# $a_1(1260)$

$I^G(J^{PC}) = 1^-(1^{++})$

See also our review under the $a_1(1260)$ in PDG 06, Journal of Physics, G **33** 1 (2006).

## $a_1(1260)$ MASS

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **1230±40 OUR ESTIMATE** | | | | | |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| $1243 \pm 12 \pm 20$ | | [1] AUBERT | 07AU | BABR | 10.6 $e^+e^- \to \rho^0\rho^\pm\pi^\mp\gamma$ |
| 1230–1270 | 6360 | [2] LINK | 07A | FOCS | $D^0 \to \pi^-\pi^+\pi^-\pi^+$ |
| $1203 \pm 3$ | | [3] GOMEZ-DUM... | 04 | RVUE | $\tau^+ \to \pi^+\pi^+\pi^-\nu_\tau$ |
| $1330 \pm 24$ | 90k | SALVINI | 04 | OBLX | $\overline{p}p \to 2\pi^+2\pi^-$ |
| $1331 \pm 10 \pm 3$ | 37k | [4] ASNER | 00 | CLE2 | 10.6 $e^+e^- \to \tau^+\tau^-$, $\tau^- \to \pi^-\pi^0\pi^0\nu_\tau$ |
| $1255 \pm 7 \pm 6$ | 5904 | [5] ABREU | 98G | DLPH | $e^+e^-$ |
| $1207 \pm 5 \pm 8$ | 5904 | [6] ABREU | 98G | DLPH | $e^+e^-$ |
| $1196 \pm 4 \pm 5$ | 5904 | [7,8] ABREU | 98G | DLPH | $e^+e^-$ |
| $1240 \pm 10$ | | BARBERIS | 98B | | 450 $pp \to p_f\pi^+\pi^-\pi^0 p_s$ |
| $1262 \pm 9 \pm 7$ | | [5,9] ACKERSTAFF | 97R | OPAL | $E^{ee}_{cm}$= 88–94, $\tau \to 3\pi\nu$ |
| $1210 \pm 7 \pm 2$ | | [6,9] ACKERSTAFF | 97R | OPAL | $E^{ee}_{cm}$= 88–94, $\tau \to 3\pi\nu$ |
| $1211 \pm 7^{+50}_{-0}$ | | [6] ALBRECHT | 93C | ARG | $\tau^+ \to \pi^+\pi^+\pi^-\nu$ |
| $1121 \pm 8$ | | [10] ANDO | 92 | SPEC | 8 $\pi^-p \to \pi^+\pi^-\pi^0 n$ |
| $1242 \pm 37$ | | [11] IVANOV | 91 | RVUE | $\tau \to \pi^+\pi^+\pi^-\nu$ |
| $1260 \pm 14$ | | [12] IVANOV | 91 | RVUE | $\tau \to \pi^+\pi^+\pi^-\nu$ |
| $1250 \pm 9$ | | [13] IVANOV | 91 | RVUE | $\tau \to \pi^+\pi^+\pi^-\nu$ |
| $1208 \pm 15$ | | ARMSTRONG | 90 | OMEG | 300.0$pp \to pp\pi^+\pi^-\pi^0$ |
| $1220 \pm 15$ | | [14] ISGUR | 89 | RVUE | $\tau^+ \to \pi^+\pi^+\pi^-\nu$ |
| $1260 \pm 25$ | | [15] BOWLER | 88 | RVUE | |
| $1166 \pm 18 \pm 11$ | | BAND | 87 | MAC | $\tau^+ \to \pi^+\pi^+\pi^-\nu$ |
| $1164 \pm 41 \pm 23$ | | BAND | 87 | MAC | $\tau^+ \to \pi^+\pi^0\pi^0\nu$ |
| $1250 \pm 40$ | | [14] TORNQVIST | 87 | RVUE | |
| $1046 \pm 11$ | | ALBRECHT | 86B | ARG | $\tau^+ \to \pi^+\pi^+\pi^-\nu$ |
| $1056 \pm 20 \pm 15$ | | RUCKSTUHL | 86 | DLCO | $\tau^+ \to \pi^+\pi^+\pi^-\nu$ |
| $1194 \pm 14 \pm 10$ | | SCHMIDKE | 86 | MRK2 | $\tau^+ \to \pi^+\pi^+\pi^-\nu$ |
| $1255 \pm 23$ | | BELLINI | 85 | SPEC | 40 $\pi^-A \to \pi^-\pi^+\pi^-A$ |
| $1240 \pm 80$ | | [16] DANKOWY... | 81 | SPEC | 8.45 $\pi^-p \to n3\pi$ |
| $1280 \pm 30$ | | [16] DAUM | 81B | CNTR | 63,94 $\pi^-p \to p3\pi$ |
| $1041 \pm 13$ | | [17] GAVILLET | 77 | HBC | 4.2 $K^-p \to \Sigma 3\pi$ |

