NODE=S091

# $B_c^\pm$

$I(J^P) = 0(0^-)$
$I$, $J$, $P$ need confirmation.

Quantum numbers shown are quark-model predictions.

NODE=S091

## $B_c^\pm$ MASS

NODE=S091205

| VALUE (GeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **6.4 ±0.39±0.13** | [1] ABE | 98M | CDF | $p\overline{p}$ 1.8 TeV |

NODE=S091M

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

| | | | | |
|---|---|---|---|---|
| 6.32±0.06 | [2] ACKERSTAFF | 98O | OPAL | $e^+e^- \to Z$ |

[1] 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 $m(J/\psi(1S)\ell)$.

NODE=S091M;LINKAGE=A

[2] 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.

NODE=S091M;LINKAGE=D

## $B_c^\pm$ MEAN LIFE

NODE=S091210

| VALUE ($10^{-12}$ s) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **$0.46^{+0.18}_{-0.16}\pm0.03$** | [3] ABE | 98M | CDF | $p\overline{p}$ 1.8 TeV |

NODE=S091T

[3] The lifetime is measured from the $J/\psi(1S)\ell$ decay vertices.

NODE=S091T;LINKAGE=A

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

NODE=S091215;NODE=S091

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

NODE=S091

| | Mode | Fraction ($\Gamma_i/\Gamma$) | | Confidence level | |
|---|---|---|---|---|---|
| | The following quanities are not pure branching ratios; rather the fraction $\Gamma_i/\Gamma \times$ B($\overline{b} \to B_c$). | | | | CLUMP=A;NODE=S091 |
| $\Gamma_1$ | $J/\psi(1S)\ell^+\nu_\ell$anything | $(5.2^{+2.4}_{-2.1}) \times 10^{-5}$ | | | DESIG=1;OUR EVAL |
| $\Gamma_2$ | $J/\psi(1S)\pi^+$ | $< 8.2$ | $\times 10^{-5}$ | 90% | DESIG=2;OUR EVAL |
| $\Gamma_3$ | $J/\psi(1S)\pi^+\pi^+\pi^-$ | $< 5.7$ | $\times 10^{-4}$ | 90% | DESIG=3;OUR EVAL |
| $\Gamma_4$ | $J/\psi(1S)a_1(1260)$ | $< 1.2$ | $\times 10^{-3}$ | 90% | DESIG=4;OUR EVAL |
| $\Gamma_5$ | $D^*(2010)^+\overline{D}^0$ | $< 6.2$ | $\times 10^{-3}$ | 90% | DESIG=5;OUR EVAL |

## $B_c^+$ BRANCHING RATIOS

NODE=S091225

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

NODE=S091R1

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **$(5.2^{+2.4}_{-2.1}) \times 10^{-5}$** | | [4] ABE | 98M | CDF | $p\overline{p}$ 1.8 TeV |

NODE=S091R1

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

| | | | | | | |
|---|---|---|---|---|---|---|
| $< 1.6$ | $\times 10^{-4}$ | 90 | [5] ACKERSTAFF | 98O | OPAL | $e^+e^- \to Z$ |
| $< 1.9$ | $\times 10^{-4}$ | 90 | [6] ABREU | 97E | DLPH | $e^+e^- \to Z$ |
| $< 1.2$ | $\times 10^{-4}$ | 90 | [7] BARATE | 97H | ALEP | $e^+e^- \to Z$ |

[4] 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$(B^+ \to J/\psi(1S)K^+)] = 0.132^{+0.041}_{-0.037}(\text{stat})\pm0.031(\text{sys})^{+0.032}_{-0.020}(\text{lifteime})$ by using PDG 98 values of B$(b \to B^+)$ and B$(B^+ \to J/\psi(1S)K^+)$.

NODE=S091R1;LINKAGE=C

[5] ACKERSTAFF 98O reports B$(Z \to B_c X)$/B$(Z \to q\overline{q})\times$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$(Z \to b\overline{b})$.

NODE=S091R1;LINKAGE=D

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

NODE=S091R1;LINKAGE=A

[7] BARATE 97H reports B$(Z \to B_c X)$/B$(Z \to q\overline{q})\cdot$B$(B_c \to J/\psi(1S)\ell\nu_\ell) < 5.2\times10^{-5}$ 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 $2 \times 10^{-3}$, which gives $m_{B_c} = 5.96^{+0.25}_{-0.19}$ GeV and $\tau_{B_c} = 1.77 \pm 0.17$ ps.

NODE=S091R1;LINKAGE=B

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

NODE=S091R2
NODE=S091R2

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **$<8.2 \times 10^{-5}$** | 90 | [8] BARATE | 97H | ALEP | $e^+e^- \to Z$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| $<2.4 \times 10^{-4}$ | 90 | [9] ACKERSTAFF | 98O | OPAL | $e^+e^- \to Z$ |
| $<3.4 \times 10^{-4}$ | 90 | [10] ABREU | 97E | DLPH | $e^+e^- \to Z$ |
| $<2.0 \times 10^{-5}$ | 95 | [11] ABE | 96R | CDF | $p\overline{p}$ 1.8 TeV |

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

NODE=S091R2;LINKAGE=B

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

NODE=S091R2;LINKAGE=D

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

NODE=S091R2;LINKAGE=A

[11] ABE 96R reports $B(b \to B_c X)/B(b \to B^+ X) \cdot B(B_c^+ \to J/\psi(1S)\pi^+)/B(B^+ \to J/\psi(1S)K^+) < 0.053$ 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 $B(B^+ \to J/\psi(1S)K^+) = 0.00101 \pm 0.00014$.

NODE=S091R2;LINKAGE=C

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

NODE=S091R3
NODE=S091R3

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **$<5.7 \times 10^{-4}$** | 90 | [12] ABREU | 97E | DLPH | $e^+e^- \to Z$ |

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

NODE=S091R3;LINKAGE=A

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

NODE=S091R4
NODE=S091R4

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **$<1.2 \times 10^{-3}$** | 90 | [13] ACKERSTAFF | 98O | OPAL | $e^+e^- \to Z$ |

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

NODE=S091R4;LINKAGE=D

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

NODE=S091R5
NODE=S091R5

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **$<6.2 \times 10^{-3}$** | 90 | [14] BARATE | 98Q | ALEP | $e^+e^- \to Z$ |

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

NODE=S091R5;LINKAGE=A

## $B_c^\pm$ REFERENCES

NODE=S091


| | | | | | |
|---|---|---|---|---|---|
| ABE | 98M | PRL 81 2432 | F. Abe *et al.* | (CDF Collab.) | REFID=46120 |
| Also | 98R | PR D58 112004 | F. Abe *et al.* | (CDF Collab.) | REFID=46488 |
| ACKERSTAFF | 98O | PL B420 157 | K. Ackerstaff *et al.* | (OPAL Collab.) | REFID=46029 |
| BARATE | 98Q | EPJ C4 387 | R. Barate *et al.* | (ALEPH Collab.) | REFID=46146 |
| PDG | 98 | EPJ C3 1 | C. Caso *et al.* | | REFID=45838 |
| ABREU | 97E | PL B398 207 | P. Abreu *et al.* | (DELPHI Collab.) | REFID=45322 |
| BARATE | 97H | PL B402 213 | R. Barate *et al.* | (ALEPH Collab.) | REFID=45480 |
| ABE | 96R | PRL 77 5176 | F. Abe *et al.* | (CDF Collab.) | REFID=45159 |
| PDG | 96 | PR D54 1 | | | REFID=44495 |