b-hadron decays to charmless final states

This section provides branching fractions (BF), polarization fractions, CP asymmetries (A_{CP}) and other observables of b-hadron decays to final states that do not contain charm hadrons or charmonium mesons[1], except for a few lepton-flavour- and lepton-number-violating decays reported in Sec. 0.6.

Four categories of B^0 and B^+ decays are reported: mesonic (*i.e.*, final states containing only mesons), baryonic (hadronic final states with baryon-antibaryon pairs), radiative (including a photon or a lepton-antilepton pair) and semileptonic/leptonic (including/only leptons). We also report measurements of B_s^0, B_c^+ and b-baryon decays, and measurements of final-state polarization in b-hadron decays. Measurements included in our averages are those supported with public notes, including journal papers, conference-contributed papers, preprints or conference proceedings, except when a result has not led to a journal publication after an extended period of time.

The averaging procedure follows the methodology described in Sec. 3 of the latest HFLAV publication. We perform fits of the full likelihood function and do not use the approximation described in Sec. 3.1. Thus, observables that are related to each other, e.g., by ratios of branching fractions, are fitted jointly. Details about all the observables involved in each average, as well as the induced correlation coefficients and p-values, are available via clickable links from each average in the tables on our web page [1][2]. In total 418 fits are performed, with on average (maximally) 1.2 (47) parameters and 4.6 (22) measurements per fit. In our tables, each group of rows contains the individual measurements and the average corresponding to a given parameter p_j. The cases where the fits incorporate measurements that are functions of p_j, which are used as direct inputs to the fits, are indicated with a footnote. In general, a value of p_j is not quoted in the tables. There are two exceptions to this: a ratio of branching fractions, p_j/p_k, where p_k is the branching fraction of a normalization mode, and a product, $p_j p_k$ of the branching fraction of interest with that of a daughter decay. In these two cases the numerical value of p_j, naively obtained using the known value of p_k, is quoted in the tables for reference, and the uncertainty on p_k is included in the systematic uncertainty on p_j.

Systematic uncertainties are taken as quoted in the original publications, without the scaling of multiplicative uncertainties discussed in Sec. 3.3 of the latest HFLAV publication. When several systematic uncertainties are given separately, we sum them in quadrature and quote a single systematic uncertainty. These cases are marked by a footnote.

If one or more experiments report a BF measurement with a significance of more than three standard deviations (σ), all available central values for that BF are used in our average. For BFs that do not satisfy this criterion, the most stringent limit is used. Quoted upper limits are at 90% confidence level (C.L.), unless mentioned otherwise. For observables that are not

[1]The treatment of intermediate charm or charmonium states differs between observables and sometimes among results for the same observable. In the latter case, when these results are averaged, we indicate the differences by footnotes.

[2]Where available, other sources of correlations between measurements of the same observable and among different observables are also taken into account.

BFs, such as A_{CP} or polarization fractions, we include in our averages all the available results, regardless of their significance.

Many of the branching fractions from *BABAR* and Belle assume equal production of charged and neutral B-meson pairs. The best measurements to date show that this is still a reasonable approximation (see Sec. 4 of the latest HFLAV publication), and thus, we do not correct for it and simply quote the results from the original publications.

At the end of some of the sections, we list results that were not included in the tables. Typical cases are measurements of distributions, such as differential branching fractions or longitudinal polarizations, which are measured in different binning schemes by the different collaborations, and thus cannot be directly used to obtain averages.

Observables obtained by Dalitz-plot analyses are marked by footnotes. In these analyses, different experimental collaborations often use different models, in particular for the nonresonant component. When applicable, we detail the model used for the nonresonant component in a footnote. In addition to this, Dalitz-plot analyses often yield multiple solutions. In this case, we take the results corresponding to the global minimum and follow the conclusions of the papers.

In most of the tables, the averages are compared to those from the PDG 2025 updates [2]. When this is done, the "Average" column quotes the PDG averages (In gray) only if they differ from ours. In general, such differences are due to different input parameters, differences in the averaging methods and different rounding conventions. Unlike the PDG, no error scaling is applied in our averages when the fit χ^2 is greater than 1. On the other hand, the fit p-value is quoted if it is below 1%. Input values that are not included in the PDG 2025 average are marked in red. These are new results published since the closing of PDG 2025 and before finalizing of this report in July 2025. Input values that were unpublished at this time (unpublished results are never included in the PDG averages) are marked in blue. Sections 0.1 and 0.2 provide compilations of branching fractions of B^0 and B^+ to mesonic and baryonic charmless final states, respectively. Sections 0.3 and 0.4 and 0.5 give branching fractions of b-baryon, B_s^0-meson, and B_c^+ meson decays to charmless final states, respectively [3]. In Sec. 0.6 observables of interest are given for radiative decays and FCNC) decays with leptons of B^0 and B^+ mesons, including limits from searches for lepton-flavour/number-violating decays. Finally, sections 0.7 and 0.8 give CP asymmetries and results of polarization measurements, respectively, in various b-hadron charmless decays.

[3]Except for decays of B_c^+ mesons to final states containing B_s^0 mesons, which are quoted in Sec. 7.5 of the latest HFLAV publication.

0.1 Mesonic decays of B^+ and B^0 mesons

This section provides branching fractions of charmless mesonic decays. Tables 1 to 13 are for B^+ and Tables 14 to 28 are for B^0 mesons. For both, decay modes with and without strange mesons in the final state appear in different tables. Finally, Tables 29 and 30 detail several relative branching fractions of B^+ and B^0 decays, respectively. Figure 1 gives a graphic representation of a selection of high-precision branching fractions given in this section.

Table 1: Branching fractions of charmless mesonic B^+ decays with strange mesons (part 1).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^+ \to K^0\pi^+)$[1]	Belle [3]	$23.97 \pm 0.53 \pm 0.71$	23.9 ± 0.6
	Belle II [4]	$24.4 \pm 0.7 \pm 0.9$	
	BaBar [5]	$23.9 \pm 1.1 \pm 1.0$	
	CLEO [6]	$18.8\,^{+3.7\,+2.1}_{-3.3\,-1.8}$	
	LHCb [7][2]		
$\mathcal{B}(B^+ \to K^+\pi^0)$	Belle [3]	$12.62 \pm 0.31 \pm 0.56$	13.2 ± 0.4
	Belle II [4]	$13.9 \pm 0.4 \pm 0.7$	
	BaBar [8]	$13.6 \pm 0.6 \pm 0.7$	
	CLEO [6]	$12.9\,^{+2.4\,+1.2}_{-2.2\,-1.1}$	
$\mathcal{B}(B^+ \to \eta' K^+)$	BaBar [9]	$71.5 \pm 1.3 \pm 3.2$	70.5 ± 2.6
	Belle [10]	$69.2 \pm 2.2 \pm 3.7$	70.4 ± 2.5
	Belle [11]	$61\,^{+10}_{-8} \pm 1$	
	CLEO [12]	$80\,^{+10}_{-9} \pm 7$	
	LHCb [13][3]		
$\mathcal{B}(B^+ \to \eta' K^*(892)^+)$	BaBar [14]	$4.8\,^{+1.6}_{-1.4} \pm 0.8$	$4.8\,^{+1.8}_{-1.6}$
	Belle [15]	< 2.9	
$\mathcal{B}(B^+ \to \eta'(K\pi)^{*+}_0)$	BaBar [14]	$6.0\,^{+2.2}_{-2.0} \pm 0.9$	6.0 ± 2.3 none
$\mathcal{B}(B^+ \to \eta' K^*_0(1430)^+)$	BaBar [14][4]	$5.2 \pm 1.9 \pm 1.0$	5.2 ± 2.1
$\mathcal{B}(B^+ \to \eta' K^*_2(1430)^+)$	BaBar [14]	$28.0\,^{+4.6}_{-4.3} \pm 2.6$	28.0 ± 5.2 $28.0\,^{+5.3}_{-5.0}$

[1] The PDG average is a result of a fit including input from other measurements.
[2] Measurement of $\mathcal{B}(B^+ \to K^+\overline{K}^0)/\mathcal{B}(B^+ \to K^0\pi^+)$ used in our fit.
[3] Measurement of $\mathcal{B}(B^0_s \to \eta'\eta')/\mathcal{B}(B^+ \to \eta' K^+)$ used in our fit.
[4] Multiple systematic uncertainties are added in quadrature.

Table 2: Branching fractions of charmless mesonic B^+ decays with strange mesons (part 2).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^+ \to \eta K^+)$[1]	Belle [16]	$2.12 \pm 0.23 \pm 0.11$	2.36 ± 0.21
	BaBar [9]	$2.94^{+0.39}_{-0.34} \pm 0.21$	$2.36^{+0.38}_{-0.37}$
	CLEO [12]	$2.2^{+2.8}_{-2.2}$	
$\mathcal{B}(B^+ \to \eta K^*(892)^+)$	BaBar [17]	$18.9 \pm 1.8 \pm 1.3$	19.2 ± 1.3
	Belle [18]	$19.3^{+2.0}_{-1.9} \pm 1.5$	19.3 ± 1.6
	CLEO [12]	$26.4^{+9.6}_{-8.2} \pm 3.3$	
$\mathcal{B}(B^+ \to \eta(K\pi)_0^{*+})$	BaBar [17]	$18.2 \pm 2.6 \pm 2.6$	18.2 ± 2.6
			none
$\mathcal{B}(B^+ \to \eta K_0^*(1430)^+)$[2]	BaBar [17][3]	$12.9 \pm 1.8 \pm 1.8$	12.9 ± 1.8
			18.2 ± 3.7
$\mathcal{B}(B^+ \to \eta K_2^*(1430)^+)$	BaBar [17]	$9.1 \pm 2.7 \pm 1.4$	9.1 ± 2.2
			9.1 ± 3.0
$\mathcal{B}(B^+ \to \eta(1295)K^+) \times \mathcal{B}(\eta(1295) \to \eta\pi\pi)$	BaBar [19]	$2.9^{+0.8}_{-0.7} \pm 0.2$	$2.9^{+0.8}_{-0.7}$
$\mathcal{B}(B^+ \to \eta(1405)K^+) \times \mathcal{B}(\eta(1405) \to \eta\pi\pi)$	BaBar [19]	< 1.3	< 1.3
$\mathcal{B}(B^+ \to \eta(1405)K^+) \times \mathcal{B}(\eta(1405) \to K^*\overline{K})$	LHCb [20][4]	$3.8 \pm 0.5 \pm 0.9$	3.8 ± 1.0
	BaBar [19]	< 1.2	< 1.2
$\mathcal{B}(B^+ \to \eta(1405)K^+) \times \mathcal{B}(\eta(1405) \to K^0K\pi)$			
	LHCb [20][4]	$8.0 \pm 0.5 \pm 1.0$	8.0 ± 1.1
			none
$\mathcal{B}(B^+ \to \eta(1475)K^+) \times \mathcal{B}(\eta(1475) \to K^*\overline{K})$			
	LHCb [20][4]	$14.5 \pm 1.1 \pm 1.5$	14.2 ± 1.4
	BaBar [19]	$13.8^{+1.8\,+1.0}_{-1.7\,-0.6}$	$13.8^{+2.1}_{-1.8}$
$\mathcal{B}(B^+ \to \eta(1475)K^+) \times \mathcal{B}(\eta(1475) \to a_0(980)\pi)$			
	LHCb [20][4]	$2.2 \pm 0.4 \pm 0.3$	2.20 ± 0.50
			none
$\mathcal{B}(B^+ \to \eta(1475)K^+) \times \mathcal{B}(\eta(1475) \to K^0K\pi)$			
	LHCb [20][4]	$15.1 \pm 1.6 \pm 2.6$	15.1 ± 3.1
			none

[1] The PDG uncertainty includes a scale factor.
[2] The PDG entry corresponds to $\mathcal{B}(B^+ \to \eta(K\pi)_0^{*+})$.
[3] Multiple systematic uncertainties are added in quadrature.
[4] Extracted from an amplitude analysis of the $K_S^0K^\pm\pi^\mp$ spectrum in $B^+ \to K_S^0K^\pm\pi^\mp K^+$ decays, in the mass region $m(K_S^0K^\pm\pi^\mp) < 1.85$ GeV.

Table 3: Branching fractions of charmless mesonic B^+ decays with strange mesons (part 3).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^+ \to \eta(1760)K^+) \times \mathcal{B}(\eta(1760) \to K^*\overline{K})$			
	LHCb [20][1]	$3.4 \pm 0.4 \pm 0.4$	3.40 ± 0.57
			none
$\mathcal{B}(B^+ \to \eta(1760)K^+) \times \mathcal{B}(\eta(1760) \to a_0(980)\pi)$			
	LHCb [20][2]	$2.6 \pm 0.4 \pm 0.3$	2.60 ± 0.50
			none
$\mathcal{B}(B^+ \to \eta(1760)K^+) \times \mathcal{B}(\eta(1760) \to K^0K\pi)$			
	LHCb [20][1]	$22.1 \pm 2.0 \pm 3.5$	22.1 ± 4.0
			none
$\mathcal{B}(B^+ \to \eta_2(1645)K^+) \times \mathcal{B}(\eta_2(1645) \to K^*\overline{K})$			
	LHCb [20][1]	$1.5 \pm 0.2 \pm 0.2$	1.50 ± 0.28
			none
$\mathcal{B}(B^+ \to f_1(1285)K^+) \times \mathcal{B}(f_1(1285) \to \eta\pi\pi)$	BaBar [19]	< 0.8	< 0.80
			none
$\mathcal{B}(B^+ \to f_1(1285)K^+) \times \mathcal{B}(f_1(1285) \to a_0(980)\pi)$			
	LHCb [20][1]	$2.8 \pm 0.2 \pm 0.3$	2.80 ± 0.36
			none
$\mathcal{B}(B^+ \to f_1(1420)K^+) \times \mathcal{B}(f_1(1420) \to \eta\pi\pi)$	BaBar [19]	< 2.9	< 2.9
$\mathcal{B}(B^+ \to f_1(1420)K^+) \times \mathcal{B}(f_1(1420) \to K^*\overline{K})$			
	LHCb [20][1]	$11.4 \pm 0.6 \pm 2.0$	11.4 ± 2.1
	BaBar [19]	< 4.1	< 4.1
$\mathcal{B}(B^+ \to f_1(1510)K^+) \times \mathcal{B}(f_1(1510) \to K^*\overline{K})$			
	LHCb [20][1]	$3.8 \pm 0.3 \pm 1.5$	3.8 ± 1.5
			none
$\mathcal{B}(B^+ \to \phi(1680)K^+) \times \mathcal{B}(\phi(1680) \to K^*\overline{K})$	BaBar [19]	< 3.4	< 3.4
$\mathcal{B}(B^+ \to f_0(1500)K^+)$	BaBar [21][3]	$17 \pm 4 \pm 12$	17 ± 12
	BaBar [21][4]	$20 \pm 10 \pm 27$	4 ± 2
$\mathcal{B}(B^+ \to h_1(1415)K^+) \times \mathcal{B}(h_1(1415) \to K^*\overline{K})$			
	LHCb [20][1]	$22.2 \pm 1.0 \pm 2.5$	22.2 ± 2.7
			none
$\mathcal{B}(B^+ \to h_1(1595)K^+) \times \mathcal{B}(h_1(1595) \to K^*\overline{K})$			
	LHCb [20][1]	$10.4 \pm 1.0 \pm 1.3$	10.4 ± 1.6
			none

[1] Extracted from an amplitude analysis of the $K^0_S K^\pm \pi^\mp$ spectrum in $B^+ \to K^0_S K^\pm \pi^\mp K^+$ decays, in the mass region $m(K^0_S K^\pm \pi^\mp) < 1.85$ GeV.

[2] Add the relevant comments

[3] Result extracted from Dalitz-plot analysis of $B^+ \to K^+K^+K^-$ decays.

[4] Result extracted from Dalitz-plot analysis of $B^+ \to K^0_S K^0_S K^+$ decays.

Table 4: Branching fractions of charmless mesonic B^+ decays with strange mesons (part 4).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^+ \to \omega(782)K^+)$[1]	Belle [22]	$6.8 \pm 0.4 \pm 0.4$	6.47 ± 0.40
	BaBar [23]	$6.3 \pm 0.5 \pm 0.3$	
	CLEO [24]	$3.2\,^{+2.4}_{-1.9} \pm 0.8$	
$\mathcal{B}(B^+ \to \omega(782)K^*(892)^+)$	BaBar [25]	< 7.4	< 7.4
$\mathcal{B}(B^+ \to \omega(782)(K\pi)_0^{*+})$	BaBar [25]	$27.5 \pm 3.0 \pm 2.6$	27.5 ± 4.0
$\mathcal{B}(B^+ \to \omega(782)K_0^*(1430)^+)$	BaBar [25]	$24.0 \pm 2.6 \pm 4.4$	24.0 ± 5.1
$\mathcal{B}(B^+ \to \omega(782)K_2^*(1430)^+)$	BaBar [25]	$21.5 \pm 3.6 \pm 2.4$	21.5 ± 4.3
$\mathcal{B}(B^+ \to a_0(980)^+K^0) \times \mathcal{B}(a_0(980)^+ \to \eta\pi^+)$	BaBar [26]	< 3.9	< 3.9
$\mathcal{B}(B^+ \to a_0(980)^0K^+) \times \mathcal{B}(a_0(980)^0 \to \eta\pi^0)$	BaBar [26]	< 2.5	< 2.5
$\mathcal{B}(B^+ \to K^*(892)^0\pi^+)$	BaBar [27][2]	$10.8 \pm 0.6\,^{+1.2}_{-1.4}$	10.0 ± 0.8
	Belle [28][2]	$9.67 \pm 0.64\,^{+0.81}_{-0.89}$	10.1 ± 0.8
	BaBar [29][3,4,5]	$10.1 \pm 1.7 \pm 1.0$	
$\mathcal{B}(B^+ \to K^*(892)^+\pi^0)$	BaBar [29][3,4,5]	$6.4 \pm 0.9\,^{+0.4}_{-0.5}$	6.81 ± 0.88
	BaBar [30]	$8.2 \pm 1.5 \pm 1.1$	$6.80\,^{+0.87}_{-0.90}$
	CLEO [24]	$7.1\,^{+11.4}_{-7.1} \pm 1.0$	
$\mathcal{B}(B^+ \to K^+\pi^+\pi^-)$	LHCb [31][6]	$56.20 \pm 0.36 \pm 1.56$	55.8 ± 1.5
	BaBar [27][2]	$54.4 \pm 1.1 \pm 4.6$	51.0 ± 2.9
	Belle [28][2]	$48.8 \pm 1.1 \pm 3.6$	
$\mathcal{B}(B^+ \to K^+\pi^+\pi^-(\mathrm{NR}))$	BaBar [27][2,7]	$9.3 \pm 1.0\,^{+6.9}_{-1.7}$	$16.3\,^{+2.0}_{-1.8}$
	Belle [28][2]	$16.9 \pm 1.3\,^{+1.7}_{-1.6}$	$16.3\,^{+2.1}_{-1.5}$

[1] The measurement from the Dalitz-plot analysis of $B^+ \to K^+\pi^+\pi^-$ decays [27] was not included in this average. It is quoted as a separate entry.

[2] Result extracted from Dalitz-plot analysis of $B^+ \to K^+\pi^+\pi^-$ decays.

[3] Result extracted from Dalitz-plot analysis of $B^+ \to K^0_S\pi^+\pi^0$ decays.

[4] The final published version includes updates to some of the results presented in the arXiv version. Readers should refer to the version published in PRD as the valid reference.

[5] Multiple systematic uncertainties are added in quadrature.

[6] Using $\mathcal{B}(B^+ \to K^+K^+K^-)$.

[7] The total nonresonant contribution is obtained by combining a exponential nonresonant component with the effective-range part of the LASS lineshape.

Table 5: Branching fractions of charmless mesonic B^+ decays with strange mesons (part 5).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^+ \to \omega(782)K^+\ (K^+\pi^+\pi^-))$[1]	BaBar [27][2]	$5.9\ ^{+8.8\ +0.5}_{-9.0\ -0.4}$	5.9 ± 8.9 $5.9\ ^{+8.8}_{-9.0}$
$\mathcal{B}(B^+ \to f_0(980)K^+) \times \mathcal{B}(f_0(980) \to \pi^+\pi^-)$	BaBar [27][2] Belle [28][2]	$10.3 \pm 0.5\ ^{+2.0}_{-1.4}$ $8.78 \pm 0.82\ ^{+0.85}_{-1.76}$	$9.40\ ^{+0.84}_{-0.92}$ $9.40\ ^{+1.02}_{-1.18}$
$\mathcal{B}(B^+ \to f_2(1270)K^+)$	Belle [28][2] BaBar [27][2]	$1.33 \pm 0.30\ ^{+0.23}_{-0.34}$ $0.89\ ^{+0.38\ +0.01}_{-0.33\ -0.03}$	1.07 ± 0.31 1.07 ± 0.27
$\mathcal{B}(B^+ \to f_0(1370)K^+) \times \mathcal{B}(f_0(1370) \to \pi^+\pi^-)$	BaBar [32][2]	< 10.7	< 11
$\mathcal{B}(B^+ \to \rho(1450)^0K^+) \times \mathcal{B}(\rho(1450)^0 \to \pi^+\pi^-)$	BaBar [32][2]	< 11.7	< 12
$\mathcal{B}(B^+ \to f_2'(1525)K^+) \times \mathcal{B}(f_2'(1525) \to \pi^+\pi^-)$	BaBar [32][2]	< 3.4	< 3.4
$\mathcal{B}(B^+ \to \rho^0(770)K^+)$	BaBar [27][2] Belle [28][2]	$3.56 \pm 0.45\ ^{+0.57}_{-0.46}$ $3.89 \pm 0.47\ ^{+0.43}_{-0.41}$	3.74 ± 0.47 $3.74\ ^{+0.48}_{-0.45}$
$\mathcal{B}(B^+ \to K_0^*(1430)^0\pi^+)$[3]	BaBar [27][2] Belle [28][2] BaBar [29][4,5,6]	$32.0 \pm 1.2\ ^{+10.8}_{-6.0}$ $51.6 \pm 1.7\ ^{+7.0}_{-7.5}$ $34.6 \pm 3.3 \pm 4.6$	39.3 ± 4.4 $39.0\ ^{+5.7}_{-5.0}$
$\mathcal{B}(B^+ \to K_2^*(1430)^0\pi^+)$	BaBar [27][2] Belle [33][2]	$5.6 \pm 1.2\ ^{+1.8}_{-0.8}$ < 6.9	$5.6\ ^{+2.2}_{-1.4}$ $5.6\ ^{+2.2}_{-1.5}$
$\mathcal{B}(B^+ \to K^*(1410)^0\pi^+)$	Belle [33][2]	< 45.0	< 45
$\mathcal{B}(B^+ \to K^*(1680)^0\pi^+)$	Belle [33][2] BaBar [32][2]	< 12.0 < 15.0	< 12
$\mathcal{B}(B^+ \to K^+\pi^0\pi^0)$	BaBar [30]	$16.2 \pm 1.2 \pm 1.5$	16.2 ± 1.9
$\mathcal{B}(B^+ \to f_0(980)K^+) \times \mathcal{B}(f_0(980) \to \pi^0\pi^0)$	BaBar [30]	$2.8 \pm 0.6 \pm 0.5$	2.8 ± 0.8

[1] This result was not included in the main entry of $\mathcal{B}(B^+ \to \omega(782)K^+)$.
[2] Result extracted from Dalitz-plot analysis of $B^+ \to K^+\pi^+\pi^-$ decays.
[3] The PDG uncertainty includes a scale factor.
[4] Result extracted from Dalitz-plot analysis of $B^+ \to K_S^0\pi^+\pi^0$ decays.
[5] The final published version includes updates to some of the results presented in the arXiv version. Readers should refer to the version published in PRD as the valid reference.
[6] Multiple systematic uncertainties are added in quadrature.

Table 6: Branching fractions of charmless mesonic B^+ decays with strange mesons (part 6).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^+ \to K^-\pi^+\pi^+)$	LHCb [34]	< 0.046	< 0.046
	BaBar [35]	< 0.95	
	Belle [36]	< 4.5	
$\mathcal{B}(B^+ \to K^-\pi^+\pi^+(\mathrm{NR}))$	CLEO [37]	< 56	< 56
$\mathcal{B}(B^+ \to K_1(1270)^0\pi^+)$	BaBar [38]	< 40	< 40
$\mathcal{B}(B^+ \to K_1(1400)^0\pi^+)$	BaBar [38]	< 39	< 39
$\mathcal{B}(B^+ \to K^0\pi^+\pi^0)$	BaBar [29][1,2,3]	$31.8 \pm 1.8\,^{+6.4}_{-2.1}$	$31.8\,^{+6.6}_{-2.8}$ < 66.0
$\mathcal{B}(B^+ \to K_0^*(1430)^+\pi^0)$	BaBar [29][1,2,3]	$11.9 \pm 1.7\,^{+1.0}_{-1.6}$	$11.9\,^{+2.0}_{-2.4}$ $11.9\,^{+2.0}_{-2.3}$
$\mathcal{B}(B^+ \to \rho^+(770)K^0)$	BaBar [29][1,2,3]	$6.5 \pm 1.1\,^{+0.8}_{-1.9}$	$6.5\,^{+1.4}_{-2.2}$ $7.3\,^{+1.0}_{-1.2}$
$\mathcal{B}(B^+ \to K^*(892)^+\pi^+\pi^-)$	BaBar [39]	$75.3 \pm 6.0 \pm 8.1$	75 ± 10
$\mathcal{B}(B^+ \to K^*(892)^+\rho^0(770))$	BaBar [40]	$4.6 \pm 1.0 \pm 0.4$	4.6 ± 1.1
$\mathcal{B}(B^+ \to f_0(980)K^*(892)^+) \times \mathcal{B}(f_0(980) \to \pi^+\pi^-)$			
	BaBar [40]	$4.2 \pm 0.6 \pm 0.3$	4.2 ± 0.7
$\mathcal{B}(B^+ \to a_1(1260)^+K^0)$	BaBar [41]	$34.9 \pm 5.0 \pm 4.4$	34.9 ± 6.7
$\mathcal{B}(B^+ \to b_1(1235)^+K^0) \times \mathcal{B}(b_1(1235)^0 \to \omega(782)\pi^+)$			
	BaBar [45]	$9.6 \pm 1.7 \pm 0.9$	9.6 ± 1.9
$\mathcal{B}(B^+ \to K^*(892)^0\rho^+(770))$	BaBar [42]	$9.6 \pm 1.7 \pm 1.5$	9.2 ± 1.5
	Belle [43][4]	$8.9 \pm 1.7 \pm 1.2$	
$\mathcal{B}(B^+ \to K_1(1400)^+\rho^0(770))$	ARGUS [44]	< 780	< 780
$\mathcal{B}(B^+ \to K_2^*(1430)^+\rho^0(770))$	ARGUS [44]	< 1500	< 1500

[1] Result extracted from Dalitz-plot analysis of $B^+ \to K^0_S\pi^+\pi^0$ decays.

[2] The final published version includes updates to some of the results presented in the arXiv version. Readers should refer to the version published in PRD as the valid reference.

[3] Multiple systematic uncertainties are added in quadrature.

[4] See also Ref. [46].

Table 7: Branching fractions of charmless mesonic B^+ decays with strange mesons (part 7).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^+ \to b_1(1235)^0 K^+) \times \mathcal{B}(b_1(1235)^0 \to \omega(782)\pi^0)$			
	BaBar [50]	$9.1 \pm 1.7 \pm 1.0$	9.1 ± 2.0
$\mathcal{B}(B^+ \to b_1(1235)^+ K^*(892)^0) \times \mathcal{B}(b_1(1235)^+ \to \omega(782)\pi^+)$			
	BaBar [51]	< 5.9	< 5.9
$\mathcal{B}(B^+ \to b_1(1235)^0 K^*(892)^+) \times \mathcal{B}(b_1(1235)^0 \to \omega(782)\pi^0)$			
	BaBar [51]	< 6.7	< 6.7
$\mathcal{B}(B^+ \to K^+ \overline{K}^0)$[1]	LHCb [7][2]	$1.32 \pm 0.10 \pm 0.06$	1.282 ± 0.095
	Belle [3]	$1.11 \pm 0.19 \pm 0.05$	
	BaBar [5]	$1.61 \pm 0.44 \pm 0.09$	1.315 ± 0.171
$\mathcal{B}(B^+ \to \overline{K}^0 K^+ \pi^0)$	CLEO [47]	< 24.0	< 24
$\mathcal{B}(B^+ \to K^+ K_S^0 K_S^0)$[3]	Belle [48]	$10.42 \pm 0.43 \pm 0.22$	10.29 ± 0.37
	BaBar [21][4,5]	$10.1 \pm 0.5 \pm 0.3$	10.49 ± 0.37
$\mathcal{B}(B^+ \to f_0(980) K^+) \times \mathcal{B}(f_0(980) \to K_S^0 K_S^0)$			
	BaBar [21][4]	$14.7 \pm 2.8 \pm 1.8$	14.7 ± 3.3
$\mathcal{B}(B^+ \to f_0(1710) K^+) \times \mathcal{B}(f_0(1710) \to K_S^0 K_S^0)$			
	BaBar [21][4]	$0.48\,^{+0.40}_{-0.24} \pm 0.11$	$0.48\,^{+0.41}_{-0.26}$
$\mathcal{B}(B^+ \to K^+ K_S^0 K_S^0(\mathrm{NR}))$	BaBar [21][6,4]	$19.8 \pm 3.7 \pm 2.5$	19.8 ± 4.5
$\mathcal{B}(B^+ \to K_S^0 K_S^0 \pi^+)$	BaBar [49]	< 0.51	< 0.51
	Belle [48]	< 0.87	

[1] The PDG average is a result of a fit including input from other measurements.
[2] Using $\mathcal{B}(B^+ \to K^0 \pi^+)$.
[3] PDG uses the BABAR result including the χ_{c0} intermediate state.
[4] Result extracted from Dalitz-plot analysis of $B^+ \to K_S^0 K_S^0 K^+$ decays.
[5] All charmonium resonances are vetoed. The analysis also reports $\mathcal{B}(B^+ \to K_S^0 K_S^0 K^+) = (10.6 \pm 0.5 \pm 0.3) \times 10^{-6}$ including the χ_{c0} intermediate state.
[6] The nonresonant amplitude is modelled using a polynomial function of order 2.

Table 8: Branching fractions of charmless mesonic B^+ decays with strange mesons (part 8).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^+ \to K^+K^-\pi^+)$	LHCb [31][1]	$4.98 \pm 0.13 \pm 0.29$	5.07 ± 0.26
	Belle [52][2]	$5.38 \pm 0.40 \pm 0.35$	5.24 ± 0.42
	BaBar [53]	$5.0 \pm 0.5 \pm 0.5$	
$\mathcal{B}(B^+ \to K^+K^-\pi^+(\mathrm{NR}))$	LHCb [54][3,4]	$1.625 \pm 0.075\,^{+0.221}_{-0.222}$	$1.63\,^{+0.24}_{-0.23}$
			1.68 ± 0.26
$\mathcal{B}(B^+ \to \overline{K}^*(892)^0K^+)$	BaBar [55]	< 1.1	$0.57\,^{+0.07}_{-0.06}$
	LHCb [54][5,6]		0.59 ± 0.08
$\mathcal{B}(B^+ \to \overline{K}^*_0(1430)^0K^+)$	BaBar [55]	< 2.2	$0.37\,^{+0.13}_{-0.12}$
	LHCb [54][5,7]		0.38 ± 0.13
$\mathcal{B}(B^+ \to K^+K^-\pi^+)$ $\pi\pi \leftrightarrow KK$ rescattering	LHCb [54][8,4]	$0.825 \pm 0.040 \pm 0.065$	$0.825\,^{+0.077}_{-0.075}$
			0.853 ± 0.094
$\mathcal{B}(B^+ \to K^+K^+\pi^-)$	LHCb [34]	< 0.011	< 0.011
	BaBar [35]	< 0.16	
	Belle [36]	< 2.4	
$\mathcal{B}(B^+ \to f_2'(1525)K^+)$[9]	BaBar [21][10]	$1.56 \pm 0.36 \pm 0.30$	1.79 ± 0.42
	BaBar [21][11]	$2.8 \pm 0.9\,^{+0.5}_{-0.4}$	1.79 ± 0.48
	Belle [33][10]	< 8.0	
$\mathcal{B}(B^+ \to f_J(2220)K^+) \times \mathcal{B}(f_J(2220) \to p\overline{p})$	Belle [56]	< 0.41	< 0.41
$\mathcal{B}(B^+ \to K^*(892)^+\pi^+K^-)$	BaBar [39]	< 11.8	< 12
$\mathcal{B}(B^+ \to K^*(892)^+\overline{K}^*(892)^0)$	Belle [57]	$0.77\,^{+0.35}_{-0.30} \pm 0.12$	0.91 ± 0.30
	BaBar [58]	$1.2 \pm 0.5 \pm 0.1$	$0.91\,^{+0.30}_{-0.27}$
$\mathcal{B}(B^+ \to K^*(892)^+K^+\pi^-)$	BaBar [39]	< 6.1	< 6.1

[1] Using $\mathcal{B}(B^+ \to K^+K^+K^-)$.

[2] Also measured in bins of $m_{K^+K^-}$ and $m_{K^+\pi^-}$.

[3] LHCb uses a model of the nonresonant contribution obtained from a phenomenological description of the partonic interaction that produces the final state. This contribution is referred to as the single pole in the paper; see Ref. [54] for details.

[4] Using $\mathcal{B}(B^+ \to K^+K^-\pi^+)$.

[5] Result extracted from Dalitz-plot analysis of $B^+ \to K^+K^-\pi^+$ decays.

[6] Measurement of $(\mathcal{B}(B^+ \to \overline{K}^*(892)^0K^+)\mathcal{B}(K^*(892)^0 \to K\pi)2/3)/\mathcal{B}(B^+ \to K^+K^-\pi^+)$ used in our fit.

[7] Measurement of $(\mathcal{B}(B^+ \to \overline{K}^*_0(1430)^0K^+)\mathcal{B}(K^*(1430) \to K\pi)2/3)/\mathcal{B}(B^+ \to K^+K^-\pi^+)$ used in our fit.

[8] LHCb uses a dedicated lineshape to take into account $\pi\pi \leftrightarrow KK$ rescattering, which is particularly significant in the region $1 < m_{KK} < 1.5$ GeV/c^2. See Ref. [54] for details.

[9] The PDG uncertainty includes a scale factor.

[10] Result extracted from Dalitz-plot analysis of $B^+ \to K^+K^+K^-$ decays.

[11] Result extracted from Dalitz-plot analysis of $B^+ \to K^0_SK^0_SK^+$ decays.

Table 9: Branching fractions of charmless mesonic B^+ decays with strange mesons (part 9).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^+ \to K^+K^+K^-)$[1,2]	BaBar [21][3,4]	$34.6 \pm 0.6 \pm 0.9$	33.0 ± 0.8
	Belle [33][3]	$30.6 \pm 1.2 \pm 2.3$	34.0 ± 1.4
	LHCb [59][5,6,7], [31][8,9,10]		
$\mathcal{B}(B^+ \to \phi(1020)K^+)$[1]	BaBar [21][3]	$9.2 \pm 0.4\,^{+0.7}_{-0.5}$	$8.84\,^{+0.52}_{-0.49}$
	Belle [33][3]	$9.60 \pm 0.92\,^{+1.05}_{-0.85}$	$8.83\,^{+0.67}_{-0.57}$
	CDF [60]	$7.6 \pm 1.3 \pm 0.6$	
	CLEO [61]	$5.5\,^{+2.1}_{-1.8} \pm 0.6$	
$\mathcal{B}(B^+ \to f_0(980)K^+) \times \mathcal{B}(f_0(980) \to K^+K^-)$			
	BaBar [21][3]	$9.4 \pm 1.6 \pm 2.8$	9.4 ± 3.2
$\mathcal{B}(B^+ \to a_2(1320)^0K^+) \times \mathcal{B}(a_2(1320)^0 \to K^+K^-)$			
	Belle [33][3]	< 1.1	< 1.1
$\mathcal{B}(B^+ \to \phi(1680)K^+) \times \mathcal{B}(\phi(1680) \to K^+K^-)$			
	Belle [33][3]	< 0.8	< 0.8
$\mathcal{B}(B^+ \to f_0(1710)K^+) \times \mathcal{B}(f_0(1710) \to K^+K^-)$			
	BaBar [21][3]	$1.12 \pm 0.25 \pm 0.50$	1.12 ± 0.56
$\mathcal{B}(B^+ \to K^+K^+K^-(\mathrm{NR}))$	Belle [33][3]	$24.0 \pm 1.5\,^{+2.6}_{-6.0}$	$23.7\,^{+3.0}_{-4.9}$
	BaBar [21][11,3]	$22.8 \pm 2.7 \pm 7.6$	$23.8\,^{+2.8}_{-4.9}$

[1] The PDG uncertainty includes a scale factor.

[2] Treatment of charmonium intermediate components differs between the results.

[3] Result extracted from Dalitz-plot analysis of $B^+ \to K^+K^+K^-$ decays.

[4] All charmonium resonances are vetoed, except for χ_{c0}. The analysis also reports $\mathcal{B}(B^+ \to K^+K^+K^-) = (33.4 \pm 0.5 \pm 0.9) \times 10^{-6}$ excluding χ_{c0}.

[5] Measurement of $\frac{f_{\Omega_b^-}}{f_u} \times \mathcal{B}(\Omega_b^- \to pK^-K^-)/\mathcal{B}(B^+ \to K^+K^+K^-)$ used in our fit.

[6] Measurement of $\frac{f_{\Omega_b^-}}{f_u} \times \mathcal{B}(\Omega_b^- \to pK^-\pi^-)/\mathcal{B}(B^+ \to K^+K^+K^-)$ used in our fit.

[7] Measurement of $\frac{f_{\Omega_b^-}}{f_u} \times \mathcal{B}(\Omega_b^- \to p\pi^-\pi^-)/\mathcal{B}(B^+ \to K^+K^+K^-)$ used in our fit.

[8] Measurement of $\mathcal{B}(B^+ \to K^+K^-\pi^+)/\mathcal{B}(B^+ \to K^+K^+K^-)$ used in our fit.

[9] Measurement of $\mathcal{B}(B^+ \to K^+\pi^+\pi^-)/\mathcal{B}(B^+ \to K^+K^+K^-)$ used in our fit.

[10] Measurement of $\mathcal{B}(B^+ \to \pi^+\pi^+\pi^-)/\mathcal{B}(B^+ \to K^+K^+K^-)$ used in our fit.

[11] The nonresonant amplitude is modelled using a polynomial function including S-wave and P-wave terms.

Table 10: Branching fractions of charmless mesonic B^+ decays with strange mesons (part 10).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^+ \to K^*(892)^+ K^+ K^-)$	BaBar [39]	$36.2 \pm 3.3 \pm 3.6$	36.2 ± 4.9
$\mathcal{B}(B^+ \to \phi(1020) K^*(892)^+)$[1]	BaBar [62][2]	$11.2 \pm 1.0 \pm 0.9$	10.0 ± 1.1
	Belle [63]	$6.7\,^{+2.1\ +0.7}_{-1.9\ -1.0}$	10.0 ± 2.0
	CLEO [61]	$10.6\,^{+6.4\ +1.8}_{-4.9\ -1.6}$	
$\mathcal{B}(B^+ \to \phi(1020)(K\pi)_0^{*+})$	BaBar [64]	$8.3 \pm 1.4 \pm 0.8$	8.3 ± 1.6
$\mathcal{B}(B^+ \to K_1(1270)^+ \phi(1020))$	BaBar [64]	$6.1 \pm 1.6 \pm 1.1$	6.1 ± 1.9
$\mathcal{B}(B^+ \to K_1(1400)^+ \phi(1020))$	BaBar [64]	< 3.2	< 3.2
$\mathcal{B}(B^+ \to K^*(1410)^+ \phi(1020))$	BaBar [64]	< 4.3	< 4.3
$\mathcal{B}(B^+ \to K_0^*(1430)^+ \phi(1020))$	BaBar [64]	$7.0 \pm 1.3 \pm 0.9$	7.0 ± 1.6
$\mathcal{B}(B^+ \to K_2^*(1430)^+ \phi(1020))$	BaBar [64]	$8.4 \pm 1.8 \pm 1.0$	8.4 ± 2.1
$\mathcal{B}(B^+ \to K_2(1770)^+ \phi(1020))$	BaBar [64]	< 15.0	< 15
$\mathcal{B}(B^+ \to \phi(1020) K_2(1820)^+)$	BaBar [64]	< 16.3	< 16
$\mathcal{B}(B^+ \to a_1(1260)^+ K^*(892)^0)$	BaBar [65]	< 3.6	< 3.6
$\mathcal{B}(B^+ \to \phi(1020)\phi(1020) K^+)$[1]	BaBar [66][3]	$5.6 \pm 0.5 \pm 0.3$	4.98 ± 0.52
	Belle [67][3]	$2.6\,^{+1.1}_{-0.9} \pm 0.3$	$4.22\,^{+0.82}_{-0.79}$
$\mathcal{B}(B^+ \to \eta'\eta' K^+)$	BaBar [68]	< 25.0	< 25
$\mathcal{B}(B^+ \to \phi(1020)\omega(782) K^+)$	Belle [69]	< 1.9	< 1.9
$\mathcal{B}(B^+ \to X(1812) K^+) \times \mathcal{B}(X(1812) \to \phi(1020)\omega(782))$			
	Belle [69]	< 0.32	< 0.32
$\mathcal{B}(B^+ \to h^+ X^0(\text{Familon}))$[4]	CLEO [70]	< 49	< 49

[1] The PDG uncertainty includes a scale factor.

[2] Combination of two final states of the $K^*(892)^\pm$, $K_S^0\pi^\pm$ and $K^\pm\pi^0$. In addition to the combined results, the paper reports separately the results for each individual final state.

[3] Measured in the $\phi\phi$ invariant mass range below the η_c resonance ($m_{\phi\phi} < 2.85$ GeV/c^2).

[4] $h = \pi, K$.

