$$B_c^{\pm}$$

$I(J^P) = 0(0^-)$

I, J, P need confirmation.

Quantum numbers shown are quark-model predictions.

$B_c^{\pm}$ MASS

VALUE (GeV)	DOCUMENT ID		TECN	COMMENT
6.277 ±0.006 OUR AVERAGE	Error includes scale factor of 1.6.			
$6.2756 \pm 0.0029 \pm 0.0025$	[1] AALTONEN	08M	CDF	$p\overline{p}$ at 1.96 TeV
$6.300 \pm 0.014 \pm 0.005$	[1] ABAZOV	08T	D0	$p\overline{p}$ at 1.96 TeV
$6.4 \pm 0.39 \pm 0.13$	[2] ABE	98M	CDF	$p\overline{p}$ at 1.8 TeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$6.2857 \pm 0.0053 \pm 0.0012$	[1] ABULENCIA	06C	CDF	Repl. by AALTONEN 08M
6.32 ± 0.06	[3] ACKERSTAFF	98O	OPAL	$e^+ e^- \to Z$

[1] Measured using a fully reconstructed decay mode of $B_c \to J/\psi \pi$.

[2] ABE 98M observed $20.4^{+6.2}_{-5.5}$ events in the $B_c^+ \to J/\psi(1s)\ell\nu_\ell$ with a significance of > 4.8 standard deviations. The mass value is estimated from $m(J/\psi(1S)\ell)$.

[3] ACKERSTAFF 98O observed 2 candidate events in the $B_c \to J/\psi(1S)\pi^+$ channel with an estimated background of 0.63 ± 0.20 events.

$B_c^{\pm}$ MEAN LIFE

"OUR EVALUATION" is an average using rescaled values of the data listed below. The average and rescaling were performed by the Heavy Flavor Averaging Group (HFAG) and are described at http://www.slac.stanford.edu/xorg/hfag/. The averaging/rescaling procedure takes into account correlations between the measurements.

VALUE (10^{-12} s)	DOCUMENT ID		TECN	COMMENT
0.453±0.041 OUR EVALUATION				
0.45 ±0.04 OUR AVERAGE				
$0.448^{+0.038}_{-0.036} \pm 0.032$	[4] ABAZOV	09H	D0	$p\overline{p}$ at 1.96 TeV
$0.463^{+0.073}_{-0.065} \pm 0.036$	[5] ABULENCIA	06O	CDF	$p\overline{p}$ at 1.96 TeV
$0.46^{+0.18}_{-0.16} \pm 0.03$	[5] ABE	98M	CDF	$p\overline{p}$ 1.8 TeV

[4] The lifetime is measured from the $J/\psi\mu$ decay vertices.

[5] The lifetime is measured from the $J/\psi e$ decay vertices.

B_c^+ DECAY MODES × B($\overline{b} \to B_c$)

B_c^- modes are charge conjugates of the modes below.

Mode	Fraction (Γ_i/Γ)	Confidence level

The following quantities are not pure branching ratios; rather the fraction $\Gamma_i/\Gamma \times B(\overline{b} \to B_c)$.

Γ_1	$J/\psi(1S)\ell^+ \nu_\ell$ anything	$(5.2^{+2.4}_{-2.1}) \times 10^{-5}$		
Γ_2	$J/\psi(1S)\pi^+$	< 8.2	$\times 10^{-5}$	90%
Γ_3	$J/\psi(1S)\pi^+\pi^+\pi^-$	< 5.7	$\times 10^{-4}$	90%
Γ_4	$J/\psi(1S)a_1(1260)$	< 1.2	$\times 10^{-3}$	90%
Γ_5	$D^*(2010)^+ \overline{D}^0$	< 6.2	$\times 10^{-3}$	90%

B_c^+ BRANCHING RATIOS

$\Gamma(J/\psi(1S)\ell^+ \nu_\ell \text{ anything})/\Gamma_{\text{total}} \times B(\overline{b} \to B_c)$ $\Gamma_1/\Gamma \times B$

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$(5.2^{+2.4}_{-2.1}) \times 10^{-5}$		[6] ABE	98M	CDF	$p\overline{p}$ 1.8 TeV

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

VALUE		CL%	DOCUMENT ID		TECN	COMMENT
< 1.6	$\times 10^{-4}$	90	[7] ACKERSTAFF	98O	OPAL	$e^+e^- \to Z$
< 1.9	$\times 10^{-4}$	90	[8] ABREU	97E	DLPH	$e^+e^- \to Z$
< 1.2	$\times 10^{-4}$	90	[9] BARATE	97H	ALEP	$e^+e^- \to Z$

[6] ABE 98M result is derived from the measurement of $[\sigma(B_c) \times B(B_c \to J/\psi(1S)\ell\nu_\ell)]$ / $[\sigma(B^+) \times B(B^+ \to J/\psi(1S)K^+)] = 0.132^{+0.041}_{-0.037}(\text{stat}) \pm 0.031(\text{sys})^{+0.032}_{-0.020}(\text{lifetime})$ by using PDG 98 values of $B(b \to B^+)$ and $B(B^+ \to J/\psi(1S)K^+)$.

[7] ACKERSTAFF 98O reports $B(Z \to B_c X)/B(Z \to q q) \times B(B_c \to J/\psi(1S)\ell\nu_\ell) < 6.95 \times 10^{-5}$ at 90%CL. We rescale to our PDG 98 values of $B(Z \to b\overline{b})$.

[8] ABREU 97E value listed is for an assumed $\tau_{B_c} = 0.4$ ps and improves to 1.6×10^{-4} for $\tau_{B_c} = 1.4$ ps.

