

# BOTTOM MESONS

## ( $B = \pm 1$ )

$$B^+ = u\bar{b}, B^0 = d\bar{b}, \bar{B}^0 = \bar{d}b, B^- = \bar{u}b, \text{ similarly for } B^{*'}s$$

### ***B*-particle organization**

Many measurements of  $B$  decays involve admixtures of  $B$  hadrons. Previously we arbitrarily included such admixtures in the  $B^\pm$  section, but because of their importance we have created two new sections: “ $B^\pm/B^0$  Admixture” for  $\Upsilon(4S)$  results and “ $B^\pm/B^0/B_s^0/b$ -baryon Admixture” for results at higher energies. Most inclusive decay branching fractions and  $\chi_b$  at high energy are found in the Admixture sections.  $B^0$ - $\bar{B}^0$  mixing data are found in the  $B^0$  section, while  $B_s^0$ - $\bar{B}_s^0$  mixing data and  $B$ - $\bar{B}$  mixing data for a  $B^0/B_s^0$  admixture are found in the  $B_s^0$  section.  $CP$ -violation data are found in the  $B^\pm$ ,  $B^0$ , and  $B^\pm/B^0$  Admixture sections.  $b$ -baryons are found near the end of the Baryon section.

The organization of the  $B$  sections is now as follows, where bullets indicate particle sections and brackets indicate reviews.

- $B^\pm$   
mass, mean life,  $CP$  violation, branching fractions
- $B^0$   
mass, mean life,  $B^0$ - $\bar{B}^0$  mixing,  $CP$  violation,  
branching fractions
- $B^\pm/B^0$  Admixtures  
 $CP$  violation, branching fractions
- $B^\pm/B^0/B_s^0/b$ -baryon Admixtures  
mean life, production fractions, branching fractions
- $B^*$   
mass
- $B_1(5721)^+$   
mass
- $B_1(5721)^0$   
mass
- $B_2^*(5747)^+$

- mass
  - $B_2^*(5747)^0$
  - mass
  - $B_J^*(5970)^+$
  - mass
  - $B_J^*(5970)^0$
  - mass
  - $B_s^0$
  - mass, mean life,  $B_s^0$ - $\bar{B}_s^0$  mixing, *CP* violation, branching fractions
  - $B_s^*$
  - mass
  - $B_{s1}(5830)^0$
  - mass
  - $B_{s2}^*(5840)^0$
  - mass
  - $B_c^\pm$
  - mass, mean life, branching fractions

At the end of Baryon Listings:

- $\Lambda_b$
- mass, mean life, branching fractions
- $\Lambda_b(5912)^0$
- mass, mean life
- $\Lambda_b(5920)^0$
- mass, mean life
- $\Sigma_b$
- mass
- $\Sigma_b^*$
- mass
- $\Xi_b^0, \Xi_b^-$
- mass, mean life, branching fractions
- $\Xi_b'(5935)^-$
- mass
- $\Xi_b(5945)^0$

mass

- $\Xi_b^*(5955)^-$

mass

- $\Omega_b^-$

mass, branching fractions

- $b$ -baryon Admixture

mean life, branching fractions

 **$B^\pm$** 

$$I(J^P) = \frac{1}{2}(0^-)$$

$I, J, P$  need confirmation. Quantum numbers shown are quark-model predictions.

$$\text{Mass } m_{B^\pm} = 5279.32 \pm 0.14 \text{ MeV} \quad (S = 1.1)$$

$$\text{Mean life } \tau_{B^\pm} = (1.638 \pm 0.004) \times 10^{-12} \text{ s}$$

$$c\tau = 491.1 \text{ } \mu\text{m}$$

**CP violation**

$$A_{CP}(B^+ \rightarrow J/\psi(1S)K^+) = (1.8 \pm 3.0) \times 10^{-3} \quad (S = 1.5)$$

$$A_{CP}(B^+ \rightarrow J/\psi(1S)\pi^+) = (1.8 \pm 1.2) \times 10^{-2} \quad (S = 1.3)$$

$$A_{CP}(B^+ \rightarrow J/\psi\rho^+) = -0.11 \pm 0.14$$

$$A_{CP}(B^+ \rightarrow J/\psi K^*(892)^+) = -0.048 \pm 0.033$$

$$A_{CP}(B^+ \rightarrow \eta_c K^+) = 0.01 \pm 0.07 \quad (S = 2.2)$$

$$A_{CP}(B^+ \rightarrow \psi(2S)\pi^+) = 0.03 \pm 0.06$$

$$A_{CP}(B^+ \rightarrow \psi(2S)K^+) = 0.012 \pm 0.020 \quad (S = 1.5)$$

$$A_{CP}(B^+ \rightarrow \psi(2S)K^*(892)^+) = 0.08 \pm 0.21$$

$$A_{CP}(B^+ \rightarrow \chi_{c1}(1P)\pi^+) = 0.07 \pm 0.18$$

$$A_{CP}(B^+ \rightarrow \chi_{c0}K^+) = -0.20 \pm 0.18 \quad (S = 1.5)$$

$$A_{CP}(B^+ \rightarrow \chi_{c1}K^+) = -0.009 \pm 0.033$$

$$A_{CP}(B^+ \rightarrow \chi_{c1}K^*(892)^+) = 0.5 \pm 0.5$$

$$A_{CP}(B^+ \rightarrow D^0 \ell^+ \nu_\ell) = (-0.14 \pm 0.20) \times 10^{-2}$$

$$A_{CP}(B^+ \rightarrow \bar{D}^0 \pi^+) = -0.007 \pm 0.007$$

$$A_{CP}(B^+ \rightarrow D_{CP(+1)} \pi^+) = -0.0080 \pm 0.0026$$

$$A_{CP}(B^+ \rightarrow D_{CP(-1)} \pi^+) = 0.017 \pm 0.026$$

$$A_{CP}([K^\mp \pi^\pm \pi^+ \pi^-]_D \pi^+) = 0.02 \pm 0.05$$

$$A_{CP}(B^+ \rightarrow [\pi^+ \pi^+ \pi^- \pi^-]_D K^+) = 0.10 \pm 0.04$$

$$A_{CP}(B^+ \rightarrow [\pi^+ \pi^- \pi^+ \pi^-]_D K^*(892)^+) = 0.02 \pm 0.11$$

$$A_{CP}(B^+ \rightarrow \bar{D}^0 K^+) = -0.017 \pm 0.005$$

$$A_{CP}([K^\mp \pi^\pm \pi^+ \pi^-]_D K^+) = -0.31 \pm 0.11$$

$$A_{CP}(B^+ \rightarrow [\pi^+ \pi^+ \pi^- \pi^-]_D \pi^+) = (-4 \pm 8) \times 10^{-3}$$

$$\begin{aligned}
A_{CP}(B^+ \rightarrow [K^- \pi^+]_D K^+) &= -0.58 \pm 0.21 \\
A_{CP}(B^+ \rightarrow [K^- \pi^+ \pi^0]_D K^+) &= 0.07 \pm 0.30 \quad (S = 1.5) \\
A_{CP}(B^+ \rightarrow [K^+ K^- \pi^0]_D K^+) &= 0.30 \pm 0.20 \\
A_{CP}(B^+ \rightarrow [\pi^+ \pi^- \pi^0]_D K^+) &= 0.05 \pm 0.09 \\
A_{CP}(B^+ \rightarrow \overline{D}^0 K^*(892)^+) &= -0.007 \pm 0.019 \\
A_{CP}(B^+ \rightarrow [K^- \pi^+]_{\overline{D}} K^*(892)^+) &= -0.75 \pm 0.16 \\
A_{CP}(B^+ \rightarrow [K^- \pi^+ \pi^- \pi^+]_{\overline{D}} K^*(892)^+) &= -0.45 \pm 0.25 \\
A_{CP}(B^+ \rightarrow [K^- \pi^+]_D \pi^+) &= 0.00 \pm 0.09 \\
A_{CP}(B^+ \rightarrow [K^- \pi^+ \pi^0]_D \pi^+) &= 0.35 \pm 0.16 \\
A_{CP}(B^+ \rightarrow [K^+ K^- \pi^0]_D \pi^+) &= -0.03 \pm 0.04 \\
A_{CP}(B^+ \rightarrow [\pi^+ \pi^- \pi^0]_D \pi^+) &= -0.016 \pm 0.020 \\
A_{CP}(B^+ \rightarrow [K^- \pi^+]_{(D\pi)} \pi^+) &= -0.09 \pm 0.27 \\
A_{CP}(B^+ \rightarrow [K^- \pi^+]_{(D\gamma)} \pi^+) &= -0.7 \pm 0.6 \\
A_{CP}(B^+ \rightarrow [K^- \pi^+]_{(D\pi)} K^+) &= 0.8 \pm 0.4 \\
A_{CP}(B^+ \rightarrow [K^- \pi^+]_{(D\gamma)} K^+) &= 0.4 \pm 1.0 \\
A_{CP}(B^+ \rightarrow [\pi^+ \pi^- \pi^0]_D K^+) &= -0.02 \pm 0.15 \\
A_{CP}(B^+ \rightarrow [K_S^0 K^+ \pi^-]_D K^+) &= 0.04 \pm 0.09 \\
A_{CP}(B^+ \rightarrow [K_S^0 K^- \pi^+]_D K^+) &= 0.23 \pm 0.13 \\
A_{CP}(B^+ \rightarrow [K_S^0 K^- \pi^+]_D \pi^+) &= -0.052 \pm 0.034 \\
A_{CP}(B^+ \rightarrow [K_S^0 K^+ \pi^-]_D \pi^+) &= -0.025 \pm 0.026 \\
A_{CP}(B^+ \rightarrow [K^*(892)^- K^+]_D K^+) &= 0.03 \pm 0.11 \\
A_{CP}(B^+ \rightarrow [K^*(892)^+ K^-]_D K^+) &= 0.34 \pm 0.21 \\
A_{CP}(B^+ \rightarrow [K^*(892)^+ K^-]_D \pi^+) &= -0.05 \pm 0.05 \\
A_{CP}(B^+ \rightarrow [K^*(892)^- K^+]_D \pi^+) &= -0.012 \pm 0.030 \\
\mathbf{A_{CP}(B^+ \rightarrow D_{CP(+1)} K^+)} &= 0.120 \pm 0.014 \quad (S = 1.4) \\
A_{ADS}(B^+ \rightarrow D K^+) &= -0.40 \pm 0.06 \\
A_{ADS}(B^+ \rightarrow D \pi^+) &= 0.100 \pm 0.032 \\
A_{ADS}(B^+ \rightarrow [K^- \pi^+]_D K^+ \pi^- \pi^+) &= -0.33 \pm 0.35 \\
A_{ADS}(B^+ \rightarrow [K^- \pi^+]_D \pi^+ \pi^- \pi^+) &= -0.01 \pm 0.09 \\
A_{CP}(B^+ \rightarrow D_{CP(-1)} K^+) &= -0.10 \pm 0.07 \\
A_{CP}(B^+ \rightarrow [K^+ K^-]_D K^+ \pi^- \pi^+) &= -0.04 \pm 0.06 \\
A_{CP}(B^+ \rightarrow [\pi^+ \pi^-]_D K^+ \pi^- \pi^+) &= -0.05 \pm 0.10 \\
A_{CP}(B^+ \rightarrow [K^- \pi^+]_D K^+ \pi^- \pi^+) &= 0.013 \pm 0.023 \\
A_{CP}(B^+ \rightarrow [K^+ K^-]_D \pi^+ \pi^- \pi^+) &= -0.019 \pm 0.015 \\
A_{CP}(B^+ \rightarrow [\pi^+ \pi^-]_D \pi^+ \pi^- \pi^+) &= -0.013 \pm 0.019 \\
A_{CP}(B^+ \rightarrow [K^- \pi^+]_D \pi^+ \pi^- \pi^+) &= -0.002 \pm 0.011 \\
A_{CP}(B^+ \rightarrow \overline{D}^{*0} \pi^+) &= 0.0010 \pm 0.0028 \\
A_{CP}(B^+ \rightarrow (D_{CP(+1)}^*)^0 \pi^+) &= 0.016 \pm 0.010 \quad (S = 1.2) \\
A_{CP}(B^+ \rightarrow (D_{CP(-1)}^*)^0 \pi^+) &= -0.09 \pm 0.05 \\
A_{CP}(B^+ \rightarrow D^{*0} K^+) &= -0.001 \pm 0.011 \quad (S = 1.1)
\end{aligned}$$

$$\begin{aligned}
 A_{CP}(B^+ \rightarrow D_{CP(+1)}^{*0} K^+) &= -0.11 \pm 0.08 \quad (S = 2.7) \\
 A_{CP}(B^+ \rightarrow D_{CP(-1)}^* K^+) &= 0.07 \pm 0.10 \\
 A_{CP}(B^+ \rightarrow D_{CP(+1)} K^*(892)^+) &= 0.08 \pm 0.06 \\
 A_{CP}(B^+ \rightarrow D_{CP(-1)} K^*(892)^+) &= -0.23 \pm 0.22 \\
 A_{CP}(B^+ \rightarrow D_s^+ \phi) &= 0.0 \pm 0.4 \\
 A_{CP}(B^+ \rightarrow D^{*+} \bar{D}^{*0}) &= -0.15 \pm 0.11 \\
 A_{CP}(B^+ \rightarrow D^{*+} \bar{D}^0) &= -0.06 \pm 0.13 \\
 A_{CP}(B^+ \rightarrow D^+ \bar{D}^{*0}) &= 0.13 \pm 0.18 \\
 A_{CP}(B^+ \rightarrow D^+ \bar{D}^0) &= -0.03 \pm 0.07 \\
 A_{CP}(B^+ \rightarrow K_S^0 \pi^+) &= -0.017 \pm 0.016 \\
 A_{CP}(B^+ \rightarrow K^+ \pi^0) &= 0.037 \pm 0.021 \\
 A_{CP}(B^+ \rightarrow \eta' K^+) &= 0.004 \pm 0.011 \\
 A_{CP}(B^+ \rightarrow \eta' K^*(892)^+) &= -0.26 \pm 0.27 \\
 A_{CP}(B^+ \rightarrow \eta' K_0^*(1430)^+) &= 0.06 \pm 0.20 \\
 A_{CP}(B^+ \rightarrow \eta' K_2^*(1430)^+) &= 0.15 \pm 0.13 \\
 \mathbf{A_{CP}(B^+ \rightarrow \eta K^+)} &= -0.37 \pm 0.08 \\
 A_{CP}(B^+ \rightarrow \eta K^*(892)^+) &= 0.02 \pm 0.06 \\
 A_{CP}(B^+ \rightarrow \eta K_0^*(1430)^+) &= 0.05 \pm 0.13 \\
 A_{CP}(B^+ \rightarrow \eta K_2^*(1430)^+) &= -0.45 \pm 0.30 \\
 A_{CP}(B^+ \rightarrow \omega K^+) &= -0.02 \pm 0.04 \\
 A_{CP}(B^+ \rightarrow \omega K^{*+}) &= 0.29 \pm 0.35 \\
 A_{CP}(B^+ \rightarrow \omega (K\pi)_0^{*+}) &= -0.10 \pm 0.09 \\
 A_{CP}(B^+ \rightarrow \omega K_2^*(1430)^+) &= 0.14 \pm 0.15 \\
 A_{CP}(B^+ \rightarrow K^{*0} \pi^+) &= -0.04 \pm 0.09 \quad (S = 2.1) \\
 A_{CP}(B^+ \rightarrow K^*(892)^+ \pi^0) &= -0.39 \pm 0.21 \quad (S = 1.6) \\
 \mathbf{A_{CP}(B^+ \rightarrow K^+ \pi^- \pi^+)} &= 0.027 \pm 0.008 \\
 A_{CP}(B^+ \rightarrow K^+ K^- K^+ \text{nonresonant}) &= 0.06 \pm 0.05 \\
 A_{CP}(B^+ \rightarrow f(980)^0 K^+) &= -0.08 \pm 0.09 \\
 \mathbf{A_{CP}(B^+ \rightarrow f_2(1270) K^+)} &= -0.68_{-0.17}^{+0.19} \\
 A_{CP}(B^+ \rightarrow f_0(1500) K^+) &= 0.28 \pm 0.30 \\
 A_{CP}(B^+ \rightarrow f_2'(1525)^0 K^+) &= -0.08_{-0.04}^{+0.05} \\
 \mathbf{A_{CP}(B^+ \rightarrow \rho^0 K^+)} &= 0.37 \pm 0.10 \\
 A_{CP}(B^+ \rightarrow K^0 \pi^+ \pi^0) &= 0.07 \pm 0.06 \\
 A_{CP}(B^+ \rightarrow K_0^*(1430)^0 \pi^+) &= 0.061 \pm 0.032 \\
 A_{CP}(B^+ \rightarrow K_0^*(1430)^+ \pi^0) &= 0.26_{-0.14}^{+0.18} \\
 A_{CP}(B^+ \rightarrow K_2^*(1430)^0 \pi^+) &= 0.05_{-0.24}^{+0.29} \\
 A_{CP}(B^+ \rightarrow K^+ \pi^0 \pi^0) &= -0.06 \pm 0.07 \\
 A_{CP}(B^+ \rightarrow K^0 \rho^+) &= -0.03 \pm 0.15 \\
 A_{CP}(B^+ \rightarrow K^{*+} \pi^+ \pi^-) &= 0.07 \pm 0.08 \\
 A_{CP}(B^+ \rightarrow \rho^0 K^*(892)^+) &= 0.31 \pm 0.13
 \end{aligned}$$

$$\begin{aligned}
 A_{CP}(B^+ \rightarrow K^*(892)^+ f_0(980)) &= -0.15 \pm 0.12 \\
 A_{CP}(B^+ \rightarrow a_1^+ K^0) &= 0.12 \pm 0.11 \\
 A_{CP}(B^+ \rightarrow b_1^+ K^0) &= -0.03 \pm 0.15 \\
 A_{CP}(B^+ \rightarrow K^*(892)^0 \rho^+) &= -0.01 \pm 0.16 \\
 A_{CP}(B^+ \rightarrow b_1^0 K^+) &= -0.46 \pm 0.20 \\
 A_{CP}(B^+ \rightarrow K^0 K^+) &= 0.04 \pm 0.14 \\
 A_{CP}(B^+ \rightarrow K_S^0 K^+) &= -0.21 \pm 0.14 \\
 A_{CP}(B^+ \rightarrow K^+ K_S^0 K_S^0) &= 0.04_{-0.05}^{+0.04} \\
 \mathbf{A_{CP}(B^+ \rightarrow K^+ K^- \pi^+)} &= -0.122 \pm 0.021 \\
 \mathbf{A_{CP}(B^+ \rightarrow K^+ K^- K^+)} &= -0.033 \pm 0.008 \\
 A_{CP}(B^+ \rightarrow \phi K^+) &= 0.024 \pm 0.028 \quad (S = 2.3) \\
 A_{CP}(B^+ \rightarrow X_0(1550) K^+) &= -0.04 \pm 0.07 \\
 A_{CP}(B^+ \rightarrow K^{*+} K^+ K^-) &= 0.11 \pm 0.09 \\
 A_{CP}(B^+ \rightarrow \phi K^*(892)^+) &= -0.01 \pm 0.08 \\
 A_{CP}(B^+ \rightarrow \phi (K\pi)_0^{*+}) &= 0.04 \pm 0.16 \\
 A_{CP}(B^+ \rightarrow \phi K_1(1270)^+) &= 0.15 \pm 0.20 \\
 A_{CP}(B^+ \rightarrow \phi K_2^*(1430)^+) &= -0.23 \pm 0.20 \\
 A_{CP}(B^+ \rightarrow K^+ \phi \phi) &= -0.10 \pm 0.08 \\
 A_{CP}(B^+ \rightarrow K^+ [\phi \phi]_{\eta_c}) &= 0.09 \pm 0.10 \\
 A_{CP}(B^+ \rightarrow K^*(892)^+ \gamma) &= 0.014 \pm 0.018 \\
 A_{CP}(B^+ \rightarrow \eta K^+ \gamma) &= -0.12 \pm 0.07 \\
 A_{CP}(B^+ \rightarrow \phi K^+ \gamma) &= -0.13 \pm 0.11 \quad (S = 1.1) \\
 A_{CP}(B^+ \rightarrow \rho^+ \gamma) &= -0.11 \pm 0.33 \\
 A_{CP}(B^+ \rightarrow \pi^+ \pi^0) &= 0.03 \pm 0.04 \\
 \mathbf{A_{CP}(B^+ \rightarrow \pi^+ \pi^- \pi^+)} &= 0.057 \pm 0.013 \\
 A_{CP}(B^+ \rightarrow \rho^0 \pi^+) &= 0.18_{-0.17}^{+0.09} \\
 A_{CP}(B^+ \rightarrow f_2(1270) \pi^+) &= 0.41 \pm 0.30 \\
 A_{CP}(B^+ \rightarrow \rho^0(1450) \pi^+) &= -0.1_{-0.5}^{+0.4} \\
 \mathbf{A_{CP}(B^+ \rightarrow f_0(1370) \pi^+)} &= 0.72 \pm 0.22 \\
 A_{CP}(B^+ \rightarrow \pi^+ \pi^- \pi^+ \text{ nonresonant}) &= -0.14_{-0.16}^{+0.23} \\
 A_{CP}(B^+ \rightarrow \rho^+ \pi^0) &= 0.02 \pm 0.11 \\
 A_{CP}(B^+ \rightarrow \rho^+ \rho^0) &= -0.05 \pm 0.05 \\
 A_{CP}(B^+ \rightarrow \omega \pi^+) &= -0.04 \pm 0.06 \\
 A_{CP}(B^+ \rightarrow \omega \rho^+) &= -0.20 \pm 0.09 \\
 A_{CP}(B^+ \rightarrow \eta \pi^+) &= -0.14 \pm 0.07 \quad (S = 1.4) \\
 A_{CP}(B^+ \rightarrow \eta \rho^+) &= 0.11 \pm 0.11 \\
 A_{CP}(B^+ \rightarrow \eta' \pi^+) &= 0.06 \pm 0.16 \\
 A_{CP}(B^+ \rightarrow \eta' \rho^+) &= 0.26 \pm 0.17 \\
 A_{CP}(B^+ \rightarrow b_1^0 \pi^+) &= 0.05 \pm 0.16 \\
 A_{CP}(B^+ \rightarrow \rho \bar{p} \pi^+) &= 0.00 \pm 0.04 \\
 A_{CP}(B^+ \rightarrow \rho \bar{p} K^+) &= 0.00 \pm 0.04 \quad (S = 2.2)
 \end{aligned}$$

$$\begin{aligned}
 A_{CP}(B^+ \rightarrow p\bar{p}K^*(892)^+) &= 0.21 \pm 0.16 \quad (S = 1.4) \\
 A_{CP}(B^+ \rightarrow p\bar{\Lambda}\gamma) &= 0.17 \pm 0.17 \\
 A_{CP}(B^+ \rightarrow p\bar{\Lambda}\pi^0) &= 0.01 \pm 0.17 \\
 A_{CP}(B^+ \rightarrow K^+\ell^+\ell^-) &= -0.02 \pm 0.08 \\
 A_{CP}(B^+ \rightarrow K^+e^+e^-) &= 0.14 \pm 0.14 \\
 A_{CP}(B^+ \rightarrow K^+\mu^+\mu^-) &= 0.011 \pm 0.017 \\
 A_{CP}(B^+ \rightarrow \pi^+\mu^+\mu^-) &= -0.11 \pm 0.12 \\
 A_{CP}(B^+ \rightarrow K^{*+}\ell^+\ell^-) &= -0.09 \pm 0.14 \\
 A_{CP}(B^+ \rightarrow K^*e^+e^-) &= -0.14 \pm 0.23 \\
 A_{CP}(B^+ \rightarrow K^*\mu^+\mu^-) &= -0.12 \pm 0.24 \\
 \gamma &= (73.5_{-5.0}^{+4.3})^\circ \\
 r_B(B^+ \rightarrow D^0K^+) &= 0.103 \pm 0.005 \\
 \delta_B(B^+ \rightarrow D^0K^+) &= (136.9_{-5.2}^{+4.6})^\circ \\
 r_B(B^+ \rightarrow \bar{D}^0K^{*+}) &= 0.075_{-0.018}^{+0.017} \\
 \delta_B(B^+ \rightarrow \bar{D}^0K^{*+}) &= (106_{-26}^{+18})^\circ \\
 r_B^*(B^+ \rightarrow D^{*0}K^+) &= 0.142_{-0.020}^{+0.019} \\
 \delta_B^*(B^+ \rightarrow D^{*0}K^+) &= (321_{-9}^{+8})^\circ
 \end{aligned}$$

$B^-$  modes are charge conjugates of the modes below. Modes which do not identify the charge state of the  $B$  are listed in the  $B^\pm/B^0$  ADMIXTURE section.

The branching fractions listed below assume 50%  $B^0\bar{B}^0$  and 50%  $B^+B^-$  production at the  $\Upsilon(4S)$ . We have attempted to bring older measurements up to date by rescaling their assumed  $\Upsilon(4S)$  production ratio to 50:50 and their assumed  $D$ ,  $D_s$ ,  $D^*$ , and  $\psi$  branching ratios to current values whenever this would affect our averages and best limits significantly.

Indentation is used to indicate a subchannel of a previous reaction. All resonant subchannels have been corrected for resonance branching fractions to the final state so the sum of the subchannel branching fractions can exceed that of the final state.

For inclusive branching fractions, *e.g.*,  $B \rightarrow D^\pm$  anything, the values usually are multiplicities, not branching fractions. They can be greater than one.

$B^+$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	Scale factor/ Confidence level(MeV/c)	$p$
<b>Semileptonic and leptonic modes</b>			
$\ell^+\nu_\ell$ anything	[a] ( 10.99 $\pm$ 0.28 ) %		—
$e^+\nu_e X_c$	( 10.8 $\pm$ 0.4 ) %		—
$D\ell^+\nu_\ell$ anything	( 8.4 $\pm$ 0.5 ) %		—
$\bar{D}^0\ell^+\nu_\ell$	[a] ( 2.20 $\pm$ 0.10 ) %		2310
$\bar{D}^0\tau^+\nu_\tau$	( 7.7 $\pm$ 2.5 ) $\times 10^{-3}$		1911

$\bar{D}^*(2007)^0 \ell^+ \nu_\ell$	[a] ( 4.88 ± 0.10 ) %	2258
$\bar{D}^*(2007)^0 \tau^+ \nu_\tau$	( 1.88 ± 0.20 ) %	1839
$D^- \pi^+ \ell^+ \nu_\ell$	( 4.1 ± 0.5 ) × 10 <sup>-3</sup>	2306
$\bar{D}_0^*(2420)^0 \ell^+ \nu_\ell, \bar{D}_0^{*0} \rightarrow$	( 2.5 ± 0.5 ) × 10 <sup>-3</sup>	—
$\bar{D}_2^*(2460)^0 \ell^+ \nu_\ell, \bar{D}_2^{*0} \rightarrow$	( 1.53 ± 0.16 ) × 10 <sup>-3</sup>	2065
$D^{(*)} n \pi \ell^+ \nu_\ell (n \geq 1)$	( 1.60 ± 0.22 ) %	—
$D^{*-} \pi^+ \ell^+ \nu_\ell$	( 6.1 ± 0.6 ) × 10 <sup>-3</sup>	2254
$\bar{D}_1(2420)^0 \ell^+ \nu_\ell, \bar{D}_1^0 \rightarrow$	( 3.03 ± 0.20 ) × 10 <sup>-3</sup>	2084
$\bar{D}_1'(2430)^0 \ell^+ \nu_\ell, \bar{D}_1'^0 \rightarrow$	( 2.7 ± 0.6 ) × 10 <sup>-3</sup>	—
$\bar{D}_2^*(2460)^0 \ell^+ \nu_\ell,$	( 1.01 ± 0.24 ) × 10 <sup>-3</sup>	S=2.0 2065
$\bar{D}_2^{*0} \rightarrow D^{*-} \pi^+$		
$\bar{D}^0 \pi^+ \pi^- \ell^+ \nu_\ell$	( 1.56 ± 0.34 ) × 10 <sup>-3</sup>	2301
$\bar{D}^{*0} \pi^+ \pi^- \ell^+ \nu_\ell$	( 7 ± 4 ) × 10 <sup>-4</sup>	2248
$D_s^{(*)-} K^+ \ell^+ \nu_\ell$	( 6.1 ± 1.0 ) × 10 <sup>-4</sup>	—
$D_s^- K^+ \ell^+ \nu_\ell$	( 3.0 $\begin{smallmatrix} + \\ - \end{smallmatrix}$ $\begin{smallmatrix} 1.4 \\ 1.2 \end{smallmatrix}$ ) × 10 <sup>-4</sup>	2242
$D_s^{*-} K^+ \ell^+ \nu_\ell$	( 2.9 ± 1.9 ) × 10 <sup>-4</sup>	2185
$\pi^0 \ell^+ \nu_\ell$	( 7.80 ± 0.27 ) × 10 <sup>-5</sup>	2638
$\eta \ell^+ \nu_\ell$	( 3.9 ± 0.5 ) × 10 <sup>-5</sup>	2611
$\eta' \ell^+ \nu_\ell$	( 2.3 ± 0.8 ) × 10 <sup>-5</sup>	2553
$\omega \ell^+ \nu_\ell$	[a] ( 1.19 ± 0.09 ) × 10 <sup>-4</sup>	2582
$\rho^0 \ell^+ \nu_\ell$	[a] ( 1.58 ± 0.11 ) × 10 <sup>-4</sup>	2583
$p \bar{p} \ell^+ \nu_\ell$	( 5.8 $\begin{smallmatrix} + \\ - \end{smallmatrix}$ $\begin{smallmatrix} 2.6 \\ 2.3 \end{smallmatrix}$ ) × 10 <sup>-6</sup>	2467
$p \bar{p} \mu^+ \nu_\mu$	< 8.5 × 10 <sup>-6</sup>	CL=90% 2446
$p \bar{p} e^+ \nu_e$	( 8.2 $\begin{smallmatrix} + \\ - \end{smallmatrix}$ $\begin{smallmatrix} 4.0 \\ 3.3 \end{smallmatrix}$ ) × 10 <sup>-6</sup>	2467
$e^+ \nu_e$	< 9.8 × 10 <sup>-7</sup>	CL=90% 2640
$\mu^+ \nu_\mu$	< 1.0 × 10 <sup>-6</sup>	CL=90% 2639
$\tau^+ \nu_\tau$	( 1.09 ± 0.24 ) × 10 <sup>-4</sup>	S=1.2 2341
$\ell^+ \nu_\ell \gamma$	< 3.5 × 10 <sup>-6</sup>	CL=90% 2640
$e^+ \nu_e \gamma$	< 6.1 × 10 <sup>-6</sup>	CL=90% 2640
$\mu^+ \nu_\mu \gamma$	< 3.4 × 10 <sup>-6</sup>	CL=90% 2639
<b>Inclusive modes</b>		
$D^0 X$	( 8.6 ± 0.7 ) %	—
$\bar{D}^0 X$	( 79 ± 4 ) %	—
$D^+ X$	( 2.5 ± 0.5 ) %	—
$D^- X$	( 9.9 ± 1.2 ) %	—
$D_s^+ X$	( 7.9 $\begin{smallmatrix} + \\ - \end{smallmatrix}$ $\begin{smallmatrix} 1.4 \\ 1.3 \end{smallmatrix}$ ) %	—