Table 11: Branching fractions of charmless mesonic B^+ decays without strange mesons (part 1).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^+ \to \pi^+\pi^0)$[1]	Belle [3]	$5.86 \pm 0.26 \pm 0.38$	5.33 ± 0.27
	Belle II [4]	$5.1 \pm 0.3 \pm 0.3$	5.31 ± 0.26
	BaBar [8]	$5.02 \pm 0.46 \pm 0.29$	
	CLEO [6]	$4.6\,^{+1.8}_{-1.6}\,^{+0.6}_{-0.7}$	
$\mathcal{B}(B^+ \to \pi^+\pi^+\pi^-)$	LHCb [31][2]	$16.10 \pm 0.17 \pm 0.50$	16.06 ± 0.50
	BaBar [71][3,4,5]	$15.2 \pm 0.6\,^{+1.3}_{-1.2}$	$15.20\,^{+1.43}_{-1.34}$
$\mathcal{B}(B^+ \to \rho^0(770)\pi^+)$	LHCb [72][3,6,5,7]	$8.82 \pm 0.10 \pm 0.50$	8.76 ± 0.47
	BaBar [71][3,5]	$8.1 \pm 0.7\,^{+1.3}_{-1.6}$	$8.29\,^{+1.20}_{-1.28}$
	Belle [73]	$8.0\,^{+2.3}_{-2.0} \pm 0.7$	
	CLEO [24]	$10.4\,^{+3.3}_{-3.4} \pm 2.1$	
$\mathcal{B}(B^+ \to f_0(980)\pi^+) \times \mathcal{B}(f_0(980) \to \pi^+\pi^-)$	BaBar [71][3]	< 1.5	< 1.5
$\mathcal{B}(B^+ \to f_2(1270)\pi^+) \times \mathcal{B}(f_2(1270) \to \pi^+\pi^-)$			
	LHCb [72][3,6,5,7]	$1.43 \pm 0.05 \pm 0.27$	$1.27\,^{+0.20}_{-0.23}$
	BaBar [71][3,5]	$0.9 \pm 0.2\,^{+0.3}_{-0.1}$	none
$\mathcal{B}(B^+ \to f_2(1270)\pi^+) \times \mathcal{B}(f_2(1270) \to K^+K^-)$			
	LHCb [54][8,9]	$0.377 \pm 0.040 \pm 0.040$	$0.378\,^{+0.057}_{-0.056}$
			none
$\mathcal{B}(B^+ \to \rho(1450)^0\pi^+) \times \mathcal{B}(\rho(1450)^0 \to \pi^+\pi^-)$			
	LHCb [72][3,6,5,7]	$0.83 \pm 0.05 \pm 0.89$	$1.14\,^{+0.59}_{-0.67}$
	BaBar [71][3,5]	$1.4 \pm 0.4\,^{+0.5}_{-0.8}$	$1.40\,^{+0.64}_{-0.89}$
$\mathcal{B}(B^+ \to \rho(1450)^0\pi^+) \times \mathcal{B}(\rho(1450)^0 \to K^+K^-)$			
	LHCb [54][8,9]	$1.545 \pm 0.060\,^{+0.089}_{-0.090}$	1.55 ± 0.11
			1.60 ± 0.14
$\mathcal{B}(B^+ \to \rho_3(1690)^0\pi^+) \times \mathcal{B}(\rho_3(1690)^0 \to \pi^+\pi^-)$			
	LHCb [72][3,6,5,7]	$0.08 \pm 0.02 \pm 0.16$	0.08 ± 0.16
			none

[1] The PDG uncertainty includes a scale factor.
[2] Using $\mathcal{B}(B^+ \to K^+K^+K^-)$.
[3] Result extracted from Dalitz-plot analysis of $B^+ \to \pi^+\pi^+\pi^-$ decays.
[4] Charm and charmonium contributions are subtracted.
[5] Multiple systematic uncertainties are added in quadrature.
[6] This analysis uses three different approaches: isobar, K-matrix and quasi-model-independent, to describe the S-wave component. The results are taken from the isobar model with an additional error accounting for the different S-wave methods as reported in Appendix D of Ref. [74].
[7] Using $\mathcal{B}(B^+ \to \pi^+\pi^+\pi^-)$.
[8] Result extracted from Dalitz-plot analysis of $B^+ \to K^+K^-\pi^+$ decays.
[9] Using $\mathcal{B}(B^+ \to K^+K^-\pi^+)$.

Table 12: Branching fractions of charmless mesonic B^+ decays without strange mesons (part 2).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^+ \to \pi^+\pi^+\pi^-)$ $S-$wave	LHCb [72][1,2,3,4]	$4.04 \pm 0.08 \pm 0.64$	4.04 ± 0.64 none
$\mathcal{B}(B^+ \to f_0(1370)\pi^+) \times \mathcal{B}(f_0(1370) \to \pi^+\pi^-)$	BaBar [71][5]	< 4.0	< 4.0
$\mathcal{B}(B^+ \to \pi^+\pi^-\pi^+(\mathrm{NR}))$	BaBar [71][6,3]	$5.3 \pm 0.7\,^{+1.3}_{-0.8}$	$5.3\,^{+1.4}_{-1.0}$ $5.3\,^{+1.5}_{-1.1}$
$\mathcal{B}(B^+ \to \pi^+\pi^0\pi^0)$	Belle [75] ARGUS [76]	$19.0 \pm 1.5 \pm 1.4$ < 890	19.0 ± 2.1
$\mathcal{B}(B^+ \to X_{\pi^0\pi^0}\pi^+) \times \mathcal{B}(X(\pi^0\pi^0) \to \pi^0\pi^0)$	Belle [75][7]	$6.9 \pm 0.9 \pm 0.6$	6.9 ± 1.1 none
$\mathcal{B}(B^+ \to \pi^+\pi^0\pi^0(\mathrm{NR}))$	Belle [75]	< 0.6	< 0.60 none
$\mathcal{B}(B^+ \to \rho^+(770)\pi^0)$	Belle [75][3] BaBar [77]	$11.2 \pm 1.1\,^{+1.2}_{-1.8}$ $10.2 \pm 1.4 \pm 0.9$	10.6 ± 1.3 $10.6\,^{+1.2}_{-1.3}$
$\mathcal{B}(B^+ \to \pi^+\pi^+\pi^-\pi^0)$	ARGUS [76]	< 4000	< 4000
$\mathcal{B}(B^+ \to \rho^+(770)\rho^0(770))$	BaBar [78] Belle [79]	$23.7 \pm 1.4 \pm 1.4$ $31.7 \pm 7.1\,^{+3.8}_{-6.7}$	24.0 ± 1.9
$\mathcal{B}(B^+ \to f_0(980)\rho^+(770)) \times \mathcal{B}(f_0(980) \to \pi^+\pi^-)$	BaBar [78]	< 2.0	< 2.0
$\mathcal{B}(B^+ \to a_1(1260)^+\pi^0)$	BaBar [80]	$26.4 \pm 5.4 \pm 4.1$	26.4 ± 6.8
$\mathcal{B}(B^+ \to a_1(1260)^0\pi^+)$	BaBar [80]	$20.4 \pm 4.7 \pm 3.4$	20.4 ± 5.8
$\mathcal{B}(B^+ \to \omega(782)\pi^+)$	BaBar [23] Belle [81] CLEO [24] LHCb [72][5,2,3,8]	$6.7 \pm 0.5 \pm 0.4$ $6.9 \pm 0.6 \pm 0.5$ $11.3\,^{+3.3}_{-2.9} \pm 1.4$	$6.60\,^{+0.46}_{-0.45}$ 6.88 ± 0.49
$\mathcal{B}(B^+ \to \omega(782)\rho^+(770))$	BaBar [25]	$15.9 \pm 1.6 \pm 1.4$	15.9 ± 2.1

[1] LHCb accounts for the S-wave component using a model that comprises the coherent sum of a σ pole and a rescattering amplitude. See Ref. [72] for details.
[2] This analysis uses three different approaches: isobar, K-matrix and quasi-model-independent, to describe the S-wave component. The results are taken from the isobar model with an additional error accounting for the different S-wave methods as reported in Appendix D of Ref. [74].
[3] Multiple systematic uncertainties are added in quadrature.
[4] Using $\mathcal{B}(B^+ \to \pi^+\pi^+\pi^-)$.
[5] Result extracted from Dalitz-plot analysis of $B^+ \to \pi^+\pi^+\pi^-$ decays.
[6] The nonresonant amplitude is modelled using a sum of exponential functions.
[7] $X_{\pi^0\pi^0}$ corresponds to a structure observed in Ref. [75], likely arising due to multiple resonances.
[8] Measurement of $(\mathcal{B}(B^+ \to \omega(782)\pi^+)\mathcal{B}(\omega(782) \to \pi^+\pi^-))/\mathcal{B}(B^+ \to \pi^+\pi^+\pi^-)$ used in our fit.

Table 13: Branching fractions of charmless mesonic B^+ decays without strange mesons (part 3).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^+ \to \eta\pi^+)$	Belle [16]	$4.07 \pm 0.26 \pm 0.21$	4.02 ± 0.27
	BaBar [9]	$4.00 \pm 0.40 \pm 0.24$	$4.02\,^{+0.27}_{-0.26}$
	CLEO [12]	$1.2\,^{+2.8}_{-1.2}$	
$\mathcal{B}(B^+ \to \eta\rho^+(770))$[1]	BaBar [82]	$9.9 \pm 1.2 \pm 0.8$	6.9 ± 1.0
	Belle [18]	$4.1\,^{+1.4}_{-1.3} \pm 0.4$	$7.0\,^{+2.9}_{-2.8}$
	CLEO [12]	$4.8\,^{+5.2}_{-3.8}$	
$\mathcal{B}(B^+ \to \eta'\pi^+)$[1]	BaBar [9]	$3.5 \pm 0.6 \pm 0.2$	2.68 ± 0.46
	Belle [10]	$1.76\,^{+0.67\,+0.15}_{-0.62\,-0.14}$	$2.70\,^{+0.87}_{-0.84}$
	CLEO [12]	$1.0\,^{+5.8}_{-1.0}$	
$\mathcal{B}(B^+ \to \eta'\rho^+(770))$	BaBar [14]	$9.7\,^{+1.9}_{-1.8} \pm 1.1$	9.8 ± 2.1
	CLEO [12]	$11.2\,^{+11.9}_{-7.0}$	$9.7\,^{+2.2}_{-2.1}$
	Belle [15]	< 5.8	
$\mathcal{B}(B^+ \to \phi(1020)\pi^+)$	BaBar [83]	< 0.24	0.031 ± 0.014
	Belle [84]	< 0.33	0.032 ± 0.015
	LHCb [54][2,3]		
$\mathcal{B}(B^+ \to \phi(1020)\rho^+(770))$	BaBar [85]	< 3.0	< 3.0
$\mathcal{B}(B^+ \to a_0(980)^0\pi^+) \times \mathcal{B}(a_0(980)^0 \to \eta\pi^0)$	BaBar [26]	< 5.8	< 5.8
$\mathcal{B}(B^+ \to \pi^+\pi^+\pi^+\pi^-\pi^-)$	ARGUS [76]	< 860	< 860
$\mathcal{B}(B^+ \to a_1(1260)^+\rho^0(770))$	CLEO [86][4]	< 620.0	< 620
$\mathcal{B}(B^+ \to a_2(1320)^+\rho^0(770))$	CLEO [86][4]	< 720.0	< 720
$\mathcal{B}(B^+ \to b_1(1235)^0\pi^+) \times \mathcal{B}(b_1(1235)^0 \to \omega(782)\pi^0)$	BaBar [50]	$6.7 \pm 1.7 \pm 1.0$	6.7 ± 2.0
$\mathcal{B}(B^+ \to b_1^+\pi^0)$	BaBar [45]	< 3.3	< 3.3
$\mathcal{B}(B^+ \to \pi^+\pi^+\pi^+\pi^-\pi^-\pi^0)$	ARGUS [76]	< 6300	< 6300
$\mathcal{B}(B^+ \to b_1(1235)^+\rho^0(770)) \times \mathcal{B}(b_1(1235)^0 \to \omega(782)\pi^+)$			
	BaBar [51]	< 5.2	< 5.2
$\mathcal{B}(B^+ \to a_1(1260)^+a_1(1260)^0)$	ARGUS [76]	< 13000	< 13000
$\mathcal{B}(B^+ \to b_1(1235)^0\rho^+(770)) \times \mathcal{B}(b_1(1235)^0 \to \omega(782)\pi^0)$			
	BaBar [51]	< 3.3	< 3.3

[1] The PDG uncertainty includes a scale factor.

[2] Result extracted from Dalitz-plot analysis of $B^+ \to K^+K^-\pi^+$ decays.

[3] Measurement of $(\mathcal{B}(B^+ \to \phi(1020)\pi^+)\mathcal{B}(\phi(1020) \to K^+K^-))/\mathcal{B}(B^+ \to K^+K^-\pi^+)$ used in our fit.

[4] CLEO assumes $\mathcal{B}(\Upsilon(4S) \to B^0\overline{B}^0) = 0.43$. The result has been modified to account for a branching fraction of 0.50.

Table 14: Branching fractions of charmless mesonic B^0 decays with strange mesons (part 1).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^0 \to K^+\pi^-)$	Belle [3]	$20.00 \pm 0.34 \pm 0.60$	20.1 ± 0.4
	Belle II [4]	$20.7 \pm 0.4 \pm 0.6$	
	BaBar [87]	$19.1 \pm 0.6 \pm 0.6$	
	CLEO [6]	$18.0\,^{+2.3\ +1.2}_{-2.1\ -0.9}$	20.0 ± 0.4
	CDF [88][1,2], [89][3,4], [90][5,6]		
	LHCb [91][3,4,1], [92][5,6]		
$\mathcal{B}(B^0 \to K^0\pi^0)$	Belle [3]	$9.68 \pm 0.46 \pm 0.50$	10.12 ± 0.43
	BaBar [93]	$10.1 \pm 0.6 \pm 0.4$	
	Belle II [4][7]	$10.73 \pm 0.63 \pm 0.62$	
	CLEO [6]	$12.8\,^{+4.0\ +1.7}_{-3.3\ -1.4}$	
$\mathcal{B}(B^0 \to \eta' K^0)$[8]	BaBar [9]	$68.5 \pm 2.2 \pm 3.1$	66.1 ± 3.1
	Belle [10]	$58.9\,^{+3.6}_{-3.5} \pm 4.3$	$66.1\,^{+4.5}_{-4.4}$
	CLEO [12]	$89.0\,^{+18.0}_{-16.0} \pm 9.0$	
	LHCb [94][9,10]		
$\mathcal{B}(B^0 \to \eta' K^*(892)^0)$	Belle [95]	$2.6 \pm 0.7 \pm 0.2$	2.8 ± 0.6
	BaBar [14]	$3.1\,^{+0.9}_{-0.8} \pm 0.3$	
$\mathcal{B}(B^0 \to \eta' K_0^*(1430)^0)$	BaBar [14][11]	$6.3 \pm 1.3 \pm 0.9$	6.3 ± 1.6
$\mathcal{B}(B^0 \to \eta'(K\pi)_0^{*0})$	BaBar [14]	$7.4\,^{+1.5}_{-1.4} \pm 0.6$	7.4 ± 1.6 none
$\mathcal{B}(B^0 \to \eta' K_2^*(1430)^0)$	BaBar [14]	$13.7\,^{+3.0}_{-2.9} \pm 1.2$	13.7 ± 3.2 $13.7\,^{+3.2}_{-3.1}$

[1] Measurement of $(\mathcal{B}(B_s^0 \to K^-\pi^+)/\mathcal{B}(B^0 \to K^+\pi^-))\frac{f_s}{f_d}$ used in our fit.
[2] Measurement of $(\mathcal{B}(\Lambda_b^0 \to p\pi^-)/\mathcal{B}(B^0 \to K^+\pi^-))(f_{\Lambda_b^0}/f_d)$ used in our fit.
[3] Measurement of $\mathcal{B}(B^0 \to \pi^+\pi^-)/\mathcal{B}(B^0 \to K^+\pi^-)$ used in our fit.
[4] Measurement of $(\mathcal{B}(B_s^0 \to K^+K^-)/\mathcal{B}(B^0 \to K^+\pi^-))\frac{f_s}{f_d}$ used in our fit.
[5] Measurement of $\mathcal{B}(B^0 \to K^+K^-)/\mathcal{B}(B^0 \to K^+\pi^-)$ used in our fit.
[6] Measurement of $(\mathcal{B}(B_s^0 \to \pi^+\pi^-)/\mathcal{B}(B^0 \to K^+\pi^-))\frac{f_s}{f_d}$ used in our fit.
[7] Combination of time-integrated and time-dependent analyses using the best linear unbiased estimator Ref. [96].
[8] The PDG uncertainty includes a scale factor.
[9] Measurement of $\mathcal{B}(\Lambda_b^0 \to \Lambda^0\eta)/\mathcal{B}(B^0 \to \eta' K^0)$ used in our fit.
[10] Measurement of $\mathcal{B}(\Lambda_b^0 \to \Lambda^0\eta')/\mathcal{B}(B^0 \to \eta' K^0)$ used in our fit.
[11] Multiple systematic uncertainties are added in quadrature.

Table 15: Branching fractions of charmless mesonic B^0 decays with strange mesons (part 2).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^0 \to \eta K^0)$	Belle [16]	$1.27\,^{+0.33}_{-0.29} \pm 0.08$	1.23 ± 0.25
	BaBar [9]	$1.15\,^{+0.43}_{-0.38} \pm 0.09$	$1.23\,^{+0.27}_{-0.24}$
$\mathcal{B}(B^0 \to \eta K^*(892)^0)$	BaBar [17]	$16.5 \pm 1.1 \pm 0.8$	16.09 ± 0.81
	Belle [18]	$15.2 \pm 1.2 \pm 1.0$	$15.87\,^{+1.01}_{-1.00}$
	CLEO [12]	$13.8\,^{+5.5}_{-4.6} \pm 1.6$	
$\mathcal{B}(B^0 \to \eta (K\pi)^{*0}_0)$	BaBar [17]	$11.0 \pm 1.6 \pm 1.5$	11.0 ± 1.6
			none
$\mathcal{B}(B^0 \to \eta K^*_0(1430)^0)$	BaBar [17][1]	$7.8 \pm 1.1 \pm 1.1$	7.8 ± 1.1
			11.0 ± 2.2
$\mathcal{B}(B^0 \to \eta K^*_2(1430)^0)$	BaBar [17]	$9.6 \pm 1.8 \pm 1.1$	9.6 ± 1.5
			9.6 ± 2.1
$\mathcal{B}(B^0 \to \omega(782) K^0)$	Belle [22]	$4.5 \pm 0.4 \pm 0.3$	
	BaBar [23]	$5.4 \pm 0.8 \pm 0.3$	4.78 ± 0.43
	CLEO [24]	$10.0\,^{+5.4}_{-4.2} \pm 1.4$	
$\mathcal{B}(B^0 \to a_0(980)^0 K^0) \times \mathcal{B}(a_0(980)^0 \to \eta\pi^0)$			
	BaBar [26]	< 7.8	< 7.8
$\mathcal{B}(B^0 \to b_1(1235)^0 K^0) \times \mathcal{B}(b_1(1235)^0 \to \omega(782)\pi^0)$			
	BaBar [45]	< 7.8	< 7.8
$\mathcal{B}(B^0 \to a_0(980)^- K^+) \times \mathcal{B}(a_0(980)^- \to \eta\pi^-)$			
	BaBar [97]	< 1.9	< 1.9
$\mathcal{B}(B^0 \to b_1(1235)^- K^+) \times \mathcal{B}(b_1(1235)^- \to \omega(782)\pi^-)$			
	BaBar [50]	$7.4 \pm 1.0 \pm 1.0$	7.4 ± 1.4
$\mathcal{B}(B^0 \to b_1(1235)^0 K^*(892)^0) \times \mathcal{B}(b_1(1235)^0 \to \omega(782)\pi^0)$			
	BaBar [51]	< 8.0	< 8.0
$\mathcal{B}(B^0 \to b_1(1235)^- K^*(892)^+) \times \mathcal{B}(b_1(1235)^- \to \omega(782)\pi^-)$			
	BaBar [51]	< 5.0	< 5.0
$\mathcal{B}(B^0 \to a_0(1450)^- K^+) \times \mathcal{B}(a_0(1450)^- \to \eta\pi^-)$			
	BaBar [97]	< 3.1	< 3.1
$\mathcal{B}(B^0 \to K^0_S X^0(\text{Familon}))$	CLEO [70]	< 53	< 53

[1] Multiple systematic uncertainties are added in quadrature.

Table 16: Branching fractions of charmless mesonic B^0 decays with strange mesons (part 3).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^0 \to \omega(782)K^*(892)^0)$	BaBar [25]	$2.2 \pm 0.6 \pm 0.2$	2.04 ± 0.49
	Belle [98]	$1.8 \pm 0.7 \pm 0.3$	
$\mathcal{B}(B^0 \to \omega(782)(K\pi)_0^{*0})$	BaBar [25]	$18.4 \pm 1.8 \pm 1.7$	18.4 ± 2.5
$\mathcal{B}(B^0 \to \omega(782)K_0^*(1430)^0)$	BaBar [25]	$16.0 \pm 1.6 \pm 3.0$	16.0 ± 3.4
$\mathcal{B}(B^0 \to \omega(782)K_2^*(1430)^0)$	BaBar [25]	$10.1 \pm 2.0 \pm 1.1$	10.1 ± 2.3
$\mathcal{B}(B^0 \to \omega(782)K^+\pi^-(\mathrm{NR}))$	Belle [98][1]	$5.1 \pm 0.7 \pm 0.7$	5.1 ± 1.0
$\mathcal{B}(B^0 \to K^+\pi^-\pi^0)$	BaBar [99][2]	$38.5 \pm 1.0 \pm 3.9$	37.8 ± 3.2
	Belle [100]	$36.6\,^{+4.2}_{-4.1} \pm 3.0$	
$\mathcal{B}(B^0 \to \rho^-(770)K^+)$	BaBar [99][2]	$6.6 \pm 0.5 \pm 0.8$	7.01 ± 0.92
	Belle [100][3]	$15.1\,^{+3.4\,+2.4}_{-3.3\,-2.6}$	
$\mathcal{B}(B^0 \to \rho(1450)^-K^+)$	BaBar [99][2]	$2.4 \pm 1.0 \pm 0.6$	2.4 ± 1.2
$\mathcal{B}(B^0 \to \rho(1700)^-K^+)$	BaBar [99][2]	$0.6 \pm 0.6 \pm 0.4$	0.6 ± 0.7
$\mathcal{B}(B^0 \to K^+\pi^-\pi^0(\mathrm{NR}))$	BaBar [99][4]	$2.8 \pm 0.5 \pm 0.4$	2.8 ± 0.6
	Belle [100]	< 9.4	
$\mathcal{B}(B^0 \to (K\pi)_0^{*+}\pi^-) \times \mathcal{B}((K\pi)_0^{*+} \to K^+\pi^0)$			
	BaBar [99][2]	$34.2 \pm 2.4 \pm 4.1$	34.2 ± 4.8
$\mathcal{B}(B^0 \to (K\pi)_0^{*0}\pi^0) \times \mathcal{B}((K\pi)_0^{*0} \to K^+\pi^-)$			
	BaBar [99][2]	$8.6 \pm 1.1 \pm 1.3$	8.6 ± 1.7
$\mathcal{B}(B^0 \to K_2^*(1430)^0\pi^0)$	BaBar [101][2]	< 4.0	< 4.0
$\mathcal{B}(B^0 \to K^*(1680)^0\pi^0)$	BaBar [101][2]	< 7.5	< 7.5
$\mathcal{B}(B^0 \to K_x^{*0}\pi^0)$	Belle [100][5,6]	$6.1\,^{+1.6\,+0.5}_{-1.5\,-0.6}$	6.1 ± 1.6 $6.1\,^{+1.7}_{-1.6}$

[1] $0.755 < m_{K\pi} < 1.250$ GeV/c^2.
[2] Result extracted from Dalitz-plot analysis of $B^0 \to K^+\pi^-\pi^0$ decays.
[3] Multiple systematic uncertainties are added in quadrature.
[4] The nonresonant amplitude is taken to be constant across the Dalitz plane.
[5] $1.1 < m_{K\pi} < 1.6$ GeV/c^2.
[6] K_x^* stands for the possible candidates of $K^*(1410)$, $K_0^*(1430)$ and $K_2^*(1430)$

Table 17: Branching fractions of charmless mesonic B^0 decays with strange mesons (part 4).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$[1,2]	BaBar [102][3,4]	$50.15 \pm 1.47 \pm 1.76$	49.5 ± 1.7
	Belle [103][3]	$47.5 \pm 2.4 \pm 3.7$	
	CLEO [47]	$50.0\,^{+10.0}_{-9.0} \pm 7.0$	
	LHCb [104][5,6], [105][7], [106][8,9], [106][8,10], [106][8,11], [106][8,12], [106][8,13], [107][14,15], [107][14,4,16]		49.7 ± 1.8
$\mathcal{B}(B^0 \to K^0\pi^+\pi^-(\mathrm{NR}))$[17]	LHCb [108][3,18,4,19]	$12.60 \pm 0.67 \pm 3.05$	14.0 ± 1.7 p=0.16%
	BaBar [102][3,20,4]	$11.07\,^{+2.51}_{-0.99} \pm 0.90$	$13.9\,^{+2.6}_{-1.8}$
	Belle [103][3,21]	$19.9 \pm 2.5\,^{+1.7}_{-2.0}$	
$\mathcal{B}(B^0 \to \rho^0(770)K^0)$[17]	BaBar [102][3,4]	$4.36\,^{+0.71}_{-0.62} \pm 0.31$	3.45 ± 0.48 p=0.16%
	LHCb [108][3,4,19]	$1.97\,^{+0.57}_{-0.83} \pm 0.42$	$3.41\,^{+1.08}_{-1.14}$
	Belle [103][3]	$6.1 \pm 1.0\,^{+1.1}_{-1.2}$	
$\mathcal{B}(B^0 \to K^*(892)^+\pi^-)$	BaBar [102][3,4]	$8.29\,^{+0.92}_{-0.81} \pm 0.82$	7.64 ± 0.44 p=0.16%
	BaBar [99][22]	$8.0 \pm 1.1 \pm 0.8$	7.50 ± 0.44
	Belle [103][3]	$8.4 \pm 1.1\,^{+1.0}_{-0.9}$	
	CLEO [47]	$16.0\,^{+6.0}_{-5.0} \pm 2.0$	
	LHCb [109][23,24], [108][3,4,25]		

[1] The PDG average is a result of a fit including input from other measurements.
[2] Treatment of charmonium intermediate components differs between the results.
[3] Result extracted from Dalitz-plot analysis of $B^0 \to K^0_S\pi^+\pi^-$ decays.
[4] Multiple systematic uncertainties are added in quadrature.
[5] Measurement of $\frac{f_{\Xi_b^0}}{f_d}\mathcal{B}(\Xi_b^0 \to p\overline{K}^0\pi^-)/\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$ used in our fit.
[6] Measurement of $\frac{f_{\Xi_b^0}}{f_d}\mathcal{B}(\Xi_b^0 \to p\overline{K}^0K^-)/\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$ used in our fit.
[7] Measurement of $\mathcal{B}(B^0 \to K^*(892)^0\overline{K}^0\text{+c.c.})/\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$ used in our fit.
[8] Regions corresponding to D, Λ_c^+ and charmonium resonances are vetoed in this analysis.
[9] Measurement of $\mathcal{B}(B^0 \to K^0K^+\pi^-\text{+c.c.})/\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$ used in our fit.
[10] Measurement of $\mathcal{B}(B^0 \to K^0K^+K^-)/\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$ used in our fit.
[11] Measurement of $\mathcal{B}(B_s^0 \to K^0\pi^+\pi^-)/\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$ used in our fit.
[12] Measurement of $\mathcal{B}(B_s^0 \to K^0K^+\pi^-\text{+c.c.})/\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$ used in our fit.
[13] Measurement of $\mathcal{B}(B_s^0 \to K^0K^+K^-)/\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$ used in our fit.
[14] The charmonium mass region has been vetoed.
[15] Measurement of $\mathcal{B}(B^0 \to p\overline{p}K^0)/\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$ used in our fit.
[16] Measurement of $\mathcal{B}(B_s^0 \to p\overline{p}K^0)/\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$ used in our fit.
[17] The PDG uncertainty includes a scale factor.
[18] The nonresonant component is modelled as a flat contribution over the Dalitz plane.
[19] Using $\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$.
[20] This value includes the flat NR component and the effective range of the LASS lineshape. The value corresponding to the flat component alone is also given in the article.
[21] The nonresonant component is modelled using a sum of two exponential functions.
[22] Result extracted from Dalitz-plot analysis of $B^0 \to K^+\pi^-\pi^0$ decays.
[23] Measurement of $\mathcal{B}(B_s^0 \to K^*(892)^-\pi^+)/\mathcal{B}(B^0 \to K^*(892)^+\pi^-)$ used in our fit.
[24] Measurement of $\mathcal{B}(B^0 \to K^*(892)^-K^+\text{+c.c.})/\mathcal{B}(B^0 \to K^*(892)^+\pi^-)$ used in our fit.
[25] Measurement of $(\mathcal{B}(B^0 \to K^*(892)^+\pi^-)2/3)/\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$ used in our fit.

Table 18: Branching fractions of charmless mesonic B^0 decays with strange mesons (part 5).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^0 \to K_0^*(1430)^+\pi^-)$[1]	BaBar [102][2,3]	$29.9\,^{+2.3}_{-1.7} \pm 3.6$	$33.6\,^{+3.8}_{-4.0}$
	Belle [103][2]	$49.7 \pm 3.8\,^{+6.8}_{-8.2}$	$33.5\,^{+7.4}_{-7.2}$
$\mathcal{B}(B^0 \to K_x^{*+}\pi^-)$	Belle [100][4,5]	$5.1 \pm 1.5\,^{+0.6}_{-0.7}$	5.1 ± 1.6
			$5.1\,^{+1.6}_{-1.7}$
$\mathcal{B}(B^0 \to K^*(1410)^+\pi^-) \times \mathcal{B}(K^*(1410)^+ \to K^0\pi^+)$			
	Belle [103][2]	< 3.8	< 3.8
$\mathcal{B}(B^0 \to (K\pi)_0^{*+}\pi^-) \times \mathcal{B}((K\pi)_0^{*+} \to K^0\pi^+)$			
	LHCb [108][2,3,6]	$16.95 \pm 0.73 \pm 1.12$	18.6 ± 1.1
	BaBar [102][2,3]	$22.7\,^{+1.7}_{-1.3} \pm 1.3$	p=0.16%
			16.2 ± 1.3
$\mathcal{B}(B^0 \to f_0(980)K^0) \times \mathcal{B}(f_0(980) \to \pi^+\pi^-)$[1]			
	LHCb [108][2,3,6]	$9.64 \pm 0.41 \pm 0.79$	8.38 ± 0.61
	BaBar [102][2,3]	$6.92 \pm 0.77 \pm 0.56$	p=0.16%
	Belle [103][2]	$7.6 \pm 1.7\,^{+0.9}_{-1.3}$	$8.15\,^{+0.78}_{-0.79}$
$\mathcal{B}(B^0 \to f_0(500)K^0)$	LHCb [108][2,3,6]	$0.166\,^{+0.207}_{-0.041} \pm 0.155$	$0.17\,^{+0.26}_{-0.16}$
			p=0.16%
			$0.16\,^{+0.25}_{-0.16}$
$\mathcal{B}(B^0 \to f_0(1500)K^0) \times \mathcal{B}(f_0(1500) \to \pi^+\pi^-)$			
			1.35 ± 0.79
	LHCb [108][2,3,6]	$1.348 \pm 0.280 \pm 0.734$	p=0.16%
			1.29 ± 0.75
$\mathcal{B}(B^0 \to f_2(1270)K^0)$	BaBar [102][2,3]	$2.71\,^{+0.99}_{-0.83} \pm 0.87$	2.7 ± 1.3
	Belle [103][2,7]	< 2.5	$2.7\,^{+1.3}_{-1.2}$
$\mathcal{B}(B^0 \to f_x(1300)^0K^0) \times \mathcal{B}(f_x(1300)^0 \to \pi^+\pi^-)$			
	BaBar [102][2,3]	$1.81\,^{+0.55}_{-0.45} \pm 0.48$	$1.81\,^{+0.73}_{-0.66}$

[1] The PDG uncertainty includes a scale factor.
[2] Result extracted from Dalitz-plot analysis of $B^0 \to K^0_S\pi^+\pi^-$ decays.
[3] Multiple systematic uncertainties are added in quadrature.
[4] $1.1 < m_{K\pi} < 1.6$ GeV/c^2.
[5] K_x^* stands for the possible candidates of $K^*(1410)$, $K_0^*(1430)$ and $K_2^*(1430)$
[6] Using $\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$.
[7] Using $\mathcal{B}(f_2(1270) \to \pi^+\pi^-)$.

Table 19: Branching fractions of charmless mesonic B^0 decays with strange mesons (part 6).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^0 \to K^*(892)^0\pi^0)$	BaBar [99][1]	$3.3 \pm 0.5 \pm 0.4$	3.3 ± 0.6
	Belle [100]	< 3.5	
$\mathcal{B}(B^0 \to K_2^*(1430)^+\pi^-)$	Belle [103][2]	< 6.3	3.82 ± 0.36
	BaBar [101][1]	< 16.2	p=0.16%
	LHCb [108][2,3,4]		$3.65\,^{+0.34}_{-0.33}$
$\mathcal{B}(B^0 \to K^*(1680)^+\pi^-)$	Belle [103][2]	< 10.1	14.7 ± 1.4
	BaBar [101][1]	< 25.0	p=0.16%
	LHCb [108][2,3,5]		14.1 ± 1.0
$\mathcal{B}(B^0 \to K^+\pi^-\pi^+\pi^-)$	DELPHI [110]	< 230	< 230
$\mathcal{B}(B^0 \to \rho^0(770)K^+\pi^-)$	Belle [111][6]	$2.8 \pm 0.5 \pm 0.5$	2.8 ± 0.7
$\mathcal{B}(B^0 \to f_0(980)K^+\pi^-) \times \mathcal{B}(f_0(980) \to \pi\pi)$			
	Belle [111][6]	$1.4 \pm 0.4\,^{+0.3}_{-0.4}$	$1.4\,^{+0.5}_{-0.6}$
$\mathcal{B}(B^0 \to K^+\pi^-\pi^+\pi^-(\mathrm{NR}))$	Belle [111][6,7]	< 2.1	< 2.1
$\mathcal{B}(B^0 \to K^*(892)^0\pi^+\pi^-)$	BaBar [112]	$54.5 \pm 2.9 \pm 4.3$	54.5 ± 5.2
$\mathcal{B}(B^0 \to K^*(892)^0\rho^0(770))$[8]	BaBar [113]	$5.1 \pm 0.6\,^{+0.6}_{-0.8}$	3.88 ± 0.77
	Belle [111]	$2.1\,^{+0.8\,+0.9}_{-0.7\,-0.5}$	$3.88\,^{+1.33}_{-1.25}$
$\mathcal{B}(B^0 \to f_0(980)K_0^*(892)^0) \times \mathcal{B}(f_0(980) \to \pi\pi)$[8]			
	Belle [111]	$1.4\,^{+0.6\,+0.6}_{-0.5\,-0.4}$	3.90 ± 0.55
	BaBar [113]	$5.7 \pm 0.6 \pm 0.4$	p=0.01%
			$3.90\,^{+2.12}_{-1.85}$

[1] Result extracted from Dalitz-plot analysis of $B^0 \to K^+\pi^-\pi^0$ decays.
[2] Result extracted from Dalitz-plot analysis of $B^0 \to K^0_S\pi^+\pi^-$ decays.
[3] Multiple systematic uncertainties are added in quadrature.
[4] Measurement of $(\mathcal{B}(B^0 \to K_2^*(1430)^+\pi^-)\mathcal{B}(K_2^*(1430)^+ \to K\pi)2/3)/\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$ used in our fit.
[5] Measurement of $(\mathcal{B}(B^0 \to K^*(1680)^+\pi^-)\mathcal{B}(K^*(1680)^+ \to K\pi)2/3)/\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$ used in our fit.
[6] $0.75 < m_{K\pi} < 1.20$ GeV/c^2.
[7] $0.55 < m_{\pi\pi} < 1.20$ GeV/c^2.
[8] The PDG uncertainty includes a scale factor.

Table 20: Branching fractions of charmless mesonic B^0 decays with strange mesons (part 7).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^0 \to K_1(1270)^+\pi^-)$	BaBar [38]	< 30	< 30
$\mathcal{B}(B^0 \to K_1(1400)^+\pi^-)$	BaBar [38]	< 27	< 27
$\mathcal{B}(B^0 \to a_1(1260)^- K^+)$	BaBar [41]	$16.3 \pm 2.9 \pm 2.3$	16.3 ± 3.7
$\mathcal{B}(B^0 \to K^*(892)^+\rho^-(770))$	BaBar [113]	$10.3 \pm 2.3 \pm 1.3$	10.3 ± 2.6
$\mathcal{B}(B^0 \to (K\pi)_0^{*+}\rho^-(770)) \times \mathcal{B}((K\pi)_0^* \to K\pi)$	BaBar [113]	< 48	< 48 none
$\mathcal{B}(B^0 \to K_0^*(1430)^+\rho^-(770))$	BaBar [113][1]	$28 \pm 10 \pm 6$	28 ± 12
$\mathcal{B}(B^0 \to K_1(1400)^0\rho^0(770))$	ARGUS [44]	< 3000	< 3000
$\mathcal{B}(B^0 \to (K\pi)_0^{*0}\rho^0(770)) \times \mathcal{B}((K\pi)_0^* \to K\pi)$	BaBar [113]	$31 \pm 4 \pm 3$	31.0 ± 5.0 none
$\mathcal{B}(B^0 \to K_0^*(1430)^0\rho^0(770))$	BaBar [113][1]	$27 \pm 4 \pm 4$	27.0 ± 5.4 27.0 ± 5.7
$\mathcal{B}(B^0 \to (K\pi)_0^{*0} f_0(980)) \times \mathcal{B}(f_0(980) \to \pi\pi) \times \mathcal{B}((K\pi)_0^* \to K\pi)$	BaBar [113]	$3.1 \pm 0.8 \pm 0.7$	3.1 ± 1.1 none
$\mathcal{B}(B^0 \to K_0^*(1430)^0 f_0(980)) \times \mathcal{B}(f_0(980) \to \pi\pi)$	BaBar [113][1]	$2.7 \pm 0.7 \pm 0.6$	2.7 ± 0.9
$\mathcal{B}(B^0 \to K_2^*(1430)^0 f_0(980)) \times \mathcal{B}(f_0(980) \to \pi\pi)$	BaBar [113]	$8.6 \pm 1.7 \pm 1.0$	8.6 ± 2.0
$\mathcal{B}(B^0 \to K^+K^-)$	LHCb [92][2]	$0.0799 \pm 0.0130 \pm 0.0086$	
	Belle [3]	$0.10 \pm 0.08 \pm 0.04$	0.082 ± 0.015
	CDF [90][2]	$0.24 \pm 0.10 \pm 0.10$	0.078 ± 0.015
	BaBar [87]	< 0.5	
$\mathcal{B}(B^0 \to K^0\overline{K}^0)$	Belle [3]	$1.26 \pm 0.19 \pm 0.05$	1.21 ± 0.16
	BaBar [5]	$1.08 \pm 0.28 \pm 0.11$	
$\mathcal{B}(B^0 \to K^0K^+\pi^-+\text{c.c.})$	LHCb [106][3,4]	$6.09 \pm 0.45 \pm 0.77$	
	Belle [114]	$7.20 \pm 0.66 \pm 0.30$	6.7 ± 0.5
	BaBar [115]	$6.4 \pm 1.0 \pm 0.6$	
$\mathcal{B}(B^0 \to K^*(892)^- K^+ + \text{c.c.})$	LHCb [109][5]	< 0.38	< 0.4
$\mathcal{B}(B^0 \to K^*(892)^0\overline{K}^0 + \text{c.c.})$[6]	LHCb [105][4]	< 1.0	< 0.99
	BaBar [116]	< 1.9	< 0.96

[1] Multiple systematic uncertainties are added in quadrature.
[2] Using $\mathcal{B}(B^0 \to K^+\pi^-)$.
[3] Regions corresponding to D, Λ_c^+ and charmonium resonances are vetoed in this analysis.
[4] Using $\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$.
[5] Using $\mathcal{B}(B^0 \to K^*(892)^+\pi^-)$.
[6] $0.75 < m_{K\pi} < 1.20$ GeV/c^2.

Table 21: Branching fractions of charmless mesonic B^0 decays with strange mesons (part 8).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^0 \to K^+K^-\pi^0)$	Belle [117]	$2.17 \pm 0.60 \pm 0.24$	2.17 ± 0.65
$\mathcal{B}(B^0 \to K^0_S K^0_S \pi^0)$	BaBar [118]	< 0.9	< 0.9
$\mathcal{B}(B^0 \to K^0_S K^0_S \eta)$	BaBar [118]	< 1.0	< 1.0
$\mathcal{B}(B^0 \to K^0_S K^0_S \eta')$	BaBar [118]	< 2.0	< 2.0
$\mathcal{B}(B^0 \to K^0 K^+ K^-)$	LHCb [106][1,2]	$27.19 \pm 0.89 \pm 1.88$	26.8 ± 1.0
	BaBar [21][3,4]	$26.5 \pm 0.9 \pm 0.8$	26.8 ± 1.1
	Belle [36]	$28.3 \pm 3.3 \pm 4.0$	
$\mathcal{B}(B^0 \to \phi(1020)K^0)$	BaBar [21][3]	$7.1 \pm 0.6 \,^{+0.4}_{-0.3}$	7.39 ± 0.65
	Belle [63]	$9.0 \,^{+2.2}_{-1.8} \pm 0.7$	$7.32 \,^{+0.69}_{-0.63}$
	LHCb [119][5], [120][6,7]		
$\mathcal{B}(B^0 \to f_0(980)K^0) \times \mathcal{B}(f_0(980) \to K^+K^-)$			
	BaBar [21][3]	$7.0 \,^{+2.6}_{-1.8} \pm 2.4$	$7.0 \,^{+3.5}_{-3.0}$
$\mathcal{B}(B^0 \to f_0(1500)K^0)$	BaBar [21][3]	$13.3 \,^{+5.8}_{-4.4} \pm 3.2$	$13.3 \,^{+6.6}_{-5.4}$
$\mathcal{B}(B^0 \to f'_2(1525)K^0)$	BaBar [21][3]	$0.29 \,^{+0.27}_{-0.18} \pm 0.36$	$0.29 \,^{+0.45}_{-0.40}$
$\mathcal{B}(B^0 \to f_0(1710)K^0) \times \mathcal{B}(f_0(1710) \to K^+K^-)$			
	BaBar [21][3]	$4.4 \pm 0.7 \pm 0.5$	4.4 ± 0.9
$\mathcal{B}(B^0 \to K^0K^+K^-(\mathrm{NR}))$	BaBar [21][8]	$33 \pm 5 \pm 9$	33 ± 10

[1] Regions corresponding to D, Λ_c^+ and charmonium resonances are vetoed in this analysis.

[2] Using $\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$.

[3] Result extracted from Dalitz-plot analysis of $B^0 \to K^0_S K^+ K^-$ decays.

[4] All charmonium resonances are vetoed, except for χ_{c0}. The analysis also reports $\mathcal{B}(B^0 \to K^0K^+K^-) = (25.4 \pm 0.9 \pm 0.8) \times 10^{-6}$ excluding χ_{c0}.

[5] Measurement of $(\mathcal{B}(\Lambda_b^0 \to \Lambda^0\phi(1020))/\mathcal{B}(B^0 \to \phi(1020)K^0))(f_{\Lambda_b^0}/f_d)2$ used in our fit.

[6] Multiple systematic uncertainties are added in quadrature.

[7] Measurement of $\mathcal{B}(B_s^0 \to K^0\overline{K}^0)/\mathcal{B}(B^0 \to \phi(1020)K^0)$ used in our fit.

[8] The nonresonant amplitude is modelled using a polynomial function including S-wave and P-wave terms.

Table 22: Branching fractions of charmless mesonic B^0 decays with strange mesons (part 9).

