NODE=M032

$\rho(2150)$

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

OMITTED FROM SUMMARY TABLE

This entry was previously called $T_1(2190)$. See the review on "Spectroscopy of Light Meson Resonances."

NODE=M032

$\rho(2150)$ MASS

NODE=M032205

e^+e^- PRODUCED

NODE=M032M3

NODE=M032M3

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$2044 \pm 31 \pm 4$		[1] ABLIKIM 23BQ	BES3	$e^+e^- \rightarrow a_2(1320)^+\pi^- +$ c.c. $\rightarrow \eta\pi^+\pi^-$	
2095 ± 4		[2] ACHASOV 23A	SND	$e^+e^- \rightarrow \omega\pi^0$	
$2034 \pm 13 \pm 9$		[3] ABLIKIM 21A	BES3	$e^+e^- \rightarrow \omega\pi^0$	
$2111 \pm 43 \pm 25$		[4] ABLIKIM 21X	BES3	$e^+e^- \rightarrow \eta'\pi^+\pi^-$	
$2255 {}^{+17}_{-18} {}^{+50}_{-41}$	1.8k	[5] ABLIKIM 20F	BES3	$\psi(2S) \rightarrow K^+K^-\eta$	
2201 ± 19		[6] LEES 20	BABR	$e^+e^- \rightarrow K^+K^-\gamma$	
$2227 \pm 9 \pm 9$		[7] LEES 20	RVUE	$e^+e^- \rightarrow K^+K^-$	OCCUR=2
$2039 \pm 8 {}^{+36}_{-18}$		[8] ABLIKIM 19AQ	BES	$J/\psi \rightarrow K^+K^-\pi^0$	
$2239.2 \pm 7.1 \pm 11.3$		[9] ABLIKIM 19L	BES3	$e^+e^- \rightarrow K^+K^-$	
2254 ± 22		[10] 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 ± 80		AUBERT 07AU	BABR	$10.6\ e^+e^- \rightarrow \eta'\pi^+\pi^-\gamma$	OCCUR=2
2153 ± 37		BIAGINI 91	RVUE	$e^+e^- \rightarrow \pi^+\pi^-,\ K^+K^-$	
2110 ± 50		[11] CLEGG 90	RVUE	$e^+e^- \rightarrow 3(\pi^+\pi^-),\ 2(\pi^+\pi^-\pi^0)$	

[1] From a fit to the cross section between 2.00 and 3.08 GeV with a coherent sum of a Breit-Wigner resonance and a non-resonant contribution. Could be another state. NODE=M032M3;LINKAGE=J

[2] From a vector dominance fit to the Born cross section between 1.05 and 2.0 GeV with $\rho(770)$, $\rho(1570)$, $\rho(1700)$, $\rho(2150)$. The fit also uses SND data from the VEPP-2M collider below 1.02 GeV and from LEES 17H and ABLIKIM 21A above 1.5 GeV. NODE=M032M3;LINKAGE=K

[3] From a fit to the cross section between 2.00 and 3.08 GeV with a coherent sum of Breit-Wigner amplitudes, including contributions from $\rho(770)$, $\rho(1450)$ and $\rho(1700)$. Could be another state. NODE=M032M3;LINKAGE=G

[4] From a Breit-Wigner fit to the Born cross section, including an s-dependent continuum amplitude. NODE=M032M3;LINKAGE=H

[5] Seen in $\psi(2S)$ decay with branching ratio $\psi(2S) \rightarrow X\eta \rightarrow K^+K^-\eta = (21.7 \pm 1.9^{+7.7}_{-8.3}) \times 10^{-6}$. NODE=M032M3;LINKAGE=F

[6] From the fit to the BABAR data of LEES 13Q assuming a coherent sum of a single Breit-Wigner resonance and a nonresonant contribution. The resonance significance is 3.5 σ. NODE=M032M3;LINKAGE=C

[7] From the fit to the BABAR data of LEES 13Q and BESIII data of ABLIKIM 19L assuming a coherent sum of a single Breit-Wigner resonance and a nonresonant contribution. NODE=M032M3;LINKAGE=D

[8] Could also be another state. Seen in J/ψ decay with branching ratio $J/\psi \rightarrow X\pi^0 \rightarrow K^+K^-\pi^0 = (6.7 \pm 1.1^{+2.2}_{-1.8}) \times 10^{-6}$. NODE=M032M3;LINKAGE=B

