APSELL 74, ESTES 74, and TIMMERMANS 76 find strong branching ratio dependence on production angle, as in earlier production experiments.

### $\Sigma(1670)$ REFERENCES (PRODUCTION EXPERIMENTS)

FERRERSORIA 81	NP B178 373	A. Ferrer Soria <i>et al.</i>	(CERN, CDEF, EPOL+)
CARROLL 76	PRL 37 806	A.S. Carroll <i>et al.</i>	(BNL) I
HEPP 76	NP B115 82	V. Hepp <i>et al.</i>	(CERN, HEID, MPIM) I
TIMMERMANS 76	NP B112 77	J.J.M. Timmermans <i>et al.</i>	(NIJM, CERN+) JP
APSELL 74	PR D10 1419	S.P. Apsell <i>et al.</i>	(BRAN, UMD, SYRA+) I
BERTHON 74	NC 21A 146	A. Berthon <i>et al.</i>	(CDEF, RHEL, SACL+)
ESTES 74	Thesis LBL-3827	R.D. Estes	(LBL)
AGUILAR-... 70B	PRL 25 58	M. Aguilar-Benitez <i>et al.</i>	(BNL, SYRA)
BARNES 69E	BNL 13823	V.E. Barnes <i>et al.</i>	(BNL, SYRA)
EBERHARD 69	PRL 22 200	P.H. Eberhard <i>et al.</i>	(LRL)
HUWE 69	PR 180 1824	D.O. Huwe	(LRL)
BUGG 68	PR 168 1466	D.V. Bugg <i>et al.</i>	(RHEL, BIRM, CAVE) I
BUTTON-... 68	PRL 21 1123	J. Button-Shafer	(MASA, LRL) JP
PRIMER 68	PRL 20 610	M. Primer <i>et al.</i>	(SYRA, BNL)
EBERHARD 67	PR 163 1446	P. Eberhard <i>et al.</i>	(LRL, ILL) IJP

BIRMINGHAM	66	PR 152 1148	M. Haque <i>et al.</i>	(BIRM, GLAS, LOIC, OXF+)
LONDON	66	PR 143 1034	G.W. London <i>et al.</i>	(BNL, SYRA) IJ
EBERHARD	65	PRL 14 466	P.H. Eberhard <i>et al.</i>	(LRL, ILL) I
LEVEQUE	65	PL 18 69	A. Leveque <i>et al.</i>	(SACL, EPOL, GLAS+) JP
ALVAREZ	63	PRL 10 184	L.W. Alvarez <i>et al.</i>	(LRL) I
SMITH	63	Athens Conf. 67	G.A. Smith	(LRL)
ALEXANDER	62C	CERN Conf. 320	G. Alexander <i>et al.</i>	(LRL) I

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