Reference = ANASHIN 14; PL B738 391
Verifier code = EIDELMAN

Normally we send all verifications for one experiment to one person, usually the spokesperson or data-analysis coordinator, 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

Simon Eidelman

EMAIL: simon.eidelman@cern.ch

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
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$c\overline{c}$ MESONS

NODE=MXXX025

NODE=M026

$\eta_c(1S)$

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

$\eta_c(1S)$ MASS

NODE=M026M

NODE=M026M

YOUR DATA

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT	
2983.4 ± 0.5 OUR AVERAGE		Error includes scale factor of 1.2.			
2982.2 ± 1.5 ± 0.1	2.0k	[1] AAIJ 15BI	LHCB	$p p \to \eta_c(1S) X$	
2983.5 ± 1.4 $^{+1.6}_{-3.6}$		[2] ANASHIN 14	KEDR	$J/\psi \to \gamma \eta_c$	
2979.8 ± 0.8 ± 3.5	4.5k	[3,4] LEES 14E	BABR	$\gamma\gamma \to K^+ K^- \pi^0$	
2984.1 ± 1.1 ± 2.1	900	[3,4,5] LEES 14E	BABR	$\gamma\gamma \to K^+ K^- \eta$	OCCUR=2
2984.3 ± 0.6 ± 0.6		[6,7] ABLIKIM 12F	BES3	$\psi(2S) \to \gamma \eta_c$	
2984.49 ± 1.16 ± 0.52	832	[3] ABLIKIM 12N	BES3	$\psi(2S) \to \pi^0 \gamma$ hadrons	
2982.7 ± 1.8 ± 2.2	486	ZHANG 12A	BELL	$e^+ e^- \to e^+ e^- \eta' \pi^+ \pi^-$	
2984.5 ± 0.8 ± 3.1	11k	DEL-AMO-SA...11M	BABR	$\gamma\gamma \to K^+ K^- \pi^+ \pi^- \pi^0$	
2985.4 ± 1.5 $^{+0.5}_{-2.0}$	920	[7] VINOKUROVA 11	BELL	$B^\pm \to K^\pm (K^0_S K^\pm \pi^\mp)$	
2982.2 ± 0.4 ± 1.6	14k	[8] LEES 10	BABR	10.6 $e^+ e^- \to e^+ e^- K^0_S K^\pm \pi^\mp$	
2985.8 ± 1.5 ± 3.1	0.9k	AUBERT 08AB	BABR	$B \to \eta_c(1S) K^{(*)} \to K \overline{K} \pi K^{(*)}$	
2986.1 ± 1.0 ± 2.5	7.5k	UEHARA 08	BELL	$\gamma\gamma \to \eta_c \to$ hadrons	
2970 ± 5 ± 6	501	[9] ABE 07	BELL	$e^+ e^- \to J/\psi(c\overline{c})$	
2971 ± 3 $^{+2}_{-1}$	195	WU 06	BELL	$B^+ \to p \overline{p} K^+$	
