Reference = GARMASH 15; PR D91 072003
Verifier code = SAKAI

Normally we send all verifications for one experiment to one person, usually the spokesperson or data-analysis co-ordinator, who then distributes them to the appropriate people. Please tell us if we should send the verifications for your experiment to someone else.

PLEASE READ NOW

PLEASE REPLY WITHIN ONE WEEK

Yoshihide Sakai

EMAIL: yoshihide.sakai@kek.jp

July 21, 2016

Dear Colleague,

(1) Please check the results of your experiment carefully. They are marked.

(2) Please reply within one week.

(3) Please reply even if everything is correct.

(4) IMPORTANT!! Please tell WHICH papers you are verifying. We have lots of requests out.

(5) Feel free to make comments on our treatment of any of the results (not just yours) you see.

Thank you for helping us make the Review accurate and useful.

Sincerely,

Simon Eidelman
BINP, Budker Inst. of Nuclear Physics
Prospekt Lavrent'eva 11
RU-630090 Novosibirsk
Russian Federation

EMAIL: simon.eidelman@cern.ch

$b\bar{b}$ MESONS

NODE=MXXX030

NODE=M207

$X(10610)^{\pm}$

$I^G(J^P) = 1^+(1^+)$

OMITTED FROM SUMMARY TABLE

Observed by BONDAR 12 in $\Upsilon(5S)$ decays to $\Upsilon(\mathrm{nS})\pi^+\pi^-$ (n = 1, 2, 3) and $h_b(\mathrm{mP})\pi^+\pi^-$ (m = 1, 2). $J^P = 1^+$ is favored from angular analyses. Isospin = 1 is favored due to observation by KROKOVNY 13 of a corresponding neutral state produced in $\Upsilon(10860) \rightarrow \Upsilon(2S)/\Upsilon(3S)\pi^0\pi^0$ decays at a consistent mass. NODE=M207

$X(10610)^{\pm}$ MASS

NODE=M207M

	VALUE (MeV)	DOCUMENT ID		TECN	COMMENT	
	10607.2±2.0	[1] BONDAR	12	BELL	$e^+e^- \rightarrow$ hadrons	
	• • • We do not use the following data for averages, fits, limits, etc. • • •					
YOUR DATA	$10608.5 \pm 3.4^{+3.7}_{-1.4}$	[2] GARMASH	15	BELL	$e^+e^- \rightarrow \Upsilon(1S)\pi^+\pi^-$	
YOUR DATA	$10608.1 \pm 1.2^{+1.5}_{-0.2}$	[2] GARMASH	15	BELL	$e^+e^- \rightarrow \Upsilon(2S)\pi^+\pi^-$	OCCUR=2
YOUR DATA	$10607.4 \pm 1.5^{+0.8}_{-0.2}$	[2] GARMASH	15	BELL	$e^+e^- \rightarrow \Upsilon(3S)\pi^+\pi^-$	OCCUR=3
	$10611 \pm 4 \pm 3$	[3] BONDAR	12	BELL	$e^+e^- \rightarrow \Upsilon(1S)\pi^+\pi^-$	OCCUR=2
	$10609 \pm 2 \pm 3$	[3] BONDAR	12	BELL	$e^+e^- \rightarrow \Upsilon(2S)\pi^+\pi^-$	OCCUR=3
	$10608 \pm 2 \pm 3$	[3] BONDAR	12	BELL	$e^+e^- \rightarrow \Upsilon(3S)\pi^+\pi^-$	OCCUR=4
	$10605 \pm 2 {}^{+3}_{-1}$	[3] BONDAR	12	BELL	$e^+e^- \rightarrow h_b(1P)\pi^+\pi^-$	OCCUR=5
	$10599 {}^{+6}_{-3} {}^{+5}_{-4}$	[3] BONDAR	12	BELL	$e^+e^- \rightarrow h_b(2P)\pi^+\pi^-$	OCCUR=6

YOUR NOTE
[1] Average of the BONDAR 12 measurements in separate channels. NODE=M207M;LINKAGE=BO
[2] Correlated with the corresponding result from BONDAR 12. NODE=M207M;LINKAGE=A
[3] Superseded by the average measurement of BONDAR 12. NODE=M207M;LINKAGE=BN

$X(10610)^{\pm}$ WIDTH

NODE=M207W

	VALUE (MeV)	DOCUMENT ID		TECN	COMMENT	
	18.4± 2.4	[4] BONDAR	12	BELL	$e^+e^- \rightarrow$ hadrons	
	• • • We do not use the following data for averages, fits, limits, etc. • • •					
YOUR DATA	$18.5 \pm 5.3^{+6.1}_{-2.3}$	[5] GARMASH	15	BELL	$e^+e^- \rightarrow \Upsilon(1S)\pi^+\pi^-$	
YOUR DATA	$20.8 \pm 2.5^{+0.3}_{-2.1}$	[5] GARMASH	15	BELL	$e^+e^- \rightarrow \Upsilon(2S)\pi^+\pi^-$	OCCUR=2
YOUR DATA	$18.7 \pm 13.4^{+2.5}_{-1.3}$	[5] GARMASH	15	BELL	$e^+e^- \rightarrow \Upsilon(3S)\pi^+\pi^-$	OCCUR=3
	$22.3 \pm 7.7^{+3.0}_{-4.0}$	[6] BONDAR	12	BELL	$e^+e^- \rightarrow \Upsilon(1S)\pi^+\pi^-$	OCCUR=2
	$24.2 \pm 3.1^{+2.0}_{-3.0}$	[6] BONDAR	12	BELL	$e^+e^- \rightarrow \Upsilon(2S)\pi^+\pi^-$	OCCUR=3
	$17.6 \pm 3.0 \pm 3.0$	[6] BONDAR	12	BELL	$e^+e^- \rightarrow \Upsilon(3S)\pi^+\pi^-$	OCCUR=4
	$11.4^{+4.5}_{-3.9}{}^{+2.1}_{-1.2}$	[6] BONDAR	12	BELL	$e^+e^- \rightarrow h_b(1P)\pi^+\pi^-$	OCCUR=5
	$13 {}^{+10}_{-8} {}^{+9}_{-7}$	[6] BONDAR	12	BELL	$e^+e^- \rightarrow h_b(2P)\pi^+\pi^-$	OCCUR=6

YOUR NOTE
[4] Average of the BONDAR 12 measurements in separate channels. NODE=M207W;LINKAGE=BO
[5] Correlated with the corresponding result from BONDAR 12. NODE=M207W;LINKAGE=A
[6] Superseded by the average measurement of BONDAR 12. NODE=M207W;LINKAGE=BN

$X(10610)^{\pm}$ BRANCHING RATIOS

NODE=M207225

$\Gamma(\Upsilon(1S)\pi^+)/\Gamma_{\mathrm{total}}$ **Γ_1/Γ**

NODE=M207R01

	VALUE	DOCUMENT ID		TECN	COMMENT	
						NODE=M207R01
YOUR DATA	seen	GARMASH	15	BELL	$e^+e^- \rightarrow \Upsilon(1S)\pi^+\pi^-$	
	seen	BONDAR	12	BELL	$e^+e^- \rightarrow \Upsilon(1S)\pi^+\pi^-$	

$\Gamma(\Upsilon(2S)\pi^+)/\Gamma_{total}$ — Γ_2/Γ

NODE=M207R02
NODE=M207R02

	VALUE	DOCUMENT ID		TECN	COMMENT
YOUR DATA	seen	GARMASH	15	BELL	$e^+e^- \to \Upsilon(2S)\pi^+\pi^-$
	seen	BONDAR	12	BELL	$e^+e^- \to \Upsilon(2S)\pi^+\pi^-$

$\Gamma(\Upsilon(3S)\pi^+)/\Gamma_{total}$ — Γ_3/Γ

NODE=M207R03
NODE=M207R03

	VALUE	DOCUMENT ID		TECN	COMMENT
YOUR DATA	seen	GARMASH	15	BELL	$e^+e^- \to \Upsilon(3S)\pi^+\pi^-$
	seen	BONDAR	12	BELL	$e^+e^- \to \Upsilon(3S)\pi^+\pi^-$

$X(10610)^\pm$ REFERENCES

NODE=M207

YOUR PAPER

GARMASH	15	PR D91 072003	A. Garmash *et al.*	(BELLE Collab.)
KROKOVNY	13	PR D88 052016	P. Krokovny *et al.*	(BELLE Collab.)
BONDAR	12	PRL 108 122001	A. Bondar *et al.*	(BELLE Collab.)