[1] The $\rho^\pm\pi^\mp$ state can be also due to the $\pi(1300)$.

[2] Using the Breit-Wigner parameterization; strong correlation between mass and width.

[3] Using the data of BARATE 98R.

[4] From a fit to the $3\pi$ mass spectrum including the $K\overline{K}^*(892)$ threshold.

[5] Uses the model of KUHN 90.

[6] Uses the model of ISGUR 89.

[7] Includes the effect of a possible $a_1'$ state.

[8] Uses the model of FEINDT 90.
[9] Supersedes AKERS 95P.
[10] Average and spread of values using 2 variants of the model of BOWLER 75.
[11] Reanalysis of RUCKSTUHL 86.
[12] Reanalysis of SCHMIDKE 86.
[13] Reanalysis of ALBRECHT 86B.
[14] From a combined reanalysis of ALBRECHT 86B, SCHMIDKE 86, and RUCKSTUHL 86.
[15] From a combined reanalysis of ALBRECHT 86B and DAUM 81B.
[16] Uses the model of BOWLER 75.
[17] Produced in $K^-$ backward scattering.

## $a_1$(1260) WIDTH

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **250 to 600 OUR ESTIMATE** | | | | | |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| $410\pm 31\pm 30$ | | [18] AUBERT | 07AU | BABR | $10.6\ e^+e^- \to \rho^0\rho^\pm\pi^\mp\gamma$ |
| 520–680 | 6360 | [19] LINK | 07A | FOCS | $D^0 \to \pi^-\pi^+\pi^-\pi^+$ |
| $480\pm 20$ | | [20] GOMEZ-DUM... | 04 | RVUE | $\tau^+ \to \pi^+\pi^+\pi^-\nu_\tau$ |
| $580\pm 41$ | 90k | SALVINI | 04 | OBLX | $\overline{p}p \to 2\pi^+2\pi^-$ |
| $460\pm 85$ | 205 | [21] DRUTSKOY | 02 | BELL | $B \to D^{(*)}K^-K^{*0}$ |
| $814\pm 36\pm 13$ | 37k | [22] ASNER | 00 | CLE2 | $10.6\ e^+e^- \to \tau^+\tau^-$, $\tau^- \to \pi^-\pi^0\pi^0\nu_\tau$ |
| $450\pm 50$ | 22k | [23] AKHMETSHIN | 99E | CMD2 | $1.05–1.38\ e^+e^- \to \pi^+\pi^-\pi^0\pi^0$ |
| $570\pm 10$ | | [24] BONDAR | 99 | RVUE | $e^+e^- \to 4\pi$, $\tau \to 3\pi\nu_\tau$ |
| $587\pm 27\pm 21$ | 5904 | [25] ABREU | 98G | DLPH | $e^+e^-$ |
| $478\pm 3\pm 15$ | 5904 | [26] ABREU | 98G | DLPH | $e^+e^-$ |
| $425\pm 14\pm 8$ | 5904 | [27,28] ABREU | 98G | DLPH | $e^+e^-$ |
| $400\pm 35$ | | BARBERIS | 98B | | $450\ pp \to p_f\pi^+\pi^-\pi^0 p_s$ |
| $621\pm 32\pm 58$ | | [25,29] ACKERSTAFF | 97R | OPAL | $E^{ee}_{cm}$= 88–94, $\tau \to 3\pi\nu$ |
| $457\pm 15\pm 17$ | | [26,29] ACKERSTAFF | 97R | OPAL | $E^{ee}_{cm}$= 88–94, $\tau \to 3\pi\nu$ |
| $446\pm 21^{+140}_{-0}$ | | [26] ALBRECHT | 93C | ARG | $\tau^+ \to \pi^+\pi^+\pi^-\nu$ |
| $239\pm 11$ | | ANDO | 92 | SPEC | $8\ \pi^-p \to \pi^+\pi^-\pi^0 n$ |
| $266\pm 13\pm 4$ | | [30] ANDO | 92 | SPEC | $8\ \pi^-p \to \pi^+\pi^-\pi^0 n$ |
| $465^{+228}_{-143}$ | | [31] IVANOV | 91 | RVUE | $\tau \to \pi^+\pi^+\pi^-\nu$ |
| $298^{+40}_{-34}$ | | [32] IVANOV | 91 | RVUE | $\tau \to \pi^+\pi^+\pi^-\nu$ |
| $488\pm 32$ | | [33] IVANOV | 91 | RVUE | $\tau \to \pi^+\pi^+\pi^-\nu$ |
| $430\pm 50$ | | ARMSTRONG | 90 | OMEG | $300.0 pp \to pp\pi^+\pi^-\pi^0$ |
| $420\pm 40$ | | [34] ISGUR | 89 | RVUE | $\tau^+ \to \pi^+\pi^+\pi^-\nu$ |
| $396\pm 43$ | | [35] BOWLER | 88 | RVUE | |
| $405\pm 75\pm 25$ | | BAND | 87 | MAC | $\tau^+ \to \pi^+\pi^+\pi^-\nu$ |
| $419\pm 108\pm 57$ | | BAND | 87 | MAC | $\tau^+ \to \pi^+\pi^0\pi^0\nu$ |
| $521\pm 27$ | | ALBRECHT | 86B | ARG | $\tau^+ \to \pi^+\pi^+\pi^-\nu$ |
| $476^{+132}_{-120}\pm 54$ | | RUCKSTUHL | 86 | DLCO | $\tau^+ \to \pi^+\pi^+\pi^-\nu$ |

