

**$\rho(2150)$** 

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

OMITTED FROM SUMMARY TABLE

This entry was previously called  $T_1(2190)$ . See our mini-review under the  $\rho(1700)$ . **$\rho(2150)$  MASS** **$e^+e^-$  PRODUCED**

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
$2254 \pm 22$	<sup>1</sup> LEES	12G BABR	$e^+e^- \rightarrow \pi^+\pi^-\gamma$
$2150 \pm 40 \pm 50$	AUBERT	07AU BABR	$10.6 e^+e^- \rightarrow f_1(1285)\pi^+\pi^-\gamma$
$1990 \pm 80$	AUBERT	07AU BABR	$10.6 e^+e^- \rightarrow \eta'\pi^+\pi^-\gamma$
$2153 \pm 37$	BIAGINI	91 RVUE	$e^+e^- \rightarrow \pi^+\pi^-, K^+K^-$
$2110 \pm 50$	<sup>2</sup> CLEGG	90 RVUE	$e^+e^- \rightarrow 3(\pi^+\pi^-), 2(\pi^+\pi^-\pi^0)$

 **$\bar{p}p \rightarrow \pi\pi$** 

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
$\sim 2191$	HASAN	94 RVUE	$\bar{p}p \rightarrow \pi\pi$
$\sim 2070$	<sup>3</sup> OAKDEN	94 RVUE	$0.36\text{--}1.55 \bar{p}p \rightarrow \pi\pi$
$\sim 2170$	<sup>4</sup> MARTIN	80B RVUE	
$\sim 2100$	<sup>4</sup> MARTIN	80C RVUE	

**S-CHANNEL  $\bar{N}N$** 

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
$2110 \pm 35$	<sup>5</sup> ANISOVICH	02 SPEC	$0.6\text{--}1.9 p\bar{p} \rightarrow \omega\pi^0, \omega\eta\pi^0, \pi^+\pi^-$
$\sim 2190$	<sup>6</sup> CUTTS	78B CNTR	$0.97\text{--}3 \bar{p}p \rightarrow \bar{N}N$
$2155 \pm 15$	<sup>6,7</sup> COUPLAND	77 CNTR	$0.7\text{--}2.4 \bar{p}p \rightarrow \bar{p}p$
$2193 \pm 2$	<sup>6,8</sup> ALSPECTOR	73 CNTR	$\bar{p}p$ S channel
$2190 \pm 10$	<sup>9</sup> ABRAMS	70 CNTR	S channel $\bar{p}N$

 **$\pi^-p \rightarrow \omega\pi^0n$** 

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
$2140 \pm 30$	ALDE	95 GAM2	$38 \pi^-p \rightarrow \omega\pi^0n$
$2170 \pm 30$	ALDE	92C GAM4	$100 \pi^-p \rightarrow \omega\pi^0n$

<sup>1</sup> Using the GOUNARIS 68 parametrization of the pion form factor leaving the masses and widths of the  $\rho(1450)$ ,  $\rho(1700)$ , and  $\rho(2150)$  resonances as free parameters of the fit.<sup>2</sup> Includes ATKINSON 85.<sup>3</sup> See however KLOET 96 who fit  $\pi^+\pi^-$  only and find waves only up to  $J = 3$  to be important but not significantly resonant.<sup>4</sup>  $I(J^P) = 1(1^-)$  from simultaneous analysis of  $p\bar{p} \rightarrow \pi^-\pi^+$  and  $\pi^0\pi^0$ .<sup>5</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02.<sup>6</sup> Isospins 0 and 1 not separated.<sup>7</sup> From a fit to the total elastic cross section.

<sup>8</sup> Referred to as  $T$  or  $T$  region by ALSPECTOR 73.

<sup>9</sup> Seen as bump in  $l = 1$  state. See also COOPER 68. PEASLEE 75 confirm  $\bar{p}p$  results of ABRAMS 70, no narrow structure.