REFID=56811
REFID=55588
REFID=53963

NODE=M208

$X(10650)^\pm$

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

OMITTED FROM SUMMARY TABLE

Observed by BONDAR 12 in $\Upsilon(5S)$ decays to $\Upsilon(nS)\pi^+\pi^-$ (n = 1, 2, 3) and $h_b(mP)\pi^+\pi^-$ (m = 1, 2). $J^P = 1^+$ is favored from angular analyses.

NODE=M208

$X(10650)^\pm$ MASS

NODE=M208M

NODE=M208M

	VALUE (MeV)	DOCUMENT ID		TECN	COMMENT	
	10652.2±1.5	[1] BONDAR	12	BELL	$e^+e^- \to$ hadrons	
	• • • We do not use the following data for averages, fits, limits, etc. • • •					
YOUR DATA	$10656.7 \pm 5.0^{+1.1}_{-3.1}$	[2] GARMASH	15	BELL	$e^+e^- \to \Upsilon(1S)\pi^+\pi^-$	
YOUR DATA	$10650.7 \pm 1.5^{+0.5}_{-0.2}$	[2] GARMASH	15	BELL	$e^+e^- \to \Upsilon(2S)\pi^+\pi^-$	OCCUR=2
YOUR DATA	$10651.2 \pm 1.0^{+0.4}_{-0.3}$	[2] GARMASH	15	BELL	$e^+e^- \to \Upsilon(3S)\pi^+\pi^-$	OCCUR=3
	$10657 \pm 6 \pm 3$	[3] BONDAR	12	BELL	$e^+e^- \to \Upsilon(1S)\pi^+\pi^-$	OCCUR=2
	$10651 \pm 2 \pm 3$	[3] BONDAR	12	BELL	$e^+e^- \to \Upsilon(2S)\pi^+\pi^-$	OCCUR=3
	$10652 \pm 1 \pm 2$	[3] BONDAR	12	BELL	$e^+e^- \to \Upsilon(3S)\pi^+\pi^-$	OCCUR=4
	$10654 \pm 3 {}^{+1}_{-2}$	[3] BONDAR	12	BELL	$e^+e^- \to h_b(1P)\pi^+\pi^-$	OCCUR=5
	$10651 {}^{+2}_{-3} {}^{+3}_{-2}$	[3] BONDAR	12	BELL	$e^+e^- \to h_b(2P)\pi^+\pi^-$	OCCUR=6

YOUR NOTE

[1] Average of the BONDAR 12 measurements in separate channels. NODE=M208M;LINKAGE=BO
[2] Correlated with the corresponding result from BONDAR 12. NODE=M208M;LINKAGE=A
[3] Superseded by the average measurement of BONDAR 12. NODE=M208M;LINKAGE=BN

$X(10650)^\pm$ WIDTH

NODE=M208W

NODE=M208W

	VALUE (MeV)	DOCUMENT ID		TECN	COMMENT	
	11.5± 2.2	[4] BONDAR	12	BELL	$e^+e^- \to$ hadrons	
	• • • We do not use the following data for averages, fits, limits, etc. • • •					
YOUR DATA	$12.1 {}^{+11.3}_{-4.8} {}^{+2.7}_{-0.6}$	[5] GARMASH	15	BELL	$e^+e^- \to \Upsilon(1S)\pi^+\pi^-$	
YOUR DATA	$14.2 \pm 3.7 {}^{+0.9}_{-0.4}$	[5] GARMASH	15	BELL	$e^+e^- \to \Upsilon(2S)\pi^+\pi^-$	OCCUR=2
YOUR DATA	$9.3 \pm 2.2 {}^{+0.3}_{-0.5}$	[5] GARMASH	15	BELL	$e^+e^- \to \Upsilon(3S)\pi^+\pi^-$	OCCUR=3
	$16.3 \pm 9.8 {}^{+6.0}_{-2.0}$	[6] BONDAR	12	BELL	$e^+e^- \to \Upsilon(1S)\pi^+\pi^-$	OCCUR=2
	$13.3 \pm 3.3 {}^{+4.0}_{-3.0}$	[6] BONDAR	12	BELL	$e^+e^- \to \Upsilon(2S)\pi^+\pi^-$	OCCUR=3
	$8.4 \pm 2.0 \pm 2.0$	[6] BONDAR	12	BELL	$e^+e^- \to \Upsilon(3S)\pi^+\pi^-$	OCCUR=4
	$20.9 {}^{+5.4}_{-4.7} {}^{+2.1}_{-5.7}$	[6] BONDAR	12	BELL	$e^+e^- \to h_b(1P)\pi^+\pi^-$	OCCUR=5
	$19 \pm 7 {}^{+11}_{-7}$	[6] BONDAR	12	BELL	$e^+e^- \to h_b(2P)\pi^+\pi^-$	OCCUR=6

YOUR NOTE

[4] Average of the BONDAR 12 measurements in separate channels. NODE=M208W;LINKAGE=BO
[5] Correlated with the corresponding result from BONDAR 12. NODE=M208W;LINKAGE=A
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$X(10650)^{\pm}$ BRANCHING RATIOS

NODE=M208225

$\Gamma(\Upsilon(1S)\pi^+)/\Gamma_{total}$ — Γ_1/Γ

NODE=M208R01
NODE=M208R01

	VALUE	DOCUMENT ID		TECN	COMMENT
YOUR DATA	seen	GARMASH	15	BELL	$e^+e^- \to \Upsilon(1S)\pi^+\pi^-$
	seen	BONDAR	12	BELL	$e^+e^- \to \Upsilon(1S)\pi^+\pi^-$

$\Gamma(\Upsilon(2S)\pi^+)/\Gamma_{total}$ — Γ_2/Γ

NODE=M208R02
NODE=M208R02

	VALUE	DOCUMENT ID		TECN	COMMENT
YOUR DATA	seen	GARMASH	15	BELL	$e^+e^- \to \Upsilon(2S)\pi^+\pi^-$
	seen	BONDAR	12	BELL	$e^+e^- \to \Upsilon(2S)\pi^+\pi^-$

$\Gamma(\Upsilon(3S)\pi^+)/\Gamma_{total}$ — Γ_3/Γ

NODE=M208R03
NODE=M208R03

	VALUE	DOCUMENT ID		TECN	COMMENT
YOUR DATA	seen	GARMASH	15	BELL	$e^+e^- \to \Upsilon(3S)\pi^+\pi^-$
	seen	BONDAR	12	BELL	$e^+e^- \to \Upsilon(3S)\pi^+\pi^-$

$X(10650)^{\pm}$ REFERENCES

NODE=M208

YOUR PAPER

GARMASH	15	PR D91 072003	A. Garmash *et al.*	(BELLE Collab.)	REFID=56811
BONDAR	12	PRL 108 122001	A. Bondar *et al.*	(BELLE Collab.)	REFID=53963

Reference = WANG 15A; PR D91 112007
Verifier code = SAKAI

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Yoshihide Sakai

EMAIL: yoshihide.sakai@kek.jp

July 21, 2016

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Prospekt Lavrent'eva 11
RU-630090 Novosibirsk
Russian Federation

EMAIL: simon.eidelman@cern.ch

$c\bar{c}$ MESONS

NODE=MXXX025

NODE=M223

$X(4055)^{\pm}$

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

OMITTED FROM SUMMARY TABLE

Needs confirmation. Seen by WANG 15A in the $\psi(2S)\pi^+$ invariant mass distribution in $X(4360) \rightarrow \psi(2S)\pi^+\pi^-$ decay.