$D_s^- X$	( 1.10 $\pm$ 0.40 $\pm$ 0.32 ) %	—
$\Lambda_c^+ X$	( 2.1 $\pm$ 0.9 $\pm$ 0.6 ) %	—
$\bar{\Lambda}_c^- X$	( 2.8 $\pm$ 1.1 $\pm$ 0.9 ) %	—
$\bar{c} X$	( 97 $\pm$ 4 ) %	—
$c X$	( 23.4 $\pm$ 2.2 $\pm$ 1.8 ) %	—
$c/\bar{c} X$	(120 $\pm$ 6 ) %	—

**$D, D^*,$  or  $D_s$  modes**

$\bar{D}^0 \pi^+$	( 4.68 $\pm$ 0.13 ) $\times 10^{-3}$	2308
$D_{CP(+1)} \pi^+$	[b] ( 2.05 $\pm$ 0.18 ) $\times 10^{-3}$	—
$D_{CP(-1)} \pi^+$	[b] ( 2.0 $\pm$ 0.4 ) $\times 10^{-3}$	—
$\bar{D}^0 \rho^+$	( 1.34 $\pm$ 0.18 ) %	2237
$\bar{D}^0 K^+$	( 3.63 $\pm$ 0.12 ) $\times 10^{-4}$	2281
$D_{CP(+1)} K^+$	[b] ( 1.80 $\pm$ 0.07 ) $\times 10^{-4}$	—
$D_{CP(-1)} K^+$	[b] ( 1.96 $\pm$ 0.18 ) $\times 10^{-4}$	—
$[K^- \pi^+]_D K^+$	[c] < 2.8 $\times 10^{-7}$ CL=90%	—
$[K^+ \pi^-]_D K^+$	[c] < 1.5 $\times 10^{-5}$ CL=90%	—
$[K^- \pi^+ \pi^0]_D K^+$	seen	—
$[K^+ \pi^- \pi^0]_D K^+$	seen	—
$[K^- \pi^+ \pi^+ \pi^-]_D K^+$	seen	—
$[K^+ \pi^- \pi^+ \pi^-]_D K^+$	seen	—
$[K^- \pi^+]_D \pi^+$	[c] ( 6.3 $\pm$ 1.1 ) $\times 10^{-7}$	—
$[K^+ \pi^-]_D \pi^+$	( 1.78 $\pm$ 0.32 ) $\times 10^{-4}$	—
$[K^- \pi^+ \pi^0]_D \pi^+$	seen	—
$[K^+ \pi^- \pi^0]_D \pi^+$	seen	—
$[K^- \pi^+ \pi^+ \pi^-]_D \pi^+$	seen	—
$[K^+ \pi^- \pi^+ \pi^-]_D \pi^+$	seen	—
$[\pi^+ \pi^- \pi^0]_D K^-$	( 4.6 $\pm$ 0.9 ) $\times 10^{-6}$	—
$[K_S^0 K^+ \pi^-]_D K^+$	seen	—
$[K_S^0 K^- \pi^+]_D K^+$	seen	—
$[K^*(892)^+ K^-]_D K^+$	seen	—
$[K_S^0 K^- \pi^+]_D \pi^+$	seen	—
$[K^*(892)^+ K^-]_D \pi^+$	seen	—
$[K_S^0 K^+ \pi^-]_D \pi^+$	seen	—
$[K^*(892)^- K^+]_D \pi^+$	seen	—
$\bar{D}^0 K^*(892)^+$	( 5.3 $\pm$ 0.4 ) $\times 10^{-4}$	2213
$D_{CP(-1)} K^*(892)^+$	[b] ( 2.7 $\pm$ 0.8 ) $\times 10^{-4}$	—
$D_{CP(+1)} K^*(892)^+$	[b] ( 6.2 $\pm$ 0.6 ) $\times 10^{-4}$	—
$\bar{D}^0 K^+ \pi^+ \pi^-$	( 5.2 $\pm$ 2.1 ) $\times 10^{-4}$	2237
$\bar{D}^0 K^+ \bar{K}^0$	( 5.5 $\pm$ 1.6 ) $\times 10^{-4}$	2189
$\bar{D}^0 K^+ \bar{K}^*(892)^0$	( 7.5 $\pm$ 1.7 ) $\times 10^{-4}$	2071

$\bar{D}^0 \pi^+ \pi^+ \pi^-$	$( 5.6 \pm 2.1 ) \times 10^{-3}$	S=3.6	2289
$\bar{D}^0 \pi^+ \pi^+ \pi^-$ nonresonant	$( 5 \pm 4 ) \times 10^{-3}$		2289
$\bar{D}^0 \pi^+ \rho^0$	$( 4.2 \pm 3.0 ) \times 10^{-3}$		2208
$\bar{D}^0 a_1(1260)^+$	$( 4 \pm 4 ) \times 10^{-3}$		2123
$\bar{D}^0 \omega \pi^+$	$( 4.1 \pm 0.9 ) \times 10^{-3}$		2206
$D^*(2010)^- \pi^+ \pi^+$	$( 1.35 \pm 0.22 ) \times 10^{-3}$		2247
$D^*(2010)^- K^+ \pi^+$	$( 8.2 \pm 1.4 ) \times 10^{-5}$		2206
$\bar{D}_1(2420)^0 \pi^+, \bar{D}_1^0 \rightarrow$ $D^*(2010)^- \pi^+$	$( 5.2 \pm 2.2 ) \times 10^{-4}$		2081
$D^- \pi^+ \pi^+$	$( 1.07 \pm 0.05 ) \times 10^{-3}$		2299
$D^- K^+ \pi^+$	$( 7.7 \pm 0.5 ) \times 10^{-5}$		2260
$D_0^*(2400)^0 K^+, D_0^{*0} \rightarrow$ $D^- \pi^+$	$( 6.1 \pm 2.4 ) \times 10^{-6}$		—
$D_2^*(2460)^0 K^+, D_2^{*0} \rightarrow$ $D^- \pi^+$	$( 2.32 \pm 0.23 ) \times 10^{-5}$		—
$D_1^*(2760)^0 K^+, D_1^{*0} \rightarrow$ $D^- \pi^+$	$( 3.6 \pm 1.2 ) \times 10^{-6}$		—
$D^+ K^0$	$< 2.9 \times 10^{-6}$	CL=90%	2278
$D^+ K^+ \pi^-$	$( 5.6 \pm 1.1 ) \times 10^{-6}$		2260
$D_2^*(2460)^0 K^+, D_2^{*0} \rightarrow$ $D^+ \pi^-$	$< 6.3 \times 10^{-7}$	CL=90%	—
$D^+ K^{*0}$	$< 4.9 \times 10^{-7}$	CL=90%	2211
$D^+ \bar{K}^{*0}$	$< 1.4 \times 10^{-6}$	CL=90%	2211
$\bar{D}^*(2007)^0 \pi^+$	$( 4.90 \pm 0.17 ) \times 10^{-3}$		2256
$\bar{D}_{CP(+1)}^{*0} \pi^+$	[d] $( 2.7 \pm 0.6 ) \times 10^{-3}$		—
$D_{CP(-1)}^{*0} \pi^+$	[d] $( 2.4 \pm 0.9 ) \times 10^{-3}$		—
$\bar{D}^*(2007)^0 \omega \pi^+$	$( 4.5 \pm 1.2 ) \times 10^{-3}$		2149
$\bar{D}^*(2007)^0 \rho^+$	$( 9.8 \pm 1.7 ) \times 10^{-3}$		2181
$\bar{D}^*(2007)^0 K^+$	$( 3.97 \begin{smallmatrix} + 0.31 \\ - 0.28 \end{smallmatrix} ) \times 10^{-4}$		2227
$\bar{D}_{CP(+1)}^{*0} K^+$	[d] $( 2.60 \pm 0.33 ) \times 10^{-4}$		—
$\bar{D}_{CP(-1)}^{*0} K^+$	[d] $( 2.19 \pm 0.30 ) \times 10^{-4}$		—
$\bar{D}^*(2007)^0 K^*(892)^+$	$( 8.1 \pm 1.4 ) \times 10^{-4}$		2156
$\bar{D}^*(2007)^0 K^+ \bar{K}^0$	$< 1.06 \times 10^{-3}$	CL=90%	2132
$\bar{D}^*(2007)^0 K^+ \bar{K}^*(892)^0$	$( 1.5 \pm 0.4 ) \times 10^{-3}$		2009
$\bar{D}^*(2007)^0 \pi^+ \pi^+ \pi^-$	$( 1.03 \pm 0.12 ) \%$		2236
$\bar{D}^*(2007)^0 a_1(1260)^+$	$( 1.9 \pm 0.5 ) \%$		2063
$\bar{D}^*(2007)^0 \pi^- \pi^+ \pi^+ \pi^0$	$( 1.8 \pm 0.4 ) \%$		2219
$\bar{D}^{*0} 3\pi^+ 2\pi^-$	$( 5.7 \pm 1.2 ) \times 10^{-3}$		2196
$D^*(2010)^+ \pi^0$	$< 3.6 \times 10^{-6}$		2255
$D^*(2010)^+ K^0$	$< 9.0 \times 10^{-6}$	CL=90%	2225
$D^*(2010)^- \pi^+ \pi^+ \pi^0$	$( 1.5 \pm 0.7 ) \%$		2235
$D^*(2010)^- \pi^+ \pi^+ \pi^+ \pi^-$	$( 2.6 \pm 0.4 ) \times 10^{-3}$		2217

$\overline{D}^{*0} \pi^+$	[e]	$( 5.7 \pm 1.2 ) \times 10^{-3}$	—
$\overline{D}_1^*(2420)^0 \pi^+$		$( 1.5 \pm 0.6 ) \times 10^{-3}$	S=1.3 2082
$\overline{D}_1(2420)^0 \pi^+ \times B(\overline{D}_1^0 \rightarrow \overline{D}^0 \pi^+ \pi^-)$		$( 2.5 \begin{smallmatrix} + 1.6 \\ - 1.4 \end{smallmatrix} ) \times 10^{-4}$	S=3.9 2082
$\overline{D}_1(2420)^0 \pi^+ \times B(\overline{D}_1^0 \rightarrow \overline{D}^0 \pi^+ \pi^- \text{ (nonresonant)})$		$( 2.2 \pm 1.0 ) \times 10^{-4}$	2082
$\overline{D}_2^*(2462)^0 \pi^+$		$( 3.56 \pm 0.24 ) \times 10^{-4}$	—
$\times B(\overline{D}_2^*(2462)^0 \rightarrow D^- \pi^+)$			
$\overline{D}_2^*(2462)^0 \pi^+ \times B(\overline{D}_2^{*0} \rightarrow \overline{D}^0 \pi^- \pi^+)$		$( 2.2 \pm 1.0 ) \times 10^{-4}$	—
$\overline{D}_2^*(2462)^0 \pi^+ \times B(\overline{D}_2^{*0} \rightarrow \overline{D}^0 \pi^- \pi^+ \text{ (nonresonant)})$	<	$1.7 \times 10^{-4}$	CL=90% —
$\overline{D}_2^*(2462)^0 \pi^+ \times B(\overline{D}_2^{*0} \rightarrow D^*(2010)^- \pi^+)$		$( 2.2 \pm 1.1 ) \times 10^{-4}$	—
$\overline{D}_0^*(2400)^0 \pi^+$		$( 6.4 \pm 1.4 ) \times 10^{-4}$	2128
$\times B(\overline{D}_0^*(2400)^0 \rightarrow D^- \pi^+)$			
$\overline{D}_1(2421)^0 \pi^+$		$( 6.8 \pm 1.5 ) \times 10^{-4}$	—
$\times B(\overline{D}_1(2421)^0 \rightarrow D^{*-} \pi^+)$			
$\overline{D}_2^*(2462)^0 \pi^+$		$( 1.8 \pm 0.5 ) \times 10^{-4}$	—
$\times B(\overline{D}_2^*(2462)^0 \rightarrow D^{*-} \pi^+)$			
$\overline{D}'_1(2427)^0 \pi^+$		$( 5.0 \pm 1.2 ) \times 10^{-4}$	—
$\times B(\overline{D}'_1(2427)^0 \rightarrow D^{*-} \pi^+)$			
$\overline{D}_1(2420)^0 \pi^+ \times B(\overline{D}_1^0 \rightarrow \overline{D}^{*0} \pi^+ \pi^-)$	<	$6 \times 10^{-6}$	CL=90% 2082
$\overline{D}_1^*(2420)^0 \rho^+$	<	$1.4 \times 10^{-3}$	CL=90% 1996
$\overline{D}_2^*(2460)^0 \pi^+$	<	$1.3 \times 10^{-3}$	CL=90% 2063
$\overline{D}_2^*(2460)^0 \pi^+ \times B(\overline{D}_2^{*0} \rightarrow \overline{D}^{*0} \pi^+ \pi^-)$	<	$2.2 \times 10^{-5}$	CL=90% 2063
$\overline{D}_1^*(2680)^0 \pi^+, \overline{D}_1^*(2680)^0 \rightarrow D^- \pi^+$		$( 8.4 \pm 2.1 ) \times 10^{-5}$	—
$\overline{D}_3^*(2760)^0 \pi^+, \overline{D}_3^*(2760)^0 \pi^+ \rightarrow D^- \pi^+$		$( 1.00 \pm 0.22 ) \times 10^{-5}$	—
$\overline{D}_2^*(3000)^0 \pi^+, \overline{D}_2^*(3000)^0 \pi^+ \rightarrow D^- \pi^+$		$( 2.0 \pm 1.4 ) \times 10^{-6}$	—
$\overline{D}_2^*(2460)^0 \rho^+$	<	$4.7 \times 10^{-3}$	CL=90% 1977
$\overline{D}^0 D_s^+$		$( 9.0 \pm 0.9 ) \times 10^{-3}$	1815
$D_{s0}^*(2317)^+ \overline{D}^0, D_{s0}^{*+} \rightarrow D_s^+ \pi^0$		$( 7.9 \begin{smallmatrix} + 1.5 \\ - 1.3 \end{smallmatrix} ) \times 10^{-4}$	1605
$D_{s0}(2317)^+ \overline{D}^0 \times B(D_{s0}(2317)^+ \rightarrow D_s^{*+} \gamma)$	<	$7.6 \times 10^{-4}$	CL=90% 1605

$D_{s0}(2317)^+ \bar{D}^*(2007)^0 \times$ $B(D_{s0}(2317)^+ \rightarrow D_s^+ \pi^0)$	$( 9 \pm 7 ) \times 10^{-4}$	1511
$D_{sJ}(2457)^+ \bar{D}^0$	$( 3.1 \begin{smallmatrix} + 1.0 \\ - 0.9 \end{smallmatrix} ) \times 10^{-3}$	—
$D_{sJ}(2457)^+ \bar{D}^0 \times$ $B(D_{sJ}(2457)^+ \rightarrow D_s^+ \gamma)$	$( 4.6 \begin{smallmatrix} + 1.3 \\ - 1.1 \end{smallmatrix} ) \times 10^{-4}$	—
$D_{sJ}(2457)^+ \bar{D}^0 \times$ $B(D_{sJ}(2457)^+ \rightarrow$ $D_s^+ \pi^+ \pi^-)$	$< 2.2 \times 10^{-4}$ CL=90%	—
$D_{sJ}(2457)^+ \bar{D}^0 \times$ $B(D_{sJ}(2457)^+ \rightarrow D_s^+ \pi^0)$	$< 2.7 \times 10^{-4}$ CL=90%	—
$D_{sJ}(2457)^+ \bar{D}^0 \times$ $B(D_{sJ}(2457)^+ \rightarrow D_s^{*+} \gamma)$	$< 9.8 \times 10^{-4}$ CL=90%	—
$D_{sJ}(2457)^+ \bar{D}^*(2007)^0$	$( 1.20 \pm 0.30 ) \%$	—
$D_{sJ}(2457)^+ \bar{D}^*(2007)^0 \times$ $B(D_{sJ}(2457)^+ \rightarrow D_s^+ \gamma)$	$( 1.4 \begin{smallmatrix} + 0.7 \\ - 0.6 \end{smallmatrix} ) \times 10^{-3}$	—
$\bar{D}^0 D_{s1}(2536)^+ \times$ $B(D_{s1}(2536)^+ \rightarrow$ $D^*(2007)^0 K^+ +$ $D^*(2010)^+ K^0)$	$( 4.0 \pm 1.0 ) \times 10^{-4}$	1447
$\bar{D}^0 D_{s1}(2536)^+ \times$ $B(D_{s1}(2536)^+ \rightarrow$ $D^*(2007)^0 K^+)$	$( 2.2 \pm 0.7 ) \times 10^{-4}$	1447
$\bar{D}^*(2007)^0 D_{s1}(2536)^+ \times$ $B(D_{s1}(2536)^+ \rightarrow$ $D^*(2007)^0 K^+)$	$( 5.5 \pm 1.6 ) \times 10^{-4}$	1339
$\bar{D}^0 D_{s1}(2536)^+ \times$ $B(D_{s1}(2536)^+ \rightarrow D^{*+} K^0)$	$( 2.3 \pm 1.1 ) \times 10^{-4}$	1447
$\bar{D}^0 D_{sJ}(2700)^+ \times$ $B(D_{sJ}(2700)^+ \rightarrow D^0 K^+)$	$( 5.6 \pm 1.8 ) \times 10^{-4}$ S=1.7	—
$\bar{D}^{*0} D_{s1}(2536)^+, D_{s1}^+ \rightarrow$ $D^{*+} K^0$	$( 3.9 \pm 2.6 ) \times 10^{-4}$	1339
$\bar{D}^0 D_{sJ}(2573)^+, D_{sJ}^+ \rightarrow$ $D^0 K^+$	$( 8 \pm 15 ) \times 10^{-6}$	—
$\bar{D}^{*0} D_{sJ}(2573), D_{sJ}^+ \rightarrow$ $D^0 K^+$	$< 2 \times 10^{-4}$ CL=90%	1306
$\bar{D}^*(2007)^0 D_{sJ}(2573), D_{sJ}^+ \rightarrow$ $D^0 K^+$	$< 5 \times 10^{-4}$ CL=90%	1306
$\bar{D}^0 D_s^{*+}$	$( 7.6 \pm 1.6 ) \times 10^{-3}$	1734
$\bar{D}^*(2007)^0 D_s^+$	$( 8.2 \pm 1.7 ) \times 10^{-3}$	1737
$\bar{D}^*(2007)^0 D_s^{*+}$	$( 1.71 \pm 0.24 ) \%$	1651
$D_s^{(*)+} \bar{D}^{*0}$	$( 2.7 \pm 1.2 ) \%$	—

$\overline{D}^*(2007)^0 D^*(2010)^+$	$( 8.1 \pm 1.7 ) \times 10^{-4}$		1713
$\overline{D}^0 D^*(2010)^+ + \overline{D}^*(2007)^0 D^+$	$< 1.30$	% CL=90%	1792
$\overline{D}^0 D^*(2010)^+$	$( 3.9 \pm 0.5 ) \times 10^{-4}$		1792
$\overline{D}^0 D^+$	$( 3.8 \pm 0.4 ) \times 10^{-4}$		1866
$\overline{D}^0 D^+ K^0$	$( 1.55 \pm 0.21 ) \times 10^{-3}$		1571
$D^+ \overline{D}^*(2007)^0$	$( 6.3 \pm 1.7 ) \times 10^{-4}$		1791
$\overline{D}^*(2007)^0 D^+ K^0$	$( 2.1 \pm 0.5 ) \times 10^{-3}$		1475
$\overline{D}^0 D^*(2010)^+ K^0$	$( 3.8 \pm 0.4 ) \times 10^{-3}$		1476
$\overline{D}^*(2007)^0 D^*(2010)^+ K^0$	$( 9.2 \pm 1.2 ) \times 10^{-3}$		1362
$\overline{D}^0 D^0 K^+$	$( 1.45 \pm 0.33 ) \times 10^{-3}$	S=2.6	1577
$\overline{D}^*(2007)^0 D^0 K^+$	$( 2.26 \pm 0.23 ) \times 10^{-3}$		1481
$\overline{D}^0 D^*(2007)^0 K^+$	$( 6.3 \pm 0.5 ) \times 10^{-3}$		1481
$\overline{D}^*(2007)^0 D^*(2007)^0 K^+$	$( 1.12 \pm 0.13 ) \%$		1368
$D^- D^+ K^+$	$( 2.2 \pm 0.7 ) \times 10^{-4}$		1571
$D^- D^*(2010)^+ K^+$	$( 6.3 \pm 1.1 ) \times 10^{-4}$		1475
$D^*(2010)^- D^+ K^+$	$( 6.0 \pm 1.3 ) \times 10^{-4}$		1475
$D^*(2010)^- D^*(2010)^+ K^+$	$( 1.32 \pm 0.18 ) \times 10^{-3}$		1363
$(\overline{D} + \overline{D}^*)(D + D^*)K$	$( 4.05 \pm 0.30 ) \%$		–
$D_s^+ \pi^0$	$( 1.6 \pm 0.5 ) \times 10^{-5}$		2270
$D_s^{*+} \pi^0$	$< 2.6$	$\times 10^{-4}$ CL=90%	2215
$D_s^+ \eta$	$< 4$	$\times 10^{-4}$ CL=90%	2235
$D_s^{*+} \eta$	$< 6$	$\times 10^{-4}$ CL=90%	2178
$D_s^+ \rho^0$	$< 3.0$	$\times 10^{-4}$ CL=90%	2197
$D_s^{*+} \rho^0$	$< 4$	$\times 10^{-4}$ CL=90%	2138
$D_s^+ \omega$	$< 4$	$\times 10^{-4}$ CL=90%	2195
$D_s^{*+} \omega$	$< 6$	$\times 10^{-4}$ CL=90%	2136
$D_s^+ a_1(1260)^0$	$< 1.8$	$\times 10^{-3}$ CL=90%	2079
$D_s^{*+} a_1(1260)^0$	$< 1.3$	$\times 10^{-3}$ CL=90%	2015
$D_s^+ K^+ K^-$	$( 7.1 \pm 1.1 ) \times 10^{-6}$		2149
$D_s^+ \phi$	$< 4.2$	$\times 10^{-7}$ CL=90%	2141
$D_s^{*+} \phi$	$< 1.2$	$\times 10^{-5}$ CL=90%	2079
$D_s^+ \overline{K}^0$	$< 8$	$\times 10^{-4}$ CL=90%	2242
$D_s^{*+} \overline{K}^0$	$< 9$	$\times 10^{-4}$ CL=90%	2185
$D_s^+ \overline{K}^*(892)^0$	$< 4.4$	$\times 10^{-6}$ CL=90%	2172
$D_s^+ K^{*0}$	$< 3.5$	$\times 10^{-6}$ CL=90%	2172
$D_s^{*+} \overline{K}^*(892)^0$	$< 3.5$	$\times 10^{-4}$ CL=90%	2112
$D_s^- \pi^+ K^+$	$( 1.80 \pm 0.22 ) \times 10^{-4}$		2222
$D_s^{*-} \pi^+ K^+$	$( 1.45 \pm 0.24 ) \times 10^{-4}$		2164
$D_s^- \pi^+ K^*(892)^+$	$< 5$	$\times 10^{-3}$ CL=90%	2138

$D_s^{*-} \pi^+ K^*(892)^+$	$< 7$	$\times 10^{-3}$	CL=90%	2076
$D_s^- K^+ K^+$	$( 9.7 \pm 2.1 )$	$\times 10^{-6}$		2149
$D_s^{*-} K^+ K^+$	$< 1.5$	$\times 10^{-5}$	CL=90%	2088

**Charmonium modes**

$\eta_c K^+$	$( 1.09 \pm 0.09 )$	$\times 10^{-3}$	S=1.1	1751
$\eta_c K^+, \eta_c \rightarrow K_S^0 K^\mp \pi^\pm$	$( 2.7 \pm 0.6 )$	$\times 10^{-5}$		—
$\eta_c K^*(892)^+$	$( 1.0 \begin{smallmatrix} + 0.5 \\ - 0.4 \end{smallmatrix} )$	$\times 10^{-3}$		1646
$\eta_c K^+ \pi^+ \pi^-$	$< 3.9$	$\times 10^{-4}$	CL=90%	1684
$\eta_c K^+ \omega(782)$	$< 5.3$	$\times 10^{-4}$	CL=90%	1475
$\eta_c K^+ \eta$	$< 2.2$	$\times 10^{-4}$	CL=90%	1588
$\eta_c K^+ \pi^0$	$< 6.2$	$\times 10^{-5}$	CL=90%	1723
$\eta_c(2S) K^+$	$( 4.4 \pm 1.0 )$	$\times 10^{-4}$		1320
$\eta_c(2S) K^+, \eta_c \rightarrow p \bar{p}$	$( 3.5 \pm 0.8 )$	$\times 10^{-8}$		—
$\eta_c(2S) K^+, \eta_c \rightarrow K_S^0 K^\mp \pi^\pm$	$( 3.4 \begin{smallmatrix} + 2.3 \\ - 1.6 \end{smallmatrix} )$	$\times 10^{-6}$		—
$h_c(1P) K^+, h_c \rightarrow J/\psi \pi^+ \pi^-$	$< 3.4$	$\times 10^{-6}$	CL=90%	1401
$X(3730)^0 K^+, X^0 \rightarrow \eta_c \eta$	$< 4.6$	$\times 10^{-5}$	CL=90%	—
$X(3730)^0 K^+, X^0 \rightarrow \eta_c \pi^0$	$< 5.7$	$\times 10^{-6}$	CL=90%	—
$\chi_{c1}(3872) K^+$	$< 2.6$	$\times 10^{-4}$	CL=90%	1141
$\chi_{c1}(3872) K^+, \chi_{c1} \rightarrow p \bar{p}$	$< 5$	$\times 10^{-9}$	CL=95%	—
$\chi_{c1}(3872) K^+, \chi_{c1} \rightarrow J/\psi \pi^+ \pi^-$	$( 8.6 \pm 0.8 )$	$\times 10^{-6}$		1141
$\chi_{c1}(3872) K^+, \chi_{c1} \rightarrow J/\psi \gamma$	$( 2.1 \pm 0.4 )$	$\times 10^{-6}$	S=1.1	1141
$\chi_{c1}(3872) K^+, \chi_{c1} \rightarrow \psi(2S) \gamma$	$( 4 \pm 4 )$	$\times 10^{-6}$	S=2.5	1141
$\chi_{c1}(3872) K^+, \chi_{c1} \rightarrow J/\psi(1S) \eta$	$< 7.7$	$\times 10^{-6}$	CL=90%	1141
$\chi_{c1}(3872) K^+, \chi_{c1} \rightarrow D^0 \bar{D}^0$	$< 6.0$	$\times 10^{-5}$	CL=90%	1141
$\chi_{c1}(3872) K^+, \chi_{c1} \rightarrow D^+ D^-$	$< 4.0$	$\times 10^{-5}$	CL=90%	1141
$\chi_{c1}(3872) K^+, \chi_{c1} \rightarrow D^0 \bar{D}^0 \pi^0$	$( 1.0 \pm 0.4 )$	$\times 10^{-4}$		1141
$\chi_{c1}(3872) K^+, \chi_{c1} \rightarrow \bar{D}^{*0} D^0$	$( 8.5 \pm 2.6 )$	$\times 10^{-5}$	S=1.4	1141
$\chi_{c1}(3872)^0 K^+, \chi_{c1}^0 \rightarrow \eta_c \pi^+ \pi^-$	$< 3.0$	$\times 10^{-5}$	CL=90%	—
$\chi_{c1}(3872)^0 K^+, \chi_{c1}^0 \rightarrow \eta_c \omega(782)$	$< 6.9$	$\times 10^{-5}$	CL=90%	—
$\chi_{c1}(3872) K^+, \chi_{c1} \rightarrow \chi_{c1}(1P) \pi^+ \pi^-$	$< 1.5$	$\times 10^{-6}$	CL=90%	—
$X(3915) K^+$	$< 2.8$	$\times 10^{-4}$	CL=90%	1103

