# BOTTOM, STRANGE MESONS ($B = \pm 1$, $S = \mp 1$)

$B_s^0 = s\overline{b}$, $\overline{B}_s^0 = \overline{s}\,b$, similarly for $B_s^*$'s

## $B_s^0$

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

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

Mass $m_{B_s^0} = 5366.3 \pm 0.6$ MeV (S = 1.1)

Mean life $\tau = (1.472^{+0.024}_{-0.026}) \times 10^{-12}$ s

$c\tau = 441\ \mu$m

### $B_s^0$-$\overline{B}_s^0$ mixing parameters

$\Delta m_{B_s^0} = m_{B_{sH}^0} - m_{B_{sL}^0} = (17.77 \pm 0.12) \times 10^{12}\ \hbar\ \text{s}^{-1}$

$= (117.0 \pm 0.8) \times 10^{-10}$ MeV

$x_s = \Delta m_{B_s^0}/\Gamma_{B_s^0} = 26.2 \pm 0.5$

$\chi_s = 0.49927 \pm 0.00003$

### CP violation parameters in $B_s^0$

$\text{Re}(\epsilon_{B_s^0})\ /\ (1 + |\epsilon_{B_s^0}|^2) = (-0.92 \pm 2.35) \times 10^{-3}$

*CP* Violation phase $\beta_s = 0.47^{+0.13}_{-0.21}$ or $1.09^{+0.21}_{-0.13}$

These branching fractions all scale with B($\overline{b} \rightarrow B_s^0$), the LEP $B_s^0$ production fraction. The first four were evaluated using B($\overline{b} \rightarrow B_s^0$) = (10.7 ± 1.2)% and the rest assume B($\overline{b} \rightarrow B_s^0$) = 12%.

The branching fraction B($B_s^0 \rightarrow D_s^- \ell^+ \nu_\ell$ anything) is not a pure measurement since the measured product branching fraction B($\overline{b} \rightarrow B_s^0$) × B($B_s^0 \rightarrow D_s^- \ell^+ \nu_\ell$ anything) was used to determine B($\overline{b} \rightarrow B_s^0$), as described in the note on "$B^0$-$\overline{B}^0$ Mixing"

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.

| $B_s^0$ DECAY MODES | | Fraction ($\Gamma_i/\Gamma$) | Confidence level | $p$ (MeV/$c$) |
|---|---|---|---|---|
| $D_s^-$ anything | | (93 ±25 ) % | | – |
| $D_s^- \ell^+ \nu_\ell$ anything | [a] | ( 7.9 ± 2.4) % | | – |
| $D_{s1}(2536)^- \mu^+ \nu_\mu X \times$ B($D_{s1}^- \rightarrow D^{*-} K_S^0$) | | ( 2.3 ± 0.7) × $10^{-3}$ | | – |
| $D_s^- \pi^+$ | | ( 3.3 ± 0.5) × $10^{-3}$ | | 2320 |
| $D_s^- \pi^+ \pi^+ \pi^-$ | | ( 8.4 ± 3.3) × $10^{-3}$ | | 2301 |
| $D_s^- K^+$ | | ( 2.4 $^{+\ 1.3}_{-\ 1.1}$) × $10^{-4}$ | | 2292 |
| $D_s^+ D_s^-$ | | ( 1.1 ± 0.4) % | | 1823 |
| $D_s^{*+} D_s^-$ | | < 12.1 % | 90% | 1742 |
| $D_s^{*+} D_s^{*-}$ | | < 25.7 % | 90% | 1655 |
| $D_s^{(*)+} D_s^{(*)-}$ | | ( 3.9 ± 1.5) % | | – |
| $J/\psi(1S)\phi$ | | ( 1.3 ± 0.4) × $10^{-3}$ | | 1587 |
| $J/\psi(1S)\pi^0$ | | < 1.2 × $10^{-3}$ | 90% | 1786 |
| $J/\psi(1S)\eta$ | | < 3.8 × $10^{-3}$ | 90% | 1733 |
| $\psi(2S)\phi$ | | ( 6.8 ± 3.0) × $10^{-4}$ | | 1119 |
| $\pi^+ \pi^-$ | | < 1.7 × $10^{-6}$ | 90% | 2680 |
| $\pi^0 \pi^0$ | | < 2.1 × $10^{-4}$ | 90% | 2680 |
| $\eta \pi^0$ | | < 1.0 × $10^{-3}$ | 90% | 2653 |
| $\eta\eta$ | | < 1.5 × $10^{-3}$ | 90% | 2627 |
| $\rho^0 \rho^0$ | | < 3.20 × $10^{-4}$ | 90% | 2569 |
| $\phi \rho^0$ | | < 6.17 × $10^{-4}$ | 90% | 2526 |
| $\phi\phi$ | | ( 1.4 ± 0.8) × $10^{-5}$ | | 2482 |
| $\pi^+ K^-$ | | < 5.6 × $10^{-6}$ | 90% | 2659 |
| $K^+ K^-$ | | ( 3.3 ± 0.9) × $10^{-5}$ | | 2637 |
| $\overline{K}^*(892)^0 \rho^0$ | | < 7.67 × $10^{-4}$ | 90% | 2550 |
| $\overline{K}^*(892)^0 K^*(892)^0$ | | < 1.681 × $10^{-3}$ | 90% | 2531 |
| $\phi K^*(892)^0$ | | < 1.013 × $10^{-3}$ | 90% | 2507 |