2974 ± 7 $^{+2}_{-1}$	20	WU 06	BELL	$B^+ \to \Lambda \overline{\Lambda} K^+$	OCCUR=2
2981.8 ± 1.3 ± 1.5	592	ASNER 04	CLEO	$\gamma\gamma \to \eta_c \to K^0_S K^\pm \pi^\mp$	
2984.1 ± 2.1 ± 1.0	190	[10] AMBROGIANI 03	E835	$\overline{p} p \to \eta_c \to \gamma\gamma$	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
2982.5 ± 0.4 ± 1.4	12k	[11] DEL-AMO-SA...11M	BABR	$\gamma\gamma \to K^0_S K^\pm \pi^\mp$	OCCUR=2
2982.2 ± 0.6		[12] MITCHELL 09	CLEO	$e^+ e^- \to \gamma X$	
2982 ± 5	270	[13] AUBERT 06E	BABR	$B^\pm \to K^\pm X_{c\overline{c}}$	
2982.5 ± 1.1 ± 0.9	2.5k	[14] AUBERT 04D	BABR	$\gamma\gamma \to \eta_c(1S) \to K \overline{K} \pi$	
2977.5 ± 1.0 ± 1.2		[12,15] BAI 03	BES	$J/\psi \to \gamma \eta_c$	
2979.6 ± 2.3 ± 1.6	180	[16] FANG 03	BELL	$B \to \eta_c K$	
2976.3 ± 2.3 ± 1.2		[12,17] BAI 00F	BES	$J/\psi,\ \psi(2S) \to \gamma \eta_c$	
2976.6 ± 2.9 ± 1.3	140	[12,18] BAI 00F	BES	$J/\psi \to \gamma \eta_c$	OCCUR=2
2980.4 ± 2.3 ± 0.6		[19] BRANDENB... 00B	CLE2	$\gamma\gamma \to \eta_c \to K^\pm K^0_S \pi^\mp$	
2975.8 ± 3.9 ± 1.2		[18] BAI 99B	BES	Sup. by BAI 00F	
2999 ± 8	25	ABREU 98O	DLPH	$e^+ e^- \to e^+ e^-$ +hadrons	
2988.3 $^{+3.3}_{-3.1}$		ARMSTRONG 95F	E760	$\overline{p} p \to \gamma\gamma$	
2974.4 ± 1.9		[12,20] BISELLO 91	DM2	$J/\psi \to \eta_c \gamma$	
2969 ± 4 ± 4	80	[12] BAI 90B	MRK3	$J/\psi \to \gamma K^+ K^- K^+ K^-$	
2956 ±12 ±12		[12] BAI 90B	MRK3	$J/\psi \to \gamma K^+ K^- K^0_S K^0_L$	OCCUR=3
2982.6 $^{+2.7}_{-2.3}$	12	BAGLIN 87B	SPEC	$\overline{p} p \to \gamma\gamma$	
2980.2 ± 1.6		[12,20] BALTRUSAIT...86	MRK3	$J/\psi \to \eta_c \gamma$	
2984 ± 2.3 ± 4.0		[12] GAISER 86	CBAL	$J/\psi \to \gamma X$, $\psi(2S) \to \gamma X$	
2976 ± 8		[12,21] BALTRUSAIT...84	MRK3	$J/\psi \to 2\phi\gamma$	
2982 ± 8	18	[22] HIMEL 80B	MRK2	$e^+ e^-$	
2980 ± 9		[22] PARTRIDGE 80B	CBAL	$e^+ e^-$	