| | | | | |
|---|---|---|---|---|
| 462± 56± 30 | SCHMIDKE | 86 | MRK2 | $\tau^+ \rightarrow \pi^+\pi^+\pi^-\nu$ |
| 292± 40 | BELLINI | 85 | SPEC | 40 $\pi^- A \rightarrow \pi^-\pi^+\pi^- A$ |
| 380±100 | [36] DANKOWY... | 81 | SPEC | 8.45 $\pi^- p \rightarrow n 3\pi$ |
| 300± 50 | [36] DAUM | 81B | CNTR | 63,94 $\pi^- p \rightarrow p 3\pi$ |
| 230± 50 | [37] GAVILLET | 77 | HBC | 4.2 $K^- p \rightarrow \Sigma 3\pi$ |

[18] The $\rho^\pm\pi^\mp$ state can be also due to the $\pi(1300)$.
[19] Using the Breit-Wigner parameterization; strong correlation between mass and width.
[20] Using the data of BARATE 98R.
[21] From a fit of the $K^- K^{*0}$ distribution assuming $m_{a_1}$= 1230 MeV and purely resonant production of the $K^- K^{*0}$ system.
[22] From a fit to the $3\pi$ mass spectrum including the $K\overline{K}^*(892)$ threshold.
[23] Using the $a_1(1260)$ mass of 1230 MeV.
[24] From AKHMETSHIN 99E and ASNER 00 data using the $a_1(1260)$ mass of 1230 MeV.
[25] Uses the model of KUHN 90.
[26] Uses the model of ISGUR 89.
[27] Includes the effect of a possible $a_1'$ state.
[28] Uses the model of FEINDT 90.
[29] Supersedes AKERS 95P.
[30] Average and spread of values using 2 variants of the model of BOWLER 75.
[31] Reanalysis of RUCKSTUHL 86.
[32] Reanalysis of SCHMIDKE 86.
[33] Reanalysis of ALBRECHT 86B.
[34] From a combined reanalysis of ALBRECHT 86B, SCHMIDKE 86, and RUCKSTUHL 86.
[35] From a combined reanalysis of ALBRECHT 86B and DAUM 81B.
[36] Uses the model of BOWLER 75.
[37] Produced in $K^-$ backward scattering.