Parameter [10^{-6}]	**Measurements**		**Average** $^{\text{HFLAV}}_{\text{PDG}}$
$\mathcal{B}(B^0 \to K^0_S K^0_S K^0_S)$[1]	BaBar [121][2,3]	$6.19 \pm 0.48 \pm 0.19$	6.04 ± 0.50
	Belle [36]	$4.2\,^{+1.6}_{-1.3} \pm 0.8$	$6.04\,^{+0.53}_{-0.52}$
$\mathcal{B}(B^0 \to f_0(980)K^0_S) \times \mathcal{B}(f_0(980) \to K^0_S K^0_S)$			
	BaBar [121][2,3]	$2.7\,^{+1.3}_{-1.2} \pm 1.3$	2.7 ± 1.8
$\mathcal{B}(B^0 \to f_0(1710)K^0_S) \times \mathcal{B}(f_0(1710) \to K^0_S K^0_S)$			
	BaBar [121][2,3]	$0.50\,^{+0.46}_{-0.24} \pm 0.11$	$0.50\,^{+0.47}_{-0.26}$
$\mathcal{B}(B^0 \to f_2(2010)K^0_S) \times \mathcal{B}(f_2(2010) \to K^0_S K^0_S)$			
	BaBar [121][2,3]	$0.54\,^{+0.21}_{-0.20} \pm 0.52$	0.54 ± 0.56
$\mathcal{B}(B^0 \to K^0_S K^0_S K^0_S(\text{NR}))$	BaBar [121][4,3]	$13.3\,^{+2.2}_{-2.3} \pm 0.6$	13.3 ± 2.3
			$13.3\,^{+3.1}_{-3.2}$
$\mathcal{B}(B^0 \to K^0_S K^0_S K^0_L)$	BaBar [122][5]	< 16	< 16

[1] The PDG uncertainty includes a scale factor.
[2] Result extracted from Dalitz-plot analysis of $B^0 \to K^0_S K^0_S K^0_S$ decays.
[3] Multiple systematic uncertainties are added in quadrature.
[4] The nonresonant amplitude is modelled using an exponential function.
[5] $0.75 < m_{K\pi} < 1.20$ GeV/c^2.

Table 23: Branching fractions of charmless mesonic B^0 decays with strange mesons (part 10).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^0 \to K^*(892)^0 K^+ K^-)$	BaBar [112]	$27.5 \pm 1.3 \pm 2.2$	27.5 ± 2.6
$\mathcal{B}(B^0 \to \phi(1020) K^*(892)^0)$	BaBar [123]	$9.7 \pm 0.5 \pm 0.5$	10.09 ± 0.49
	Belle [124]	$10.4 \pm 0.5 \pm 0.6$	
	CLEO [61]	$11.5\ ^{+4.5\ +1.8}_{-3.7\ -1.7}$	10.04 ± 0.52
	LHCb [125][1,2], [126][1,3], [127][1,4], [128][5]		
$\mathcal{B}(B^0 \to K^+\pi^-\pi^+K^-(\mathrm{NR}))$	Belle [129][6]	< 71.7	< 72
$\mathcal{B}(B^0 \to K^*(892)^0 \pi^+ K^-)$	BaBar [112]	$4.6 \pm 1.1 \pm 0.8$	4.5 ± 1.3
	Belle [129][6]	$2.11\ ^{+5.63\ +4.85}_{-5.26\ -4.75}$	
$\mathcal{B}(B^0 \to K^*(892)^0 \overline{K}^*(892)^0)$[7]	LHCb [130][1,8]	$0.65 \pm 0.05 \pm 0.15$	$0.68\ ^{+0.15}_{-0.14}$
	Belle [129]	$0.26\ ^{+0.33\ +0.10}_{-0.29\ -0.08}$	$0.83\ ^{+0.25}_{-0.23}$
	BaBar [131]	$1.28\ ^{+0.35}_{-0.30} \pm 0.11$	
$\mathcal{B}(B^0 \to K^+\pi^- K^+\pi^-(\mathrm{NR}))$	Belle [129][6]	< 6.0	< 6.0
$\mathcal{B}(B^0 \to K^*(892)^0 K^+\pi^-)$	BaBar [112]	< 2.2	< 2.2
	Belle [129][6]	< 7.6	
$\mathcal{B}(B^0 \to K^*(892)^0 K^*(892)^0)$	Belle [129]	< 0.20	< 0.2
	BaBar [131]	< 0.41	
$\mathcal{B}(B^0 \to K^*(892)^+ K^*(892)^-)$	BaBar [132]	< 2.0	< 2.0
$\mathcal{B}(B^0 \to K_1(1400)^0 \phi(1020))$	ARGUS [44]	< 5000	< 5000
$\mathcal{B}(B^0 \to (K\pi)_0^{*0} \phi(1020))$	Belle [124]	$4.3 \pm 0.4 \pm 0.4$	4.30 ± 0.45
	BaBar [123]	$4.3 \pm 0.6 \pm 0.4$	
$\mathcal{B}(B^0 \to (K\pi)_0^{*0} \phi), 1.60 < m_{K\pi} < 2.15$ GeV/c^2.			
	BaBar [133]	< 1.7	< 1.7

[1] Multiple systematic uncertainties are added in quadrature.
[2] Measurement of $\mathcal{B}(B_s^0 \to \phi(1020)\overline{K}^*(892)^0)/\mathcal{B}(B^0 \to \phi(1020)K^*(892)^0)$ used in our fit.
[3] Measurement of $\mathcal{B}(B_s^0 \to K^*(892)^0\overline{K}^*(892)^0)/\mathcal{B}(B^0 \to \phi(1020)K^*(892)^0)$ used in our fit.
[4] Measurement of $\mathcal{B}(B_s^0 \to \phi(1020)\phi(1020))/\mathcal{B}(B^0 \to \phi(1020)K^*(892)^0)$ used in our fit.
[5] Measurement of $\mathcal{B}(B^0 \to \rho^0(770)\rho^0(770))/\mathcal{B}(B^0 \to \phi(1020)K^*(892)^0)$ used in our fit.
[6] $0.70 < m_{K\pi} < 1.70$ GeV/c^2.
[7] The PDG uncertainty includes a scale factor.
[8] Using $\mathcal{B}(B_s^0 \to K^*(892)^0\overline{K}^*(892)^0)$.

Table 24: Branching fractions of charmless mesonic B^0 decays with strange mesons (part 11).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^0 \to K_0^*(1430)^0\pi^+K^-)$	Belle [129][1]	< 31.8	< 32
$\mathcal{B}(B^0 \to K_0^*(1430)^0\overline{K}^*(892)^0)$	Belle [129]	< 3.3	< 3.3
$\mathcal{B}(B^0 \to K_0^*(1430)^0\overline{K}_0^*(1430)^0)$	Belle [129]	< 8.4	< 8.4
$\mathcal{B}(B^0 \to \phi(1020)K_0^*(1430)^0)$	BaBar [123]	$3.9 \pm 0.5 \pm 0.6$	3.90 ± 0.78
$\mathcal{B}(B^0 \to K_0^*(1430)^0K^*(892)^0)$	Belle [129]	< 1.7	< 1.7
$\mathcal{B}(B^0 \to K_0^*(1430)^0K_0^*(1430)^0)$	Belle [129]	< 4.7	< 4.7
$\mathcal{B}(B^0 \to \phi(1020)K^*(1680)^0)$	BaBar [133]	< 3.5	< 3.5
$\mathcal{B}(B^0 \to \phi(1020)K_3^*(1780)^0)$	BaBar [133]	< 2.7	< 2.7
$\mathcal{B}(B^0 \to \phi(1020)K_4^*(2045)^0)$	BaBar [133]	< 15.3	< 15
$\mathcal{B}(B^0 \to \rho^0(770)K_2^*(1430)^0)$	ARGUS [44]	< 1100	< 1100
$\mathcal{B}(B^0 \to \phi(1020)K_2^*(1430)^0)$[2]	Belle [124] BaBar [123]	$5.5\,^{+0.9}_{-0.7} \pm 1.0$ $7.5 \pm 0.9 \pm 0.5$	6.8 ± 0.8 $6.8\,^{+1.0}_{-0.9}$
$\mathcal{B}(B^0 \to \phi(1020)\phi(1020)K^0)$	BaBar [66][3]	$4.5 \pm 0.8 \pm 0.3$	4.5 ± 0.9 3.7 ± 0.7
$\mathcal{B}(B^0 \to \eta'\eta'K^0)$	BaBar [68]	< 31.0	< 31

[1] $0.70 < m_{K\pi} < 1.70$ GeV/c^2.

[2] The PDG uncertainty includes a scale factor.

[3] Measured in the $\phi\phi$ invariant mass range below the η_c resonance ($m_{\phi\phi} < 2.85$ GeV/c^2).

Table 25: Branching fractions of charmless mesonic B^0 decays without strange mesons (part 1).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^0 \to \pi^+\pi^-)$	LHCb [91][1]	$5.26 \pm 0.18 \pm 0.36$	
	Belle II [4]	$5.8 \pm 0.2 \pm 0.2$	
	Belle [3]	$5.04 \pm 0.21 \pm 0.18$	5.36 ± 0.16
	CDF [89][1]	$5.20 \pm 0.34 \pm 0.34$	5.37 ± 0.20
	BaBar [87]	$5.5 \pm 0.4 \pm 0.3$	
	CLEO [6]	$4.5\,^{+1.4\,+0.5}_{-1.2\,-0.4}$	
$\mathcal{B}(B^0 \to \pi^0\pi^0)$[2]	Belle [134]	$1.31 \pm 0.19 \pm 0.19$	1.46 ± 0.14
	Belle II [135]	$1.25 \pm 0.20 \pm 0.11$	1.55 ± 0.17
	BaBar [93]	$1.83 \pm 0.21 \pm 0.13$	
$\mathcal{B}(B^0 \to \eta\pi^0)$	Belle [136]	$0.41\,^{+0.17\,+0.05}_{-0.15\,-0.07}$	0.41 ± 0.17
	BaBar [82]	< 1.5	$0.41\,^{+0.18}_{-0.17}$
	CLEO [12]	< 2.9	
$\mathcal{B}(B^0 \to \eta\eta)$	BaBar [9]	< 1.0	< 1.0
$\mathcal{B}(B^0 \to \eta'\pi^0)$[2]	BaBar [82]	$0.9 \pm 0.4 \pm 0.1$	1.2 ± 0.4
	Belle [10]	$2.79\,^{+1.02\,+0.25}_{-0.96\,-0.34}$	1.2 ± 0.6
$\mathcal{B}(B^0 \to \eta'\eta')$	BaBar [9]	< 1.7	< 1.7
	Belle [15]	< 6.5	
$\mathcal{B}(B^0 \to \eta'\eta)$	BaBar [82]	< 1.2	< 1.2
	Belle [15]	< 4.5	
$\mathcal{B}(B^0 \to \eta'\rho^0(770))$	Belle [15]	< 1.3	< 1.3
	BaBar [14]	< 2.8	
$\mathcal{B}(B^0 \to f_0(980)\eta') \times \mathcal{B}(f_0(980) \to \pi^+\pi^-)$			
	BaBar [14]	< 0.9	< 0.9
$\mathcal{B}(B^0 \to \eta\rho^0(770))$	BaBar [97]	< 1.5	< 1.5
	Belle [18]	< 1.9	
$\mathcal{B}(B^0 \to f_0(980)\eta) \times \mathcal{B}(f_0(980) \to \pi^+\pi^-)$			
	BaBar [97]	< 0.4	< 0.4
$\mathcal{B}(B^0 \to \omega(782)\eta)$	BaBar [9]	$0.94\,^{+0.35}_{-0.30} \pm 0.09$	$0.94\,^{+0.36}_{-0.31}$

[1] Using $\mathcal{B}(B^0 \to K^+\pi^-)$.

[2] The PDG uncertainty includes a scale factor.

Table 26: Branching fractions of charmless mesonic B^0 decays without strange mesons (part 2).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^0 \to \omega(782)\eta')$	BaBar [9]	$1.01\,^{+0.46}_{-0.38} \pm 0.09$	$1.01\,^{+0.47}_{-0.39}$
	Belle [15]	< 2.2	
$\mathcal{B}(B^0 \to \omega(782)\rho^0(770))$	BaBar [25]	< 1.6	< 1.6
$\mathcal{B}(B^0 \to f_0(980)\omega(782)) \times \mathcal{B}(f_0(980) \to \pi^+\pi^-)$			
	BaBar [25]	< 1.5	< 1.5
$\mathcal{B}(B^0 \to \omega(782)\omega(782))$	BaBar [137]	$1.2 \pm 0.3\,^{+0.3}_{-0.2}$	1.2 ± 0.4
			$1.4\,^{+0.3}_{-0.2}$
$\mathcal{B}(B^0 \to \phi(1020)\pi^0)$	Belle [84]	< 0.15	< 0.15
	BaBar [83]	< 0.28	
$\mathcal{B}(B^0 \to \phi(1020)\eta)$	BaBar [9]	< 0.5	< 0.5
$\mathcal{B}(B^0 \to \phi(1020)\eta')$	Belle [15]	< 0.5	< 0.5
	BaBar [9]	< 1.1	
$\mathcal{B}(B^0 \to \phi(1020)\pi^+\pi^-)$	LHCb [138][1,2]	$0.182 \pm 0.025 \pm 0.043$	0.182 ± 0.050
$\mathcal{B}(B^0 \to \phi(1020)\rho^0(770))$	BaBar [85]	< 0.33	< 0.33
$\mathcal{B}(B^0 \to f_0(980)\phi(1020)) \times \mathcal{B}(f_0(980) \to \pi^+\pi^-)$			
	BaBar [85]	< 0.38	< 0.38
$\mathcal{B}(B^0 \to \omega(782)\phi(1020))$	BaBar [137]	< 0.7	< 0.7
$\mathcal{B}(B^0 \to \phi(1020)\phi(1020))$	LHCb [139]	< 0.013	< 0.013
	BaBar [85]	< 0.2	< 0.027
$\mathcal{B}(B^0 \to a_0(980)^+\pi^-$+c.c.$) \times \mathcal{B}(a_0(980)^+ \to \eta\pi^+)$			
	BaBar [97]	< 3.1	< 3.1
$\mathcal{B}(B^0 \to a_0(1450)^+\pi^-$+c.c.$) \times \mathcal{B}(a_0(1450)^+ \to \eta\pi^+)$			
	BaBar [97]	< 2.3	< 2.3

[1] $400 < m_{\pi^+\pi^-} < 1600$ MeV/c^2.
[2] Multiple systematic uncertainties are added in quadrature.

Table 27: Branching fractions of charmless mesonic B^0 decays without strange mesons (part 3).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^0 \to \pi^+\pi^-\pi^0)$	ARGUS [76]	< 720	< 720
$\mathcal{B}(B^0 \to \rho^0(770)\pi^0)$	Belle [140][1]	$3.0 \pm 0.5 \pm 0.7$	2.0 ± 0.5
	BaBar [141]	$1.4 \pm 0.6 \pm 0.3$	
	CLEO [24]	$1.6\,^{+2.0}_{-1.4} \pm 0.8$	
$\mathcal{B}(B^0 \to \rho^+(770)\pi^-$+c.c.)	Belle [140][1]	$22.6 \pm 1.1 \pm 4.4$	23.0 ± 2.3
	BaBar [142]	$22.6 \pm 1.8 \pm 2.2$	
	CLEO [24]	$27.6\,^{+8.4}_{-7.4} \pm 4.2$	
$\mathcal{B}(B^0 \to \pi^+\pi^-\pi^+\pi^-)$	Belle [143][2]	< 11.2	< 11
	BaBar [144][3]	< 23.1	
$\mathcal{B}(B^0 \to \rho^0(770)\pi^+\pi^-)$	BaBar [144][3]	< 8.8	< 8.8
	Belle [143][2]	< 12.0	
$\mathcal{B}(B^0 \to \rho^0(770)\rho^0(770))$	LHCb [128][4]	$0.95 \pm 0.17 \pm 0.10$	0.96 ± 0.15
	Belle [143]	$1.02 \pm 0.30 \pm 0.15$	
	BaBar [144]	$0.92 \pm 0.32 \pm 0.14$	
$\mathcal{B}(B^0 \to f_0(980)\pi^+\pi^-) \times \mathcal{B}(f_0(980) \to \pi^+\pi^-)$			
	Belle [143][2]	< 3.0	< 3.0
$\mathcal{B}(B^0 \to f_0(980)\rho^0(770)) \times \mathcal{B}(f_0(980) \to \pi^+\pi^-)$			
	Belle [143]	$0.78 \pm 0.22 \pm 0.11$	0.78 ± 0.25
	BaBar [144]	< 0.40	
$\mathcal{B}(B^0 \to f_0(980)f_0(980)) \times \mathcal{B}(f_0(980) \to \pi^+\pi^-) \times \mathcal{B}(f_0(980) \to \pi^+\pi^-)$			
	BaBar [144]	< 0.19	< 0.19
	Belle [143]	< 0.2	
$\mathcal{B}(B^0 \to f_0(980)f_0(980)) \times \mathcal{B}(f_0(980) \to \pi^+\pi^-) \times \mathcal{B}(f_0(980) \to K^+K^-)$			
	BaBar [85]	< 0.23	< 0.23

[1] Result extracted from Dalitz-plot analysis of $B^0 \to \pi^+\pi^-\pi^0$ decays.
[2] $0.52 < m_{\pi^+\pi^-} < 1.15$ GeV/c^2.
[3] $0.55 < m_{\pi^+\pi^-} < 1.050$ GeV/c^2.
[4] Using $\mathcal{B}(B^0 \to \phi(1020)K^*(892)^0)$.

Table 28: Branching fractions of charmless mesonic B^0 decays without strange mesons (part 4).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^0 \to a_1(1260)^+\pi^-$+c.c.)[1]	Belle [145]	$22.2 \pm 2.0 \pm 2.8$	25.9 ± 2.8
	BaBar [146]	$33.2 \pm 3.8 \pm 3.0$	25.9 ± 5.2
$\mathcal{B}(B^0 \to a_2(1320)^+\pi^-$+c.c.)	Belle [145]	< 6.3	< 6.3
$\mathcal{B}(B^0 \to \pi^+\pi^-\pi^0\pi^0)$	ARGUS [76]	< 3100	< 3100
$\mathcal{B}(B^0 \to \rho^+(770)\rho^-(770))$	Belle [147]	$28.3 \pm 1.5 \pm 1.5$	28.0 ± 1.7
	BaBar [148]	$25.5 \pm 2.1\,^{+3.6}_{-3.9}$	
	Belle II [149]	$28.8\,^{+2.3\ +2.9}_{-2.2\ -2.7}$	27.7 ± 1.9
$\mathcal{B}(B^0 \to a_1(1260)^0\pi^0)$	ARGUS [76]	< 1100	< 1100
$\mathcal{B}(B^0 \to \omega(782)\pi^0)$	BaBar [82]	< 0.5	< 0.5
	Belle [81]	< 2.0	
$\mathcal{B}(B^0 \to \pi^+\pi^+\pi^-\pi^-\pi^0)$	ARGUS [76]	< 9000	< 9000
$\mathcal{B}(B^0 \to a_1(1260)^+\rho^-(770)$+c.c.)	BaBar [150]	< 61.0	< 61
$\mathcal{B}(B^0 \to a_1(1260)^0\rho^0(770))$	ARGUS [76]	< 2400	< 2400
$\mathcal{B}(B^0 \to b_1(1235)^+\pi^-$+c.c.) $\times\, \mathcal{B}(b_1(1235)^+ \to \omega(782)\pi^+)$			
	BaBar [50]	$10.9 \pm 1.2 \pm 0.9$	10.9 ± 1.5
$\mathcal{B}(B^0 \to b_1(1235)^0\pi^0) \times \mathcal{B}(b_1(1235)^0 \to \omega(782)\pi^0)$			
	BaBar [45]	< 1.9	< 1.9
$\mathcal{B}(B^0 \to b_1(1235)^-\rho^+(770)) \times \mathcal{B}(b_1(1235)^- \to \omega(782)\pi^-)$			
	BaBar [51]	< 1.4	< 1.4
$\mathcal{B}(B^0 \to b_1(1235)^0\rho^0(770)) \times \mathcal{B}(b_1(1235)^0 \to \omega(782)\pi^0)$			
	BaBar [51]	< 3.4	< 3.4
$\mathcal{B}(B^0 \to \pi^+\pi^+\pi^+\pi^-\pi^-\pi^-)$	ARGUS [76]	< 3000	< 3000
$\mathcal{B}(B^0 \to a_1(1260)^+a_1(1260)^-) \times \mathcal{B}(a_1(1260)^+ \to \pi^+\pi^+\pi^-) \times \mathcal{B}(a_1(1260)^- \to \pi^-\pi^-\pi^+)$			
	BaBar [151]	$11.8 \pm 2.6 \pm 1.6$	11.8 ± 3.1
$\mathcal{B}(B^0 \to \pi^+\pi^+\pi^+\pi^-\pi^-\pi^-\pi^0)$	ARGUS [76]	< 11000	< 11000

[1] The PDG uncertainty includes a scale factor.

Table 29: Relative branching fractions of mesonic B^+ decays.

Parameter	**Measurements**		**Average**
$\frac{\mathcal{B}(B^+ \to K^+K^-\pi^+)}{\mathcal{B}(B^+ \to K^+K^+K^-)}$	LHCb [31]	$0.151 \pm 0.004 \pm 0.008$	0.151 ± 0.009
$\frac{\mathcal{B}(B^+ \to K^+\pi^+\pi^-)}{\mathcal{B}(B^+ \to K^+K^+K^-)}$	LHCb [31]	$1.703 \pm 0.011 \pm 0.022$	1.703 ± 0.025
$\frac{\mathcal{B}(B^+ \to \pi^+\pi^+\pi^-)}{\mathcal{B}(B^+ \to K^+K^+K^-)}$	LHCb [31]	$0.488 \pm 0.005 \pm 0.009$	0.488 ± 0.010
$\frac{\mathcal{B}(B^+ \to K^+\overline{K}^0)}{\mathcal{B}(B^+ \to K^0\pi^+)}$ $[10^{-2}]$	LHCb [7]	$5.5 \pm 0.4 \pm 0.2$	5.50 ± 0.45

Table 30: Relative branching fractions of mesonic B^0 decays.

Parameter	Measurements		Average
$\frac{\mathcal{B}(B^0 \to K^+K^-)}{\mathcal{B}(B^0 \to K^+\pi^-)}$ $[10^{-3}]$	LHCb [92] CDF [90]	$3.98 \pm 0.65 \pm 0.42$ $12 \pm 5 \pm 5$	4.07 ± 0.77
$\frac{\mathcal{B}(B^0 \to K^*(892)^+K^-+\text{c.c.})}{\mathcal{B}(B^0 \to K^*(892)^+\pi^-)}$ $[10^{-2}]$	LHCb [109]	< 5	< 5.0
$\frac{\mathcal{B}(B^0 \to K^0_S K^*(892)^0+\text{c.c.})}{\mathcal{B}(B^0 \to K^0_S\pi^+\pi^-)}$ $[10^{-2}]$	LHCb [105]	< 2	< 2.0
$\frac{\mathcal{B}(B^0 \to \pi^+\pi^-)}{\mathcal{B}(B^0 \to K^+\pi^-)}$	LHCb [91] CDF [89]	$0.262 \pm 0.009 \pm 0.017$ $0.259 \pm 0.017 \pm 0.016$	0.261 ± 0.015
$\frac{\mathcal{B}(B^0 \to K^0K^+\pi^-+\text{c.c.})}{\mathcal{B}(B^0 \to K^0\pi^+\pi^-)}$	LHCb [106][1]	$0.123 \pm 0.009 \pm 0.015$	0.123 ± 0.017
$\frac{\mathcal{B}(B^0 \to K^0K^+K^-)}{\mathcal{B}(B^0 \to K^0\pi^+\pi^-)}$	LHCb [106][1]	$0.549 \pm 0.018 \pm 0.033$	0.549 ± 0.038
$\frac{\mathcal{B}(B^0 \to K^*(892)^0\overline{K}^*(892)^0)}{\mathcal{B}(B^0_s \to K^*(892)^0\overline{K}^*(892)^0)}$ $[10^{-2}]$	LHCb [130][2]	$5.4 \pm 0.4 \pm 0.7$	5.40 ± 0.83
$\frac{f_s}{f_d}\frac{\mathcal{B}(B^0 \to K^+K^-)}{\mathcal{B}(B^0_s \to K^+K^-)}$ $[10^{-2}]$	LHCb [91]	$1.8\,^{+0.8}_{-0.7} \pm 0.9$	1.8 ± 1.2
$\frac{\mathcal{B}(B^0 \to \rho^0(770)\rho^0(770))}{\mathcal{B}(B^0 \to \phi(1020)K^*(892)^0)}$ $[10^{-2}]$	LHCb [128]	$9.4 \pm 1.7 \pm 0.9$	9.4 ± 1.9
$\frac{\mathcal{B}(B^0 \to K^0\overline{K}^0)}{\mathcal{B}(B^0_s \to K^0\overline{K}^0)}$ $[10^{-2}]$	LHCb [120][2]	$7.5 \pm 3.1 \pm 0.6$	7.5 ± 3.2
$\frac{\mathcal{B}(B^0 \to K^0\overline{K}^0)}{\mathcal{B}(B^0 \to \phi(1020)K^0)}$	LHCb [120]	$0.17 \pm 0.08 \pm 0.02$	0.17 ± 0.08

[1] Regions corresponding to D, Λ_c^+ and charmonium resonances are vetoed in this analysis.
[2] Multiple systematic uncertainties are added in quadrature.

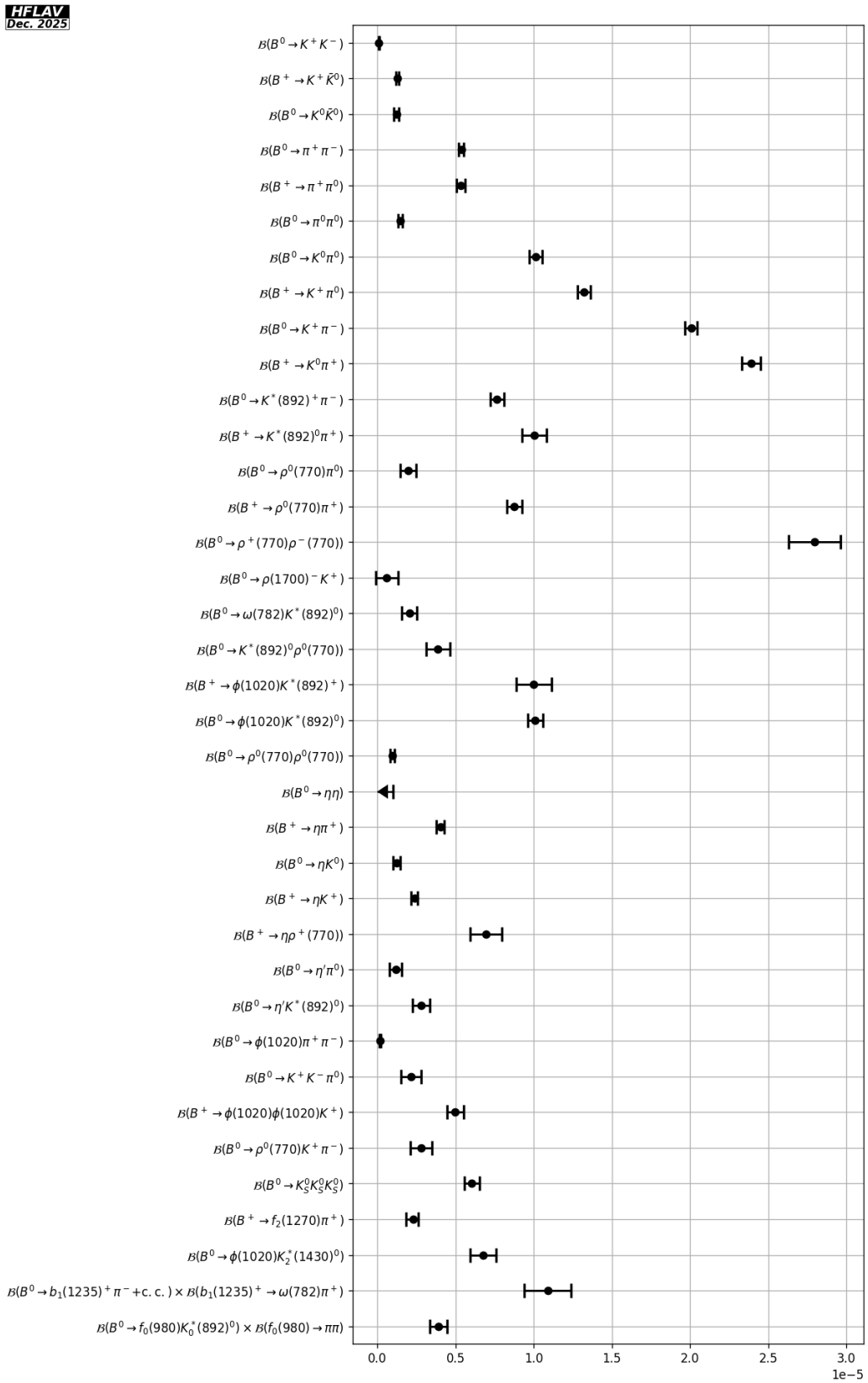

Figure 1: A selection of high-precision measurements of Branching Fractions of B-meson decays into charmless mesonic final states.

0.2 Baryonic decays of B^+ and B^0 mesons

This section provides branching fractions of charmless baryonic decays of B^+ and B^0 mesons in Tables 31-33 and 34-35, respectively. Relative branching fractions are given in Table 36. Figures 2 and 3 show graphic representations of a selection of results given in this section.

Table 31: Branching fractions of charmless baryonic B^+ decays (part 1).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^+ \to p\overline{n}\pi^0)$	Belle [152]	< 6.1	< 6.1 none
$\mathcal{B}(B^+ \to p\overline{p}\pi^+)$	Belle [153][1] BaBar [154][2]	$1.60\,^{+0.22}_{-0.19} \pm 0.12$ $1.69 \pm 0.29 \pm 0.26$	1.62 ± 0.21 $1.62\,^{+0.21}_{-0.19}$
$\mathcal{B}(B^+ \to p\overline{p}\pi^+),\ m_{p\overline{p}} < 2.85$ GeV/c^2	LHCb [155][3]		1.00 ± 0.10 none
$\mathcal{B}(B^+ \to p\overline{p}\pi^+(\mathrm{NR}))$	CLEO [37]	< 53	< 53
$\mathcal{B}(B^+ \to p\overline{p}\pi^+\pi^0)$	Belle [156][4]	$4.58 \pm 1.17 \pm 0.67$	4.6 ± 1.3
$\mathcal{B}(B^+ \to p\overline{p}\pi^+\pi^+\pi^-)$	ARGUS [157]	< 520	< 520 none

[1] The charmonium mass regions are vetoed.
[2] Charmonium decays to $p\overline{p}$ have been statistically subtracted.
[3] Measurement of $\mathcal{B}(B^+ \to p\overline{p}\pi^+),\ m_{p\overline{p}} < 2.85$ GeV/c^2/($\mathcal{B}(B^+ \to J/\psi\pi^+)\mathcal{B}(J/\psi \to p\overline{p})$) used in our fit.
[4] $m_{\pi^+\pi^0} < 1.3$ GeV/c^2.

Table 32: Branching fractions of charmless baryonic B^+ decays (part 2).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^+ \to p\overline{p}K^+)$[1]	Belle [153][2]	$5.54\,^{+0.27}_{-0.25} \pm 0.36$	5.9 ± 0.4
	BaBar [158][3]	$6.7 \pm 0.5 \pm 0.4$	5.9 ± 0.5
$\mathcal{B}(B^+ \to p\overline{p}K^+),\ m_{p\overline{p}} < 2.85$ GeV/c^2	LHCb [159][4]		4.37 ± 0.29
			none
$\mathcal{B}(B^+ \to \Theta^{++}(1710)\overline{p}) \times \mathcal{B}(\Theta^{++}(1710) \to pK^+)$[5]			
	Belle [56]	< 0.091	< 0.091
$\mathcal{B}(B^+ \to f_J(2220)K^+) \times \mathcal{B}(f_J(2220) \to p\overline{p})$			
	Belle [56]	< 0.41	< 0.41
$\mathcal{B}(B^+ \to p\overline{\Lambda}(1520))$	BaBar [158]	< 1.5	$0.305\,^{+0.084}_{-0.081}$
	LHCb [155][6]		0.315 ± 0.055
$\mathcal{B}(B^+ \to p\overline{p}K^+(\mathrm{NR}))$	CLEO [37]	< 89	< 89
$\mathcal{B}(B^+ \to p\overline{p}K^*(892)^+)$	Belle [160][7]	$3.38\,^{+0.73}_{-0.60} \pm 0.39$	$3.6\,^{+0.8}_{-0.7}$
	BaBar [154][3]	$5.3 \pm 1.5 \pm 1.3$	
$\mathcal{B}(B^+ \to f_J(2220)K^*(892)^+) \times \mathcal{B}(f_J(2220) \to p\overline{p})$			
	BaBar [154]	< 0.77	< 0.77
$\mathcal{B}(B^+ \to p\overline{\Lambda}^0)$	LHCb [161][8,9]	$0.124 \pm 0.017 \pm 0.006$	0.124 ± 0.018
	Belle [162]	< 0.32	$0.240\,^{+0.104}_{-0.085}$
$\mathcal{B}(B^+ \to p\overline{\Lambda}^0\pi^0)$	Belle [163]	$3.00\,^{+0.61}_{-0.53} \pm 0.33$	$3.00\,^{+0.69}_{-0.62}$
$\mathcal{B}(B^+ \to p\overline{\Sigma}(1385)^0)$	Belle [163]	< 0.47	< 0.47
$\mathcal{B}(B^+ \to \Delta(1232)^+\overline{\Lambda}^0)$	Belle [163]	< 0.82	< 0.82

[1] The PDG uncertainty includes a scale factor.
[2] The charmonium mass regions are vetoed.
[3] Charmonium decays to $p\overline{p}$ have been statistically subtracted.
[4] Measurement of $\mathcal{B}(B^+ \to p\overline{p}K^+),\ m_{p\overline{p}} < 2.85$ GeV/c^2/$(\mathcal{B}(B^+ \to J/\psi K^+)\mathcal{B}(J/\psi \to p\overline{p}))$ used in our fit.
[5] Pentaquark candidate.
[6] Measurement of $(\mathcal{B}(B^+ \to p\overline{\Lambda}(1520))\mathcal{B}(\overline{\Lambda(1520)} \to K^+p))/(\mathcal{B}(B^+ \to J/\psi K^+)\mathcal{B}(J/\psi \to p\overline{p}))$ used in our fit.
[7] The charmonium mass region has been vetoed.
[8] Normalization mode: $\mathcal{B}(B^+ \to K^0_S\pi^+) = (1.19 \pm 0.03) \times 10^{-5}$. The third uncertainty is due to knowledge of $\mathcal{B}(B^+ \to K^0_S\pi^+)$.
[9] Multiple systematic uncertainties are added in quadrature.

Table 33: Branching fractions of charmless baryonic B^+ decays (part 3).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^+ \to p\overline{\Lambda}^0\pi^+\pi^-)$	Belle [164]	$11.28\,^{+0.91}_{-0.72} \pm 1.03$	11.3 ± 1.3 $11.3\,^{+1.4}_{-1.3}$
$\mathcal{B}(B^+ \to p\overline{\Lambda}^0\pi^+\pi^-(\mathrm{NR}))$	Belle [164]	$5.92\,^{+0.88}_{-0.84} \pm 0.69$	5.9 ± 1.1
$\mathcal{B}(B^+ \to p\overline{\Lambda}^0\rho^0(770)) \times \mathcal{B}(\rho^0(770) \to \pi^+\pi^-)$			
	Belle [164]	$4.78\,^{+0.67}_{-0.64} \pm 0.60$	4.8 ± 0.9
$\mathcal{B}(B^+ \to p\overline{\Lambda}^0 f_2(1270)) \times \mathcal{B}(f_2(1270) \to \pi^+\pi^-)$			
	Belle [164]	$2.03\,^{+0.77}_{-0.72} \pm 0.27$	2.0 ± 0.8
$\mathcal{B}(B^+ \to p\overline{\Lambda}^0 K^+K^-)$	Belle [165]	$4.10\,^{+0.45}_{-0.43} \pm 0.50$	4.1 ± 0.7
$\mathcal{B}(B^+ \to p\overline{\Lambda}^0\phi(1020))$	Belle [165]	$0.795 \pm 0.209 \pm 0.077$	0.80 ± 0.22
$\mathcal{B}(B^+ \to \overline{p}\Lambda^0 K^+K^-)$	Belle [165]	$3.70\,^{+0.39}_{-0.37} \pm 0.44$	3.7 ± 0.6
$\mathcal{B}(B^+ \to \Lambda^0\overline{\Lambda}^0\pi^+)$	Belle [166][1,2]	< 0.94	< 0.94
$\mathcal{B}(B^+ \to \Lambda^0\overline{\Lambda}^0 K^+)$	Belle [166][1]	$3.38\,^{+0.41}_{-0.36} \pm 0.41$	3.4 ± 0.6 $3.4\,^{+0.6}_{-0.5}$
$\mathcal{B}(B^+ \to \Lambda^0\overline{\Lambda}^0 K^*(892)^+)$	Belle [166][1,2]	$2.19\,^{+1.13}_{-0.88} \pm 0.33$	$2.2\,^{+1.2}_{-0.9}$
$\mathcal{B}(B^+ \to \Lambda(1520)\overline{\Lambda}^0 K^+)$	Belle [165]	$2.23 \pm 0.63 \pm 0.25$	2.2 ± 0.7
$\mathcal{B}(B^+ \to \overline{\Lambda}(1520)\Lambda^0 K^+)$	Belle [165]	< 2.08	< 2.1
$\mathcal{B}(B^+ \to \overline{\Delta}(1232)^0 p)$	Belle [153]	< 1.38	< 1.4
$\mathcal{B}(B^+ \to \Delta^{++}\overline{p})$	Belle [153]	< 0.14	< 0.14
$\mathcal{B}(B^+ \to \overline{\Lambda}^0 p\overline{p}p)$	LHCb [167][3,4]	$0.215 \pm 0.035 \pm 0.030$	0.215 ± 0.046 none

[1] The charmonium mass regions are vetoed.
[2] $m_{\Lambda^0\overline{\Lambda}^0} < 2.85$ GeV/c^2.
[3] LHCb determines the absolute branching fractions from a simultaneous unbinned maximum-likelihood fit to the signal and the normalization channels.
[4] Multiple systematic uncertainties are added in quadrature.

Table 34: Branching fractions of charmless baryonic B^0 decays (part 1).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^0 \to p\bar{p})$	LHCb [168][1,2]	$0.0127 \pm 0.0013 \pm 0.0006$	0.0127 ± 0.0014
	Belle [162]	< 0.11	
	BaBar [169]	< 0.27	
$\mathcal{B}(B^0 \to p\bar{p}\pi^+\pi^-)$	LHCb [170][3,2]	$2.7 \pm 0.1 \pm 0.2$	2.7 ± 0.2
			2.9 ± 0.2
$\mathcal{B}(B^0 \to p\bar{p}\pi^+\pi^-)$, $m_{\pi^+\pi^-} < 1.22$ GeV/c^2	Belle [156][4]	$0.83 \pm 0.17 \pm 0.17$	0.8 ± 0.2
			none
$\mathcal{B}(B^0 \to p\bar{p}K^+\pi^-)$	LHCb [170][3,2]	$5.9 \pm 0.3 \pm 0.5$	5.90 ± 0.58
			6.27 ± 0.52
$\mathcal{B}(B^0 \to p\bar{p}K^0)$	LHCb [107][5,6]	$2.808 \pm 0.084 \pm 0.169$	2.8 ± 0.2
	Belle [160][5]	$2.51\,^{+0.35}_{-0.29} \pm 0.21$	
	BaBar [154][7]	$3.0 \pm 0.5 \pm 0.3$	2.7 ± 0.3
$\mathcal{B}(B^0 \to \Theta(1540)^+\bar{p}) \times \mathcal{B}(\Theta(1540)^+ \to pK^0_S)$[8]			
	BaBar [154]	< 0.05	< 0.05
	Belle [56]	< 0.23	
$\mathcal{B}(B^0 \to f_J(2220)K^0) \times \mathcal{B}(f_J(2220) \to p\bar{p})$			
	BaBar [154]	< 0.45	< 0.45
$\mathcal{B}(B^0 \to p\bar{p}K^*(892)^0)$	Belle [160][5]	$1.18\,^{+0.29}_{-0.25} \pm 0.11$	1.24 ± 0.27
	BaBar [154][7]	$1.47 \pm 0.45 \pm 0.40$	$1.24\,^{+0.28}_{-0.25}$
$\mathcal{B}(B^0 \to f_J(2220)K^*(892)^0) \times \mathcal{B}(f_J(2220) \to p\bar{p})$			
	BaBar [154]	< 0.15	< 0.15

[1] Run I and run II combination.
[2] Multiple systematic uncertainties are added in quadrature.
[3] $m_{p\bar{p}} < 2.85$ GeV/c^2.
[4] $0.46 < m_{\pi^+\pi^-} < 0.53$ GeV/c^2 invariant mass region has been excluded.
[5] The charmonium mass region has been vetoed.
[6] Using $\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$.
[7] Charmonium decays to $p\bar{p}$ have been statistically subtracted.
[8] Pentaquark candidate.

Table 35: Branching fractions of charmless baryonic B^0 decays (part 2).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^0 \to p\bar{p}K^+K^-)$	LHCb [170][1,2]	$0.113 \pm 0.028 \pm 0.014$	0.113 ± 0.031 0.121 ± 0.032
$\mathcal{B}(B^0 \to p\bar{p}\pi^0)$	Belle [171]	$0.50 \pm 0.18 \pm 0.06$	0.50 ± 0.19
$\mathcal{B}(B^0 \to pp\overline{p}\overline{p})$	BaBar [172]	< 0.2	< 0.2 0.0 ± 0.0
$\mathcal{B}(B^0 \to p\overline{\Lambda}^0\pi^-)$	Belle [173] BaBar [174]	$3.21\,^{+0.28}_{-0.25} \pm 0.16$ $3.07 \pm 0.31 \pm 0.23$	3.16 ± 0.24 $3.16\,^{+0.25}_{-0.24}$
$\mathcal{B}(B^0 \to p\overline{\Sigma}(1385)^-)$	Belle [163]	< 0.26	< 0.26
$\mathcal{B}(B^0 \to \Delta(1232)^+\bar{p}$+c.c.)	Belle [171]	< 1.6	< 1.6
$\mathcal{B}(B^0 \to \Delta(1232)^0\overline{\Lambda}^0)$	Belle [163]	< 0.93	< 0.93
$\mathcal{B}(B^0 \to p\overline{\Lambda}^0K^-)$	Belle [175]	< 0.82	< 0.82
$\mathcal{B}(B^0 \to p\overline{\Sigma}^0\pi^-)$	Belle [173]	$1.17\,^{+0.43}_{-0.40} \pm 0.07$	1.17 ± 0.42 $1.17\,^{+0.44}_{-0.41}$
$\mathcal{B}(B^0 \to \overline{\Lambda}^0\Lambda^0)$	Belle [162]	< 0.32	< 0.32
$\mathcal{B}(B^0 \to \overline{\Lambda}^0\Lambda^0K^0)$	Belle [166][3]	$4.76\,^{+0.84}_{-0.68} \pm 0.61$	$4.8\,^{+1.0}_{-0.9}$
$\mathcal{B}(B^0 \to \Lambda^0\overline{\Lambda}^0K^*(892)^0)$	Belle [166][3]	$2.46\,^{+0.87}_{-0.72} \pm 0.34$	$2.46\,^{+0.93}_{-0.80}$
$\mathcal{B}(B^0 \to \Delta(1232)^0\overline{\Delta}(1232)^0)$	CLEO [86][4]	< 1500	< 1500
$\mathcal{B}(B^0 \to \Delta^{++}\overline{\Delta}^{--})$	CLEO [86][4]	< 110	< 110
$\mathcal{B}(B^0 \to p\bar{p}p\bar{p})$	LHCb [176][5]		0.0222 ± 0.0038 none

[1] $m_{p\bar{p}} < 2.85$ GeV/c^2.

[2] Multiple systematic uncertainties are added in quadrature.

[3] The charmonium mass regions are vetoed.