## $\rho(2150)$ WIDTH

### $e^+e^-$ PRODUCED

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
$109 \pm 76$	<sup>10</sup> LEES	12G BABR	$e^+e^- \rightarrow \pi^+\pi^-\gamma$
$350 \pm 40 \pm 50$	AUBERT	07AU BABR	$10.6 e^+e^- \rightarrow f_1(1285)\pi^+\pi^-\gamma$
$310 \pm 140$	AUBERT	07AU BABR	$10.6 e^+e^- \rightarrow \eta'\pi^+\pi^-\gamma$
$389 \pm 79$	BIAGINI	91 RVUE	$e^+e^- \rightarrow \pi^+\pi^-, K^+K^-$
$410 \pm 100$	<sup>11</sup> CLEGG	90 RVUE	$e^+e^- \rightarrow 3(\pi^+\pi^-), 2(\pi^+\pi^-\pi^0)$

### $\bar{p}p \rightarrow \pi\pi$

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
$\sim 296$	HASAN	94 RVUE	$\bar{p}p \rightarrow \pi\pi$
$\sim 40$	<sup>12</sup> OAKDEN	94 RVUE	$0.36\text{--}1.55 \bar{p}p \rightarrow \pi\pi$
$\sim 250$	<sup>13</sup> MARTIN	80B RVUE	
$\sim 200$	<sup>13</sup> MARTIN	80C RVUE	

### S-CHANNEL $\bar{N}N$

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
$230 \pm 50$	<sup>14</sup> ANISOVICH	02 SPEC	$0.6\text{--}1.9 p\bar{p} \rightarrow \omega\pi^0, \omega\eta\pi^0, \pi^+\pi^-$
$135 \pm 75$	<sup>15,16</sup> COUPLAND	77 CNTR	$0.7\text{--}2.4 \bar{p}p \rightarrow \bar{p}p$
$98 \pm 8$	<sup>16</sup> ALSPECTOR	73 CNTR	$\bar{p}p$ S channel
$\sim 85$	<sup>17</sup> ABRAMS	70 CNTR	S channel $\bar{p}N$

### $\pi^-p \rightarrow \omega\pi^0n$

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
$320 \pm 70$	ALDE	95 GAM2	$38 \pi^-p \rightarrow \omega\pi^0n$
$\sim 300$	ALDE	92C GAM4	$100 \pi^-p \rightarrow \omega\pi^0n$

<sup>10</sup> Using the GOUNARIS 68 parametrization of the pion form factor leaving the masses and widths of the  $\rho(1450)$ ,  $\rho(1700)$ , and  $\rho(2150)$  resonances as free parameters of the fit.

<sup>11</sup> Includes ATKINSON 85.

<sup>12</sup> See however KLOET 96 who fit  $\pi^+\pi^-$  only and find waves only up to  $J = 3$  to be important but not significantly resonant.

<sup>13</sup>  $J(J^P) = 1(1^-)$  from simultaneous analysis of  $p\bar{p} \rightarrow \pi^-\pi^+$  and  $\pi^0\pi^0$ .

<sup>14</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02.

<sup>15</sup> From a fit to the total elastic cross section.

<sup>16</sup> Isospins 0 and 1 not separated.

<sup>17</sup> Seen as bump in  $l = 1$  state. See also COOPER 68. PEASLEE 75 confirm  $\bar{p}p$  results of ABRAMS 70, no narrow structure.

**$\rho(2150)$  DECAY MODES**

Mode	Fraction ( $\Gamma_i/\Gamma$ )
$\Gamma_1$ $e^+ e^-$	
$\Gamma_2$ $\pi^+ \pi^-$	seen
$\Gamma_3$ $K^+ K^-$	seen
$\Gamma_4$ $3(\pi^+ \pi^-)$	seen
$\Gamma_5$ $2(\pi^+ \pi^- \pi^0)$	seen
$\Gamma_6$ $\eta' \pi^+ \pi^-$	seen
$\Gamma_7$ $f_1(1285) \pi^+ \pi^-$	seen
$\Gamma_8$ $\omega \pi^0$	seen
$\Gamma_9$ $\omega \pi^0 \eta$	seen
$\Gamma_{10}$ $\rho \bar{\rho}$	