## $a_1(1260)$ DECAY MODES

| | Mode | Fraction ($\Gamma_i/\Gamma$) |
|---|---|---|
| $\Gamma_1$ | $\pi^+\pi^-\pi^0$ | |
| $\Gamma_2$ | $\pi^0\pi^0\pi^0$ | |
| $\Gamma_3$ | $(\rho\pi)_{S-\text{wave}}$ | seen |
| $\Gamma_4$ | $(\rho\pi)_{D-\text{wave}}$ | seen |
| $\Gamma_5$ | $(\rho(1450)\pi)_{S-\text{wave}}$ | seen |
| $\Gamma_6$ | $(\rho(1450)\pi)_{D-\text{wave}}$ | seen |
| $\Gamma_7$ | $\sigma\pi$ | seen |
| $\Gamma_8$ | $f_0(980)\pi$ | not seen |
| $\Gamma_9$ | $f_0(1370)\pi$ | seen |
| $\Gamma_{10}$ | $f_2(1270)\pi$ | seen |
| $\Gamma_{11}$ | $K\overline{K}^*(892)$+ c.c. | seen |
| $\Gamma_{12}$ | $\pi\gamma$ | seen |

## $a_1(1260)$ PARTIAL WIDTHS

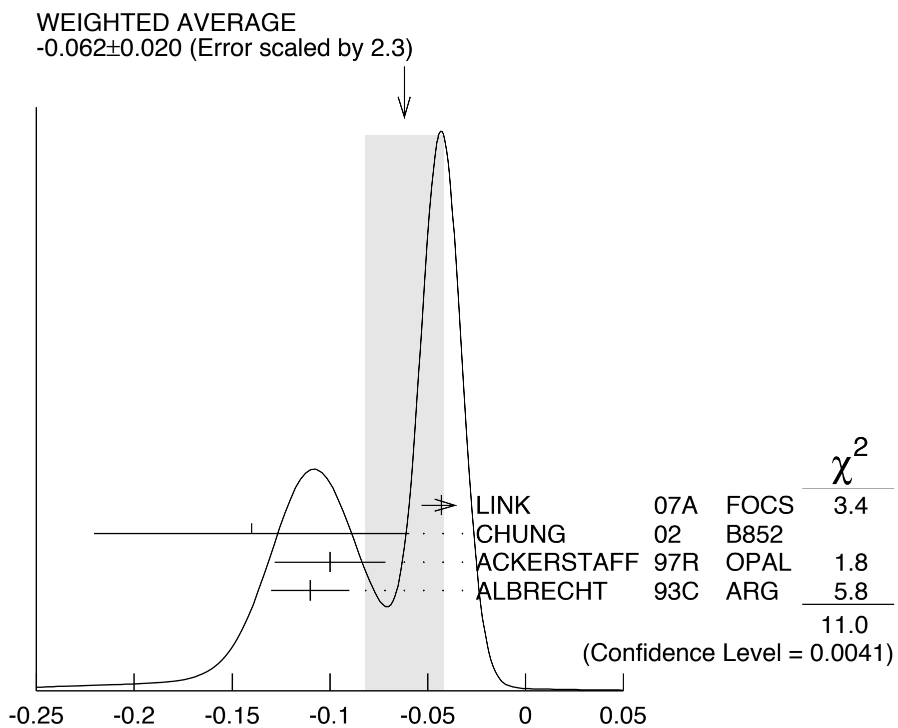
### $\Gamma(\pi\gamma)$ $\Gamma_{12}$

| *VALUE* (keV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **640±246** | ZIELINSKI | 84C | SPEC | 200 $\pi^+ Z \rightarrow Z 3\pi$ |

## *D*-wave/*S*-wave AMPLITUDE RATIO IN DECAY OF $a_1(1260) \rightarrow \rho\pi$

| *VALUE* | | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| **−0.062±0.020 OUR AVERAGE** Error includes scale factor of 2.3. See the ideogram below. | | | | | |
| −0.043±0.009±0.005 | | LINK | 07A | FOCS | $D^0 \rightarrow \pi^-\pi^+\pi^-\pi^+$ |
| −0.14 ±0.04 ±0.07 | [38] | CHUNG | 02 | B852 | 18.3 $\pi^- p \rightarrow \pi^+\pi^-\pi^- p$ |
| −0.10 ±0.02 ±0.02 | [39,40] | ACKERSTAFF | 97R | OPAL | $E^{ee}_{cm}$= 88–94, $\tau \rightarrow 3\pi\nu$ |
| −0.11 ±0.02 | [39] | ALBRECHT | 93C | ARG | $\tau^+ \rightarrow \pi^+\pi^+\pi^-\nu$ |

[38] Deck-type background not subtracted.
[39] Uses the model of ISGUR 89.
[40] Supersedes AKERS 95P.