[4] CLEO assumes $\mathcal{B}(\Upsilon(4S) \to B^0\overline{B}^0) = 0.43$. The result has been modified to account for a branching fraction of 0.50.

[5] Measurement of $\mathcal{B}(B^0 \to p\bar{p}p\bar{p})/(\mathcal{B}(B^0 \to J/\psi K^*(892)^0)\mathcal{B}(J/\psi \to p\bar{p})\mathcal{B}(K^*(892)^0 \to K\pi)2/3)$ used in our fit.

Table 36: Baryonic relative branching fractions.

Parameter	Measurements		Average
$\frac{\mathcal{B}(B^+\to p\bar{p}\pi^+, m_{p\bar{p}}<2.85\ \mathrm{GeV}/c^2)}{\mathcal{B}(B^+\to J/\psi\pi^+)\times\mathcal{B}(J/\psi\to p\bar{p})}$	LHCb [155]	$12.0 \pm 1.2 \pm 0.3$	12.0 ± 1.2
$\frac{\mathcal{B}(B^+\to p\bar{p}K^+)}{\mathcal{B}(B^+\to J/\psi K^+)\times\mathcal{B}(J/\psi\to p\bar{p})}$	LHCb [159][1]	$4.91 \pm 0.19 \pm 0.14$	4.91 ± 0.24
$\frac{\mathcal{B}(B^+\to p\bar{p}K^+, m_{p\bar{p}}<2.85\ \mathrm{GeV}/c^2)}{\mathcal{B}(B^+\to J/\psi\pi^+)\times\mathcal{B}(J/\psi\to p\bar{p})}$	LHCb [159]	$2.02 \pm 0.10 \pm 0.08$	2.02 ± 0.13
$\frac{\mathcal{B}(B^+\to\overline{\Lambda}(1520)p)\times\mathcal{B}(\overline{\Lambda}(1520)\to K^+\bar{p}))}{\mathcal{B}(B^+\to J/\psi\pi^+)\times\mathcal{B}(J/\psi\to p\bar{p})}$	LHCb [155]	$0.033 \pm 0.005 \pm 0.007$	0.033 ± 0.009
$\frac{\mathcal{B}(B^0\to p\bar{p}K^+K^-)}{\mathcal{B}(B^0\to p\bar{p}K^+\pi^-)}$	LHCb [170][2]	$0.019 \pm 0.005 \pm 0.002$	0.019 ± 0.005
$\frac{\mathcal{B}(B^0\to p\bar{p}\pi^+\pi^-)}{\mathcal{B}(B^0\to p\bar{p}K^+\pi^-)}$	LHCb [170][2]	$0.46 \pm 0.02 \pm 0.02$	0.46 ± 0.03
$\frac{\mathcal{B}(B^0\to p\bar{p}K^0)}{\mathcal{B}(B^0\to\pi^+\pi^-K^0)}$	LHCb [107][3]	$0.0567 \pm 0.0017 \pm 0.0028$	0.0567 ± 0.0033
$\frac{\mathcal{B}(B^0\to p\bar{p}p\bar{p})}{\mathcal{B}(B^0\to J/\psi K^{*0})\mathcal{B}(J/\psi\to p\bar{p})\mathcal{B}(K^{*0}\to K^+\pi^-)}$	LHCb [176]	$0.0124 \pm 0.0021 \pm 0.0004$	0.0124 ± 0.0021
$\frac{\mathcal{B}(B^0\to p\bar{p}p\bar{p})}{\mathcal{B}(B^0\to J/\psi\phi)\mathcal{B}(J/\psi\to p\bar{p})\mathcal{B}(\phi\to K^+K^-)}$	LHCb [176]	$0.021 \pm 0.009 \pm 0.002$	0.0210 ± 0.0092
$\frac{\mathcal{B}(B^+\to\overline{\Lambda}^0 p\bar{p}p)}{\mathcal{B}(B^+\to J/\psi K^+)\times\mathcal{B}(J/\psi\to\overline{\Lambda}^0 pK^-)}$	LHCb [167]	$0.245 \pm 0.040 \pm 0.014$	0.245 ± 0.042

[1] Includes contribution where $p\bar{p}$ is produced in charmonium decays.
[2] $m_{p\bar{p}} < 2.85$ GeV/c^2.
[3] The charmonium mass region has been vetoed.

Measurements that are not included in the tables:

- In Ref. [177], Belle searches for B^0 mesons decaying into a final state containing a Λ baryon and missing energy. Upper limits on the branching fractions are set in the range $2.1 - 3.8 \times 10^{-5}$.

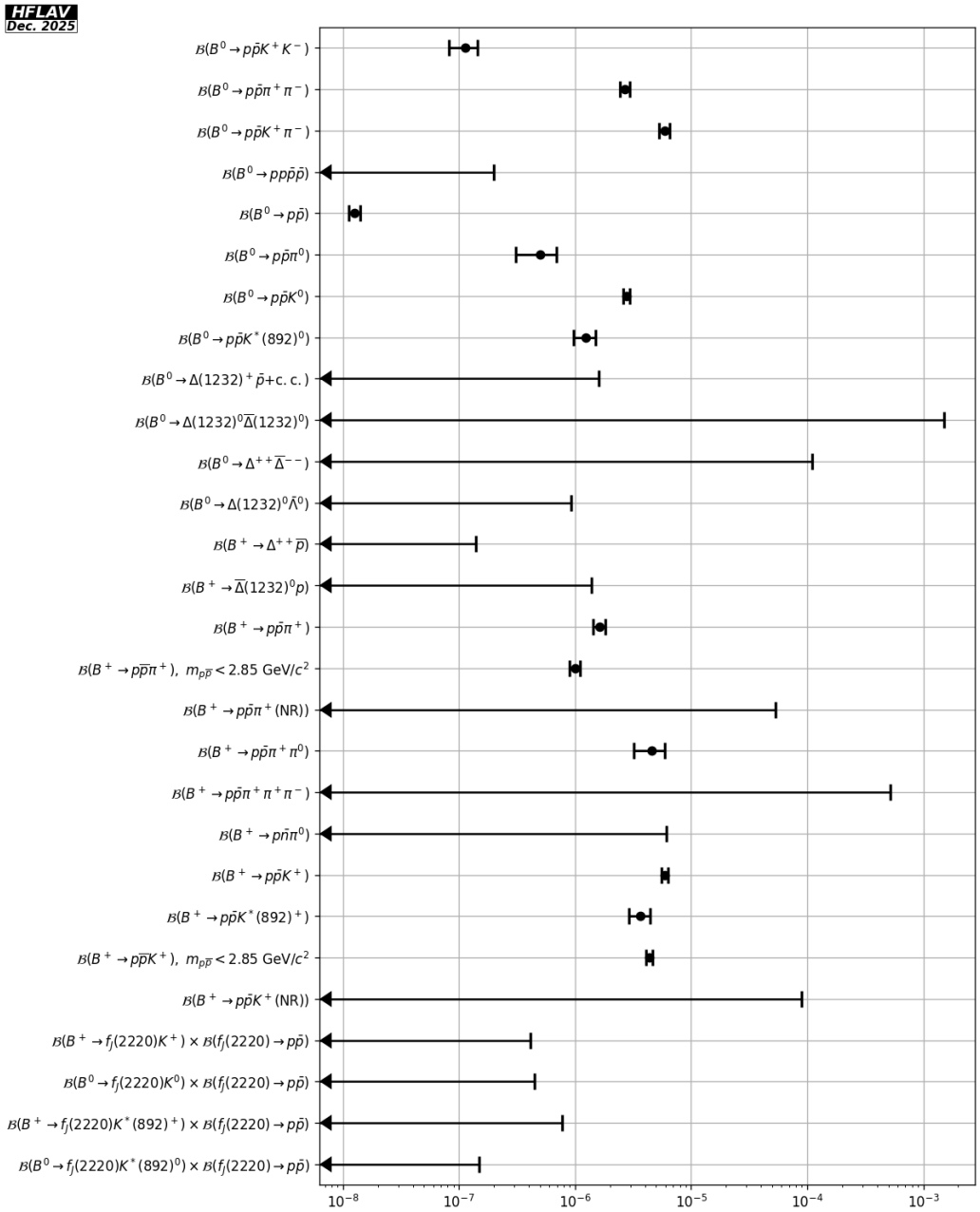

Figure 2: Branching fractions of charmless B^+ and B^0 decays into nonstrange baryons.

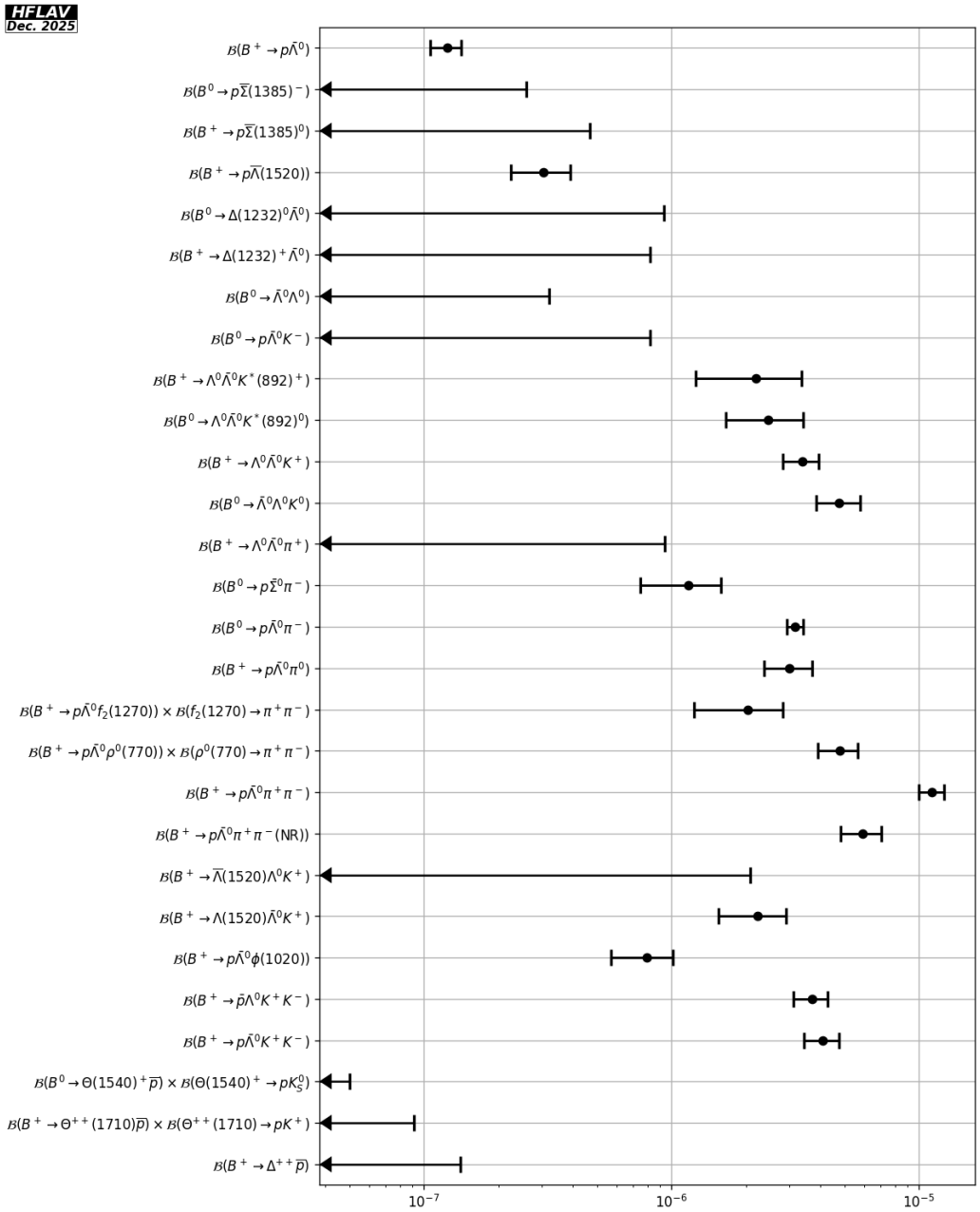

Figure 3: Branching fractions of charmless B^+ and B^0 decays into strange baryons.

0.3 Decays of b baryons

A compilation of branching fractions of Λ_b^0 baryon decays is given in Tables 37 to 39. Table 40 provides the partial branching fractions of $\Lambda_b^0 \to \Lambda\mu^+\mu^-$ decays in intervals of $q^2 = m^2(\mu^+\mu^-)$. Compilations of branching fractions of Ξ_b^0, Ξ_b^- and Ω_b^- baryon decays are given in Tables 41, 42, and 43, respectively. Finally, ratios of branching fractions of Λ_b^0, Ξ_b^0, Ξ_b^- and Ω_b^- baryon decays are detailed in Tables 44, to 48. Figures 4 and 5 show graphic representations of branching fractions of Λ_b^0 and Ξ_b decays, respectively.

Table 37: Branching fractions of charmless Λ_b^0 decays (part 1).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(\Lambda_b^0 \to p\overline{K}^0\pi^-)$	LHCb [178][1]		10.6 ± 1.0 12.6 ± 4.1
$\mathcal{B}(\Lambda_b^0 \to pK^0K^-)$	LHCb [178][2]		$0.62\,^{+0.12}_{-0.11}$ < 3.50
$\mathcal{B}(\Lambda_b^0 \to p\pi^-)$[3]	LHCb [91][4] CDF [88][5]	$4.76 \pm 0.44 \pm 0.95$	$4.6\,^{+0.9}_{-0.8}$ 4.6 ± 0.8
$\mathcal{B}(\Lambda_b^0 \to pK^-)$[3]	CDF [88] LHCb [91][6]	$6.3 \pm 1.2 \pm 0.8$	5.5 ± 1.1 5.5 ± 1.0
$\mathcal{B}(\Lambda_b^0 \to \Lambda^0\mu^+\mu^-)$	LHCb [179][7,8] CDF [180][8]	$0.955 \pm 0.186 \pm 0.249$ $1.520 \pm 0.366 \pm 0.387$	$1.09\,^{+0.34}_{-0.29}$ 1.08 ± 0.28
$\mathcal{B}(\Lambda_b^0 \to p\pi^-\mu^+\mu^-)$	LHCb [181][9]		$0.068\,^{+0.027}_{-0.023}$ $0.069\,^{+0.025}_{-0.024}$
$\mathcal{B}(\Lambda_b^0 \to pK^-e^+e^-)$	LHCb [182][10,11]	$0.314\,^{+0.045}_{-0.042}\,^{+0.064}_{-0.055}$	$0.31\,^{+0.08}_{-0.07}$ $0.31\,^{+0.07}_{-0.06}$
$\mathcal{B}(\Lambda_b^0 \to pK^-\mu^+\mu^-)$	LHCb [182][10,11]	$0.269 \pm 0.013\,^{+0.052}_{-0.044}$	$0.269\,^{+0.054}_{-0.045}$ $0.265\,^{+0.051}_{-0.041}$

[1] Measurement of $\mathcal{B}(\Lambda_b^0 \to p\overline{K}^0\pi^-)/(\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-)\mathcal{B}(\Lambda_c^+ \to pK_S^0))$ used in our fit.

[2] Measurement of $\mathcal{B}(\Lambda_b^0 \to pK^0K^-)/(\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-)\mathcal{B}(\Lambda_c^+ \to pK_S^0))$ used in our fit.

[3] The PDG average is a result of a fit including input from other measurements.

[4] Using $\mathcal{B}(\Lambda_b^0 \to pK^-)$.

[5] Measurement of $(\mathcal{B}(\Lambda_b^0 \to p\pi^-)/\mathcal{B}(B^0 \to K^+\pi^-))(f_{\Lambda_b^0}/f_d)$ used in our fit.

[6] Measurement of $\mathcal{B}(\Lambda_b^0 \to p\pi^-)/\mathcal{B}(\Lambda_b^0 \to pK^-)$ used in our fit.

[7] Multiple systematic uncertainties are added in quadrature.

[8] Using $\mathcal{B}(\Lambda_b^0 \to J/\psi\Lambda^0)$.

[9] Measurement of $\mathcal{B}(\Lambda_b^0 \to p\pi^-\mu^+\mu^-)/(\mathcal{B}(\Lambda_b^0 \to J/\psi p\pi^-)\mathcal{B}(J/\psi \to \mu^+\mu^-))$ used in our fit.

[10] Measured in the $m^2_{\ell^+\ell^-}$ bin $[0.1, 6.0]$ GeV^2/c^4 and for $m_{pK} < 2.6$ GeV/c^2.

[11] Using $\mathcal{B}(\Lambda_b^0 \to J/\psi pK^-)$.

Table 38: Branching fractions of charmless Λ_b^0 decays (part 2).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(\Lambda_b^0 \to \Lambda^0\gamma)$	LHCb [183][1]		6.9 ± 1.5 7.1 ± 1.7
$\mathcal{B}(\Lambda_b^0 \to \Lambda^0\eta)$	LHCb [94][2]	$9.39\,^{+7.28}_{-5.29} \pm 0.44$	$9.4\,^{+7.3}_{-5.3}$
$\mathcal{B}(\Lambda_b^0 \to \Lambda^0\eta')$	LHCb [94][2]	< 3.11	< 3.1
$\mathcal{B}(\Lambda_b^0 \to \Lambda^0\pi^+\pi^-)$	LHCb [184][3,4]	$5.3 \pm 0.4 \pm 0.7$	5.30 ± 0.81 4.65 ± 1.89
$\mathcal{B}(\Lambda_b^0 \to \Lambda^0 K^+\pi^-)$	LHCb [184][3,4]	$4.6 \pm 0.2 \pm 0.6$	4.60 ± 0.67 5.67 ± 1.22
$\mathcal{B}(\Lambda_b^0 \to \Lambda^0 K^+K^-)$	LHCb [184][3,4]	$10.7 \pm 0.3 \pm 1.2$	10.7 ± 1.2 16.1 ± 2.2
$\mathcal{B}(\Lambda_b^0 \to \Lambda^0\phi(1020))$	LHCb [119][5]		$10.2\,^{+3.0}_{-2.5}$ 9.8 ± 2.6

[1] Measurement of $(\mathcal{B}(\Lambda_b^0 \to \Lambda^0\gamma)/\mathcal{B}(B^0 \to K^*(892)^0\gamma))\frac{f_{\Lambda_b^0}}{f_d}$ used in our fit.

[2] Using $\mathcal{B}(B^0 \to \eta' K^0)$.

[3] LHCb measures a ratio of branching fractions, using $\Lambda_b^0 \to \Lambda_c^+(\to \Lambda\pi^+)\pi^-$ as a reference mode for normalization.

[4] Multiple systematic uncertainties are added in quadrature.

[5] Measurement of $(\mathcal{B}(\Lambda_b^0 \to \Lambda^0\phi(1020))/\mathcal{B}(B^0 \to \phi(1020)K^0))(f_{\Lambda_b^0}/f_d)2$ used in our fit.

Table 39: Branching fractions of charmless Λ_b^0 decays (part 3).

Parameter $[10^{-6}]$	**Measurements**	**Average** HFLAV PDG
$\mathcal{B}(\Lambda_b^0 \to p\pi^+\pi^-\pi^-)$	LHCb [185][1,2,3]	$21.1\,^{+2.4}_{-2.3}$ 21.2 ± 2.1
$\mathcal{B}(\Lambda_b^0 \to pK^-K^+\pi^-)$	LHCb [185][2,4]	$4.06\,^{+0.66}_{-0.61}$ 4.09 ± 0.60
$\mathcal{B}(\Lambda_b^0 \to pK^-\pi^+\pi^-)$	LHCb [185][2,5]	$50.5\,^{+5.6}_{-5.3}$ 50.8 ± 4.9
$\mathcal{B}(\Lambda_b^0 \to pK^-K^+K^-)$	LHCb [185][2,6]	$12.6\,^{+1.5}_{-1.4}$ 12.7 ± 1.3

[1] Vetoes on charm and charmonium resonances are applied.
[2] Multiple systematic uncertainties are added in quadrature.
[3] Measurement of $\mathcal{B}(\Lambda_b^0 \to p\pi^+\pi^-\pi^-)/(\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-)\mathcal{B}(\Lambda_c^+ \to pK^-\pi^+))$ used in our fit.
[4] Measurement of $\mathcal{B}(\Lambda_b^0 \to pK^-K^+\pi^-)/(\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-)\mathcal{B}(\Lambda_c^+ \to pK^-\pi^+))$ used in our fit.
[5] Measurement of $\mathcal{B}(\Lambda_b^0 \to pK^-\pi^+\pi^-)/(\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-)\mathcal{B}(\Lambda_c^+ \to pK^-\pi^+))$ used in our fit.
[6] Measurement of $\mathcal{B}(\Lambda_b^0 \to pK^-K^+K^-)/(\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-)\mathcal{B}(\Lambda_c^+ \to pK^-\pi^+))$ used in our fit.

Table 40: Partial branching fractions of $\Lambda_b^0 \to \Lambda\mu^+\mu^-$ decays in intervals of $m^2_{\mu^+\mu^-}$.

Parameter [10^{-7}]	**Measurements**		**Average** HFLAV PDG
$m^2_{\mu^+\mu^-} < 2.0$ GeV^2/c^4			
	LHCb [186]	$0.72\,^{+0.24}_{-0.22} \pm 0.14$	0.7 ± 0.3
	CDF [180]	$0.15 \pm 2.01 \pm 0.05$	
$2.0 < m^2_{\mu^+\mu^-} < 4.3$ GeV^2/c^4			
	LHCb [186]	$0.253\,^{+0.276}_{-0.207} \pm 0.046$	$0.3\,^{+0.3}_{-0.2}$
	CDF [180]	$1.84 \pm 1.66 \pm 0.59$	
$4.3 < m^2_{\mu^+\mu^-} < 8.68$ GeV^2/c^4			
	LHCb [179]	$0.66 \pm 0.72 \pm 0.16$	0.5 ± 0.7
	CDF [180]	$-0.20 \pm 1.64 \pm 0.08$	
$10.09 < m^2_{\mu^+\mu^-} < 12.86$ GeV^2/c^4			
	LHCb [186]	$2.08\,^{+0.42}_{-0.39} \pm 0.42$	2.2 ± 0.6
	CDF [180]	$2.97 \pm 1.47 \pm 0.95$	$2.2\,^{+0.6}_{-0.5}$
$14.18 < m^2_{\mu^+\mu^-} < 16.00$ GeV^2/c^4			
	LHCb [186]	$2.04\,^{+0.35}_{-0.33} \pm 0.42$	1.7 ± 0.4
	CDF [180]	$0.96 \pm 0.73 \pm 0.31$	1.7 ± 0.5
$m^2_{\mu^+\mu^-} > 16.00$ GeV^2/c^4			
	CDF [180]	$6.97 \pm 1.88 \pm 2.23$	7.0 ± 2.9

Table 41: Branching fractions of charmless Ξ_b^0 decays.

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV / PDG
$\frac{f_{\Xi_b^0}}{f_d}\mathcal{B}(\Xi_b^0 \to p\overline{K}^0\pi^-)$	LHCb [104][1]	< 1.5	< 1.5 < 1.6
$\frac{f_{\Xi_b^0}}{f_d}\mathcal{B}(\Xi_b^0 \to p\overline{K}^0 K^-)$	LHCb [104][1]	< 1.0	< 0.99 < 1.10
$\mathcal{B}(\Xi_b^0 \to \Lambda^0\pi^+\pi^-)$	LHCb [184][2,3]	$11.0 \pm 2.6 \pm 4.0$	11.0 ± 4.8 none
$\mathcal{B}(\Xi_b^0 \to \Lambda^0 K^-\pi^+)$	LHCb [184][2,3]	$10.4 \pm 1.4 \pm 3.4$	10.4 ± 3.7 none
$\mathcal{B}(\Xi_b^0 \to \Lambda^0 K^+K^-)$	LHCb [184][2]	< 2.4	< 2.4 none
$\frac{f_{\Xi_b^0}}{f_{\Lambda_b^0}}\mathcal{B}(\Xi_b^0 \to pK^-\pi^+\pi^-)$	LHCb [185][3,4]		$1.91\,^{+0.41}_{-0.38}$ 1.92 ± 0.39
$\frac{f_{\Xi_b^0}}{f_{\Lambda_b^0}}\mathcal{B}(\Xi_b^0 \to pK^-K^-\pi^+)$	LHCb [185][3,5]		$1.72\,^{+0.33}_{-0.30}$ 1.73 ± 0.31
$\frac{f_{\Xi_b^0}}{f_{\Lambda_b^0}}\mathcal{B}(\Xi_b^0 \to pK^+K^-K^-)$	LHCb [185][3,6]		0.18 ± 0.10
$\mathcal{B}(\Xi_b^0 \to p\overline{K}^0\pi^-)$	LHCb [178][7]	< 2.8	< 2.8 none
$\mathcal{B}(\Xi_b^0 \to pK^0K^-)$	LHCb [178][7,3]	$3.9 \pm 0.1 \pm 0.1$	3.900 ± 0.088 none

[1] Using $\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$.

[2] LHCb measures a ratio of branching fractions, using $\Lambda_b^0 \to \Lambda_c^+(\to \Lambda\pi^+)\pi^-$ as a reference mode for normalization.

[3] Multiple systematic uncertainties are added in quadrature.

[4] Measurement of $\frac{f_{\Xi_b^0}}{f_{\Lambda_b^0}}\mathcal{B}(\Xi_b^0 \to pK^-\pi^+\pi^-)/(\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-)\mathcal{B}(\Lambda_c^+ \to pK^-\pi^+))$ used in our fit.

[5] Measurement of $\frac{f_{\Xi_b^0}}{f_{\Lambda_b^0}}\mathcal{B}(\Xi_b^0 \to pK^-K^-\pi^+)/(\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-)\mathcal{B}(\Lambda_c^+ \to pK^-\pi^+))$ used in our fit.

[6] Measurement of $\frac{f_{\Xi_b^0}}{f_{\Lambda_b^0}}\mathcal{B}(\Xi_b^0 \to pK^+K^-K^-)/(\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-)\mathcal{B}(\Lambda_c^+ \to pK^-\pi^+))$ used in our fit.

[7] the fragmentation fraction ratio fXib0..fLb0 has to be derived from other measurements, not clear from where

Table 42: Branching fractions of charmless Ξ_b^- decays.

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(\Xi_b^- \to \Sigma(1385)^0 K^-)$	LHCb [187][1,2]	$0.26 \pm 0.11 \pm 0.20$	0.26 ± 0.23 none
$\mathcal{B}(\Xi_b^- \to \Lambda(1405) K^-)$	LHCb [187][1,2]	$0.19 \pm 0.06 \pm 0.10$	0.19 ± 0.12 none
$\mathcal{B}(\Xi_b^- \to \Lambda(1520) K^-)$	LHCb [187][1,2]	$0.76 \pm 0.09 \pm 0.31$	0.76 ± 0.32 none
$\mathcal{B}(\Xi_b^- \to \Lambda(1670) K^-)$	LHCb [187][1,2]	$0.45 \pm 0.07 \pm 0.22$	0.45 ± 0.23 none
$\mathcal{B}(\Xi_b^- \to \Sigma(1775) K^-)$	LHCb [187][1,2]	$0.22 \pm 0.08 \pm 0.13$	0.22 ± 0.15 none
$\mathcal{B}(\Xi_b^- \to \Sigma(1915) K^-)$	LHCb [187][1,2]	$0.26 \pm 0.09 \pm 0.23$	0.26 ± 0.25 none

[1] Result extracted from Dalitz plot analysis of $\Xi_b^- \to pK^-K^-$.
[2] Multiple systematic uncertainties are added in quadrature.

Table 43: Branching fractions of charmless Ω_b^- decays.

Parameter [10^{-8}]	**Measurements**		**Average**
$\frac{f_{\Omega_b^-}}{f_u} \times \mathcal{B}(\Omega_b^- \to pK^-K^-)$	LHCb [59][1]	< 0.59	< 0.59
$\frac{f_{\Omega_b^-}}{f_u} \times \mathcal{B}(\Omega_b^- \to pK^-\pi^-)$	LHCb [59][1]	< 1.68	< 1.7
$\frac{f_{\Omega_b^-}}{f_u} \times \mathcal{B}(\Omega_b^- \to p\pi^-\pi^-)$	LHCb [59][1]	< 3.60	< 3.6

[1] Using $\mathcal{B}(B^+ \to K^+K^+K^-)$.

Table 44: Relative branching fractions of Λ_b^0 decays (part 1).

Parameter	**Measurements**		**Average**
$\frac{\mathcal{B}(\Lambda_b^0 \to p\pi^-)}{\mathcal{B}(\Lambda_b^0 \to pK^-)}$	LHCb [91]	$0.86 \pm 0.08 \pm 0.05$	0.86 ± 0.09
$\frac{\mathcal{B}(\Lambda_b^0 \to \Lambda^0\eta)}{\mathcal{B}(B^0 \to \eta' K^0)}$	LHCb [94]	$0.142\,^{+0.110}_{-0.080}$	$0.14\,^{+0.11}_{-0.08}$
$\frac{f_{\Lambda_b^0}}{f_d}\frac{\mathcal{B}(\Lambda_b^0\to p\pi^-)}{\mathcal{B}(B^0\to K^+\pi^-)}$	CDF [88]	$0.042 \pm 0.007 \pm 0.006$	0.042 ± 0.009
$\frac{f_{\Lambda_b^0}}{f_d}\frac{\mathcal{B}(\Lambda_b^0\to pK^-)}{\mathcal{B}(B^0\to K^+\pi^-)}$	CDF [88]	$0.066 \pm 0.009 \pm 0.008$	0.066 ± 0.012
$\frac{f_{\Lambda_b^0}}{f_d}\frac{\mathcal{B}(\Lambda_b^0\to \Lambda^0\phi)}{\mathcal{B}(B^0\to K_S^0\phi)}$	LHCb [119]	$0.55 \pm 0.11 \pm 0.04$	0.55 ± 0.12
$\frac{\mathcal{B}(\Lambda_b^0 \to p\pi^-\mu^+\mu^-)}{\mathcal{B}(\Lambda_b^0 \to J/\psi p\pi^-) \times \mathcal{B}(J/\psi \to \mu^+\mu^-)}$	LHCb [181]	$0.044 \pm 0.012 \pm 0.007$	0.044 ± 0.014
$\frac{\mathcal{B}(\Lambda_b^0 \to \Lambda^0\pi^+\pi^-)}{\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-) \times \mathcal{B}(\Lambda_c^+ \to \Lambda^0\pi^+)}$	LHCb [184]	$0.088 \pm 0.006 \pm 0.009$	0.088 ± 0.011
$\frac{\mathcal{B}(\Lambda_b^0 \to \Lambda^0 K^+\pi^-)}{\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-) \times \mathcal{B}(\Lambda_c^+ \to \Lambda^0\pi^+)}$	LHCb [184]	$0.078 \pm 0.004 \pm 0.006$	0.0780 ± 0.0072
$\frac{\mathcal{B}(\Lambda_b^0 \to \Lambda^0 K^+K^-)}{\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-) \times \mathcal{B}(\Lambda_c^+ \to \Lambda^0\pi^+)}$	LHCb [184]	$0.178 \pm 0.005 \pm 0.007$	0.1780 ± 0.0086

Table 45: Relative branching fractions of Λ_b^0 decays (part 2).

Parameter	Measurements		Average
$\frac{\mathcal{B}(\Lambda_b^0 \to p\pi^+\pi^-\pi^-)}{\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-) \times \mathcal{B}(\Lambda_c^+ \to pK^-\pi^+)}$	LHCb [185][1]	$0.0685 \pm 0.0019 \pm 0.0033$	0.0685 ± 0.0038
$\frac{\mathcal{B}(\Lambda_b^0 \to pK^-\pi^+\pi^-)}{\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-) \times \mathcal{B}(\Lambda_c^+ \to pK^-\pi^+)}$	LHCb [185][1]	$0.164 \pm 0.003 \pm 0.007$	0.164 ± 0.008
$\frac{\mathcal{B}(\Lambda_b^0 \to pK^-K^+\pi^-)}{\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-) \times \mathcal{B}(\Lambda_c^+ \to pK^-\pi^+)}$	LHCb [185][1]	$0.0132 \pm 0.0009 \pm 0.0013$	0.0132 ± 0.0016
$\frac{\mathcal{B}(\Lambda_b^0 \to pK^-K^+K^-)}{\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-) \times \mathcal{B}(\Lambda_c^+ \to pK^-\pi^+)}$	LHCb [185][1]	$0.0411 \pm 0.0012 \pm 0.0020$	0.0411 ± 0.0023
$\frac{\mathcal{B}(\Lambda_b^0 \to p\overline{K}^0\pi^-)}{\mathcal{B}(B^0 \to K^0\pi^+\pi^-)}$	LHCb [104][1]	$0.25 \pm 0.04 \pm 0.07$	0.25 ± 0.08
$\frac{\mathcal{B}(\Lambda_b^0 \to p\overline{K}^0K^-)}{\mathcal{B}(B^0 \to K^0\pi^+\pi^-)}$	LHCb [104]	< 0.07	< 0.07
$\frac{\mathcal{B}(\Lambda_b^0 \to \Lambda^0\mu^+\mu^-)}{\mathcal{B}(\Lambda_b^0 \to J/\psi\Lambda^0)}$	LHCb [179][1]	$0.00154 \pm 0.00030 \pm 0.00020$	0.00154 ± 0.00036
$\frac{\mathcal{B}(\Lambda_b^0 \to pK^-e^+e^-)}{\mathcal{B}(\Lambda_b^0 \to J/\psi pK^-)}$	LHCb [182][2]	$0.00098\,^{+0.00014}_{-0.00013} \pm 0.00008$	0.00098 ± 0.00016
$\frac{\mathcal{B}(\Lambda_b^0 \to pK^-\mu^+\mu^-)}{\mathcal{B}(\Lambda_b^0 \to J/\psi pK^-)}$	LHCb [182][2]	$0.00084 \pm 0.00004 \pm 0.00004$	0.000840 ± 0.000057
$\frac{\mathcal{B}(\Lambda_b^0 \to pK^-e^+e^-)}{\mathcal{B}(\Lambda_b^0 \to pK^-\mu^+\mu^-)}$	LHCb [182][2]	$1.17\,^{+0.18}_{-0.16} \pm 0.07$	$1.17\,^{+0.19}_{-0.17}$
$\frac{\mathcal{B}(\Lambda_b^0 \to p\overline{K}^0\pi^-)}{\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-) \times \mathcal{B}(\Lambda_c^+ \to pK_S^0)}$	LHCb [178]	$0.1363 \pm 0.0027 \pm 0.0020$	0.1363 ± 0.0034
$\frac{\mathcal{B}(\Lambda_b^0 \to pK^0K^-)}{\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-) \times \mathcal{B}(\Lambda_c^+ \to pK_S^0)}$	LHCb [178]	$0.0079 \pm 0.0010 \pm 0.0007$	0.0079 ± 0.0012

[1] Multiple systematic uncertainties are added in quadrature.
[2] Measured in the $m^2_{\ell^+\ell^-}$ bin $[0.1, 6.0]$ GeV^2/c^4 and for $m_{pK} < 2.6$ GeV/c^2.

Table 46: Relative branching fractions of Ξ_b^0 decays.

Parameter $[10^{-2}]$	**Measurements**		**Average**
$\frac{f_{\Xi_b^0}}{f_d} \times \frac{\mathcal{B}(\Xi_b^0 \to p\overline{K^0}K^-)}{\mathcal{B}(B^0 \to K^0\pi^+\pi^-)}$	LHCb [104]	< 2	< 2.0
$\frac{f_{\Xi_b^0}}{f_{\Lambda_b^0}} \times \frac{\mathcal{B}(\Xi_b^0 \to pK^-K^+K^-)}{\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-) \times \mathcal{B}(\Lambda_c^+ \to pK^-\pi^+)}$	LHCb [185][1]	$0.057 \pm 0.028 \pm 0.013$	0.057 ± 0.031
$\frac{f_{\Xi_b^0}}{f_{\Lambda_b^0}} \times \frac{\mathcal{B}(\Xi_b^0 \to pK^-\pi^+\pi^-)}{\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-) \times \mathcal{B}(\Lambda_c^+ \to pK^-\pi^+)}$	LHCb [185][1]	$0.62 \pm 0.08 \pm 0.08$	0.62 ± 0.11
$\frac{f_{\Xi_b^0}}{f_{\Lambda_b^0}} \times \frac{\mathcal{B}(\Xi_b^0 \to pK^-K^-\pi^+)}{\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-) \times \mathcal{B}(\Lambda_c^+ \to pK^-\pi^+)}$	LHCb [185][1]	$0.56 \pm 0.06 \pm 0.06$	0.560 ± 0.088
$\frac{\mathcal{B}(\Xi_b^0 \to \Lambda^0\pi^+\pi^-)}{\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-) \times \mathcal{B}(\Lambda_c^+ \to \Lambda^0\pi^+)}$	LHCb [184][1]	$18.5 \pm 4.3 \pm 6.5$	18.5 ± 7.8
$\frac{\mathcal{B}(\Xi_b^0 \to \Lambda^0K^+\pi^-)}{\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-) \times \mathcal{B}(\Lambda_c^+ \to \Lambda^0\pi^+)}$	LHCb [184][1]	$17.3 \pm 2.3 \pm 5.9$	17.3 ± 6.4
$\frac{\mathcal{B}(\Xi_b^0 \to \Lambda^0K^+K^-)}{\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-) \times \mathcal{B}(\Lambda_c^+ \to \Lambda^0\pi^+)}$	LHCb [184][1]	$2.0 \pm 1.2 \pm 1.3$	2.0 ± 1.8
$\frac{f_{\Xi_b^0}}{f_{\Lambda_b^0}} \times \frac{\mathcal{B}(\Xi_b^0 \to pK_s^0\pi^-)}{\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-) \times \mathcal{B}(\Lambda_c^+ \to pK_s^0)}$	LHCb [178]	< 0.28	< 0.28
$\frac{f_{\Xi_b^0}}{f_{\Lambda_b^0}} \times \frac{\mathcal{B}(\Xi_b^0 \to pK_s^0K^-)}{\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-) \times \mathcal{B}(\Lambda_c^+ \to pK_s^0)}$	LHCb [178]	$0.41 \pm 0.06 \pm 0.05$	0.410 ± 0.078

[1] Multiple systematic uncertainties are added in quadrature.

Table 47: Relative branching fractions of Ξ_b^- decays.

Parameter $[10^{-2}]$	**Measurements**		**Average**
$\frac{f_{\Xi_b^-}}{f_u} \frac{\mathcal{B}(\Xi_b^- \to pK^-K^-)}{\mathcal{B}(B^- \to K^+K^-K^-)}$	LHCb [59]	$0.2650 \pm 0.0350 \pm 0.0470$	0.265 ± 0.059
$\frac{f_{\Xi_b^-}}{f_u} \frac{\mathcal{B}(\Xi_b^- \to p\pi^-\pi^-)}{\mathcal{B}(B^- \to K^+K^-K^-)}$	LHCb [59]	< 0.1470	< 0.15
$\frac{f_{\Xi_b^-}}{f_u} \frac{\mathcal{B}(\Xi_b^- \to pK^-\pi^-)}{\mathcal{B}(B^- \to K^+K^-K^-)}$	LHCb [59]	$0.2590 \pm 0.0640 \pm 0.0490$	0.259 ± 0.081
$\frac{\mathcal{B}(\Xi_b^- \to p\pi^-\pi^-)}{\mathcal{B}(\Xi_b^- \to pK^-K^-)}$	LHCb [59]	< 56	< 56
$\frac{\mathcal{B}(\Xi_b^- \to pK^-\pi^-)}{\mathcal{B}(\Xi_b^- \to pK^-K^-)}$	LHCb [59]	$98 \pm 27 \pm 9$	98 ± 28
$\frac{\mathcal{B}(\Xi_b^- \to \Xi^-\gamma)}{\mathcal{B}(\Xi_b^- \to \Xi^- J/\psi)}$	LHCb [188]	< 8	< 8.0

Table 48: Relative branching fractions of Ω_b^- decays.

Parameter $[10^{-3}]$	**Measurements**		**Average**
$\frac{f_{\Omega_b^-}}{f_u}\frac{\mathcal{B}(\Omega_b^-\to pK^-K^-)}{\mathcal{B}(B^-\to K^+K^-K^-)}$	LHCb [59]	< 0.180	< 0.18
$\frac{f_{\Omega_b^-}}{f_u}\frac{\mathcal{B}(\Omega_b^-\to p\pi^-\pi^-)}{\mathcal{B}(B^-\to K^+K^-K^-)}$	LHCb [59]	< 1.090	< 1.1
$\frac{f_{\Omega_b^-}}{f_u}\frac{\mathcal{B}(\Omega_b^-\to pK^-\pi^-)}{\mathcal{B}(B^-\to K^+K^-K^-)}$	LHCb [59]	< 0.510	< 0.51

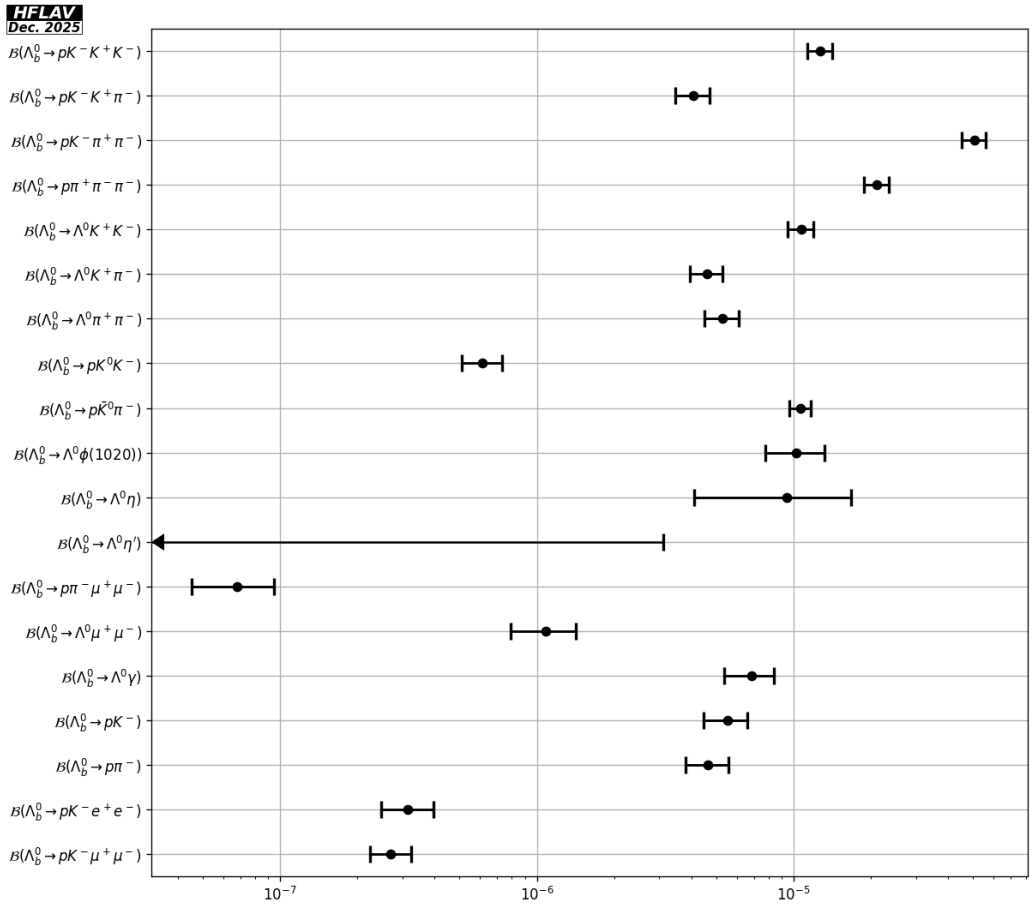

Figure 4: Branching fractions of charmless Λ_b^0 decays.

