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

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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

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

NODE=M207

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

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 $\Upsilon(10860) \to \Upsilon(2S)/\Upsilon(3S)\pi^0\pi^0$ 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 | $e^+e^- \to$ hadrons | NODE=M207M |
| | • • • 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 | $e^+e^- \to \Upsilon(1S)\pi^+\pi^-$ | |
| YOUR DATA | $10608.1 \pm 1.2^{+1.5}_{-0.2}$ | [2] GARMASH | 15 | BELL | $e^+e^- \to \Upsilon(2S)\pi^+\pi^-$ | OCCUR=2 |
| YOUR DATA | $10607.4 \pm 1.5^{+0.8}_{-0.2}$ | [2] GARMASH | 15 | BELL | $e^+e^- \to \Upsilon(3S)\pi^+\pi^-$ | OCCUR=3 |
| | 10611 ±4 ±3 | [3] BONDAR | 12 | BELL | $e^+e^- \to \Upsilon(1S)\pi^+\pi^-$ | OCCUR=2 |
| | 10609 ±2 ±3 | [3] BONDAR | 12 | BELL | $e^+e^- \to \Upsilon(2S)\pi^+\pi^-$ | OCCUR=3 |
| | 10608 ±2 ±3 | [3] BONDAR | 12 | BELL | $e^+e^- \to \Upsilon(3S)\pi^+\pi^-$ | OCCUR=4 |
| | $10605 \pm 2\ ^{+3}_{-1}$ | [3] BONDAR | 12 | BELL | $e^+e^- \to h_b(1P)\pi^+\pi^-$ | OCCUR=5 |
| | $10599\ ^{+6}_{-3}\ ^{+5}_{-4}$ | [3] BONDAR | 12 | BELL | $e^+e^- \to h_b(2P)\pi^+\pi^-$ | OCCUR=6 |

[1] Average of the BONDAR 12 measurements in separate channels. NODE=M207M;LINKAGE=BO

YOUR NOTE [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 | $e^+e^- \to$ hadrons | NODE=M207W |
| | • • • 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 | $e^+e^- \to \Upsilon(1S)\pi^+\pi^-$ | |
| YOUR DATA | $20.8 \pm 2.5^{+0.3}_{-2.1}$ | [5] GARMASH | 15 | BELL | $e^+e^- \to \Upsilon(2S)\pi^+\pi^-$ | OCCUR=2 |
| YOUR DATA | $18.7 \pm 13.4^{+2.5}_{-1.3}$ | [5] GARMASH | 15 | BELL | $e^+e^- \to \Upsilon(3S)\pi^+\pi^-$ | OCCUR=3 |
| | $22.3 \pm 7.7^{+3.0}_{-4.0}$ | [6] BONDAR | 12 | BELL | $e^+e^- \to \Upsilon(1S)\pi^+\pi^-$ | OCCUR=2 |
| | $24.2 \pm 3.1^{+2.0}_{-3.0}$ | [6] BONDAR | 12 | BELL | $e^+e^- \to \Upsilon(2S)\pi^+\pi^-$ | OCCUR=3 |
| | 17.6± 3.0±3.0 | [6] BONDAR | 12 | BELL | $e^+e^- \to \Upsilon(3S)\pi^+\pi^-$ | OCCUR=4 |
| | $11.4^{+\ 4.5+2.1}_{-\ 3.9-1.2}$ | [6] BONDAR | 12 | BELL | $e^+e^- \to h_b(1P)\pi^+\pi^-$ | OCCUR=5 |
| | $13\ ^{+10}_{-\ 8}\ ^{+9}_{-7}$ | [6] BONDAR | 12 | BELL | $e^+e^- \to h_b(2P)\pi^+\pi^-$ | OCCUR=6 |

[4] Average of the BONDAR 12 measurements in separate channels. NODE=M207W;LINKAGE=BO

YOUR NOTE [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

**$\Gamma(\Upsilon(1S)\pi^+)/\Gamma_{\text{total}}$** **$\Gamma_1/\Gamma$** NODE=M207R01

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

### $\Gamma(\Upsilon(2S)\pi^+)/\Gamma_{total}$ $\Gamma_2/\Gamma$

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 | $e^+e^- \to \Upsilon(2S)\pi^+\pi^-$ |

### $\Gamma(\Upsilon(3S)\pi^+)/\Gamma_{total}$ $\Gamma_3/\Gamma$

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.) | REFID=56811 |
| | KROKOVNY 13 | PR D88 052016 | P. Krokovny *et al.* | (BELLE Collab.) | REFID=55588 |
| | BONDAR 12 | PRL 108 122001 | A. Bondar *et al.* | (BELLE Collab.) | 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 $\Upsilon(\mathrm{nS})\pi^+\pi^-$ (n = 1, 2, 3) and $h_b(\mathrm{mP})\pi^+\pi^-$ (m = 1, 2). $J^P = 1^+$ is favored from angular analyses.