NODE=M223

$X(4055)^{\pm}$ MASS

NODE=M223M

	VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
YOUR DATA	**4054±3±1**	[1] WANG	15A	BELL	10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$

YOUR NOTE [1] Statistical significance of 3.5 σ.

NODE=M223M

NODE=M223M;LINKAGE=A

$X(4055)^{\pm}$ WIDTH

NODE=M223W

	VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
YOUR DATA	**45±11±6**	[1] WANG	15A	BELL	10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$

YOUR NOTE [1] Statistical significance of 3.5 σ.

NODE=M223W

NODE=M223W;LINKAGE=A

$X(4055)^{\pm}$ BRANCHING RATIOS

NODE=M223225

$\Gamma(\pi^+\psi(2S))/\Gamma_{total}$ **Γ_1/Γ**

NODE=M223R01

	VALUE	DOCUMENT ID		TECN	COMMENT
YOUR DATA	**seen**	[1] WANG	15A	BELL	10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$

NODE=M223R01

YOUR NOTE [1] Statistical significance of 3.5 σ.

NODE=M223R01;LINKAGE=A

$X(4055)^{\pm}$ REFERENCES

NODE=M223

YOUR PAPER WANG 15A PR D91 112007 X.L. Wang *et al.* (BELLE Collab.)

REFID=56839

NODE=M181

$X(4360)$

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

Seen in radiative return from e^+e^- collisions at $\sqrt{s}$ = 9.54–10.58 GeV by AUBERT 07S, WANG 07D, and LEES 14F. See also the review under the $X(3872)$ particle listings. (See the index for the page number.)

NODE=M181

$X(4360)$ MASS

NODE=M181M

	VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
	4346± 6 OUR AVERAGE					
YOUR DATA	4347± 6±3	279	[1] WANG	15A	BELL	10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$
	4340±16±9	37	[2] LEES	14F	BABR	10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$
	• • • We do not use the following data for averages, fits, limits, etc. • • •					
	$4355^{+9}_{-10}\pm9$	74	[3] LIU	08H	RVUE	10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$
	4324±24		[4] AUBERT	07S	BABR	10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$
	4361± 9±9	47	[2] WANG	07D	BELL	10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$

YOUR NOTE
[1] From a two-resonance fit. Supersedes WANG 07D.
[2] From a two-resonance fit.
[3] From a combined fit of AUBERT 07S and WANG 07D data with two resonances.
[4] From a single-resonance fit. Systematic errors not estimated.

NODE=M181M;LINKAGE=A
NODE=M181M;LINKAGE=WA
NODE=M181M;LINKAGE=LI
NODE=M181M;LINKAGE=AU

$X(4360)$ WIDTH

NODE=M181W

	VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
	102±10 OUR AVERAGE					
YOUR DATA	103± 9± 5	279	[1] WANG	15A	BELL	10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$
	94±32±13	37	[2] LEES	14F	BABR	10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$

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

$103^{+17}_{-15}\pm11$	74	[3] LIU	08H	RVUE	10.58 $e^+e^- \to \gamma\pi^+\pi^-\psi(2S)$
172 ± 33		[4] AUBERT	07S	BABR	10.58 $e^+e^- \to \gamma\pi^+\pi^-\psi(2S)$
$74\pm15\pm10$	47	[2] WANG	07D	BELL	10.58 $e^+e^- \to \gamma\pi^+\pi^-\psi(2S)$

YOUR NOTE
[1] From a two-resonance fit. Supersedes WANG 07D. NODE=M181W;LINKAGE=A
[2] From a two-resonance fit. NODE=M181W;LINKAGE=WA
[3] From a combined fit of AUBERT 07S and WANG 07D data with two resonances. NODE=M181W;LINKAGE=LI
[4] From a single-resonance fit. Systematic errors not estimated. NODE=M181W;LINKAGE=AU

$X(4360)$ $\Gamma(i)\times\Gamma(e^+e^-)/\Gamma(\text{total})$

NODE=M181230

$\Gamma(\psi(2S)\pi^+\pi^-)\times\Gamma(e^+e^-)/\Gamma_{\text{total}}$ — $\Gamma_2\Gamma_1/\Gamma$

NODE=M181G1
NODE=M181G1

VALUE (eV)	EVTS	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
YOUR DATA $9.2\pm0.6\pm0.6$	279	[1] WANG	15A BELL	10.58 $e^+e^- \to \gamma\pi^+\pi^-\psi(2S)$
YOUR DATA $10.9\pm0.6\pm0.7$	279	[2] WANG	15A BELL	10.58 $e^+e^- \to \gamma\pi^+\pi^-\psi(2S)$ OCCUR=2
$6.0\pm1.0\pm0.5$	37	[3] LEES	14F BABR	10.58 $e^+e^- \to \gamma\pi^+\pi^-\psi(2S)$
$7.2\pm1.0\pm0.6$	37	[4] LEES	14F BABR	10.58 $e^+e^- \to \gamma\pi^+\pi^-\psi(2S)$ OCCUR=2
$11.1^{+1.3}_{-1.2}$	74	[5] LIU	08H RVUE	10.58 $e^+e^- \to \gamma\pi^+\pi^-\psi(2S)$
12.3 ± 1.2	74	[6] LIU	08H RVUE	10.58 $e^+e^- \to \gamma\pi^+\pi^-\psi(2S)$ OCCUR=2
$10.4\pm1.7\pm1.5$	47	[3] WANG	07D BELL	10.58 $e^+e^- \to \gamma\pi^+\pi^-\psi(2S)$
$11.8\pm1.8\pm1.4$	47	[4] WANG	07D BELL	10.58 $e^+e^- \to \gamma\pi^+\pi^-\psi(2S)$ OCCUR=2

YOUR NOTE
[1] Solution I of two equivalent solutions from a fit using two interfering resonances. Supersedes WANG 07D. NODE=M181G1;LINKAGE=A
YOUR NOTE
[2] Solution II of two equivalent solutions from a fit using two interfering resonances. Supersedes WANG 07D. NODE=M181G1;LINKAGE=B
[3] Solution I of two equivalent solutions in a fit using two interfering resonances. NODE=M181G1;LINKAGE=WA
[4] Solution II of two equivalent solutions in a fit using two interfering resonances. NODE=M181G1;LINKAGE=WN
[5] Solution I in a combined fit of AUBERT 07S and WANG 07D data with two resonances. NODE=M181G1;LINKAGE=LI
[6] Solution II in a combined fit of AUBERT 07S and WANG 07D data with two resonances. NODE=M181G1;LINKAGE=LU

$X(4360)$ REFERENCES

NODE=M181

YOUR PAPER

WANG	15A	PR D91 112007	X.L. Wang *et al.*	(BELLE Collab.) REFID=56839
LEES	14F	PR D89 111103	J.P. Lees *et al.*	(BABAR Collab.) REFID=55938
LIU	08H	PR D78 014032	Z.Q. Liu, X.S. Qin, C.Z. Yuan	REFID=52296
AUBERT	07S	PRL 98 212001	B. Aubert *et al.*	(BABAR Collab.) REFID=51724
WANG	07D	PRL 99 142002	X.L. Wang *et al.*	(BELLE Collab.) REFID=51959

NODE=M189

$X(4660)$

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

Seen in radiative return from e^+e^- collisions at $\sqrt{s}$ = 9.54–10.58 GeV by WANG 07D. Also obtained in a combined fit of WANG 07D, AUBERT 07S, and LEES 14F. See also the review under the $X(3872)$ particle listings. (See the index for the page number.) NODE=M189

$X(4660)$ MASS

NODE=M189M

NODE=M189M

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
4643± 9 OUR AVERAGE		Error includes scale factor of 1.2.		
YOUR DATA $4652\pm10\pm11$	279	[1] WANG	15A BELL	10.58 $e^+e^- \to \gamma\pi^+\pi^-\psi(2S)$
$4669\pm21\pm3$	37	[2] LEES	14F BABR	10.58 $e^+e^- \to \gamma\pi^+\pi^-\psi(2S)$
$4634^{+8}_{-7}{}^{+5}_{-8}$	142	[3] PAKHLOVA	08B BELL	$e^+e^- \to \Lambda_c^+\Lambda_c^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$4661^{+9}_{-8}\pm6$	44	[4] LIU	08H RVUE	10.58 $e^+e^- \to \gamma\pi^+\pi^-\psi(2S)$
$4664\pm11\pm5$	44	WANG	07D BELL	10.58 $e^+e^- \to \gamma\pi^+\pi^-\psi(2S)$