[1] AAIJ 15BI reports $m_{J/\psi} - m_{\eta_c(1S)} = 114.7 \pm 1.5 \pm 0.1$ MeV from a sample of $\eta_c(1S)$ and J/ψ produced in b-hadron decays. We have used current value of $m_{J/\psi} = 3096.900 \pm 0.006$ MeV to arrive at the quoted $m_{\eta_c(1S)}$ result. NODE=M026M;LINKAGE=D

YOUR NOTE

[2] Taking into account an asymmetric photon lineshape. NODE=M026M;LINKAGE=E
[3] With floating width. NODE=M026M;LINKAGE=AL
[4] Ignoring possible interference with the non-resonant 0^- amplitude. NODE=M026M;LINKAGE=LS
[5] Using both, $\eta \to \gamma\gamma$ and $\eta \to \pi^+\pi^-\pi^0$ decays. NODE=M026M;LINKAGE=EL
[6] From a simultaneous fit to six decay modes of the η_c. NODE=M026M;LINKAGE=BL
[7] Accounts for interference with non-resonant continuum. NODE=M026M;LINKAGE=VA
[8] Taking into account interference with the non-resonant $J^P = 0^-$ amplitude. NODE=M026M;LINKAGE=LE
[9] From a fit of the J/ψ recoil mass spectrum. Supersedes ABE,K 02 and ABE 04G. NODE=M026M;LINKAGE=EB
[10] Using mass of $\psi(2S) = 3686.00$ MeV. NODE=M026M;LINKAGE=BG
[11] Not independent from the measurements reported by LEES 10. NODE=M026M;LINKAGE=DE
[12] MITCHELL 09 observes a significant asymmetry in the lineshapes of $\psi(2S) \to \gamma\eta_c$ and $J/\psi \to \gamma\eta_c$ transitions. If ignored, this asymmetry could lead to significant bias whenever the mass and width are measured in $\psi(2S)$ or J/ψ radiative decays. NODE=M026M;LINKAGE=MI
[13] From the fit of the kaon momentum spectrum. Systematic errors not evaluated. NODE=M026M;LINKAGE=AU
[14] Superseded by LEES 10. NODE=M026M;LINKAGE=UB
[15] From a simultaneous fit of five decay modes of the η_c. NODE=M026M;LINKAGE=AK
[16] Superseded by VINOKUROVA 11. NODE=M026M;LINKAGE=FA
[17] Weighted average of the $\psi(2S)$ and $J/\psi(1S)$ samples. Using an η_c width of 13.2 MeV. NODE=M026M;LINKAGE=KZ
[18] Average of several decay modes. Using an η_c width of 13.2 MeV. NODE=M026M;LINKAGE=C1
[19] Superseded by ASNER 04. NODE=M026M;LINKAGE=NN
[20] Average of several decay modes. NODE=M026M;LINKAGE=A
[21] $\eta_c \to \phi\phi$. NODE=M026M;LINKAGE=B
[22] Mass adjusted by us to correspond to $J/\psi(1S)$ mass = 3097 MeV. NODE=M026M;LINKAGE=M