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 | $e^+e^- \to \Upsilon(2S)\pi^+\pi^-$ |
| YOUR DATA | $10651.2 \pm 1.0^{+0.4}_{-0.3}$ | [2] GARMASH | 15 | BELL | $e^+e^- \to \Upsilon(3S)\pi^+\pi^-$ |
| | $10657 \pm 6 \pm 3$ | [3] BONDAR | 12 | BELL | $e^+e^- \to \Upsilon(1S)\pi^+\pi^-$ |
| | $10651 \pm 2 \pm 3$ | [3] BONDAR | 12 | BELL | $e^+e^- \to \Upsilon(2S)\pi^+\pi^-$ |
| | $10652 \pm 1 \pm 2$ | [3] BONDAR | 12 | BELL | $e^+e^- \to \Upsilon(3S)\pi^+\pi^-$ |
| | $10654 \pm 3\ ^{+1}_{-2}$ | [3] BONDAR | 12 | BELL | $e^+e^- \to h_b(1P)\pi^+\pi^-$ |
| | $10651\ ^{+2}_{-3}\ ^{+3}_{-2}$ | [3] BONDAR | 12 | BELL | $e^+e^- \to h_b(2P)\pi^+\pi^-$ |

OCCUR=2
OCCUR=3
OCCUR=2
OCCUR=3
OCCUR=4
OCCUR=5
OCCUR=6

[1] Average of the BONDAR 12 measurements in separate channels.
YOUR NOTE [2] Correlated with the corresponding result from BONDAR 12.
[3] Superseded by the average measurement of BONDAR 12.

NODE=M208M;LINKAGE=BO
NODE=M208M;LINKAGE=A
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 | $12.1^{+11.3}_{-\ 4.8} \pm\ ^{2.7}_{0.6}$ | [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 | $e^+e^- \to \Upsilon(2S)\pi^+\pi^-$ |
| YOUR DATA | $9.3 \pm 2.2^{+\ 0.3}_{-\ 0.5}$ | [5] GARMASH | 15 | BELL | $e^+e^- \to \Upsilon(3S)\pi^+\pi^-$ |
| | $16.3 \pm 9.8^{+\ 6.0}_{-\ 2.0}$ | [6] BONDAR | 12 | BELL | $e^+e^- \to \Upsilon(1S)\pi^+\pi^-$ |
| | $13.3 \pm 3.3^{+\ 4.0}_{-\ 3.0}$ | [6] BONDAR | 12 | BELL | $e^+e^- \to \Upsilon(2S)\pi^+\pi^-$ |
| | $8.4 \pm 2.0 \pm 2.0$ | [6] BONDAR | 12 | BELL | $e^+e^- \to \Upsilon(3S)\pi^+\pi^-$ |
| | $20.9^{+\ 5.4}_{-\ 4.7} \pm\ ^{2.1}_{5.7}$ | [6] BONDAR | 12 | BELL | $e^+e^- \to h_b(1P)\pi^+\pi^-$ |
| | $19 \pm 7\ ^{+11}_{-\ 7}$ | [6] BONDAR | 12 | BELL | $e^+e^- \to h_b(2P)\pi^+\pi^-$ |

OCCUR=2
OCCUR=3
OCCUR=2
OCCUR=3
OCCUR=4
OCCUR=5
OCCUR=6

[4] Average of the BONDAR 12 measurements in separate channels. NODE=M208W;LINKAGE=BO
YOUR NOTE [5] Correlated with the corresponding result from BONDAR 12. NODE=M208W;LINKAGE=A
[6] Superseded by the average measurement of BONDAR 12. NODE=M208W;LINKAGE=BN

## $X(10650)^{\pm}$ BRANCHING RATIOS

NODE=M208225

### $\Gamma(\Upsilon(1S)\pi^+)/\Gamma_{total}$ $\Gamma_1/\Gamma$

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 | $e^+e^- \to \Upsilon(1S)\pi^+\pi^-$ |

### $\Gamma(\Upsilon(2S)\pi^+)/\Gamma_{total}$ $\Gamma_2/\Gamma$

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 | $e^+e^- \to \Upsilon(2S)\pi^+\pi^-$ |

### $\Gamma(\Upsilon(3S)\pi^+)/\Gamma_{total}$ $\Gamma_3/\Gamma$

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