$X(3915)^0 K^+, X^0 \rightarrow \eta_c \eta$	< 4.7	$\times 10^{-5}$	CL=90%	—
$X(3915)^0 K^+, X^0 \rightarrow \eta_c \pi^0$	< 1.7	$\times 10^{-5}$	CL=90%	—
$X(4014)^0 K^+, X^0 \rightarrow \eta_c \eta$	< 3.9	$\times 10^{-5}$	CL=90%	—
$X(4014)^0 K^+, X^0 \rightarrow \eta_c \pi^0$	< 1.2	$\times 10^{-5}$	CL=90%	—
$Z_c(3900)^0 K^+, Z_c^- \rightarrow \eta_c \pi^+ \pi^-$	< 4.7	$\times 10^{-5}$	CL=90%	—
$X(4020)^0 K^+, X^0 \rightarrow \eta_c \pi^+ \pi^-$	< 1.6	$\times 10^{-5}$	CL=90%	—
$\chi_{c1}(3872) K^*(892)^+, \chi_{c1} \rightarrow J/\psi \gamma$	< 4.8	$\times 10^{-6}$	CL=90%	939
$\chi_{c1}(3872) K^*(892)^+, \chi_{c1} \rightarrow \psi(2S) \gamma$	< 2.8	$\times 10^{-5}$	CL=90%	939
$\chi_{c1}(3872)^+ K^0, \chi_{c1}^+ \rightarrow J/\psi(1S) \pi^+ \pi^0$	[f] < 6.1	$\times 10^{-6}$	CL=90%	—
$\chi_{c1}(3872) K^0 \pi^+, \chi_{c1} \rightarrow J/\psi(1S) \pi^+ \pi^-$	( 1.06 ± 0.31 )	$\times 10^{-5}$		—
$Z_c(4430)^+ K^0, Z_c^+ \rightarrow J/\psi \pi^+$	< 1.5	$\times 10^{-5}$	CL=95%	—
$Z_c(4430)^+ K^0, Z_c^+ \rightarrow \psi(2S) \pi^+$	< 4.7	$\times 10^{-5}$	CL=95%	—
$\psi(4260)^0 K^+, \psi^0 \rightarrow J/\psi \pi^+ \pi^-$	< 2.9	$\times 10^{-5}$	CL=95%	—
$X(3915) K^+, X \rightarrow J/\psi \gamma$	< 1.4	$\times 10^{-5}$	CL=90%	—
$X(3930)^0 K^+, X^0 \rightarrow J/\psi \gamma$	< 2.5	$\times 10^{-6}$	CL=90%	—
$J/\psi(1S) K^+$	( 1.010 ± 0.029 )	$\times 10^{-3}$		1684
$J/\psi(1S) K^0 \pi^+$	( 1.14 ± 0.11 )	$\times 10^{-3}$		1651
$J/\psi(1S) K^+ \pi^+ \pi^-$	( 8.1 ± 1.3 )	$\times 10^{-4}$	S=2.5	1612
$J/\psi(1S) K^+ K^- K^+$	( 3.37 ± 0.29 )	$\times 10^{-5}$		1252
$X(3915) K^+, X \rightarrow p \bar{p}$	< 7.1	$\times 10^{-8}$	CL=95%	—
$J/\psi(1S) K^*(892)^+$	( 1.43 ± 0.08 )	$\times 10^{-3}$		1571
$J/\psi(1S) K(1270)^+$	( 1.8 ± 0.5 )	$\times 10^{-3}$		1390
$J/\psi(1S) K(1400)^+$	< 5	$\times 10^{-4}$	CL=90%	1308
$J/\psi(1S) \eta K^+$	( 1.24 ± 0.14 )	$\times 10^{-4}$		1510
$\chi_{c1-odd}(3872) K^+, \chi_{c1-odd} \rightarrow J/\psi \eta$	< 3.8	$\times 10^{-6}$	CL=90%	—
$\psi(4160) K^+, \psi \rightarrow J/\psi \eta$	< 7.4	$\times 10^{-6}$	CL=90%	—
$J/\psi(1S) \eta' K^+$	< 8.8	$\times 10^{-5}$	CL=90%	1273
$J/\psi(1S) \phi K^+$	( 5.0 ± 0.4 )	$\times 10^{-5}$		1227
$J/\psi(1S) K_1(1650), K_1 \rightarrow \phi K^+$	( 6 $\begin{smallmatrix} +10 \\ -6 \end{smallmatrix}$ )	$\times 10^{-6}$		—
$J/\psi(1S) K^*(1680)^+, K^* \rightarrow \phi K^+$	( 3.4 $\begin{smallmatrix} +1.9 \\ -2.2 \end{smallmatrix}$ )	$\times 10^{-6}$		—
$J/\psi(1S) K_2^*(1980), K_2^* \rightarrow \phi K^+$	( 1.5 $\begin{smallmatrix} +0.9 \\ -0.5 \end{smallmatrix}$ )	$\times 10^{-6}$		—

$J/\psi(1S)K(1830)^+$ , $K(1830)^+ \rightarrow \phi K^+$	$( 1.3 \begin{smallmatrix} + 1.3 \\ - 1.1 \end{smallmatrix} ) \times 10^{-6}$	–
$\chi_{c1}(4140)K^+$ , $\chi_{c1} \rightarrow$ $J/\psi(1S)\phi$	$( 10 \pm 4 ) \times 10^{-6}$	–
$\chi_{c1}(4274)K^+$ , $\chi_{c1} \rightarrow$ $J/\psi(1S)\phi$	$( 3.6 \begin{smallmatrix} + 2.2 \\ - 1.8 \end{smallmatrix} ) \times 10^{-6}$	–
$\chi_{c0}(4500)K^+$ , $\chi_c^0 \rightarrow$ $J/\psi(1S)\phi$	$( 3.3 \begin{smallmatrix} + 2.1 \\ - 1.7 \end{smallmatrix} ) \times 10^{-6}$	–
$\chi_{c0}(4700)K^+$ , $\chi_{c0} \rightarrow$ $J/\psi(1S)\phi$	$( 6 \begin{smallmatrix} + 5 \\ - 4 \end{smallmatrix} ) \times 10^{-6}$	–
$J/\psi(1S)\omega K^+$	$( 3.20 \begin{smallmatrix} + 0.60 \\ - 0.32 \end{smallmatrix} ) \times 10^{-4}$	1388
$\chi_{c1}(3872)K^+$ , $\chi_{c1} \rightarrow$ $J/\psi\omega$	$( 6.0 \pm 2.2 ) \times 10^{-6}$	1141
$X(3915)K^+$ , $X \rightarrow J/\psi\omega$	$( 3.0 \begin{smallmatrix} + 0.9 \\ - 0.7 \end{smallmatrix} ) \times 10^{-5}$	1103
$J/\psi(1S)\pi^+$	$( 3.88 \pm 0.12 ) \times 10^{-5}$	1728
$J/\psi(1S)\pi^+\pi^+\pi^+\pi^-\pi^-$	$( 1.17 \pm 0.13 ) \times 10^{-5}$	1635
$\psi(2S)\pi^+\pi^+\pi^-$	$( 1.9 \pm 0.4 ) \times 10^{-5}$	1304
$J/\psi(1S)\rho^+$	$( 5.0 \pm 0.8 ) \times 10^{-5}$	1611
$J/\psi(1S)\pi^+\pi^0$ nonresonant	$< 7.3 \times 10^{-6}$	CL=90% 1717
$J/\psi(1S)a_1(1260)^+$	$< 1.2 \times 10^{-3}$	CL=90% 1415
$J/\psi(1S)\rho\bar{p}\pi^+$	$< 5.0 \times 10^{-7}$	CL=90% 643
$J/\psi(1S)\rho\bar{\Lambda}$	$( 1.18 \pm 0.31 ) \times 10^{-5}$	567
$J/\psi(1S)\bar{\Sigma}^0\rho$	$< 1.1 \times 10^{-5}$	CL=90% –
$J/\psi(1S)D^+$	$< 1.2 \times 10^{-4}$	CL=90% 871
$J/\psi(1S)\bar{D}^0\pi^+$	$< 2.5 \times 10^{-5}$	CL=90% 665
$\psi(2S)\pi^+$	$( 2.44 \pm 0.30 ) \times 10^{-5}$	1347
$\psi(2S)K^+$	$( 6.21 \pm 0.23 ) \times 10^{-4}$	1284
$\psi(2S)K^*(892)^+$	$( 6.7 \pm 1.4 ) \times 10^{-4}$	S=1.3 1115
$\psi(2S)K^+\pi^+\pi^-$	$( 4.3 \pm 0.5 ) \times 10^{-4}$	1179
$\psi(2S)\phi(1020)K^+$	$( 4.0 \pm 0.7 ) \times 10^{-6}$	417
$\psi(3770)K^+$	$( 4.9 \pm 1.3 ) \times 10^{-4}$	1218
$\psi(3770)K^+, \psi \rightarrow D^0\bar{D}^0$	$( 1.5 \pm 0.5 ) \times 10^{-4}$	S=1.4 1218
$\psi(3770)K^+, \psi \rightarrow D^+D^-$	$( 9.4 \pm 3.5 ) \times 10^{-5}$	1218
$\psi(3770)K^+, \psi \rightarrow \rho\bar{p}$	$< 2 \times 10^{-7}$	CL=95% –
$\psi(4040)K^+$	$< 1.3 \times 10^{-4}$	CL=90% 1003
$\psi(4160)K^+$	$( 5.1 \pm 2.7 ) \times 10^{-4}$	868
$\psi(4160)K^+, \psi \rightarrow \bar{D}^0D^0$	$( 8 \pm 5 ) \times 10^{-5}$	–
$\chi_{c0}\pi^+$ , $\chi_{c0} \rightarrow \pi^+\pi^-$	$< 1 \times 10^{-7}$	CL=90% 1531
$\chi_{c0}K^+$	$( 1.49 \begin{smallmatrix} + 0.15 \\ - 0.14 \end{smallmatrix} ) \times 10^{-4}$	1478
$\chi_{c0}K^*(892)^+$	$< 2.1 \times 10^{-4}$	CL=90% 1341
$\chi_{c1}(1P)\pi^+$	$( 2.2 \pm 0.5 ) \times 10^{-5}$	1468



$\chi_{c1}(1P)K^+$	$(4.84 \pm 0.23) \times 10^{-4}$		1412
$\chi_{c1}(1P)K^*(892)^+$	$(3.0 \pm 0.6) \times 10^{-4}$	S=1.1	1265
$\chi_{c1}(1P)K^0\pi^+$	$(5.8 \pm 0.4) \times 10^{-4}$		1370
$\chi_{c1}(1P)K^+\pi^0$	$(3.29 \pm 0.35) \times 10^{-4}$		1373
$\chi_{c1}(1P)K^+\pi^+\pi^-$	$(3.74 \pm 0.30) \times 10^{-4}$		1319
$\chi_{c1}(2P)K^+, \chi_{c1}(2P) \rightarrow \pi^+\pi^-\chi_{c1}(1P)$	$< 1.1 \times 10^{-5}$	CL=90%	–
$\chi_{c2}K^+$	$(1.1 \pm 0.4) \times 10^{-5}$		1379
$\chi_{c2}K^*(892)^+$	$< 1.2 \times 10^{-4}$	CL=90%	1228
$\chi_{c2}K^0\pi^+$	$(1.16 \pm 0.25) \times 10^{-4}$		1336
$\chi_{c2}K^+\pi^0$	$< 6.2 \times 10^{-5}$	CL=90%	1339
$\chi_{c2}K^+\pi^+\pi^-$	$(1.34 \pm 0.19) \times 10^{-4}$		1284
$\chi_{c2}(3930)\pi^+, \chi_{c2} \rightarrow \pi^+\pi^-$	$< 1 \times 10^{-7}$	CL=90%	1437
$h_c(1P)K^+$	$< 3.8 \times 10^{-5}$	CL=90%	1401
$h_c(1P)K^+, h_c \rightarrow p\bar{p}$	$< 6.4 \times 10^{-8}$	CL=95%	–

**K or K\* modes**

$K^0\pi^+$	$(2.37 \pm 0.08) \times 10^{-5}$		2614
$K^+\pi^0$	$(1.29 \pm 0.05) \times 10^{-5}$		2615
$\eta'K^+$	$(7.06 \pm 0.25) \times 10^{-5}$		2528
$\eta'K^*(892)^+$	$(4.8 \pm 1.8 - 1.6) \times 10^{-6}$		2472
$\eta'K_0^*(1430)^+$	$(5.2 \pm 2.1) \times 10^{-6}$		–
$\eta'K_2^*(1430)^+$	$(2.8 \pm 0.5) \times 10^{-5}$		2346
$\eta K^+$	$(2.4 \pm 0.4) \times 10^{-6}$	S=1.7	2588
$\eta K^*(892)^+$	$(1.93 \pm 0.16) \times 10^{-5}$		2534
$\eta K_0^*(1430)^+$	$(1.8 \pm 0.4) \times 10^{-5}$		–
$\eta K_2^*(1430)^+$	$(9.1 \pm 3.0) \times 10^{-6}$		2414
$\eta(1295)K^+ \times B(\eta(1295) \rightarrow \eta\pi\pi)$	$(2.9 \pm 0.8 - 0.7) \times 10^{-6}$		2455
$\eta(1405)K^+ \times B(\eta(1405) \rightarrow \eta\pi\pi)$	$< 1.3 \times 10^{-6}$	CL=90%	2425
$\eta(1405)K^+ \times B(\eta(1405) \rightarrow K^*K)$	$< 1.2 \times 10^{-6}$	CL=90%	2425
$\eta(1475)K^+ \times B(\eta(1475) \rightarrow K^*K)$	$(1.38 \pm 0.21 - 0.18) \times 10^{-5}$		2406
$f_1(1285)K^+$	$< 2.0 \times 10^{-6}$	CL=90%	2458
$f_1(1420)K^+ \times B(f_1(1420) \rightarrow \eta\pi\pi)$	$< 2.9 \times 10^{-6}$	CL=90%	2420
$f_1(1420)K^+ \times B(f_1(1420) \rightarrow K^*K)$	$< 4.1 \times 10^{-6}$	CL=90%	2420
$\phi(1680)K^+ \times B(\phi(1680) \rightarrow K^*K)$	$< 3.4 \times 10^{-6}$	CL=90%	2344
$f_0(1500)K^+$	$(3.7 \pm 2.2) \times 10^{-6}$		2398

$\omega K^+$	$( 6.5 \pm 0.4 ) \times 10^{-6}$		2558
$\omega K^*(892)^+$	$< 7.4 \times 10^{-6}$	CL=90%	2503
$\omega (K\pi)_0^{*+}$	$( 2.8 \pm 0.4 ) \times 10^{-5}$		—
$\omega K_0^*(1430)^+$	$( 2.4 \pm 0.5 ) \times 10^{-5}$		—
$\omega K_2^*(1430)^+$	$( 2.1 \pm 0.4 ) \times 10^{-5}$		2380
$a_0(980)^+ K^0 \times B(a_0(980)^+ \rightarrow \eta\pi^+)$	$< 3.9 \times 10^{-6}$	CL=90%	—
$a_0(980)^0 K^+ \times B(a_0(980)^0 \rightarrow \eta\pi^0)$	$< 2.5 \times 10^{-6}$	CL=90%	—
$K^*(892)^0 \pi^+$	$( 1.01 \pm 0.08 ) \times 10^{-5}$		2562
$K^*(892)^+ \pi^0$	$( 6.8 \pm 0.9 ) \times 10^{-6}$		2563
$K^+ \pi^- \pi^+$	$( 5.10 \pm 0.29 ) \times 10^{-5}$		2609
$K^+ \pi^- \pi^+$ nonresonant	$( 1.63 \begin{smallmatrix} + 0.21 \\ - 0.15 \end{smallmatrix} ) \times 10^{-5}$		2609
$\omega(782) K^+$	$( 6 \pm 9 ) \times 10^{-6}$		2558
$K^+ f_0(980) \times B(f_0(980) \rightarrow \pi^+ \pi^-)$	$( 9.4 \begin{smallmatrix} + 1.0 \\ - 1.2 \end{smallmatrix} ) \times 10^{-6}$		2522
$f_2(1270)^0 K^+$	$( 1.07 \pm 0.27 ) \times 10^{-6}$		—
$f_0(1370)^0 K^+ \times B(f_0(1370)^0 \rightarrow \pi^+ \pi^-)$	$< 1.07 \times 10^{-5}$	CL=90%	—
$\rho^0(1450) K^+ \times B(\rho^0(1450) \rightarrow \pi^+ \pi^-)$	$< 1.17 \times 10^{-5}$	CL=90%	—
$f_2'(1525) K^+ \times B(f_2'(1525) \rightarrow \pi^+ \pi^-)$	$< 3.4 \times 10^{-6}$	CL=90%	2392
$K^+ \rho^0$	$( 3.7 \pm 0.5 ) \times 10^{-6}$		2559
$K_0^*(1430)^0 \pi^+$	$( 3.9 \begin{smallmatrix} + 0.6 \\ - 0.5 \end{smallmatrix} ) \times 10^{-5}$	S=1.4	2445
$K_0^*(1430)^+ \pi^0$	$( 1.19 \begin{smallmatrix} + 0.20 \\ - 0.23 \end{smallmatrix} ) \times 10^{-5}$		—
$K_2^*(1430)^0 \pi^+$	$( 5.6 \begin{smallmatrix} + 2.2 \\ - 1.5 \end{smallmatrix} ) \times 10^{-6}$		2445
$K^*(1410)^0 \pi^+$	$< 4.5 \times 10^{-5}$	CL=90%	2446
$K^*(1680)^0 \pi^+$	$< 1.2 \times 10^{-5}$	CL=90%	2358
$K^+ \pi^0 \pi^0$	$( 1.62 \pm 0.19 ) \times 10^{-5}$		2610
$f_0(980) K^+ \times B(f_0 \rightarrow \pi^0 \pi^0)$	$( 2.8 \pm 0.8 ) \times 10^{-6}$		2522
$K^- \pi^+ \pi^+$	$< 4.6 \times 10^{-8}$	CL=90%	2609
$K^- \pi^+ \pi^+$ nonresonant	$< 5.6 \times 10^{-5}$	CL=90%	2609
$K_1(1270)^0 \pi^+$	$< 4.0 \times 10^{-5}$	CL=90%	2484
$K_1(1400)^0 \pi^+$	$< 3.9 \times 10^{-5}$	CL=90%	2451
$K^0 \pi^+ \pi^0$	$< 6.6 \times 10^{-5}$	CL=90%	2609
$K^0 \rho^+$	$( 7.3 \begin{smallmatrix} + 1.0 \\ - 1.2 \end{smallmatrix} ) \times 10^{-6}$		2558
$K^*(892)^+ \pi^+ \pi^-$	$( 7.5 \pm 1.0 ) \times 10^{-5}$		2557
$K^*(892)^+ \rho^0$	$( 4.6 \pm 1.1 ) \times 10^{-6}$		2504
$K^*(892)^+ f_0(980)$	$( 4.2 \pm 0.7 ) \times 10^{-6}$		2466

$a_1^+ K^0$	$( 3.5 \pm 0.7 ) \times 10^{-5}$	—
$b_1^+ K^0 \times B(b_1^+ \rightarrow \omega \pi^+)$	$( 9.6 \pm 1.9 ) \times 10^{-6}$	—
$K^*(892)^0 \rho^+$	$( 9.2 \pm 1.5 ) \times 10^{-6}$	2504
$K_1(1400)^+ \rho^0$	$< 7.8 \times 10^{-4}$	CL=90% 2388
$K_2^*(1430)^+ \rho^0$	$< 1.5 \times 10^{-3}$	CL=90% 2381
$b_1^0 K^+ \times B(b_1^0 \rightarrow \omega \pi^0)$	$( 9.1 \pm 2.0 ) \times 10^{-6}$	—
$b_1^+ K^{*0} \times B(b_1^+ \rightarrow \omega \pi^+)$	$< 5.9 \times 10^{-6}$	CL=90% —
$b_1^0 K^{*+} \times B(b_1^0 \rightarrow \omega \pi^0)$	$< 6.7 \times 10^{-6}$	CL=90% —
$K^+ \bar{K}^0$	$( 1.31 \pm 0.17 ) \times 10^{-6}$	S=1.2 2593
$\bar{K}^0 K^+ \pi^0$	$< 2.4 \times 10^{-5}$	CL=90% 2578
$K^+ K_S^0 K_S^0$	$( 1.08 \pm 0.06 ) \times 10^{-5}$	2521
$f_0(980) K^+, f_0 \rightarrow K_S^0 K_S^0$	$( 1.47 \pm 0.33 ) \times 10^{-5}$	—
$f_0(1710) K^+, f_0 \rightarrow K_S^0 K_S^0$	$( 4.8 \pm_{-2.6}^{4.0} ) \times 10^{-7}$	—
$K^+ K_S^0 K_S^0$ nonresonant	$( 2.0 \pm 0.4 ) \times 10^{-5}$	2521
$K_S^0 K_S^0 \pi^+$	$< 5.1 \times 10^{-7}$	CL=90% 2577
$K^+ K^- \pi^+$	$( 5.2 \pm 0.4 ) \times 10^{-6}$	2578
$K^+ K^- \pi^+$ nonresonant	$< 7.5 \times 10^{-5}$	CL=90% 2578
$K^+ \bar{K}^*(892)^0$	$< 1.1 \times 10^{-6}$	CL=90% 2540
$K^+ \bar{K}_0^*(1430)^0$	$< 2.2 \times 10^{-6}$	CL=90% 2421
$K^+ K^+ \pi^-$	$< 1.1 \times 10^{-8}$	CL=90% 2578
$K^+ K^+ \pi^-$ nonresonant	$< 8.79 \times 10^{-5}$	CL=90% 2578
$f_2'(1525) K^+$	$( 1.8 \pm 0.5 ) \times 10^{-6}$	S=1.1 2392
$K^{*+} \pi^+ K^-$	$< 1.18 \times 10^{-5}$	CL=90% 2524
$K^*(892)^+ K^*(892)^0$	$( 9.1 \pm 2.9 ) \times 10^{-7}$	2484
$K^{*+} K^+ \pi^-$	$< 6.1 \times 10^{-6}$	CL=90% 2524
$K^+ K^- K^+$	$( 3.40 \pm 0.14 ) \times 10^{-5}$	S=1.4 2523
$K^+ \phi$	$( 8.8 \pm_{-0.6}^{0.7} ) \times 10^{-6}$	S=1.1 2516
$f_0(980) K^+ \times B(f_0(980) \rightarrow K^+ K^-)$	$( 9.4 \pm 3.2 ) \times 10^{-6}$	2522
$a_2(1320) K^+ \times B(a_2(1320) \rightarrow K^+ K^-)$	$< 1.1 \times 10^{-6}$	CL=90% 2449
$X_0(1550) K^+ \times B(X_0(1550) \rightarrow K^+ K^-)$	$( 4.3 \pm 0.7 ) \times 10^{-6}$	—
$\phi(1680) K^+ \times B(\phi(1680) \rightarrow K^+ K^-)$	$< 8 \times 10^{-7}$	CL=90% 2344
$f_0(1710) K^+ \times B(f_0(1710) \rightarrow K^+ K^-)$	$( 1.1 \pm 0.6 ) \times 10^{-6}$	2330
$K^+ K^- K^+$ nonresonant	$( 2.38 \pm_{-0.50}^{0.28} ) \times 10^{-5}$	2523
$K^*(892)^+ K^+ K^-$	$( 3.6 \pm 0.5 ) \times 10^{-5}$	2466
$K^*(892)^+ \phi$	$( 10.0 \pm 2.0 ) \times 10^{-6}$	S=1.7 2460
$\phi(K\pi)_0^{*+}$	$( 8.3 \pm 1.6 ) \times 10^{-6}$	—

$\phi K_1(1270)^+$	$( 6.1 \pm 1.9 ) \times 10^{-6}$		2375
$\phi K_1(1400)^+$	$< 3.2 \times 10^{-6}$	CL=90%	2339
$\phi K^*(1410)^+$	$< 4.3 \times 10^{-6}$	CL=90%	—
$\phi K_0^*(1430)^+$	$( 7.0 \pm 1.6 ) \times 10^{-6}$		—
$\phi K_2^*(1430)^+$	$( 8.4 \pm 2.1 ) \times 10^{-6}$		2333
$\phi K_2^*(1770)^+$	$< 1.50 \times 10^{-5}$	CL=90%	—
$\phi K_2^*(1820)^+$	$< 1.63 \times 10^{-5}$	CL=90%	—
$a_1^+ K^{*0}$	$< 3.6 \times 10^{-6}$	CL=90%	—
$K^+ \phi \phi$	$( 5.0 \pm 1.2 ) \times 10^{-6}$	S=2.3	2306
$\eta' \eta' K^+$	$< 2.5 \times 10^{-5}$	CL=90%	2338
$\omega \phi K^+$	$< 1.9 \times 10^{-6}$	CL=90%	2374
$X(1812) K^+ \times B(X \rightarrow \omega \phi)$	$< 3.2 \times 10^{-7}$	CL=90%	—
$K^*(892)^+ \gamma$	$( 3.92 \pm 0.22 ) \times 10^{-5}$	S=1.7	2564
$K_1(1270)^+ \gamma$	$( 4.4 \begin{smallmatrix} + 0.7 \\ - 0.6 \end{smallmatrix} ) \times 10^{-5}$		2486
$\eta K^+ \gamma$	$( 7.9 \pm 0.9 ) \times 10^{-6}$		2588
$\eta' K^+ \gamma$	$( 2.9 \begin{smallmatrix} + 1.0 \\ - 0.9 \end{smallmatrix} ) \times 10^{-6}$		2528
$\phi K^+ \gamma$	$( 2.7 \pm 0.4 ) \times 10^{-6}$	S=1.2	2516
$K^+ \pi^- \pi^+ \gamma$	$( 2.58 \pm 0.15 ) \times 10^{-5}$	S=1.3	2609
$K^*(892)^0 \pi^+ \gamma$	$( 2.33 \pm 0.12 ) \times 10^{-5}$		2562
$K^+ \rho^0 \gamma$	$( 8.2 \pm 0.9 ) \times 10^{-6}$		2559
$(K^+ \pi^-)_{NR} \pi^+ \gamma$	$( 9.9 \begin{smallmatrix} + 1.7 \\ - 2.0 \end{smallmatrix} ) \times 10^{-6}$		2609
$K^0 \pi^+ \pi^0 \gamma$	$( 4.6 \pm 0.5 ) \times 10^{-5}$		2609
$K_1(1400)^+ \gamma$	$( 10 \begin{smallmatrix} + 5 \\ - 4 \end{smallmatrix} ) \times 10^{-6}$		2453
$K^*(1410)^+ \gamma$	$( 2.7 \begin{smallmatrix} + 0.8 \\ - 0.6 \end{smallmatrix} ) \times 10^{-5}$		—
$K_0^*(1430)^0 \pi^+ \gamma$	$( 1.32 \begin{smallmatrix} + 0.26 \\ - 0.32 \end{smallmatrix} ) \times 10^{-6}$		2445
$K_2^*(1430)^+ \gamma$	$( 1.4 \pm 0.4 ) \times 10^{-5}$		2447
$K^*(1680)^+ \gamma$	$( 6.7 \begin{smallmatrix} + 1.7 \\ - 1.4 \end{smallmatrix} ) \times 10^{-5}$		2360
$K_3^*(1780)^+ \gamma$	$< 3.9 \times 10^{-5}$	CL=90%	2341
$K_4^*(2045)^+ \gamma$	$< 9.9 \times 10^{-3}$	CL=90%	2244

**Light unflavored meson modes**

$\rho^+ \gamma$	$( 9.8 \pm 2.5 ) \times 10^{-7}$		2583
$\pi^+ \pi^0$	$( 5.5 \pm 0.4 ) \times 10^{-6}$	S=1.2	2636
$\pi^+ \pi^+ \pi^-$	$( 1.52 \pm 0.14 ) \times 10^{-5}$		2630
$\rho^0 \pi^+$	$( 8.3 \pm 1.2 ) \times 10^{-6}$		2581
$\pi^+ f_0(980), f_0 \rightarrow \pi^+ \pi^-$	$< 1.5 \times 10^{-6}$	CL=90%	2545
$\pi^+ f_2(1270)$	$( 1.6 \begin{smallmatrix} + 0.7 \\ - 0.4 \end{smallmatrix} ) \times 10^{-6}$		2484
$\rho(1450)^0 \pi^+, \rho^0 \rightarrow \pi^+ \pi^-$	$( 1.4 \begin{smallmatrix} + 0.6 \\ - 0.9 \end{smallmatrix} ) \times 10^{-6}$		2434

$f_0(1370)\pi^+$ , $f_0 \rightarrow \pi^+\pi^-$	< 4.0	$\times 10^{-6}$	CL=90%	2460
$f_0(500)\pi^+$ , $f_0 \rightarrow \pi^+\pi^-$	< 4.1	$\times 10^{-6}$	CL=90%	–
$\pi^+\pi^-\pi^+$ nonresonant	( 5.3 $\pm$ 1.5 – 1.1 )	$\times 10^{-6}$		2630
$\pi^+\pi^0\pi^0$	< 8.9	$\times 10^{-4}$	CL=90%	2631
$\rho^+\pi^0$	( 1.09 $\pm$ 0.14 )	$\times 10^{-5}$		2581
$\pi^+\pi^-\pi^+\pi^0$	< 4.0	$\times 10^{-3}$	CL=90%	2622
$\rho^+\rho^0$	( 2.40 $\pm$ 0.19 )	$\times 10^{-5}$		2523
$\rho^+f_0(980)$ , $f_0 \rightarrow \pi^+\pi^-$	< 2.0	$\times 10^{-6}$	CL=90%	2486
$a_1(1260)^+\pi^0$	( 2.6 $\pm$ 0.7 )	$\times 10^{-5}$		2494
$a_1(1260)^0\pi^+$	( 2.0 $\pm$ 0.6 )	$\times 10^{-5}$		2494
$\omega\pi^+$	( 6.9 $\pm$ 0.5 )	$\times 10^{-6}$		2580
$\omega\rho^+$	( 1.59 $\pm$ 0.21 )	$\times 10^{-5}$		2522
$\eta\pi^+$	( 4.02 $\pm$ 0.27 )	$\times 10^{-6}$		2609
$\eta\rho^+$	( 7.0 $\pm$ 2.9 )	$\times 10^{-6}$	S=2.8	2553
$\eta'\pi^+$	( 2.7 $\pm$ 0.9 )	$\times 10^{-6}$	S=1.9	2551
$\eta'\rho^+$	( 9.7 $\pm$ 2.2 )	$\times 10^{-6}$		2492
$\phi\pi^+$	< 1.5	$\times 10^{-7}$	CL=90%	2539
$\phi\rho^+$	< 3.0	$\times 10^{-6}$	CL=90%	2480
$a_0(980)^0\pi^+$ , $a_0^0 \rightarrow \eta\pi^0$	< 5.8	$\times 10^{-6}$	CL=90%	–
$a_0(980)^+\pi^0$ , $a_0^+ \rightarrow \eta\pi^+$	< 1.4	$\times 10^{-6}$	CL=90%	–
$\pi^+\pi^+\pi^+\pi^-\pi^-$	< 8.6	$\times 10^{-4}$	CL=90%	2608
$\rho^0 a_1(1260)^+$	< 6.2	$\times 10^{-4}$	CL=90%	2433
$\rho^0 a_2(1320)^+$	< 7.2	$\times 10^{-4}$	CL=90%	2410
$b_1^0\pi^+$ , $b_1^0 \rightarrow \omega\pi^0$	( 6.7 $\pm$ 2.0 )	$\times 10^{-6}$		–
$b_1^+\pi^0$ , $b_1^+ \rightarrow \omega\pi^+$	< 3.3	$\times 10^{-6}$	CL=90%	–
$\pi^+\pi^+\pi^+\pi^-\pi^-\pi^0$	< 6.3	$\times 10^{-3}$	CL=90%	2592
$b_1^+\rho^0$ , $b_1^+ \rightarrow \omega\pi^+$	< 5.2	$\times 10^{-6}$	CL=90%	–
$a_1(1260)^+ a_1(1260)^0$	< 1.3	%	CL=90%	2336
$b_1^0\rho^+$ , $b_1^0 \rightarrow \omega\pi^0$	< 3.3	$\times 10^{-6}$	CL=90%	–