$\eta_c(1S)$ WIDTH

NODE=M026W

NODE=M026W

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT	
31.9± 1.0 OUR AVERAGE		Error includes scale factor of 1.2.			
$27.2 \pm 3.1^{+5.4}_{-2.6}$		[1] ANASHIN 14	KEDR	$J/\psi \to \gamma\eta_c$	
$25.2 \pm 2.6 \pm 2.4$	4.5k	[2,3] LEES 14E	BABR	$\gamma\gamma \to K^+K^-\pi^0$	
$34.8 \pm 3.1 \pm 4.0$	900	[2,3,4] LEES 14E	BABR	$\gamma\gamma \to K^+K^-\eta$	OCCUR=2
$32.0 \pm 1.2 \pm 1.0$		[5,6] ABLIKIM 12F	BES3	$\psi(2S) \to \gamma\eta_c$	
$36.4 \pm 3.2 \pm 1.7$	832	[2] ABLIKIM 12N	BES3	$\psi(2S) \to \pi^0\gamma$ hadrons	
$37.8^{+5.8}_{-5.3} \pm 3.1$	486	ZHANG 12A	BELL	$e^+e^- \to e^+e^-\eta'\pi^+\pi^-$	
$36.2 \pm 2.8 \pm 3.0$	11k	DEL-AMO-SA..11M	BABR	$\gamma\gamma \to K^+K^-\pi^+\pi^-\pi^0$	
$35.1 \pm 3.1^{+1.0}_{-1.6}$	920	[6] VINOKUROVA 11	BELL	$B^\pm \to K^\pm(K^0_S K^\pm\pi^\mp)$	
$31.7 \pm 1.2 \pm 0.8$	14k	[7] LEES 10	BABR	$10.6\ e^+e^- \to e^+e^-K^0_S K^\pm\pi^\mp$	
$36.3^{+3.7}_{-3.6} \pm 4.4$	0.9k	AUBERT 08AB	BABR	$B \to \eta_c(1S)K^{(*)} \to K\overline{K}\pi K^{(*)}$	
$28.1 \pm 3.2 \pm 2.2$	7.5k	UEHARA 08	BELL	$\gamma\gamma \to \eta_c \to$ hadrons	
$48\ ^{+8}_{-7} \pm 5$	195	WU 06	BELL	$B^+ \to p\overline{p}K^+$	
$40 \pm 19 \pm 5$	20	WU 06	BELL	$B^+ \to \Lambda\overline{\Lambda}K^+$	OCCUR=2
$24.8 \pm 3.4 \pm 3.5$	592	ASNER 04	CLEO	$\gamma\gamma \to \eta_c \to K^0_S K^\pm\pi^\mp$	
$20.4^{+7.7}_{-6.7} \pm 2.0$	190	AMBROGIANI 03	E835	$\overline{p}p \to \eta_c \to \gamma\gamma$	
$23.9^{+12.6}_{-7.1}$		ARMSTRONG 95F	E760	$\overline{p}p \to \gamma\gamma$	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$32.1 \pm 1.1 \pm 1.3$	12k	[8] DEL-AMO-SA..11M	BABR	$\gamma\gamma \to K^0_S K^\pm\pi^\mp$	OCCUR=2
$34.3 \pm 2.3 \pm 0.9$	2.5k	[9] AUBERT 04D	BABR	$\gamma\gamma \to \eta_c(1S) \to K\overline{K}\pi$	
$17.0 \pm 3.7 \pm 7.4$		[10] BAI 03	BES	$J/\psi \to \gamma\eta_c$	
$29 \pm 8 \pm 6$	180	[11] FANG 03	BELL	$B \to \eta_c K$	
$11.0 \pm 8.1 \pm 4.1$		[12] BAI 00F	BES	$J/\psi \to \gamma\eta_c$ and $\psi(2S) \to \gamma\eta_c$	
$27.0 \pm 5.8 \pm 1.4$		[13] BRANDENB... 00B	CLE2	$\gamma\gamma \to \eta_c \to K^\pm K^0_S\pi^\mp$	
$7.0^{+7.5}_{-7.0}$	12	BAGLIN 87B	SPEC	$\overline{p}p \to \gamma\gamma$	
$10.1^{+33.0}_{-8.2}$	23	[14] BALTRUSAIT..86	MRK3	$J/\psi \to \gamma p\overline{p}$	

YOUR DATA

11.5± 4.5			GAISER	86	CBAL	$J/\psi \to \gamma X$, $\psi(2S) \to \gamma X$
< 40	90% CL	18	HIMEL	80B	MRK2	$e^+ e^-$
< 20	90% CL		PARTRIDGE	80B	CBAL	$e^+ e^-$

YOUR NOTE

[1] Taking into account an asymmetric photon lineshape. NODE=M026W;LINKAGE=A
[2] With floating mass. NODE=M026W;LINKAGE=AL
[3] Ignoring possible interference with the non-resonant 0^- amplitude. NODE=M026W;LINKAGE=LS
[4] Using both, $\eta \to \gamma\gamma$ and $\eta \to \pi^+\pi^-\pi^0$ decays. NODE=M026W;LINKAGE=EL
[5] From a simultaneous fit to six decay modes of the η_c. NODE=M026W;LINKAGE=BL
[6] Accounts for interference with non-resonant continuum. NODE=M026W;LINKAGE=VA
[7] Taking into account interference with the non-resonant $J^P = 0^-$ amplitude. NODE=M026W;LINKAGE=LE
[8] Not independent from the measurements reported by LEES 10. NODE=M026W;LINKAGE=DE
[9] Superseded by LEES 10. NODE=M026W;LINKAGE=UB
[10] From a simultaneous fit of five decay modes of the η_c. NODE=M026W;LINKAGE=AK
[11] Superseded by VINOKUROVA 11. NODE=M026W;LINKAGE=FA
[12] From a fit to the 4-prong invariant mass in $\psi(2S) \to \gamma\eta_c$ and $J/\psi(1S) \to \gamma\eta_c$ decays. NODE=M026W;LINKAGE=KZ
[13] Superseded by ASNER 04. NODE=M026W;LINKAGE=NN
[14] Positive and negative errors correspond to 90% confidence level. NODE=M026W;LINKAGE=L

