$T_{c\overline{c}s1}(4000)$

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

OMITTED FROM SUMMARY TABLE
was $Z_{cs}(4000)$

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

Seen by AAIJ 21E in $B^+ \to T_{c\overline{c}s1}(4000)^+ \phi$ with $T_{c\overline{c}s1}(4000)^+ \to J/\psi K^+$ using an amplitude analysis of $B^+ \to J/\psi\phi K^+$ with a significance (accounting for systematic uncertainties) of 15 σ. The $J^P = 1^+$ assignment is favored with high significance. ABLIKIM 21G also reports a $J^P = 1^+$ $T_{c\overline{c}s}$ state in this mass region using $e^+e^- \to K^+(D_s^- D^{*0} + D_s^{*-} D^0)$ with a significance of 5.3 σ. 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).

$T_{c\overline{c}s1}(4000)$ MASS

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
3980–4010 OUR EVALUATION					
3988 ± 5 OUR AVERAGE		Error includes scale factor of 2.7.			
$3991\ ^{+12}_{-10}\ ^{+9}_{-17}$		[1] AAIJ	23AQ	LHCB	$B^0 \to J/\psi\phi K^0_S$
$3992.2 \pm 1.7 \pm 1.6$		[2] ABLIKIM	22AE	BES3	$e^+e^- \to K^0_S(D_s^- D^{*+} + D_s^{*-} D^+)$
$4003 \pm 6\ ^{+4}_{-14}$	24k	[3] AAIJ	21E	LHCB	$B^+ \to J/\psi\phi K^+$
$3982.5^{+1.8}_{-2.6} \pm 2.1$		[4] ABLIKIM	21G	BES3	$e^+e^- \to K^+(D_s^- D^{*0} + D_s^{*-} D^0)$

[1] From an amplitude analysis of the decay $B^0 \to J/\psi\phi K^0_S$ with a significance of 4.0 σ. The mass difference with respect to the charged partner in AAIJ 21E is -12^{+11+6}_{-10-4} MeV.

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

[3] From an amplitude analysis of the decay $B^+ \to J/\psi\phi K^+$ with a significance of 15 σ.

[4] 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 5.3 σ.

$T_{c\bar{c}s1}(4000)$ WIDTH

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
5–150 OUR EVALUATION					
14 ± 4 OUR AVERAGE		Error includes scale factor of 1.1.			
$105\ ^{+29}_{-25}\ ^{+17}_{-23}$		[1] AAIJ	23AQ	LHCB	$B^0 \to J/\psi\phi K^0_S$
$7.7^{+\ 4.1}_{-\ 3.8} \pm 4.3$		[2] ABLIKIM	22AE	BES3	$e^+e^- \to K^0_S(D_s^- D^{*+} + D_s^{*-} D^+)$
$131\ \pm 15\ \pm 26$	24k	[3] AAIJ	21E	LHCB	$B^+ \to J/\psi\phi K^+$
$12.8^{+\ 5.3}_{-\ 4.4} \pm 3.0$		[4] ABLIKIM	21G	BES3	$e^+e^- \to K^+(D_s^- D^{*0} + D_s^{*-} D^0)$

[1] From an amplitude analysis of the decay $B^0 \to J/\psi\phi K^0_S$ with a significance of 4.0 σ.
[2] Pole width for a mass-, width-dependent Breit-Wigner fit to the mass spectrum recoiling against K^0_S at center of mass energies between 4.628 and 4.699 GeV, with a significance of 4.6 σ.
[3] From an amplitude analysis of the decay $B^+ \to J/\psi\phi K^+$ with a significance of 15 σ.
[4] 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.

$T_{c\bar{c}s1}(4000)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$J/\psi K^+$	seen
Γ_2	$J/\psi K^0_S$	seen
Γ_3	$D_s^+ \overline{D}^{*0}$ or $D_s^{*+} \overline{D}^0$	seen
Γ_4	$D_s^+ D^{*-}$ or $D_s^{*+} D^-$	seen

$T_{c\bar{c}s1}(4000)$ BRANCHING RATIOS

$\Gamma(J/\psi K^+)/\Gamma_{\text{total}}$ Γ_1/Γ

VALUE	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
seen	24k	[1] AAIJ	21E	LHCB	$B^+ \to J/\psi\phi K^+$

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

$\Gamma(J/\psi K^0_S)/\Gamma_{\text{total}}$ Γ_2/Γ

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
seen	[1] AAIJ	23AQ	LHCB	$B^0 \to J/\psi\phi K^0_S$

[1] From an amplitude analysis of the decay $B^0 \to J/\psi\phi K^0_S$ with a significance of 4.0 σ.

$\Gamma(D_s^+ \overline{D}^{*0}$ or $D_s^{*+} \overline{D}^0)/\Gamma_{\text{total}}$ Γ_3/Γ

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
seen	[1] ABLIKIM	21G	BES3	$e^+e^- \to K^+(D_s^- D^{*0} + D_s^{*-} D^0)$

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

$\Gamma(J/\psi K^+)/\Gamma(D_s^+ \overline{D}^{*0}$ or $D_s^{*+} \overline{D}^0)$ Γ_1/Γ_3

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.03	90	ABLIKIM	23BI	BES3	$e^+e^- \to K^+K^- J/\psi$

$\Gamma(D_s^+ D^{*-}$ or $D_s^{*+} D^-)/\Gamma_{\text{total}}$ Γ_4/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
seen	[1] ABLIKIM	22AE	BES3	$e^+e^- \to K^0_S(D_s^- D^{*+} + D_s^{*-} D^+)$

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

$T_{c\bar{c}s1}(4000)$ REFERENCES

AAIJ	23AQ	PRL 131 131901	R. Aaij *et al.*	(LHCb Collab.)
ABLIKIM	23BI	PRL 131 211902	M. Ablikim *et al.*	(BESIII Collab.)
ABLIKIM	22AE	PRL 129 112003	M. Ablikim *et al.*	(BESIII Collab.)
AAIJ	21E	PRL 127 082001	R. Aaij *et al.*	(LHCb Collab.) JP
ABLIKIM	21G	PRL 126 102001	M. Ablikim *et al.*	(BESIII Collab.)
ORTEGA	21	PL B818 136382	P.G. Ortega, D.R. Entem, F. Fernandez	