| | | | | | |
|---|---|---|---|---|---|
| $p\overline{p}$ | | $<$ 5.9 | $\times 10^{-5}$ | 90% | 2514 |
| $\gamma\gamma$ | *B1* | $<$ 8.7 | $\times 10^{-6}$ | 90% | 2683 |
| $\phi\gamma$ | | ( 5.7 $^{+\ 2.2}_{-\ 1.9}$ ) | $\times 10^{-5}$ | | 2586 |

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

| | | | | | |
|---|---|---|---|---|---|
| $\mu^+\mu^-$ | *B1* | $<$ 4.7 | $\times 10^{-8}$ | 90% | 2681 |
| $e^+e^-$ | *B1* | $<$ 5.4 | $\times 10^{-5}$ | 90% | 2683 |
| $e^\pm\mu^\mp$ | *LF* | [*b*] $<$ 6.1 | $\times 10^{-6}$ | 90% | 2682 |
| $\phi(1020)\mu^+\mu^-$ | *B1* | $<$ 3.2 | $\times 10^{-6}$ | 90% | 2582 |
| $\phi\nu\overline{\nu}$ | *B1* | $<$ 5.4 | $\times 10^{-3}$ | 90% | 2586 |

## $B_s^*$

$I(J^P) = 0(1^-)$

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

Mass $m = 5415.4 \pm 1.4$ MeV (S = 2.5)
$m_{B_s^*} - m_{B_s} = 49.0 \pm 1.5$ MeV (S = 2.0)

| $B_s^*$ DECAY MODES | Fraction ($\Gamma_i/\Gamma$) | *p* (MeV/*c*) |
|---|---|---|
| $B_s\gamma$ | dominant | – |

## $B_{s1}(5830)^0$

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

Mass $m = 5829.4 \pm 0.7$ MeV
$m_{B_{s1}^0} - m_{B^{*+}} = 504.41 \pm 0.25$ MeV

| $B_{s1}(5830)^0$ DECAY MODES | Fraction ($\Gamma_i/\Gamma$) | *p* (MeV/*c*) |
|---|---|---|
| $B^{*+}K^-$ | dominant | – |

## $B_{s2}^*(5840)^0$

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

Mass $m = 5839.7 \pm 0.6$ MeV
$m_{B_{s2}^{*0}} - m_{B_{s1}^0} = 10.5 \pm 0.6$ MeV

| $B_{s2}^*(5840)^0$ DECAY MODES | Fraction ($\Gamma_i/\Gamma$) | *p* (MeV/*c*) |
|---|---|---|
| $B^+K^-$ | dominant | 252 |

## NOTES

[*a*] Not a pure measurement. See note at head of $B_s^0$ Decay Modes.

[*b*] The value is for the sum of the charge states or particle/antiparticle states indicated.