$\eta_c(1S)$ REFERENCES

NODE=M026

YOUR PAPER

AAIJ	15BI	EPJ C75 311	R. Aaij *et al.*	(LHCb Collab.)	REFID=57147
ANASHIN	14	PL B738 391	V.V. Anashin *et al.*	(KEDR Collab.)	REFID=56130
LEES	14E	PR D89 112004	J.P. Lees *et al.*	(BABAR Collab.)	REFID=55937
ABLIKIM	12F	PRL 108 222002	M. Ablikim *et al.*	(BES III Collab.)	REFID=54271
ABLIKIM	12N	PR D86 092009	M. Ablikim *et al.*	(BES III Collab.)	REFID=54741
ZHANG	12A	PR D86 052002	C.C. Zhang *et al.*	(BELLE Collab.)	REFID=54763
DEL-AMO-SA...	11M	PR D84 012004	P. del Amo Sanchez *et al.*	(BABAR Collab.)	REFID=16751
VINOKUROVA	11	PL B706 139	A. Vinokurova *et al.*	(BELLE Collab.)	REFID=53927
LEES	10	PR D81 052010	J.P. Lees *et al.*	(BABAR Collab.)	REFID=53236
MITCHELL	09	PRL 102 011801	R.E. Mitchell *et al.*	(CLEO Collab.)	REFID=52676
AUBERT	08AB	PR D78 012006	B. Aubert *et al.*	(BABAR Collab.)	REFID=52267
UEHARA	08	EPJ C53 1	S. Uehara *et al.*	(BELLE Collab.)	REFID=52064
ABE	07	PRL 98 082001	K. Abe *et al.*	(BELLE Collab.)	REFID=51627
AUBERT	06E	PRL 96 052002	B. Aubert *et al.*	(BABAR Collab.)	REFID=51059
WU	06	PRL 97 162003	C.-H. Wu *et al.*	(BELLE Collab.)	REFID=51472
ABE	04G	PR D70 071102	K. Abe *et al.*	(BELLE Collab.)	REFID=50182
ASNER	04	PRL 92 142001	D.M. Asner *et al.*	(CLEO Collab.)	REFID=49745
AUBERT	04D	PRL 92 142002	B. Aubert *et al.*	(BABAR Collab.)	REFID=49746
AMBROGIANI	03	PL B566 45	M. Ambrogiani *et al.*	(FNAL E835 Collab.)	REFID=49465
BAI	03	PL B555 174	J.Z. Bai *et al.*	(BES Collab.)	REFID=49185
FANG	03	PRL 90 071801	F. Fang *et al.*	(BELLE Collab.)	REFID=49206
ABE,K	02	PRL 89 142001	K. Abe *et al.*	(BELLE Collab.)	REFID=49188
BAI	00F	PR D62 072001	J.Z. Bai *et al.*	(BES Collab.)	REFID=48546
BRANDENB...	00B	PRL 85 3095	G. Brandenburg *et al.*	(CLEO Collab.)	REFID=48553
BAI	99B	PR D60 072001	J.Z. Bai *et al.*	(BES Collab.)	REFID=47385
ABREU	98O	PL B441 479	P. Abreu *et al.*	(DELPHI Collab.)	REFID=46553
ARMSTRONG	95F	PR D52 4839	T.A. Armstrong *et al.*	(FNAL, FERR, GENO+)	REFID=44623
BISELLO	91	NP B350 1	D. Bisello *et al.*	(DM2 Collab.)	REFID=41668
BAI	90B	PRL 65 1309	Z. Bai *et al.*	(Mark III Collab.)	REFID=41354
BAGLIN	87B	PL B187 191	C. Baglin *et al.*	(R704 Collab.)	REFID=40018
BALTRUSAIT...	86	PR D33 629	R.M. Baltrusaitis *et al.*	(Mark III Collab.)	REFID=22009
GAISER	86	PR D34 711	J. Gaiser *et al.*	(Crystal Ball Collab.)	REFID=22012
BALTRUSAIT...	84	PRL 52 2126	R.M. Baltrusaitis *et al.*	(CIT, UCSC+) JP	REFID=22006
HIMEL	80B	PRL 45 1146	T.M. Himel *et al.*	(SLAC, LBL, UCB)	REFID=22003
PARTRIDGE	80B	PRL 45 1150	R. Partridge *et al.*	(CIT, HARV, PRIN+)	REFID=22004