YOUR NOTE
[1] From a two-resonance fit. Supersedes WANG 07D. NODE=M189M;LINKAGE=A
[2] From a two-resonance fit. NODE=M189M;LINKAGE=LE
[3] The $\pi^+\pi^-\psi(2S)$ and $\Lambda_c^+\Lambda_c^-$ states are not necessarily the same. NODE=M189M;LINKAGE=PA
[4] From a combined fit of AUBERT 07S and WANG 07D data with two resonances. NODE=M189M;LINKAGE=LI

$X(4660)$ WIDTH

NODE=M189W

NODE=M189W

	VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
	72±11 OUR AVERAGE					
YOUR DATA	68±11± 5	279	[1] WANG	15A	BELL	10.58 $e^+e^- \to \gamma\pi^+\pi^-\psi(2S)$
	104±48±10	37	[2] LEES	14F	BABR	10.58 $e^+e^- \to \gamma\pi^+\pi^-\psi(2S)$
	$92^{+40}_{-24}{}^{+10}_{-21}$	142	[3] PAKHLOVA	08B	BELL	$e^+e^- \to \Lambda_c^+\Lambda_c^-$
	• • • We do not use the following data for averages, fits, limits, etc. • • •					
	42^{+17}_{-12}± 6	44	[4] LIU	08H	RVUE	10.58 $e^+e^- \to \gamma\pi^+\pi^-\psi(2S)$
	48±15± 3	44	WANG	07D	BELL	10.58 $e^+e^- \to \gamma\pi^+\pi^-\psi(2S)$

YOUR NOTE

[1] From a two-resonance fit. Supersedes WANG 07D. — NODE=M189W;LINKAGE=A

[2] From a two-resonance fit. — NODE=M189W;LINKAGE=LE

[3] The $\pi^+\pi^-\psi(2S)$ and $\Lambda_c^+\Lambda_c^-$ states are not necessarily the same. — NODE=M189W;LINKAGE=B

[4] From a combined fit of AUBERT 07S and WANG 07D data with two resonances. — NODE=M189W;LINKAGE=LI

$X(4660)$ $\Gamma(i) \times \Gamma(e^+e^-)/\Gamma(\text{total})$

NODE=M189230

$\Gamma(\psi(2S)\pi^+\pi^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ — $\Gamma_2\Gamma_1/\Gamma$

NODE=M189G1

NODE=M189G1

	VALUE (eV)	EVTS	DOCUMENT ID		TECN	COMMENT	
	• • • We do not use the following data for averages, fits, limits, etc. • • •						
YOUR DATA	2.0±0.3±0.2	279	[1] WANG	15A	BELL	10.58 $e^+e^- \to \gamma\pi^+\pi^-\psi(2S)$	
YOUR DATA	8.1±1.1±1.0	279	[2] WANG	15A	BELL	10.58 $e^+e^- \to \gamma\pi^+\pi^-\psi(2S)$	OCCUR=2
	2.7±1.3±0.5	37	[3] LEES	14F	BABR	10.58 $e^+e^- \to \gamma\pi^+\pi^-\psi(2S)$	
	7.5±1.7±0.7	37	[4] LEES	14F	BABR	10.58 $e^+e^- \to \gamma\pi^+\pi^-\psi(2S)$	OCCUR=2
	$2.2^{+0.7}_{-0.6}$	44	[5] LIU	08H	RVUE	10.58 $e^+e^- \to \gamma\pi^+\pi^-\psi(2S)$	
	5.9±1.6	44	[6] LIU	08H	RVUE	10.58 $e^+e^- \to \gamma\pi^+\pi^-\psi(2S)$	OCCUR=2
	3.0±0.9±0.3	44	[3] WANG	07D	BELL	10.58 $e^+e^- \to \gamma\pi^+\pi^-\psi(2S)$	
	7.6±1.8±0.8	44	[4] WANG	07D	BELL	10.58 $e^+e^- \to \gamma\pi^+\pi^-\psi(2S)$	OCCUR=2

YOUR NOTE

[1] Solution I of two equivalent solutions from a fit using two interfering resonances. Supersedes WANG 07D. — NODE=M189G1;LINKAGE=A

YOUR NOTE

[2] Solution II of two equivalent solutions from a fit using two interfering resonances. Supersedes WANG 07D. — NODE=M189G1;LINKAGE=B

[3] Solution I of two equivalent solutions in a fit using two interfering resonances. — NODE=M189G1;LINKAGE=WA

[4] Solution II of two equivalent solutions in a fit using two interfering resonances. — NODE=M189G1;LINKAGE=WN

[5] Solution I in a combined fit of AUBERT 07S and WANG 07D data with two resonances. — NODE=M189G1;LINKAGE=LI

[6] Solution II in a combined fit of AUBERT 07S and WANG 07D data with two resonances. — NODE=M189G1;LINKAGE=LU

$X(4660)$ REFERENCES

NODE=M189

YOUR PAPER

WANG	15A	PR D91 112007	X.L. Wang *et al.*	(BELLE Collab.)	REFID=56839
LEES	14F	PR D89 111103	J.P. Lees *et al.*	(BABAR Collab.)	REFID=55938
LIU	08H	PR D78 014032	Z.Q. Liu, X.S. Qin, C.Z. Yuan		REFID=52296
PAKHLOVA	08B	PRL 101 172001	C. Pakhlova *et al.*	(BELLE Collab.)	REFID=52596
AUBERT	07S	PRL 98 212001	B. Aubert *et al.*	(BABAR Collab.)	REFID=51724
WANG	07D	PRL 99 142002	X.L. Wang *et al.*	(BELLE Collab.)	REFID=51959

Reference = MATVIENKO 15; PR D92 012013
Verifier code = SAKAI

Normally we send all verifications for one experiment to one person, usually the spokesperson or data-analysis co-ordinator, who then distributes them to the appropriate people. Please tell us if we should send the verifications for your experiment to someone else.

PLEASE READ NOW

PLEASE REPLY WITHIN ONE WEEK

Yoshihide Sakai

EMAIL: yoshihide.sakai@kek.jp

July 21, 2016

Dear Colleague,

(1) Please check the results of your experiment carefully. They are marked.

(2) Please reply within one week.

(3) Please reply even if everything is correct.

(4) IMPORTANT!! Please tell WHICH papers you are verifying. We have lots of requests out.

(5) Feel free to make comments on our treatment of any of the results (not just yours) you see.

Thank you for helping us make the Review accurate and useful.

Sincerely,

Simon Eidelman
BINP, Budker Inst. of Nuclear Physics
Prospekt Lavrent'eva 11
RU-630090 Novosibirsk
Russian Federation

EMAIL: simon.eidelman@cern.ch

LIGHT UNFLAVORED MESONS
($S = C = B = 0$)

NODE=MXXX005

For $I = 1$ (π, b, ρ, a): $u\overline{d}$, $(u\overline{u}-d\overline{d})/\sqrt{2}$, $d\overline{u}$;
for $I = 0$ (η, η', h, h', ω, ϕ, f, f'): $c_1(u\overline{u} + d\overline{d}) + c_2(s\overline{s})$

NODE=MXXX005

NODE=M105

$\rho(1450)$

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

See our mini-review under the $\rho(1450)$.