[9] The observed structure can be due to both the $\phi(2170)$ and $\rho(2150)$. NODE=M032M3;LINKAGE=E

[10] 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. NODE=M032M3;LINKAGE=LE

[11] Includes ATKINSON 85. NODE=M032M3;LINKAGE=A

$\overline{p}p \rightarrow \pi\pi$

NODE=M032M1

NODE=M032M1

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •			
~ 2191	HASAN 94	RVUE	$\overline{p}p \rightarrow \pi\pi$
~ 2070	[1] OAKDEN 94	RVUE	0.36–1.55 $\overline{p}p \rightarrow \pi\pi$
~ 2170	[2] MARTIN 80B	RVUE	
~ 2100	[2] MARTIN 80C	RVUE	

[1] See however KLOET 96 who fit $\pi^+\pi^-$ only and find waves only up to $J = 3$ to be important but not significantly resonant. NODE=M032M1;LINKAGE=CC

[2] $I(J^P) = 1(1^-)$ from simultaneous analysis of $p\overline{p} \rightarrow \pi^-\pi^+$ and $\pi^0\pi^0$. NODE=M032M;LINKAGE=P

S-CHANNEL $\overline{N}N$

NODE=M032M2

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •			
2110±35	[1] ANISOVICH 02	SPEC	0.6–1.9 $p\overline{p} \to \omega\pi^0$, $\omega\eta\pi^0$, $\pi^+\pi^-$
~ 2190	[2] CUTTS 78B	CNTR	0.97–3 $\overline{p}p \to \overline{N}N$
2155±15	[2,3] COUPLAND 77	CNTR	0.7–2.4 $\overline{p}p \to \overline{p}p$
2193± 2	[2,4] ALSPECTOR 73	CNTR	$\overline{p}p$ S channel
2190±10	[5] ABRAMS 70	CNTR	S channel $\overline{p}N$

[1] From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02. NODE=M032M;LINKAGE=AY

[2] Isospins 0 and 1 not separated. NODE=M032M;LINKAGE=I

[3] From a fit to the total elastic cross section. NODE=M032M;LINKAGE=E

[4] Referred to as T or T region by ALSPECTOR 73. NODE=M032M;LINKAGE=M

[5] Seen as bump in $I = 1$ state. See also COOPER 68. PEASLEE 75 confirm $\overline{p}p$ results of ABRAMS 70, no narrow structure. NODE=M032M;LINKAGE=B

$\pi^- p \to \omega\pi^0 n$

NODE=M032M4

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

ρ(2150) WIDTH

NODE=M032210

e^+e^- PRODUCED

NODE=M032W3

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
163 ± 69 ± 24		[1] ABLIKIM 23BQ	BES3	$e^+e^- \to a_2(1320)^+\pi^- +$ c.c. $\to \eta\pi^+\pi^-$
270 ± 3		[2] ACHASOV 23A	SND	$e^+e^- \to \omega\pi^0$
234 ± 30 ± 25		[3] ABLIKIM 21A	BES3	$e^+e^- \to \omega\pi^0$
135 ± 34 ± 30		[4] ABLIKIM 21X	BES3	$e^+e^- \to \eta'\pi^+\pi^-$
$460\ ^{+54}_{-48}\ ^{+160}_{-90}$	1.8k	[5] ABLIKIM 20F	BES3	$\psi(2S) \to K^+K^-\eta$
70 ± 38		[6] LEES 20	BABR	$e^+e^- \to K^+K^-\gamma$
127 ± 14 ± 4		[7] LEES 20	RVUE	$e^+e^- \to K^+K^-$ OCCUR=2
$196 \pm 23\ ^{+25}_{-27}$		[8] ABLIKIM 19AQ	BES	$J/\psi \to K^+K^-\pi^0$
139.8± 12.3± 20.6		[9] ABLIKIM 19L	BES3	$e^+e^- \to K^+K^-$
109 ± 76		[10] LEES 12G	BABR	$e^+e^- \to \pi^+\pi^-\gamma$
350 ± 40 ± 50		AUBERT 07AU	BABR	10.6 $e^+e^- \to f_1(1285)\pi^+\pi^-\gamma$
310 ±140		AUBERT 07AU	BABR	10.6 $e^+e^- \to \eta'\pi^+\pi^-\gamma$ OCCUR=2
389 ± 79		BIAGINI 91	RVUE	$e^+e^- \to \pi^+\pi^-$, K^+K^-
410 ±100		[11] CLEGG 90	RVUE	$e^+e^- \to 3(\pi^+\pi^-)$, $2(\pi^+\pi^-\pi^0)$

