

Z_{cs}(4000)

$$I(J^P) = \frac{1}{2}(1^+)$$

OMITTED FROM SUMMARY TABLE

Properties incompatible with a $q\bar{q}$ structure (exotic state). See the review on "Heavy Non- $q\bar{q}$ Mesons."

Seen by AAIJ 21E in $B^+ \rightarrow Z_{cs}(4000)^+ \phi$ with $Z_{cs}(4000)^+ \rightarrow J/\psi K^+$ using an amplitude analysis of $B^+ \rightarrow J/\psi \phi K^+$ with a significance (accounting for systematic uncertainties) of 15σ . The $J^P = 1^+$ assignment is favored with high significance. ABLIKIM 21G also reports a $J^P = 1^+$ Z_{cs} state in this mass region using $e^+ e^- \rightarrow K^+(D_s^- D^{*0} + D_s^{*-} D^0)$ with a significance of 5.3σ . The incompatible values for the widths reported by AAIJ 21E and ABLIKIM 21G could either indicate the existence of two separate states or possibly be explained in a coupled channel model (see ORTEGA 21).

Z_{cs}(4000) MASS

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
3980–4010 OUR EVALUATION				
3988 ± 5 OUR AVERAGE Error includes scale factor of 2.7.				
3992.2 ± 1.7 ± 1.6		¹ ABLIKIM	22AE BES3	$e^+ e^- \rightarrow K_S^0 (D_s^- D^{*+} + D_s^{*-} D^+)$
4003 ± 6 ⁺⁴ / ₋₁₄	24k	² AAIJ	21E LHCb	$B^+ \rightarrow J/\psi \phi K^+$
3982.5 ^{+1.8} / _{-2.6} ± 2.1		³ ABLIKIM	21G BES3	$e^+ e^- \rightarrow K^+ (D_s^- D^{*0} + D_s^{*-} D^0)$

¹ Pole mass for a mass-, width-dependent Breit-Wigner fit to the mass spectrum recoiling against K_S^0 at center of mass energies between 4.628 and 4.699 GeV, with a significance of 4.6σ .

² From an amplitude analysis of the decay $B^+ \rightarrow J/\psi \phi K^+$ with a significance of 15σ .

³ Pole mass for a mass-dependent Breit-Wigner fit to the mass spectrum recoiling against K^+ at center of mass energies between 4.628 and 4.698 GeV, with a significance of 5.3σ .

Z_{cs}(4000) WIDTH

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
5–150 OUR EVALUATION				
13 ± 4 OUR AVERAGE				
7.7 ^{+4.1} / _{-3.8} ± 4.3		¹ ABLIKIM	22AE BES3	$e^+ e^- \rightarrow K_S^0 (D_s^- D^{*+} + D_s^{*-} D^+)$
131 ± 15 ± 26	24k	² AAIJ	21E LHCb	$B^+ \rightarrow J/\psi \phi K^+$

$$12.8^{+5.3}_{-4.4} \pm 3.0 \quad {}^3\text{ABLIKIM} \quad 21\text{G BES3} \quad e^+e^- \rightarrow K^+(D_s^- D^{*0} + D_s^{*-} D^0)$$

¹ Pole width for a mass-, width-dependent Breit-Wigner fit to the mass spectrum recoiling against K_S^0 at center of mass energies between 4.628 and 4.699 GeV, with a significance of 4.6 σ .

² From an amplitude analysis of the decay $B^+ \rightarrow J/\psi \phi K^+$ with a significance of 15 σ .

³ Pole width for a mass-dependent Breit-Wigner fit to the mass spectrum recoiling against K^+ at center of mass energies between 4.628 and 4.698 GeV, with a significance of 5.3 σ .

$Z_{cs}(4000)$ DECAY MODES

Mode	Fraction (Γ_i/Γ)
$\Gamma_1 \quad J/\psi K^+$	seen
$\Gamma_2 \quad D_s^+ \bar{D}^{*0} \text{ or } D_s^{*+} \bar{D}^0$	seen

$\Gamma(J/\psi K^+)/\Gamma_{\text{total}} \quad \Gamma_1/\Gamma$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
seen	24k	¹ AAIJ	21E LHCb	$B^+ \rightarrow J/\psi \phi K^+$

¹ From an amplitude analysis of the decay $B^+ \rightarrow J/\psi \phi K^+$ with a significance of 15 σ .

$\Gamma(D_s^+ \bar{D}^{*0} \text{ or } D_s^{*+} \bar{D}^0)/\Gamma_{\text{total}} \quad \Gamma_2/\Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
seen	¹ ABLIKIM	22AE BES3	$e^+e^- \rightarrow K_S^0(D_s^- D^{*+} + D_s^{*-} D^+)$
seen	² ABLIKIM	21G BES3	$e^+e^- \rightarrow K^+(D_s^- D^{*0} + D_s^{*-} D^0)$

¹ Seen in the mass spectrum recoiling against K_S^0 at center of mass energies between 4.628 and 4.699 GeV, with a significance of 4.6 σ .

² Seen in the spectrum recoiling against K^+ in $e^+e^- \rightarrow K^+(D_s^- D^{*0} + D_s^{*-} D^0)$ collisions at center of mass energies between 4.628 and 4.698 GeV, with a significance of 5.3 σ .

$Z_{cs}(4000)$ REFERENCES

ABLIKIM	22AE PRL 129 112003	M. Ablikim <i>et al.</i>	(BESIII Collab.)
AAIJ	21E PRL 127 082001	R. Aaij <i>et al.</i>	(LHCb Collab.) JP
ABLIKIM	21G PRL 126 102001	M. Ablikim <i>et al.</i>	(BESIII Collab.)
ORTEGA	21 PL B818 136382	P.G. Ortega, D.R. Entem, F. Fernandez	