NODE=M105

$\rho(1450)$ MASS

NODE=M105205

$\omega\pi$ MODE

NODE=M105M3
NODE=M105M3

	VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
	• • • We do not use the following data for averages, fits, limits, etc. • • •					
YOUR DATA	$1544 \pm 22^{+11}_{-46}$	821	[1] MATVIENKO	15	BELL	$\overline{B}^0 \to D^{*0}\omega\pi^-$
	1491 ± 19	7815	[2] ACHASOV	13	SND	1.05–2.00 $e^+e^- \to \pi^0\pi^0\gamma$
	$1582 \pm 17 \pm 25$	2382	[3] AKHMETSHIN	03B	CMD2	$e^+e^- \to \pi^0\pi^0\gamma$
	$1349 \pm 25^{+10}_{-5}$	341	[4] ALEXANDER	01B	CLE2	$B \to D^{(*)}\omega\pi^-$
	1523 ± 10		[5] EDWARDS	00A	CLE2	$\tau^- \to \omega\pi^-\nu_\tau$
	1463 ± 25		[6] CLEGG	94	RVUE	
	1250		[7] ASTON	80C	OMEG	20–70 $\gamma p \to \omega\pi^0 p$
	1290 ± 40		[7] BARBER	80C	SPEC	3–5 $\gamma p \to \omega\pi^0 p$

YOUR NOTE

[1] Using Breit-Wigner parameterization of the $\rho(1450)$ and assuming equal probabilities of the $\rho(1450) \to \pi\pi$ and $\rho(1450) \to \omega\pi$ decays. NODE=M105M3;LINKAGE=C

[2] From a phenomenological model based on vector meson dominance with the interfering $\rho(1450)$ and $\rho(1700)$ and their widths fixed at 400 and 250 MeV, respectively. Systematic uncertainty not estimated. NODE=M105M3;LINKAGE=AC

[3] Using the data of AKHMETSHIN 03B and BISELLO 91B assuming the $\omega\pi^0$ and $\pi^+\pi^-$ mass dependence of the total width. $\rho(1700)$ mass and width fixed at 1700 MeV and 240 MeV, respectively. NODE=M105M3;LINKAGE=HK

[4] Using Breit-Wigner parameterization of the $\rho(1450)$ and assuming the $\omega\pi^-$ mass dependence for the total width. NODE=M105M3;LINKAGE=3Z

[5] Mass-independent width parameterization. $\rho(1700)$ mass and width fixed at 1700 MeV and 235 MeV respectively. NODE=M105M;LINKAGE=E1

[6] Using data from BISELLO 91B, DOLINSKY 86 and ALBRECHT 87L. NODE=M105M3;LINKAGE=B

[7] Not separated from $b_1(1235)$, not pure $J^P = 1^-$ effect. NODE=M105M3;LINKAGE=A

$\rho(1450)$ WIDTH

NODE=M105210

$\omega\pi$ MODE

NODE=M105W3
NODE=M105W3

	VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
	• • • We do not use the following data for averages, fits, limits, etc. • • •					
YOUR DATA	303^{+31+69}_{-52-7}	821	[1] MATVIENKO	15	BELL	$\overline{B}^0 \to D^{*0}\omega\pi^-$
	$429 \pm 42 \pm 10$	2382	[2] AKHMETSHIN	03B	CMD2	$e^+e^- \to \pi^0\pi^0\gamma$
	$547 \pm 86^{+46}_{-45}$	341	[3] ALEXANDER	01B	CLE2	$B \to D^{(*)}\omega\pi^-$
	400 ± 35		[4] EDWARDS	00A	CLE2	$\tau^- \to \omega\pi^-\nu_\tau$
	311 ± 62		[5] CLEGG	94	RVUE	
	300		[6] ASTON	80C	OMEG	20–70 $\gamma p \to \omega\pi^0 p$
	320 ± 100		[6] BARBER	80C	SPEC	3–5 $\gamma p \to \omega\pi^0 p$

YOUR NOTE

[1] Using Breit-Wigner parameterization of the $\rho(1450)$ and assuming equal probabilities of the $\rho(1450) \to \pi\pi$ and $\rho(1450) \to \omega\pi$ decays. NODE=M105W3;LINKAGE=C

[2] Using the data of AKHMETSHIN 03B and BISELLO 91B assuming the $\omega\pi^0$ and $\pi^+\pi^-$ mass dependence of the total width. $\rho(1700)$ mass and width fixed at 1700 MeV and 240 MeV, respectively. NODE=M105W3;LINKAGE=HK

[3] Using Breit-Wigner parameterization of the $\rho(1450)$ and assuming the $\omega\pi^-$ mass dependence for the total width. NODE=M105W3;LINKAGE=3Z

[4] Mass-independent width parameterization. $\rho(1700)$ mass and width fixed at 1700 MeV and 235 MeV respectively. NODE=M105W;LINKAGE=E1

[5] Using data from BISELLO 91B, DOLINSKY 86 and ALBRECHT 87L. NODE=M105W3;LINKAGE=B
[6] Not separated from $b_1(1235)$, not pure $J^P = 1^-$ effect. NODE=M105W3;LINKAGE=A

$\rho(1450)$ BRANCHING RATIOS

NODE=M105225

$\Gamma(\omega\pi)/\Gamma_{total}$ — Γ_3/Γ

NODE=M105R5
NODE=M105R5

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
YOUR DATA seen	821	[1] MATVIENKO	15	BELL	$\overline{B}^0 \to D^{*0}\omega\pi^-$
seen	1.6k	ACHASOV	12	SND	$e^+e^- \to \pi^0\pi^0\gamma$
~ 0.21		CLEGG	94	RVUE	

YOUR NOTE [1] Using Breit-Wigner parameterization of the $\rho(1450)$ and assuming equal probabilities of the $\rho(1450) \to \pi\pi$ and $\rho(1450) \to \omega\pi$ decays. NODE=M105R5;LINKAGE=A

$\rho(1450)$ REFERENCES

NODE=M105

YOUR PAPER MATVIENKO	15	PR D92 012013	D. Matvienko *et al.*	(BELLE Collab.)	REFID=56601
ACHASOV	13	PR D88 054013	M.N. Achasov *et al.*	(SND Collab.)	REFID=55584
ACHASOV	12	JETPL 94 734 Translated from ZETFP 94 796.	M.N. Achasov *et al.*		REFID=54275
AKHMETSHIN	03B	PL B562 173	R.R. Akhmetshin *et al.*	(Novosibirsk CMD-2 Collab.)	REFID=49406
ALEXANDER	01B	PR D64 092001	J.P. Alexander *et al.*	(CLEO Collab.)	REFID=48391
EDWARDS	00A	PR D61 072003	K.W. Edwards *et al.*	(CLEO Collab.)	REFID=47465
CLEGG	94	ZPHY C62 455	A.B. Clegg, A. Donnachie	(LANC, MCHS)	REFID=44081
BISELLO	91B	NPBPS B21 111	D. Bisello	(DM2 Collab.)	REFID=41752
ALBRECHT	87L	PL B185 223	H. Albrecht *et al.*	(ARGUS Collab.)	REFID=40418
DOLINSKY	86	PL B174 453	S.I. Dolinsky *et al.*	(NOVO)	REFID=20246
ASTON	80C	PL 92B 211	D. Aston	(BONN, CERN, EPOL, GLAS, LANC+)	REFID=20652
BARBER	80C	ZPHY C4 169	D.P. Barber *et al.*	(DARE, LANC, SHEF)	REFID=20653

NODE=M065

$\rho(1700)$

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

$\rho(1700)$ BRANCHING RATIOS

NODE=M065230

$\Gamma(\pi^0\omega)/\Gamma_{total}$ — Γ_{18}/Γ

NODE=M065R13
NODE=M065R13

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
YOUR DATA not seen		MATVIENKO	15	BELL	$\overline{B}^0 \to D^{*0}\omega\pi^-$
seen	1.6k	ACHASOV	12	SND	$e^+e^- \to \pi^0\pi^0\gamma$
not seen	2382	AKHMETSHIN	03B	CMD2	$e^+e \to \pi^0\pi^0\gamma$
seen		ACHASOV	97	RVUE	$e^+e^- \to \omega\pi^0$

$\rho(1700)$ REFERENCES

NODE=M065

YOUR PAPER MATVIENKO	15	PR D92 012013	D. Matvienko *et al.*	(BELLE Collab.)	REFID=56601
ACHASOV	12	JETPL 94 734 Translated from ZETFP 94 796.	M.N. Achasov *et al.*		REFID=54275
AKHMETSHIN	03B	PL B562 173	R.R. Akhmetshin *et al.*	(Novosibirsk CMD-2 Collab.)	REFID=49406
ACHASOV	97	PR D55 2663	N.N. Achasov *et al.*	(NOVM)	REFID=45382

Reference = SANTEL 16; PR D93 011101
Verifier code = SAKAI

Normally we send all verifications for one experiment to one person, usually the spokesperson or data-analysis co-ordinator, who then distributes them to the appropriate people. Please tell us if we should send the verifications for your experiment to someone else.