[1] From a fit to the cross section between 2.00 and 3.08 GeV with a coherent sum of a Breit-Wigner resonance and a non-resonant contribution. Could be another state. NODE=M032W3;LINKAGE=J

[2] From a vector dominance fit to the Born cross section between 1.05 and 2.0 GeV with $\rho(770)$, $\rho(1570)$, $\rho(1700)$, $\rho(2150)$. The fit also uses SND data from the VEPP-2M collider below 1.02 GeV and from LEES 17H and ABLIKIM 21A above 1.5 GeV. NODE=M032W3;LINKAGE=K

[3] From a fit to the cross section between 2.00 and 3.08 GeV with a coherent sum of Breit-Wigner amplitudes, including contributions from $\rho(770)$, $\rho(1450)$ and $\rho(1700)$. Could be another state. NODE=M032W3;LINKAGE=G

[4] From a Breit-Wigner fit to the Born cross section, including an s-dependent continuum amplitude. NODE=M032W3;LINKAGE=H

[5] Seen in $\psi(2S)$ decay with branching ratio $\psi(2S) \to X\eta \to K^+K^-\eta = (21.7 \pm 1.9^{+7.7}_{-8.3}) \times 10^{-6}$. NODE=M032W3;LINKAGE=F

[6] From the fit to the BABAR data of LEES 13Q assuming a coherent sum of a single Breit-Wigner resonance and a nonresonant contribution. The resonance significance is 3.5 σ. NODE=M032W3;LINKAGE=C

[7] From the fit to the BABAR data of LEES 13Q and BESIII data of ABLIKIM 19L assuming a coherent sum of a single Breit-Wigner resonance and a nonresonant contribution. NODE=M032W3;LINKAGE=D

[8] Could also be another state. Seen in J/ψ decay with branching ratio $J/\psi \to X\pi^0 \to K^+K^-\pi^0 = (6.7 \pm 1.1^{+2.2}_{-1.8}) \times 10^{-6}$. NODE=M032W3;LINKAGE=B

[9] The observed structure can be due to both the $\phi(2170)$ and $\rho(2150)$. NODE=M032W3;LINKAGE=E

[10] 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. NODE=M032W3;LINKAGE=LE

[11] Includes ATKINSON 85. NODE=M032W3;LINKAGE=A

$\overline{p}p \to \pi\pi$

NODE=M032W1
NODE=M032W1

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
~ 296	HASAN	94	RVUE	$\overline{p}p \to \pi\pi$
~ 40	[1] OAKDEN	94	RVUE	0.36–1.55 $\overline{p}p \to \pi\pi$
~ 250	[2] MARTIN	80B	RVUE	
~ 200	[2] MARTIN	80C	RVUE	

[1] See however KLOET 96 who fit $\pi^+\pi^-$ only and find waves only up to $J = 3$ to be important but not significantly resonant.

NODE=M032W1;LINKAGE=CC

[2] $I(J^P) = 1(1^-)$ from simultaneous analysis of $p\overline{p} \to \pi^-\pi^+$ and $\pi^0\pi^0$.

NODE=M032W;LINKAGE=P

S-CHANNEL $\overline{N}N$

NODE=M032W2
NODE=M032W2

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
230±50	[1] ANISOVICH	02	SPEC	0.6–1.9 $p\overline{p} \to \omega\pi^0$, $\omega\eta\pi^0$, $\pi^+\pi^-$
135±75	[2,3] COUPLAND	77	CNTR	0.7–2.4 $\overline{p}p \to \overline{p}p$
98± 8	[3] ALSPECTOR	73	CNTR	$\overline{p}p$ *S* channel
~ 85	[4] ABRAMS	70	CNTR	*S* channel $\overline{p}N$

[1] From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02.

