

# ψ(4040)

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

## ψ(4040) MASS

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
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### 4039± 1 OUR ESTIMATE

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

4037± 2	<sup>1</sup> SETH	05A	RVUE	e <sup>+</sup> e <sup>-</sup> → hadrons
4040± 1	<sup>2</sup> SETH	05A	RVUE	e <sup>+</sup> e <sup>-</sup> → hadrons
4040±10	BRANDELIK	78C	DASP	e <sup>+</sup> e <sup>-</sup>

<sup>1</sup> From a fit to Crystal Ball (OSTERHELD 86) data.

<sup>2</sup> From a fit to BES (BAI 02C) data.

## ψ(4040) WIDTH

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
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### 80±10 OUR ESTIMATE

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

85±10	<sup>3</sup> SETH	05A	RVUE	e <sup>+</sup> e <sup>-</sup> → hadrons
89± 6	<sup>4</sup> SETH	05A	RVUE	e <sup>+</sup> e <sup>-</sup> → hadrons
52±10	BRANDELIK	78C	DASP	e <sup>+</sup> e <sup>-</sup>

<sup>3</sup> From a fit to Crystal Ball (OSTERHELD 86) data.

<sup>4</sup> From a fit to BES (BAI 02C) data.

## ψ(4040) DECAY MODES

Mode	Fraction (Γ <sub>i</sub> /Γ)	Confidence level
Γ <sub>1</sub> e <sup>+</sup> e <sup>-</sup>	(1.07±0.16) × 10 <sup>-5</sup>	
Γ <sub>2</sub> D <sup>0</sup> $\bar{D}^0$	seen	
Γ <sub>3</sub> D*(2007) <sup>0</sup> $\bar{D}^0$ + c.c.	seen	
Γ <sub>4</sub> D*(2007) <sup>0</sup> $\bar{D}^*(2007)^0$	seen	
Γ <sub>5</sub> J/ψ(1S)hadrons		
Γ <sub>6</sub> J/ψ π <sup>+</sup> π <sup>-</sup>	< 4 × 10 <sup>-3</sup>	90%
Γ <sub>7</sub> J/ψ π <sup>0</sup> π <sup>0</sup>	< 2 × 10 <sup>-3</sup>	90%
Γ <sub>8</sub> J/ψ η	< 7 × 10 <sup>-3</sup>	90%
Γ <sub>9</sub> J/ψ π <sup>0</sup>	< 2 × 10 <sup>-3</sup>	90%
Γ <sub>10</sub> J/ψ π <sup>+</sup> π <sup>-</sup> π <sup>0</sup>	< 2 × 10 <sup>-3</sup>	90%
Γ <sub>11</sub> χ <sub>c1</sub> γ	< 1.1 %	90%
Γ <sub>12</sub> χ <sub>c2</sub> γ	< 1.7 %	90%
Γ <sub>13</sub> χ <sub>c1</sub> π <sup>+</sup> π <sup>-</sup> π <sup>0</sup>	< 1.1 %	90%
Γ <sub>14</sub> χ <sub>c2</sub> π <sup>+</sup> π <sup>-</sup> π <sup>0</sup>	< 3.2 %	90%
Γ <sub>15</sub> φ π <sup>+</sup> π <sup>-</sup>	< 3 × 10 <sup>-3</sup>	90%
Γ <sub>16</sub> μ <sup>+</sup> μ <sup>-</sup>		

## $\psi(4040)$ PARTIAL WIDTHS

### $\Gamma(e^+e^-)$ $\Gamma_1$

VALUE (keV)	DOCUMENT ID	TECN	COMMENT
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**0.86±0.07 OUR ESTIMATE**

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

0.88±0.11	<sup>5</sup> SETH	05A	RVUE $e^+e^- \rightarrow$ hadrons
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0.91±0.13	<sup>6</sup> SETH	05A	RVUE $e^+e^- \rightarrow$ hadrons
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0.75±0.15	BRANDELIK	78C	DASP $e^+e^-$
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<sup>5</sup> From a fit to Crystal Ball (OSTERHELD 86) data.

<sup>6</sup> From a fit to BES (BAI 02C) data.

## $\psi(4040)$ BRANCHING RATIOS

### $\Gamma(e^+e^-)/\Gamma_{\text{total}}$ $\Gamma_1/\Gamma$

VALUE (units $10^{-5}$ )	DOCUMENT ID	TECN	COMMENT
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• • • We do not use the following data for averages, fits, limits, etc. • • •

~ 1.0	FELDMAN	77	MRK1 $e^+e^-$
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### $\Gamma(D^0\bar{D}^0)/\Gamma(D^*(2007)^0\bar{D}^0 + \text{c.c.})$ $\Gamma_2/\Gamma_3$

VALUE	DOCUMENT ID	TECN	COMMENT
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<b>0.05±0.03</b>	<sup>7</sup> GOLDHABER	77	MRK1 $e^+e^-$
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### $\Gamma(D^*(2007)^0\bar{D}^*(2007)^0)/\Gamma(D^*(2007)^0\bar{D}^0 + \text{c.c.})$ $\Gamma_4/\Gamma_3$