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PLEASE REPLY WITHIN ONE WEEK

Yoshihide Sakai

EMAIL: yoshihide.sakai@kek.jp

July 21, 2016

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Thank you for helping us make the Review accurate and useful.

Sincerely,

Simon Eidelman
BINP, Budker Inst. of Nuclear Physics
Prospekt Lavrent'eva 11
RU-630090 Novosibirsk
Russian Federation

EMAIL: simon.eidelman@cern.ch

$b\bar{b}$ MESONS

NODE=MXXX030

NODE=M092

$\Upsilon(10860)$

$I^G(J^{PC}) = 0^-(1^{--})$

$\Upsilon(10860)$ MASS

NODE=M092M

	VALUE (MeV)	DOCUMENT ID		TECN	COMMENT	
YOUR DATA	**$10891.1 \pm 3.2^{+1.2}_{-2.0}$**	[1] SANTEL	16	BELL	$e^+e^- \to \Upsilon(1S,2S,3S)\pi^+\pi^-$	OCCUR=2
	• • • We do not use the following data for averages, fits, limits, etc. • • •					
YOUR DATA	$10881.8^{+1.0}_{-1.1} \pm 1.2$	[2,3] SANTEL	16	BELL	$e^+e^- \to$ hadrons	
	10879 ± 3	[4,5] CHEN	10	BELL	$e^+e^- \to$ hadrons	
	$10888.4^{+2.7}_{-2.6} \pm 1.2$	[6] CHEN	10	BELL	$e^+e^- \to \Upsilon(1S,2S,3S)\pi^+\pi^-$	OCCUR=2
	10876 ± 2	[4] AUBERT	09E	BABR	$e^+e^- \to$ hadrons	
	10869 ± 2	[7] AUBERT	09E	BABR	$e^+e^- \to$ hadrons	OCCUR=2
	$10868 \pm 6 \pm 5$	[8] BESSON	85	CLEO	$e^+e^- \to$ hadrons	
	10845 ± 20	[9] LOVELOCK	85	CUSB	$e^+e^- \to$ hadrons	

YOUR NOTE [1] From a simultaneous fit to the $\Upsilon(nS)\pi^+\pi^-$, n = 1, 2, 3 cross sections at 25 energy points within $\sqrt{s}$ = 10.6–11.05 GeV to a pair of interfering Breit-Wigner amplitudes modified by phase space factors, with fourteen resonance parameters (a mass, width, and three amplitudes for each of $\Upsilon(10860)$ and $\Upsilon(11020)$, a single universal relative phase, and three decoherence coefficients, one for each n). Continuum contributions were measured (and therefore fixed) to be zero. NODE=M092M;LINKAGE=C

YOUR NOTE [2] From a fit to the total hadronic cross sections measured at 60 energy points within $\sqrt{s}$ = 10.82–11.05 GeV to a pair of interfering Breit-Wigner amplitudes and two floating continuum amplitudes with $1/\sqrt{s}$ dependence, one coherent with the resonances and one incoherent, with six resonance parameters (a mass, width, and an amplitude for each of $\Upsilon(10860)$ and $\Upsilon(11020)$, one relative phase, and one decoherence coefficient). NODE=M092M;LINKAGE=A

YOUR NOTE [3] Not including uncertain and potentially large systematic errors due to assumed continuum amplitude $1/\sqrt{s}$ dependence and related interference contributions. NODE=M092M;LINKAGE=B

[4] In a model where a flat non-resonant $b\bar{b}$-continuum is incoherently added to a second flat component interfering with two Breit-Wigner resonances. Systematic uncertainties not estimated. NODE=M092M;LINKAGE=AU

[5] The parameters of the $\Upsilon(11020)$ are fixed to those in AUBERT 09E. NODE=M092M;LINKAGE=CH

[6] In a model where a flat nonresonant $\Upsilon(1S,2S,3S)\pi^+\pi^-$ continuum interferes with a single Breit-Wigner resonance. NODE=M092M;LINKAGE=CE

[7] In a model where a non-resonant $b\bar{b}$-continuum represented by a threshold function at $\sqrt{s}$=$2m_B$ is incoherently added to a flat component interfering with two Breit-Wigner resonances. Not independent of other AUBERT 09E results. Systematic uncertainties not estimated. NODE=M092M;LINKAGE=UB

[8] Assuming four Gaussians with radiative tails and a single step in R. NODE=M092M;LINKAGE=BE

[9] In a coupled-channel model with three resonances and a smooth step in R. NODE=M092M;LINKAGE=LO

$\Upsilon(10860)$ WIDTH

NODE=M092W

	VALUE (MeV)	DOCUMENT ID		TECN	COMMENT	
YOUR DATA	**$53.7^{+7.1}_{-5.6}{}^{+1.3}_{-5.4}$**	[10] SANTEL	16	BELL	$e^+e^- \to \Upsilon(1S,2S,3S)\pi^+\pi^-$	OCCUR=2
	• • • We do not use the following data for averages, fits, limits, etc. • • •					
YOUR DATA	$48.5^{+1.9}_{-1.8}{}^{+2.0}_{-2.8}$	[11,12] SANTEL	16	BELL	$e^+e^- \to$ hadrons	
	46^{+9}_{-7}	[13,14] CHEN	10	BELL	$e^+e^- \to$ hadrons	
	$30.7^{+8.3}_{-7.0} \pm 3.1$	[15] CHEN	10	BELL	$e^+e^- \to \Upsilon(1S,2S,3S)\pi^+\pi^-$	OCCUR=2
	43 ± 4	[13] AUBERT	09E	BABR	$e^+e^- \to$ hadrons	
	74 ± 4	[16] AUBERT	09E	BABR	$e^+e^- \to$ hadrons	OCCUR=2
	$112 \pm 17 \pm 23$	[17] BESSON	85	CLEO	$e^+e^- \to$ hadrons	
	110 ± 15	[18] LOVELOCK	85	CUSB	$e^+e^- \to$ hadrons	

YOUR NOTE [10] From a simultaneous fit to the $\Upsilon(\mathrm{nS})\pi^+\pi^-$, n = 1, 2, 3 cross sections at 25 energy points within $\sqrt{s}$ = 10.6–11.05 GeV to a pair of interfering Breit-Wigner amplitudes modified by phase space factors, with fourteen resonance parameters (a mass, width, and three amplitudes for each of $\Upsilon(10860)$ and $\Upsilon(11020)$, a single universal relative phase, and three decoherence coefficients, one for each n). Continuum contributions were measured (and therefore fixed) to be zero. NODE=M092W;LINKAGE=C

YOUR NOTE [11] From a fit to the total hadronic cross sections measured at 60 energy points within $\sqrt{s}$ = 10.82–11.05 GeV to a pair of interfering Breit-Wigner amplitudes and two floating continuum amplitudes with $1/\sqrt{s}$ dependence, one coherent with the resonances and one incoherent, with six resonance parameters (a mass, width, and an amplitude for each of $\Upsilon(10860)$ and $\Upsilon(11020)$, one relative phase, and one decoherence coefficient). NODE=M092W;LINKAGE=A

YOUR NOTE [12] Not including uncertain and potentially large systematic errors due to assumed continuum amplitude $1/\sqrt{s}$ dependence and related interference contributions. NODE=M092W;LINKAGE=B

[13] In a model where a flat non-resonant $b\overline{b}$-continuum is incoherently added to a second flat component interfering with two Breit-Wigner resonances. Systematic uncertainties not estimated. NODE=M092W;LINKAGE=AU

[14] The parameters of the $\Upsilon(11020)$ are fixed to those in AUBERT 09E. NODE=M092W;LINKAGE=CH