[9] BARATE 97H reports $B(Z \to B_c X)/B(Z \to q q) \cdot B(B_c \to J/\psi(1S)\ell\nu_\ell) < 5.2 \times 10^{-5}$ at 90%CL. We rescale to our PDG 96 values of $B(Z \to b\overline{b})$. A $B_c^+ \to J/\psi(1S)\mu^+\nu_\mu$ candidate event is found, compared to all the known background sources 2×10^{-3}, which gives $m_{B_c} = 5.96^{+0.25}_{-0.19}$ GeV and $\tau_{B_c} = 1.77 \pm 0.17$ ps.

$\Gamma(J/\psi(1S)\pi^+)/\Gamma_{\text{total}} \times B(\overline{b} \to B_c)$ $\Gamma_2/\Gamma \times B$

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<8.2 \times 10^{-5}$	90	[10] BARATE	97H	ALEP	$e^+e^- \to Z$

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<2.4 \times 10^{-4}$	90	[11] ACKERSTAFF	98O	OPAL	$e^+e^- \to Z$
$<3.4 \times 10^{-4}$	90	[12] ABREU	97E	DLPH	$e^+e^- \to Z$
$<2.0 \times 10^{-5}$	95	[13] ABE	96R	CDF	$p\overline{p}$ 1.8 TeV

[10] BARATE 97H reports $B(Z \to B_c X)/B(Z \to q q) \cdot B(B_c \to J/\psi(1S)\pi) < 3.6 \times 10^{-5}$ at 90%CL. We rescale to our PDG 96 values of $B(Z \to b\overline{b})$.

[11] ACKERSTAFF 98O reports $B(Z \to B_c X)/B(Z \to q q) \times B(B_c \to J/\psi(1S)\pi^+) < 1.06 \times 10^{-4}$ at 90%CL. We rescale to our PDG 98 values of $B(Z \to b\overline{b})$.

[12] ABREU 97E value listed is for an assumed $\tau_{B_c} = 0.4$ ps and improves to 2.7×10^{-4} for $\tau_{B_c} = 1.4$ ps.

[13] ABE 96R reports B($b \to B_c$X)/B($b \to B^+$X)·B($B_c^+ \to J/\psi(1S)\pi^+$)/B($B^+ \to J/\psi(1S)K^+$) < 0.053 at 95%CL for $\tau_{B_c} = 0.8$ ps. It changes from 0.15 to 0.04 for 0.17 ps$< \tau_{B_c} < 1.6$ ps. We rescale to our PDG 96 values of B($b \to B^+$) $= 0.378 \pm 0.022$ and B($B^+ \to J/\psi(1S)K^+$) $= 0.00101 \pm 0.00014$.

$\Gamma(J/\psi(1S)\pi^+\pi^+\pi^-)/\Gamma_{total} \times B(\overline{b} \to B_c)$ $\qquad$ $\Gamma_3/\Gamma \times B$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<5.7 × 10⁻⁴	90	[14] ABREU 97E	DLPH	$e^+e^- \to Z$

$<5.7 \times 10^{-4}$

[14] ABREU 97E value listed is independent of 0.4 ps$< \tau_{B_c} < 1.4$ ps.

$\Gamma(J/\psi(1S)a_1(1260))/\Gamma_{total} \times B(\overline{b} \to B_c)$ $\qquad$ $\Gamma_4/\Gamma \times B$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<1.2 × 10⁻³	90	[15] ACKERSTAFF 98O	OPAL	$e^+e^- \to Z$

$<1.2 \times 10^{-3}$

[15] ACKERSTAFF 98O reports B($Z \to B_c$X)/B($Z \to q\overline{q}$)×B($B_c \to J/\psi(1S)a_1(1260)$) $< 5.29 \times 10^{-4}$ at 90%CL. We rescale to our PDG 98 values of B($Z \to b\overline{b}$).

$\Gamma(D^*(2010)^+\overline{D^0})/\Gamma_{total} \times B(\overline{b} \to B_c)$ $\qquad$ $\Gamma_5/\Gamma \times B$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<6.2 × 10⁻³	90	[16] BARATE 98Q	ALEP	$e^+e^- \to Z$

$<6.2 \times 10^{-3}$

[16] BARATE 98Q reports B($Z \to B_c$X)×B($B_c \to D^*(2010)^+\overline{D^0}$) $< 1.9 \times 10^{-3}$ at 90%CL. We rescale to our PDG 98 values of B($Z \to b\overline{b}$).

$B_c^\pm$ REFERENCES

ABAZOV	09H	PRL 102 092001	V.M. Abazov *et al.*	(D0 Collab.)
AALTONEN	08M	PRL 100 182002	T. Aaltonen *et al.*	(CDF Collab.)
ABAZOV	08T	PRL 101 012001	V.M. Abazov *et al.*	(D0 Collab.)
ABULENCIA	06C	PRL 96 082002	A. Abulencia *et al.*	(CDF Collab.)
ABULENCIA	06O	PRL 97 012002	A. Abulencia *et al.*	(CDF Collab.)
ABE	98M	PRL 81 2432	F. Abe *et al.*	(CDF Collab.)
Also		PR D58 112004	F. Abe *et al.*	(CDF Collab.)
ACKERSTAFF	98O	PL B420 157	K. Ackerstaff *et al.*	(OPAL Collab.)
BARATE	98Q	EPJ C4 387	R. Barate *et al.*	(ALEPH Collab.)
PDG	98	EPJ C3 1	C. Caso *et al.*	
ABREU	97E	PL B398 207	P. Abreu *et al.*	(DELPHI Collab.)
BARATE	97H	PL B402 213	R. Barate *et al.*	(ALEPH Collab.)
ABE	96R	PRL 77 5176	F. Abe *et al.*	(CDF Collab.)
PDG	96	PR D54 1	R. M. Barnett *et al.*	