VALUE	DOCUMENT ID	TECN	COMMENT
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<b>32.0±12.0</b>	<sup>7</sup> GOLDHABER	77	MRK1 $e^+e^-$
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### $\Gamma(J/\psi\pi^+\pi^-)/\Gamma_{\text{total}}$ $\Gamma_6/\Gamma$

VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT
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<4	90	COAN	06	CLEO 3.97–4.06 $e^+e^- \rightarrow$ hadrons
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### $\Gamma(J/\psi\pi^0\pi^0)/\Gamma_{\text{total}}$ $\Gamma_7/\Gamma$

VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT
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<2	90	COAN	06	CLEO 3.97–4.06 $e^+e^- \rightarrow$ hadrons
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### $\Gamma(J/\psi\eta)/\Gamma_{\text{total}}$ $\Gamma_8/\Gamma$

VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT
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<7	90	COAN	06	CLEO 3.97–4.06 $e^+e^- \rightarrow$ hadrons
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### $\Gamma(J/\psi\pi^0)/\Gamma_{\text{total}}$ $\Gamma_9/\Gamma$

VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT
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<2	90	COAN	06	CLEO 3.97–4.06 $e^+e^- \rightarrow$ hadrons
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### $\Gamma(J/\psi\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$ $\Gamma_{10}/\Gamma$

VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT
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<2	90	COAN	06	CLEO 3.97–4.06 $e^+e^- \rightarrow$ hadrons
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$\Gamma(\chi_{c1}\gamma)/\Gamma_{\text{total}}$					$\Gamma_{11}/\Gamma$
VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT	
<11	90	COAN 06	CLEO	3.97–4.06 $e^+e^- \rightarrow$ hadrons	
$\Gamma(\chi_{c2}\gamma)/\Gamma_{\text{total}}$					$\Gamma_{12}/\Gamma$
VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT	
<17	90	COAN 06	CLEO	3.97–4.06 $e^+e^- \rightarrow$ hadrons	
$\Gamma(\chi_{c1}\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$					$\Gamma_{13}/\Gamma$
VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT	
<11	90	COAN 06	CLEO	3.97–4.06 $e^+e^- \rightarrow$ hadrons	
$\Gamma(\chi_{c2}\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$					$\Gamma_{14}/\Gamma$
VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT	
<32	90	COAN 06	CLEO	3.97–4.06 $e^+e^- \rightarrow$ hadrons	
$\Gamma(\phi\pi^+\pi^-)/\Gamma_{\text{total}}$					$\Gamma_{15}/\Gamma$
VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT	
<3	90	COAN 06	CLEO	3.97–4.06 $e^+e^- \rightarrow$ hadrons	

<sup>7</sup> Phase-space factor ( $p^3$ ) explicitly removed.

### $\psi(4040)$ REFERENCES

COAN 06	PRL 96 162003	T.E. Coan <i>et al.</i>	(CLEO Collab.)
SETH 05A	PR D72 017501	K.K. Seth	
BAI 02C	PRL 88 101802	J.Z. Bai <i>et al.</i>	(BES Collab.)
OSTERHELD 86	SLAC-PUB-4160	A. Osterheld <i>et al.</i>	(SLAC Crystal Ball Collab.)
BRANDELIK 78C	PL 76B 361	R. Brandelik <i>et al.</i>	(DASP Collab.)
Also	ZPHY C1 233	R. Brandelik <i>et al.</i>	(DASP Collab.)
FELDMAN 77	PRPL 33C 285	G.J. Feldman, M.L. Perl	(LBL, SLAC)
GOLDHABER 77	PL 69B 503	G. Goldhaber <i>et al.</i>	(Mark I Collab.)

### OTHER RELATED PAPERS

PAKHLOVA 07	PRL 98 092001	G. Pakhlova <i>et al.</i>	(BELLE Collab.)
DUBYNSKIY 06A	MPL A21 2779	S. Dubynskiy, M.B. Voloshin	
HEIKKILA 84	PR D29 110	K. Heikkila, N.A. Tornqvist, S. Ono	(HELS, AACHT)
ONO 84	ZPHY C26 307	S. Ono	(ORSAY)
SIEGRIST 82	PR D26 969	J.L. Siegrist <i>et al.</i>	(SLAC, LBL)
AUGUSTIN 75	PRL 34 764	J.E. Augustin <i>et al.</i>	(SLAC, LBL)
BACCI 75	PL 58B 481	C. Bacci <i>et al.</i>	(ROMA, FRAS)
BOYARSKI 75B	PRL 34 762	A.M. Boyarski <i>et al.</i>	(SLAC, LBL)
ESPOSITO 75	PL 58B 478	B. Esposito <i>et al.</i>	(FRAS, NAPL, PADO+)