### Charged particle ( $h^\pm$ ) modes

$$h^\pm = K^\pm \text{ or } \pi^\pm$$

$h^+\pi^0$	( 1.6 $\pm$ 0.7 – 0.6 )	$\times 10^{-5}$		2636
$\omega h^+$	( 1.38 $\pm$ 0.27 – 0.24 )	$\times 10^{-5}$		2580
$h^+ X^0$ (Familon)	< 4.9	$\times 10^{-5}$	CL=90%	–
$K^+ X^0$ , $X^0 \rightarrow \mu^+\mu^-$	< 1	$\times 10^{-7}$	CL=95%	–

**Baryon modes**

$p\bar{p}\pi^+$	( 1.62 ± 0.20 ) × 10 <sup>-6</sup>		2439
$p\bar{p}\pi^+$ nonresonant	< 5.3	× 10 <sup>-5</sup> CL=90%	2439
$p\bar{p}K^+$	( 5.9 ± 0.5 ) × 10 <sup>-6</sup>	S=1.5	2348
$\Theta(1710)^{++}\bar{p}, \Theta^{++} \rightarrow pK^+$	[g] < 9.1	× 10 <sup>-8</sup> CL=90%	—
$f_J(2220)K^+, f_J \rightarrow p\bar{p}$	[g] < 4.1	× 10 <sup>-7</sup> CL=90%	2135
$\rho\bar{\Lambda}(1520)$	( 3.1 ± 0.6 ) × 10 <sup>-7</sup>		2322
$p\bar{p}K^+$ nonresonant	< 8.9	× 10 <sup>-5</sup> CL=90%	2348
$p\bar{p}K^*(892)^+$	( 3.6 + 0.8 / - 0.7 ) × 10 <sup>-6</sup>		2215
$f_J(2220)K^{*+}, f_J \rightarrow p\bar{p}$	< 7.7	× 10 <sup>-7</sup> CL=90%	2059
$\rho\bar{\Lambda}$	( 2.4 + 1.0 / - 0.9 ) × 10 <sup>-7</sup>		2430
$\rho\bar{\Lambda}\gamma$	( 2.4 + 0.5 / - 0.4 ) × 10 <sup>-6</sup>		2430
$\rho\bar{\Lambda}\pi^0$	( 3.0 + 0.7 / - 0.6 ) × 10 <sup>-6</sup>		2402
$\rho\bar{\Sigma}(1385)^0$	< 4.7	× 10 <sup>-7</sup> CL=90%	2362
$\Delta^+\bar{\Lambda}$	< 8.2	× 10 <sup>-7</sup> CL=90%	—
$\rho\bar{\Sigma}\gamma$	< 4.6	× 10 <sup>-6</sup> CL=90%	2413
$\rho\bar{\Lambda}\pi^+\pi^-$	( 5.9 ± 1.1 ) × 10 <sup>-6</sup>		2367
$\rho\bar{\Lambda}\rho^0$	( 4.8 ± 0.9 ) × 10 <sup>-6</sup>		2214
$\rho\bar{\Lambda}f_2(1270)$	( 2.0 ± 0.8 ) × 10 <sup>-6</sup>		2026
$\Lambda\bar{\Lambda}\pi^+$	< 9.4	× 10 <sup>-7</sup> CL=90%	2358
$\Lambda\bar{\Lambda}K^+$	( 3.4 ± 0.6 ) × 10 <sup>-6</sup>		2251
$\Lambda\bar{\Lambda}K^{*+}$	( 2.2 + 1.2 / - 0.9 ) × 10 <sup>-6</sup>		2098
$\bar{\Delta}^0\rho$	< 1.38	× 10 <sup>-6</sup> CL=90%	2403
$\Delta^{++}\bar{p}$	< 1.4	× 10 <sup>-7</sup> CL=90%	2403
$D^+\rho\bar{p}$	< 1.5	× 10 <sup>-5</sup> CL=90%	1860
$D^*(2010)^+\rho\bar{p}$	< 1.5	× 10 <sup>-5</sup> CL=90%	1786
$\bar{D}^0\rho\bar{p}\pi^+$	( 3.72 ± 0.27 ) × 10 <sup>-4</sup>		1789
$\bar{D}^{*0}\rho\bar{p}\pi^+$	( 3.73 ± 0.32 ) × 10 <sup>-4</sup>		1709
$D^-\rho\bar{p}\pi^+\pi^-$	( 1.66 ± 0.30 ) × 10 <sup>-4</sup>		1705
$D^{*-}\rho\bar{p}\pi^+\pi^-$	( 1.86 ± 0.25 ) × 10 <sup>-4</sup>		1621
$\rho\bar{\Lambda}^0\bar{D}^0$	( 1.43 ± 0.32 ) × 10 <sup>-5</sup>		—
$\rho\bar{\Lambda}^0\bar{D}^*(2007)^0$	< 5	× 10 <sup>-5</sup> CL=90%	—
$\bar{\Lambda}_c^-\rho\pi^+$	( 2.3 ± 0.4 ) × 10 <sup>-4</sup>	S=2.2	1980
$\bar{\Lambda}_c^-\Delta(1232)^{++}$	< 1.9	× 10 <sup>-5</sup> CL=90%	1928
$\bar{\Lambda}_c^-\Delta_X(1600)^{++}$	( 4.7 ± 1.0 ) × 10 <sup>-5</sup>		—
$\bar{\Lambda}_c^-\Delta_X(2420)^{++}$	( 3.8 ± 0.9 ) × 10 <sup>-5</sup>		—
$(\bar{\Lambda}_c^-\rho)_s\pi^+$	[h] ( 3.1 ± 0.7 ) × 10 <sup>-5</sup>		—
$\bar{\Sigma}_c(2520)^0\rho$	< 3	× 10 <sup>-6</sup> CL=90%	1904
$\bar{\Sigma}_c(2800)^0\rho$	( 2.7 ± 0.9 ) × 10 <sup>-5</sup>		—

$\overline{\Lambda}_c^- p \pi^+ \pi^0$		$( 1.8 \pm 0.6 ) \times 10^{-3}$		1935
$\overline{\Lambda}_c^- p \pi^+ \pi^+ \pi^-$		$( 2.2 \pm 0.7 ) \times 10^{-3}$		1880
$\overline{\Lambda}_c^- p \pi^+ \pi^+ \pi^- \pi^0$		$< 1.34$	% CL=90%	1823
$\Lambda_c^+ \Lambda_c^- K^+$		$( 7.0 \pm 2.2 ) \times 10^{-4}$		—
$\overline{\Sigma}_c(2455)^0 p$		$( 3.0 \pm 0.7 ) \times 10^{-5}$		1938
$\overline{\Sigma}_c(2455)^0 p \pi^0$		$( 3.5 \pm 1.1 ) \times 10^{-4}$		1896
$\overline{\Sigma}_c(2455)^0 p \pi^- \pi^+$		$( 3.5 \pm 1.1 ) \times 10^{-4}$		1845
$\overline{\Sigma}_c(2455)^{--} p \pi^+ \pi^+$		$( 2.39 \pm 0.20 ) \times 10^{-4}$		1845
$\overline{\Lambda}_c(2593)^- / \overline{\Lambda}_c(2625)^- p \pi^+$		$< 1.9$	$\times 10^{-4}$ CL=90%	—
$\Xi_c^0 \Lambda_c^+, \Xi_c^0 \rightarrow \Xi^+ \pi^-$		$( 2.4 \pm 0.9 ) \times 10^{-5}$	S=1.4	1144
$\Xi_c^0 \Lambda_c^+, \Xi_c^0 \rightarrow \Lambda K^+ \pi^-$		$( 2.1 \pm 0.9 ) \times 10^{-5}$	S=1.5	1144

**Lepton Family number (LF) or Lepton number (L) or Baryon number (B) violating modes, or/and  $\Delta B = 1$  weak neutral current (B1) modes**

$\pi^+ \ell^+ \ell^-$	B1	$< 4.9$	$\times 10^{-8}$	CL=90%	2638
$\pi^+ e^+ e^-$	B1	$< 8.0$	$\times 10^{-8}$	CL=90%	2638
$\pi^+ \mu^+ \mu^-$	B1	$( 1.76 \pm 0.23 )$	$\times 10^{-8}$		2634
$\pi^+ \nu \bar{\nu}$	B1	$< 1.4$	$\times 10^{-5}$	CL=90%	2638
$K^+ \ell^+ \ell^-$	B1	[a] $( 4.51 \pm 0.23 )$	$\times 10^{-7}$	S=1.1	2617
$K^+ e^+ e^-$	B1	$( 5.5 \pm 0.7 )$	$\times 10^{-7}$		2617
$K^+ \mu^+ \mu^-$	B1	$( 4.41 \pm 0.23 )$	$\times 10^{-7}$	S=1.2	2612
$K^+ \mu^+ \mu^-$ nonresonant	B1	$( 4.37 \pm 0.27 )$	$\times 10^{-7}$		2612
$K^+ \tau^+ \tau^-$	B1	$< 2.25$	$\times 10^{-3}$	CL=90%	1687
$K^+ \bar{\nu} \nu$	B1	$< 1.6$	$\times 10^{-5}$	CL=90%	2617
$\rho^+ \nu \bar{\nu}$	B1	$< 3.0$	$\times 10^{-5}$	CL=90%	2583
$K^*(892)^+ \ell^+ \ell^-$	B1	[a] $( 1.01 \pm 0.11 )$	$\times 10^{-6}$	S=1.1	2564
$K^*(892)^+ e^+ e^-$	B1	$( 1.55 \pm_{0.31}^{0.40} )$	$\times 10^{-6}$		2564
$K^*(892)^+ \mu^+ \mu^-$	B1	$( 9.6 \pm 1.0 )$	$\times 10^{-7}$		2560
$K^*(892)^+ \nu \bar{\nu}$	B1	$< 4.0$	$\times 10^{-5}$	CL=90%	2564
$K^+ \pi^+ \pi^- \mu^+ \mu^-$	B1	$( 4.3 \pm 0.4 )$	$\times 10^{-7}$		2593
$\phi K^+ \mu^+ \mu^-$	B1	$( 7.9 \pm_{1.7}^{2.1} )$	$\times 10^{-8}$		2490
$\pi^+ e^+ \mu^-$	LF	$< 6.4$	$\times 10^{-3}$	CL=90%	2637
$\pi^+ e^- \mu^+$	LF	$< 6.4$	$\times 10^{-3}$	CL=90%	2637
$\pi^+ e^\pm \mu^\mp$	LF	$< 1.7$	$\times 10^{-7}$	CL=90%	2637
$\pi^+ e^+ \tau^-$	LF	$< 7.4$	$\times 10^{-5}$	CL=90%	2338
$\pi^+ e^- \tau^+$	LF	$< 2.0$	$\times 10^{-5}$	CL=90%	2338
$\pi^+ e^\pm \tau^\mp$	LF	$< 7.5$	$\times 10^{-5}$	CL=90%	2338
$\pi^+ \mu^+ \tau^-$	LF	$< 6.2$	$\times 10^{-5}$	CL=90%	2333
$\pi^+ \mu^- \tau^+$	LF	$< 4.5$	$\times 10^{-5}$	CL=90%	2333
$\pi^+ \mu^\pm \tau^\mp$	LF	$< 7.2$	$\times 10^{-5}$	CL=90%	2333
$K^+ e^+ \mu^-$	LF	$< 9.1$	$\times 10^{-8}$	CL=90%	2615
$K^+ e^- \mu^+$	LF	$< 1.3$	$\times 10^{-7}$	CL=90%	2615

$K^+ e^\pm \mu^\mp$	LF	< 9.1	$\times 10^{-8}$	CL=90%	2615
$K^+ e^+ \tau^-$	LF	< 4.3	$\times 10^{-5}$	CL=90%	2312
$K^+ e^- \tau^+$	LF	< 1.5	$\times 10^{-5}$	CL=90%	2312
$K^+ e^\pm \tau^\mp$	LF	< 3.0	$\times 10^{-5}$	CL=90%	2312
$K^+ \mu^+ \tau^-$	LF	< 4.5	$\times 10^{-5}$	CL=90%	2298
$K^+ \mu^- \tau^+$	LF	< 2.8	$\times 10^{-5}$	CL=90%	2298
$K^+ \mu^\pm \tau^\mp$	LF	< 4.8	$\times 10^{-5}$	CL=90%	2298
$K^*(892)^+ e^+ \mu^-$	LF	< 1.3	$\times 10^{-6}$	CL=90%	2563
$K^*(892)^+ e^- \mu^+$	LF	< 9.9	$\times 10^{-7}$	CL=90%	2563
$K^*(892)^+ e^\pm \mu^\mp$	LF	< 1.4	$\times 10^{-6}$	CL=90%	2563
$\pi^- e^+ e^+$	L	< 2.3	$\times 10^{-8}$	CL=90%	2638
$\pi^- \mu^+ \mu^+$	L	< 4.0	$\times 10^{-9}$	CL=95%	2634
$\pi^- e^+ \mu^+$	L	< 1.5	$\times 10^{-7}$	CL=90%	2637
$\rho^- e^+ e^+$	L	< 1.7	$\times 10^{-7}$	CL=90%	2583
$\rho^- \mu^+ \mu^+$	L	< 4.2	$\times 10^{-7}$	CL=90%	2578
$\rho^- e^+ \mu^+$	L	< 4.7	$\times 10^{-7}$	CL=90%	2582
$K^- e^+ e^+$	L	< 3.0	$\times 10^{-8}$	CL=90%	2617
$K^- \mu^+ \mu^+$	L	< 4.1	$\times 10^{-8}$	CL=90%	2612
$K^- e^+ \mu^+$	L	< 1.6	$\times 10^{-7}$	CL=90%	2615
$K^*(892)^- e^+ e^+$	L	< 4.0	$\times 10^{-7}$	CL=90%	2564
$K^*(892)^- \mu^+ \mu^+$	L	< 5.9	$\times 10^{-7}$	CL=90%	2560
$K^*(892)^- e^+ \mu^+$	L	< 3.0	$\times 10^{-7}$	CL=90%	2563
$D^- e^+ e^+$	L	< 2.6	$\times 10^{-6}$	CL=90%	2309
$D^- e^+ \mu^+$	L	< 1.8	$\times 10^{-6}$	CL=90%	2307
$D^- \mu^+ \mu^+$	L	< 6.9	$\times 10^{-7}$	CL=95%	2303
$D^{*-} \mu^+ \mu^+$	L	< 2.4	$\times 10^{-6}$	CL=95%	2251
$D_s^- \mu^+ \mu^+$	L	< 5.8	$\times 10^{-7}$	CL=95%	2267
$\overline{D}^0 \pi^- \mu^+ \mu^+$	L	< 1.5	$\times 10^{-6}$	CL=95%	2295
$\Lambda^0 \mu^+$	L,B	< 6	$\times 10^{-8}$	CL=90%	—
$\Lambda^0 e^+$	L,B	< 3.2	$\times 10^{-8}$	CL=90%	—
$\overline{\Lambda}^0 \mu^+$	L,B	< 6	$\times 10^{-8}$	CL=90%	—
$\overline{\Lambda}^0 e^+$	L,B	< 8	$\times 10^{-8}$	CL=90%	—



$$I(J^P) = \frac{1}{2}(0^-)$$

$I, J, P$  need confirmation. Quantum numbers shown are quark-model predictions.

$$\text{Mass } m_{B^0} = 5279.63 \pm 0.15 \text{ MeV} \quad (S = 1.1)$$

$$m_{B^0} - m_{B^\pm} = 0.31 \pm 0.06 \text{ MeV}$$

$$\text{Mean life } \tau_{B^0} = (1.520 \pm 0.004) \times 10^{-12} \text{ s}$$

$$c\tau = 455.7 \text{ } \mu\text{m}$$

$$\tau_{B^+}/\tau_{B^0} = 1.076 \pm 0.004 \quad (\text{direct measurements})$$



**$B^0$ - $\bar{B}^0$  mixing parameters**

$$\chi_d = 0.1860 \pm 0.0011$$

$$\begin{aligned} \Delta m_{B^0} = m_{B_H^0} - m_{B_L^0} &= (0.5064 \pm 0.0019) \times 10^{12} \hbar \text{ s}^{-1} \\ &= (3.333 \pm 0.013) \times 10^{-10} \text{ MeV} \end{aligned}$$

$$x_d = \Delta m_{B^0} / \Gamma_{B^0} = 0.770 \pm 0.004$$

$$\text{Re}(\lambda_{CP} / |\lambda_{CP}|) \text{ Re}(z) = 0.047 \pm 0.022$$

$$\Delta \Gamma \text{ Re}(z) = -0.007 \pm 0.004$$

$$\text{Re}(z) = (-4 \pm 4) \times 10^{-2} \quad (S = 1.4)$$

$$\text{Im}(z) = (-0.8 \pm 0.4) \times 10^{-2}$$

**CP violation parameters**

$$\text{Re}(\epsilon_{B^0}) / (1 + |\epsilon_{B^0}|^2) = (-0.5 \pm 0.4) \times 10^{-3}$$

$$A_{T/CP}(B^0 \leftrightarrow \bar{B}^0) = 0.005 \pm 0.018$$

$$A_{CP}(B^0 \rightarrow D^*(2010)^+ D^-) = 0.037 \pm 0.034$$

$$A_{CP}(B^0 \rightarrow [K^+ \pi^-]_D K^*(892)^0) = -0.03 \pm 0.04$$

$$\begin{aligned} R_d^+ = \Gamma(B^0 \rightarrow [\pi^+ K^-]_D K^{*0}) / \Gamma(B^0 \rightarrow [\pi^- K^+]_D K^{*0}) &= \\ 0.06 \pm 0.032 \end{aligned}$$

$$\begin{aligned} R_d^- = \Gamma(\bar{B}^0 \rightarrow [\pi^- K^+]_D K^{*0}) / \Gamma(\bar{B}^0 \rightarrow [\pi^+ K^-]_D K^{*0}) &= \\ 0.06 \pm 0.032 \end{aligned}$$

$$\mathbf{A}_{CP}(B^0 \rightarrow K^+ \pi^-) = -0.082 \pm 0.006$$

$$A_{CP}(B^0 \rightarrow \eta' K^*(892)^0) = -0.07 \pm 0.18$$

$$A_{CP}(B^0 \rightarrow \eta' K_0^*(1430)^0) = -0.19 \pm 0.17$$

$$A_{CP}(B^0 \rightarrow \eta' K_2^*(1430)^0) = 0.14 \pm 0.18$$

$$\mathbf{A}_{CP}(B^0 \rightarrow \eta K^*(892)^0) = 0.19 \pm 0.05$$

$$A_{CP}(B^0 \rightarrow \eta K_0^*(1430)^0) = 0.06 \pm 0.13$$

$$A_{CP}(B^0 \rightarrow \eta K_2^*(1430)^0) = -0.07 \pm 0.19$$

$$A_{CP}(B^0 \rightarrow b_1 K^+) = -0.07 \pm 0.12$$

$$A_{CP}(B^0 \rightarrow \omega K^{*0}) = 0.45 \pm 0.25$$

$$A_{CP}(B^0 \rightarrow \omega (K\pi)_0^{*0}) = -0.07 \pm 0.09$$

$$A_{CP}(B^0 \rightarrow \omega K_2^*(1430)^0) = -0.37 \pm 0.17$$

$$A_{CP}(B^0 \rightarrow K^+ \pi^- \pi^0) = (0 \pm 6) \times 10^{-2}$$

$$A_{CP}(B^0 \rightarrow \rho^- K^+) = 0.20 \pm 0.11$$

$$A_{CP}(B^0 \rightarrow \rho(1450)^- K^+) = -0.10 \pm 0.33$$

$$A_{CP}(B^0 \rightarrow \rho(1700)^- K^+) = -0.4 \pm 0.6$$

$$A_{CP}(B^0 \rightarrow K^+ \pi^- \pi^0 \text{ nonresonant}) = 0.10 \pm 0.18$$

$$A_{CP}(B^0 \rightarrow K^0 \pi^+ \pi^-) = -0.01 \pm 0.05$$

$$\mathbf{A}_{CP}(B^0 \rightarrow K^*(892)^+ \pi^-) = -0.22 \pm 0.06$$

$$A_{CP}(B^0 \rightarrow (K\pi)_0^{*+} \pi^-) = 0.09 \pm 0.07$$

$$A_{CP}(B^0 \rightarrow (K\pi)_0^{*0} \pi^0) = -0.15 \pm 0.11$$

$$A_{CP}(B^0 \rightarrow K^{*0} \pi^0) = -0.15 \pm 0.13$$

$$\begin{aligned}
 A_{CP}(B^0 \rightarrow K^*(892)^0 \pi^+ \pi^-) &= 0.07 \pm 0.05 \\
 A_{CP}(B^0 \rightarrow K^*(892)^0 \rho^0) &= -0.06 \pm 0.09 \\
 A_{CP}(B^0 \rightarrow K^{*0} f_0(980)) &= 0.07 \pm 0.10 \\
 A_{CP}(B^0 \rightarrow K^{*+} \rho^-) &= 0.21 \pm 0.15 \\
 A_{CP}(B^0 \rightarrow K^*(892)^0 K^+ K^-) &= 0.01 \pm 0.05 \\
 A_{CP}(B^0 \rightarrow a_1^- K^+) &= -0.16 \pm 0.12 \\
 A_{CP}(B^0 \rightarrow K^0 K^0) &= -0.6 \pm 0.7 \\
 A_{CP}(B^0 \rightarrow K^*(892)^0 \phi) &= 0.00 \pm 0.04 \\
 A_{CP}(B^0 \rightarrow K^*(892)^0 K^- \pi^+) &= 0.2 \pm 0.4 \\
 A_{CP}(B^0 \rightarrow \phi(K\pi)_0^{*0}) &= 0.12 \pm 0.08 \\
 A_{CP}(B^0 \rightarrow \phi K_2^*(1430)^0) &= -0.11 \pm 0.10 \\
 A_{CP}(B^0 \rightarrow K^*(892)^0 \gamma) &= -0.006 \pm 0.011 \\
 A_{CP}(B^0 \rightarrow K_2^*(1430)^0 \gamma) &= -0.08 \pm 0.15 \\
 A_{CP}(B^0 \rightarrow \rho^+ \pi^-) &= 0.13 \pm 0.06 \quad (S = 1.1) \\
 A_{CP}(B^0 \rightarrow \rho^- \pi^+) &= -0.08 \pm 0.08 \\
 A_{CP}(B^0 \rightarrow a_1(1260)^\pm \pi^\mp) &= -0.07 \pm 0.06 \\
 A_{CP}(B^0 \rightarrow b_1^- \pi^+) &= -0.05 \pm 0.10 \\
 A_{CP}(B^0 \rightarrow p\bar{p}K^*(892)^0) &= 0.05 \pm 0.12 \\
 A_{CP}(B^0 \rightarrow p\bar{\Lambda}\pi^-) &= 0.04 \pm 0.07 \\
 A_{CP}(B^0 \rightarrow K^{*0} \ell^+ \ell^-) &= -0.05 \pm 0.10 \\
 A_{CP}(B^0 \rightarrow K^{*0} e^+ e^-) &= -0.21 \pm 0.19 \\
 A_{CP}(B^0 \rightarrow K^{*0} \mu^+ \mu^-) &= -0.034 \pm 0.024 \\
 C_{D^{*-}D^+}(B^0 \rightarrow D^*(2010)^- D^+) &= -0.01 \pm 0.11 \\
 \mathbf{S_{D^{*-}D^+}(B^0 \rightarrow D^*(2010)^- D^+)} &= -0.72 \pm 0.15 \\
 C_{D^{*+}D^-}(B^0 \rightarrow D^*(2010)^+ D^-) &= 0.00 \pm 0.13 \quad (S = 1.3) \\
 \mathbf{S_{D^{*+}D^-}(B^0 \rightarrow D^*(2010)^+ D^-)} &= -0.73 \pm 0.14 \\
 C_{D^{*+}D^{*-}}(B^0 \rightarrow D^{*+} D^{*-}) &= 0.01 \pm 0.09 \quad (S = 1.6) \\
 \mathbf{S_{D^{*+}D^{*-}}(B^0 \rightarrow D^{*+} D^{*-})} &= -0.59 \pm 0.14 \quad (S = 1.8) \\
 C_+(B^0 \rightarrow D^{*+} D^{*-}) &= 0.00 \pm 0.10 \quad (S = 1.6) \\
 \mathbf{S_+(B^0 \rightarrow D^{*+} D^{*-})} &= -0.73 \pm 0.09 \\
 C_-(B^0 \rightarrow D^{*+} D^{*-}) &= 0.19 \pm 0.31 \\
 S_-(B^0 \rightarrow D^{*+} D^{*-}) &= 0.1 \pm 1.6 \quad (S = 3.5) \\
 C(B^0 \rightarrow D^*(2010)^+ D^*(2010)^- K_S^0) &= 0.01 \pm 0.29 \\
 S(B^0 \rightarrow D^*(2010)^+ D^*(2010)^- K_S^0) &= 0.1 \pm 0.4 \\
 C_{D^+D^-}(B^0 \rightarrow D^+ D^-) &= -0.22 \pm 0.24 \quad (S = 2.5) \\
 \mathbf{S_{D^+D^-}(B^0 \rightarrow D^+ D^-)} &= -0.76_{-0.13}^{+0.15} \quad (S = 1.2) \\
 C_{J/\psi(1S)\pi^0}(B^0 \rightarrow J/\psi(1S)\pi^0) &= -0.13 \pm 0.13 \\
 \mathbf{S_{J/\psi(1S)\pi^0}(B^0 \rightarrow J/\psi(1S)\pi^0)} &= -0.94 \pm 0.29 \quad (S = 1.9) \\
 C(B^0 \rightarrow J/\psi(1S)\rho^0) &= -0.06 \pm 0.06 \\
 \mathbf{S(B^0 \rightarrow J/\psi(1S)\rho^0)} &= -0.66_{-0.12}^{+0.16}
 \end{aligned}$$

$$\begin{aligned}
 C_{D_{CP}^{(*)} h^0} (B^0 \rightarrow D_{CP}^{(*)} h^0) &= -0.02 \pm 0.08 \\
 S_{D_{CP}^{(*)} h^0} (B^0 \rightarrow D_{CP}^{(*)} h^0) &= -0.66 \pm 0.12 \\
 C_{K^0 \pi^0} (B^0 \rightarrow K^0 \pi^0) &= 0.00 \pm 0.13 \quad (S = 1.4) \\
 S_{K^0 \pi^0} (B^0 \rightarrow K^0 \pi^0) &= 0.58 \pm 0.17 \\
 C_{\eta'(958) K_S^0} (B^0 \rightarrow \eta'(958) K_S^0) &= -0.04 \pm 0.20 \quad (S = 2.5) \\
 S_{\eta'(958) K_S^0} (B^0 \rightarrow \eta'(958) K_S^0) &= 0.43 \pm 0.17 \quad (S = 1.5) \\
 C_{\eta' K^0} (B^0 \rightarrow \eta' K^0) &= -0.06 \pm 0.04 \\
 S_{\eta' K^0} (B^0 \rightarrow \eta' K^0) &= 0.63 \pm 0.06 \\
 C_{\omega K_S^0} (B^0 \rightarrow \omega K_S^0) &= 0.0 \pm 0.4 \quad (S = 3.0) \\
 S_{\omega K_S^0} (B^0 \rightarrow \omega K_S^0) &= 0.70 \pm 0.21 \\
 C (B^0 \rightarrow K_S^0 \pi^0 \pi^0) &= 0.2 \pm 0.5 \\
 S (B^0 \rightarrow K_S^0 \pi^0 \pi^0) &= 0.7 \pm 0.7 \\
 C_{\rho^0 K_S^0} (B^0 \rightarrow \rho^0 K_S^0) &= -0.04 \pm 0.20 \\
 S_{\rho^0 K_S^0} (B^0 \rightarrow \rho^0 K_S^0) &= 0.50^{+0.17}_{-0.21} \\
 C_{f_0 K_S^0} (B^0 \rightarrow f_0(980) K_S^0) &= 0.29 \pm 0.20 \\
 S_{f_0 K_S^0} (B^0 \rightarrow f_0(980) K_S^0) &= -0.50 \pm 0.16 \\
 S_{f_2 K_S^0} (B^0 \rightarrow f_2(1270) K_S^0) &= -0.5 \pm 0.5 \\
 C_{f_2 K_S^0} (B^0 \rightarrow f_2(1270) K_S^0) &= 0.3 \pm 0.4 \\
 S_{f_x K_S^0} (B^0 \rightarrow f_x(1300) K_S^0) &= -0.2 \pm 0.5 \\
 C_{f_x K_S^0} (B^0 \rightarrow f_x(1300) K_S^0) &= 0.13 \pm 0.35 \\
 S_{K^0 \pi^+ \pi^-} (B^0 \rightarrow K^0 \pi^+ \pi^- \text{ nonresonant}) &= -0.01 \pm 0.33 \\
 C_{K^0 \pi^+ \pi^-} (B^0 \rightarrow K^0 \pi^+ \pi^- \text{ nonresonant}) &= 0.01 \pm 0.26 \\
 C_{K_S^0 K_S^0} (B^0 \rightarrow K_S^0 K_S^0) &= 0.0 \pm 0.4 \quad (S = 1.4) \\
 S_{K_S^0 K_S^0} (B^0 \rightarrow K_S^0 K_S^0) &= -0.8 \pm 0.5 \\
 C_{K^+ K^- K_S^0} (B^0 \rightarrow K^+ K^- K_S^0 \text{ nonresonant}) &= 0.06 \pm 0.08 \\
 S_{K^+ K^- K_S^0} (B^0 \rightarrow K^+ K^- K_S^0 \text{ nonresonant}) &= -0.66 \pm 0.11 \\
 C_{K^+ K^- K_S^0} (B^0 \rightarrow K^+ K^- K_S^0 \text{ inclusive}) &= 0.01 \pm 0.09 \\
 S_{K^+ K^- K_S^0} (B^0 \rightarrow K^+ K^- K_S^0 \text{ inclusive}) &= -0.65 \pm 0.12 \\
 C_{\phi K_S^0} (B^0 \rightarrow \phi K_S^0) &= 0.01 \pm 0.14 \\
 S_{\phi K_S^0} (B^0 \rightarrow \phi K_S^0) &= 0.59 \pm 0.14 \\
 C_{K_S K_S K_S} (B^0 \rightarrow K_S K_S K_S) &= -0.23 \pm 0.14 \\
 S_{K_S K_S K_S} (B^0 \rightarrow K_S K_S K_S) &= -0.5 \pm 0.6 \quad (S = 3.0)
 \end{aligned}$$

