NODE=M093

$\Upsilon(11020)$

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

$\Upsilon(11020)$ MASS

NODE=M093M

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT	
11000 ± 4 OUR AVERAGE					NODE=M093M
$11000.0^{+\ 4.0}_{-\ 4.5}{}^{+\ 1.0}_{-\ 1.3}$	[1] MIZUK	19	BELL	$e^+e^- \to \Upsilon(1S,2S,3S)\pi^+\pi^-$	
$10999.0^{+\ 7.3}_{-\ 7.8}{}^{+16.9}_{-\ 1.0}$	[2] MIZUK	16	BELL	$e^+e^- \to h_b(1P,2P)\pi^+\pi^-$	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
11001 ± 1	[3] DONG	20A		$e^+e^- \to b\bar{b}$	
$11003.0 \pm 1.1^{+\ 0.9}_{-\ 1.0}$	[4,5] SANTEL	16	BELL	$e^+e^- \to$ hadrons	
$10987.5^{+\ 6.4}_{-\ 2.5}{}^{+\ 9.1}_{-\ 2.3}$	[6,7] SANTEL	16	BELL	$e^+e^- \to \Upsilon(1S,2S,3S)\pi^+\pi^-$	OCCUR=2
10996 ± 2	[8] AUBERT	09E	BABR	$e^+e^- \to$ hadrons	
11019 ± 5 ± 7	BESSON	85	CLEO	$e^+e^- \to$ hadrons	
11020 ±30	LOVELOCK	85	CUSB	$e^+e^- \to$ hadrons	

[1] From a simultaneous fit to the $\Upsilon(nS)\pi^+\pi^-$, n = 1, 2, 3, cross sections at 28 energy points within $\sqrt{s}$ = 10.6–11.05 GeV, including the initial-state radiation at $\Upsilon(10860)$. NODE=M093M;LINKAGE=E

[2] From a simultaneous fit to the $h_b(nP)\pi^+\pi^-$, n = 1, 2 cross sections at 22 energy points within $\sqrt{s}$ = 10.77–11.02 GeV to a pair of interfering Breit-Wigner amplitudes modified by phase space factors, with eight resonance parameters (a mass and width for each of $\Upsilon(10860)$ and $\Upsilon(11020)$, a single relative phase, a single relative amplitude, and two overall normalization factors, one for each n). The systematic error estimate is dominated by possible interference with a small nonresonant continuum amplitude. NODE=M093M;LINKAGE=D

[3] From a fit to the dressed cross sections of AUBERT 09E by BaBar and SANTEL 16 by Belle above 10.68 GeV with a coherent sum of a continuum amplitude and three Breit-Wigner functions with constant widths. NODE=M093M;LINKAGE=G

[4] 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

[5] 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

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

[7] Superseded by MIZUK 19. NODE=M093M;LINKAGE=F

[8] 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=M093M;LINKAGE=AU

$\Upsilon(11020)$ WIDTH

NODE=M093W

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT	
$24^{+\ 8}_{-\ 6}$ OUR AVERAGE					NODE=M093W
$23.8^{+\ 8.0}_{-\ 6.8}{}^{+\ 0.7}_{-\ 1.8}$	[1] MIZUK	19	BELL	$e^+e^- \to \Upsilon(nS)\pi^+\pi^-$	
$27\ {}^{+27}_{-11}\ {}^{+\ 5}_{-12}$	[2] MIZUK	16	BELL	$e^+e^- \to h_b(1P,2P)\pi^+\pi^-$	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
35.1 ± 1.2	[3] DONG	20A		$e^+e^- \to b\bar{b}$	
$39.3^{+\ 1.7}_{-\ 1.6}{}^{+\ 1.3}_{-\ 2.4}$	[4,5] SANTEL	16	BELL	$e^+e^- \to$ hadrons	
$61\ {}^{+\ 9}_{-19}\ {}^{+\ 2}_{-20}$	[6,7] SANTEL	16	BELL	$e^+e^- \to \Upsilon(1S,2S,3S)\pi^+\pi^-$	OCCUR=2
37 ± 3	[8] AUBERT	09E	BABR	$e^+e^- \to$ hadrons	
61 ±13 ±22	BESSON	85	CLEO	$e^+e^- \to$ hadrons	
90 ±20	LOVELOCK	85	CUSB	$e^+e^- \to$ hadrons	