NODE=M070

$J/\psi(1S)$

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

$J/\psi(1S)$ BRANCHING RATIOS

NODE=M070230

RADIATIVE DECAYS

NODE=M070310

$\Gamma(\gamma\eta_c(1S))/\Gamma_{total}$ — Γ_{146}/Γ

NODE=M070R85
NODE=M070R85

VALUE (units 10^{-2})	*EVTS*	*DOCUMENT ID*	*TECN*	*COMMENT*
1.7 ±0.4 OUR AVERAGE Error includes scale factor of 1.5.				
2.01±0.32±0.02		[1] MITCHELL 09	CLEO	$e^+e^- \to \gamma X$
1.27±0.36		GAISER 86	CBAL	$J/\psi \to \gamma X$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
seen		ANASHIN 14	KEDR	$J/\psi \to \gamma\eta_c$
0.79±0.20	273 ± 43	[2] AUBERT 06E	BABR	$B^\pm \to K^\pm X_{c\overline{c}}$
seen	16	BALTRUSAIT...84	MRK3	$J/\psi \to 2\phi\gamma$

YOUR DATA

[1] MITCHELL 09 reports $(1.98 \pm 0.09 \pm 0.30) \times 10^{-2}$ from a measurement of $[\Gamma(J/\psi(1S) \rightarrow \gamma\eta_c(1S))/\Gamma_{total}] \times [B(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-)]$ assuming $B(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-) = (35.04 \pm 0.07 \pm 0.77) \times 10^{-2}$, which we rescale to our best value $B(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-) = (34.49 \pm 0.30) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value. NODE=M070R85;LINKAGE=MI

[2] Calculated by the authors using an average of $B(J/\psi \rightarrow \gamma\eta_c) \times B(\eta_c \rightarrow K\overline{K}\pi)$ from BALTRUSAITIS 86, BISELLO 91, BAI 04 and $B(\eta_c \rightarrow K\overline{K}\pi) = (8.5 \pm 1.8)\%$ from AUBERT 06E. NODE=M070R85;LINKAGE=AU

$J/\psi(1S)$ REFERENCES

NODE=M070

YOUR PAPER	ANASHIN	14	PL B738 391	V.V. Anashin *et al.*	(KEDR Collab.)	REFID=56130
	MITCHELL	09	PRL 102 011801	R.E. Mitchell *et al.*	(CLEO Collab.)	REFID=52676
	AUBERT	06E	PRL 96 052002	B. Aubert *et al.*	(BABAR Collab.)	REFID=51059
	BAI	04	PL B578 16	J.Z. Bai *et al.*	(BES Collab.)	REFID=49620
	BISELLO	91	NP B350 1	D. Bisello *et al.*	(DM2 Collab.)	REFID=41668
	BALTRUSAIT...	86	PR D33 629	R.M. Baltrusaitis *et al.*	(Mark III Collab.)	REFID=22009
	GAISER	86	PR D34 711	J. Gaiser *et al.*	(Crystal Ball Collab.)	REFID=22012
	BALTRUSAIT...	84	PRL 52 2126	R.M. Baltrusaitis *et al.*	(CIT, UCSC+)	REFID=22006