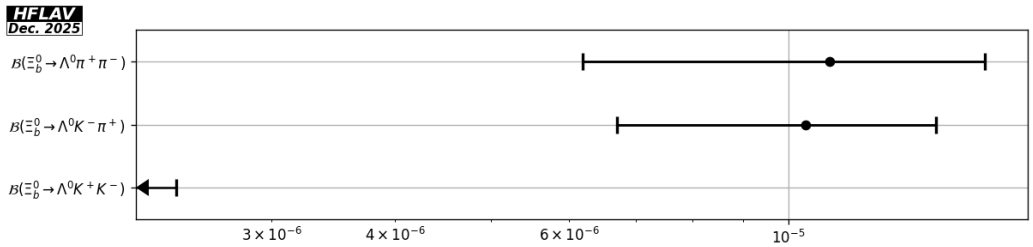

Figure 5: Branching fractions of charmless Ξ_b decays.

Measurements that are not included in the tables:

- In Ref. [189], LHCb performs the measurement of the partial branching fraction and angular observables of the $\Lambda_b^0 \to pk^-\mu^+\mu^-$ decay, in bins of $m^2(\mu\mu)$ and $K\pi$ mass.
- In Ref. [190], LHCb measures angular observables of the decay $\Lambda_b^0 \to \Lambda\mu^+\mu^-$, including the lepton-side, hadron-side and combined forward-backward asymmetries of the decay in the low recoil region $15 < m^2(\ell\ell) < 20$ GeV$^2/c^4$.
- In Ref. [191], LHCb performs a search for baryon-number-violating Ξ_b^0 oscillations and set an upper limit of $\omega < 0.08$ ps^{-1} on the oscillation rate.
- In Ref. [192], LHCb measures the photon polarization in $\Lambda_b \to \Lambda\gamma$ decays to be $\alpha_\gamma = 0.82\,^{+0.17\ +0.04}_{-0.26\ -0.13}$.
- In Ref. [193], LHCb reports the amplitude analysis of the $\Lambda_b \to pK\gamma$ decay, in the region $m(pK) < 2.5$GeV$^2/c^4$.

0.4 Decays of B_s^0 mesons

Tables 49 to 54 and 55 to 57 detail branching fractions and relative branching fractions of B_s^0 meson decays, respectively. Figures 6 and 7 show graphic representations of a selection of results given in this section.

Table 49: Branching fractions of charmless B_s^0 decays (part 1).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B_s^0 \to \pi^+\pi^-)$	Belle [194]	< 12	$0.74\,^{+0.12}_{-0.10}$
	CDF [90][1]		0.72 ± 0.10
	LHCb [92][1]		
$\mathcal{B}(B_s^0 \to \pi^0\pi^0)$	Belle [195]	< 7.7	< 7.7
$\mathcal{B}(B_s^0 \to \eta\pi^0)$	L3 [196]	< 1000	< 1000
$\mathcal{B}(B_s^0 \to \eta\eta)$	Belle [197][2]	< 144	< 144
			< 143
$f_s \times \mathcal{B}(B_s^0 \to \eta\eta)$	Belle [197]	< 29	< 29
			none
$\mathcal{B}(B_s^0 \to \rho^0(770)\rho^0(770))$	SLD [198]	< 320	< 320
$\mathcal{B}(B_s^0 \to \eta'\eta')$	LHCb [13][3]	$33.1 \pm 6.3 \pm 3.1$	33 ± 7
$\mathcal{B}(B_s^0 \to \eta'\phi(1020))$	LHCb [199]	< 0.82	< 0.82
$\mathcal{B}(B_s^0 \to \phi(1020)f_0(980)) \times \mathcal{B}(f_0(980) \to \pi^+\pi^-)$			
	LHCb [138][4]	$1.12 \pm 0.16 \pm 0.14$	1.12 ± 0.21
$\mathcal{B}(B_s^0 \to f_2(1270)\phi(1020)) \times \mathcal{B}(f_2(1270) \to \pi^+\pi^-)$			
	LHCb [138][4]	$0.61 \pm 0.13\,^{+0.13}_{-0.08}$	$0.61\,^{+0.19}_{-0.15}$
			$0.61\,^{+0.18}_{-0.15}$
$\mathcal{B}(B_s^0 \to \phi(1020)\rho^0(770))$	LHCb [138][4]	$0.27 \pm 0.07 \pm 0.03$	0.27 ± 0.08
$\mathcal{B}(B_s^0 \to \phi(1020)\pi^+\pi^-)$	LHCb [138][5,4]	$3.48 \pm 0.23 \pm 0.39$	3.48 ± 0.45
$\mathcal{B}(B_s^0 \to \phi(1020)\phi(1020))$	LHCb [127][4,6]	$18.6 \pm 0.5 \pm 1.6$	18.5 ± 1.4
	CDF [200][7]	$18.5 \pm 1.5 \pm 2.2$	18.4 ± 1.4

[1] Measurement of $(\mathcal{B}(B_s^0 \to \pi^+\pi^-)/\mathcal{B}(B^0 \to K^+\pi^-))\frac{f_s}{f_d}$ used in our fit.
[2] Using f_s.
[3] Using $\mathcal{B}(B^+ \to \eta' K^+)$.
[4] Multiple systematic uncertainties are added in quadrature.
[5] $400 < m_{\pi^+\pi^-} < 1600$ MeV/c^2.
[6] Using $\mathcal{B}(B^0 \to \phi(1020)K^*(892)^0)$.
[7] Using $\mathcal{B}(B_s^0 \to J/\psi\phi(1020))$.

Table 50: Branching fractions of charmless B_s^0 decays (part 2).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B_s^0 \to K^-\pi^+)$	Belle [194]	< 26	$6.1\,^{+0.9}_{-0.8}$
	CDF [88][1]		5.9 ± 0.7
	LHCb [91][1]		
$\mathcal{B}(B_s^0 \to K^+K^-)$	Belle [194][2]	$38\,^{+10}_{-9} \pm 7$	$27.4\,^{+3.2}_{-2.8}$
	CDF [89][3]		27.2 ± 2.3
	LHCb [91][3]		
$\mathcal{B}(B_s^0 \to K^0\overline{K}^0)$	LHCb [120][2,4]	$17.0 \pm 3.0 \pm 2.2$	17.7 ± 3.1
	Belle [201][2]	$19.6\,^{+5.8}_{-5.1} \pm 2.2$	$17.6\,^{+3.2}_{-3.1}$
$\mathcal{B}(B_s^0 \to K^0\pi^+\pi^-)$	LHCb [106][5,6]	$9.46 \pm 1.34 \pm 1.66$	9.5 ± 2.1
$\mathcal{B}(B_s^0 \to K^0K^+\pi^-$+c.c.)	LHCb [106][5,6]	$84.2 \pm 3.5 \pm 7.9$	84.1 ± 8.6
			84.5 ± 8.8
$\mathcal{B}(B_s^0 \to K^*(892)^-\pi^+)$	LHCb [109][7]	$2.98 \pm 0.99 \pm 0.42$	3.0 ± 1.1 p=0.16%
			2.9 ± 1.1

[1] Measurement of $(\mathcal{B}(B_s^0 \to K^-\pi^+)/\mathcal{B}(B^0 \to K^+\pi^-))\frac{f_s}{f_d}$ used in our fit.
[2] Multiple systematic uncertainties are added in quadrature.
[3] Measurement of $(\mathcal{B}(B_s^0 \to K^+K^-)/\mathcal{B}(B^0 \to K^+\pi^-))\frac{f_s}{f_d}$ used in our fit.
[4] Using $\mathcal{B}(B^0 \to \phi(1020)K^0)$.
[5] Regions corresponding to D, Λ_c^+ and charmonium resonances are vetoed in this analysis.
[6] Using $\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$.
[7] Using $\mathcal{B}(B^0 \to K^*(892)^+\pi^-)$.

Table 51: Branching fractions of charmless B_s^0 decays (part 3).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B_s^0 \to K^*(892)^+K^-$+c.c.)	LHCb [202][1,2]	$18.6 \pm 1.2 \pm 4.5$	18.6 ± 4.7
$\mathcal{B}(B_s^0 \to (K\pi)_0^{*+}K^-$+c.c.)	LHCb [202][1,2]	$24.9 \pm 1.8 \pm 20.2$	25 ± 20 none
$\mathcal{B}(B_s^0 \to K_0^*(1430)^+K^-$+c.c.)	LHCb [202][1,2]	$31.3 \pm 2.3 \pm 25.3$	31 ± 25
$\mathcal{B}(B_s^0 \to K_2^*(1430)^+K^-$+c.c.)	LHCb [202][1,2]	$10.3 \pm 2.5 \pm 16.4$	10 ± 17
$\mathcal{B}(B_s^0 \to K^*(892)^0\overline{K}^0$+c.c.)	LHCb [202][1,2]	$19.8 \pm 2.8 \pm 5.0$	19.8 ± 5.7
$\mathcal{B}(B_s^0 \to (K\pi)_0^{*0}\overline{K}^0$+c.c.)	LHCb [202][1,2]	$26.2 \pm 2.0 \pm 7.8$	26.2 ± 8.1 none
$\mathcal{B}(B_s^0 \to K_0^*(1430)^0\overline{K}^0$+c.c.)	LHCb [202][1,2]	$33.0 \pm 2.5 \pm 9.8$	33 ± 10
$\mathcal{B}(B_s^0 \to K_2^*(1430)^0\overline{K}^0$+c.c.)	LHCb [202][1,2]	$16.8 \pm 4.5 \pm 21.3$	17 ± 22
$\mathcal{B}(B_s^0 \to K_S^0K^*(892)^0$+c.c.)	LHCb [105][2,3]	$17.1 \pm 3.6 \pm 2.4$	17.1 ± 4.3 p=0.16% 16.4 ± 4.1
$\mathcal{B}(B_s^0 \to K^0K^+K^-)$	LHCb [106][4,5]	$1.29 \pm 0.54 \pm 0.36$	1.29 ± 0.65
$\mathcal{B}(B_s^0 \to \overline{K}^*(892)^0\rho^0(770))$	SLD [198]	< 767	< 767
$\mathcal{B}(B_s^0 \to K^*(892)^0\overline{K}^*(892)^0)$	LHCb [126][2,6] LHCb [130][2,7]	$11.2 \pm 2.2 \pm 1.5$	12.1 ± 2.3 11.1 ± 2.7
$\mathcal{B}(B_s^0 \to \phi(1020)\overline{K}^*(892)^0)$	LHCb [125][2,6]	$1.14 \pm 0.24 \pm 0.17$	1.14 ± 0.29 1.14 ± 0.30

[1] Result extracted from Dalitz-plot analysis of $B_s^0 \to K_S^0K^+\pi^-$ decays.
[2] Multiple systematic uncertainties are added in quadrature.
[3] Using $\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$.
[4] Regions corresponding to D, Λ_c^+ and charmonium resonances are vetoed in this analysis.
[5] Using $\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$.
[6] Using $\mathcal{B}(B^0 \to \phi(1020)K^*(892)^0)$.
[7] Measurement of $\mathcal{B}(B^0 \to K^*(892)^0\overline{K}^*(892)^0)/\mathcal{B}(B_s^0 \to K^*(892)^0\overline{K}^*(892)^0)$ used in our fit.

Table 52: Branching fractions of charmless B_s^0 decays (part 4).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B_s^0 \to p\bar{p})$	LHCb [168]	< 0.0044	< 0.0044
$\mathcal{B}(B_s^0 \to p\bar{p}K^+K^-)$	LHCb [170][1,2]	$4.2 \pm 0.3 \pm 0.4$	4.2 ± 0.5 4.5 ± 0.5
$\mathcal{B}(B_s^0 \to p\bar{p}K^+\pi^-)$	LHCb [170][1,2]	$1.3 \pm 0.2 \pm 0.2$	1.3 ± 0.3 1.4 ± 0.3
$\mathcal{B}(B_s^0 \to p\bar{p}\pi^+\pi^-)$	LHCb [170][1]	< 0.66	< 0.66 0.43 ± 0.20
$\mathcal{B}(B_s^0 \to p\bar{p}K^0)$	LHCb [107][3,2,4]	$0.911 \pm 0.168 \pm 0.097$	0.91 ± 0.19 none
$\mathcal{B}(B_s^0 \to p\overline{\Lambda}^0 K^-$+c.c.)	LHCb [203][2]	$5.46 \pm 0.61 \pm 0.82$	5.5 ± 1.0
$\mathcal{B}(B_s^0 \to \gamma\gamma)$	Belle [204]	< 3.1	< 3.1
$\mathcal{B}(B_s^0 \to \phi(1020)\gamma)$	LHCb [205][5] Belle [204] LHCb [206][6,7], [206][6,8]	$33.8 \pm 1.7 \pm 3.0$ $36.0 \pm 5.0 \pm 7.0$	34.1 ± 3.2 34.2 ± 3.6
$\mathcal{B}(B_s^0 \to f_2'(1525)\gamma)$	LHCb [206][6,7]		$6.50\,^{+0.85}_{-0.72}$ none
$\mathcal{B}(B_s^0 \to f_2(1270)\gamma)$	LHCb [206][6,8]		8.4 ± 4.2 none

[1] $m_{p\bar{p}} < 2.85$ GeV/c^2.
[2] Multiple systematic uncertainties are added in quadrature.
[3] The charmonium mass region has been vetoed.
[4] Using $\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$.
[5] Using $\mathcal{B}(B^0 \to K^*(892)^0\gamma)$.
[6] Result extracted from Dalitz-plot analysis of $B_s^0 \to K^+K^-\gamma$ decays.
[7] Measurement of $\mathcal{B}(B_s^0 \to f_2'(1525)\gamma)/\mathcal{B}(B_s^0 \to \phi(1020)\gamma)(\mathcal{B}(f_2'(1525) \to K\overline{K})/\mathcal{B}(\phi(1020) \to K^+K^-))0.5$ used in our fit.
[8] Measurement of $\mathcal{B}(B_s^0 \to f_2(1270)\gamma)/\mathcal{B}(B_s^0 \to \phi(1020)\gamma)(\mathcal{B}(f_2(1270) \to K\overline{K})/\mathcal{B}(\phi(1020) \to K^+K^-))0.5$ used in our fit.

Table 53: Branching fractions of charmless B_s^0 decays (part 5).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B_s^0 \to e^+e^-)$	LHCb [207]	< 0.0094	< 0.0094
	CDF [208]	< 0.28	
	Belle [209]	< 15.3	
$\mathcal{B}(B_s^0 \to \tau^+\tau^-)$[1]	LHCb [210]	< 5200	< 5200
			< 6800
$\mathcal{B}(B_s^0 \to \mu^+\mu^-\gamma)$	LHCb [211][2]	< 0.025	< 0.025
			none
$\mathcal{B}(B_s^0 \to \mu^+\mu^-\mu^+\mu^-)$	LHCb [212][3]	< 0.00086	< 0.00086
$\mathcal{B}(B_s^0 \to aa) \times \mathcal{B}(a \to \mu^+\mu^-) \times \mathcal{B}(a \to \mu^+\mu^-)$			
	LHCb [212][4,5,3]	< 0.00058	< 0.00058
			none
$\mathcal{B}(B_s^0 \to \phi(1020)\mu^+\mu^-)$[6,7]	LHCb [213][8,9]	$0.832 \pm 0.022 \pm 0.035$	$0.838\,^{+0.042}_{-0.041}$
	CDF [180][9]	$1.18 \pm 0.20 \pm 0.09$	0.829 ± 0.040
$\mathcal{B}(B_s^0 \to \phi(1020)\tau^+\tau^-)$	LHCb [214]	< 410	< 410
			none
$\mathcal{B}(B_s^0 \to \overline{K}^*(892)^0\mu^+\mu^-)$	LHCb [215][8]	$0.029 \pm 0.010 \pm 0.004$	0.029 ± 0.011
$\mathcal{B}(B_s^0 \to \pi^+\pi^-\mu^+\mu^-)$	LHCb [216][10,11]		0.084 ± 0.016
			0.084 ± 0.017
$\mathcal{B}(B_s^0 \to \phi(1020)\nu\overline{\nu})$	DELPHI [110]	< 5400	< 5400

[1] PDG shows the result obtained at 95% CL.
[2] Limit obtained via a simultaneous fit in three q^2 regions. Limits from the individual q^2 regions are reported in the paper.
[3] At CL=95 %.
[4] The mass windows corresponding to ϕ and charmonium resonances decaying to $\mu\mu$ are vetoed.
[5] a is a promptly decaying scalar particle with a mass of 1 GeV/c^2
[6] The PDG uncertainty includes a scale factor.
[7] Treatment of charmonium intermediate components differs between the results.
[8] Multiple systematic uncertainties are added in quadrature.
[9] Using $\mathcal{B}(B_s^0 \to J/\psi\phi(1020))$.
[10] $0.5 < m_{\pi^+\pi^-} < 1.3$ GeV/c^2.
[11] Measurement of $\mathcal{B}(B_s^0 \to \pi^+\pi^-\mu^+\mu^-)/(\mathcal{B}(B^0 \to J/\psi K^*(892)^0)\mathcal{B}(J/\psi \to \mu^+\mu^-)\mathcal{B}(K^*(892)^0 \to K\pi)2/3)$ used in our fit.

Table 54: Branching fractions of charmless B_s^0 decays (part 6).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B_s^0 \to e^+\mu^-$+c.c.)	LHCb [217]	< 0.0054	< 0.0054
	CDF [208]	< 0.2	
$\mathcal{B}(B_s^0 \to \tau^+e^-$+c.c.)	Belle [218]	< 1410	< 1410
			none
$\mathcal{B}(B_s^0 \to \tau^+\mu^-$+c.c.)[1]	LHCb [219]	< 34	< 34
	Belle [218]	< 730	< 42
$\mathcal{B}(B_s^0 \to \phi(1020)e^+\mu^-$+c.c.)	LHCb [220]	< 0.0160	< 0.016
			none
$\mathcal{B}(B_s^0 \to \phi(1020)\mu^+\tau^-$+c.c.)	LHCb [221]	< 10	< 10
			none
$\mathcal{B}(B_s^0 \to p\mu^-)$	LHCb [222]	< 0.0121	< 0.012
			none
$\mathcal{B}(B_s^0 \to \eta'\eta)$	Belle [223]	< 65	< 65
$\mathcal{B}(B_s^0 \to f_2'(1525)\mu^+\mu^-)$	LHCb [213][2,3]	$0.161 \pm 0.020 \pm 0.011$	0.161 ± 0.022
			none
$\mathcal{B}(B_s^0 \to \eta' X_{s\bar{s}})$	Belle [224][4]	< 1400	< 1400
			none
$\mathcal{B}(B_s^0 \to \eta' K_S^0)$	Belle [225][5]	< 8.16	< 8.2
			none
$\mathcal{B}(B_s^0 \to p\bar{p}p\bar{p})$	LHCb [176][6]		0.0227 ± 0.0100
			none

[1] PDG shows the result obtained at 95% CL.
[2] Multiple systematic uncertainties are added in quadrature.
[3] Using $\mathcal{B}(B_s^0 \to J/\psi\phi(1020))$.
[4] $m_{X_{ss}} < 2.4$ GeV/c^2
[5] Using f_s.
[6] Measurement of $\mathcal{B}(B_s^0 \to p\bar{p}p\bar{p})/(\mathcal{B}(B_s^0 \to J/\psi\phi(1020))\mathcal{B}(J/\psi \to p\bar{p})\mathcal{B}(\phi(1020) \to K^+K^-))$ used in our fit.

Table 55: Relative branching fractions of B_s^0 decays (part 1).

Parameter $[10^{-2}]$	**Measurements**		**Average**
$\frac{f_s}{f_d}\frac{\mathcal{B}(B_s^0\to\pi^+\pi^-)}{\mathcal{B}(B^0\to K^+\pi^-)}$	LHCb [92] CDF [90]	$0.915 \pm 0.071 \pm 0.083$ $0.8 \pm 0.2 \pm 0.1$	0.893 ± 0.098
$\frac{f_s}{f_d}\frac{\mathcal{B}(B_s^0\to\pi^+\pi^-)}{\mathcal{B}(B^0\to\pi^+\pi^-)}$	LHCb [91]	$5.0\,^{+1.1}_{-0.9} \pm 0.4$	$5.0\,^{+1.2}_{-1.0}$
$\frac{\mathcal{B}(B_s^0\to\phi(1020)\phi(1020))}{\mathcal{B}(B_s^0\to J/\psi\phi(1020))}$ [1]	CDF [200]	$1.78 \pm 0.14 \pm 0.20$	1.78 ± 0.24
$\frac{\mathcal{B}(B_s^0\to\phi(1020)\phi(1020))}{\mathcal{B}(B^0\to\phi(1020)K^*(892)^0)}$	LHCb [127] [2]	$184 \pm 5 \pm 13$	184 ± 14
$\frac{f_s}{f_d}\frac{\mathcal{B}(B_s^0\to K^+\pi^-)}{\mathcal{B}(B_d^0\to K^+\pi^-)}$	LHCb [91] CDF [88]	$7.4 \pm 0.6 \pm 0.6$ $7.1 \pm 1.0 \pm 0.7$	7.30 ± 0.70
$\frac{f_s}{f_d}\frac{\mathcal{B}(B_s^0\to K^+K^-)}{\mathcal{B}(B_d^0\to K^+\pi^-)}$	LHCb [91] CDF [89]	$31.6 \pm 0.9 \pm 1.9$ $34.7 \pm 2.0 \pm 2.1$	32.7 ± 1.7
$\frac{\mathcal{B}(B_s^0\to K^0\pi^+\pi^-)}{\mathcal{B}(B^0\to K^0\pi^+\pi^-)}$	LHCb [106] [3,2]	$19.1 \pm 2.7 \pm 3.3$	19.1 ± 4.3
$\frac{\mathcal{B}(B_s^0\to K^0K^+\pi^-+\text{c.c.})}{\mathcal{B}(B^0\to K^0\pi^+\pi^-)}$	LHCb [106] [3,2]	$170 \pm 7 \pm 15$	170 ± 16
$\frac{\mathcal{B}(B_s^0\to K^0K^+K^-)}{\mathcal{B}(B^0\to K^0\pi^+\pi^-)}$	LHCb [106] [3]	< 5.1	< 5.1
$\frac{\mathcal{B}(B_s^0\to K^*(892)^-\pi^+)}{\mathcal{B}(B^0\to K^*(892)^+\pi^-)}$	LHCb [109]	$39 \pm 13 \pm 5$	39 ± 14
$\frac{\mathcal{B}(B_s^0\to K^*(892)^0\overline{K}^*(892)^0)}{\mathcal{B}(B^0\to\phi(1020)K^*(892)^0)}$	LHCb [126] [2]	$111 \pm 22 \pm 13$	111 ± 26
$\frac{\mathcal{B}(B_s^0\to\phi(1020)\overline{K}^*(892)^0)}{\mathcal{B}(B^0\to\phi(1020)K^*(892)^0)}$	LHCb [125] [2]	$11.3 \pm 2.4 \pm 1.6$	11.3 ± 2.9
$\frac{\mathcal{B}(B_s^0\to\phi(1020)\mu^+\mu^-)}{\mathcal{B}(B_s^0\to J/\psi\phi(1020))}$	LHCb [213] [2] CDF [180]	$0.0800 \pm 0.0021 \pm 0.0016$ $0.113 \pm 0.019 \pm 0.007$	0.0806 ± 0.0026

[1] The PDG average is a result of a fit including input from other measurements.
[2] Multiple systematic uncertainties are added in quadrature.
[3] Regions corresponding to D, Λ_c^+ and charmonium resonances are vetoed in this analysis.

Table 56: Relative branching fractions of B_s^0 decays (part 2).

Parameter [10^{-2}]	**Measurements**		**Average**
$\frac{\mathcal{B}(B_s^0 \to p\overline{p}K^+\pi^-)}{\mathcal{B}(B^0 \to p\overline{p}K^+\pi^-)}$	LHCb [170][1,2]	$22 \pm 4 \pm 2$	22 ± 5
$\frac{\mathcal{B}(B_s^0 \to p\overline{p}K^+\pi^-)}{\mathcal{B}(B_s^0 \to p\overline{p}K^+K^-)}$	LHCb [170][1]	$31 \pm 5 \pm 2$	31 ± 5
$\frac{\mathcal{B}(B_s^0 \to p\overline{p}K^0)}{\mathcal{B}(B^0 \to \pi^+\pi^-K^0)}$	LHCb [107][3,2]	$1.84 \pm 0.34 \pm 0.18$	1.84 ± 0.39
$\frac{\mathcal{B}(B_s^0 \to p\overline{p}K^0)}{\mathcal{B}(B^0 \to p\overline{p}K^0))}$	LHCb [107][3,2]	$32.5 \pm 6.1 \pm 3.7$	32.5 ± 7.1
$\frac{\mathcal{B}(B_s^0 \to \overline{K}^*(892)^0\mu^+\mu^-)}{\mathcal{B}(B_s^0 \to J/\psi\overline{K}^*(892)^0) \times \mathcal{B}(J/\psi \to \mu^+\mu^-)}$	LHCb [215][2]	$1.4 \pm 0.4 \pm 0.1$	1.4 ± 0.4
$\frac{\mathcal{B}(B_s^0 \to \overline{K}^*(892)^0\mu^+\mu^-)}{\mathcal{B}(\overline{B}^0 \to \overline{K}^*(892)^0\mu^+\mu^-)}$	LHCb [215][2]	$3.3 \pm 1.1 \pm 0.4$	3.3 ± 1.2
$\frac{\mathcal{B}(B_s^0 \to \phi(1020)\phi(1020)\phi(1020))}{\mathcal{B}(B_s^0 \to \phi(1020)\phi(1020))}$	LHCb [226]	$11.7 \pm 3.0 \pm 1.5$	11.7 ± 3.4
$\frac{\mathcal{B}(B_s^0 \to K^0\overline{K}^0)}{\mathcal{B}(B^0 \to \phi(1020)K^0)}$	LHCb [120][2]	$230 \pm 40 \pm 22$	230 ± 46
$\frac{\mathcal{B}(B_s^0 \to K_S^0K^*(892)^0+\text{c.c.})}{\mathcal{B}(B^0 \to K_S^0\pi^+\pi^-)}$	LHCb [105][2]	$33 \pm 7 \pm 4$	33 ± 8
$\frac{\mathcal{B}(B_s^0 \to f_2'(1525)\mu^+\mu^-)}{\mathcal{B}(B_s^0 \to J/\psi\phi(1020))}$	LHCb [213][2]	$0.0155 \pm 0.0019 \pm 0.0008$	0.0155 ± 0.0021
$\frac{\mathcal{B}(B_s^0 \to \pi^+\pi^-\mu^+\mu^-)}{\mathcal{B}(B^0 \to J/\psi K^*(892)^0) \times \mathcal{B}(J/\psi \to \mu^+\mu^-) \times \mathcal{B}(K^*(892)^0 \to K^+\pi^-)}$	LHCb [216][4]	$0.167 \pm 0.029 \pm 0.013$	0.167 ± 0.032
$\frac{\mathcal{B}(B^0 \to p\overline{p}p\overline{p})}{\mathcal{B}(B^0 \to J/\psi\phi)\mathcal{B}(J/\psi \to p\overline{p})\mathcal{B}(\phi \to K^+K^-)}$	LHCb [176]	$2.1 \pm 0.9 \pm 0.2$	2.10 ± 0.92

[1] $m_{p\overline{p}} < 2.85$ GeV/c^2.
[2] Multiple systematic uncertainties are added in quadrature.
[3] The charmonium mass region has been vetoed.
[4] $0.5 < m_{\pi^+\pi^-} < 1.3$ GeV/c^2.

Table 57: Relative branching fractions of B_s^0 decays (part 3).

Parameter [10^{-2}]	**Measurements**		**Average**
$\frac{\mathcal{B}(B_s^0 \to f_2'(1525)\gamma)}{\mathcal{B}(B_s^0 \to \phi(1020)\gamma)}$	LHCb [206][1,2]		$19.1\,^{+1.8}_{-1.1}$
$\frac{\mathcal{B}(B_s^0 \to f_2(1270)\gamma)}{\mathcal{B}(B_s^0 \to \phi(1020)\gamma)}$	LHCb [206][1,3]		$25\,^{+11}_{-13}$
$\frac{\mathcal{B}(B_s^0 \to \phi(1680)\gamma) \times \mathcal{B}(\phi(1680) \to K^+K^-)}{\mathcal{B}(B_s^0 \to \phi(1020)\gamma)}$	LHCb [206][1]	$2.6\,^{+0.4}_{-0.3} \pm 0.5$	2.60 ± 0.61
$\frac{\mathcal{B}(B_s^0 \to \phi e^+e^-)}{\mathcal{B}(B_s^0 \to \phi \mu^+\mu^-)}$, $0.1 < m^2_{\ell^+\ell^-} < 1.1$ GeV^2/c^4	LHCb [227]	$157\,^{+28}_{-25} \pm 5$	$157\,^{+28}_{-25}$
$\frac{\mathcal{B}(B_s^0 \to \phi e^+e^-)}{\mathcal{B}(B_s^0 \to \phi \mu^+\mu^-)}$, $1.1 < m^2_{\ell^+\ell^-} < 6.0$ GeV^2/c^4	LHCb [227]	$91\,^{+20}_{-19} \pm 5$	91 ± 20
$\frac{\mathcal{B}(B_s^0 \to \phi e^+e^-)}{\mathcal{B}(B_s^0 \to \phi \mu^+\mu^-)}$, $15.0 < m^2_{\ell^+\ell^-} < 19.0$ GeV^2/c^4	LHCb [227]	$85\,^{+24}_{-23} \pm 10$	85 ± 26

[1] Result extracted from Dalitz-plot analysis of $B_s^0 \to K^+K^-\gamma$ decays.

[2] Measurement of $\frac{\mathcal{B}(B_s^0 \to f_2'(1525)\gamma)}{\mathcal{B}(B_s^0 \to \phi(1020)\gamma)}(\mathcal{B}(f_2'(1525) \to K\overline{K})/\mathcal{B}(\phi(1020) \to K^+K^-))0.5$ used in our fit.

[3] Measurement of $\frac{\mathcal{B}(B_s^0 \to f_2(1270)\gamma)}{\mathcal{B}(B_s^0 \to \phi(1020)\gamma)}(\mathcal{B}(f_2(1270) \to K\overline{K})/\mathcal{B}(\phi(1020) \to K^+K^-))0.5$ used in our fit.

Measurements that are not included in the tables (the definitions of observables can be found in the corresponding experimental papers):

- In Ref. [228], LHCb reports the angular analysis of the decay $B_s^0 \to \phi e^+ e^-$ in three bins of $m^2(e^+e^-)$ corresponding to $[0.1; 1.1]$, $[1.1; 6.0]$, and $[15.0; 19.0]$ GeV$^2/c^4$ and reports F_L, A_6', S_3 and A_9.

- In Ref. [229], LHCb performs an angular analysis of $B_s^0 \to \phi e^+ e^-$ in the $m^2(e^+e^-)$ mass region $[0.0009; 0.2615]$ GeV$^2/c^4$ and measures $A_T^{(2)}$, A_T^{ImCP},A_T^{ReCP} and F_L.

- In Ref. [213], LHCb reports the differential $B_s^0 \to \phi\mu^+\mu^-$ branching fraction in bins of $m^2(\mu^+\mu^-)$.

- In Ref. [230], LHCb performs an angular analysis of $B_s^0 \to \phi\mu^+\mu^-$ decays and reports F_L, S_3, S_4, S_7, A_5, A_{FB}^{CP}, A_8 and A_9 in bins of $m^2(\mu^+\mu^-)$.

- In Ref. [231], LHCb reports the photon polarization in $B_s^0 \to \phi\gamma$ decays.

- We do not perform the average of the branching fraction of $B \to \mu^+\mu^-$ decays, which is taken care of by the LHC Heavy Flavour Working Group [232], taking into account the correlations between the $B^0 \to \mu^+\mu^-$ and $B_s^0 \to \mu^+\mu^-$ branching fractions. The latest results from ATLAS, CMS and LHCb are in Refs. [233–235], respectively.

- In [227], LHCb reports the branching fraction of $B_s^0 \to \phi e^+ e^-$ in three bins of $m^2(e^+e^-)$.

- In Ref. [206], which describes a Dalitz-Plot analysis of $B_s^0 \to K^+K^-\gamma$ decays, LHCb reports the overall tensor contribution to the decay amplitude. This includes the resonant contributions of the $f_2(1270)$, $f_2'(1525)$, and $f_2(2010)$ states.

- In Ref. [130], LHCb also reports the uncorrected branching fraction of $B_s^0 \to K^*(892)^0\overline{K}^*(892)^0$ that includes the effects mediated by $B_s^0 - \overline{B}_s^0$ mixing.

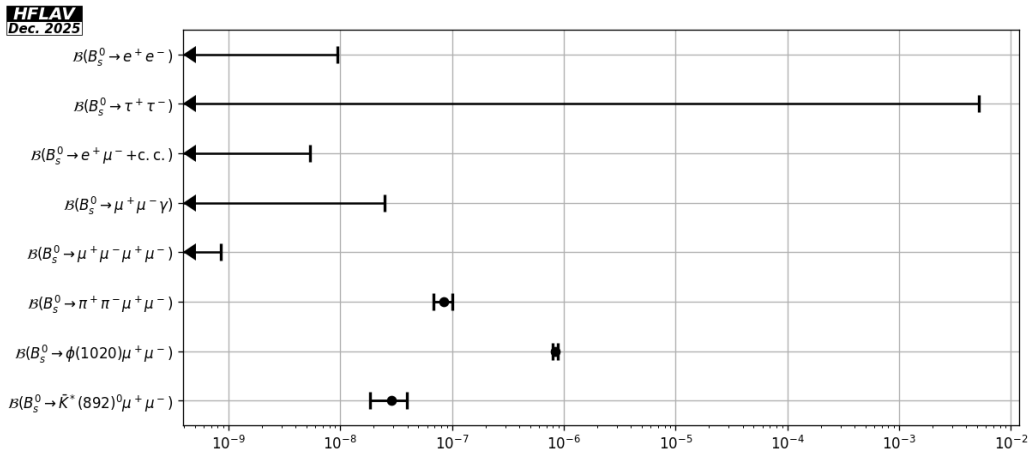

Figure 6: Branching fractions of charmless leptonic B_s^0 decays.

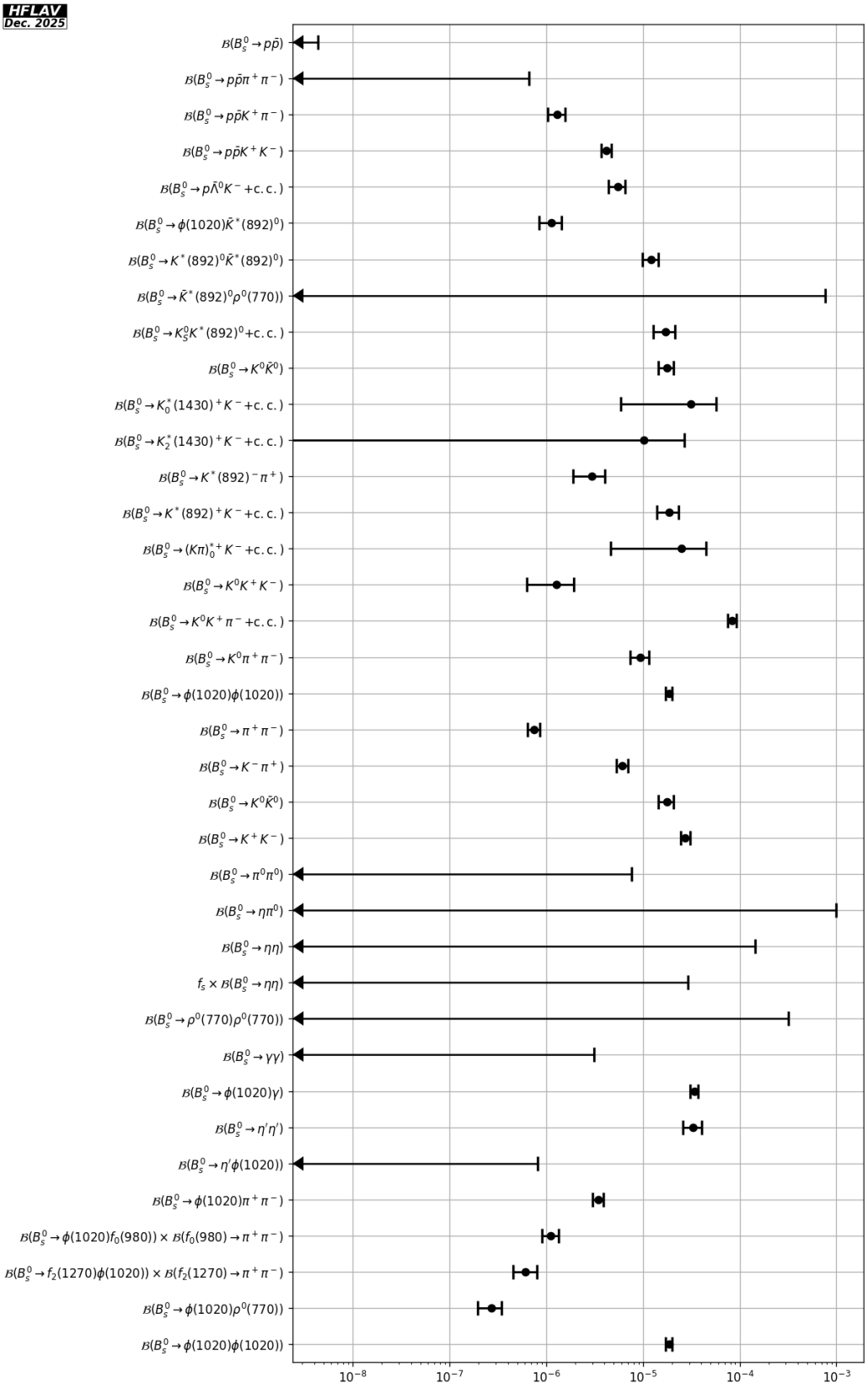

Figure 7: Branching fractions of charmless nonleptonic B_s^0 decays.

0.5 Decays of B_c^+ mesons

Table 58 details branching fractions and ratios of branching fractions of B_c^+ meson decays to charmless hadronic final states, except for decays to final states containing B_s^0 mesons that are quoted in Sec. 7.5 of the latest HFLAV publication.

Table 58: Branching fractions and relative branching fractions of B_c^+ decays.

Parameter	Measurements		Average
$\mathcal{B}(B_c^+ \to p\bar{p}\pi^+) \times \frac{f_c}{f_u}$ $[10^{-8}]$	LHCb [236][1]	< 2.8	< 2.8
$\frac{\mathcal{B}(B_c^+ \to K^+ K_S^0)}{\mathcal{B}(B^+ \to K_S^0 \pi^+)} \times \frac{f_c}{f_u}$ $[10^{-2}]$	LHCb [7]	< 1.5	< 1.5
$\mathcal{B}(B_c^+ \to K^+K^-\pi^+) \times \frac{f_c}{f_u}$ $[10^{-7}]$	LHCb [237][2]	< 1.50	< 1.5
$\frac{\mathcal{B}(B_c^+ \to \pi^+\mu^+\mu^-)}{\mathcal{B}(B_c^+ \to J/\psi\pi^+)}$ $[10^{-4}]$	LHCb [238]	< 2.1	< 2.1
$\frac{\mathcal{B}(B_c^+ \to B_s^{*0}(\to \mu^+\mu^-)\pi^+)}{\mathcal{B}(B_c^+ \to J/\psi\pi^+)}$ $[10^{-5}]$	LHCb [239]	< 5.0	< 5.0
$\frac{\mathcal{B}(B_c^+ \to B^{*0}(\to \mu^+\mu^-)\pi^+)}{\mathcal{B}(B_c^+ \to J/\psi\pi^+)}$ $[10^{-5}]$	LHCb [239]	< 3.8	< 3.8

[1] Measured in the region $_{p\bar{p}} < 2.85$ GeV/c^2, $p_T(B) < 20$ GeV/c and $2.0 < y(B) < 4.5$.

[2] Measured in the annihilation region $m_{K^+\pi^+} < 1.834$ GeV/c^2, and in the fiducial region $p_T(B) < 20$ GeV/c and $2.0 < y(B) < 4.5$

0.6 Rare decays of B^0 and B^+ mesons with photons and/or leptons

This section reports different observables for radiative decays, lepton-flavour/number-violating (LFV/LNV) decays and flavour-changing-neutral-current (FCNC) decays with leptons of B^0 and B^+ mesons. In all decays listed in this section, charmonium intermediate states are vetoed. Tables 59 to 63, 64 to 68 and 69 to 71 provide compilations of branching fractions of radiative and FCNC decays with leptons of B^+ mesons, B^0 mesons and their admixture, respectively. Tables 68 and 71 also include LFV/LNV decays. Tables 72 and 73 contain branching fractions of leptonic and radiative-leptonic B^+ and B^0 decays. These are followed by Tables 74 to 76, which give relative branching fractions of B^+ and B^0 decays, then Table 77, which gives a compilation of inclusive decays. In the modes listed in Table 77, the radiated particle is a gluon, which is an exception in this section. Table 78 contains isospin asymmetry measurements. Finally, Tables 79 to 81 and 82 provide compilations of branching fractions of B^+ and B^0 mesons to lepton-flavour/number-violating final states, respectively. The average of Figures 8 to 13 show graphic representations of a selection of results given in this section.

Table 59: Branching fractions of B^+ radiative and FCNC decays with leptons (part 1).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^+ \to K^*(892)^+\gamma)$[1]	Belle [240]	$37.6 \pm 1.0 \pm 1.2$	
	Belle II [241]	$40.4 \pm 1.3 ^{+1.3}_{-1.5}$	39.5 ± 1.1
	BaBar [242]	$42.2 \pm 1.4 \pm 1.6$	39.2 ± 2.2
	CLEO [243]	$37.6 ^{+8.9}_{-8.3} \pm 2.8$	
$\mathcal{B}(B^+ \to K^+\pi^0\gamma)$	Belle [240][2]	$39.1 \pm 1.6 \pm 1.6$	40.7 ± 1.9
	BaBar [242][3]	$43.8 \pm 1.9 \pm 2.6$	none
$\mathcal{B}(B^+ \to K^0_S\pi^+\gamma)$	Belle [240][2]	$36.9 \pm 1.2 \pm 1.2$	38.4 ± 1.4
	BaBar [242][3]	$41.3 \pm 1.8 \pm 1.6$	none
$\mathcal{B}(B^+ \to K_1(1270)^+\gamma)$	BaBar [244][4]	$44.1 ^{+6.3}_{-4.4} \pm 5.8$	$43.8 ^{+7.0}_{-6.3}$
	Belle [245][5]	$43.0 \pm 9.0 \pm 9.0$	$43.8 ^{+7.1}_{-6.3}$
$\mathcal{B}(B^+ \to \eta K^+\gamma)$	BaBar [246][6]	$7.7 \pm 1.0 \pm 0.4$	7.89 ± 0.92
	Belle [247][7]	$8.4 \pm 1.5 ^{+1.2}_{-0.9}$	$7.88 ^{+0.94}_{-0.92}$
$\mathcal{B}(B^+ \to \eta' K^+\gamma)$	Belle [248][8]	$3.6 \pm 1.2 \pm 0.4$	2.9 ± 1.0
	BaBar [249][6]	$1.9 ^{+1.5}_{-1.2} \pm 0.1$	$2.9 ^{+1.0}_{-0.9}$
$\mathcal{B}(B^+ \to \phi(1020) K^+\gamma)$[1]	Belle [250]	$2.48 \pm 0.30 \pm 0.24$	2.71 ± 0.34
	BaBar [251][9]	$3.5 \pm 0.6 \pm 0.4$	2.71 ± 0.42

[1] The PDG uncertainty includes a scale factor.
[2] $m_{K\pi} < 2.0$ GeV/c^2.
[3] $0.79 < m_{K\pi} < 1.0$ GeV/c^2.
[4] Multiple systematic uncertainties are added in quadrature.
[5] $1 < m_{K\pi\pi} < 2$ GeV/c^2.
[6] $m_{K\eta^{(\prime)}} < 3.25$ GeV/c^2.
[7] $m_{K\eta} < 2.4$ GeV/c^2.
[8] $m_{K\eta'} < 3.4$ GeV/c^2
[9] $m_{\phi K} < 3.0$ GeV/c^2.