[15] In a model where a flat nonresonant $\Upsilon(1S, 2S, 3S)\pi^+\pi^-$ continuum interferes with a single Breit-Wigner resonance. NODE=M092W;LINKAGE=CE

[16] In a model where a non-resonant $b\overline{b}$-continuum represented by a threshold function at $\sqrt{s}$=$2m_B$ is incoherently added to a flat component interfering with two Breit-Wigner resonances. Not independent of other AUBERT 09E results. Systematic uncertainties not estimated. NODE=M092W;LINKAGE=UB

[17] Assuming four Gaussians with radiative tails and a single step in R. NODE=M092W;LINKAGE=BE

[18] In a coupled-channel model with three resonances and a smooth step in R. NODE=M092W;LINKAGE=LO

$\Upsilon(10860)$ REFERENCES

NODE=M092

YOUR PAPER

SANTEL	16	PR D93 011101	D. Santel *et al.*	(BELLE Collab.)	REFID=57121
CHEN	10	PR D82 091106	K.-F. Chen *et al.*	(BELLE Collab.)	REFID=53531
AUBERT	09E	PRL 102 012001	B. Aubert *et al.*	(BABAR Collab.)	REFID=52661
BESSON	85	PRL 54 381	D. Besson *et al.*	(CLEO Collab.)	REFID=22368
LOVELOCK	85	PRL 54 377	D.M.J. Lovelock *et al.*	(CUSB Collab.)	REFID=22369

NODE=M093

$\Upsilon(11020)$

$I^G(J^{PC}) = 0^-(1^{--})$

$\Upsilon(11020)$ MASS

NODE=M093M

NODE=M093M

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
YOUR DATA **$10987.5^{+6.4+9.1}_{-2.5-2.3}$**	[1] SANTEL	16	BELL	$e^+e^- \to \Upsilon(1S, 2S, 3S)\pi^+\pi^-$ OCCUR=2
• • • We do not use the following data for averages, fits, limits, etc. • • •				
YOUR DATA $11003.0 \pm 1.1^{+0.9}_{-1.0}$	[2,3] SANTEL	16	BELL	$e^+e^- \to$ hadrons
10996 ± 2	[4] AUBERT	09E	BABR	$e^+e^- \to$ hadrons
$11019 \pm 5 \pm 7$	BESSON	85	CLEO	$e^+e^- \to$ hadrons
11020 ± 30	LOVELOCK	85	CUSB	$e^+e^- \to$ hadrons

YOUR NOTE [1] From a simultaneous fit to the $\Upsilon(\mathrm{nS})\pi^+\pi^-$, n = 1, 2, 3 cross sections at 25 energy points within $\sqrt{s}$ = 10.6–11.05 GeV to a pair of interfering Breit-Wigner amplitudes modified by phase space factors, with fourteen resonance parameters (a mass, width, and three amplitudes for each of $\Upsilon(10860)$ and $\Upsilon(11020)$, a single universal relative phase, and three decoherence coefficients, one for each n). Continuum contributions were measured (and therefore fixed) to be zero. NODE=M093M;LINKAGE=C

YOUR NOTE [2] From a fit to the total hadronic cross sections measured at 60 energy points within $\sqrt{s}$ = 10.82–11.05 GeV to a pair of interfering Breit-Wigner amplitudes and two floating continuum amplitudes with $1/\sqrt{s}$ dependence, one coherent with the resonances and one incoherent, with six resonance parameters (a mass, width, and an amplitude for each of $\Upsilon(10860)$ and $\Upsilon(11020)$, one relative phase, and one decoherence coefficient). NODE=M093M;LINKAGE=A

YOUR NOTE [3] Not including uncertain and potentially large systematic errors due to assumed continuum amplitude $1/\sqrt{s}$ dependence and related interference contributions. NODE=M093M;LINKAGE=B

[4] In a model where a flat non-resonant $b\overline{b}$-continuum is incoherently added to a second flat component interfering with two Breit-Wigner resonances. Systematic uncertainties not estimated. NODE=M093M;LINKAGE=AU

$\Upsilon(11020)$ WIDTH

NODE=M093W

NODE=M093W

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
YOUR DATA **$61^{+9}_{-19}{}^{+2}_{-20}$**	[5] SANTEL	16	BELL	$e^+e^- \to \Upsilon(1S, 2S, 3S)\pi^+\pi^-$ OCCUR=2

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

YOUR DATA	$39.3^{+1.7}_{-1.6}{}^{+1.3}_{-2.4}$	[6,7] SANTEL	16	BELL	$e^+e^- \to$ hadrons	
	37 ± 3	[8] AUBERT	09E	BABR	$e^+e^- \to$ hadrons	
	$61 \pm 13 \pm 22$	BESSON	85	CLEO	$e^+e^- \to$ hadrons	
	90 ± 20	LOVELOCK	85	CUSB	$e^+e^- \to$ hadrons	

YOUR NOTE [5] From a simultaneous fit to the Υ(nS)$\pi^+\pi^-$, n=1, 2, 3 cross sections at 25 energy points within $\sqrt{s}$ = 10.6–11.05 GeV to a pair of interfering Breit-Wigner amplitudes modified by phase space factors, with fourteen resonance parameters (a mass, width, and three amplitudes for each of Υ(10860) and Υ(11020), a single universal relative phase, and three decoherence coefficients, one for each n). Continuum contributions were measured (and therefore fixed) to be zero. NODE=M093W;LINKAGE=C

YOUR NOTE [6] From a fit to the total hadronic cross sections measured at 60 energy points within $\sqrt{s}$ = 10.82–11.05 GeV to a pair of interfering Breit-Wigner amplitudes and two floating continuum amplitudes with $1/\sqrt{s}$ dependence, one coherent with the resonances and one incoherent, with six resonance parameters (a mass, width, and an amplitude for each of Υ(10860) and Υ(11020), one relative phase, and one decoherence coefficient). NODE=M093W;LINKAGE=A

YOUR NOTE [7] Not including uncertain and potentially large systematic errors due to assumed continuum amplitude $1/\sqrt{s}$ dependence and related interference contributions. NODE=M093W;LINKAGE=B

[8] In a model where a flat non-resonant $b\overline{b}$-continuum is incoherently added to a second flat component interfering with two Breit-Wigner resonances. Systematic uncertainties not estimated. NODE=M093W;LINKAGE=AU

Υ(11020) REFERENCES

NODE=M093

YOUR PAPER

SANTEL	16	PR D93 011101	D. Santel *et al.*	(BELLE Collab.)	REFID=57121
AUBERT	09E	PRL 102 012001	B. Aubert *et al.*	(BABAR Collab.)	REFID=52661
BESSON	85	PRL 54 381	D. Besson *et al.*	(CLEO Collab.)	REFID=22368
LOVELOCK	85	PRL 54 377	D.M.J. Lovelock *et al.*	(CUSB Collab.)	REFID=22369

Reference = TAMPONI 15; PRL 115 142001
Verifier code = SAKAI

Normally we send all verifications for one experiment to one person, usually the spokesperson or data-analysis co-ordinator, who then distributes them to the appropriate people. Please tell us if we should send the verifications for your experiment to someone else.

PLEASE READ NOW

PLEASE REPLY WITHIN ONE WEEK

Yoshihide Sakai

EMAIL: yoshihide.sakai@kek.jp

July 21, 2016

Dear Colleague,

(1) Please check the results of your experiment carefully. They are marked.

(2) Please reply within one week.

(3) Please reply even if everything is correct.

(4) IMPORTANT!! Please tell WHICH papers you are verifying. We have lots of requests out.

(5) Feel free to make comments on our treatment of any of the results (not just yours) you see.

Thank you for helping us make the Review accurate and useful.

Sincerely,

Simon Eidelman
BINP, Budker Inst. of Nuclear Physics
Prospekt Lavrent'eva 11
RU-630090 Novosibirsk
Russian Federation

EMAIL: simon.eidelman@cern.ch

$b\bar{b}$ MESONS

NODE=MXXX030

NODE=M171

$\eta_b(1S)$

$I^G(J^{PC}) = 0^+(0^{-+})$

OMITTED FROM SUMMARY TABLE

Quantum numbers shown are quark-model predictions. Observed in radiative decay of the $\Upsilon(3S)$, therefore $C = +$.