$$\begin{aligned}
 C_{K_S^0 \pi^0 \gamma} (B^0 \rightarrow K_S^0 \pi^0 \gamma) &= 0.36 \pm 0.33 \\
 S_{K_S^0 \pi^0 \gamma} (B^0 \rightarrow K_S^0 \pi^0 \gamma) &= -0.8 \pm 0.6 \\
 C_{K_S^0 \pi^+ \pi^- \gamma} (B^0 \rightarrow K_S^0 \pi^+ \pi^- \gamma) &= -0.39 \pm 0.20 \\
 S_{K_S^0 \pi^+ \pi^- \gamma} (B^0 \rightarrow K_S^0 \pi^+ \pi^- \gamma) &= 0.14 \pm 0.25 \\
 C_{K^{*0} \gamma} (B^0 \rightarrow K^*(892)^0 \gamma) &= -0.04 \pm 0.16 \quad (S = 1.2) \\
 S_{K^{*0} \gamma} (B^0 \rightarrow K^*(892)^0 \gamma) &= -0.15 \pm 0.22 \\
 C_{\eta K^0 \gamma} (B^0 \rightarrow \eta K^0 \gamma) &= -0.3 \pm 0.4 \\
 S_{\eta K^0 \gamma} (B^0 \rightarrow \eta K^0 \gamma) &= -0.2 \pm 0.5 \\
 C_{K^0 \phi \gamma} (B^0 \rightarrow K^0 \phi \gamma) &= -0.3 \pm 0.6 \\
 S_{K^0 \phi \gamma} (B^0 \rightarrow K^0 \phi \gamma) &= 0.7^{+0.7}_{-1.1} \\
 C(B^0 \rightarrow K_S^0 \rho^0 \gamma) &= -0.05 \pm 0.19 \\
 S(B^0 \rightarrow K_S^0 \rho^0 \gamma) &= -0.04 \pm 0.23 \\
 C(B^0 \rightarrow \rho^0 \gamma) &= 0.4 \pm 0.5 \\
 S(B^0 \rightarrow \rho^0 \gamma) &= -0.8 \pm 0.7 \\
 \mathbf{C_{\pi\pi} (B^0 \rightarrow \pi^+ \pi^-)} &= -0.31 \pm 0.05 \\
 \mathbf{S_{\pi\pi} (B^0 \rightarrow \pi^+ \pi^-)} &= -0.67 \pm 0.06 \\
 C_{\pi^0 \pi^0} (B^0 \rightarrow \pi^0 \pi^0) &= -0.33 \pm 0.22 \\
 C_{\rho\pi} (B^0 \rightarrow \rho^+ \pi^-) &= -0.03 \pm 0.07 \quad (S = 1.2) \\
 S_{\rho\pi} (B^0 \rightarrow \rho^+ \pi^-) &= 0.05 \pm 0.07 \\
 \mathbf{\Delta C_{\rho\pi} (B^0 \rightarrow \rho^+ \pi^-)} &= 0.27 \pm 0.06 \\
 \mathbf{\Delta S_{\rho\pi} (B^0 \rightarrow \rho^+ \pi^-)} &= 0.01 \pm 0.08 \\
 C_{\rho^0 \pi^0} (B^0 \rightarrow \rho^0 \pi^0) &= 0.27 \pm 0.24 \\
 S_{\rho^0 \pi^0} (B^0 \rightarrow \rho^0 \pi^0) &= -0.23 \pm 0.34 \\
 C_{a_1 \pi} (B^0 \rightarrow a_1(1260)^+ \pi^-) &= -0.05 \pm 0.11 \\
 S_{a_1 \pi} (B^0 \rightarrow a_1(1260)^+ \pi^-) &= -0.2 \pm 0.4 \quad (S = 3.2) \\
 \mathbf{\Delta C_{a_1 \pi} (B^0 \rightarrow a_1(1260)^+ \pi^-)} &= 0.43 \pm 0.14 \quad (S = 1.3) \\
 \mathbf{\Delta S_{a_1 \pi} (B^0 \rightarrow a_1(1260)^+ \pi^-)} &= -0.11 \pm 0.12 \\
 C(B^0 \rightarrow b_1^- K^+) &= -0.22 \pm 0.24 \\
 \mathbf{\Delta C (B^0 \rightarrow b_1^- \pi^+)} &= -1.04 \pm 0.24 \\
 C_{\rho^0 \rho^0} (B^0 \rightarrow \rho^0 \rho^0) &= 0.2 \pm 0.9 \\
 S_{\rho^0 \rho^0} (B^0 \rightarrow \rho^0 \rho^0) &= 0.3 \pm 0.7 \\
 C_{\rho\rho} (B^0 \rightarrow \rho^+ \rho^-) &= 0.00 \pm 0.09 \\
 S_{\rho\rho} (B^0 \rightarrow \rho^+ \rho^-) &= -0.14 \pm 0.13 \\
 |\lambda| (B^0 \rightarrow J/\psi K^*(892)^0) &< 0.25, \text{ CL} = 95\% \\
 \cos 2\beta (B^0 \rightarrow J/\psi K^*(892)^0) &= 1.7^{+0.7}_{-0.9} \quad (S = 1.6) \\
 \cos 2\beta (B^0 \rightarrow [K_S^0 \pi^+ \pi^-]_{D^{(*)}} h^0) &= 0.84 \pm 0.31 \\
 (S_+ + S_-)/2 (B^0 \rightarrow D^{*-} \pi^+) &= -0.039 \pm 0.011
 \end{aligned}$$

$$\begin{aligned}
 (S_- - S_+)/2 (B^0 \rightarrow D^{*-} \pi^+) &= -0.009 \pm 0.015 \\
 (S_+ + S_-)/2 (B^0 \rightarrow D^- \pi^+) &= -0.046 \pm 0.023 \\
 (S_- - S_+)/2 (B^0 \rightarrow D^- \rho^+) &= -0.022 \pm 0.021 \\
 (S_+ + S_-)/2 (B^0 \rightarrow D^- \rho^+) &= -0.024 \pm 0.032 \\
 (S_- - S_+)/2 (B^0 \rightarrow D^- \rho^+) &= -0.10 \pm 0.06 \\
 C_{\eta_c K_S^0} (B^0 \rightarrow \eta_c K_S^0) &= 0.08 \pm 0.13 \\
 \mathbf{S_{\eta_c K_S^0} (B^0 \rightarrow \eta_c K_S^0)} &= 0.93 \pm 0.17 \\
 C_{c\bar{c}K^{(*)0}} (B^0 \rightarrow c\bar{c}K^{(*)0}) &= (0.5 \pm 1.7) \times 10^{-2} \\
 \mathbf{\sin(2\beta)} &= 0.699 \pm 0.017 \\
 C_{J/\psi(nS)K^0} (B^0 \rightarrow J/\psi(nS)K^0) &= (0.5 \pm 2.0) \times 10^{-2} \\
 \mathbf{S_{J/\psi(nS)K^0} (B^0 \rightarrow J/\psi(nS)K^0)} &= 0.701 \pm 0.017 \\
 C_{J/\psi K^{*0}} (B^0 \rightarrow J/\psi K^{*0}) &= 0.03 \pm 0.10 \\
 S_{J/\psi K^{*0}} (B^0 \rightarrow J/\psi K^{*0}) &= 0.60 \pm 0.25 \\
 C_{\chi_{c0} K_S^0} (B^0 \rightarrow \chi_{c0} K_S^0) &= -0.3_{-0.4}^{+0.5} \\
 S_{\chi_{c0} K_S^0} (B^0 \rightarrow \chi_{c0} K_S^0) &= -0.7 \pm 0.5 \\
 C_{\chi_{c1} K_S^0} (B^0 \rightarrow \chi_{c1} K_S^0) &= 0.06 \pm 0.07 \\
 \mathbf{S_{\chi_{c1} K_S^0} (B^0 \rightarrow \chi_{c1} K_S^0)} &= 0.63 \pm 0.10 \\
 \sin(2\beta_{\text{eff}})(B^0 \rightarrow \phi K^0) &= 0.22 \pm 0.30 \\
 \sin(2\beta_{\text{eff}})(B^0 \rightarrow \phi K_0^*(1430)^0) &= 0.97_{-0.52}^{+0.03} \\
 \mathbf{\sin(2\beta_{\text{eff}})(B^0 \rightarrow K^+ K^- K_S^0)} &= 0.77_{-0.12}^{+0.13} \\
 \sin(2\beta_{\text{eff}})(B^0 \rightarrow [K_S^0 \pi^+ \pi^-]_{D^{(*)}} h^0) &= 0.37 \pm 0.22 \\
 \beta_{\text{eff}}(B^0 \rightarrow [K_S^0 \pi^+ \pi^-]_{D^{(*)}} h^0) &= (12 \pm 8)^\circ \\
 2\beta_{\text{eff}}(B^0 \rightarrow J/\psi \rho^0) &= (42_{-11}^{+10})^\circ \\
 |\lambda| (B^0 \rightarrow [K_S^0 \pi^+ \pi^-]_{D^{(*)}} h^0) &= 1.01 \pm 0.08 \\
 |\sin(2\beta + \gamma)| &> 0.40, \text{ CL} = 90\% \\
 2\beta + \gamma &= (83 \pm 60)^\circ \\
 \alpha &= (93 \pm 5)^\circ \\
 x_+(B^0 \rightarrow DK^{*0}) &= 0.04 \pm 0.17 \\
 x_-(B^0 \rightarrow DK^{*0}) &= -0.16 \pm 0.14 \\
 y_+(B^0 \rightarrow DK^{*0}) &= -0.68 \pm 0.22 \\
 y_-(B^0 \rightarrow DK^{*0}) &= 0.20 \pm 0.25 \quad (S = 1.2) \\
 r_{B^0}(B^0 \rightarrow DK^{*0}) &= 0.223_{-0.045}^{+0.041} \\
 \delta_{B^0}(B^0 \rightarrow DK^{*0}) &= (193_{-21}^{+27})^\circ
 \end{aligned}$$

$\bar{B}^0$  modes are charge conjugates of the modes below. Reactions indicate the weak decay vertex and do not include mixing. Modes which do not identify the charge state of the  $B$  are listed in the  $B^\pm/B^0$  ADMIXTURE section.

The branching fractions listed below assume 50%  $B^0\bar{B}^0$  and 50%  $B^+B^-$  production at the  $\Upsilon(4S)$ . We have attempted to bring older measurements up to date by rescaling their assumed  $\Upsilon(4S)$  production ratio to 50:50 and their assumed  $D$ ,  $D_S$ ,  $D^*$ , and  $\psi$  branching ratios to current values whenever this would affect our averages and best limits significantly.

Indentation is used to indicate a subchannel of a previous reaction. All resonant subchannels have been corrected for resonance branching fractions to the final state so the sum of the subchannel branching fractions can exceed that of the final state.

For inclusive branching fractions, e.g.,  $B \rightarrow D^\pm$  anything, the values usually are multiplicities, not branching fractions. They can be greater than one.

$B^0$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	Scale factor/ Confidence level	$p$ (MeV/c)
$\ell^+ \nu_\ell$ anything	[a] ( 10.33 ± 0.28 ) %		—
$e^+ \nu_e X_C$	( 10.1 ± 0.4 ) %		—
$D \ell^+ \nu_\ell$ anything	( 9.1 ± 0.8 ) %		—
$D^- \ell^+ \nu_\ell$	[a] ( 2.20 ± 0.10 ) %		2309
$D^- \tau^+ \nu_\tau$	( 1.03 ± 0.22 ) %		1909
$D^*(2010)^- \ell^+ \nu_\ell$	[a] ( 4.88 ± 0.10 ) %		2257
$D^*(2010)^- \tau^+ \nu_\tau$	( 1.67 ± 0.13 ) %	S=1.1	1838
$\bar{D}^0 \pi^- \ell^+ \nu_\ell$	( 4.3 ± 0.6 ) × 10 <sup>-3</sup>		2308
$D_0^*(2400)^- \ell^+ \nu_\ell, D_0^{*-} \rightarrow \bar{D}^0 \pi^-$	( 3.0 ± 1.2 ) × 10 <sup>-3</sup>	S=1.8	—
$D_2^*(2460)^- \ell^+ \nu_\ell, D_2^{*-} \rightarrow \bar{D}^0 \pi^-$	( 1.21 ± 0.33 ) × 10 <sup>-3</sup>	S=1.8	2065
$\bar{D}^{(*)} n \pi \ell^+ \nu_\ell (n \geq 1)$	( 2.3 ± 0.4 ) %		—
$\bar{D}^{*0} \pi^- \ell^+ \nu_\ell$	( 4.9 ± 0.8 ) × 10 <sup>-3</sup>		2256
$D_1(2420)^- \ell^+ \nu_\ell, D_1^- \rightarrow \bar{D}^{*0} \pi^-$	( 2.80 ± 0.28 ) × 10 <sup>-3</sup>		—
$D_1'(2430)^- \ell^+ \nu_\ell, D_1'^- \rightarrow \bar{D}^{*0} \pi^-$	( 3.1 ± 0.9 ) × 10 <sup>-3</sup>		—
$D_2^*(2460)^- \ell^+ \nu_\ell, D_2^{*-} \rightarrow \bar{D}^{*0} \pi^-$	( 6.8 ± 1.2 ) × 10 <sup>-4</sup>		2065
$D^- \pi^+ \pi^- \ell^+ \nu_\ell$	( 1.3 ± 0.5 ) × 10 <sup>-3</sup>		2299
$D^{*-} \pi^+ \pi^- \ell^+ \nu_\ell$	( 1.4 ± 0.5 ) × 10 <sup>-3</sup>		2247
$\rho^- \ell^+ \nu_\ell$	[a] ( 2.94 ± 0.21 ) × 10 <sup>-4</sup>		2583
$\pi^- \ell^+ \nu_\ell$	[a] ( 1.50 ± 0.06 ) × 10 <sup>-4</sup>		2638
$\pi^- \tau^+ \nu_\tau$	< 2.5 × 10 <sup>-4</sup>	CL=90%	2338

**Inclusive modes**

$K^\pm$ anything	( 78 ± 8 ) %		—
$D^0 X$	( 8.1 ± 1.5 ) %		—
$\overline{D}^0 X$	( 47.4 ± 2.8 ) %		—
$D^+ X$	< 3.9 %	CL=90%	—
$D^- X$	( 36.9 ± 3.3 ) %		—
$D_s^+ X$	( 10.3 $\begin{smallmatrix} + 2.1 \\ - 1.8 \end{smallmatrix}$ ) %		—
$D_s^- X$	< 2.6 %	CL=90%	—
$\Lambda_c^+ X$	< 3.1 %	CL=90%	—
$\overline{\Lambda}_c^- X$	( 5.0 $\begin{smallmatrix} + 2.1 \\ - 1.5 \end{smallmatrix}$ ) %		—
$\overline{c} X$	( 95 ± 5 ) %		—
$c X$	( 24.6 ± 3.1 ) %		—
$\overline{c} c X$	(119 ± 6 ) %		—

**$D, D^*$ , or  $D_s$  modes**

$D^- \pi^+$	( 2.52 ± 0.13 ) × 10 <sup>-3</sup>	S=1.1	2306
$D^- \rho^+$	( 7.9 ± 1.3 ) × 10 <sup>-3</sup>		2235
$D^- K^0 \pi^+$	( 4.9 ± 0.9 ) × 10 <sup>-4</sup>		2259
$D^- K^*(892)^+$	( 4.5 ± 0.7 ) × 10 <sup>-4</sup>		2211
$D^- \omega \pi^+$	( 2.8 ± 0.6 ) × 10 <sup>-3</sup>		2204
$D^- K^+$	( 1.86 ± 0.20 ) × 10 <sup>-4</sup>		2279
$D^- K^+ \pi^+ \pi^-$	( 3.5 ± 0.8 ) × 10 <sup>-4</sup>		2236
$D^- K^+ \overline{K}^0$	< 3.1 × 10 <sup>-4</sup>	CL=90%	2188
$D^- K^+ \overline{K}^*(892)^0$	( 8.8 ± 1.9 ) × 10 <sup>-4</sup>		2070
$\overline{D}^0 \pi^+ \pi^-$	( 8.8 ± 0.5 ) × 10 <sup>-4</sup>		2301
$D^*(2010)^- \pi^+$	( 2.74 ± 0.13 ) × 10 <sup>-3</sup>		2255
$\overline{D}^0 K^+ K^-$	( 4.9 ± 1.2 ) × 10 <sup>-5</sup>		2191
$D^- \pi^+ \pi^+ \pi^-$	( 6.0 ± 0.7 ) × 10 <sup>-3</sup>	S=1.1	2287
( $D^- \pi^+ \pi^+ \pi^-$ ) nonresonant	( 3.9 ± 1.9 ) × 10 <sup>-3</sup>		2287
$D^- \pi^+ \rho^0$	( 1.1 ± 1.0 ) × 10 <sup>-3</sup>		2206
$D^- a_1(1260)^+$	( 6.0 ± 3.3 ) × 10 <sup>-3</sup>		2121
$D^*(2010)^- \pi^+ \pi^0$	( 1.5 ± 0.5 ) %		2248
$D^*(2010)^- \rho^+$	( 2.2 $\begin{smallmatrix} + 1.8 \\ - 2.7 \end{smallmatrix}$ ) × 10 <sup>-3</sup>	S=5.2	2180
$D^*(2010)^- K^+$	( 2.12 ± 0.15 ) × 10 <sup>-4</sup>		2226
$D^*(2010)^- K^0 \pi^+$	( 3.0 ± 0.8 ) × 10 <sup>-4</sup>		2205
$D^*(2010)^- K^*(892)^+$	( 3.3 ± 0.6 ) × 10 <sup>-4</sup>		2155
$D^*(2010)^- K^+ \overline{K}^0$	< 4.7 × 10 <sup>-4</sup>	CL=90%	2131
$D^*(2010)^- K^+ \overline{K}^*(892)^0$	( 1.29 ± 0.33 ) × 10 <sup>-3</sup>		2007
$D^*(2010)^- \pi^+ \pi^+ \pi^-$	( 7.21 ± 0.29 ) × 10 <sup>-3</sup>		2235
( $D^*(2010)^- \pi^+ \pi^+ \pi^-$ ) non-resonant	( 0.0 ± 2.5 ) × 10 <sup>-3</sup>		2235
$D^*(2010)^- \pi^+ \rho^0$	( 5.7 ± 3.2 ) × 10 <sup>-3</sup>		2150
$D^*(2010)^- a_1(1260)^+$	( 1.30 ± 0.27 ) %		2061

$\bar{D}_1(2420)^0 \pi^- \pi^+, \bar{D}_1^0 \rightarrow$ $D^{*-} \pi^+$	$(1.47 \pm 0.35) \times 10^{-4}$	—
$D^*(2010)^- K^+ \pi^- \pi^+$	$(4.7 \pm 0.4) \times 10^{-4}$	2181
$D^*(2010)^- \pi^+ \pi^+ \pi^- \pi^0$	$(1.76 \pm 0.27) \%$	2218
$D^{*-} 3\pi^+ 2\pi^-$	$(4.7 \pm 0.9) \times 10^{-3}$	2195
$\bar{D}^*(2010)^- \omega \pi^+$	$(2.46 \pm 0.18) \times 10^{-3}$	S=1.2 2148
$D_1(2430)^0 \omega, D_1^0 \rightarrow$ $D^{*-} \pi^+$	$(2.7 \pm_{-0.4}^{+0.8}) \times 10^{-4}$	1992
$\bar{D}^{*-} \rho(1450)^+$	$(1.07 \pm_{-0.34}^{+0.40}) \times 10^{-3}$	—
$\bar{D}_1(2420)^0 \omega$	$(7.0 \pm 2.2) \times 10^{-5}$	1995
$\bar{D}_2^*(2460)^0 \omega$	$(4.0 \pm 1.4) \times 10^{-5}$	1975
$\bar{D}^{*-} b_1(1235)^-, b_1^- \rightarrow \omega \pi^-$	$< 7 \times 10^{-5}$	CL=90% —
$\bar{D}^{*-} \pi^+$	[e] $(1.9 \pm 0.9) \times 10^{-3}$	—
$D_1(2420)^- \pi^+, D_1^- \rightarrow$ $D^- \pi^+ \pi^-$	$(9.9 \pm_{-2.5}^{+2.0}) \times 10^{-5}$	—
$D_1(2420)^- \pi^+, D_1^- \rightarrow$	$< 3.3 \times 10^{-5}$	CL=90% —
$\bar{D}_2^*(2460)^- \pi^+, (D_2^*)^- \rightarrow$ $D^{*-} \pi^+ \pi^-$	$(2.38 \pm 0.16) \times 10^{-4}$	2062
$\bar{D}_0^*(2400)^- \pi^+, (D_0^*)^- \rightarrow$ $D^0 \pi^-$	$(7.6 \pm 0.8) \times 10^{-5}$	2090
$D_2^*(2460)^- \pi^+, (D_2^*)^- \rightarrow$ $D^0 \pi^-$	$< 2.4 \times 10^{-5}$	CL=90% —
$\bar{D}_2^*(2460)^- \rho^+$ $D^0 \bar{D}^0$	$< 4.9 \times 10^{-3}$	CL=90% 1974
$D^{*0} \bar{D}^0$	$(1.4 \pm 0.7) \times 10^{-5}$	1868
$D^- D^+$	$< 2.9 \times 10^{-4}$	CL=90% 1794
$D^\pm D^{*\mp} (CP\text{-averaged})$	$(2.11 \pm 0.18) \times 10^{-4}$	1864
$D^- D_s^+$	$(6.1 \pm 0.6) \times 10^{-4}$	—
$D^*(2010)^- D_s^+$	$(7.2 \pm 0.8) \times 10^{-3}$	1812
$D^- D_s^{*+}$	$(8.0 \pm 1.1) \times 10^{-3}$	1735
$D^*(2010)^- D_s^{*+}$	$(7.4 \pm 1.6) \times 10^{-3}$	1732
$D^*(2010)^- D_s^{*+}$	$(1.77 \pm 0.14) \%$	1649
$D_{s0}(2317)^- K^+, D_{s0}^- \rightarrow$ $D_s^- \pi^0$	$(4.2 \pm 1.4) \times 10^{-5}$	2097
$D_{s0}(2317)^- \pi^+, D_{s0}^- \rightarrow$ $D_s^- \pi^0$	$< 2.5 \times 10^{-5}$	CL=90% 2128
$D_{sJ}(2457)^- K^+, D_{sJ}^- \rightarrow$ $D_s^- \pi^0$	$< 9.4 \times 10^{-6}$	CL=90% —
$D_{sJ}(2457)^- \pi^+, D_{sJ}^- \rightarrow$ $D_s^- \pi^0$	$< 4.0 \times 10^{-6}$	CL=90% —
$D_s^- D_s^+$	$< 3.6 \times 10^{-5}$	CL=90% 1759



$D_s^{*-} D_s^+$	$< 1.3 \times 10^{-4}$	CL=90%	1674
$D_s^{*0} D_s^+$	$< 2.4 \times 10^{-4}$	CL=90%	1583
$D_{s0}^*(2317)^+ D^-, D_{s0}^{*+} \rightarrow D_s^+ \pi^0$	$(1.09 \pm 0.16) \times 10^{-3}$		1602
$D_{s0}(2317)^+ D^-, D_{s0}^+ \rightarrow D_s^{*+} \gamma$	$< 9.5 \times 10^{-4}$	CL=90%	—
$D_{s0}(2317)^+ D^*(2010)^-, D_{s0}^+ \rightarrow D_s^+ \pi^0$	$(1.5 \pm 0.6) \times 10^{-3}$		1509
$D_{sJ}(2457)^+ D^-$	$(3.5 \pm 1.1) \times 10^{-3}$		—
$D_{sJ}(2457)^+ D^-, D_{sJ}^+ \rightarrow D_s^+ \gamma$	$(6.5 \begin{smallmatrix} +1.7 \\ -1.4 \end{smallmatrix}) \times 10^{-4}$		—
$D_{sJ}(2457)^+ D^-, D_{sJ}^+ \rightarrow D_s^{*+} \gamma$	$< 6.0 \times 10^{-4}$	CL=90%	—
$D_{sJ}(2457)^+ D^-, D_{sJ}^+ \rightarrow D_s^+ \pi^+ \pi^-$	$< 2.0 \times 10^{-4}$	CL=90%	—
$D_{sJ}(2457)^+ D^-, D_{sJ}^+ \rightarrow D_s^+ \pi^0$	$< 3.6 \times 10^{-4}$	CL=90%	—
$D^*(2010)^- D_{sJ}(2457)^+$	$(9.3 \pm 2.2) \times 10^{-3}$		—
$D_{sJ}(2457)^+ D^*(2010), D_{sJ}^+ \rightarrow D_s^+ \gamma$	$(2.3 \begin{smallmatrix} +0.9 \\ -0.7 \end{smallmatrix}) \times 10^{-3}$		—
$D^- D_{s1}(2536)^+, D_{s1}^+ \rightarrow D^{*0} K^+ + D^{*+} K^0$	$(2.8 \pm 0.7) \times 10^{-4}$		1444
$D^- D_{s1}(2536)^+, D_{s1}^+ \rightarrow D^{*0} K^+$	$(1.7 \pm 0.6) \times 10^{-4}$		1444
$D^- D_{s1}(2536)^+, D_{s1}^+ \rightarrow D^{*+} K^0$	$(2.6 \pm 1.1) \times 10^{-4}$		1444
$D^*(2010)^- D_{s1}(2536)^+, D_{s1}^+ \rightarrow D^{*0} K^+ + D^{*+} K^0$	$(5.0 \pm 1.4) \times 10^{-4}$		1336
$D^*(2010)^- D_{s1}(2536)^+, D_{s1}^+ \rightarrow D^{*0} K^+$	$(3.3 \pm 1.1) \times 10^{-4}$		1336
$D^{*-} D_{s1}(2536)^+, D_{s1}^+ \rightarrow D^{*+} K^0$	$(5.0 \pm 1.7) \times 10^{-4}$		1336
$D^- D_{sJ}(2573)^+, D_{sJ}^+ \rightarrow D^0 K^+$	$(3.4 \pm 1.8) \times 10^{-5}$		1414
$D^*(2010)^- D_{sJ}(2573)^+, D_{sJ}^+ \rightarrow D^0 K^+$	$< 2 \times 10^{-4}$	CL=90%	1304
$D^- D_{sJ}(2700)^+, D_{sJ}^+ \rightarrow D^0 K^+$	$(7.1 \pm 1.2) \times 10^{-4}$		—
$D^+ \pi^-$	$(7.4 \pm 1.3) \times 10^{-7}$		2306
$D_s^+ \pi^-$	$(2.16 \pm 0.26) \times 10^{-5}$		2270

$D_s^{*+} \pi^-$	$( 2.1 \pm 0.4 ) \times 10^{-5}$	S=1.4	2215
$D_s^+ \rho^-$	$< 2.4$	$\times 10^{-5}$ CL=90%	2197
$D_s^{*+} \rho^-$	$( 4.1 \pm 1.3 ) \times 10^{-5}$		2138
$D_s^+ a_0^-$	$< 1.9$	$\times 10^{-5}$ CL=90%	—
$D_s^{*+} a_0^-$	$< 3.6$	$\times 10^{-5}$ CL=90%	—
$D_s^+ a_1(1260)^-$	$< 2.1$	$\times 10^{-3}$ CL=90%	2080
$D_s^{*+} a_1(1260)^-$	$< 1.7$	$\times 10^{-3}$ CL=90%	2015
$D_s^+ a_2^-$	$< 1.9$	$\times 10^{-4}$ CL=90%	—
$D_s^{*+} a_2^-$	$< 2.0$	$\times 10^{-4}$ CL=90%	—
$D_s^- K^+$	$( 2.7 \pm 0.5 ) \times 10^{-5}$	S=2.7	2242
$D_s^{*-} K^+$	$( 2.19 \pm 0.30 ) \times 10^{-5}$		2185
$D_s^- K^*(892)^+$	$( 3.5 \pm 1.0 ) \times 10^{-5}$		2172
$D_s^{*-} K^*(892)^+$	$( 3.2 \begin{smallmatrix} + 1.5 \\ - 1.3 \end{smallmatrix} ) \times 10^{-5}$		2112
$D_s^- \pi^+ K^0$	$( 9.7 \pm 1.4 ) \times 10^{-5}$		2222
$D_s^{*-} \pi^+ K^0$	$< 1.10$	$\times 10^{-4}$ CL=90%	2164
$D_s^- K^+ \pi^+ \pi^-$	$( 1.7 \pm 0.5 ) \times 10^{-4}$		2198
$D_s^- \pi^+ K^*(892)^0$	$< 3.0$	$\times 10^{-3}$ CL=90%	2138
$D_s^{*-} \pi^+ K^*(892)^0$	$< 1.6$	$\times 10^{-3}$ CL=90%	2076
$\bar{D}^0 K^0$	$( 5.2 \pm 0.7 ) \times 10^{-5}$		2280
$\bar{D}^0 K^+ \pi^-$	$( 8.8 \pm 1.7 ) \times 10^{-5}$		2261
$\bar{D}^0 K^*(892)^0$	$( 4.5 \pm 0.6 ) \times 10^{-5}$		2213
$\bar{D}^0 K^*(1410)^0$	$< 6.7$	$\times 10^{-5}$ CL=90%	2059
$\bar{D}^0 K_0^*(1430)^0$	$( 7 \pm 7 ) \times 10^{-6}$		2057
$\bar{D}^0 K_2^*(1430)^0$	$( 2.1 \pm 0.9 ) \times 10^{-5}$		2057
$D_0^*(2400)^-, D_0^{*-} \rightarrow \bar{D}^0 \pi^-$	$( 1.9 \pm 0.9 ) \times 10^{-5}$		—
$D_2^*(2460)^- K^+, D_2^{*-} \rightarrow \bar{D}^0 \pi^-$	$( 2.03 \pm 0.35 ) \times 10^{-5}$		2029
$D_3^*(2760)^- K^+, D_3^{*-} \rightarrow \bar{D}^0 \pi^-$	$< 1.0$	$\times 10^{-6}$ CL=90%	—
$\bar{D}^0 K^+ \pi^-$ non-resonant	$< 3.7$	$\times 10^{-5}$ CL=90%	—
$\bar{D}^0 \pi^0$	$( 2.63 \pm 0.14 ) \times 10^{-4}$		2308
$\bar{D}^0 \rho^0$	$( 3.21 \pm 0.21 ) \times 10^{-4}$		2237
$\bar{D}^0 f_2$	$( 1.56 \pm 0.21 ) \times 10^{-4}$		—
$\bar{D}^0 \eta$	$( 2.36 \pm 0.32 ) \times 10^{-4}$	S=2.5	2274
$\bar{D}^0 \eta'$	$( 1.38 \pm 0.16 ) \times 10^{-4}$	S=1.3	2198
$\bar{D}^0 \omega$	$( 2.54 \pm 0.16 ) \times 10^{-4}$		2235
$D^0 \phi$	$< 1.16$	$\times 10^{-5}$ CL=90%	2183
$D^0 K^+ \pi^-$	$( 5.3 \pm 3.2 ) \times 10^{-6}$		2261
$D^0 K^*(892)^0$	$< 1.1$	$\times 10^{-5}$ CL=90%	2213
$\bar{D}^{*0} \gamma$	$< 2.5$	$\times 10^{-5}$ CL=90%	2258
$\bar{D}^*(2007)^0 \pi^0$	$( 2.2 \pm 0.6 ) \times 10^{-4}$	S=2.6	2256