Table 60: Branching fractions of B^+ radiative and FCNC decays with leptons (part 2).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^+ \to K^+\pi^-\pi^+\gamma)$[1]	BaBar [244][2]	$24.5 \pm 0.9 \pm 1.2$	24.6 ± 1.3
	Belle [245][3]	$25.0 \pm 1.8 \pm 2.2$	25.8 ± 1.5
$\mathcal{B}(B^+ \to K^*(892)^0\pi^+\gamma)$	BaBar [244][2]	$23.4 \pm 0.9\,^{+0.8}_{-0.7}$	23.3 ± 1.2
	Belle [252][4]	$20.0\,^{+7.0}_{-6.0} \pm 2.0$	$23.3\,^{+1.2}_{-1.1}$
$\mathcal{B}(B^+ \to K^+\rho^0(770)\gamma)$	BaBar [244][2]	$8.2 \pm 0.4 \pm 0.8$	8.2 ± 0.9
	Belle [252][4]	< 20.0	
$\mathcal{B}(B^+ \to (K\pi)_0^{*0}\pi^+\gamma) \times \mathcal{B}((K\pi)_0^{*0} \to K^+\pi^-)$[5]			
	BaBar [244][2]	$10.3\,^{+0.7\,+1.5}_{-0.8\,-2.0}$	$10.3\,^{+1.7}_{-2.2}$
			none
$\mathcal{B}(B^+ \to K^+\pi^-\pi^+\gamma(\mathrm{NR}))$	BaBar [244][2,6]	$9.9 \pm 0.7\,^{+1.5}_{-1.9}$	$9.9\,^{+1.7}_{-2.0}$
	Belle [252][7]	< 9.2	
$\mathcal{B}(B^+ \to K^0\pi^+\pi^0\gamma)$	BaBar [253][2]	$45.6 \pm 4.2 \pm 3.1$	45.6 ± 5.2
$\mathcal{B}(B^+ \to K_1(1400)^+\gamma)$	BaBar [244][2,8]	$9.7\,^{+4.6\,+2.9}_{-2.9\,-2.4}$	$9.7\,^{+5.4}_{-3.8}$
	Belle [245]	< 15.0	
$\mathcal{B}(B^+ \to K^*(1410)^+\gamma)$	BaBar [244][2,8]	$27.1\,^{+5.4\,+5.9}_{-4.8\,-3.7}$	$27.1\,^{+8.0}_{-6.1}$
$\mathcal{B}(B^+ \to K_0^*(1430)^0\pi^+\gamma)$	BaBar [244][2,8]	$1.32\,^{+0.09\,+0.24}_{-0.10\,-0.30}$	$1.32\,^{+0.26}_{-0.31}$
			$1.32\,^{+0.26}_{-0.32}$
$\mathcal{B}(B^+ \to K_2^*(1430)^+\gamma)$	BaBar [254]	$14.5 \pm 4.0 \pm 1.5$	13.8 ± 4.0
	BaBar [244][2,8]	$8.7\,^{+7.0\,+8.7}_{-5.3\,-10.4}$	
$\mathcal{B}(B^+ \to K^*(1680)^+\gamma)$	BaBar [244][2,8]	$66.7\,^{+9.3\,+14.4}_{-7.8\,-11.4}$	$67\,^{+17}_{-14}$
$\mathcal{B}(B^+ \to K_3^*(1780)^+\gamma)$	Belle [247]	< 14	< 14
			< 39
$\mathcal{B}(B^+ \to K_4^*(2045)^+\gamma)$	ARGUS [255]	< 9900	< 9900

[1] The PDG uncertainty includes a scale factor.
[2] $m_{K\pi\pi} < 1.8$ GeV/c^2.
[3] $1 < m_{K\pi\pi} < 2$ GeV/c^2.
[4] $m_{K\pi\pi} < 2.4$ GeV/c^2.
[5] This corresponds to the $(K\pi)$ S-wave obtained with LASS parameterisation [256].
[6] $m_{K\pi} < 1.6$ GeV/c^2.
[7] $1.25 < m_{K\pi} < 1.6$ GeV/c^2 and $m_{K\pi\pi} < 2.4$ GeV/c^2.
[8] Multiple systematic uncertainties are added in quadrature.

Table 61: Branching fractions of B^+ radiative and FCNC decays with leptons (part 3).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^+ \to \rho^+(770)\gamma)$	Belle [257][1]	$1.31\,^{+0.20}_{-0.19}\,^{+0.13}_{-0.12}$	1.29 ± 0.20
	BaBar [258]	$1.2 \pm 0.4 \pm 0.2$	$0.98\,^{+0.25}_{-0.24}$
$\mathcal{B}(B^+ \to p\overline{\Lambda}^0\gamma)$	Belle [163]	$2.45\,^{+0.44}_{-0.38} \pm 0.22$	$2.45\,^{+0.49}_{-0.44}$
$\mathcal{B}(B^+ \to p\overline{\Sigma}^0\gamma)$	Belle [259]	< 4.6	< 4.6

[1] Result obtained with a combination of Belle and Belle II datasets.

Table 62: Branching fractions of B^+ radiative and FCNC decays with leptons (part 4).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^+ \to \pi^+\ell^+\ell^-)$[1]	Belle [260]	< 0.049	< 0.049
	BaBar [261]	< 0.066	
$\mathcal{B}(B^+ \to \pi^+e^+e^-)$[1]	Belle [262][2]	< 0.054	< 0.05
	BaBar [261]	< 0.125	
$\mathcal{B}(B^+ \to \pi^+\mu^+\mu^-)$[1]	BaBar [261]	< 0.055	0.0178 ± 0.0023
	Belle [260]	< 0.069	
	LHCb [263][3,4]		
$\mathcal{B}(B^+ \to \rho^+(770)\ell^+\ell^-)$	Belle [262][2]	< 0.189	< 0.19 none
$\mathcal{B}(B^+ \to \rho^+(770)e^+e^-)$	Belle [262][2]	< 0.467	< 0.47 none
$\mathcal{B}(B^+ \to \rho^+(770)\mu^+\mu^-)$	Belle [262][2]	< 0.381	< 0.38 none
$\mathcal{B}(B^+ \to \pi^+\nu\overline{\nu})$	Belle [264]	< 14.0	< 14
	BaBar [265]	< 100.0	

[1] Treatment of charmonium intermediate components differs between the results.
[2] Result obtained with Belle dataset.
[3] LHCb also reports the branching fraction in bins of $m^2_{\ell^+\ell^-}$.
[4] Measurement of $\mathcal{B}(B^+ \to \pi^+\mu^+\mu^-)/(\mathcal{B}(B^+ \to J/\psi K^+)\mathcal{B}(J/\psi \to \mu^+\mu^-))$ used in our fit.

Table 63: Branching fractions of B^+ radiative and FCNC decays with leptons (part 5).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^+ \to K^+\ell^+\ell^-)^1$	BELLE [266]	$0.599\,^{+0.045}_{-0.043} \pm 0.014$	0.576 ± 0.040
	BaBar [267]	$0.476\,^{+0.092}_{-0.086} \pm 0.022$	0.471 ± 0.046
$\mathcal{B}(B^+ \to K^+e^+e^-)^1$	BELLE [266]	$0.575\,^{+0.064}_{-0.061} \pm 0.015$	0.561 ± 0.056
	BaBar [267]	$0.51\,^{+0.12}_{-0.11} \pm 0.02$	$0.560\,^{+0.058}_{-0.055}$
$\mathcal{B}(B^+ \to K^+\mu^+\mu^-)^{2,1}$	LHCb [268]	$0.429 \pm 0.007 \pm 0.021$	
	CMS [269][3]	$0.435 \pm 0.019 \pm 0.015$	0.443 ± 0.016
	BELLE [266]	$0.624\,^{+0.065}_{-0.061} \pm 0.016$	0.453 ± 0.035
	BaBar [267]	$0.41\,^{+0.16}_{-0.15} \pm 0.02$	
$\mathcal{B}(B^+ \to K^+\tau^+\tau^-)$	BaBar [270]	< 2250.0	< 2250
$\mathcal{B}(B^+ \to K^+\nu\overline{\nu})$	Belle [264][4]	10.0 ± 6.0	
	Belle II [271]	$23 \pm 5\,^{+5}_{-4}$	13.8 ± 3.5
	BaBar [272][5]	$2.0\,^{+8.0}_{-7.0}$	$23.0\,^{+7.1}_{-6.4}$
	Belle [273][6]	29.0 ± 16.0	
	BaBar [274][7]	$15.0\,^{+17.0}_{-8.0}\,^{+4.0}_{-2.0}$	
$\mathcal{B}(B^+ \to \rho^+(770)\nu\overline{\nu})$	Belle [264]	< 30.0	< 30
$\mathcal{B}(B^+ \to K^*(892)^+\ell^+\ell^-)^{2,1}$	LHCb [268][8]	$0.924 \pm 0.093 \pm 0.067$	1.010 ± 0.099
	Belle [275]	$1.24\,^{+0.23}_{-0.21} \pm 0.13$	$1.009\,^{+0.113}_{-0.112}$
	BaBar [267]	$1.40\,^{+0.40}_{-0.37} \pm 0.09$	
$\mathcal{B}(B^+ \to K^*(892)^+e^+e^-)^1$	BaBar [267]	$1.38\,^{+0.47}_{-0.42} \pm 0.08$	1.55 ± 0.33
	Belle [275]	$1.73\,^{+0.50}_{-0.42} \pm 0.20$	$1.55\,^{+0.36}_{-0.31}$
$\mathcal{B}(B^+ \to K^*(892)^+\mu^+\mu^-)^1$	LHCb [268]	$0.924 \pm 0.093 \pm 0.067$	
	Belle [275]	$1.11\,^{+0.32}_{-0.27} \pm 0.10$	0.96 ± 0.10
	BaBar [267]	$1.46\,^{+0.79}_{-0.75} \pm 0.12$	
$\mathcal{B}(B^+ \to K^*(892)^+\nu\overline{\nu})$	Belle [273]	< 40.0	
	Belle [264]	< 61.0	< 40
	BaBar [274]	< 64.0	
$\mathcal{B}(B^+ \to K^+\pi^+\pi^-\mu^+\mu^-)$	LHCb [276][9]	$0.4337\,^{+0.0287}_{-0.0268} \pm 0.0254$	0.434 ± 0.038
			$0.434\,^{+0.039}_{-0.037}$
$\mathcal{B}(B^+ \to \phi(1020)K^+\mu^+\mu^-)$	LHCb [276][10]	$0.0790\,^{+0.0180}_{-0.0160}\,^{+0.0114}_{-0.0072}$	$0.079\,^{+0.022}_{-0.017}$
			$0.079\,^{+0.021}_{-0.017}$
$\mathcal{B}(B^+ \to \overline{\Lambda}^0 p\nu\overline{\nu})$	BaBar [277]	< 30.0	< 30

[1] Treatment of charmonium intermediate components differs between the results.
[2] The PDG uncertainty includes a scale factor.
[3] Value extrapolated from the low q^2 region using Flavio package. The paper also provides the value using SuperIso, which is 0.439 with the same errors.
[4] Semileptonic tag. Paper only reports UL. The value reported here is calculated in Ref. [271].
[5] Semileptonic tag
[6] Hadronic tag. Paper only reports UL. The value reported here is calculated in Ref. [271].
[7] Hadronic tag
[8] Only muons are used.
[9] Using $\mathcal{B}(B^+ \to \psi(2S)K^+)$.
[10] Using $\mathcal{B}(B^+ \to J/\psi\phi(1020)K^+)$.

Table 64: Branching fractions of B^0 radiative and FCNC decays with leptons (part 1).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^0 \to K^*(892)^0\gamma)$[1]	Belle [240]	$39.6 \pm 0.7 \pm 1.4$	41.68 ± 0.92
	BaBar [242]	$44.7 \pm 1.0 \pm 1.6$	
	Belle II [241]	$41.4 \pm 1.0 \pm 1.1$	
	CLEO [243]	$45.5\,^{+7.2}_{-6.8} \pm 3.4$	
	LHCb [205][2], [183][3], [278][4]		41.77 ± 2.48
$\mathcal{B}(B^0 \to K^+\pi^-\gamma)$	Belle [240][5]	$39.5 \pm 0.7 \pm 1.4$	41.4 ± 1.2
	BaBar [242][6]	$44.5 \pm 1.0 \pm 1.7$	4.6 ± 1.4
$\mathcal{B}(B^0 \to K^0_S\pi^0\gamma)$	Belle [240][5]	$40.0 \pm 2.7 \pm 2.4$	42.2 ± 2.9
	BaBar [242][7]	$46.6 \pm 3.7 \pm 3.5$	none
$\mathcal{B}(B^0 \to K^*(1410)^0\gamma)$	Belle [252][8]	< 130.0	< 130
$\mathcal{B}(B^0 \to K^+\pi^-\gamma(\mathrm{NR}))$	Belle [252][8]	< 2.6	< 2.6
$\mathcal{B}(B^0 \to \eta K^0\gamma)$	BaBar [246][9]	$7.1\,^{+2.1}_{-2.0} \pm 0.4$	7.6 ± 1.8
	Belle [247][10]	$8.7\,^{+3.1\,+1.9}_{-2.7\,-1.6}$	$7.6\,^{+1.8}_{-1.7}$
$\mathcal{B}(B^0 \to \eta' K^0\gamma)$	Belle [248][11]	< 6.4	< 6.4
	BaBar [249][9]	< 6.6	
$\mathcal{B}(B^0 \to \phi(1020)K^0\gamma)$	Belle [250]	$2.74 \pm 0.60 \pm 0.32$	2.74 ± 0.68
	BaBar [251][12]	< 27	
$\mathcal{B}(K^{*0}X(214)) \times \mathcal{B}(X(214) \to \mu^+\mu^-)$			
	Belle [279][13]	< 0.0226	< 0.023

[1] The PDG uncertainty includes a scale factor.
[2] Measurement of $\mathcal{B}(B^0_s \to \phi(1020)\gamma)/\mathcal{B}(B^0 \to K^*(892)^0\gamma)$ used in our fit.
[3] Measurement of $(\mathcal{B}(\Lambda^0_b \to \Lambda^0\gamma)/\mathcal{B}(B^0 \to K^*(892)^0\gamma))\frac{f_{\Lambda^0_b}}{f_d}$ used in our fit.
[4] Measurement of $\mathcal{B}(B^0 \to \rho^0(770)\gamma)/\mathcal{B}(B^0 \to K^*(892)^0\gamma)$ used in our fit.
[5] $m_{K\pi} < 2.0$ GeV/c^2.
[6] $0.78 < m_{K\pi} < 1.1$ GeV/c^2.
[7] $0.82 < m_{K\pi} < 1.0$ GeV/c^2.
[8] $1.25 < m_{K\pi} < 1.6$ GeV/c^2.
[9] $m_{K\eta^{(\prime)}} < 3.25$ GeV/c^2.
[10] $m_{K\eta} < 2.4$ GeV/c^2.
[11] $m_{K\eta'} < 3.4$ GeV/c^2
[12] $m_{\phi K} < 3.0$ GeV/c^2.
[13] $X(214)$ is searched for in the mass range $[212, 300]$ MeV/c^2.

Table 65: Branching fractions of B^0 radiative and FCNC decays with leptons (part 2).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^0 \to K^0\pi^+\pi^-\gamma)$	BaBar [244][1]	$20.5 \pm 2.0\,^{+2.6}_{-2.2}$	19.9 ± 1.8
	BaBar [253][1]	$18.5 \pm 2.1 \pm 1.2$	
	Belle [245][2]	$24.0 \pm 4.0 \pm 3.0$	
$\mathcal{B}(B^0 \to K^+\pi^-\pi^0\gamma)$	BaBar [253][1]	$40.7 \pm 2.2 \pm 3.1$	40.7 ± 3.8
$\mathcal{B}(B^0 \to K_1(1270)^0\gamma)$	Belle [245]	< 58.0	< 58
$\mathcal{B}(B^0 \to K^0_S K^0_S\gamma)$	Belle [280][3]	< 0.58	< 0.58 none
$\mathcal{B}(B^0 \to f_2(1270)\gamma) \times \mathcal{B}(f_2(1270) \to K^0_S K^0_S)$	Belle [280][4]	< 0.31	< 0.31 none
$\mathcal{B}(B^0 \to f'_2(1525)\gamma) \times \mathcal{B}(f'_2(1525) \to K^0_S K^0_S)$	Belle [280][5]	< 0.21	< 0.21 none
$\mathcal{B}(B^0 \to K_1(1400)^0\gamma)$	Belle [245]	< 12.0	< 12
$\mathcal{B}(B^0 \to K^*_2(1430)^0\gamma)$	BaBar [254]	$12.2 \pm 2.5 \pm 1.0$	12.4 ± 2.4
	Belle [252]	$13.0 \pm 5.0 \pm 1.0$	
$\mathcal{B}(B^0 \to K^*_3(1780)^0\gamma)$	Belle [247]	< 30	< 30 < 83

[1] $m_{K\pi\pi} < 1.8$ GeV/c^2.
[2] $1 < m_{K\pi\pi} < 2$ GeV/c^2.
[3] Measured in bins of $m_{K^0_S K^0_S}$. We report the result for the full range, 1.0 GeV/c^2 $< m_{K^0_S K^0_S} <$ 3.0 GeV/c^2.
[4] Measured in bins of $m_{K^0_S K^0_S}$. We report the result for the full range, 1.00 GeV/c^2 $< m_{K^0_S K^0_S} <$ 1.44 GeV/c^2.
[5] Measured in bins of $m_{K^0_S K^0_S}$. We report the result for the full range, 1.44 GeV/c^2 $< m_{K^0_S K^0_S} <$ 1.63 GeV/c^2.

Table 66: Branching fractions of B^0 radiative and FCNC decays with leptons (part 3).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^0 \to \rho^0(770)\gamma)$	LHCb [278][1]	$0.788 \pm 0.029 \pm 0.027$	0.790 ± 0.038
	Belle [257][2]	$0.75 \pm 0.13\,^{+0.10}_{-0.08}$	$0.857\,^{+0.152}_{-0.145}$
	BaBar [258]	$0.97\,^{+0.24}_{-0.22} \pm 0.06$	
$\mathcal{B}(\rho^0 X(214)) \times \mathcal{B}(X(214) \to \mu^+\mu^-)$	Belle [279][3]	< 0.0173	< 0.017
$\mathcal{B}(B^0 \to \omega(782)\gamma)$	Belle [281]	$0.40\,^{+0.19}_{-0.17} \pm 0.13$	0.44 ± 0.17
	BaBar [258]	$0.50\,^{+0.27}_{-0.23} \pm 0.09$	$0.44\,^{+0.18}_{-0.16}$
$\mathcal{B}(B^0 \to \phi(1020)\gamma)$	Belle [282]	< 0.1	< 0.1
	BaBar [283]	< 0.85	
$\mathcal{B}(B^0 \to p\overline{\Lambda}^0\pi^-\gamma)$	Belle [284]	< 0.65	< 0.65
$\mathcal{B}(B^0 \to \pi^0\ell^+\ell^-)$[4]	Belle [262][5]	< 0.038	< 0.038
	BaBar [261]	< 0.053	
$\mathcal{B}(B^0 \to \pi^0 e^+ e^-)$[4]	Belle [262][5]	< 0.079	< 0.079
	BaBar [261]	< 0.084	
$\mathcal{B}(B^0 \to \pi^0\mu^+\mu^-)$[4]	Belle [262][5]	< 0.059	< 0.059
	BaBar [261]	< 0.069	

[1] Using $\mathcal{B}(B^0 \to K^*(892)^0\gamma)$.
[2] Result obtained with a combination of Belle and Belle II datasets.
[3] $X(214)$ is searched for in the mass range $[212, 300]$ MeV/c^2.
[4] Treatment of charmonium intermediate components differs between the results.
[5] Result obtained with Belle dataset.

Table 67: Branching fractions of B^0 radiative and FCNC decays with leptons (part 4).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^0 \to \eta\ell^+\ell^-)$	Belle [262][1]	< 0.048	< 0.048
	BaBar [261]	< 0.064	
$\mathcal{B}(B^0 \to \eta e^+e^-)$	Belle [262][1]	< 0.105	< 0.10
	BaBar [261]	< 0.108	< 0.11
$\mathcal{B}(B^0 \to \eta\mu^+\mu^-)$	Belle [262][1]	< 0.094	< 0.094
	BaBar [261]	< 0.112	
$\mathcal{B}(B^0 \to \omega(782)\ell^+\ell^-)$	Belle [262][1]	< 0.220	< 0.22
			none
$\mathcal{B}(B^0 \to \omega(782)e^+e^-)$	Belle [262][1]	< 0.307	< 0.31
			none
$\mathcal{B}(B^0 \to \omega(782)\mu^+\mu^-)$	Belle [262][1]	< 0.249	< 0.25
			none
$\mathcal{B}(B^0 \to \rho^0(770)e^+e^-)$	Belle [262][1]	< 0.455	< 0.46
			none
$\mathcal{B}(B^0 \to \pi^0\nu\overline{\nu})$	Belle [264]	< 9.0	< 9.0
$\mathcal{B}(B^0 \to K^0\ell^+\ell^-)^2$	LHCb [268][3]	$0.327 \pm 0.034 \pm 0.017$	0.328 ± 0.032
	BELLE [266]	$0.351\,^{+0.069}_{-0.060} \pm 0.010$	$0.329\,^{+0.063}_{-0.055}$
	BaBar [267]	$0.21\,^{+0.15}_{-0.13} \pm 0.02$	
$\mathcal{B}(B^0 \to K^0e^+e^-)^{4,2}$	BELLE [266]	$0.306\,^{+0.098}_{-0.086} \pm 0.008$	0.249 ± 0.072
	BaBar [267]	$0.08\,^{+0.15}_{-0.12} \pm 0.01$	$0.247\,^{+0.109}_{-0.094}$
$\mathcal{B}(B^0 \to K^0\mu^+\mu^-)^{4,2}$	LHCb [268]	$0.327 \pm 0.034 \pm 0.017$	0.341 ± 0.034
	BELLE [266]	$0.394\,^{+0.096}_{-0.084} \pm 0.012$	0.339 ± 0.035
	BaBar [267]	$0.49\,^{+0.29}_{-0.25} \pm 0.03$	
$\mathcal{B}(B^0 \to K^0\nu\overline{\nu})$	Belle [264]	< 26.0	< 26
	BaBar [274]	< 49.0	
$\mathcal{B}(B^0 \to \rho^0(770)\nu\overline{\nu})$	Belle [264]	< 40.0	< 40
$\mathcal{B}(B^0 \to K^*(892)^0\ell^+\ell^-)^2$	Belle [275]	$0.97\,^{+0.13}_{-0.11} \pm 0.07$	0.99 ± 0.12
	BaBar [267]	$1.03\,^{+0.22}_{-0.21} \pm 0.07$	$0.99\,^{+0.12}_{-0.11}$
$\mathcal{B}(B^0 \to K^*(892)^0e^+e^-)^2$	Belle [275]	$1.18\,^{+0.27}_{-0.22} \pm 0.09$	1.04 ± 0.17
	BaBar [267]	$0.86\,^{+0.26}_{-0.24} \pm 0.05$	$1.03\,^{+0.19}_{-0.17}$
$\mathcal{B}(B^0 \to K^*(892)^0\mu^+\mu^-)^{5,2}$	LHCb [285][6]	$0.904\,^{+0.016}_{-0.015} \pm 0.062$	0.94 ± 0.06
	Belle [275]	$1.06\,^{+0.19}_{-0.14} \pm 0.07$	0.94 ± 0.05
	BaBar [267]	$1.35\,^{+0.40}_{-0.37} \pm 0.10$	
$\mathcal{B}(B^0 \to K^*(892)^0\tau^+\tau^-)$	LHCb [214]	< 250	< 250
	Belle II [286]	< 1800	none
	Belle [287]	< 3100	

[1] Result obtained with Belle dataset.
[2] Treatment of charmonium intermediate components differs between the results.
[3] Only muons are used.
[4] The PDG uncertainty includes a scale factor.
[5] The PDG average is a result of a fit including input from other measurements.
[6] Multiple systematic uncertainties are added in quadrature.

Table 68: Branching fractions of B^0 radiative and FCNC decays with leptons (part 5).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^0 \to \pi^+\pi^-\mu^+\mu^-)$	LHCb [216][1,2,3]		0.021 ± 0.005
$\mathcal{B}(B^0 \to K^*(892)^0\nu\overline{\nu})$	Belle [264]	< 18.0	< 18
	Belle [273]	< 55.0	
	BaBar [274]	< 120.0	
$\mathcal{B}(B^0 \to \phi(1020)\nu\overline{\nu})$	Belle [273]	< 127.0	< 127
$\mathcal{B}(B^0 \to \pi^0 e^+\mu^-$+c.c.)	BaBar [288]	< 0.14	< 0.14
$\mathcal{B}(B^0 \to K^0 e^+\mu^-$+c.c.)	BELLE [266]	< 0.038	< 0.038
	BaBar [289]	< 0.27	
$\mathcal{B}(B^0 \to K^*(892)^0 e^+\mu^-)$	LHCb [220]	< 0.0068	< 0.0068
	Belle [290]	< 0.16	
	BaBar [289]	< 0.53	
$\mathcal{B}(B^0 \to K^*(892)^0 e^-\mu^+)$	LHCb [220]	< 0.0057	< 0.0057
	Belle [290]	< 0.12	
	BaBar [289]	< 0.34	
$\mathcal{B}(B^0 \to K^*(892)^0 e^+\mu^-$+c.c.)	LHCb [220]	< 0.0101	< 0.010
	Belle [290]	< 0.18	
	BaBar [289]	< 0.58	
$\mathcal{B}(B^0 \to \Lambda_c^+\mu^-)$	BaBar [291]	< 1.4	< 1.4
$\mathcal{B}(B^0 \to \Lambda_c^+ e^-)$	BaBar [291]	< 4.0	< 4.0
$\mathcal{B}(B^0 \to \phi(1020)\mu^+\mu^-)$	LHCb [292][4]	< 0.0032	< 0.0032
			none

[1] The mass windows corresponding to ϕ and charmonium resonances decaying to $\mu\mu$ are vetoed.

[2] $0.5 < m_{\pi^+\pi^-} < 1.3$ GeV/c^2.

[3] Measurement of $\mathcal{B}(B^0 \to \pi^+\pi^-\mu^+\mu^-)/(\mathcal{B}(B^0 \to J/\psi K^*(892)^0)\mathcal{B}(J/\psi \to \mu^+\mu^-)\mathcal{B}(K^*(892)^0 \to K\pi)2/3)$ used in our fit.

[4] LHCb also reports an upper limit at 2.3×10^{-9} excluding the ϕ and charmonium regions.

Table 69: Branching fractions of radiative, FCNC decays with leptons and LFV/LNV decays of $B^{\pm}/B^0$ admixture (part 1).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B \to K\eta\gamma)$	Belle [247][1]	$8.5 \pm 1.3\,^{+1.2}_{-0.9}$	$8.5\,^{+1.8}_{-1.6}$
$\mathcal{B}(B \to K_1(1400)\gamma)$	CLEO [243]	< 127	< 127
$\mathcal{B}(B \to K_2^*(1430)\gamma)$	CLEO [243]	$16.6\,^{+5.9}_{-5.3} \pm 1.3$	$16.6\,^{+6.0}_{-5.5}$
$\mathcal{B}(B \to K_3^*(1780)\gamma)$	Belle [247]	< 14	< 14 < 37
$\mathcal{B}(B \to X_s\gamma)$	Belle [293][2,3] BaBar [294][2,4] Belle [295][2,5] BaBar [296][2,5] CLEO [297][2,6] BaBar [298][2,5]	$351 \pm 15 \pm 41$ $331 \pm 16 \pm 31$ $375 \pm 18 \pm 35$ $352 \pm 20 \pm 51$ $328 \pm 44 \pm 28$ $390 \pm 91 \pm 64$	349 ± 19
$\mathcal{B}(B \to X_d\gamma)$	BaBar [299]	$9.2 \pm 2.0 \pm 2.3$	9.2 ± 3.0
$\mathcal{B}(B \to \rho\gamma)$[7]	Belle [281] BaBar [258]	$1.21\,^{+0.24}_{-0.22} \pm 0.12$ $1.73\,^{+0.34}_{-0.32} \pm 0.17$	1.40 ± 0.22 $1.39\,^{+0.25}_{-0.24}$
$\mathcal{B}(B \to \rho/\omega\gamma)$[7]	Belle [281] BaBar [258]	$1.14 \pm 0.20\,^{+0.10}_{-0.12}$ $1.63\,^{+0.30}_{-0.28} \pm 0.16$	1.30 ± 0.18 $1.30\,^{+0.23}_{-0.24}$
$\mathcal{B}(B \to K^*\gamma)$	Belle II [241]	$41.0 \pm 0.8 \pm 0.9$	41.0 ± 1.2 none
$\mathcal{B}(B \to X_s e^+e^-)$[7,8,9]	BaBar [300][10] Belle [301]	$7.69\,^{+0.82\,+0.71}_{-0.77\,-0.60}$ $4.04 \pm 1.30\,^{+0.87}_{-0.83}$	6.67 ± 0.83 $6.67\,^{+1.76}_{-1.63}$
$\mathcal{B}(B \to X_s\mu^+\mu^-)$[8,9]	Belle [301] BaBar [300][10]	$4.13 \pm 1.05\,^{+0.85}_{-0.81}$ $4.41\,^{+1.31\,+0.63}_{-1.17\,-0.50}$	4.27 ± 0.95 $4.27\,^{+0.99}_{-0.92}$
$\mathcal{B}(B \to X_s\ell^+\ell^-)$[8,7,9]	BaBar [300][10] Belle [301]	$6.73\,^{+0.70\,+0.60}_{-0.64\,-0.56}$ $4.11 \pm 0.83\,^{+0.85}_{-0.81}$	5.84 ± 0.69 $5.84\,^{+1.31}_{-1.23}$
$\mathcal{B}(B \to X_s\nu\overline{\nu})$	Belle II [302]	< 320	< 320 none

[1] $m_{K\eta} < 2.4$ GeV/c^2.
[2] Measurement extrapolated to $E_\gamma > 1.6$ GeV using the method from Ref. [303].
[3] The systematic error includes a shape-function systematic of 0.01.
[4] The systematic error includes a shape-function systematic of 0.02.
[5] The systematic error includes a shape-function systematic of 0.04.
[6] The systematic error includes a shape-function systematic of 0.06.
[7] The PDG uncertainty includes a scale factor.
[8] Belle uses $m_{\ell^+\ell^-} > 0.2$ GeV/c^2, BABAR uses $m_{\ell^+\ell^-} > 0.1$ GeV/c^2.
[9] Treatment of charmonium intermediate components differs between the results.
[10] Multiple systematic uncertainties are added in quadrature.

Table 70: Branching fractions of radiative, FCNC decays with leptons and LFV/LNV decays of $B^{\pm}/B^0$ admixture (part 2).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B \to \pi\ell^+\ell^-)^1$	BaBar [261]	< 0.059	< 0.059
	Belle [260]	< 0.062	
$\mathcal{B}(B \to \pi e^+e^-)$	BaBar [261]	< 0.11	< 0.11
$\mathcal{B}(B \to \pi\mu^+\mu^-)$	BaBar [261]	< 0.05	< 0.05
$\mathcal{B}(B \to Ke^+e^-)^1$	Belle [275]	$0.48\,^{+0.08}_{-0.07} \pm 0.03$	0.44 ± 0.06
	BaBar [267]	$0.388\,^{+0.090}_{-0.083} \pm 0.020$	
$\mathcal{B}(B \to K^*e^+e^-)^{2,1}$	Belle [275]	$1.39\,^{+0.23}_{-0.20} \pm 0.12$	1.20 ± 0.16
	BaBar [267]	$0.99\,^{+0.23}_{-0.21} \pm 0.06$	$1.19\,^{+0.21}_{-0.19}$
$\mathcal{B}(B \to K\mu^+\mu^-)^1$	CDF [180]	$0.42 \pm 0.04 \pm 0.02$	0.442 ± 0.036
	Belle [275]	$0.50 \pm 0.06 \pm 0.03$	
	BaBar [267]	$0.41\,^{+0.13}_{-0.12} \pm 0.02$	
$\mathcal{B}(B \to K^*\mu^+\mu^-)^1$	CDF [180]	$1.01 \pm 0.10 \pm 0.05$	1.06 ± 0.09
	Belle [275]	$1.10\,^{+0.16}_{-0.14} \pm 0.08$	
	BaBar [267]	$1.35\,^{+0.35}_{-0.33} \pm 0.10$	
$\mathcal{B}(B \to K\ell^+\ell^-)^1$	Belle [275]	$0.48\,^{+0.05}_{-0.04} \pm 0.03$	0.48 ± 0.04
	BaBar [304]	$0.47 \pm 0.06 \pm 0.02$	
$\mathcal{B}(B \to K^*\ell^+\ell^-)^1$	Belle [275]	$1.07\,^{+0.11}_{-0.10} \pm 0.09$	1.05 ± 0.10
	BaBar [304]	$1.02\,^{+0.14}_{-0.13} \pm 0.05$	

[1] Treatment of charmonium intermediate components differs between the results.

[2] The PDG uncertainty includes a scale factor.

Table 71: Branching fractions of radiative, FCNC decays with leptons and LFV/LNV decays of $B^{\pm}/B^0$ admixture (part 3).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B \to K\nu\overline{\nu})$	Belle [264]	< 16.0	< 16
	BaBar [274]	< 17.0	
$\mathcal{B}(B \to K^*\nu\overline{\nu})$	Belle [264]	< 27.0	< 27
	BaBar [274]	< 76.0	
$\mathcal{B}(B \to \pi\nu\overline{\nu})$	Belle [264]	< 8.0	< 8.0
$\mathcal{B}(B \to \rho\nu\overline{\nu})$	Belle [264]	< 28.0	< 28
$\mathcal{B}(B \to \pi e^{\pm}\mu^{\mp})$	BaBar [288]	< 0.092	< 0.092
$\mathcal{B}(B \to \rho e^{\pm}\mu^{\mp})$	CLEO [305]	< 3.2	< 3.2
$\mathcal{B}(B \to Ke^{\pm}\mu^{\mp})$	BaBar [289]	< 0.038	< 0.038
$\mathcal{B}(B \to K^*e^{\pm}\mu^{\mp})$	BaBar [289]	< 0.51	< 0.51

Table 72: Branching fractions of leptonic and radiative-leptonic B^+ and B^0 decays (part 1).

Parameter [10^{-7}]	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^+ \to e^+\nu_e)$	Belle [306]	< 9.8	< 9.8
	BaBar [307]	< 19	
$\mathcal{B}(B^+ \to \mu^+\nu_\mu)$	Belle [308]	< 8.6	< 8.6
	BaBar [307]	< 10	
	Belle [309]	< 10.7	
$\mathcal{B}(B^+ \to \tau^+\nu_\tau)$[1]	Belle [310][2]	$720\,^{+270}_{-250} \pm 110$	1119 ± 189
	Belle [311][3]	$1250 \pm 280 \pm 270$	$1094\,^{+247}_{-236}$
	Belle II [312][2]	$1240 \pm 410 \pm 190$	
	BaBar [313][2]	$1830\,^{+530}_{-490} \pm 240$	
	BaBar [314][3]	$1700 \pm 800 \pm 200$	
$\mathcal{B}(B^+ \to \ell^+\nu_\ell\gamma)$	Belle [315][4]	< 30	< 30
	BaBar [316]	< 156	
$\mathcal{B}(B^+ \to e^+\nu_e\gamma)$	Belle [315][4]	< 43	< 43
	BaBar [316]	< 170	
$\mathcal{B}(B^+ \to \mu^+\nu_\mu\gamma)$	Belle [315][4]	< 34	< 34
	BaBar [316]	< 260	
$\mathcal{B}(B^0 \to \gamma\gamma)$	Belle [317][5]	< 0.64	< 0.64
	BaBar [318]	< 3.3	
$\mathcal{B}(B^0 \to e^+e^-)$	LHCb [207]	< 0.025	< 0.025
	CDF [208]	< 0.83	
	BaBar [319]	< 1.13	
	Belle [320]	< 1.9	
$\mathcal{B}(B^0 \to e^+e^-\gamma)$	BaBar [321]	< 1.2	< 1.2

[1] The PDG uncertainty includes a scale factor.
[2] Hadronic tagging method
[3] Semileptonic tagging method
[4] $E_\gamma > 1$ GeV.
[5] Result obtained with a combination of Belle and Belle II datasets.

Table 73: Branching fractions of leptonic and radiative-leptonic B^+ and B^0 decays (part 2).

Parameter [10^{-7}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^0 \to \mu^+\mu^-\gamma)$	BaBar [321]	< 1.5	< 1.5 none
$\mathcal{B}(B^0 \to \mu^+\mu^-\mu^+\mu^-)$	LHCb [212][1,2]	< 0.0018	< 0.0018
$\mathcal{B}(B^0 \to SP) \times \mathcal{B}(S \to \mu^+\mu^-) \times \mathcal{B}(P \to \mu^+\mu^-)$	LHCb [326][1,2]	< 0.006	< 0.0060
$\mathcal{B}(B^0 \to aa) \times \mathcal{B}(a \to \mu^+\mu^-) \times \mathcal{B}(a \to \mu^+\mu^-)$	LHCb [212][1,3,2]	< 0.0023	< 0.0023 none
$\mathcal{B}(B^0 \to \tau^+\tau^-)$[4]	LHCb [210]	< 16000	< 16000
	BaBar [322]	< 41000	< 21000
$\mathcal{B}(B^0 \to \nu\overline{\nu})$	BaBar [323]	< 240	< 240
	Belle [324]	< 780	
$\mathcal{B}(B^0 \to \nu\overline{\nu}\gamma)$	Belle [324][5]	< 160	< 160
	BaBar [323][6]	< 170	
$\mathcal{B}(B^+ \to \mu^+\mu^-\mu^+\nu_\mu)$	LHCb [325][2]	< 0.16	< 0.16

[1] The mass windows corresponding to ϕ and charmonium resonances decaying to $\mu\mu$ are vetoed.
[2] At CL=95 %.
[3] a is a promptly decaying scalar particle with a mass of 1 GeV/c^2
[4] PDG shows the result obtained at 95% CL.
[5] $E_\gamma > 0.5$ GeV.
[6] $E_\gamma > 1.2$ GeV.

Table 74: Relative branching fractions of B radiative and FCNC decays with leptons (part 1).

Parameter	**Measurements**		**Average**
$\frac{\mathcal{B}(B^+\to\pi^+\mu^+\mu^-)}{\mathcal{B}(B^+\to K^+\mu^+\mu^-)}$, $1.0 < m^2_{\ell^+\ell^-} < 6.0$ GeV^2/c^4			
	LHCb [263]	$0.038 \pm 0.009 \pm 0.001$	0.038 ± 0.009
$\frac{\mathcal{B}(B^+\to K^+\mu^+\mu^-)}{\mathcal{B}(B^+\to K^+e^+e^-)}$, Full $m^2_{\ell^+\ell^-}$ range	BELLE [266]	$1.08\,^{+0.16}_{-0.15} \pm 0.02$	1.08 ± 0.16
$\frac{\mathcal{B}(B^+\to K^+\mu^+\mu^-)}{\mathcal{B}(B^+\to K^+e^+e^-)}$, $0.1 < m^2_{\ell^+\ell^-} < 1.1$ GeV^2/c^4			
	LHCb [327]	$0.994\,^{+0.090\ +0.029}_{-0.082\ -0.027}$	0.994 ± 0.090
$\frac{\mathcal{B}(B^+\to K^+\mu^+\mu^-)}{\mathcal{B}(B^+\to K^+e^+e^-)}$, $1.1 < m^2_{\ell^+\ell^-} < 6.0$ GeV^2/c^4			
	LHCb [327]	$0.949\,^{+0.042}_{-0.041} \pm 0.022$	0.947 ± 0.047
	CMS [269]	$0.78\,^{+0.46\ +0.09}_{-0.23\ -0.05}$	
$\frac{\mathcal{B}(B^+\to K^+\mu^+\mu^-)}{\mathcal{B}(B^+\to K^+e^+e^-)}$, $0.10 < m^2_{\ell^+\ell^-} < 8.12$ GeV^2/c^4 and $m^2_{\ell^+\ell^-} > 10.11$ GeV^2/c^4			
	BaBar [304]	$1.00\,^{+0.31}_{-0.25} \pm 0.07$	$1.00\,^{+0.32}_{-0.26}$
$\frac{\mathcal{B}(B^+\to K^+\mu^+\mu^-)}{\mathcal{B}(B^+\to K^+e^+e^-)}$, $1.0 < m^2_{\ell^+\ell^-} < 6.0$ GeV^2/c^4 [1]			
	BELLE [266]	$1.39\,^{+0.36}_{-0.33} \pm 0.02$	1.39 ± 0.35
$\frac{\mathcal{B}(B^+\to K^+\mu^+\mu^-)}{\mathcal{B}(B^+\to K^+e^+e^-)}$, 14.3GeV^2/c$^4 < m^2_{\ell^+\ell^-}$	LHCb [328]	$1.08\,^{+0.11}_{-0.09} \pm 0.04$	$1.08\,^{+0.12}_{-0.10}$
$\frac{\mathcal{B}(B^0\to K^0_S\mu^+\mu^-)}{\mathcal{B}(B^0\to K^0_S e^+e^-)}$, Full $m^2_{\ell^+\ell^-}$ range	BELLE [266]	$1.29\,^{+0.52}_{-0.45} \pm 0.01$	$1.29\,^{+0.52}_{-0.45}$
$\frac{\mathcal{B}(B^0\to K^0_S\mu^+\mu^-)}{\mathcal{B}(B^0\to K^0_S e^+e^-)}$, $1.0 < m^2_{\ell^+\ell^-} < 6.0$ GeV^2/c^4 [1]			
	BELLE [266]	$0.55\,^{+0.46}_{-0.34} \pm 0.01$	$0.55\,^{+0.46}_{-0.34}$
$\frac{\mathcal{B}(B^0\to K^0_S\mu^+\mu^-)}{\mathcal{B}(B^0\to K^0_S e^+e^-)}$, $1.1 < m^2_{\ell^+\ell^-} < 6.0$ GeV^2/c^4	LHCb [329]	$0.66\,^{+0.20\ +0.02}_{-0.14\ -0.04}$	$0.66\,^{+0.20}_{-0.15}$
$\frac{\mathcal{B}(B\to K\mu^+\mu^-)}{\mathcal{B}(B\to Ke^+e^-)}$, Full $m^2_{\ell^+\ell^-}$ range	BELLE [266]	$1.10\,^{+0.16}_{-0.15} \pm 0.02$	1.10 ± 0.16
$\frac{\mathcal{B}(B\to K\mu^+\mu^-)}{\mathcal{B}(B\to Ke^+e^-)}$, $1.0 < m^2_{\ell^+\ell^-} < 6.0$ GeV^2/c^4 [1]			
	BELLE [266]	$1.03\,^{+0.28}_{-0.24} \pm 0.01$	$1.03\,^{+0.28}_{-0.24}$

[1] For the other bins see the article.