*D*-wave/*S*-wave AMPLITUDE RATIO IN DECAY OF $a_1(1260) \rightarrow \rho\pi$

## $a_1(1260)$ BRANCHING RATIOS

### $\Gamma((\rho\pi)_{S-\mathrm{wave}})/\Gamma_{\mathrm{total}}$ $\Gamma_3/\Gamma$

| *VALUE* (units $10^{-2}$) | *EVTS* | | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | | |
| 60.19 | 37k | [41] | ASNER | 00 | CLE2 | 10.6 $e^+e^- \rightarrow \tau^+\tau^-$, $\tau^- \rightarrow \pi^-\pi^0\pi^0\nu_\tau$ |

## $\Gamma((\rho\pi)_{D\text{-wave}})/\Gamma_{total}$ — $\Gamma_4/\Gamma$

| VALUE (units $10^{-2}$) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| $1.30\pm0.60\pm0.22$ | 37k | [41] ASNER | 00 | CLE2 | 10.6 $e^+e^- \to \tau^+\tau^-$, $\tau^- \to \pi^-\pi^0\pi^0\nu_\tau$ |

## $\Gamma((\rho(1450)\pi)_{S\text{-wave}})/\Gamma_{total}$ — $\Gamma_5/\Gamma$

| VALUE (units $10^{-2}$) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| $0.56\pm0.84\pm0.32$ | 37k | [41,42] ASNER | 00 | CLE2 | 10.6 $e^+e^- \to \tau^+\tau^-$, $\tau^- \to \pi^-\pi^0\pi^0\nu_\tau$ |

## $\Gamma((\rho(1450)\pi)_{D\text{-wave}})/\Gamma_{total}$ — $\Gamma_6/\Gamma$

| VALUE (units $10^{-2}$) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| $2.04\pm1.20\pm0.28$ | 37k | [41,42] ASNER | 00 | CLE2 | 10.6 $e^+e^- \to \tau^+\tau^-$, $\tau^- \to \pi^-\pi^0\pi^0\nu_\tau$ |

## $\Gamma(\sigma\pi)/\Gamma_{total}$ — $\Gamma_7/\Gamma$

| VALUE (units $10^{-2}$) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| seen | | CHUNG | 02 | B852 | 18.3 $\pi^- p \to \pi^+\pi^-\pi^- p$ |
| $18.76\pm4.29\pm1.48$ | 37k | [41,43] ASNER | 00 | CLE2 | 10.6 $e^+e^- \to \tau^+\tau^-$, $\tau^- \to \pi^-\pi^0\pi^0\nu_\tau$ |

## $\Gamma(f_0(980)\pi)/\Gamma_{total}$ — $\Gamma_8/\Gamma$

| VALUE (units $10^{-2}$) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| not seen | 37k | ASNER | 00 | CLE2 | 10.6 $e^+e^- \to \tau^+\tau^-$, $\tau^- \to \pi^-\pi^0\pi^0\nu_\tau$ |

## $\Gamma(f_0(1370)\pi)/\Gamma_{total}$ — $\Gamma_9/\Gamma$

| VALUE (units $10^{-2}$) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| $7.40\pm2.71\pm1.26$ | 37k | [41,44] ASNER | 00 | CLE2 | 10.6 $e^+e^- \to \tau^+\tau^-$, $\tau^- \to \pi^-\pi^0\pi^0\nu_\tau$ |

## $\Gamma(f_2(1270)\pi)/\Gamma_{total}$ — $\Gamma_{10}/\Gamma$

| VALUE (units $10^{-2}$) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| $1.19\pm0.49\pm0.17$ | 37k | [41,45] ASNER | 00 | CLE2 | 10.6 $e^+e^- \to \tau^+\tau^-$, $\tau^- \to \pi^-\pi^0\pi^0\nu_\tau$ |