$\bar{D}^*(2007)^0 \rho^0$	< 5.1	$\times 10^{-4}$	CL=90%	2182
$\bar{D}^*(2007)^0 \eta$	( 2.3 ± 0.6 )	$\times 10^{-4}$	S=2.8	2220
$\bar{D}^*(2007)^0 \eta'$	( 1.40 ± 0.22 )	$\times 10^{-4}$		2141
$\bar{D}^*(2007)^0 \pi^+ \pi^-$	( 6.2 ± 2.2 )	$\times 10^{-4}$		2249
$\bar{D}^*(2007)^0 K^0$	( 3.6 ± 1.2 )	$\times 10^{-5}$		2227
$\bar{D}^*(2007)^0 K^*(892)^0$	< 6.9	$\times 10^{-5}$	CL=90%	2157
$D^*(2007)^0 K^*(892)^0$	< 4.0	$\times 10^{-5}$	CL=90%	2157
$D^*(2007)^0 \pi^+ \pi^+ \pi^- \pi^-$	( 2.7 ± 0.5 )	$\times 10^{-3}$		2219
$D^*(2010)^+ D^*(2010)^-$	( 8.0 ± 0.6 )	$\times 10^{-4}$		1711
$\bar{D}^*(2007)^0 \omega$	( 3.6 ± 1.1 )	$\times 10^{-4}$	S=3.1	2180
$D^*(2010)^+ D^-$	( 6.1 ± 1.5 )	$\times 10^{-4}$	S=1.6	1790
$D^*(2007)^0 \bar{D}^*(2007)^0$	< 9	$\times 10^{-5}$	CL=90%	1715
$D^- D^0 K^+$	( 1.07 ± 0.11 )	$\times 10^{-3}$		1574
$D^- D^*(2007)^0 K^+$	( 3.5 ± 0.4 )	$\times 10^{-3}$		1478
$D^*(2010)^- D^0 K^+$	( 2.47 ± 0.21 )	$\times 10^{-3}$		1479
$D^*(2010)^- D^*(2007)^0 K^+$	( 1.06 ± 0.09 )	%		1366
$D^- D^+ K^0$	( 7.5 ± 1.7 )	$\times 10^{-4}$		1568
$D^*(2010)^- D^+ K^0 +$ $D^- D^*(2010)^+ K^0$	( 6.4 ± 0.5 )	$\times 10^{-3}$		1473
$D^*(2010)^- D^*(2010)^+ K^0$	( 8.1 ± 0.7 )	$\times 10^{-3}$		1360
$D^{*-} D_{s1}(2536)^+, D_{s1}^+ \rightarrow$ $D^{*+} K^0$	( 8.0 ± 2.4 )	$\times 10^{-4}$		1336
$\bar{D}^0 D^0 K^0$	( 2.7 ± 1.1 )	$\times 10^{-4}$		1574
$\bar{D}^0 D^*(2007)^0 K^0 +$ $\bar{D}^*(2007)^0 D^0 K^0$	( 1.1 ± 0.5 )	$\times 10^{-3}$		1478
$\bar{D}^*(2007)^0 D^*(2007)^0 K^0$	( 2.4 ± 0.9 )	$\times 10^{-3}$		1365
$(\bar{D} + \bar{D}^*)(D + D^*)K$	( 3.68 ± 0.26 )	%		-

### Charmonium modes

$\eta_c K^0$	( 7.9 ± 1.2 )	$\times 10^{-4}$		1751
$\eta_c K^*(892)^0$	( 6.9 ± 0.9 )	$\times 10^{-4}$		1646
$\eta_c(2S) K^{*0}$	< 3.9	$\times 10^{-4}$	CL=90%	1159
$h_c(1P) K^{*0}$	< 4	$\times 10^{-4}$	CL=90%	1253
$J/\psi(1S) K^0$	( 8.73 ± 0.32 )	$\times 10^{-4}$		1683
$J/\psi(1S) K^+ \pi^-$	( 1.15 ± 0.05 )	$\times 10^{-3}$		1652
$J/\psi(1S) K^*(892)^0$	( 1.27 ± 0.05 )	$\times 10^{-3}$		1571
$J/\psi(1S) \eta K_S^0$	( 5.4 ± 0.9 )	$\times 10^{-5}$		1508
$J/\psi(1S) \eta' K_S^0$	< 2.5	$\times 10^{-5}$	CL=90%	1271
$J/\psi(1S) \phi K^0$	( 4.9 ± 1.0 )	$\times 10^{-5}$	S=1.3	1224
$J/\psi(1S) \omega K^0$	( 2.3 ± 0.4 )	$\times 10^{-4}$		1386
$\chi_{c1}(3872) K^0, \chi_{c1} \rightarrow$ $J/\psi \omega$	( 6.0 ± 3.2 )	$\times 10^{-6}$		1140
$X(3915), X \rightarrow J/\psi \omega$	( 2.1 ± 0.9 )	$\times 10^{-5}$		1102
$J/\psi(1S) K(1270)^0$	( 1.3 ± 0.5 )	$\times 10^{-3}$		1391

$J/\psi(1S)\pi^0$	$(1.76 \pm 0.16) \times 10^{-5}$	S=1.1	1728
$J/\psi(1S)\eta$	$(1.08 \pm 0.23) \times 10^{-5}$	S=1.5	1673
$J/\psi(1S)\pi^+\pi^-$	$(3.96 \pm 0.17) \times 10^{-5}$		1716
$J/\psi(1S)\pi^+\pi^-$ nonresonant	$< 1.2 \times 10^{-5}$	CL=90%	1716
$J/\psi(1S)f_0(500), f_0 \rightarrow \pi\pi$	$(8.0 \pm_{-0.9}^{+1.1}) \times 10^{-6}$		—
$J/\psi(1S)f_2$	$(3.3 \pm 0.5) \times 10^{-6}$	S=1.5	—
$J/\psi(1S)\rho^0$	$(2.55 \pm_{-0.16}^{+0.18}) \times 10^{-5}$		1612
$J/\psi(1S)f_0(980), f_0 \rightarrow \pi^+\pi^-$	$< 1.1 \times 10^{-6}$	CL=90%	—
$J/\psi(1S)\rho(1450)^0, \rho^0 \rightarrow \pi\pi$	$(2.9 \pm_{-0.7}^{+1.6}) \times 10^{-6}$		—
$J/\psi\rho(1700)^0, \rho^0 \rightarrow \pi^+\pi^-$	$(2.0 \pm 1.3) \times 10^{-6}$		—
$J/\psi(1S)\omega$	$(1.8 \pm_{-0.5}^{+0.7}) \times 10^{-5}$		1609
$J/\psi(1S)K^+K^-$	$(2.51 \pm 0.35) \times 10^{-6}$		1533
$J/\psi(1S)a_0(980), a_0 \rightarrow K^+K^-$	$(4.7 \pm 3.4) \times 10^{-7}$		—
$J/\psi(1S)\phi$	$< 1.9 \times 10^{-7}$	CL=90%	1520
$J/\psi(1S)\eta'(958)$	$(7.6 \pm 2.4) \times 10^{-6}$		1546
$J/\psi(1S)K^0\pi^+\pi^-$	$(4.4 \pm 0.4) \times 10^{-4}$		1611
$J/\psi(1S)K^0K^-\pi^+ + c.c.$	$< 2.1 \times 10^{-5}$	CL=90%	1467
$J/\psi(1S)K^0K^+K^-$	$(2.5 \pm 0.7) \times 10^{-5}$	S=1.8	1249
$J/\psi(1S)K^0\rho^0$	$(5.4 \pm 3.0) \times 10^{-4}$		1390
$J/\psi(1S)K^*(892)^+\pi^-$	$(8 \pm 4) \times 10^{-4}$		1514
$J/\psi(1S)\pi^+\pi^-\pi^+\pi^-$	$(1.43 \pm 0.12) \times 10^{-5}$		1670
$J/\psi(1S)f_1(1285)$	$(8.2 \pm 2.1) \times 10^{-6}$		1385
$J/\psi(1S)K^*(892)^0\pi^+\pi^-$	$(6.6 \pm 2.2) \times 10^{-4}$		1447
$\chi_{c1}(3872)^-K^+$	$< 5 \times 10^{-4}$	CL=90%	—
$\chi_{c1}(3872)^-K^+, [f]$	$< 4.2 \times 10^{-6}$	CL=90%	—
$\chi_{c1}(3872)^- \rightarrow J/\psi(1S)\pi^-\pi^0$			
$\chi_{c1}(3872)K^0, \chi_{c1} \rightarrow J/\psi\pi^+\pi^-$	$(4.3 \pm 1.3) \times 10^{-6}$		1140
$\chi_{c1}(3872)K^0, \chi_{c1} \rightarrow J/\psi\gamma$	$< 2.4 \times 10^{-6}$	CL=90%	1140
$\chi_{c1}(3872)K^*(892)^0, \chi_{c1} \rightarrow J/\psi\gamma$	$< 2.8 \times 10^{-6}$	CL=90%	940
$\chi_{c1}(3872)K^0, \chi_{c1} \rightarrow \psi(2S)\gamma$	$< 6.62 \times 10^{-6}$	CL=90%	1140
$\chi_{c1}(3872)K^*(892)^0, \chi_{c1} \rightarrow \psi(2S)\gamma$	$< 4.4 \times 10^{-6}$	CL=90%	940
$\chi_{c1}(3872)K^0, \chi_{c1} \rightarrow D^0\bar{D}^0\pi^0$	$(1.7 \pm 0.8) \times 10^{-4}$		1140
$\chi_{c1}(3872)K^0, \chi_{c1} \rightarrow \bar{D}^{*0}D^0$	$(1.2 \pm 0.4) \times 10^{-4}$		1140
$\chi_{c1}(3872)K^+\pi^-, \chi_{c1} \rightarrow J/\psi\pi^+\pi^-$	$(7.9 \pm 1.4) \times 10^{-6}$		—

$\chi_{c1}(3872)K^*(892)^0, \chi_{c1} \rightarrow J/\psi \pi^+ \pi^-$	$(4.0 \pm 1.5) \times 10^{-6}$	—
$Z_c(4430)^\pm K^\mp, Z_c^\pm \rightarrow \psi(2S)\pi^\pm$	$(6.0 \pm_{-2.4}^{3.0}) \times 10^{-5}$	583
$Z_c(4430)^\pm K^\mp, Z_c^\pm \rightarrow J/\psi \pi^\pm$	$(5.4 \pm_{-1.2}^{4.0}) \times 10^{-6}$	583
$Z_c(3900)^\pm K^\mp, Z_c^\pm \rightarrow J/\psi \pi^\pm$	$< 9 \times 10^{-7}$	—
$Z_c(4200)^\pm K^\mp, X^\pm \rightarrow J/\psi \pi^\pm$	$(2.2 \pm_{-0.8}^{1.3}) \times 10^{-5}$	—
$J/\psi(1S)p\bar{p}$	$< 5.2 \times 10^{-7}$	CL=90% 862
$J/\psi(1S)\gamma$	$< 1.5 \times 10^{-6}$	CL=90% 1732
$J/\psi(1S)\bar{D}^0$	$< 1.3 \times 10^{-5}$	CL=90% 877
$\psi(2S)\pi^0$	$(1.17 \pm 0.19) \times 10^{-5}$	1348
$\psi(2S)K^0$	$(5.8 \pm 0.5) \times 10^{-4}$	1283
$\psi(3770)K^0, \psi \rightarrow \bar{D}^0 D^0$	$< 1.23 \times 10^{-4}$	CL=90% 1217
$\psi(3770)K^0, \psi \rightarrow D^- D^+$	$< 1.88 \times 10^{-4}$	CL=90% 1217
$\psi(2S)\pi^+ \pi^-$	$(2.22 \pm 0.35) \times 10^{-5}$	1331
$\psi(2S)K^+ \pi^-$	$(5.8 \pm 0.4) \times 10^{-4}$	1239
$\psi(2S)K^*(892)^0$	$(5.9 \pm 0.4) \times 10^{-4}$	1116
$\chi_{c0}K^0$	$(1.46 \pm 0.27) \times 10^{-4}$	1477
$\chi_{c0}K^*(892)^0$	$(1.7 \pm 0.4) \times 10^{-4}$	1342
$\chi_{c1}\pi^0$	$(1.12 \pm 0.28) \times 10^{-5}$	1468
$\chi_{c1}K^0$	$(3.93 \pm 0.27) \times 10^{-4}$	1411
$\chi_{c1}\pi^- K^+$	$(4.97 \pm 0.30) \times 10^{-4}$	1371
$\chi_{c1}K^*(892)^0$	$(2.38 \pm 0.19) \times 10^{-4}$	S=1.2 1265
$X(4051)^- K^+, X^- \rightarrow \chi_{c1}\pi^-$	$(3.0 \pm_{-1.8}^{4.0}) \times 10^{-5}$	—
$X(4248)^- K^+, X^- \rightarrow \chi_{c1}\pi^-$	$(4.0 \pm_{-1.0}^{20.0}) \times 10^{-5}$	—
$\chi_{c1}\pi^+ \pi^- K^0$	$(3.2 \pm 0.5) \times 10^{-4}$	1318
$\chi_{c1}\pi^- \pi^0 K^+$	$(3.5 \pm 0.6) \times 10^{-4}$	1321
$\chi_{c2}K^0$	$< 1.5 \times 10^{-5}$	CL=90% 1379
$\chi_{c2}K^*(892)^0$	$(4.9 \pm 1.2) \times 10^{-5}$	S=1.1 1228
$\chi_{c2}\pi^- K^+$	$(7.2 \pm 1.0) \times 10^{-5}$	1338
$\chi_{c2}\pi^+ \pi^- K^0$	$< 1.70 \times 10^{-4}$	CL=90% 1282
$\chi_{c2}\pi^- \pi^0 K^+$	$< 7.4 \times 10^{-5}$	CL=90% 1286
<b>K or K* modes</b>		
$K^+ \pi^-$	$(1.96 \pm 0.05) \times 10^{-5}$	2615
$K^0 \pi^0$	$(9.9 \pm 0.5) \times 10^{-6}$	2615
$\eta' K^0$	$(6.6 \pm 0.4) \times 10^{-5}$	S=1.4 2528
$\eta' K^*(892)^0$	$(2.8 \pm 0.6) \times 10^{-6}$	2472

$\eta' K_0^*(1430)^0$	$( 6.3 \pm 1.6 ) \times 10^{-6}$		2346
$\eta' K_2^*(1430)^0$	$( 1.37 \pm 0.32 ) \times 10^{-5}$		2346
$\eta K^0$	$( 1.23_{-0.24}^{+0.27} ) \times 10^{-6}$		2587
$\eta K^*(892)^0$	$( 1.59 \pm 0.10 ) \times 10^{-5}$		2534
$\eta K_0^*(1430)^0$	$( 1.10 \pm 0.22 ) \times 10^{-5}$		2415
$\eta K_2^*(1430)^0$	$( 9.6 \pm 2.1 ) \times 10^{-6}$		2414
$\omega K^0$	$( 4.8 \pm 0.4 ) \times 10^{-6}$		2557
$a_0(980)^0 K^0, a_0^0 \rightarrow \eta \pi^0$	$< 7.8$	$\times 10^{-6}$ CL=90%	—
$b_1^0 K^0, b_1^0 \rightarrow \omega \pi^0$	$< 7.8$	$\times 10^{-6}$ CL=90%	—
$a_0(980)^\pm K^\mp, a_0^\pm \rightarrow \eta \pi^\pm$	$< 1.9$	$\times 10^{-6}$ CL=90%	—
$b_1^- K^+, b_1^- \rightarrow \omega \pi^-$	$( 7.4 \pm 1.4 ) \times 10^{-6}$		—
$b_1^0 K^{*0}, b_1^0 \rightarrow \omega \pi^0$	$< 8.0$	$\times 10^{-6}$ CL=90%	—
$b_1^- K^{*+}, b_1^- \rightarrow \omega \pi^-$	$< 5.0$	$\times 10^{-6}$ CL=90%	—
$a_0(1450)^\pm K^\mp, a_0^\pm \rightarrow \eta \pi^\pm$	$< 3.1$	$\times 10^{-6}$ CL=90%	—
$K_S^0 X^0$ (Familon)	$< 5.3$	$\times 10^{-5}$ CL=90%	—
$\omega K^*(892)^0$	$( 2.0 \pm 0.5 ) \times 10^{-6}$		2503
$\omega (K\pi)_0^{*0}$	$( 1.84 \pm 0.25 ) \times 10^{-5}$		—
$\omega K_0^*(1430)^0$	$( 1.60 \pm 0.34 ) \times 10^{-5}$		2380
$\omega K_2^*(1430)^0$	$( 1.01 \pm 0.23 ) \times 10^{-5}$		2380
$\omega K^+ \pi^-$ nonresonant	$( 5.1 \pm 1.0 ) \times 10^{-6}$		2542
$K^+ \pi^- \pi^0$	$( 3.78 \pm 0.32 ) \times 10^{-5}$		2609
$K^+ \rho^-$	$( 7.0 \pm 0.9 ) \times 10^{-6}$		2559
$K^+ \rho(1450)^-$	$( 2.4 \pm 1.2 ) \times 10^{-6}$		—
$K^+ \rho(1700)^-$	$( 6 \pm 7 ) \times 10^{-7}$		—
$(K^+ \pi^- \pi^0)$ non-resonant	$( 2.8 \pm 0.6 ) \times 10^{-6}$		—
$(K\pi)_0^{*+} \pi^-, (K\pi)_0^{*+} \rightarrow$	$( 3.4 \pm 0.5 ) \times 10^{-5}$		—
$K^+ \pi^0$			
$(K\pi)_0^{*0} \pi^0, (K\pi)_0^{*0} \rightarrow$	$( 8.6 \pm 1.7 ) \times 10^{-6}$		—
$K^+ \pi^-$			
$K_2^*(1430)^0 \pi^0$	$< 4.0$	$\times 10^{-6}$ CL=90%	2445
$K^*(1680)^0 \pi^0$	$< 7.5$	$\times 10^{-6}$ CL=90%	2358
$K_x^{*0} \pi^0$	[i] $( 6.1 \pm 1.6 ) \times 10^{-6}$		—
$K^0 \pi^+ \pi^-$	$( 4.94 \pm 0.18 ) \times 10^{-5}$		2609
$K^0 \pi^+ \pi^-$ non-resonant	$( 1.47_{-0.26}^{+0.40} ) \times 10^{-5}$	S=2.1	—
$K^0 \rho^0$	$( 4.7 \pm 0.6 ) \times 10^{-6}$		2558
$K^*(892)^+ \pi^-$	$( 8.4 \pm 0.8 ) \times 10^{-6}$		2563
$K_0^*(1430)^+ \pi^-$	$( 3.3 \pm 0.7 ) \times 10^{-5}$	S=2.0	—
$K_x^{*+} \pi^-$	[i] $( 5.1 \pm 1.6 ) \times 10^{-6}$		—
$K^*(1410)^+ \pi^-, K^{*+} \rightarrow$	$< 3.8$	$\times 10^{-6}$ CL=90%	—
$K^0 \pi^+$			
$f_0(980) K^0, f_0 \rightarrow \pi^+ \pi^-$	$( 7.0 \pm 0.9 ) \times 10^{-6}$		2522

$f_2(1270)K^0$	$( 2.7 \pm_{-1.2}^{+1.3} ) \times 10^{-6}$	2459
$f_x(1300)K^0, f_x \rightarrow \pi^+\pi^-$	$( 1.8 \pm 0.7 ) \times 10^{-6}$	—
$K^*(892)^0\pi^0$	$( 3.3 \pm 0.6 ) \times 10^{-6}$	2563
$K_2^*(1430)^+\pi^-$	$< 6 \times 10^{-6}$ CL=90%	2445
$K^*(1680)^+\pi^-$	$< 1.0 \times 10^{-5}$ CL=90%	2358
$K^+\pi^-\pi^+\pi^-$	[j] $< 2.3 \times 10^{-4}$ CL=90%	2600
$\rho^0 K^+\pi^-$	$( 2.8 \pm 0.7 ) \times 10^{-6}$	2543
$f_0(980)K^+\pi^-, f_0 \rightarrow \pi\pi$	$( 1.4 \pm_{-0.6}^{+0.5} ) \times 10^{-6}$	2506
$K^+\pi^-\pi^+\pi^-$ nonresonant	$< 2.1 \times 10^{-6}$ CL=90%	2600
$K^*(892)^0\pi^+\pi^-$	$( 5.5 \pm 0.5 ) \times 10^{-5}$	2557
$K^*(892)^0\rho^0$	$( 3.9 \pm 1.3 ) \times 10^{-6}$ S=1.9	2504
$K^*(892)^0 f_0(980), f_0 \rightarrow \pi\pi$	$( 3.9 \pm_{-1.8}^{+2.1} ) \times 10^{-6}$ S=3.9	2466
$K_1(1270)^+\pi^-$	$< 3.0 \times 10^{-5}$ CL=90%	2484
$K_1(1400)^+\pi^-$	$< 2.7 \times 10^{-5}$ CL=90%	2451
$a_1(1260)^-K^+$	[j] $( 1.6 \pm 0.4 ) \times 10^{-5}$	2471
$K^*(892)^+\rho^-$	$( 1.03 \pm 0.26 ) \times 10^{-5}$	2504
$K_0^*(1430)^+\rho^-$	$( 2.8 \pm 1.2 ) \times 10^{-5}$	—
$K_1(1400)^0\rho^0$	$< 3.0 \times 10^{-3}$ CL=90%	2388
$K_0^*(1430)^0\rho^0$	$( 2.7 \pm 0.6 ) \times 10^{-5}$	2381
$K_0^*(1430)^0 f_0(980), f_0 \rightarrow \pi\pi$	$( 2.7 \pm 0.9 ) \times 10^{-6}$	—
$K_2^*(1430)^0 f_0(980), f_0 \rightarrow \pi\pi$	$( 8.6 \pm 2.0 ) \times 10^{-6}$	—
$K^+K^-$	$( 7.8 \pm 1.5 ) \times 10^{-8}$	2593
$K^0\bar{K}^0$	$( 1.21 \pm 0.16 ) \times 10^{-6}$	2592
$K^0K^-\pi^+$	$( 6.2 \pm 0.7 ) \times 10^{-6}$	2578
$K^*(892)^\pm K^\mp$	$< 4 \times 10^{-7}$ CL=90%	2540
$\bar{K}^{*0}K^0 + K^{*0}\bar{K}^0$	$< 9.6 \times 10^{-7}$ CL=90%	—
$K^+K^-\pi^0$	$( 2.2 \pm 0.6 ) \times 10^{-6}$	2579
$K_S^0 K_S^0 \pi^0$	$< 9 \times 10^{-7}$ CL=90%	2578
$K_S^0 K_S^0 \eta$	$< 1.0 \times 10^{-6}$ CL=90%	2515
$K_S^0 K_S^0 \eta'$	$< 2.0 \times 10^{-6}$ CL=90%	2453
$K^0 K^+ K^-$	$( 2.67 \pm 0.11 ) \times 10^{-5}$	2522
$K^0 \phi$	$( 7.3 \pm 0.7 ) \times 10^{-6}$	2516
$f_0(980)K^0, f_0 \rightarrow K^+K^-$	$( 7.0 \pm_{-3.0}^{+3.5} ) \times 10^{-6}$	—
$f_0(1500)K^0$	$( 1.3 \pm_{-0.5}^{+0.7} ) \times 10^{-5}$	2398
$f_2'(1525)^0 K^0$	$( 3 \pm_{-4}^{+5} ) \times 10^{-7}$	—
$f_0(1710)K^0, f_0 \rightarrow K^+K^-$	$( 4.4 \pm 0.9 ) \times 10^{-6}$	—
$K^0 K^+ K^-$ nonresonant	$( 3.3 \pm 1.0 ) \times 10^{-5}$	2522
$K_S^0 K_S^0 K_S^0$	$( 6.0 \pm 0.5 ) \times 10^{-6}$ S=1.1	2521
$f_0(980)K^0, f_0 \rightarrow K_S^0 K_S^0$	$( 2.7 \pm 1.8 ) \times 10^{-6}$	—

$f_0(1710)K^0, f_0 \rightarrow K_S^0 K_S^0$	$( 5.0 \pm_{-2.6}^{+5.0} ) \times 10^{-7}$	—
$f_0(2010)K^0, f_0 \rightarrow K_S^0 K_S^0$	$( 5 \pm 6 ) \times 10^{-7}$	—
$K_S^0 K_S^0 K_S^0$ nonresonant	$( 1.33 \pm 0.31 ) \times 10^{-5}$	2521
$K_S^0 K_S^0 K_L^0$	$< 1.6 \times 10^{-5}$	CL=90% 2521
$K^*(892)^0 K^+ K^-$	$( 2.75 \pm 0.26 ) \times 10^{-5}$	2467
$K^*(892)^0 \phi$	$( 1.00 \pm 0.05 ) \times 10^{-5}$	2460
$K^+ K^- \pi^+ \pi^-$ nonresonant	$< 7.17 \times 10^{-5}$	CL=90% 2559
$K^*(892)^0 K^- \pi^+$	$( 4.5 \pm 1.3 ) \times 10^{-6}$	2524
$K^*(892)^0 \bar{K}^*(892)^0$	$( 8 \pm 5 ) \times 10^{-7}$	S=2.2 2485
$K^+ K^+ \pi^- \pi^-$ nonresonant	$< 6.0 \times 10^{-6}$	CL=90% 2559
$K^*(892)^0 K^+ \pi^-$	$< 2.2 \times 10^{-6}$	CL=90% 2524
$K^*(892)^0 K^*(892)^0$	$< 2 \times 10^{-7}$	CL=90% 2485
$K^*(892)^+ K^*(892)^-$	$< 2.0 \times 10^{-6}$	CL=90% 2485
$K_1(1400)^0 \phi$	$< 5.0 \times 10^{-3}$	CL=90% 2339
$\phi(K\pi)_0^{*0}$	$( 4.3 \pm 0.4 ) \times 10^{-6}$	—
$\phi(K\pi)_0^{*0} (1.60 < m_{K\pi} < 2.15)$ [k]	$< 1.7 \times 10^{-6}$	CL=90% —
$K_0^*(1430)^0 K^- \pi^+$	$< 3.18 \times 10^{-5}$	CL=90% 2403
$K_0^*(1430)^0 \bar{K}^*(892)^0$	$< 3.3 \times 10^{-6}$	CL=90% 2360
$K_0^*(1430)^0 \bar{K}_0^*(1430)^0$	$< 8.4 \times 10^{-6}$	CL=90% 2222
$K_0^*(1430)^0 \phi$	$( 3.9 \pm 0.8 ) \times 10^{-6}$	2333
$K_0^*(1430)^0 K^*(892)^0$	$< 1.7 \times 10^{-6}$	CL=90% 2360
$K_0^*(1430)^0 K_0^*(1430)^0$	$< 4.7 \times 10^{-6}$	CL=90% 2222
$K^*(1680)^0 \phi$	$< 3.5 \times 10^{-6}$	CL=90% 2238
$K^*(1780)^0 \phi$	$< 2.7 \times 10^{-6}$	CL=90% —
$K^*(2045)^0 \phi$	$< 1.53 \times 10^{-5}$	CL=90% —
$K_2^*(1430)^0 \rho^0$	$< 1.1 \times 10^{-3}$	CL=90% 2381
$K_2^*(1430)^0 \phi$	$( 6.8 \pm 0.9 ) \times 10^{-6}$	S=1.2 2333
$K^0 \phi \phi$	$( 4.5 \pm 0.9 ) \times 10^{-6}$	2305
$\eta' \eta' K^0$	$< 3.1 \times 10^{-5}$	CL=90% 2337
$\eta K^0 \gamma$	$( 7.6 \pm 1.8 ) \times 10^{-6}$	2587
$\eta' K^0 \gamma$	$< 6.4 \times 10^{-6}$	CL=90% 2528
$K^0 \phi \gamma$	$( 2.7 \pm 0.7 ) \times 10^{-6}$	2516
$K^+ \pi^- \gamma$	$( 4.6 \pm 1.4 ) \times 10^{-6}$	2615
$K^*(892)^0 \gamma$	$( 4.18 \pm 0.25 ) \times 10^{-5}$	S=2.1 2565
$K^*(1410) \gamma$	$< 1.3 \times 10^{-4}$	CL=90% 2449
$K^+ \pi^- \gamma$ nonresonant	$< 2.6 \times 10^{-6}$	CL=90% 2615
$K^*(892)^0 X(214), X \rightarrow \mu^+ \mu^-$	[l] $< 2.26 \times 10^{-8}$	CL=90% —
$K^0 \pi^+ \pi^- \gamma$	$( 1.99 \pm 0.18 ) \times 10^{-5}$	2609
$K^+ \pi^- \pi^0 \gamma$	$( 4.1 \pm 0.4 ) \times 10^{-5}$	2609
$K_1(1270)^0 \gamma$	$< 5.8 \times 10^{-5}$	CL=90% 2486
$K_1(1400)^0 \gamma$	$< 1.2 \times 10^{-5}$	CL=90% 2454