Table 75: Relative branching fractions of B radiative and FCNC decays with leptons (part 2).

Parameter	**Measurements**		**Average**
$\frac{\mathcal{B}(B\to K^*\mu^+\mu^-)}{\mathcal{B}(B\to K^*e^+e^-)}$, Full $m^2_{\ell^+\ell^-}$ range	Belle [275]	$0.83 \pm 0.17 \pm 0.08$	0.83 ± 0.19
$\frac{\mathcal{B}(B\to K^*\mu^+\mu^-)}{\mathcal{B}(B\to K^*e^+e^-)}$, $0.10 < m^2_{\ell^+\ell^-} < 8.12$ GeV^2/c^4 and $m^2_{\ell^+\ell^-} > 10.11$ GeV^2/c^4			
	BaBar [304]	$1.13\,^{+0.34}_{-0.26} \pm 0.10$	$1.13\,^{+0.35}_{-0.28}$
$\frac{\mathcal{B}(B\to K^*\mu^+\mu^-)}{\mathcal{B}(B\to K^*e^+e^-)}$, $0.045 < m^2_{\ell^+\ell^-} < 1.1$ GeV^2/c^4			
	Belle [331]	$0.52\,^{+0.36}_{-0.26} \pm 0.06$	$0.52\,^{+0.36}_{-0.27}$
$\frac{\mathcal{B}(B\to K^*\mu^+\mu^-)}{\mathcal{B}(B\to K^*e^+e^-)}$, $1.1 < m^2_{\ell^+\ell^-} < 6.0$ GeV^2/c^4			
	Belle [331]	$0.96\,^{+0.45}_{-0.29} \pm 0.11$	$0.96\,^{+0.46}_{-0.31}$
$\frac{\mathcal{B}(B\to K^*\mu^+\mu^-)}{\mathcal{B}(B\to K^*e^+e^-)}$, $15 < m^2_{\ell^+\ell^-} < 19$ GeV^2/c^4			
	Belle [331]	$1.18\,^{+0.52}_{-0.32} \pm 0.11$	$1.18\,^{+0.53}_{-0.34}$
$\frac{\mathcal{B}(B^0\to K^*(892)^0\mu^+\mu^-)}{\mathcal{B}(B^0\to K^*(892)^0e^+e^-)}$, $0.045 < m^2_{\ell^+\ell^-} < 1.1$ GeV^2/c^4			
	Belle [331]	$0.46\,^{+0.55}_{-0.27} \pm 0.13$	$0.46\,^{+0.56}_{-0.30}$
$\frac{\mathcal{B}(B^0\to K^*(892)^0\mu^+\mu^-)}{\mathcal{B}(B^0\to K^*(892)^0e^+e^-)}$, $1.1 < m^2_{\ell^+\ell^-} < 6.0$ GeV^2/c^4			
	LHCb [327]	$1.027\,^{+0.072\,+0.027}_{-0.068\,-0.026}$	1.028 ± 0.074
	Belle [331]	$1.06\,^{+0.63}_{-0.38} \pm 0.14$	
$\frac{\mathcal{B}(B^0\to K^*(892)^0\mu^+\mu^-)}{\mathcal{B}(B^0\to K^*(892)^0e^+e^-)}$, $15 < m^2_{\ell^+\ell^-} < 19$ GeV^2/c^4			
	Belle [331]	$1.12\,^{+0.61}_{-0.36} \pm 0.10$	$1.12\,^{+0.62}_{-0.37}$
$\frac{\mathcal{B}(B^0\to K^*(892)^0\mu^+\mu^-)}{\mathcal{B}(B^0\to K^*(892)^0e^+e^-)}$, $0.1 < m^2_{\ell^+\ell^-} < 1.1$ GeV^2/c^4			
	LHCb [327]	$0.927\,^{+0.093\,+0.036}_{-0.087\,-0.035}$	0.927 ± 0.097
$\frac{\mathcal{B}(B^+\to K^*(892)^+\mu^+\mu^-)}{\mathcal{B}(B^+\to K^*(892)^+e^+e^-)}$, $0.045 < m^2_{\ell^+\ell^-} < 1.1$ GeV^2/c^4			
	Belle [331]	$0.62\,^{+0.60}_{-0.36} \pm 0.09$	$0.62\,^{+0.61}_{-0.37}$
$\frac{\mathcal{B}(B^+\to K^*(892)^+\mu^+\mu^-)}{\mathcal{B}(B^+\to K^*(892)^+e^+e^-)}$, $1.1 < m^2_{\ell^+\ell^-} < 6.0$ GeV^2/c^4			
	Belle [331]	$0.72\,^{+0.99}_{-0.44} \pm 0.15$	$0.7\,^{+1.0}_{-0.5}$
$\frac{\mathcal{B}(B^+\to K^*(892)^+\mu^+\mu^-)}{\mathcal{B}(B^+\to K^*(892)^+e^+e^-)}$, $15 < m^2_{\ell^+\ell^-} < 19$ GeV^2/c^4			
	Belle [331]	$1.40\,^{+1.99}_{-0.68} \pm 0.12$	$1.4\,^{+2.0}_{-0.7}$
$\frac{\mathcal{B}(B^+\to K^*(892)^+\mu^+\mu^-)}{\mathcal{B}(B^+\to K^*(892)^+e^+e^-)}$, $0.045 < m^2_{\ell^+\ell^-} < 6.0$ GeV^2/c^4			
	LHCb [329]	$0.70\,^{+0.18\,+0.03}_{-0.13\,-0.04}$	$0.70\,^{+0.18}_{-0.14}$
$\frac{\mathcal{B}(B^+\to K^+\pi^+\pi^-e^+e^-)}{\mathcal{B}(B^+\to K^+\pi^+\pi^-\mu^+\mu^-)}$, $1.1 < m^2_{\ell^+\ell^-} < 7.0$ GeV^2/c^4			
	LHCb [330]	$1.31\,^{+0.18\,+0.12}_{-0.17\,-0.09}$	$1.31\,^{+0.22}_{-0.19}$

Table 76: Relative branching fractions of B radiative and FCNC decays with leptons (part 3).

Parameter	**Measurements**		**Average**
$\frac{\mathcal{B}(B^0 \to K^*(892)^0\gamma)}{\mathcal{B}(B_s^0 \to \phi(1020)\gamma)}$	LHCb [205][1]	$1.23 \pm 0.06 \pm 0.11$	1.21 ± 0.11
	Belle [240][1]	$1.10 \pm 0.16 \pm 0.20$	
$\frac{\mathcal{B}(B^0 \to \mu^+\mu^-)}{\mathcal{B}(B_s^0 \to \mu^+\mu^-)}$ $[10^{-2}]$	LHCb [235]	< 8.1	< 8.1
$\frac{\mathcal{B}(B^0 \to \phi(1020)\mu^+\mu^-)}{\mathcal{B}(B_s^0 \to \phi(1020)\mu^+\mu^-)}$ $[10^{-3}]$	LHCb [292][2]	< 4.4	< 4.4
$\frac{\mathcal{B}(B^0 \to \pi^+\pi^-\mu^+\mu^-)}{\mathcal{B}(B^0 \to J/\psi K^*(892)^0) \times \mathcal{B}(J/\psi \to \mu^+\mu^-) \times \mathcal{B}(K^*(892)^0 \to K^+\pi^-)}$ $[10^{-4}]$			
	LHCb [216][3,4]	$4.1 \pm 1.0 \pm 0.3$	4.1 ± 1.0
$\frac{\mathcal{B}(B^0 \to \rho^0(770)\gamma)}{\mathcal{B}(B^0 \to K^*(892)^0\gamma)}$ $[10^{-2}]$	LHCb [278]	$1.89 \pm 0.07 \pm 0.05$	1.890 ± 0.086

[1] Multiple systematic uncertainties are added in quadrature.
[2] ϕ and charmonium regions excluded from the dimuon spectrum.
[3] The mass windows corresponding to ϕ and charmonium resonances decaying to $\mu\mu$ are vetoed.
[4] $0.5 < m_{\pi^+\pi^-} < 1.3$ GeV/c^2.

Table 77: Branching fractions of $B^+/B^0 \to q\overline{q}'$ gluon decays.

Parameter $[10^{-4}]$	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B \to \eta X)$	Belle [332][1]	$2.610 \pm 0.300\,^{+0.440}_{-0.740}$	$2.61\,^{+0.53}_{-0.80}$
	CLEO [333][2]	< 4.400	
$\mathcal{B}(B \to \eta' X)$	BaBar [334][3]	$3.90 \pm 0.80 \pm 0.90$	4.24 ± 0.87
	CLEO [335][3]	$4.60 \pm 1.10 \pm 0.60$	
$\mathcal{B}(B \to K^+ X)$	BaBar [336][4]	< 1.87	< 1.9
$\mathcal{B}(B \to K^0 X)$	BaBar [336][4]	$1.95\,^{+0.51}_{-0.45} \pm 0.50$	1.95 ± 0.69 / $1.95\,^{+0.71}_{-0.67}$
$\mathcal{B}(B \to \pi^+ X)$	BaBar [336][5]	$3.72\,^{+0.50}_{-0.47} \pm 0.59$	3.72 ± 0.76 / $3.72\,^{+0.77}_{-0.75}$

[1] $0.4 < m_X < 2.6$ GeV/c^2.
[2] $2.1 < p_\eta < 2.7$ GeV/c.
[3] $2.0 < p^*(\eta') < 2.7$ GeV/c.
[4] $p^*(K) < 2.34$ GeV/c.
[5] $p^*(\pi^+) < 2.36$ GeV/c.

Table 78: Isospin asymmetry in B mesons radiative and FCNC decays with leptons. In some of the B-factory results it is assumed that $\mathcal{B}(\Upsilon(4S) \to B^+B^-) = \mathcal{B}(\Upsilon(4S) \to B^0\overline{B}^0)$, and in others a measured value of the ratio of branching fractions is used. See original papers for details. The averages quoted here are computed naively and should be treated with caution.

Parameter	**Measurements**		**Average** HFLAV / PDG
$\Delta_{0^-}(B \to X_s\gamma)$	Belle [337][1,2]	$-0.0048 \pm 0.0149 \pm 0.0150$	-0.005 ± 0.020
	BaBar [338][1,2]	$-0.006 \pm 0.058 \pm 0.026$	
$\Delta_{0^-}(B \to X_{s+d}\gamma)$	BaBar [298][3]	$-0.06 \pm 0.15 \pm 0.07$	-0.06 ± 0.17
$\Delta_{0^+}(B \to K^*\gamma)$	Belle [240][2]	$0.062 \pm 0.015 \pm 0.013$	0.059 ± 0.014
	Belle II [241][2]	$0.048 \pm 0.020 \pm 0.018$	0.063 ± 0.017
	BaBar [242]	$0.066 \pm 0.021 \pm 0.022$	
$\frac{\Gamma(B^+\to\rho^+\gamma)}{2\Gamma(B^0\to\rho^0\gamma)} - 1$	Belle [281]	$-0.48\,^{+0.21}_{-0.19}\,^{+0.08}_{-0.09}$	-0.46 ± 0.17
	BaBar [258]	$-0.43\,^{+0.25}_{-0.22} \pm 0.10$	$-0.46\,^{+0.17}_{-0.16}$
$\Delta_{0-}(B \to K\ell^+\ell^-)$[4]	LHCb [268][5]	$-0.10\,^{+0.08}_{-0.09} \pm 0.02$	$-0.191\,^{+0.073}_{-0.071}$
	BELLE [266][6]	$-0.31\,^{+0.13}_{-0.11} \pm 0.01$	$-0.148\,^{+0.064}_{-0.065}$
	BaBar [304][6]	$-0.41 \pm 0.25 \pm 0.01$	
$\Delta_{0-}(B \to K^*\ell^+\ell^-)$[4]	BaBar [304][6]	$-0.20\,^{+0.30}_{-0.23} \pm 0.03$	$-0.01\,^{+0.11}_{-0.09}$
	Belle [275][6]	$0.33\,^{+0.37}_{-0.43} \pm 0.08$	$-0.03\,^{+0.08}_{-0.07}$
	LHCb [268][5]	$0.00\,^{+0.12}_{-0.10} \pm 0.02$	
$\Delta_{0^-}(B \to K^{(*)}\ell^+\ell^-)$[4]	Belle [275][7]	$-0.30\,^{+0.12}_{-0.11} \pm 0.08$	-0.45 ± 0.10
	BaBar [267][8]	$-0.64\,^{+0.15}_{-0.14} \pm 0.03$	$-0.45\,^{+0.17}_{-0.16}$
$\frac{2\Gamma(\overset{(-)}{B}{}^0\to\rho^0\gamma)-\Gamma(B^\pm\to\rho^\pm\gamma)}{2\Gamma(\overset{(-)}{B}{}^0\to\rho^0\gamma)+\Gamma(B^\pm\to\rho^\pm\gamma)}$[9]	Belle [257][10,2]	$0.109\,^{+0.112}_{-0.117}\,^{+0.078}_{-0.073}$	0.11 ± 0.14
			none

[1] $m_{X_s} < 2.8$ GeV/c^2.
[2] Multiple systematic uncertainties are added in quadrature.
[3] $E_\gamma > 2.2$ GeV.
[4] The PDG uncertainty includes a scale factor.
[5] Only muons are used, $1.1 < m^2_{\ell^+\ell^-} < 6.0$ GeV^2/c^4.
[6] $1.0 < m^2_{\ell^+\ell^-} < 6.0$ GeV^2/c^4.
[7] $m^2_{\ell^+\ell^-} < 8.68$ GeV^2/c^4.
[8] $0.1 < m^2_{\ell^+\ell^-} < 7.02$ GeV^2/c^4.
[9] Isospin asymmetry with CP-average branching fractions.
[10] Result obtained with a combination of Belle and Belle II datasets.

Table 79: Branching fractions of semileptonic B^+ decays to LFV and LNV final states (part 1).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^+ \to \pi^+ e^+ \mu^- + \text{c.c.})$	BaBar [288]	< 0.17	< 0.17
$\mathcal{B}(B^+ \to \pi^+ e^+ \tau^-)$	BaBar [339]	< 74.0	< 74
$\mathcal{B}(B^+ \to \pi^+ e^- \tau^+)$	BaBar [339]	< 20.0	< 20
$\mathcal{B}(B^+ \to \pi^+ e^+ \tau^- + \text{c.c.})$	BaBar [339]	< 75.0	< 75
$\mathcal{B}(B^+ \to \pi^+ \mu^+ \tau^-)$	BaBar [339]	< 62.0	< 62
$\mathcal{B}(B^+ \to \pi^+ \mu^- \tau^+)$	BaBar [339]	< 45.0	< 45
$\mathcal{B}(B^+ \to \pi^+ \mu^+ \tau^- + \text{c.c.})$	BaBar [339]	< 72.0	< 72
$\mathcal{B}(B^+ \to K^+ e^+ \mu^-)$	LHCb [340] BELLE [266] BaBar [289]	< 0.0070 < 0.03 < 0.091	< 0.007
$\mathcal{B}(B^+ \to K^+ e^- \mu^+)$	LHCb [340] BELLE [266] BaBar [289]	< 0.0064 < 0.085 < 0.13	< 0.0064
$\mathcal{B}(B^+ \to K^+ e^+ \mu^- + \text{c.c.})$	BaBar [289]	< 0.091	< 0.091
$\mathcal{B}(B^+ \to K^+ e^+ \tau^-)$	BaBar [339]	< 43.0	< 43 < 15
$\mathcal{B}(B^+ \to K^+ e^- \tau^+)$	BaBar [339] Belle [209]	< 15.0 < 15.1	< 15
$\mathcal{B}(B^+ \to K^+ e^+ \tau^- + \text{c.c.})$	BaBar [339]	< 30.0	< 30
$\mathcal{B}(B^+ \to K^+ \mu^+ \tau^-)$	Belle [209] BaBar [339]	< 24.5 < 45.0	< 24
$\mathcal{B}(B^+ \to K^+ \mu^- \tau^+)$	Belle [209] BaBar [339] LHCb [341]	< 5.9 < 28.0 < 39.0	< 5.9
$\mathcal{B}(B^+ \to K^+ \mu^+ \tau^- + \text{c.c.})$	BaBar [339]	< 48.0	< 48

Table 80: Branching fractions of semileptonic B^+ decays to LFV and LNV final states (part 2).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^+ \to K^*(892)^+ e^+ \mu^-)$	BaBar [289]	< 1.30	< 1.3
$\mathcal{B}(B^+ \to K^*(892)^+ e^- \mu^+)$	BaBar [289]	< 0.99	< 0.99
$\mathcal{B}(B^+ \to K^*(892)^+ e^+ \mu^-$+c.c.)	BaBar [289]	< 1.40	< 1.4
$\mathcal{B}(B^+ \to \pi^- e^+ e^+)$	BaBar [342]	< 0.023	< 0.023
$\mathcal{B}(B^+ \to \pi^- \mu^+ \mu^+)$	LHCb [343][1] BaBar [342]	< 0.0040 < 0.107	< 0.004
$\mathcal{B}(B^+ \to \pi^- e^+ \mu^+)$	BaBar [344]	< 0.15	< 0.15
$\mathcal{B}(B^+ \to \rho^-(770) e^+ e^+)$	BaBar [344]	< 0.17	< 0.17
$\mathcal{B}(B^+ \to \rho^-(770) \mu^+ \mu^+)$	BaBar [344]	< 0.42	< 0.42
$\mathcal{B}(B^+ \to \rho^-(770) e^+ \mu^+)$	BaBar [344]	< 0.47	< 0.47

[1] At CL=95 %.

Table 81: Branching fractions of semileptonic B^+ decays to LFV and LNV final states (part 3).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^+ \to K^- e^+ e^+)$	BaBar [342]	< 0.030	< 0.030
$\mathcal{B}(B^+ \to K^- \mu^+ \mu^+)$	LHCb [345] BaBar [342]	< 0.041 < 0.067	< 0.041
$\mathcal{B}(B^+ \to K^- e^+ \mu^+)$	BaBar [344]	< 0.16	< 0.16
$\mathcal{B}(B^+ \to K^*(892)^- e^+ e^+)$	BaBar [344]	< 0.40	< 0.40
$\mathcal{B}(B^+ \to K^*(892)^- \mu^+ \mu^+)$	BaBar [344]	< 0.59	< 0.59
$\mathcal{B}(B^+ \to K^*(892)^- e^+ \mu^+)$	BaBar [344]	< 0.30	< 0.30
$\mathcal{B}(B^+ \to D^- e^+ e^+)$	BaBar [344] BELLE [346]	< 2.6 < 2.6	< 2.6
$\mathcal{B}(B^+ \to D^- e^+ \mu^+)$	BELLE [346] BaBar [344]	< 1.8 < 2.1	< 1.8
$\mathcal{B}(B^+ \to D^- \mu^+ \mu^+)$	LHCb [347][1] BELLE [346] BaBar [344]	< 0.69 < 1.0 < 1.7	< 0.69
$\mathcal{B}(B^+ \to D^*(2010)^- \mu^+ \mu^+)$	LHCb [347][1]	< 2.4	< 2.4
$\mathcal{B}(B^+ \to D_s^- \mu^+ \mu^+)$	LHCb [347][1]	< 0.58	< 0.58
$\mathcal{B}(B^+ \to \overline{D}^0 \pi^- \mu^+ \mu^+)$	LHCb [347][1]	< 1.5	< 1.5
$\mathcal{B}(B^+ \to \Lambda^0 \mu^+)$	BaBar [291]	< 0.061	< 0.061 < 0.060
$\mathcal{B}(B^+ \to \Lambda^0 e^+)$	BaBar [291]	< 0.032	< 0.032
$\mathcal{B}(B^+ \to \overline{\Lambda}^0 \mu^+)$	BaBar [291]	< 0.062	< 0.062 < 0.060
$\mathcal{B}(B^+ \to \overline{\Lambda}^0 e^+)$	BaBar [291]	< 0.081	< 0.081 < 0.080

[1] At CL=95 %.

Table 82: Branching fractions of semileptonic B^0 decays to LFV and LNV final states.

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^0 \to K^*(892)^0 e^- \mu^+)$	LHCb [220]	< 0.0057	< 0.0057
	Belle [290]	< 0.12	
	BaBar [289]	< 0.34	
$\mathcal{B}(B^0 \to K^*(892)^0 e^+ \mu^-)$	LHCb [220]	< 0.0068	< 0.0068
	Belle [290]	< 0.16	
	BaBar [289]	< 0.53	
$\mathcal{B}(B^0 \to K^*(892)^0 e^+ \mu^- + \text{c.c.})$	LHCb [220]	< 0.0101	< 0.010
	Belle [290]	< 0.18	
	BaBar [289]	< 0.58	
$\mathcal{B}(B^0 \to K^0 e^+ \mu^- + \text{c.c.})$	BELLE [266]	< 0.038	< 0.038
	BaBar [289]	< 0.27	
$\mathcal{B}(B^0 \to \pi^0 e^+ \mu^- + \text{c.c.})$	BaBar [288]	< 0.14	< 0.14
$\mathcal{B}(B^0 \to e^+ \mu^- + \text{c.c.})$	LHCb [217]	< 0.0010	< 0.001
	CDF [208]	< 0.064	
	BaBar [319]	< 0.092	
	Belle [320]	< 0.17	
$\mathcal{B}(B^0 \to K^0_S \tau^+ \mu^-)$	Belle [348][1]	< 11.0	< 11
			none
$\mathcal{B}(B^0 \to K^0_S \tau^- \mu^+)$	Belle [348][1]	< 36.0	< 36
			none
$\mathcal{B}(B^0 \to K^0_S \tau^+ e^-)$	Belle [348][1]	< 15.0	< 15
			none
$\mathcal{B}(B^0 \to K^0_S \tau^- e^+)$	Belle [348][1]	< 8.0	< 8.0
			none
$\mathcal{B}(B^0 \to K^*(892)^0 \tau^+ \mu^-)$	LHCb [349]	< 10	< 10
	Belle [350][1]	< 42	none
$\mathcal{B}(B^0 \to K^*(892)^0 \tau^- \mu^+)$	LHCb [349]	< 8.2	< 8.2
	Belle [350][1]	< 56	none
$\mathcal{B}(B^0 \to K^*(892)^0 \tau^+ e^-)$	LHCb [351]	< 4.9	< 4.9
	Belle [350][1]	< 29	none
$\mathcal{B}(B^0 \to K^*(892)^0 \tau^- e^+)$	LHCb [351]	< 5.9	< 5.9
	Belle [350][1]	< 64	none
$\mathcal{B}(B^0 \to \tau^\pm \mu^\mp)$[2]	LHCb [219]	< 12	< 12
	Belle [352]	< 15	< 14
	BaBar [353]	< 22.0	
$\mathcal{B}(B^0 \to \tau^\pm e^\mp)$	Belle [352]	< 16	< 16
	BaBar [353]	< 28.0	
$\mathcal{B}(B^0 \to p \mu^-)$	LHCb [222]	< 0.0026	< 0.0026
			none

[1] Result obtained with a combination of Belle and Belle II datasets.
[2] PDG shows the result obtained at 95% CL.

Measurements that are not included in the tables (the definitions of observables can be found in the corresponding experimental papers):

- In Ref. [354], LHCb reports the up-down asymmetries in bins of the $K\pi\pi\gamma$ mass of the $B^+ \to K^+\pi^-\pi^+\gamma$ decay.

- For the $B \to K\ell^-\ell^+$ analysis, partial branching fractions and angular observables in bins of $m^2(\ell^+\ell^-)$ are also available:

  - LHCb measures the differential branching fraction of $B^+ \to K^+\mu^-\mu^+$, $B^0 \to K^0\mu^-\mu^+$ and isospin asymmetries [268]
  - CMS measures the differential branching fraction of $B^+ \to K^+\mu^-\mu^+$ [269].
  - In Ref. [355], LHCb measures the phase difference between the short- and long-distance contributions to the $B^+ \to K^+\mu^+\mu^-$ decay. The measurement is based on the analysis of the dimuon mass distribution in the regions of the J/ψ and $\psi(2S)$ resonances and far from their poles, to probe long and short distance effects, respectively.
  - In Ref. [356], CMS performs the study of the angular distribution of the $B^+ \to K^+\mu^+\mu^-$ channel and measures, in 7 $m^2(\mu^+\mu^-)$ bins, $A_{\rm FB}$ and the contribution $F_{\rm H}$ from the pseudoscalar, scalar and tensor amplitudes to the decay.
  - LHCb measures F_H and $A_{\rm FB}$ in 17 (5) bins of $m^2(\ell^+\ell^-)$ for the K^+ (K^0_S) final state [357].
  - Belle measures F_L and $A_{\rm FB}$ in 6 $m^2(\ell^+\ell^-)$ [275].

- For the $B \to K^*\ell^-\ell^+$ analyses, partial branching fractions and angular observables in bins of $m^2(\ell^+\ell^-)$ are also available:

  - $B^0 \to K^{*0}e^-e^+$: LHCb reports F_L, $A_T^{(2)}$, $A_T^{\rm Im}$, $A_T^{\rm Re}$ in the $[0.0008, 0.257]$ GeV$^2/c^4$ bin of $m^2(\ell^+\ell^-)$ putting constraints on the $B \to K^{*0}\gamma$ photon polarization [358]. In Ref. [359], LHCb determines the branching fraction in the dilepton mass region $[0.0009, 1.0]$ GeV$^2/c^4$. In Ref. [360], LHCb measures angular observables in S- and P-bases. Additionally, they compute the LFU observables, Q_i using the P-basis angular observables of the muon and electron modes.
  - $B \to K^*e^-e^+$: Belle reports $A_T^{(2)}$, $A_T^{\rm Im}$,fixing F_L and $A_T^{\rm Re}$ in the $[0.0008, 0.257]$ GeV$^2/c^4$ bin of $m^2(e^+e^-)$ putting constraints on the Wilson coefficient $\mathcal{C}_7'$ [361].
  - $B \to K^*\ell^-\ell^+$: Belle measures F_L, $A_{\rm FB}$, isospin asymmetry in 6 $m^2(\ell^+\ell^-)$ bins [275] and P_4', P_5', P_6', P_8' in 4 $m^2(\ell^+\ell^-)$ bins [362]. In a more recent paper [363], they report measurements of P_4' and P_5', separately for $\ell = \mu$ or e, in 4 $m^2(\ell^+\ell^-)$ bins and in the region $[1, 6]$ GeV$^2/c^4$. The measurements use both B^0 and B^+ decays. They also measure the LFU observables $Q_i = P_i^\mu - P_i^e$, for $i = 4, 5$. *BABAR* reports F_L, $A_{\rm FB}$, P_2 in 5 $m^2(\ell^+\ell^-)$ bins [364].
  - $B^0 \to K^{*0}\mu^-\mu^+$: LHCb measures F_L, $A_{\rm FB}$, $S_3 - S_9$, $A_3 - A_9$, $P_1 - P_3$, $P_4' - P_8'$ in 8 $m^2(\ell^+\ell^-)$ bins [365]. An updated measurement of the *CP*-averaged observables is presented in Ref. [366]. In [367], the full set of CP-averaged and CP-violating angular observables is measured in 8 bins of $m^2(\mu^+\mu^-)$, taking into account the invariant

mass of the kaon-pion system and the lepton mass. The differential branching fraction is also measured simultaneously. In [368], LHCb performs an amplitude analysis in the $m^2(\mu^+\mu^-)$ range $[0.1, 18.0]\text{GeV}^2/c^4$ to measure directly the Wilson coefficients $\mathcal{C}^{(\prime)}_{\exists,\infty\prime}$ and $\mathcal{C}_{\exists\tau}$ and isolate the local and non-local contributions. CMS measures F_L and $A_{\rm FB}$ in 7 $m^2(\ell^+\ell^-)$ bins [369], as well as P_1, P_5' [370] using Run1 data. In [371], CMS uses 140fb^{-1} of Run2 data to measure F_L and the CP-averaged angular observables $P_{1,2,3}$ and $P'_{4,5,6,8}$ in six bins of $M^2(\mu^+\mu^-)$. ATLAS measures F_L, $S_{3,4,5,7,8}$ and $P'_{1,4,5,6,8}$ in 6 $m^2(\ell^+\ell^-)$ bins [372].

- $B^+ \to K^{*+}\mu^-\mu^+$: LHCb reports the full set of *CP*-averaged angular observables in 8 $m^2(\ell^+\ell^-)$ bins [373]. CMS measures F_L and $A_{\rm FB}$ in 3 $m^2(\ell^+\ell^-)$ bins [374].
- In Ref. [375, 376], LHCb performs an unbinned amplitude analysis extracting the coefficients associated to short-distance physics effect ($\mathcal{C}^{(\prime)}_{9,10}$ Wilson coefficients) using events in the bins $[1, 1, 8.0]$ GeV^2/c^4 and $[11.0, 12.5]$ GeV^2/c^4 of $m^2(\ell^+\ell^-)$.
- In Ref. [368], LHCb determines the non-local contributions and the local ones (Wilson coefficients $\mathcal{C}^{(\prime)}_{9,10}$ and $\mathcal{C}_{9\tau}$) in the $m^2(\ell^+\ell^-)$ range $[.1, 18.0]$ GeV^2/c^4 $m^2(\ell^+\ell^-)$.
- In Ref. [361], Belle reports on an angular analysis of the $B \to K^* e^+e^-$ decay for $q^2 \in (0.0008, 1.1200)$ GeV^2/c^4, where the imaginary component of the transversality amplitude is measured to be $A_T^{\rm Im} = -1.27 \pm 0.52 \pm 0.12$, and the K^* transverse asymmetry to be $A_T^{(2)} = 0.52 \pm 0.53 \pm 0.11$.

- $B \to X_s\ell^-\ell^+$ (where X_s is a hadronic system with an s quark): Belle measures $A_{\rm FB}$ in bins of $m^2(\ell^+\ell^-)$ with a sum of 10 exclusive final states [377].

- $B^0 \to K^+\pi^-\mu^+\mu^-$, with $1330 < m(K^+\pi^-) < 1530$ GeV/c^2: LHCb measures the partial branching fraction in bins of $m^2(\mu^+\mu^-)$ in the range $[0.1, 8.0]$ GeV^2/c^4, and reports angular moments [378].

- In Ref. [379], LHCb performs a search for a hidden-sector boson χ decaying into two muons in $B^0 \to K^{*0}\mu^+\mu^-$ decays. Results are given as function of mass and lifetime in the range $214 < m(\chi) < 4350$ $\text{MeV}/c^2$and $0 < \tau(\chi) < 1000$ ps.

- In Ref. [380], LHCb performs a search for a hypothetical new scalar particle χ, assumed to have a narrow width, through the decay $B^+ \to K^+\chi(\mu^+\mu^-)$ in the ranges of mass $250 < m(\chi) < 4700$ MeV/c^2 and lifetime $0.1 < \tau(\chi) < 1000$ ps. Upper limits are given as a function of $m(\chi)$ and $\tau(\chi)$.

- In Ref. [381] LHCb reports the differential branching fraction of $\Lambda_b^0 \to \Lambda(1520)\mu^+\mu^-$ in 5 $m(\mu^+\mu^-)$ intervals in the range $[0.1, 17]$ GeV^2/c^4. It also reports the branching fraction in the interval $1.1 < m^2(\mu^+\mu^-) < 6$ GeV^2/c^4.

- In Ref. [382], Belle-II performs a search for long-lived spin-0 particles (S) in B-meson decays mediated by a $b \to s$ quark transition. They set model-independent upper limits, at the level of 10^{-7}, on the products of branching fractions $\mathcal{B}(B^0 \to K^*(892)^0 S) \times \mathcal{B}(S \to x^+x^-)$ and $\mathcal{B}(B^+ \to K^+S) \times \mathcal{B}(S \to x^+x^-)$, where x^+x^- indicates e^+e^-, $\mu^+\mu^-$, $\pi^+\pi^-$, or K^+K^-, as functions of the S mass and lifetime.

- We do not perform the average of the branching fraction of $B \to \mu^+\mu^-$ decays, which is taken care of by the LHC Heavy Flavour Working Group [232], taking into account the correlations between the $B^0 \to \mu^+\mu^-$ and $B_s^0 \to \mu^+\mu^-$ branching fractions. The latest results from ATLAS, CMS and LHCb are in Refs. [233–235], respectively.

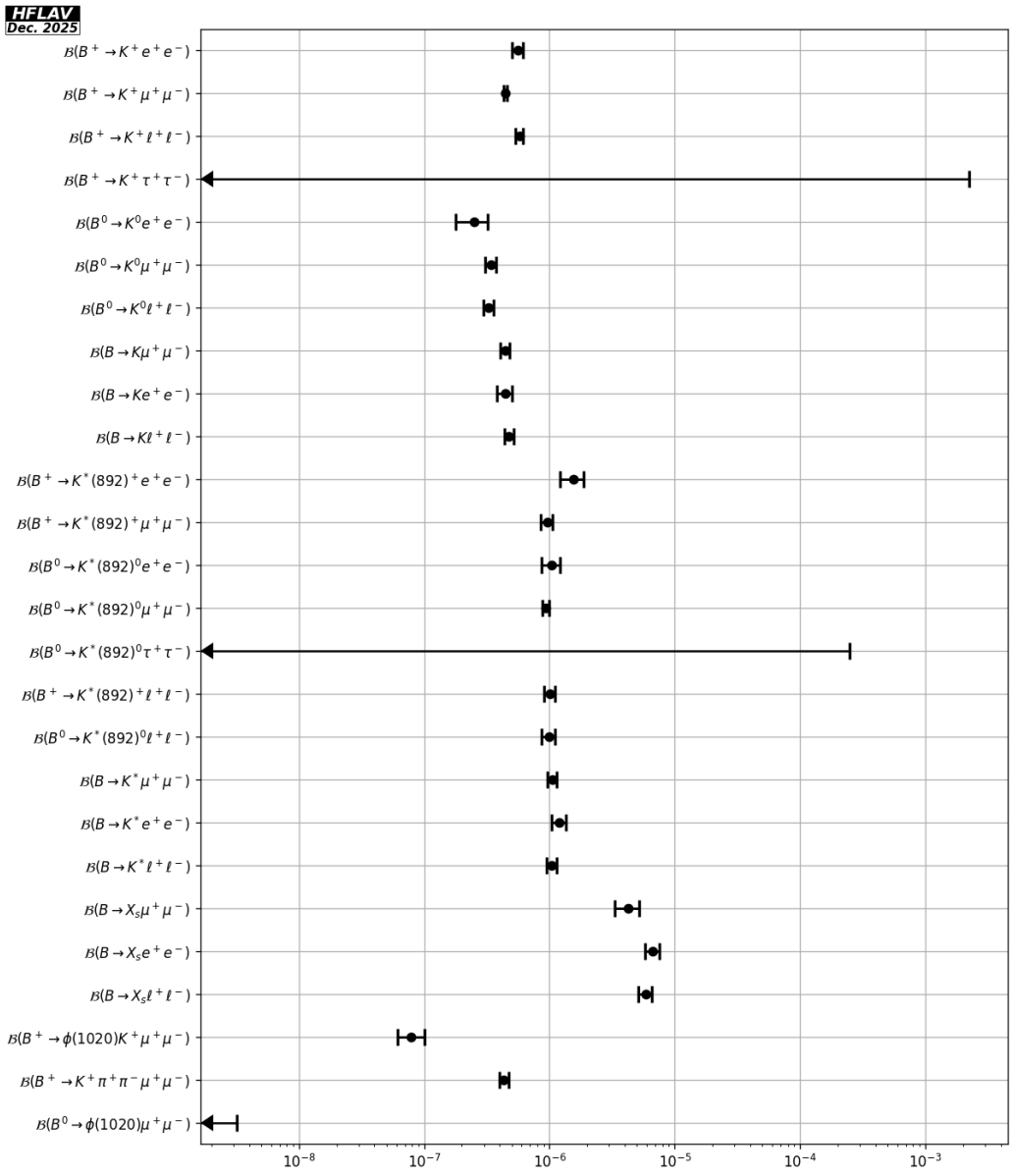

Figure 8: Branching fractions of B^+ and B^0 decays of the type $b \to s\ell^+\ell^-$.

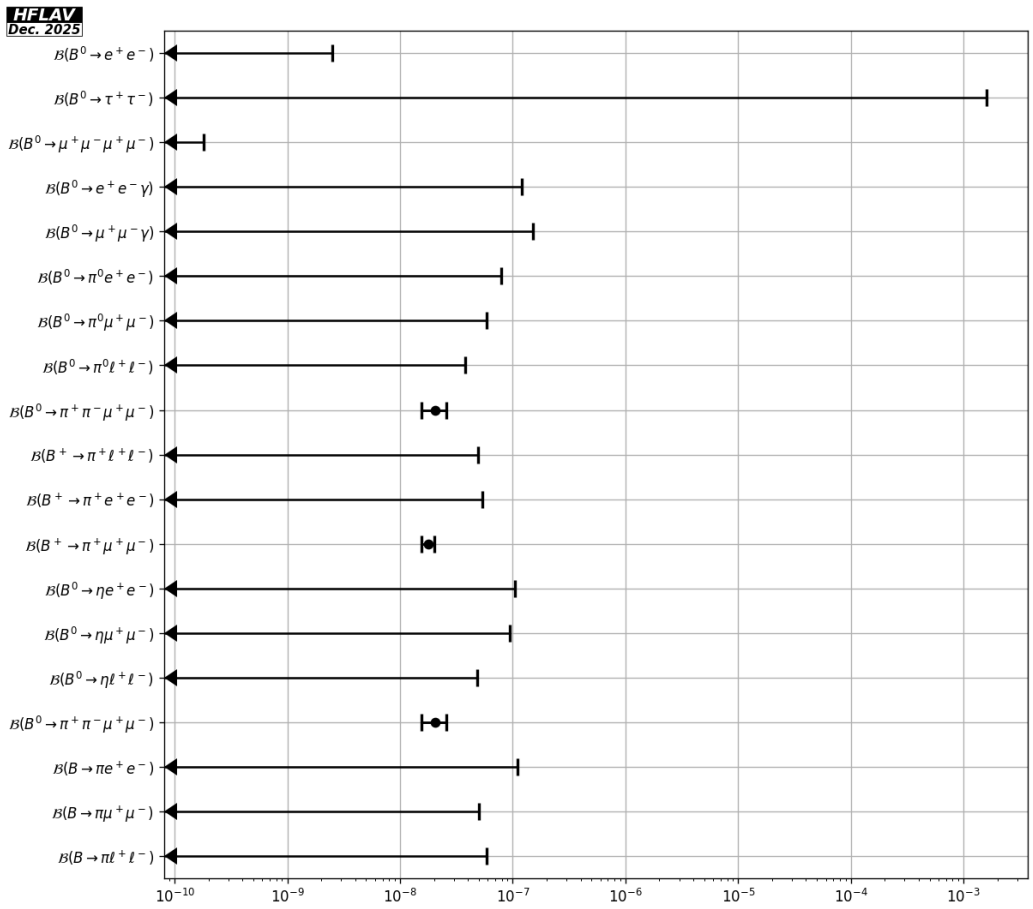

Figure 9: Branching fractions of B^+ and B^0 decays of the type $b \to u\ell^+\ell^-$, purely leptonic and leptonic radiative.

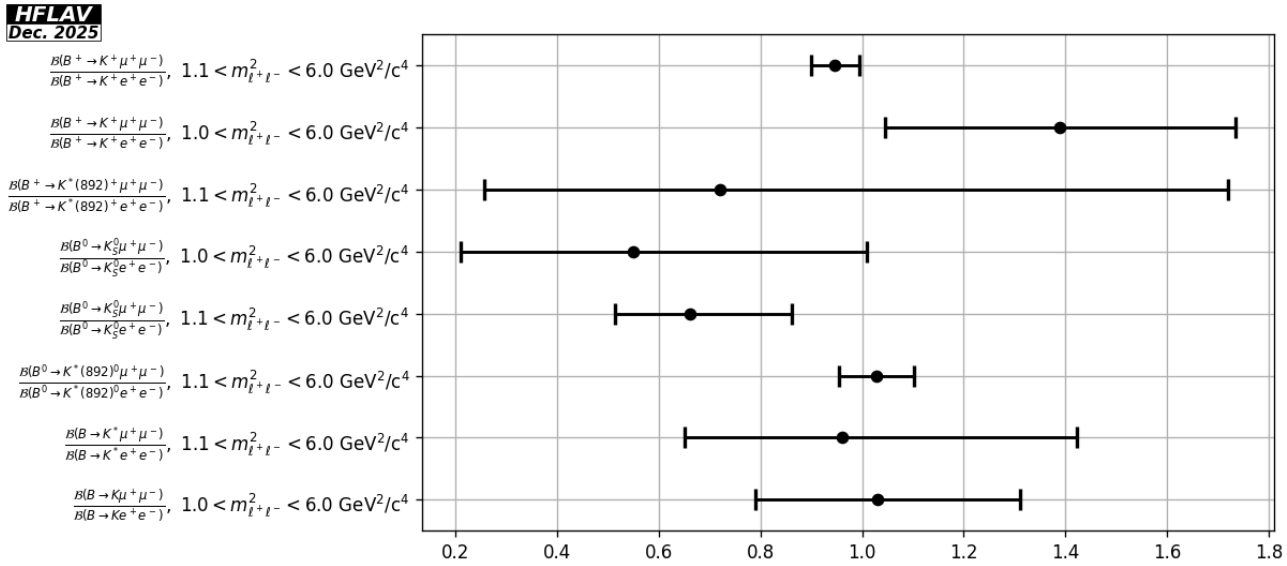

Figure 10: Compilation of $R_K^{(*)}$ ratios in the low dilepton invariant-mass region. These are ratios between branching fractions of B-meson decays to $K^{(*)}\mu^+\mu^-$ and $K^{(*)}e^+e^-$, which provide information on lepton universality.