NODE=M171

$\eta_b(1S)$ MASS

NODE=M171M

NODE=M171M

	VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
	9399.0± 2.3 OUR AVERAGE		Error includes scale factor of 1.6. See the ideogram below.			
YOUR DATA	9400.7± 1.7± 1.6	33.1k	TAMPONI	15	BELL	$e^+e^- \to \eta_b(1S)\gamma\eta$
	9402.4± 1.5± 1.8	34k	[1] MIZUK	12	BELL	$e^+e^- \to \gamma\pi^+\pi^-$ + hadrons
	9391.8± 6.6± 2.0	2.3k	[2] BONVICINI	10	CLEO	$\Upsilon(3S) \to \gamma X$
	$9394.2^{+4.8}_{-4.9} \pm 2.0$	13k	[2] AUBERT	09AQ	BABR	$\Upsilon(2S) \to \gamma X$
	$9388.9^{+3.1}_{-2.3} \pm 2.7$	19k	[2] AUBERT	08V	BABR	$\Upsilon(3S) \to \gamma X$
	• • • We do not use the following data for averages, fits, limits, etc. • • •					
	9393.2± 3.4± 2.3	10	[2,3] DOBBS	12		$\Upsilon(2S) \to \gamma$ hadrons
	9300 ±20 ±20		HEISTER	02D	ALEP	181–209 e^+e^-

[1] With floating width. Not independent of the corresponding mass difference measurement.

[2] Assuming $\Gamma_{\eta_b(1S)} = 10$ MeV. Not independent of the corresponding γ energy or mass difference measurements.

[3] Obtained by analyzing CLEO III data but not authored by the CLEO Collaboration.

NODE=M171M;LINKAGE=MI

NODE=M171M;LINKAGE=AU

NODE=M171M;LINKAGE=DO

$\eta_b(1S)$ WIDTH

NODE=M171W

NODE=M171W

	VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
	10^{+5}_{-4} OUR AVERAGE					
YOUR DATA	$8^{+6}_{-5} \pm 5$	33.1k	TAMPONI	15	BELL	$e^+e^- \to \eta_b(1S)\gamma\eta$
	$10.8^{+4.0}_{-3.7}{}^{+4.5}_{-2.0}$	34k	[9] MIZUK	12	BELL	$e^+e^- \to \gamma\pi^+\pi^-$ + hadrons

[9] With floating mass.

NODE=M171W;LINKAGE=MI

$\eta_b(1S)$ REFERENCES

NODE=M171

YOUR PAPER	TAMPONI	15	PRL 115 142001	U. Tamponi *et al.*	(BELLE Collab.)
	DOBBS	12	PRL 109 082001	S. Dobbs *et al.*	
	MIZUK	12	PRL 109 232002	R. Mizuk *et al.*	(BELLE Collab.)
	BONVICINI	10	PR D81 031104	G. Bonvicini *et al.*	(CLEO Collab.)
	AUBERT	09AQ	PRL 103 161801	B. Aubert *et al.*	(BABAR Collab.)
	AUBERT	08V	PRL 101 071801	B. Aubert *et al.*	(BABAR Collab.)
	HEISTER	02D	PL B530 56	A. Heister *et al.*	(ALEPH Collab.)

REFID=56996
REFID=54288
REFID=54718
REFID=53231
REFID=53106
REFID=52262
REFID=48577

NODE=M204

$h_b(1P)$

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

Quantum numbers are quark model predictions, $C = -$ established by $\eta_b\gamma$ decay.

NODE=M204

$h_b(1P)$ MASS

NODE=M204M

NODE=M204M

	VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
	9899.3±0.8 OUR AVERAGE					
YOUR DATA	9899.3±0.4±1.0	112k	TAMPONI	15	BELL	$e^+e^- \to h_b(1P)\eta$
	9899.1±0.4±1.0	70k	MIZUK	12	BELL	$e^+e^- \to \pi^+\pi^-$ hadrons
	9902 ±4 ±2	10.8k	LEES	11K	BABR	$\Upsilon(3S) \to \eta_b\gamma\pi^0$
	• • • We do not use the following data for averages, fits, limits, etc. • • •					
	$9898.2^{+1.1}_{-1.0}{}^{+1.0}_{-1.1}$	50.0k	[1] ADACHI	12	BELL	10.86 $e^+e^- \to \pi^+\pi^-$ MM

[1] Superseded by MIZUK 12. NODE=M204M;LINKAGE=AD

$h_b(1P)$ BRANCHING RATIOS

NODE=M204225

$\Gamma(\eta_b(1S)\gamma)/\Gamma_{total}$ — Γ_1/Γ

NODE=M204R01
NODE=M204R01

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
$52\ ^{+6}_{-5}$ OUR AVERAGE					
YOUR DATA $56 \pm 8 \pm 4$	33.1k	[1] TAMPONI	15	BELL	$e^+e^- \to \eta_b(1S)\gamma\eta$
$49.2 \pm 5.7\ ^{+5.6}_{-3.3}$	24k	MIZUK	12	BELL	$e^+e^- \to (\gamma)\pi^+\pi^-$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •					
seen	10.8k	LEES	11K	BABR	$\Upsilon(3S) \to \eta_b\gamma\pi^0$

YOUR NOTE [1] Using B($\eta \to 2\gamma$) = (39.41 ± 0.20)%. NODE=M204R01;LINKAGE=A

$h_b(1P)$ REFERENCES

NODE=M204

YOUR PAPER

TAMPONI	15	PRL 115 142001	U. Tamponi *et al.*	(BELLE Collab.)
ADACHI	12	PRL 108 032001	I. Adachi *et al.*	(BELLE Collab.)
MIZUK	12	PRL 109 232002	R. Mizuk *et al.*	(BELLE Collab.)
LEES	11K	PR D84 091101	J.P. Lees *et al.*	(BABAR Collab.)

REFID=56996
REFID=53962
REFID=54718
REFID=53937
NODE=M047

$\Upsilon(4S)$ or $\Upsilon(10580)$

$I^G(J^{PC}) = 0^-(1^{--})$

$\Upsilon(4S)$ BRANCHING RATIOS

NODE=M047230

non-$B\overline{B}$ DECAYS

NODE=M047NBB

$\Gamma(\Upsilon(1S)\eta)/\Gamma_{total}$ — Γ_{19}/Γ

NODE=M047R18
NODE=M047R18

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
1.96±0.26±0.09		56	[24] AUBERT	08BP	BABR	$\Upsilon(4S) \to \pi^+\pi^-\pi^0\ell^+\ell^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
YOUR DATA <2.7	90		[25] TAMPONI	15	BELL	$e^+e^- \to \Upsilon(1S)\eta$

[24] Using B($\Upsilon(1S) \to e^+e^-$) = (2.38 ± 0.11)% and B($\Upsilon(1S) \to \mu^+\mu^-$) = (2.48 ± 0.05)%. NODE=M047R18;LINKAGE=UB

YOUR NOTE [25] Using B($\eta \to 2\gamma$) = (39.41 ± 0.20)%. NODE=M047R18;LINKAGE=A

$\Gamma(h_b(1P)\eta)/\Gamma_{total}$ — Γ_{22}/Γ

NODE=M047R00
NODE=M047R00

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
YOUR DATA **2.18±0.11±0.18**	112k	[31] TAMPONI	15	BELL	$e^+e^- \to h_b(1P)\eta$

YOUR NOTE [31] Using B($\eta \to 2\gamma$) = (39.41 ± 0.20)%. NODE=M047R00;LINKAGE=A

$\Upsilon(4S)$ REFERENCES

NODE=M047

YOUR PAPER

TAMPONI	15	PRL 115 142001	U. Tamponi *et al.*	(BELLE Collab.)
AUBERT	08BP	PR D78 112002	B. Aubert *et al.*	(BABAR Collab.)

REFID=56996
REFID=52660