$K_2^*(1430)^0 \gamma$	( $1.24 \pm 0.24$ ) $\times 10^{-5}$	2447
$K^*(1680)^0 \gamma$	< 2.0 $\times 10^{-3}$ CL=90%	2360
$K_3^*(1780)^0 \gamma$	< 8.3 $\times 10^{-5}$ CL=90%	2341
$K_4^*(2045)^0 \gamma$	< 4.3 $\times 10^{-3}$ CL=90%	2244

### Light unflavored meson modes

$\rho^0 \gamma$	( $8.6 \pm 1.5$ ) $\times 10^{-7}$	2583
$\rho^0 X(214), X \rightarrow \mu^+ \mu^-$	[ $l$ ] < 1.73 $\times 10^{-8}$ CL=90%	–
$\omega \gamma$	( $4.4 \begin{smallmatrix} + 1.8 \\ - 1.6 \end{smallmatrix}$ ) $\times 10^{-7}$	2582
$\phi \gamma$	< 1.0 $\times 10^{-7}$ CL=90%	2541
$\pi^+ \pi^-$	( $5.12 \pm 0.19$ ) $\times 10^{-6}$	2636
$\pi^0 \pi^0$	( $1.59 \pm 0.26$ ) $\times 10^{-6}$ S=1.4	2636
$\eta \pi^0$	( $4.1 \pm 1.7$ ) $\times 10^{-7}$	2610
$\eta \eta$	< 1.0 $\times 10^{-6}$ CL=90%	2582
$\eta' \pi^0$	( $1.2 \pm 0.6$ ) $\times 10^{-6}$ S=1.7	2551
$\eta' \eta'$	< 1.7 $\times 10^{-6}$ CL=90%	2460
$\eta' \eta$	< 1.2 $\times 10^{-6}$ CL=90%	2523
$\eta' \rho^0$	< 1.3 $\times 10^{-6}$ CL=90%	2492
$\eta' f_0(980), f_0 \rightarrow \pi^+ \pi^-$	< 9 $\times 10^{-7}$ CL=90%	2454
$\eta \rho^0$	< 1.5 $\times 10^{-6}$ CL=90%	2553
$\eta f_0(980), f_0 \rightarrow \pi^+ \pi^-$	< 4 $\times 10^{-7}$ CL=90%	2516
$\omega \eta$	( $9.4 \begin{smallmatrix} + 4.0 \\ - 3.1 \end{smallmatrix}$ ) $\times 10^{-7}$	2552
$\omega \eta'$	( $1.0 \begin{smallmatrix} + 0.5 \\ - 0.4 \end{smallmatrix}$ ) $\times 10^{-6}$	2491
$\omega \rho^0$	< 1.6 $\times 10^{-6}$ CL=90%	2522
$\omega f_0(980), f_0 \rightarrow \pi^+ \pi^-$	< 1.5 $\times 10^{-6}$ CL=90%	2485
$\omega \omega$	( $1.2 \pm 0.4$ ) $\times 10^{-6}$	2521
$\phi \pi^0$	< 1.5 $\times 10^{-7}$ CL=90%	2540
$\phi \eta$	< 5 $\times 10^{-7}$ CL=90%	2511
$\phi \eta'$	< 5 $\times 10^{-7}$ CL=90%	2448
$\phi \pi^+ \pi^-$	( $1.8 \pm 0.5$ ) $\times 10^{-7}$	2533
$\phi \rho^0$	< 3.3 $\times 10^{-7}$ CL=90%	2480
$\phi f_0(980), f_0 \rightarrow \pi^+ \pi^-$	< 3.8 $\times 10^{-7}$ CL=90%	2441
$\phi \omega$	< 7 $\times 10^{-7}$ CL=90%	2479
$\phi \phi$	< 2.8 $\times 10^{-8}$ CL=90%	2435
$a_0(980)^\pm \pi^\mp, a_0^\pm \rightarrow \eta \pi^\pm$	< 3.1 $\times 10^{-6}$ CL=90%	–
$a_0(1450)^\pm \pi^\mp, a_0^\pm \rightarrow \eta \pi^\pm$	< 2.3 $\times 10^{-6}$ CL=90%	–
$\pi^+ \pi^- \pi^0$	< 7.2 $\times 10^{-4}$ CL=90%	2631
$\rho^0 \pi^0$	( $2.0 \pm 0.5$ ) $\times 10^{-6}$	2581
$\rho^\mp \pi^\pm$	[ $n$ ] ( $2.30 \pm 0.23$ ) $\times 10^{-5}$	2581
$\pi^+ \pi^- \pi^+ \pi^-$	< 1.12 $\times 10^{-5}$ CL=90%	2621
$\rho^0 \pi^+ \pi^-$	< 8.8 $\times 10^{-6}$ CL=90%	2575
$\rho^0 \rho^0$	( $9.6 \pm 1.5$ ) $\times 10^{-7}$	2523

$f_0(980)\pi^+\pi^-$ , $f_0 \rightarrow \pi^+\pi^-$	< 3.0	$\times 10^{-6}$	CL=90%	–
$\rho^0 f_0(980)$ , $f_0 \rightarrow \pi^+\pi^-$	( 7.8 $\pm$ 2.5 )	$\times 10^{-7}$		2486
$f_0(980)f_0(980)$ , $f_0 \rightarrow \pi^+\pi^-$	< 1.9	$\times 10^{-7}$	CL=90%	2447
$f_0(980)f_0(980)$ , $f_0 \rightarrow \pi^+\pi^-$ , $f_0 \rightarrow K^+K^-$	< 2.3	$\times 10^{-7}$	CL=90%	2447
$a_1(1260)^{\mp}\pi^{\pm}$	[ $n$ ] ( 2.6 $\pm$ 0.5 )	$\times 10^{-5}$	S=1.9	2494
$a_2(1320)^{\mp}\pi^{\pm}$	[ $n$ ] < 6.3	$\times 10^{-6}$	CL=90%	2473
$\pi^+\pi^-\pi^0\pi^0$	< 3.1	$\times 10^{-3}$	CL=90%	2622
$\rho^+\rho^-$	( 2.77 $\pm$ 0.19 )	$\times 10^{-5}$		2523
$a_1(1260)^0\pi^0$	< 1.1	$\times 10^{-3}$	CL=90%	2495
$\omega\pi^0$	< 5	$\times 10^{-7}$	CL=90%	2580
$\pi^+\pi^+\pi^-\pi^-\pi^0$	< 9.0	$\times 10^{-3}$	CL=90%	2609
$a_1(1260)^+\rho^-$	< 6.1	$\times 10^{-5}$	CL=90%	2433
$a_1(1260)^0\rho^0$	< 2.4	$\times 10^{-3}$	CL=90%	2433
$b_1^{\mp}\pi^{\pm}$ , $b_1^{\mp} \rightarrow \omega\pi^{\mp}$	( 1.09 $\pm$ 0.15 )	$\times 10^{-5}$		–
$b_1^0\pi^0$ , $b_1^0 \rightarrow \omega\pi^0$	< 1.9	$\times 10^{-6}$	CL=90%	–
$b_1^-\rho^+$ , $b_1^- \rightarrow \omega\pi^-$	< 1.4	$\times 10^{-6}$	CL=90%	–
$b_1^0\rho^0$ , $b_1^0 \rightarrow \omega\pi^0$	< 3.4	$\times 10^{-6}$	CL=90%	–
$\pi^+\pi^+\pi^+\pi^-\pi^-\pi^-$	< 3.0	$\times 10^{-3}$	CL=90%	2592
$a_1(1260)^+a_1(1260)^-$ , $a_1^+ \rightarrow 2\pi^+\pi^-$ , $a_1^- \rightarrow 2\pi^-\pi^+$	( 1.18 $\pm$ 0.31 )	$\times 10^{-5}$		2336
$\pi^+\pi^+\pi^+\pi^-\pi^-\pi^-\pi^0$	< 1.1	%	CL=90%	2572

### Baryon modes

$p\bar{p}$	( 1.25 $\pm$ 0.32 )	$\times 10^{-8}$		2467
$p\bar{p}\pi^+\pi^-$	( 2.87 $\pm$ 0.19 )	$\times 10^{-6}$		2406
$p\bar{p}K^+\pi^-$	( 6.3 $\pm$ 0.5 )	$\times 10^{-6}$		2306
$p\bar{p}K^0$	( 2.66 $\pm$ 0.32 )	$\times 10^{-6}$		2347
$\Theta(1540)^+\bar{p}$ , $\Theta^+ \rightarrow pK_S^0$	[ $\sigma$ ] < 5	$\times 10^{-8}$	CL=90%	2318
$f_J(2220)K^0$ , $f_J \rightarrow p\bar{p}$	< 4.5	$\times 10^{-7}$	CL=90%	2135
$p\bar{p}K^*(892)^0$	( 1.24 $^{+0.28}_{-0.25}$ )	$\times 10^{-6}$		2216
$f_J(2220)K_0^*$ , $f_J \rightarrow p\bar{p}$	< 1.5	$\times 10^{-7}$	CL=90%	–
$p\bar{p}K^+K^-$	( 1.21 $\pm$ 0.32 )	$\times 10^{-7}$		2179
$p\bar{\Lambda}\pi^-$	( 3.14 $\pm$ 0.29 )	$\times 10^{-6}$		2401
$p\bar{\Lambda}\pi^-\gamma$	< 6.5	$\times 10^{-7}$	CL=90%	2401
$p\bar{\Sigma}^-(1385)^-$	< 2.6	$\times 10^{-7}$	CL=90%	2363
$\Delta^0\bar{\Lambda}$	< 9.3	$\times 10^{-7}$	CL=90%	2364
$p\bar{\Lambda}K^-$	< 8.2	$\times 10^{-7}$	CL=90%	2308
$p\bar{\Lambda}D^-$	( 2.5 $\pm$ 0.4 )	$\times 10^{-5}$		1765
$p\bar{\Lambda}D^{*-}$	( 3.4 $\pm$ 0.8 )	$\times 10^{-5}$		1685
$p\bar{\Sigma}^0\pi^-$	< 3.8	$\times 10^{-6}$	CL=90%	2383

$\bar{\Lambda}\Lambda$	< 3.2	$\times 10^{-7}$	CL=90%	2392
$\bar{\Lambda}\Lambda K^0$	( 4.8	$\pm 1.0$	$\times 10^{-6}$	2250
$\bar{\Lambda}\Lambda K^{*0}$	( 2.5	$\pm 0.9$	$\times 10^{-6}$	2098
$\bar{\Lambda}\Lambda D^0$	( 1.00	$\pm 0.30$	$\times 10^{-5}$	1661
$D^0 \Sigma^0 \bar{\Lambda} + \text{c.c.}$	< 3.1	$\times 10^{-5}$	CL=90%	1611
$\Delta^0 \bar{\Delta}^0$	< 1.5	$\times 10^{-3}$	CL=90%	2335
$\Delta^{++} \bar{\Delta}^{--}$	< 1.1	$\times 10^{-4}$	CL=90%	2335
$\bar{D}^0 p \bar{p}$	( 1.04	$\pm 0.07$	$\times 10^{-4}$	1863
$D_s^- \bar{\Lambda} p$	( 2.8	$\pm 0.9$	$\times 10^{-5}$	1710
$\bar{D}^{*}(2007)^0 p \bar{p}$	( 9.9	$\pm 1.1$	$\times 10^{-5}$	1788
$D^{*}(2010)^- p \bar{n}$	( 1.4	$\pm 0.4$	$\times 10^{-3}$	1785
$D^- p \bar{p} \pi^+$	( 3.32	$\pm 0.31$	$\times 10^{-4}$	1786
$D^{*}(2010)^- p \bar{p} \pi^+$	( 4.7	$\pm 0.5$	$\times 10^{-4}$	S=1.2 1708
$\bar{D}^0 p \bar{p} \pi^+ \pi^-$	( 3.0	$\pm 0.5$	$\times 10^{-4}$	1708
$\bar{D}^{*0} p \bar{p} \pi^+ \pi^-$	( 1.9	$\pm 0.5$	$\times 10^{-4}$	1623
$\Theta_c \bar{p} \pi^+, \Theta_c \rightarrow D^- p$	< 9	$\times 10^{-6}$	CL=90%	–
$\Theta_c \bar{p} \pi^+, \Theta_c \rightarrow D^{*-} p$	< 1.4	$\times 10^{-5}$	CL=90%	–
$\bar{\Sigma}_c^- \Delta^{++}$	< 8	$\times 10^{-4}$	CL=90%	1839
$\bar{\Lambda}_c^- p \pi^+ \pi^-$	( 1.03	$\pm 0.14$	$\times 10^{-3}$	S=1.3 1934
$\bar{\Lambda}_c^- p$	( 1.55	$\pm 0.18$	$\times 10^{-5}$	2021
$\bar{\Lambda}_c^- p \pi^0$	( 1.56	$\pm 0.19$	$\times 10^{-4}$	1982
$\bar{\Sigma}_c(2455)^- p$	< 2.4	$\times 10^{-5}$		–
$\bar{\Lambda}_c^- p \pi^+ \pi^- \pi^0$	< 5.07	$\times 10^{-3}$	CL=90%	1882
$\bar{\Lambda}_c^- p \pi^+ \pi^- \pi^+ \pi^-$	< 2.74	$\times 10^{-3}$	CL=90%	1821
$\bar{\Lambda}_c^- p \pi^+ \pi^-$ (nonresonant)	( 5.5	$\pm 1.0$	$\times 10^{-4}$	S=1.3 1934
$\bar{\Sigma}_c(2520)^{--} p \pi^+$	( 1.03	$\pm 0.18$	$\times 10^{-4}$	1860
$\bar{\Sigma}_c(2520)^0 p \pi^-$	< 3.1	$\times 10^{-5}$	CL=90%	1860
$\bar{\Sigma}_c(2455)^0 p \pi^-$	( 1.08	$\pm 0.16$	$\times 10^{-4}$	1895
$\bar{\Sigma}_c(2455)^0 N^0, N^0 \rightarrow p \pi^-$	( 6.4	$\pm 1.7$	$\times 10^{-5}$	–
$\bar{\Sigma}_c(2455)^{--} p \pi^+$	( 1.85	$\pm 0.24$	$\times 10^{-4}$	1895
$\Lambda_c^- p K^+ \pi^-$	( 3.5	$\pm 0.7$	$\times 10^{-5}$	–
$\bar{\Sigma}_c(2455)^{--} p K^+, \bar{\Sigma}_c^{--} \rightarrow \bar{\Lambda}_c^- \pi^-$	( 8.9	$\pm 2.6$	$\times 10^{-6}$	1754
$\Lambda_c^- p K^*(892)^0$	< 2.42	$\times 10^{-5}$	CL=90%	–
$\Lambda_c^- p K^+ K^-$	( 2.0	$\pm 0.4$	$\times 10^{-5}$	–
$\Lambda_c^- p \phi$	< 1.0	$\times 10^{-5}$	CL=90%	–
$\Lambda_c^- p \bar{p} p$	< 2.8	$\times 10^{-6}$		–
$\bar{\Lambda}_c^- \Lambda K^+$	( 4.7	$\pm 1.1$	$\times 10^{-5}$	1767
$\bar{\Lambda}_c^+ \Lambda_c^+$	< 1.6	$\times 10^{-5}$	CL=95%	1319

$\bar{\Lambda}_c(2593)^- / \bar{\Lambda}_c(2625)^- p$	< 1.1	$\times 10^{-4}$	CL=90%	—
$\Xi_c^- \Lambda_c^+, \Xi_c^- \rightarrow \Xi^+ \pi^- \pi^-$	( 1.8 ± 1.8 )	$\times 10^{-5}$	S=2.2	1147
$\Lambda_c^+ \Lambda_c^- K^0$	( 4.3 ± 2.3 )	$\times 10^{-4}$		—

**Lepton Family number (LF) or Lepton number (L) or Baryon number (B) violating modes, or/and  $\Delta B = 1$  weak neutral current (B1) modes**

$\gamma\gamma$	B1	< 3.2	$\times 10^{-7}$	CL=90%	2640
$e^+ e^-$	B1	< 8.3	$\times 10^{-8}$	CL=90%	2640
$e^+ e^- \gamma$	B1	< 1.2	$\times 10^{-7}$	CL=90%	2640
$\mu^+ \mu^-$	B1	( 1.6 $\pm$ 1.6 / $-$ 1.4 )	$\times 10^{-10}$	S=1.9	2638
$\mu^+ \mu^- \gamma$	B1	< 1.6	$\times 10^{-7}$	CL=90%	2638
$\mu^+ \mu^- \mu^+ \mu^-$	B1	< 6.9	$\times 10^{-10}$	CL=95%	2629
$SP, S \rightarrow \mu^+ \mu^-,$ $P \rightarrow \mu^+ \mu^-$	B1	[p] < 6.0	$\times 10^{-10}$	CL=95%	—
$\tau^+ \tau^-$	B1	< 2.1	$\times 10^{-3}$	CL=95%	1952
$\pi^0 \ell^+ \ell^-$	B1	< 5.3	$\times 10^{-8}$	CL=90%	2638
$\pi^0 e^+ e^-$	B1	< 8.4	$\times 10^{-8}$	CL=90%	2638
$\pi^0 \mu^+ \mu^-$	B1	< 6.9	$\times 10^{-8}$	CL=90%	2634
$\eta \ell^+ \ell^-$	B1	< 6.4	$\times 10^{-8}$	CL=90%	2611
$\eta e^+ e^-$	B1	< 1.08	$\times 10^{-7}$	CL=90%	2611
$\eta \mu^+ \mu^-$	B1	< 1.12	$\times 10^{-7}$	CL=90%	2607
$\pi^0 \nu \bar{\nu}$	B1	< 9	$\times 10^{-6}$	CL=90%	2638
$K^0 \ell^+ \ell^-$	B1	[a] ( 3.1 $\pm$ 0.8 / $-$ 0.7 )	$\times 10^{-7}$		2616
$K^0 e^+ e^-$	B1	( 1.6 $\pm$ 1.0 / $-$ 0.8 )	$\times 10^{-7}$		2616
$K^0 \mu^+ \mu^-$	B1	( 3.39 ± 0.34 )	$\times 10^{-7}$		2612
$K^0 \nu \bar{\nu}$	B1	< 2.6	$\times 10^{-5}$	CL=90%	2616
$\rho^0 \nu \bar{\nu}$	B1	< 4.0	$\times 10^{-5}$	CL=90%	2583
$K^*(892)^0 \ell^+ \ell^-$	B1	[a] ( 9.9 $\pm$ 1.2 / $-$ 1.1 )	$\times 10^{-7}$		2565
$K^*(892)^0 e^+ e^-$	B1	( 1.03 $\pm$ 0.19 / $-$ 0.17 )	$\times 10^{-6}$		2565
$K^*(892)^0 \mu^+ \mu^-$	B1	( 9.4 ± 0.5 )	$\times 10^{-7}$		2560
$\pi^+ \pi^- \mu^+ \mu^-$	B1	( 2.1 ± 0.5 )	$\times 10^{-8}$		2626
$K^*(892)^0 \nu \bar{\nu}$	B1	< 1.8	$\times 10^{-5}$	CL=90%	2565
invisible	B1	< 2.4	$\times 10^{-5}$	CL=90%	—
$\nu \bar{\nu} \gamma$	B1	< 1.7	$\times 10^{-5}$	CL=90%	2640
$\phi \nu \bar{\nu}$	B1	< 1.27	$\times 10^{-4}$	CL=90%	2541
$e^\pm \mu^\mp$	LF	[n] < 2.8	$\times 10^{-9}$	CL=90%	2639
$\pi^0 e^\pm \mu^\mp$	LF	< 1.4	$\times 10^{-7}$	CL=90%	2637
$K^0 e^\pm \mu^\mp$	LF	< 2.7	$\times 10^{-7}$	CL=90%	2615
$K^*(892)^0 e^+ \mu^-$	LF	< 5.3	$\times 10^{-7}$	CL=90%	2563
$K^*(892)^0 e^- \mu^+$	LF	< 3.4	$\times 10^{-7}$	CL=90%	2563
$K^*(892)^0 e^\pm \mu^\mp$	LF	< 5.8	$\times 10^{-7}$	CL=90%	2563

$e^\pm \tau^\mp$	$LF$	$[\eta] < 2.8$	$\times 10^{-5}$	$CL=90\%$	2341
$\mu^\pm \tau^\mp$	$LF$	$[\eta] < 2.2$	$\times 10^{-5}$	$CL=90\%$	2339
$\Lambda_c^+ \mu^-$	$L,B$	$< 1.4$	$\times 10^{-6}$	$CL=90\%$	2143
$\Lambda_c^+ e^-$	$L,B$	$< 4$	$\times 10^{-6}$	$CL=90\%$	2145

## $B^\pm/B^0$ ADMIXTURE

### CP violation

$$A_{CP}(B \rightarrow K^*(892)\gamma) = -0.003 \pm 0.011$$

$$A_{CP}(b \rightarrow s\gamma) = 0.015 \pm 0.020$$

$$A_{CP}(b \rightarrow (s+d)\gamma) = 0.010 \pm 0.031$$

$$A_{CP}(B \rightarrow X_s \ell^+ \ell^-) = 0.04 \pm 0.11$$

$$A_{CP}(B \rightarrow X_s \ell^+ \ell^-) (1.0 < q^2 < 6.0 \text{ GeV}^2/c^4) = -0.06 \pm 0.22$$

$$A_{CP}(B \rightarrow X_s \ell^+ \ell^-) (10.1 < q^2 < 12.9 \text{ or } q^2 > 14.2 \text{ GeV}^2/c^4) = 0.19 \pm 0.18$$

$$A_{CP}(B \rightarrow K^* e^+ e^-) = -0.18 \pm 0.15$$

$$A_{CP}(B \rightarrow K^* \mu^+ \mu^-) = -0.03 \pm 0.13$$

$$A_{CP}(B \rightarrow K^* \ell^+ \ell^-) = -0.04 \pm 0.07$$

$$A_{CP}(B \rightarrow \eta \text{ anything}) = -0.13^{+0.04}_{-0.05}$$

$$\Delta A_{CP}(X_s \gamma) = A_{CP}(B^\pm \rightarrow X_s \gamma) - A_{CP}(B^0 \rightarrow X_s \gamma) = 0.05 \pm 0.04$$

$$\Delta A_{CP}(B \rightarrow K^* \gamma) = A_{CP}(B^+ \rightarrow K^{*+} \gamma) - A_{CP}(B^0 \rightarrow K^{*0} \gamma) = 0.024 \pm 0.028$$

$$\bar{A}_{CP}(B \rightarrow K^* \gamma) = (A_{CP}(B^+ \rightarrow K^{*+} \gamma) + A_{CP}(B^0 \rightarrow K^{*0} \gamma))/2 = -0.001 \pm 0.014$$

The branching fraction measurements are for an admixture of  $B$  mesons at the  $\Upsilon(4S)$ . The values quoted assume that  $B(\Upsilon(4S) \rightarrow B\bar{B}) = 100\%$ .

For inclusive branching fractions, e.g.,  $B \rightarrow D^\pm \text{ anything}$ , the treatment of multiple  $D$ 's in the final state must be defined. One possibility would be to count the number of events with one-or-more  $D$ 's and divide by the total number of  $B$ 's. Another possibility would be to count the total number of  $D$ 's and divide by the total number of  $B$ 's, which is the definition of average multiplicity. The two definitions are identical if only one  $D$  is allowed in the final state. Even though the "one-or-more" definition seems sensible, for practical reasons inclusive branching fractions are almost always measured using the multiplicity definition. For heavy final state particles, authors call their results inclusive branching fractions while for light particles some authors call their results multiplicities. In the  $B$  sections, we list all results as inclusive branching fractions, adopting a multiplicity definition. This means that inclusive branching fractions can exceed 100% and that inclusive partial widths can exceed total widths, just as inclusive cross sections can exceed total cross section.

$\bar{B}$  modes are charge conjugates of the modes below. Reactions indicate the weak decay vertex and do not include mixing.

<b>B DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	Scale factor/ Confidence level (MeV/c)	$p$
<b>Semileptonic and leptonic modes</b>			
$\ell^+ \nu_\ell$ anything	[a,q] ( 10.86 $\pm$ 0.16 ) %		—
$D^- \ell^+ \nu_\ell$ anything	[a] ( 2.8 $\pm$ 0.9 ) %		—
$\bar{D}^0 \ell^+ \nu_\ell$ anything	[a] ( 7.3 $\pm$ 1.5 ) %		—
$\bar{D} \ell^+ \nu_\ell$	( 2.42 $\pm$ 0.12 ) %		2310
$D^{*-} \ell^+ \nu_\ell$ anything	[r] ( 6.7 $\pm$ 1.3 ) $\times 10^{-3}$		—
$D^* \ell^+ \nu_\ell$	[s] ( 4.95 $\pm$ 0.11 ) %		2257
$\bar{D}^{**} \ell^+ \nu_\ell$	[a,t] ( 2.7 $\pm$ 0.7 ) %		—
$\bar{D}_1(2420) \ell^+ \nu_\ell$ anything	( 3.8 $\pm$ 1.3 ) $\times 10^{-3}$	S=2.4	—
$D\pi \ell^+ \nu_\ell$ anything + $D^* \pi \ell^+ \nu_\ell$ anything	( 2.6 $\pm$ 0.5 ) %	S=1.5	—
$D\pi \ell^+ \nu_\ell$ anything	( 1.5 $\pm$ 0.6 ) %		—
$D^* \pi \ell^+ \nu_\ell$ anything	( 1.9 $\pm$ 0.4 ) %		—
$\bar{D}_2^*(2460) \ell^+ \nu_\ell$ anything	( 4.4 $\pm$ 1.6 ) $\times 10^{-3}$		—
$D^{*-} \pi^+ \ell^+ \nu_\ell$ anything	( 1.00 $\pm$ 0.34 ) %		—
$\bar{D} \pi^+ \pi^- \ell^+ \nu_\ell$	( 1.62 $\pm$ 0.32 ) $\times 10^{-3}$		2301
$\bar{D}^* \pi^+ \pi^- \ell^+ \nu_\ell$	( 9.4 $\pm$ 3.2 ) $\times 10^{-4}$		2247
$D_s^- \ell^+ \nu_\ell$ anything	[a] < 7 $\times 10^{-3}$	CL=90%	—
$D_s^- \ell^+ \nu_\ell K^+$ anything	[a] < 5 $\times 10^{-3}$	CL=90%	—
$D_s^- \ell^+ \nu_\ell K^0$ anything	[a] < 7 $\times 10^{-3}$	CL=90%	—
$X_c \ell^+ \nu_\ell$	( 10.65 $\pm$ 0.16 ) %		—
$X_u \ell^+ \nu_\ell$	( 2.13 $\pm$ 0.31 ) $\times 10^{-3}$		—
$K^+ \ell^+ \nu_\ell$ anything	[a] ( 6.3 $\pm$ 0.6 ) %		—
$K^- \ell^+ \nu_\ell$ anything	[a] ( 10 $\pm$ 4 ) $\times 10^{-3}$		—
$K^0 / \bar{K}^0 \ell^+ \nu_\ell$ anything	[a] ( 4.6 $\pm$ 0.5 ) %		—
$\bar{D} \tau^+ \nu_\tau$	( 9.9 $\pm$ 1.2 ) $\times 10^{-3}$		1911
$D^* \tau^+ \nu_\tau$	( 1.50 $\pm$ 0.08 ) %		1838
<b>D, D*, or D<sub>s</sub> modes</b>			
$D^\pm$ anything	( 24.1 $\pm$ 1.4 ) %		—
$D^0 / \bar{D}^0$ anything	( 62.4 $\pm$ 2.9 ) %	S=1.3	—
$D^*(2010)^\pm$ anything	( 22.5 $\pm$ 1.5 ) %		—
$D^*(2007)^0$ anything	( 26.0 $\pm$ 2.7 ) %		—
$D_s^\pm$ anything	[n] ( 8.3 $\pm$ 0.8 ) %		—
$D_s^{*\pm}$ anything	( 6.3 $\pm$ 1.0 ) %		—
$D_s^{*\pm} \bar{D}^*$	( 3.4 $\pm$ 0.6 ) %		—
$\bar{D} D_{s0}(2317)$	seen		1605
$\bar{D} D_{sJ}(2457)$	seen		—

$D^{(*)}\bar{D}^{(*)}K^0 + D^{(*)}\bar{D}^{(*)}K^\pm$	$[n,u]$	$( 7.1 \pm_{-1.7}^{2.7} )\%$		—
$b \rightarrow c\bar{c}s$		$( 22 \pm 4 )\%$		—
$D_s^{(*)}\bar{D}^{(*)}$	$[n,u]$	$( 3.9 \pm 0.4 )\%$		—
$D^*D^*(2010)^\pm$	$[n]$	$< 5.9$	$\times 10^{-3}$ CL=90%	1711
$DD^*(2010)^\pm + D^*D^\pm$	$[n]$	$< 5.5$	$\times 10^{-3}$ CL=90%	—
$DD^\pm$	$[n]$	$< 3.1$	$\times 10^{-3}$ CL=90%	1866
$D_s^{(*)\pm}\bar{D}^{(*)}X(n\pi^\pm)$	$[n,u]$	$( 9 \pm_{-4}^5 )\%$		—
$D^*(2010)\gamma$		$< 1.1$	$\times 10^{-3}$ CL=90%	2257
$D_s^+\pi^-, D_s^{*+}\pi^-, D_s^+\rho^-, D_s^{*+}\rho^-, D_s^+\pi^0, D_s^{*+}\pi^0, D_s^+\eta, D_s^{*+}\eta, D_s^+\rho^0, D_s^{*+}\rho^0, D_s^+\omega, D_s^{*+}\omega$	$[n]$	$< 4$	$\times 10^{-4}$ CL=90%	—
$D_{s1}(2536)^+$ anything		$< 9.5$	$\times 10^{-3}$ CL=90%	—