[1] From a simultaneous fit to the $\Upsilon(nS)\pi^+\pi^-$, n = 1, 2, 3, cross sections at 28 energy points within $\sqrt{s}$ = 10.6–11.05 GeV, including the initial-state radiation at $\Upsilon(10860)$. NODE=M093W;LINKAGE=E

[2] From a simultaneous fit to the $h_b(nP)\pi^+\pi^-$, n = 1, 2 cross sections at 22 energy points within $\sqrt{s}$ = 10.77–11.02 GeV to a pair of interfering Breit-Wigner amplitudes modified by phase space factors, with eight resonance parameters (a mass and width for each of $\Upsilon(10860)$ and $\Upsilon(11020)$, a single relative phase, a single relative amplitude, and two overall normalization factors, one for each n). The systematic error estimate is dominated by possible interference with a small nonresonant continuum amplitude. NODE=M093W;LINKAGE=D

[3] From a fit to the dressed cross sections of AUBERT 09E by BaBar and SANTEL 16 by Belle above 10.68 GeV with a coherent sum of a continuum amplitude and three Breit-Wigner functions with constant widths. NODE=M093W;LINKAGE=G

[4] 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=M093W;LINKAGE=A

[5] 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

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

[7] Superseded by MIZUK 19. NODE=M093W;LINKAGE=F

[8] 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=M093W;LINKAGE=AU

$\Upsilon(11020)$ DECAY MODES

NODE=M093215;NODE=M093

	Mode	Fraction (Γ_i/Γ)	
Γ_1	e^+e^-	$(5.4^{+1.9}_{-2.1})\times10^{-6}$	DESIG=1
Γ_2	$\Upsilon(1S)\pi^+\pi^-$		DESIG=5
Γ_3	$\Upsilon(2S)\pi^+\pi^-$		DESIG=6
Γ_4	$\Upsilon(3S)\pi^+\pi^-$		DESIG=7
Γ_5	$\chi_{bJ}(1P)\pi^+\pi^-\pi^0$	$(9\ ^{+9}_{-8}\ )\times10^{-3}$	DESIG=2
Γ_6	$\chi_{b1}(1P)\pi^+\pi^-\pi^0$	seen	DESIG=3
Γ_7	$\chi_{b2}(1P)\pi^+\pi^-\pi^0$	seen	DESIG=4

$\Upsilon(11020)$ PARTIAL WIDTHS

NODE=M093220

$\Gamma(e^+e^-)$ Γ_1

NODE=M093W1

VALUE (keV)	DOCUMENT ID		TECN	COMMENT	NODE=M093W1
0.130±0.030 OUR AVERAGE					
0.095±0.03 ±0.035	BESSON	85	CLEO	$e^+e^-\to$ hadrons	
0.156±0.040	LOVELOCK	85	CUSB	$e^+e^-\to$ hadrons	

$\Gamma(e^+e^-)\times\Gamma(\Upsilon(1S)\pi^+\pi^-)/\Gamma_{total}$ $\Gamma_1\Gamma_2/\Gamma$

NODE=M093R04

VALUE (eV)	DOCUMENT ID		TECN	COMMENT	NODE=M093R04
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.46±0.08	[1,2] MIZUK	19	BELL	$e^+e^-\to\ \Upsilon(nS)\pi^+\pi^-$	

[1] From a simultaneous fit to the $\Upsilon(nS)\pi^+\pi^-$, n = 1, 2, 3, cross sections at 28 energy points within $\sqrt{s}$ = 10.6–11.05 GeV, including the initial-state radiation at $\Upsilon(10860)$. NODE=M093R04;LINKAGE=A