NODE=M032W;LINKAGE=AY

[2] From a fit to the total elastic cross section.

NODE=M032W;LINKAGE=E

[3] Isospins 0 and 1 not separated.

NODE=M032W;LINKAGE=I

[4] Seen as bump in $I = 1$ state. See also COOPER 68. PEASLEE 75 confirm $\overline{p}p$ results of ABRAMS 70, no narrow structure.

NODE=M032W;LINKAGE=B

$\pi^- p \to \omega\pi^0 n$

NODE=M032W4
NODE=M032W4

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

$\rho(2150)$ DECAY MODES

NODE=M032215;NODE=M032

	Mode	Fraction (Γ_i/Γ)	
Γ_1	e^+e^-		DESIG=1
Γ_2	$\pi^+\pi^-$	seen	DESIG=2;OUR EVAL;→ UNCHECKED ←
Γ_3	K^+K^-	seen	DESIG=3;OUR EVAL;→ UNCHECKED ←
Γ_4	$3(\pi^+\pi^-)$	seen	DESIG=4;OUR EVAL;→ UNCHECKED ←
Γ_5	$2(\pi^+\pi^-\pi^0)$	seen	DESIG=5;OUR EVAL;→ UNCHECKED ←
Γ_6	$\eta'\pi^+\pi^-$	seen	DESIG=6;OUR EVAL;→ UNCHECKED ←
Γ_7	$f_1(1285)\pi^+\pi^-$	seen	DESIG=7;OUR EVAL;→ UNCHECKED ←
Γ_8	$\omega\pi^0$	seen	DESIG=8;OUR EVAL;→ UNCHECKED ←
Γ_9	$\omega\pi^0\eta$	seen	DESIG=9;OUR EVAL;→ UNCHECKED ←
Γ_{10}	$a_2(1320)\pi$		DESIG=12
Γ_{11}	$p\overline{p}$		DESIG=10

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

NODE=M032220

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

NODE=M032R02
NODE=M032R02

VALUE (eV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
23.3±5.3±3.3	[1] ABLIKIM	21X	BES3	$e^+e^- \to \eta'\pi^+\pi^-$

[1] From a Breit-Wigner fit to the Born cross section interfering constructively with the continuum. For destructive interference the value is 0.64 ± 0.49 ± 0.42 eV.

NODE=M032R02;LINKAGE=A

$\Gamma(\omega\pi^0) \times \Gamma(e^+e^-)/\Gamma_{total}$ — $\Gamma_8\Gamma_1/\Gamma$

NODE=M032R00
NODE=M032R00

VALUE (eV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
34±11±16	ABLIKIM	21A	BES3	$e^+e^- \to \omega\pi^0$

$\Gamma(a_2(1320)\pi)$ × $\Gamma(e^+e^-)/\Gamma_{total}$ $\Gamma_{10}\Gamma_1/\Gamma$

NODE=M032R04
NODE=M032R04

VALUE (eV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
34.6±17.1±6.0	[1] ABLIKIM	23BQ	BES3	$e^+e^- \rightarrow a_2(1320)^+\pi^-$+c.c. $\rightarrow \eta\pi^+\pi^-$

[1] From a solution of the fit to the cross section between 2.00 and 3.08 GeV using a coherent sum of a single Breit-Wigner resonance and a non-resonant contribution. B($a_2(1320) \rightarrow \eta\pi$) × B($\eta \rightarrow \gamma\gamma$) fixed to 0.057. Another solution with equal fit quality gives 137.1 ± 73.3 ± 2.1 eV.

NODE=M032R04;LINKAGE=A

$\rho(2150)$ $\Gamma(i)\Gamma(e^+e^-)/\Gamma^2$(total)

NODE=M032230

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

NODE=M032G01
NODE=M032G01

VALUE (units 10^{-7})	DOCUMENT ID		TECN	COMMENT
3.1±0.6±0.5	[1] AUBERT	07AU	BABR	10.6 $e^+e^- \rightarrow f_1(1285)\pi^+\pi^-\gamma$

[1] Calculated by us from the reported value of cross section at the peak.

NODE=M032G01;LINKAGE=AU

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

NODE=M032G02
NODE=M032G02

VALUE (units 10^{-8})	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
4.9±1.9	[1] AUBERT	07AU	BABR	10.6 $e^+e^- \rightarrow \eta'\pi^+\pi^-\gamma$

[1] Calculated by us from the reported value of cross section at the peak.