### Charmonium modes

$J/\psi(1S)$ anything		$( 1.094 \pm 0.032 )\%$	S=1.1	—
$J/\psi(1S)$ (direct) anything		$( 7.8 \pm 0.4 ) \times 10^{-3}$	S=1.1	—
$\psi(2S)$ anything		$( 3.07 \pm 0.21 ) \times 10^{-3}$		—
$\chi_{c1}(1P)$ anything		$( 3.55 \pm 0.27 ) \times 10^{-3}$	S=1.3	—
$\chi_{c1}(1P)$ (direct) anything		$( 3.08 \pm 0.19 ) \times 10^{-3}$		—
$\chi_{c2}(1P)$ anything		$( 10.0 \pm 1.7 ) \times 10^{-4}$	S=1.6	—
$\chi_{c2}(1P)$ (direct) anything		$( 7.5 \pm 1.1 ) \times 10^{-4}$		—
$\eta_c(1S)$ anything		$< 9$	$\times 10^{-3}$ CL=90%	—
$K\chi_{c1}(3872), \chi_{c1} \rightarrow D^0\bar{D}^0\pi^0$		$( 1.2 \pm 0.4 ) \times 10^{-4}$		1141
$K\chi_{c1}(3872), \chi_{c1} \rightarrow D^{*0}D^0$		$( 8.0 \pm 2.2 ) \times 10^{-5}$		1141
$KX(3940), X \rightarrow D^{*0}D^0$		$< 6.7$	$\times 10^{-5}$ CL=90%	1084
$KX(3915), X \rightarrow \omega J/\psi$	$[v]$	$( 7.1 \pm 3.4 ) \times 10^{-5}$		1103

### K or K\* modes

$K^\pm$ anything	$[n]$	$( 78.9 \pm 2.5 )\%$		—
$K^+$ anything		$( 66 \pm 5 )\%$		—
$K^-$ anything		$( 13 \pm 4 )\%$		—
$K^0/\bar{K}^0$ anything	$[n]$	$( 64 \pm 4 )\%$		—
$K^*(892)^\pm$ anything		$( 18 \pm 6 )\%$		—
$K^*(892)^0/\bar{K}^*(892)^0$ anything	$[n]$	$( 14.6 \pm 2.6 )\%$		—
$K^*(892)\gamma$		$( 4.2 \pm 0.6 ) \times 10^{-5}$		2565
$\eta K\gamma$		$( 8.5 \pm_{-1.6}^{1.8} ) \times 10^{-6}$		2588
$K_1(1400)\gamma$		$< 1.27$	$\times 10^{-4}$ CL=90%	2454
$K_2^*(1430)\gamma$		$( 1.7 \pm_{-0.5}^{0.6} ) \times 10^{-5}$		2447
$K_2(1770)\gamma$		$< 1.2$	$\times 10^{-3}$ CL=90%	2342

$K_3^*(1780)\gamma$	<	3.7	$\times 10^{-5}$	CL=90%	2341
$K_4^*(2045)\gamma$	<	1.0	$\times 10^{-3}$	CL=90%	2244
$K\eta'(958)$	(	8.3 ± 1.1	) $\times 10^{-5}$		2528
$K^*(892)\eta'(958)$	(	4.1 ± 1.1	) $\times 10^{-6}$		2472
$K\eta$	<	5.2	$\times 10^{-6}$	CL=90%	2588
$K^*(892)\eta$	(	1.8 ± 0.5	) $\times 10^{-5}$		2534
$K\phi\phi$	(	2.3 ± 0.9	) $\times 10^{-6}$		2306
$\bar{b} \rightarrow \bar{s}\gamma$	(	3.49 ± 0.19	) $\times 10^{-4}$		—
$\bar{b} \rightarrow \bar{d}\gamma$	(	9.2 ± 3.0	) $\times 10^{-6}$		—
$\bar{b} \rightarrow \bar{s}$ gluon	<	6.8	%	CL=90%	—
$\eta$ anything	(	2.6 + 0.5 - 0.8	) $\times 10^{-4}$		—
$\eta'$ anything	(	4.2 ± 0.9	) $\times 10^{-4}$		—
$K^+$ gluon (charmless)	<	1.87	$\times 10^{-4}$	CL=90%	—
$K^0$ gluon (charmless)	(	1.9 ± 0.7	) $\times 10^{-4}$		—

**Light unflavored meson modes**

$\rho\gamma$	(	1.39 ± 0.25	) $\times 10^{-6}$	S=1.2	2583
$\rho/\omega\gamma$	(	1.30 ± 0.23	) $\times 10^{-6}$	S=1.2	—
$\pi^\pm$ anything	[n,x]	( 358 ± 7 )%			—
$\pi^0$ anything	(	235 ± 11	)%		—
$\eta$ anything	(	17.6 ± 1.6	)%		—
$\rho^0$ anything	(	21 ± 5	)%		—
$\omega$ anything	<	81	%	CL=90%	—
$\phi$ anything	(	3.43 ± 0.12	)%		—
$\phi K^*(892)$	<	2.2	$\times 10^{-5}$	CL=90%	2460
$\pi^+$ gluon (charmless)	(	3.7 ± 0.8	) $\times 10^{-4}$		—

**Baryon modes**

$\Lambda_c^+ / \bar{\Lambda}_c^-$ anything	(	3.6 ± 0.4	)%		—
$\Lambda_c^+$ anything	<	1.3	%	CL=90%	—
$\bar{\Lambda}_c^-$ anything	<	7	%	CL=90%	—
$\bar{\Lambda}_c^- \ell^+$ anything	<	9	$\times 10^{-4}$	CL=90%	—
$\bar{\Lambda}_c^- e^+$ anything	<	1.8	$\times 10^{-3}$	CL=90%	—
$\bar{\Lambda}_c^- \mu^+$ anything	<	1.4	$\times 10^{-3}$	CL=90%	—
$\bar{\Lambda}_c^- p$ anything	(	2.06 ± 0.33	)%		—
$\bar{\Lambda}_c^- p e^+ \nu_e$	<	8	$\times 10^{-4}$	CL=90%	2021
$\bar{\Sigma}_c^{--}$ anything	(	3.4 ± 1.7	) $\times 10^{-3}$		—
$\bar{\Sigma}_c^-$ anything	<	8	$\times 10^{-3}$	CL=90%	—
$\bar{\Sigma}_c^0$ anything	(	3.7 ± 1.7	) $\times 10^{-3}$		—
$\bar{\Sigma}_c^0 N (N = p \text{ or } n)$	<	1.2	$\times 10^{-3}$	CL=90%	1938
$\Xi_c^0$ anything, $\Xi_c^0 \rightarrow \Xi^- \pi^+$	(	1.93 ± 0.30	) $\times 10^{-4}$	S=1.1	—
$\Xi_c^+$ , $\Xi_c^+ \rightarrow \Xi^- \pi^+ \pi^+$	(	4.5 + 1.3 - 1.2	) $\times 10^{-4}$		—



$p/\bar{p}$ anything	[ <i>n</i> ] ( 8.0 ± 0.4 ) %	—
$p/\bar{p}$ (direct) anything	[ <i>n</i> ] ( 5.5 ± 0.5 ) %	—
$\bar{p}e^+\nu_e$ anything	< 5.9 × 10 <sup>-4</sup> CL=90%	—
$\Lambda/\bar{\Lambda}$ anything	[ <i>n</i> ] ( 4.0 ± 0.5 ) %	—
$\Lambda$ anything	seen	—
$\bar{\Lambda}$ anything	seen	—
$\Xi^-/\bar{\Xi}^+$ anything	[ <i>n</i> ] ( 2.7 ± 0.6 ) × 10 <sup>-3</sup>	—
baryons anything	( 6.8 ± 0.6 ) %	—
$p\bar{p}$ anything	( 2.47 ± 0.23 ) %	—
$\Lambda\bar{\Lambda}/\bar{\Lambda}p$ anything	[ <i>n</i> ] ( 2.5 ± 0.4 ) %	—
$\Lambda\bar{\Lambda}$ anything	< 5 × 10 <sup>-3</sup> CL=90%	—

**Lepton Family number (LF) violating modes or  
ΔB = 1 weak neutral current (B1) modes**

$se^+e^-$	B1	( 6.7 ± 1.7 ) × 10 <sup>-6</sup>	S=2.0	—
$s\mu^+\mu^-$	B1	( 4.3 ± 1.0 ) × 10 <sup>-6</sup>		—
$sl^+\ell^-$	B1 [a]	( 5.8 ± 1.3 ) × 10 <sup>-6</sup>	S=1.8	—
$\pi\ell^+\ell^-$	B1	< 5.9 × 10 <sup>-8</sup>	CL=90%	2638
$\pi e^+e^-$	B1	< 1.10 × 10 <sup>-7</sup>	CL=90%	2638
$\pi\mu^+\mu^-$	B1	< 5.0 × 10 <sup>-8</sup>	CL=90%	2634
$Ke^+e^-$	B1	( 4.4 ± 0.6 ) × 10 <sup>-7</sup>		2617
$K^*(892)e^+e^-$	B1	( 1.19 ± 0.20 ) × 10 <sup>-6</sup>	S=1.2	2565
$K\mu^+\mu^-$	B1	( 4.4 ± 0.4 ) × 10 <sup>-7</sup>		2612
$K^*(892)\mu^+\mu^-$	B1	( 1.06 ± 0.09 ) × 10 <sup>-6</sup>		2560
$K\ell^+\ell^-$	B1	( 4.8 ± 0.4 ) × 10 <sup>-7</sup>		2617
$K^*(892)\ell^+\ell^-$	B1	( 1.05 ± 0.10 ) × 10 <sup>-6</sup>		2565
$K\nu\bar{\nu}$	B1	< 1.6 × 10 <sup>-5</sup>	CL=90%	2617
$K^*\nu\bar{\nu}$	B1	< 2.7 × 10 <sup>-5</sup>	CL=90%	—
$\pi\nu\bar{\nu}$	B1	< 8 × 10 <sup>-6</sup>	CL=90%	2638
$\rho\nu\bar{\nu}$	B1	< 2.8 × 10 <sup>-5</sup>	CL=90%	2583
$se^\pm\mu^\mp$	LF [n]	< 2.2 × 10 <sup>-5</sup>	CL=90%	—
$\pi e^\pm\mu^\mp$	LF	< 9.2 × 10 <sup>-8</sup>	CL=90%	2637
$\rho e^\pm\mu^\mp$	LF	< 3.2 × 10 <sup>-6</sup>	CL=90%	2582
$Ke^\pm\mu^\mp$	LF	< 3.8 × 10 <sup>-8</sup>	CL=90%	2616
$K^*(892)e^\pm\mu^\mp$	LF	< 5.1 × 10 <sup>-7</sup>	CL=90%	2563

## $B^\pm/B^0/B_s^0/b$ -baryon ADMIXTURE

These measurements are for an admixture of bottom particles at high energy (LHC, LEP, Tevatron,  $S\bar{p}\bar{p}S$ ).

$$\text{Mean life } \tau = (1.566 \pm 0.003) \times 10^{-12} \text{ s}$$

$$\text{Mean life } \tau = (1.72 \pm 0.10) \times 10^{-12} \text{ s} \quad \text{Charged } b\text{-hadron admixture}$$

$$\text{Mean life } \tau = (1.58 \pm 0.14) \times 10^{-12} \text{ s} \quad \text{Neutral } b\text{-hadron admixture}$$

$$\tau_{\text{charged } b\text{-hadron}}/\tau_{\text{neutral } b\text{-hadron}} = 1.09 \pm 0.13$$

$$|\Delta\tau_b|/\tau_{b,\bar{b}} = -0.001 \pm 0.014$$

$$\text{Re}(\epsilon_b) / (1 + |\epsilon_b|^2) = (-1.3 \pm 0.4) \times 10^{-3}$$

The branching fraction measurements are for an admixture of  $B$  mesons and baryons at energies above the  $\Upsilon(4S)$ . Only the highest energy results (LHC, LEP, Tevatron,  $S\bar{p}\bar{p}S$ ) are used in the branching fraction averages. In the following, we assume that the production fractions are the same at the LHC, LEP, and at the Tevatron.

For inclusive branching fractions, *e.g.*,  $B \rightarrow D^\pm$  anything, the values usually are multiplicities, not branching fractions. They can be greater than one.

The modes below are listed for a  $\bar{b}$  initial state.  $b$  modes are their charge conjugates. Reactions indicate the weak decay vertex and do not include mixing.

$\bar{b}$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	Scale factor/ Confidence level	$p$ (MeV/c)
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### PRODUCTION FRACTIONS

The production fractions for weakly decaying  $b$ -hadrons at high energy have been calculated from the best values of mean lives, mixing parameters, and branching fractions in this edition by the Heavy Flavor Averaging Group (HFLAV) as described in the note “ $B^0$ - $\bar{B}^0$  Mixing” in the  $B^0$  Particle Listings. The production fractions in  $b$ -hadronic  $Z$  decay or  $p\bar{p}$  collisions at the Tevatron are also listed at the end of the section. Values assume

$$B(\bar{b} \rightarrow B^+) = B(\bar{b} \rightarrow B^0)$$

$$B(\bar{b} \rightarrow B^+) + B(\bar{b} \rightarrow B^0) + B(\bar{b} \rightarrow B_s^0) + B(b \rightarrow b\text{-baryon}) = 100\%.$$

The correlation coefficients between production fractions are also reported:

$$\text{cor}(B_s^0, b\text{-baryon}) = -0.259$$

$$\text{cor}(B_s^0, B^\pm=B^0) = -0.133$$

$$\text{cor}(b\text{-baryon}, B^\pm=B^0) = -0.923.$$

The notation for production fractions varies in the literature ( $f_d$ ,  $d_{B^0}$ ,  $f(b \rightarrow \bar{B}^0)$ ,  $\text{Br}(b \rightarrow \bar{B}^0)$ ). We use our own branching fraction notation here,  $\text{B}(\bar{b} \rightarrow B^0)$ .

Note these production fractions are  $b$ -hadronization fractions, not the conventional branching fractions of  $b$ -quark to a  $B$ -hadron, which may have considerable dependence on the initial and final state kinematic and production environment.

$B^+$	( 40.5 ± 0.6 ) %	—
$B^0$	( 40.5 ± 0.6 ) %	—
$B_s^0$	( 10.1 ± 0.4 ) %	—
$b$ -baryon	( 8.9 ± 1.2 ) %	—

## DECAY MODES

### Semileptonic and leptonic modes

$\nu$ anything	( 23.1 ± 1.5 ) %	—
$\ell^+ \nu_\ell$ anything	[a] ( 10.69 ± 0.22 ) %	—
$e^+ \nu_e$ anything	( 10.86 ± 0.35 ) %	—
$\mu^+ \nu_\mu$ anything	( 10.95 <sup>+0.29</sup> <sub>-0.25</sub> ) %	—
$D^- \ell^+ \nu_\ell$ anything	[a] ( 2.30 ± 0.34 ) %	S=1.6 —
$D^- \pi^+ \ell^+ \nu_\ell$ anything	( 4.9 ± 1.9 ) × 10 <sup>-3</sup>	—
$D^- \pi^- \ell^+ \nu_\ell$ anything	( 2.6 ± 1.6 ) × 10 <sup>-3</sup>	—
$\bar{D}^0 \ell^+ \nu_\ell$ anything	[a] ( 6.83 ± 0.35 ) %	—
$\bar{D}^0 \pi^- \ell^+ \nu_\ell$ anything	( 1.07 ± 0.27 ) %	—
$\bar{D}^0 \pi^+ \ell^+ \nu_\ell$ anything	( 2.3 ± 1.6 ) × 10 <sup>-3</sup>	—
$D^{*-} \ell^+ \nu_\ell$ anything	[a] ( 2.75 ± 0.19 ) %	—
$D^{*-} \pi^- \ell^+ \nu_\ell$ anything	( 6 ± 7 ) × 10 <sup>-4</sup>	—
$D^{*-} \pi^+ \ell^+ \nu_\ell$ anything	( 4.8 ± 1.0 ) × 10 <sup>-3</sup>	—
$\bar{D}_j^0 \ell^+ \nu_\ell$ anything × B( $\bar{D}_j^0 \rightarrow D^{*+} \pi^-$ )	[a,y] ( 2.6 ± 0.9 ) × 10 <sup>-3</sup>	—
$D_j^- \ell^+ \nu_\ell$ anything × B( $D_j^- \rightarrow D^0 \pi^-$ )	[a,y] ( 7.0 ± 2.3 ) × 10 <sup>-3</sup>	—
$\bar{D}_2^*(2460)^0 \ell^+ \nu_\ell$ anything × B( $\bar{D}_2^*(2460)^0 \rightarrow$ $D^{*-} \pi^+$ )	< 1.4 × 10 <sup>-3</sup> CL=90%	—
$D_2^*(2460)^- \ell^+ \nu_\ell$ anything × B( $D_2^*(2460)^- \rightarrow$ $D^0 \pi^-$ )	( 4.2 <sup>+1.5</sup> <sub>-1.8</sub> ) × 10 <sup>-3</sup>	—
$\bar{D}_2^*(2460)^0 \ell^+ \nu_\ell$ anything × B( $\bar{D}_2^*(2460)^0 \rightarrow$ $D^- \pi^+$ )	( 1.6 ± 0.8 ) × 10 <sup>-3</sup>	—

charmless $\ell\bar{\nu}_\ell$	[a]	( 1.7 ± 0.5 ) × 10 <sup>-3</sup>	—
$\tau^+ \nu_\tau$ anything		( 2.41 ± 0.23 ) %	—
$D^{*-} \tau \nu_\tau$ anything		( 9 ± 4 ) × 10 <sup>-3</sup>	—
$\bar{c} \rightarrow \ell^- \bar{\nu}_\ell$ anything	[a]	( 8.02 ± 0.19 ) %	—
$c \rightarrow \ell^+ \nu$ anything		( 1.6 $\begin{smallmatrix} + \\ - \end{smallmatrix}$ 0.4 / 0.5 ) %	—

### Charmed meson and baryon modes

$\bar{D}^0$ anything		( 59.5 ± 2.9 ) %	—
$D^0 D_s^\pm$ anything	[n]	( 9.1 $\begin{smallmatrix} + \\ - \end{smallmatrix}$ 4.0 / 2.8 ) %	—
$D^\mp D_s^\pm$ anything	[n]	( 4.0 $\begin{smallmatrix} + \\ - \end{smallmatrix}$ 2.3 / 1.8 ) %	—
$\bar{D}^0 D^0$ anything	[n]	( 5.1 $\begin{smallmatrix} + \\ - \end{smallmatrix}$ 2.0 / 1.8 ) %	—
$D^0 D^\pm$ anything	[n]	( 2.7 $\begin{smallmatrix} + \\ - \end{smallmatrix}$ 1.8 / 1.6 ) %	—
$D^\pm D^\mp$ anything	[n]	< 9 × 10 <sup>-3</sup> CL=90%	—
$D^-$ anything		( 23.7 ± 1.8 ) %	—
$D^*(2010)^+$ anything		( 17.3 ± 2.0 ) %	—
$D_1(2420)^0$ anything		( 5.0 ± 1.5 ) %	—
$D^*(2010)^\mp D_s^\pm$ anything	[n]	( 3.3 $\begin{smallmatrix} + \\ - \end{smallmatrix}$ 1.6 / 1.3 ) %	—
$D^0 D^*(2010)^\pm$ anything	[n]	( 3.0 $\begin{smallmatrix} + \\ - \end{smallmatrix}$ 1.1 / 0.9 ) %	—
$D^*(2010)^\pm D^\mp$ anything	[n]	( 2.5 $\begin{smallmatrix} + \\ - \end{smallmatrix}$ 1.2 / 1.0 ) %	—
$D^*(2010)^\pm D^*(2010)^\mp$ anything	[n]	( 1.2 ± 0.4 ) %	—
$\bar{D} D$ anything		( 10 $\begin{smallmatrix} + \\ - \end{smallmatrix}$ 11 / 10 ) %	—
$D_2^*(2460)^0$ anything		( 4.7 ± 2.7 ) %	—
$D_s^-$ anything		( 14.7 ± 2.1 ) %	—
$D_s^+$ anything		( 10.1 ± 3.1 ) %	—
$\Lambda_c^+$ anything		( 7.8 ± 1.2 ) %	—
$\bar{c}/c$ anything	[x]	(116.2 ± 3.2) %	—

### Charmonium modes

$J/\psi(1S)$ anything		( 1.16 ± 0.10 ) %	—
$\psi(2S)$ anything		( 2.86 ± 0.28 ) × 10 <sup>-3</sup>	—
$\chi_{c0}(1P)$ anything		( 1.5 ± 0.6 ) %	—
$\chi_{c1}(1P)$ anything		( 1.4 ± 0.4 ) %	—
$\chi_{c2}(1P)$ anything		( 6.2 ± 2.9 ) × 10 <sup>-3</sup>	—
$\chi_c(2P)$ anything, $\chi_c \rightarrow \phi\phi$	<	2.8 × 10 <sup>-7</sup> CL=95%	—
$\eta_c(1S)$ anything		( 4.5 ± 1.9 ) %	—
$\eta_c(2S)$ anything, $\eta_c \rightarrow \phi\phi$		( 3.2 ± 1.7 ) × 10 <sup>-6</sup>	—
$\chi_{c1}(3872)$ anything, $\chi_{c1} \rightarrow \phi\phi$	<	4.5 × 10 <sup>-7</sup> CL=95%	—
$X(3915)$ anything, $X \rightarrow \phi\phi$	<	3.1 × 10 <sup>-7</sup> CL=95%	—

**K or K\* modes**

$\bar{S}\gamma$		$( 3.1 \pm 1.1 ) \times 10^{-4}$	—
$\bar{S}\nu\nu$	<i>B1</i>	$< 6.4 \times 10^{-4}$	CL=90% —
$K^\pm$ anything		$( 74 \pm 6 ) \%$	—
$K_S^0$ anything		$( 29.0 \pm 2.9 ) \%$	—

**Pion modes**

$\pi^\pm$ anything		$( 397 \pm 21 ) \%$	—
$\pi^0$ anything	[x]	$( 278 \pm 60 ) \%$	—
$\phi$ anything		$( 2.82 \pm 0.23 ) \%$	—

**Baryon modes**

$p/\bar{p}$ anything		$( 13.1 \pm 1.1 ) \%$	—
$\Lambda/\bar{\Lambda}$ anything		$( 5.9 \pm 0.6 ) \%$	—
<i>b</i> -baryon anything		$( 10.2 \pm 2.8 ) \%$	—

**Other modes**

charged anything	[x]	$( 497 \pm 7 ) \%$	—
hadron <sup>+</sup> hadron <sup>-</sup>		$( 1.7 \begin{smallmatrix} + 1.0 \\ - 0.7 \end{smallmatrix} ) \times 10^{-5}$	—
charmless		$( 7 \pm 21 ) \times 10^{-3}$	—

**$\Delta B = 1$  weak neutral current (*B1*) modes**

$\mu^+ \mu^-$ anything	<i>B1</i>	$< 3.2 \times 10^{-4}$	CL=90% —
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**$B^*$**

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

*I, J, P* need confirmation. Quantum numbers shown are quark-model predictions.

$$\text{Mass } m_{B^*} = 5324.65 \pm 0.25 \text{ MeV}$$

$$m_{B^*} - m_B = 45.18 \pm 0.23 \text{ MeV}$$

$$m_{B^{*+}} - m_{B^+} = 45.34 \pm 0.23 \text{ MeV}$$

***B\** DECAY MODES**

	Fraction ( $\Gamma_i/\Gamma$ )	<i>p</i> (MeV/c)
<i>B</i> $\gamma$	dominant	45

**$B_1(5721)^+$**

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

*I, J, P* need confirmation.

$$\text{Mass } m = 5725.9^{+2.5}_{-2.7} \text{ MeV}$$

$$m_{B_1^+} - m_{B^{*0}} = 401.2^{+2.4}_{-2.7} \text{ MeV}$$

$$\text{Full width } \Gamma = 31 \pm 6 \text{ MeV} \quad (S = 1.1)$$

<b><math>B_1(5721)^+</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$B^{*0} \pi^+$	seen	363

 **$B_1(5721)^0$** 

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

$I, J, P$  need confirmation.

$$B_1(5721)^0 \text{ MASS} = 5726.0 \pm 1.3 \text{ MeV} \quad (S = 1.2)$$

$$m_{B_1^0} - m_{B^+} = 446.7 \pm 1.3 \text{ MeV} \quad (S = 1.2)$$

$$m_{B_1^0} - m_{B^{*+}} = 401.4 \pm 1.2 \text{ MeV} \quad (S = 1.2)$$

$$\text{Full width } \Gamma = 27.5 \pm 3.4 \text{ MeV} \quad (S = 1.1)$$

<b><math>B_1(5721)^0</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$B^{*+} \pi^-$	dominant	363

 **$B_2^*(5747)^+$** 

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

$I, J, P$  need confirmation.

$$\text{Mass } m = 5737.2 \pm 0.7 \text{ MeV}$$

$$m_{B_2^{*+}} - m_{B^0} = 457.5 \pm 0.7 \text{ MeV}$$

$$\text{Full width } \Gamma = 20 \pm 5 \text{ MeV} \quad (S = 2.2)$$

<b><math>B_2^*(5747)^+</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$B^0 \pi^+$	seen	418
$B^{*0} \pi^+$	seen	374

 **$B_2^*(5747)^0$** 

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

$I, J, P$  need confirmation.

$$B_2^*(5747)^0 \text{ MASS} = 5739.5 \pm 0.7 \text{ MeV} \quad (S = 1.4)$$

$$m_{B_2^{*0}} - m_{B_1^0} = 13.5 \pm 1.4 \text{ MeV} \quad (S = 1.3)$$

$$m_{B_2^{*0}} - m_{B^+} = 460.2 \pm 0.6 \text{ MeV} \quad (S = 1.4)$$

$$\text{Full width } \Gamma = 24.2 \pm 1.7 \text{ MeV}$$

<b><math>B_2^*(5747)^0</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$B^+ \pi^-$	dominant	421
$B^{*+} \pi^-$	dominant	377

**$B_J(5970)^+$**

$I(J^P) = \frac{1}{2}(??)$   
 $I, J, P$  need confirmation.

Mass  $m = 5964 \pm 5$  MeV  
 $m_{B_J(5970)^+} - m_{B^0} = 685 \pm 5$  MeV  
 Full width  $\Gamma = 62 \pm 20$  MeV

<b><math>B_J(5970)^+</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$B^0 \pi^+$	possibly seen	632
$B^{*0} \pi^+$	seen	591

**$B_J(5970)^0$**

$I(J^P) = \frac{1}{2}(??)$   
 $I, J, P$  need confirmation.

Mass  $m = 5971 \pm 5$  MeV  
 $m_{B_J(5970)^0} - m_{B^+} = 691 \pm 5$  MeV  
 Full width  $\Gamma = 81 \pm 12$  MeV

<b><math>B_J(5970)^0</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$B^+ \pi^-$	possibly seen	638
$B^{*+} \pi^-$	seen	597

NOTES

- [a] An  $\ell$  indicates an  $e$  or a  $\mu$  mode, not a sum over these modes.
- [b] An  $CP(\pm 1)$  indicates the  $CP=+1$  and  $CP=-1$  eigenstates of the  $D^0-\bar{D}^0$  system.
- [c]  $D$  denotes  $D^0$  or  $\bar{D}^0$ .
- [d]  $D_{CP+}^{*0}$  decays into  $D^0 \pi^0$  with the  $D^0$  reconstructed in  $CP$ -even eigenstates  $K^+ K^-$  and  $\pi^+ \pi^-$ .
- [e]  $\bar{D}^{**}$  represents an excited state with mass  $2.2 < M < 2.8$  GeV/c<sup>2</sup>.
- [f]  $\chi_{c1}(3872)^+$  is a hypothetical charged partner of the  $\chi_{c1}(3872)$ .
- [g]  $\Theta(1710)^{++}$  is a possible narrow pentaquark state and  $G(2220)$  is a possible glueball resonance.
- [h]  $(\bar{\Lambda}_c^- p)_s$  denotes a low-mass enhancement near 3.35 GeV/c<sup>2</sup>.
- [i] Stands for the possible candidates of  $K^*(1410)$ ,  $K_0^*(1430)$  and  $K_2^*(1430)$ .
- [j]  $B^0$  and  $B_s^0$  contributions not separated. Limit is on weighted average of the two decay rates.

- [k] This decay refers to the coherent sum of resonant and nonresonant  $J^P = 0^+ K\pi$  components with  $1.60 < m_{K\pi} < 2.15 \text{ GeV}/c^2$ .
- [l]  $X(214)$  is a hypothetical particle of mass  $214 \text{ MeV}/c^2$  reported by the HyperCP experiment, Physical Review Letters **94** 021801 (2005)
- [n] The value is for the sum of the charge states or particle/antiparticle states indicated.
- [o]  $\Theta(1540)^+$  denotes a possible narrow pentaquark state.
- [p] Here  $S$  and  $P$  are the hypothetical scalar and pseudoscalar particles with masses of  $2.5 \text{ GeV}/c^2$  and  $214.3 \text{ MeV}/c^2$ , respectively.
- [q] These values are model dependent.
- [r] Here “anything” means at least one particle observed.
- [s] This is a  $B(B^0 \rightarrow D^{*-} \ell^+ \nu_\ell)$  value.
- [t]  $D^{**}$  stands for the sum of the  $D(1^1P_1)$ ,  $D(1^3P_0)$ ,  $D(1^3P_1)$ ,  $D(1^3P_2)$ ,  $D(2^1S_0)$ , and  $D(2^1S_1)$  resonances.
- [u]  $D^{(*)}\bar{D}^{(*)}$  stands for the sum of  $D^*\bar{D}^*$ ,  $D^*\bar{D}$ ,  $D\bar{D}^*$ , and  $D\bar{D}$ .
- [v]  $X(3915)$  denotes a near-threshold enhancement in the  $\omega J/\psi$  mass spectrum.
- [x] Inclusive branching fractions have a multiplicity definition and can be greater than 100%.
- [y]  $D_j$  represents an unresolved mixture of pseudoscalar and tensor  $D^{**}$  ( $P$ -wave) states.