 **$\rho(2150) \Gamma(i)\Gamma(e^+ e^-)/\Gamma^2(\text{total})$** 

$$\Gamma(f_1(1285)\pi^+\pi^-)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \qquad \Gamma_7/\Gamma \times \Gamma_1/\Gamma$$

VALUE (units $10^{-7}$ )	DOCUMENT ID	TECN	COMMENT
<b><math>3.1 \pm 0.6 \pm 0.5</math></b>	<sup>18</sup> AUBERT	07AU BABR	$10.6 e^+ e^- \rightarrow f_1(1285) \pi^+ \pi^- \gamma$

<sup>18</sup> Calculated by us from the reported value of cross section at the peak.

$$\Gamma(\eta' \pi^+ \pi^-)/\Gamma_{\text{total}} \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \qquad \Gamma_6/\Gamma \times \Gamma_1/\Gamma$$

VALUE (units $10^{-8}$ )	DOCUMENT ID	TECN	COMMENT
$4.9 \pm 1.9$	<sup>19</sup> AUBERT	07AU BABR	$10.6 e^+ e^- \rightarrow \eta' \pi^+ \pi^- \gamma$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$4.9 \pm 1.9$  <sup>19</sup> AUBERT 07AU BABR  $10.6 e^+ e^- \rightarrow \eta' \pi^+ \pi^- \gamma$

<sup>19</sup> Calculated by us from the reported value of cross section at the peak.

 **$\rho(2150)$  REFERENCES**

LEES	12G PR D86 032013	J.P. Lees <i>et al.</i>	(BABAR Collab.)
AUBERT	07AU PR D76 092005	B. Aubert <i>et al.</i>	(BABAR Collab.)
ANISOVICH	02 PL B542 8	A.V. Anisovich <i>et al.</i>	
ANISOVICH	01D PL B508 6	A.V. Anisovich <i>et al.</i>	
ANISOVICH	01E PL B513 281	A.V. Anisovich <i>et al.</i>	
ANISOVICH	00J PL B491 47	A.V. Anisovich <i>et al.</i>	(RAL, LOQM, PNPI+)
KLOET	96 PR D53 6120	W.M. Kloet, F. Myhrer	(RUTG, NORD)
ALDE	95 ZPHY C66 379	D.M. Alde <i>et al.</i>	(GAMS Collab.) JP
HASAN	94 PL B334 215	A. Hasan, D.V. Bugg	(LOQM)
OAKDEN	94 NP A574 731	M.N. Oakden, M.R. Pennington	(DURH)
ALDE	92C ZPHY C54 553	D.M. Alde <i>et al.</i>	(BELG, SERP, KEK, LANL+)
BIAGINI	91 NC 104A 363	M.E. Biagini <i>et al.</i>	(FRAS, PRAG)
CLEGG	90 ZPHY C45 677	A.B. Clegg, A. Donnachie	(LANC, MCHS)
ATKINSON	85 ZPHY C29 333	M. Atkinson <i>et al.</i>	(BONN, CERN, GLAS+)
MARTIN	80B NP B176 355	B.R. Martin, D. Morgan	(LOUC, RHEL) JP
MARTIN	80C NP B169 216	A.D. Martin, M.R. Pennington	(DURH) JP
CUTTS	78B PR D17 16	D. Cutts <i>et al.</i>	(STON, WISC)
COUPLAND	77 PL 71B 460	M. Coupland <i>et al.</i>	(LOQM, RHEL)
PEASLEE	75 PL 57B 189	D.C. Peaslee <i>et al.</i>	(CANB, BARI, BROW+)
ALSPECTOR	73 PRL 30 511	J. Alspector <i>et al.</i>	(RUTG, UPNJ)
ABRAMS	70 PR D1 1917	R.J. Abrams <i>et al.</i>	(BNL)
COOPER	68 PRL 20 1059	W.A. Cooper <i>et al.</i>	(ANL)
GOUNARIS	68 PRL 21 244	G.J. Gounaris, J.J. Sakurai	