[2] Reported as the range 0.38–0.54 eV obtained from multiple solutions of an amplitude fit within a model composed as a sum of Breit-Wigner functions. NODE=M093R04;LINKAGE=B

$\Gamma(e^+e^-)\times\Gamma(\Upsilon(2S)\pi^+\pi^-)/\Gamma_{total}$ $\Gamma_1\Gamma_3/\Gamma$

NODE=M093R05

VALUE (eV)	DOCUMENT ID		TECN	COMMENT	NODE=M093R05
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.65±0.52	[1,2] MIZUK	19	BELL	$e^+e^-\to\ \Upsilon(nS)\pi^+\pi^-$	

[1] From a simultaneous fit to the $\Upsilon(nS)\pi^+\pi^-$, n = 1, 2, 3, cross sections at 28 energy points within $\sqrt{s}$ = 10.6–11.05 GeV, including the initial-state radiation at $\Upsilon(10860)$. NODE=M093R05;LINKAGE=A

[2] Reported as the range 0.13–1.16 eV obtained from multiple solutions of an amplitude fit within a model composed as a sum of Breit-Wigner functions. NODE=M093R05;LINKAGE=B

$\Gamma(e^+e^-) \times \Gamma(\Upsilon(3S)\pi^+\pi^-)/\Gamma_{total}$ $\Gamma_1\Gamma_4/\Gamma$

NODE=M093R06
NODE=M093R06

VALUE (eV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.33±0.16	[1,2] MIZUK	19	BELL	$e^+e^- \to \Upsilon(nS)\pi^+\pi^-$

[1] From a simultaneous fit to the $\Upsilon(nS)\pi^+\pi^-$, n = 1, 2, 3, cross sections at 28 energy points within $\sqrt{s}$ = 10.6–11.05 GeV, including the initial-state radiation at $\Upsilon(10860)$. NODE=M093R06;LINKAGE=A

[2] Reported as the range 0.17–0.49 eV obtained from multiple solutions of an amplitude fit within a model composed as a sum of Breit-Wigner functions. NODE=M093R06;LINKAGE=B

$\Gamma(\chi_{bJ}(1P)\pi^+\pi^-\pi^0)/\Gamma_{total}$ Γ_5/Γ

NODE=M093R00
NODE=M093R00

VALUE (10^{-3})	DOCUMENT ID		TECN	COMMENT
$8.7\pm4.3^{+7.6}_{-6.6}$	YIN	18	BELL	$e^+e^- \to$ hadrons

$\Gamma(\chi_{b1}(1P)\pi^+\pi^-\pi^0)/\Gamma_{total}$ Γ_6/Γ

NODE=M093R01
NODE=M093R01

VALUE	DOCUMENT ID		TECN	COMMENT
seen	YIN	18	BELL	$e^+e^- \to$ hadrons

$\Gamma(\chi_{b2}(1P)\pi^+\pi^-\pi^0)/\Gamma_{total}$ Γ_7/Γ

NODE=M093R02
NODE=M093R02

VALUE	DOCUMENT ID		TECN	COMMENT
seen	YIN	18	BELL	$e^+e^- \to$ hadrons

$\Gamma(\chi_{b2}(1P)\pi^+\pi^-\pi^0)/\Gamma(\chi_{b1}(1P)\pi^+\pi^-\pi^0)$ Γ_7/Γ_6

NODE=M093R03
NODE=M093R03

VALUE	DOCUMENT ID		TECN	COMMENT
0.4±0.2	YIN	18	BELL	$e^+e^- \to$ hadrons

$\Upsilon(11020)$ REFERENCES

NODE=M093

DONG	20A	CP C44 083001	X.-K. Dong *et al.*	REFID=60595
MIZUK	19	JHEP 1910 220	R. Mizuk *et al.*	(BELLE Collab.) REFID=60090
YIN	18	PR D98 091102	J.H. Yin *et al.*	(BELLE Collab.) REFID=59468
MIZUK	16	PRL 117 142001	R. Mizuk *et al.*	(BELLE Collab.) REFID=57465
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