NODE=M032G02;LINKAGE=AU

$\rho(2150)$ REFERENCES

NODE=M032

ABLIKIM	23BQ	PR D108 L111101	M. Ablikim *et al.*	(BESIII Collab.)	REFID=62510
ACHASOV	23A	PR D108 092012	M.N. Achasov *et al.*	(SND Collab.)	REFID=62428
ABLIKIM	21A	PL B813 136059	M. Ablikim *et al.*	(BESIII Collab.)	REFID=61028
ABLIKIM	21X	PR D103 072007	M. Ablikim *et al.*	(BESIII Collab.)	REFID=61231
ABLIKIM	20F	PR D101 032008	M. Ablikim *et al.*	(BESIII Collab.)	REFID=60256
LEES	20	PR D101 012011	J.P. Lees *et al.*	(BESIII Collab.)	REFID=60211
ABLIKIM	19AQ	PR D100 032004	M. Ablikim *et al.*	(BESIII Collab.)	REFID=59909
ABLIKIM	19L	PR D99 032001	M. Ablikim *et al.*	(BESIII Collab.)	REFID=59612
LEES	17H	PR D96 092009	J.P. Lees *et al.*	(BABAR Collab.)	REFID=58311
LEES	13Q	PR D88 032013	J.P. Lees *et al.*	(BABAR Collab.)	REFID=55404
LEES	12G	PR D86 032013	J.P. Lees *et al.*	(BABAR Collab.)	REFID=54299
AUBERT	07AU	PR D76 092005	B. Aubert *et al.*	(BABAR Collab.)	REFID=52049
ANISOVICH	02	PL B542 8	A.V. Anisovich *et al.*		REFID=48828
ANISOVICH	01D	PL B508 6	A.V. Anisovich *et al.*		REFID=48327
ANISOVICH	01E	PL B513 281	A.V. Anisovich *et al.*		REFID=48349
ANISOVICH	00J	PL B491 47	A.V. Anisovich *et al.*	(RAL, LOQM, PNPI+)	REFID=47950
KLOET	96	PR D53 6120	W.M. Kloet, F. Myhrer	(RUTG, NORD)	REFID=45212
ALDE	95	ZPHY C66 379	D.M. Alde *et al.*	(GAMS Collab.) JP	REFID=44371
HASAN	94	PL B334 215	A. Hasan, D.V. Bugg	(LOQM)	REFID=44103
OAKDEN	94	NP A574 731	M.N. Oakden, M.R. Pennington	(DURH)	REFID=45210
ALDE	92C	ZPHY C54 553	D.M. Alde *et al.*	(BELG, SERP, KEK, LANL+)	REFID=41859
BIAGINI	91	NC 104A 363	M.E. Biagini *et al.*	(FRAS, PRAG)	REFID=41894
CLEGG	90	ZPHY C45 677	A.B. Clegg, A. Donnachie	(LANC, MCHS)	REFID=41355
ATKINSON	85	ZPHY C29 333	M. Atkinson *et al.*	(BONN, CERN, GLAS+)	REFID=22000
MARTIN	80B	NP B176 355	B.R. Martin, D. Morgan	(LOUC, RHEL) JP	REFID=21838
MARTIN	80C	NP B169 216	A.D. Martin, M.R. Pennington	(DURH) JP	REFID=21837
CUTTS	78B	PR D17 16	D. Cutts *et al.*	(STON, WISC)	REFID=21733
COUPLAND	77	PL 71B 460	M. Coupland *et al.*	(LOQM, RHEL)	REFID=21830
PEASLEE	75	PL 57B 189	D.C. Peaslee *et al.*	(CANB, BARI, BROW+)	REFID=21824
ALSPECTOR	73	PRL 30 511	J. Alspector *et al.*	(RUTG, UPNJ)	REFID=21813
ABRAMS	70	PR D1 1917	R.J. Abrams *et al.*	(BNL)	REFID=21807
COOPER	68	PRL 20 1059	W.A. Cooper *et al.*	(ANL)	REFID=21805
GOUNARIS	68	PRL 21 244	G.J. Gounaris, J.J. Sakurai		REFID=48054