### $\Gamma(K\overline{K}^*(892)+\text{c.c.})/\Gamma_{\text{total}}$ $\Gamma_{11}/\Gamma$

| VALUE (units $10^{-2}$) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| $2.2\pm0.5$ | 2255 | [46] COAN | 04 | CLEO | $\tau^- \to K^-\pi^-K^+\nu_\tau$ |
| 8 to 15 | 205 | [47] DRUTSKOY | 02 | BELL | $B \to D^{(*)}K^-K^{*0}$ |
| $3.3\pm0.5\pm0.1$ | 37k | [48] ASNER | 00 | CLE2 | $10.6\ e^+e^- \to \tau^+\tau^-$, $\tau^- \to \pi^-\pi^0\pi^0\nu_\tau$ |
| $2.6\pm0.3$ | | [49] BARATE | 99R | ALEP | $\tau \to K\overline{K}\pi\nu_\tau$ |

### $\Gamma(\sigma\pi)/\Gamma((\rho\pi)_{S-\text{wave}})$ $\Gamma_7/\Gamma_3$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| $0.06\ \pm0.05$ | 90k | SALVINI | 04 | OBLX | $\overline{p}p \to 2\pi^+2\pi^-$ |
| $\sim 0.3$ | 28k | AKHMETSHIN | 99E | CMD2 | 1.05–1.38 $e^+e^- \to \pi^+\pi^-\pi^+\pi^-$ |
| $0.003\pm0.003$ | | [50] LONGACRE | 82 | RVUE | |

### $\Gamma(\pi^0\pi^0\pi^0)/\Gamma(\pi^+\pi^-\pi^0)$ $\Gamma_2/\Gamma_1$

| VALUE | CL% | DOCUMENT ID | | COMMENT |
|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| $<0.008$ | 90 | [51] BARBERIS | 01 | 450 $pp \to p_f 3\pi^0 p_s$ |

[41] From a fit to the Dalitz plot.
[42] Assuming for $\rho(1450)$ mass and width of 1370 and 386 MeV respectively.
[43] Assuming for $\sigma$ mass and width of 860 and 880 MeV respectively.
[44] Assuming for $f_0(1370)$ mass and width of 1186 and 350 MeV respectively.
[45] Assuming for $f_2(1270)$ mass and width of 1275 and 185 MeV respectively.
[46] Using structure functions from KUHN 92 and DECKER 93A and B($\tau^- \to K^-\pi^-K^+\nu_\tau$) = (0.155 ± 0.006 ± 0.009)% from BRIERE 03.
[47] From a comparison to ALAM 94 assuming purely resonant production of the $K^-K^{*0}$ system.
[48] From a fit to the $3\pi$ mass spectrum including the $K\overline{K}^*(892)$ threshold.
[49] Assuming $a_1(1260)$ dominance and taking B($\tau \to a_1(1260)\nu_\tau$) from BUSKULIC 96.
[50] Uses multichannel Aitchison-Bowler model (BOWLER 75). Uses data from GAVILLET 77, DAUM 80, and DANKOWYCH 81.
[51] Inconsistent with observations of $\sigma\pi$, $f_0(1370)\pi$, and $f_2(1270)\pi$ decay modes.

## $a_1(1260)$ REFERENCES


| | | | | |
|---|---|---|---|---|
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| | | | | |
|---|---|---|---|---|
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| | | Translated from YAF 41 1223. | | |
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| LONGACRE | 82 | PR D26 82 | R.S. Longacre | (BNL) |
| DANKOWY... | 81 | PRL 46 580 | J.A. Dankowych *et al.* | (TNTO, BNL, CARL+) |
| DAUM | 81B | NP B182 269 | C. Daum *et al.* | (AMST, CERN, CRAC, MPIM+) |
| DAUM | 80 | PL 89B 281 | C. Daum *et al.* | (AMST, CERN, CRAC, MPIM+) JP |
| GAVILLET | 77 | PL 69B 119 | P. Gavillet *et al.* | (AMST, CERN, NIJM+) JP |
| BOWLER | 75 | NP B97 227 | M.G. Bowler *et al.* | (OXFTP, DARE) |