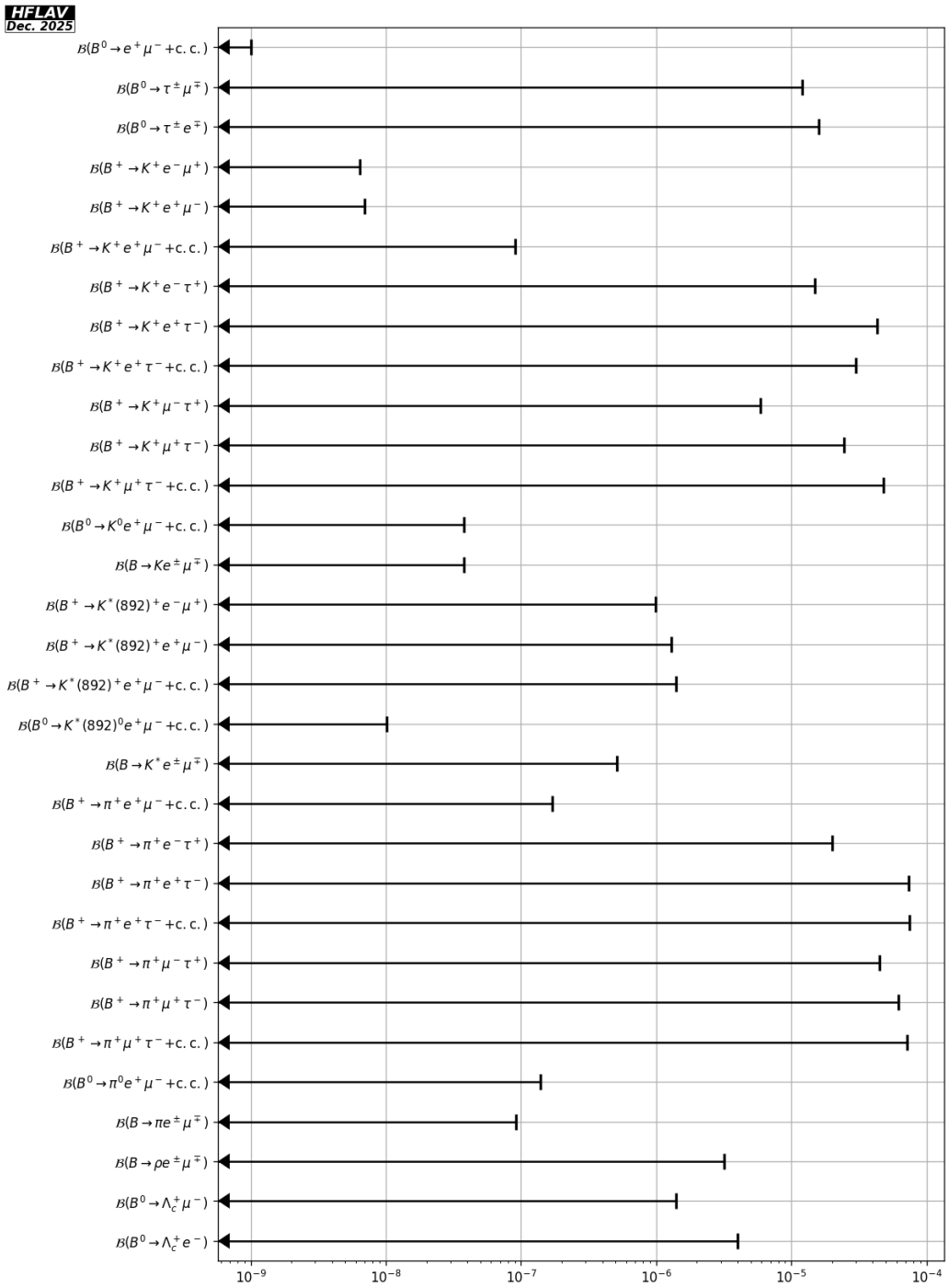

Figure 11: Limits on branching fractions of lepton-flavour-violating B^+ and B^0 decays.

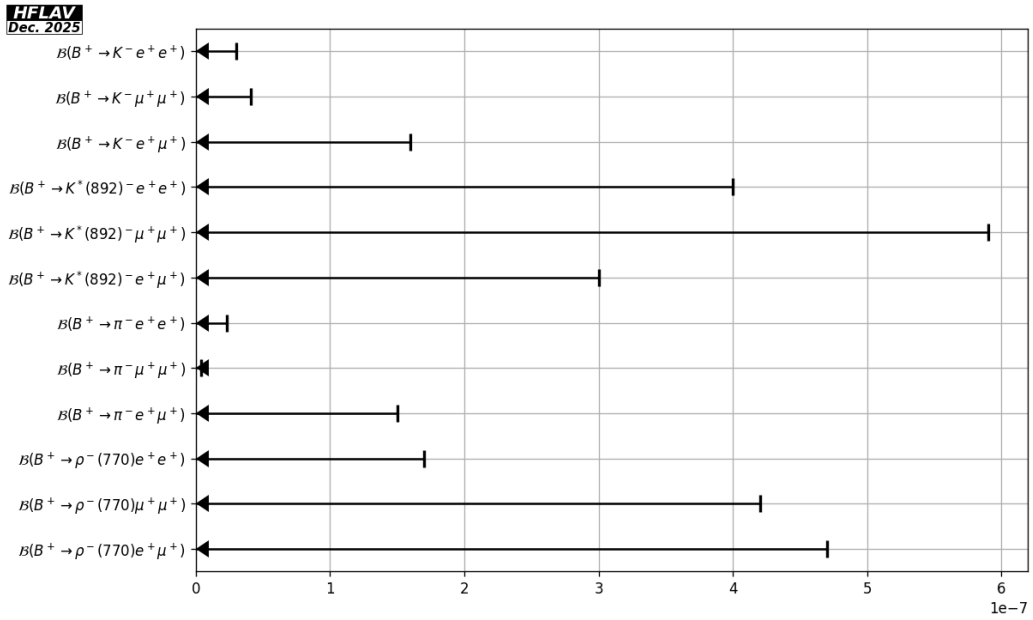

Figure 12: Limits on branching fractions of lepton-number-violating B^+ and B^0 decays.

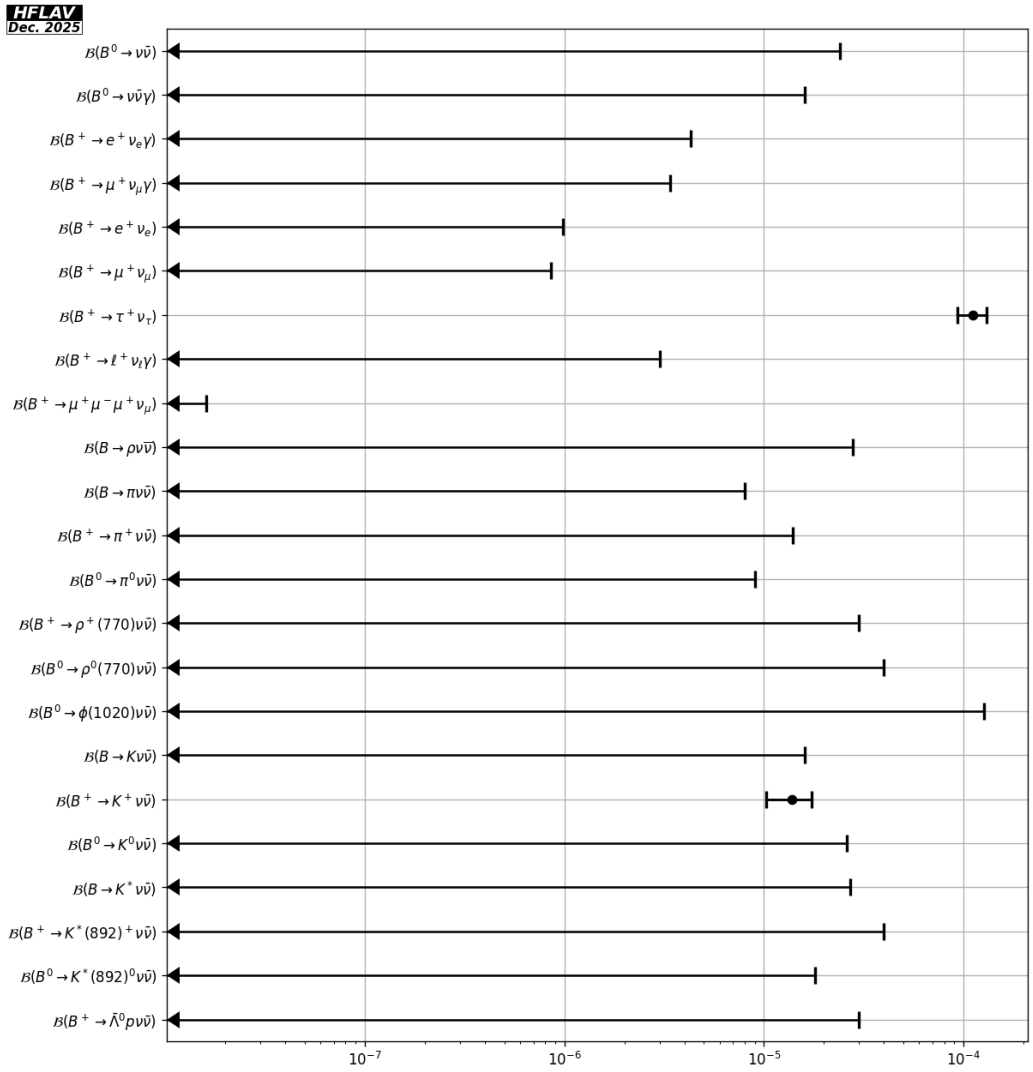

Figure 13: Branching fractions of charmless B decays with neutrinos.

0.7 *CP* asymmetries in *b*-hadron decays

This section contains, in Tables 83 to 101, compilations of *CP* asymmetries in decays of various b-hadrons: B^+, B^0 mesons, $B^\pm/B^0$ admixtures, B_s^0 mesons and finally Λ_b^0 baryons. The *CP* asymmetry is defined as

$$A_{CP} = \frac{N_b - N_{\bar{b}}}{N_b + N_{\bar{b}}}, \tag{1}$$

where N_b ($N_{\bar{b}}$) is the number of hadrons containing a b ($\bar{b}$) quark decaying into a specific final state (the *CP*-conjugate state). Figure 14 shows a graphic representation of a selection of results given in this section.

Table 83: *CP* asymmetries of charmless hadronic B^+ decays (part 1).

Parameter	**Measurements**		**Average**
$A_{\rm CP}(B^+ \to K^0_S\pi^+)$	LHCb [7]	$-0.028 \pm 0.005 \pm 0.009$	-0.0267 ± 0.0087
	Belle [3]	$-0.011 \pm 0.021 \pm 0.006$	
	Belle II [4]	$-0.05 \pm 0.03 \pm 0.01$	
	BaBar [5]	$-0.029 \pm 0.039 \pm 0.010$	
	CLEO [383]	$0.18 \pm 0.24 \pm 0.02$	
$A_{\rm CP}(B^+ \to K^+\pi^0)$	LHCb [384][1]	$0.025 \pm 0.015 \pm 0.007$	0.027 ± 0.012
	Belle [3]	$0.043 \pm 0.024 \pm 0.002$	
	Belle II [4]	$0.01 \pm 0.03 \pm 0.01$	
	BaBar [8]	$0.030 \pm 0.039 \pm 0.010$	
	CLEO [383]	$-0.29 \pm 0.23 \pm 0.02$	
$A_{\rm CP}(B^+ \to \eta' K^+)$	LHCb [13][1]	$-0.002 \pm 0.012 \pm 0.006$	0.004 ± 0.011
	BaBar [9]	$0.008\,^{+0.017}_{-0.018} \pm 0.009$	
	Belle [10]	$0.028 \pm 0.028 \pm 0.021$	
	CLEO [383]	$0.03 \pm 0.12 \pm 0.02$	
$A_{\rm CP}(B^+ \to \eta' K^*(892)^+)$	BaBar [14]	$-0.26 \pm 0.27 \pm 0.02$	-0.26 ± 0.27
$A_{\rm CP}(B^+ \to \eta'(K\pi)^{*+}_0)$	BaBar [14]	$0.06 \pm 0.20 \pm 0.02$	0.06 ± 0.20
$A_{\rm CP}(B^+ \to \eta' K^*_2(1430)^+)$	BaBar [14]	$0.15 \pm 0.13 \pm 0.02$	0.15 ± 0.13
$A_{\rm CP}(B^+ \to \eta K^+)$	BaBar [9]	$-0.36 \pm 0.11 \pm 0.03$	-0.37 ± 0.08
	Belle [16]	$-0.38 \pm 0.11 \pm 0.01$	
$A_{\rm CP}(B^+ \to \eta K^*(892)^+)$	BaBar [17]	$0.01 \pm 0.08 \pm 0.02$	0.02 ± 0.05
	Belle [18]	$0.03 \pm 0.10 \pm 0.01$	
$A_{\rm CP}(B^+ \to \eta(K\pi)^{*+}_0)$	BaBar [17]	$0.05 \pm 0.13 \pm 0.02$	0.050 ± 0.093
$A_{\rm CP}(B^+ \to \eta K^*_2(1430)^+)$	BaBar [17]	$-0.45 \pm 0.30 \pm 0.02$	-0.45 ± 0.21

[1] Multiple systematic uncertainties are added in quadrature.

Table 84: *CP* asymmetries of charmless hadronic B^+ decays (part 2).

Parameter	**Measurements**		**Average**
$A_{\rm CP}(B^+ \to \omega(782)K^+)$	Belle [22]	$-0.03 \pm 0.04 \pm 0.01$	-0.025 ± 0.036
	BaBar [23]	$-0.01 \pm 0.07 \pm 0.01$	
$A_{\rm CP}(B^+ \to \omega(782)K^*(892)^+)$	BaBar [25]	$0.29 \pm 0.35 \pm 0.02$	0.29 ± 0.35
$A_{\rm CP}(B^+ \to \omega(782)(K\pi)_0^{*+})$	BaBar [25]	$-0.10 \pm 0.09 \pm 0.02$	-0.10 ± 0.09
$A_{\rm CP}(B^+ \to \omega(782)K_2^*(1430)^+)$	BaBar [25]	$0.14 \pm 0.15 \pm 0.02$	0.14 ± 0.15
$A_{\rm CP}(B^+ \to K^*(892)^0\pi^+)$	BaBar [27][1,2]	$0.032 \pm 0.052\,^{+0.016}_{-0.013}$	-0.04 ± 0.04
	Belle [28][1,2]	$-0.149 \pm 0.064 \pm 0.022$	
	BaBar [29][3,2]	$-0.12 \pm 0.21\,^{+0.08}_{-0.14}$	
$A_{\rm CP}(B^+ \to K^*(892)^+\pi^0)$	BaBar [29][3,2]	$-0.52 \pm 0.14\,^{+0.06}_{-0.04}$	-0.39 ± 0.13
	BaBar [30]	$-0.06 \pm 0.24 \pm 0.04$	
$A_{\rm CP}(B^+ \to K^+\pi^+\pi^-)$[4]	LHCb [385][5,6,2]	$0.011 \pm 0.002 \pm 0.004$	0.0148 ± 0.0041
	LHCb [386][7,2]	$0.025 \pm 0.004 \pm 0.008$	
	BaBar [27][1,2]	$0.028 \pm 0.020 \pm 0.023$	
	Belle [28][1]	$0.049 \pm 0.026 \pm 0.020$	
$A_{\rm CP}(B^+ \to K^+K^+K^-(\text{NR}))$	BaBar [21][8]	$0.060 \pm 0.044 \pm 0.019$	0.06 ± 0.05

[1] Result extracted from Dalitz-plot analysis of $B^+ \to K^+\pi^+\pi^-$ decays.
[2] Multiple systematic uncertainties are added in quadrature.
[3] Result extracted from Dalitz-plot analysis of $B^+ \to K^0_S\pi^+\pi^0$ decays.
[4] Treatment of charmonium intermediate components differs between the results.
[5] Using run II dataset, corresponding to an integrated luminosity of 5.9 fb^{-1} collected at a center-of-mass energy of 13 TeV (2015 to 2018).
[6] Also measured in several invariant mass regions.
[7] Using run I dataset, corresponding to an integrated luminosity of 3.0 fb^{-1} collected at a center-of-mass energy of 7 TeV (2011) and 8 TeV (2012).
[8] The nonresonant amplitude is modelled using a polynomial function including S-wave and P-wave terms.

Table 85: *CP* asymmetries of charmless hadronic B^+ decays (part 3).

Parameter	**Measurements**		**Average**
$A_{\rm CP}(B^+ \to f_0(980)K^+)$	BaBar [27][1,2]	$-0.106 \pm 0.050\,^{+0.036}_{-0.015}$	-0.08 ± 0.04
	Belle [28][1,2]	$-0.077 \pm 0.065\,^{+0.046}_{-0.026}$	
	BaBar [21][3]	$-0.08 \pm 0.08 \pm 0.04$	
	BaBar [30]	$0.18 \pm 0.18 \pm 0.04$	
$A_{\rm CP}(B^+ \to f_2(1270)K^+)$	BaBar [27][1,2]	$-0.85 \pm 0.22\,^{+0.26}_{-0.13}$	-0.67 ± 0.19
	Belle [28][1,2]	$-0.59 \pm 0.22 \pm 0.04$	
$A_{\rm CP}(B^+ \to f_2'(1525)K^+)$	BaBar [21][3]	$0.14 \pm 0.10 \pm 0.04$	0.14 ± 0.11
$A_{\rm CP}(B^+ \to \rho^0(770)K^+)$	BaBar [27][1,2]	$0.44 \pm 0.10\,^{+0.06}_{-0.14}$	0.37 ± 0.12
	Belle [28][1,2]	$0.30 \pm 0.11\,^{+0.11}_{-0.04}$	
$A_{\rm CP}(B^+ \to K^0\pi^+\pi^0)$	BaBar [29][4,2]	$0.07 \pm 0.05 \pm 0.04$	0.07 ± 0.06
$A_{\rm CP}(B^+ \to K_0^*(1430)^0\pi^+)$	Belle [28][1,2]	$0.076 \pm 0.038\,^{+0.028}_{-0.022}$	0.084 ± 0.043
	BaBar [29][4,2]	$0.14 \pm 0.10\,^{+0.14}_{-0.06}$	
$A_{\rm CP}(B^+ \to (K\pi)_0^{*0}\pi^+)$	BaBar [27][1,2]	$0.032 \pm 0.035\,^{+0.034}_{-0.028}$	0.032 ± 0.046
$A_{\rm CP}(B^+ \to K_0^*(1430)^+\pi^0)$	BaBar [29][4,2]	$0.26 \pm 0.12\,^{+0.14}_{-0.08}$	$0.26\,^{+0.19}_{-0.14}$
$A_{\rm CP}(B^+ \to K_2^*(1430)^0\pi^+)$	BaBar [27][1,2]	$0.05 \pm 0.23\,^{+0.18}_{-0.08}$	$0.05\,^{+0.29}_{-0.24}$
$A_{\rm CP}(B^+ \to K^+\pi^0\pi^0)$	BaBar [30]	$-0.06 \pm 0.06 \pm 0.04$	-0.06 ± 0.07
$A_{\rm CP}(B^+ \to \rho^+(770)K^0)$	BaBar [29][4,2]	$0.21 \pm 0.19\,^{+0.24}_{-0.20}$	$0.21\,^{+0.31}_{-0.28}$
$A_{\rm CP}(B^+ \to K^*(892)^+\pi^+\pi^-)$	BaBar [39]	$0.07 \pm 0.07 \pm 0.04$	0.07 ± 0.08
$A_{\rm CP}(B^+ \to K^*(892)^+\rho^0(770))$	LHCb [387]	$0.507 \pm 0.062 \pm 0.017$	0.470 ± 0.058
	BaBar [40]	$0.31 \pm 0.13 \pm 0.03$	
$A_{\rm CP}(B^+ \to f_0(980)K^*(892)^+)$	BaBar [40]	$-0.15 \pm 0.12 \pm 0.03$	-0.15 ± 0.12
$A_{CP}(B^+ \to X_{\pi^0\pi^0}\pi^+)$	Belle [75][5]	$0.182 \pm 0.116 \pm 0.007$	0.18 ± 0.12

[1] Result extracted from Dalitz-plot analysis of $B^+ \to K^+\pi^+\pi^-$ decays.
[2] Multiple systematic uncertainties are added in quadrature.
[3] Result extracted from Dalitz-plot analysis of $B^+ \to K^+K^+K^-$ decays.
[4] Result extracted from Dalitz-plot analysis of $B^+ \to K^0_S\pi^+\pi^0$ decays.
[5] $X_{\pi^0\pi^0}$ corresponds to a structure observed in Ref. [75], likely arising due to multiple resonances.

Table 86: *CP* asymmetries of charmless hadronic B^+ decays (part 4).

Parameter	**Measurements**		**Average**
$A_{\rm CP}(B^+ \to a_1(1260)^+ K^0)$	BaBar [41]	$0.12 \pm 0.11 \pm 0.02$	0.12 ± 0.11
$A_{\rm CP}(B^+ \to b_1(1235)^+ K^0)$	BaBar [45]	$-0.03 \pm 0.15 \pm 0.02$	-0.03 ± 0.15
$A_{\rm CP}(B^+ \to K^*(892)^0 \rho^+(770))$	BaBar [42]	$-0.01 \pm 0.16 \pm 0.02$	-0.01 ± 0.16
$A_{\rm CP}(B^+ \to b_1(1235)^0 K^+)$	BaBar [50]	$-0.46 \pm 0.20 \pm 0.02$	-0.46 ± 0.20
$A_{\rm CP}(B^+ \to K^+ K^0_S)$	LHCb [7]	$-0.118 \pm 0.062 \pm 0.031$	-0.088 ± 0.062
	Belle [3]	$0.014 \pm 0.168 \pm 0.002$	
	BaBar [5]	$0.10 \pm 0.26 \pm 0.03$	
$A_{\rm CP}(B^+ \to K^+ K^0_S K^0_S)$[1]	Belle [48][2]	$0.016 \pm 0.039 \pm 0.009$	0.025 ± 0.032
	BaBar [21][3]	$0.04 \,^{+0.04}_{-0.05} \pm 0.02$	
$A_{\rm CP}(B^+ \to K^+ K^- \pi^+)$[1]	LHCb [385][4,5,6]	$-0.114 \pm 0.007 \pm 0.004$	-0.1151 ± 0.0076
	LHCb [386][7,6]	$-0.123 \pm 0.017 \pm 0.014$	
	Belle [52][8]	$-0.170 \pm 0.073 \pm 0.017$	
	BaBar [53]	$0.00 \pm 0.10 \pm 0.03$	
$A_{\rm CP}(B^+ \to K^+ K^- \pi^+ ({\rm NR}))$	LHCb [54][9]	$-0.107 \pm 0.053 \pm 0.035$	-0.107 ± 0.064
$A_{\rm CP}(B^+ \to \overline{K}^*(892)^0 K^+)$	LHCb [54][10]	$0.123 \pm 0.087 \pm 0.045$	0.123 ± 0.098
$A_{\rm CP}(B^+ \to \overline{K}^*_0(1430)^0 K^+)$	LHCb [54][10]	$0.104 \pm 0.149 \pm 0.088$	0.10 ± 0.17
$A_{\rm CP}(B^+ \to \phi(1020)\pi^+)$	LHCb [54][10]	$0.098 \pm 0.436 \pm 0.266$	0.10 ± 0.51
$A_{CP}(B^+ \to K^+ K^- \pi^+)$ $\pi\pi \leftrightarrow KK$ rescattering	LHCb [54][10]	$-0.664 \pm 0.038 \pm 0.019$	-0.664 ± 0.042

[1] Treatment of charmonium intermediate components differs between the results.

[2] A_{CP} is also measured in bins of $m_{K^0_S K^0_S}$

[3] Result extracted from Dalitz-plot analysis of $B^0 \to K^0_S K^+ K^-$ decays.

[4] Using run II dataset, corresponding to an integrated luminosity of 5.9 fb^{-1} collected at a center-of-mass energy of 13 TeV (2015 to 2018).

[5] Also measured in several invariant mass regions.

[6] Multiple systematic uncertainties are added in quadrature.

[7] Using run I dataset, corresponding to an integrated luminosity of 3.0 fb^{-1} collected at a center-of-mass energy of 7 TeV (2011) and 8 TeV (2012).

[8] Also measured in bins of $m_{K^+K^-}$.

[9] LHCb uses a model of the nonresonant contribution obtained from a phenomenological description of the partonic interaction that produces the final state. This contribution is referred to as the single pole in the paper; see Ref. [54] for details.

[10] Result extracted from Dalitz-plot analysis of $B^+ \to K^+ K^- \pi^+$ decays.

Table 87: *CP* asymmetries of charmless hadronic B^+ decays (part 5).

Parameter	**Measurements**		**Average**
$A_{\rm CP}(B^+ \to K^+K^+K^-)$	LHCb [385][1,2,3]	$-0.037 \pm 0.002 \pm 0.004$	-0.036 ± 0.004
	LHCb [386][4,3]	$-0.036 \pm 0.004 \pm 0.007$	
	BaBar [21][5]	$-0.017\,^{+0.019}_{-0.014} \pm 0.014$	
$A_{\rm CP}(B^+ \to \phi(1020)K^+)$	LHCb [13][4,3]	$0.017 \pm 0.011 \pm 0.006$	0.024 ± 0.012
	BaBar [21][5]	$0.128 \pm 0.044 \pm 0.013$	
	Belle [63]	$0.01 \pm 0.12 \pm 0.05$	
	CDF [60]	$-0.07 \pm 0.17\,^{+0.03}_{-0.02}$	
$A_{\rm CP}(B^+ \to K^*(892)^+K^+K^-)$	BaBar [39]	$0.11 \pm 0.08 \pm 0.03$	0.11 ± 0.09
$A_{\rm CP}(B^+ \to \phi(1020)K^*(892)^+)$	Belle [388]	$-0.02 \pm 0.14 \pm 0.03$	-0.01 ± 0.08
	BaBar [62][6]	$0.00 \pm 0.09 \pm 0.04$	
$A_{\rm CP}(B^+ \to (K\pi)_0^{*+}\phi(1020))$	BaBar [64]	$0.04 \pm 0.15 \pm 0.04$	0.04 ± 0.16
$A_{\rm CP}(B^+ \to K_1(1270)^+\phi(1020))$	BaBar [64]	$0.15 \pm 0.19 \pm 0.05$	0.15 ± 0.20
$A_{\rm CP}(B^+ \to K_2^*(1430)^+\phi(1020))$	BaBar [64]	$-0.23 \pm 0.19 \pm 0.06$	-0.23 ± 0.20
$A_{\rm CP}(B^+ \to \phi(1020)\phi(1020)K^+)$	BaBar [66][7]	$-0.10 \pm 0.08 \pm 0.02$	-0.10 ± 0.08

[1] Using run II dataset, corresponding to an integrated luminosity of 5.9 fb^{-1} collected at a center-of-mass energy of 13 TeV (2015 to 2018).

[2] Also measured in several invariant mass regions.

[3] Multiple systematic uncertainties are added in quadrature.

[4] Using run I dataset, corresponding to an integrated luminosity of 3.0 fb^{-1} collected at a center-of-mass energy of 7 TeV (2011) and 8 TeV (2012).

[5] Result extracted from Dalitz-plot analysis of $B^+ \to K^+K^+K^-$ decays.

[6] Combination of two final states of the $K^*(892)^\pm$, $K^0_S\pi^\pm$ and $K^\pm\pi^0$. In addition to the combined results, the paper reports separately the results for each individual final state.

[7] Measured in the $\phi\phi$ invariant mass range below the η_c resonance ($m_{\phi\phi} < 2.85$ GeV/c^2).

Table 88: *CP* asymmetries of charmless hadronic B^+ decays (part 6).

Parameter	**Measurements**		**Average**
$A_{\rm CP}(B^+ \to K^*(892)^+\gamma)$	Belle [240]	$0.011 \pm 0.023 \pm 0.003$	0.008 ± 0.015
	BaBar [242]	$0.018 \pm 0.028 \pm 0.007$	
	Belle II [241]	$-0.007 \pm 0.029 \pm 0.005$	
$A_{\rm CP}(B^+ \to K^+\pi^0\gamma)$	Belle [240][1]	$0.010 \pm 0.036 \pm 0.003$	0.024 ± 0.027
	BaBar [242][2]	$0.040 \pm 0.039 \pm 0.007$	
$A_{\rm CP}(B^+ \to K^0_S\pi^+\gamma)$	Belle [240][1]	$0.013 \pm 0.029 \pm 0.004$	0.007 ± 0.024
	BaBar [242][2]	$-0.006 \pm 0.041 \pm 0.007$	
$A_{CP}(B^+ \to X_s\gamma)$	Belle [337][3]	$0.0275 \pm 0.0184 \pm 0.0032$	0.028 ± 0.019
$A_{\rm CP}(B^+ \to \eta K^+\gamma)$	Belle [247][4]	$-0.16 \pm 0.09 \pm 0.06$	-0.12 ± 0.07
	BaBar [246][5]	$-0.090\,^{+0.104}_{-0.098} \pm 0.014$	
$A_{\rm CP}(B^+ \to \phi(1020)K^+\gamma)$	Belle [250][6]	$-0.03 \pm 0.11 \pm 0.08$	-0.13 ± 0.10
	BaBar [251][7]	$-0.26 \pm 0.14 \pm 0.05$	
$A_{\rm CP}(B^+ \to \rho^+(770)\gamma)$	Belle [257][8]	$-0.082 \pm 0.152\,^{+0.016}_{-0.012}$	-0.08 ± 0.15

[1] $m_{K\pi} < 2.0$ GeV/c^2.
[2] $0.79 < m_{K\pi} < 1.0$ GeV/c^2.
[3] $m_{X_s} < 2.8$ GeV/c^2.
[4] $m_{K\eta} < 2.4$ GeV/c^2.
[5] $m_{K\eta^{(\prime)}} < 3.25$ GeV/c^2.
[6] $1.4 \leq E^*_\gamma \leq 3.4$ GeV/c^2, where E^*_γ is the photon energy in the center-of-mass frame.
[7] $m_{\phi K} < 3.0$ GeV/c^2.
[8] Result obtained with a combination of Belle and Belle II datasets.

Table 89: *CP* asymmetries of charmless hadronic B^+ decays (part 7).

Parameter	**Measurements**		**Average**
$A_{\rm CP}(B^+ \to \pi^+\pi^0)$	Belle [3]	$0.025 \pm 0.043 \pm 0.007$	-0.01 ± 0.03
	Belle II [4]	$-0.08 \pm 0.05 \pm 0.01$	
	BaBar [8]	$0.03 \pm 0.08 \pm 0.01$	
$A_{\rm CP}(B^+ \to \pi^+\pi^+\pi^-)$[1]	LHCb [385][2,3,4]	$0.080 \pm 0.004 \pm 0.004$	0.0764 ± 0.0054
	LHCb [386][5,4]	$0.058 \pm 0.008 \pm 0.011$	
	BaBar [71][6,4]	$0.032 \pm 0.044\,^{+0.040}_{-0.037}$	
$A_{\rm CP}(B^+ \to \rho^0(770)\pi^+)$	LHCb [72][5,6,7,4]	$0.007 \pm 0.011 \pm 0.040$	$0.016\,^{+0.041}_{-0.039}$
	BaBar [71][6,4]	$0.18 \pm 0.07\,^{+0.05}_{-0.15}$	
$A_{\rm CP}(B^+ \to f_2(1270)\pi^+)$	LHCb [72][6,7,4]	$0.468 \pm 0.061 \pm 0.103$	0.365 ± 0.079
	LHCb [54][8]	$0.267 \pm 0.102 \pm 0.048$	
	BaBar [71][6,4]	$0.41 \pm 0.25\,^{+0.18}_{-0.15}$	
$A_{\rm CP}(B^+ \to \rho(1450)^0\pi^+)$	LHCb [72][6,7,4]	$-0.129 \pm 0.033 \pm 0.421$	-0.109 ± 0.049
	LHCb [54][8]	$-0.109 \pm 0.044 \pm 0.024$	
	BaBar [71][6,4]	$-0.06 \pm 0.28\,^{+0.23}_{-0.40}$	
$A_{\rm CP}(B^+ \to \rho_3(1690)^0\pi^+)$	LHCb [72][6,7,4]	$-0.801 \pm 0.114 \pm 0.511$	-0.80 ± 0.52
$A_{\rm CP}(B^+ \to f_0(1370)\pi^+)$	BaBar [71][6,4]	$0.72 \pm 0.15 \pm 0.16$	0.72 ± 0.22
$A_{CP}(B^+ \to \pi^+\pi^+\pi^-), S-$ wave	LHCb [72][6,7,4]	$0.144 \pm 0.018 \pm 0.026$	0.144 ± 0.032
$A_{\rm CP}(B^+ \to \pi^+\pi^+\pi^-(\rm NR))$	BaBar [71][9,4]	$-0.14 \pm 0.14\,^{+0.18}_{-0.08}$	$-0.14\,^{+0.23}_{-0.16}$
$A_{\rm CP}(B^+ \to \rho^+(770)\pi^0)$	BaBar [77]	$-0.01 \pm 0.13 \pm 0.02$	0.03 ± 0.10
	Belle [75]	$0.080 \pm 0.150\,^{+0.023}_{-0.075}$	

[1] Treatment of charmonium intermediate components differs between the results.

[2] Using run II dataset, corresponding to an integrated luminosity of 5.9 fb^{-1} collected at a center-of-mass energy of 13 TeV (2015 to 2018).

[3] Also measured in several invariant mass regions.

[4] Multiple systematic uncertainties are added in quadrature.

[5] Using run I dataset, corresponding to an integrated luminosity of 3.0 fb^{-1} collected at a center-of-mass energy of 7 TeV (2011) and 8 TeV (2012).

[6] Result extracted from Dalitz-plot analysis of $B^+ \to \pi^+\pi^+\pi^-$ decays.

[7] This analysis uses three different approaches: isobar, K-matrix and quasi-model-independent, to describe the S-wave component. The A_{CP} results are taken from the isobar model with an additional error accounting for the different S-wave methods as reported in Appendix D of Ref. [74].

[8] Result extracted from Dalitz-plot analysis of $B^+ \to K^+K^-\pi^+$ decays.

[9] The nonresonant amplitude is modelled using a sum of exponential functions.

Table 90: *CP* asymmetries of charmless hadronic B^+ decays (part 8).

Parameter	**Measurements**		**Average**
$A_{\rm CP}(B^+ \to \rho^+(770)\rho^0(770))$	BaBar [78]	$-0.054 \pm 0.055 \pm 0.010$	-0.051 ± 0.054
	Belle [79]	$0.00 \pm 0.22 \pm 0.03$	
$A_{\rm CP}(B^+ \to \omega(782)\pi^+)$	LHCb [72][1,2,3]	$-0.048 \pm 0.065 \pm 0.049$	-0.041 ± 0.048
	BaBar [23]	$-0.02 \pm 0.08 \pm 0.01$	
	Belle [81]	$-0.02 \pm 0.09 \pm 0.01$	
	CLEO [383]	$-0.34 \pm 0.25 \pm 0.02$	
$A_{\rm CP}(B^+ \to \omega(782)\rho^+(770))$	BaBar [25]	$-0.20 \pm 0.09 \pm 0.02$	-0.20 ± 0.09
$A_{\rm CP}(B^+ \to \pi^+\pi^0\pi^0)$	Belle [75]	$0.092 \pm 0.068 \pm 0.007$	0.092 ± 0.068
$A_{\rm CP}(B^+ \to \eta\pi^+)$	Belle [16]	$-0.19 \pm 0.06 \pm 0.01$	-0.14 ± 0.05
	BaBar [9]	$-0.03 \pm 0.09 \pm 0.03$	
$A_{\rm CP}(B^+ \to \eta\rho^+(770))$	BaBar [82]	$0.13 \pm 0.11 \pm 0.02$	0.11 ± 0.11
	Belle [18]	$-0.04\,^{+0.34}_{-0.32} \pm 0.01$	
$A_{\rm CP}(B^+ \to \eta'\pi^+)$	BaBar [9]	$0.03 \pm 0.17 \pm 0.02$	0.06 ± 0.15
	Belle [10]	$0.20\,^{+0.37}_{-0.36} \pm 0.04$	
$A_{\rm CP}(B^+ \to \eta'\rho^+(770))$	BaBar [14]	$0.26 \pm 0.17 \pm 0.02$	0.26 ± 0.17
$A_{\rm CP}(B^+ \to b_1(1235)^0\pi^+)$	BaBar [50]	$0.05 \pm 0.16 \pm 0.02$	0.05 ± 0.16

[1] Result extracted from Dalitz-plot analysis of $B^+ \to \pi^+\pi^+\pi^-$ decays.

[2] This analysis uses three different approaches: isobar, K-matrix and quasi-model-independent, to describe the S-wave component. The A_{CP} results are taken from the isobar model with an additional error accounting for the different S-wave methods as reported in Appendix D of Ref. [74].

[3] Multiple systematic uncertainties are added in quadrature.

Table 91: *CP* asymmetries of charmless hadronic B^+ decays (part 9).

Parameter	**Measurements**		**Average**
$A_{\rm CP}(B^+ \to p\bar{p}\pi^+)$	BaBar [154]	$0.04 \pm 0.07 \pm 0.04$	0.04 ± 0.08
$A_{CP}(B^+ \to p\bar{p}\pi^+), m_{p\bar{p}} < 2.85$ GeV/c^2			
	LHCb [155]	$-0.041 \pm 0.039 \pm 0.005$	-0.058 ± 0.037
	Belle [153]	$-0.17 \pm 0.10 \pm 0.02$	
$A_{CP}(B^+ \to p\bar{p}K^+), m_{p\bar{p}} < 2.85$ GeV/c^2			
	LHCb [155]	$0.021 \pm 0.020 \pm 0.004$	
	Belle [153]	$-0.02 \pm 0.05 \pm 0.02$	0.007 ± 0.019
	BaBar [158]	$-0.16\,^{+0.07}_{-0.08} \pm 0.04$	
$A_{\rm CP}(B^+ \to p\bar{p}K^*(892)^+)$[1]	BaBar [154]	$0.32 \pm 0.13 \pm 0.05$	0.21 ± 0.11
	Belle [160]	$-0.01 \pm 0.19 \pm 0.02$	
$A_{\rm CP}(B^+ \to p\overline{\Lambda}^0\gamma)$	Belle [163]	$0.17 \pm 0.16 \pm 0.05$	0.17 ± 0.17
$A_{\rm CP}(B^+ \to p\overline{\Lambda}^0\pi^0)$	Belle [163]	$0.01 \pm 0.17 \pm 0.04$	0.01 ± 0.17
$A_{\rm CP}(B^+ \to \overline{\Lambda}^0 p\bar{p}p)$	LHCb [167]	$0.054 \pm 0.156 \pm 0.024$	0.05 ± 0.16

[1] Treatment of charmonium intermediate components differs between the results.

Table 92: *CP* asymmetries of charmless hadronic B^+ decays (part 10).

Parameter	**Measurements**		**Average**
$A_{\rm CP}(B^+ \to K^+\ell^+\ell^-)$	Belle [275]	$0.04 \pm 0.10 \pm 0.02$	0.02 ± 0.08
	BaBar [304]	$-0.03 \pm 0.14 \pm 0.01$	
$A_{\rm CP}(B^+ \to K^+e^+e^-)$	Belle [275]	$0.14 \pm 0.14 \pm 0.03$	0.14 ± 0.14
$A_{\rm CP}(B^+ \to K^+\mu^+\mu^-)$	LHCb [389][1,2]	$0.012 \pm 0.017 \pm 0.001$	0.011 ± 0.017
	Belle [275][3]	$-0.05 \pm 0.13 \pm 0.03$	
$A_{\rm CP}(B^+ \to \pi^+\mu^+\mu^-)$	LHCb [263]	$-0.11 \pm 0.12 \pm 0.01$	-0.11 ± 0.12
$A_{\rm CP}(B^+ \to K^*(892)^+\ell^+\ell^-)$	Belle [275]	$-0.13\,^{+0.17}_{-0.16} \pm 0.01$	-0.09 ± 0.14
	BaBar [267]	$0.01\,^{+0.26}_{-0.24} \pm 0.02$	
$A_{\rm CP}(B^+ \to K^*(892)^+e^+e^-)$	Belle [275]	$-0.14\,^{+0.23}_{-0.22} \pm 0.02$	-0.14 ± 0.23
$A_{\rm CP}(B^+ \to K^*(892)^+\mu^+\mu^-)$	Belle [275]	$-0.12 \pm 0.24 \pm 0.02$	-0.12 ± 0.24

[1] A_{CP} is also measured in bins of $m_{\mu^+\mu^-}$

[2] Mass regions corresponding to ϕ, J/ψ and $\psi(2S)$ are vetoed.

[3] Mass regions corresponding to J/ψ and $\psi(2S)$ are vetoed.

Table 93: *CP* asymmetries of charmless hadronic B^0 decays (part 1).

Parameter	**Measurements**		**Average**
$A_{CP}(B^0 \to \pi^0\pi^0)$	BaBar [93]	$0.43 \pm 0.26 \pm 0.05$	0.23 ± 0.18
	Belle II [135]	$0.03 \pm 0.30 \pm 0.04$	
	Belle [134]	$0.14 \pm 0.36 \pm 0.10$	
$A_{CP}(B^0 \to K^+\pi^-)$	LHCb [390][1]	-0.0831 ± 0.0034	-0.0831 ± 0.0031
	CDF [391]	$-0.083 \pm 0.013 \pm 0.004$	
	Belle [3]	$-0.069 \pm 0.014 \pm 0.007$	
	BaBar [93]	$-0.107 \pm 0.016\,^{+0.006}_{-0.004}$	
	Belle II [4]	$-0.07 \pm 0.02 \pm 0.01$	
$A_{CP}(B^0 \to K^0\pi^0)$	Belle II [4][2]	$-0.01 \pm 0.12 \pm 0.04$	-0.01 ± 0.13
$A_{CP}(B^0 \to \eta' K^*(892)^0)$	BaBar [14]	$0.02 \pm 0.23 \pm 0.02$	-0.07 ± 0.18
	Belle [95]	$-0.22 \pm 0.29 \pm 0.07$	
$A_{CP}(B^0 \to \eta'(K\pi)_0^{*0})$	BaBar [14]	$-0.19 \pm 0.17 \pm 0.02$	-0.19 ± 0.17
$A_{CP}(B^0 \to \eta' K_2^*(1430)^0)$	BaBar [14]	$0.14 \pm 0.18 \pm 0.02$	0.14 ± 0.18
$A_{CP}(B^0 \to \eta K^*(892)^0)$	BaBar [17]	$0.21 \pm 0.06 \pm 0.02$	0.20 ± 0.04
	Belle [18]	$0.17 \pm 0.08 \pm 0.01$	
$A_{CP}(B^0 \to \eta(K\pi)_0^{*0})$	BaBar [17]	$0.06 \pm 0.13 \pm 0.02$	0.060 ± 0.093
$A_{CP}(B^0 \to \eta K_2^*(1430)^0)$	BaBar [17]	$-0.07 \pm 0.19 \pm 0.02$	-0.07 ± 0.14
$A_{CP}(B^0 \to b_1(1235)^- K^+)$	BaBar [50]	$-0.07 \pm 0.12 \pm 0.02$	-0.07 ± 0.12
$A_{CP}(B^0 \to \omega(782) K^*(892)^0)$	BaBar [25]	$0.45 \pm 0.25 \pm 0.02$	0.45 ± 0.25
$A_{CP}(B^0 \to \omega(782)(K\pi)_0^{*0})$	BaBar [25]	$-0.07 \pm 0.09 \pm 0.02$	-0.07 ± 0.09
$A_{CP}(B^0 \to \omega(782) K_2^*(1430)^0)$	BaBar [25]	$-0.37 \pm 0.17 \pm 0.02$	-0.37 ± 0.17

[1] LHCb combines results of the 1.9 fb^{-1} run 2 data analysis with those based on Run 1 dataset [392]. The full statistical and systematic covariance matrices are used in the combination.

[2] Combination of time-integrated and time-dependent analyses using the best linear unbiased estimator Ref. [96].

Table 94: *CP* asymmetries of charmless hadronic B^0 decays (part 2).

Parameter	**Measurements**		**Average**
$A_{\rm CP}(B^0 \to K^+\pi^-\pi^0)$	BaBar [101][1]	$-0.030\,^{+0.045}_{-0.051} \pm 0.055$	-0.00 ± 0.06
	Belle [100]	$0.07 \pm 0.11 \pm 0.01$	
$A_{\rm CP}(B^0 \to \rho^-(770)K^+)$	BaBar [99][1]	$0.20 \pm 0.09 \pm 0.08$	0.20 ± 0.11
	Belle [100]	$0.22\,^{+0.22\,+0.06}_{-0.23\,-0.02}$	
$A_{\rm CP}(B^0 \to \rho(1450)^-K^+)$	BaBar [99][1]	$-0.10 \pm 0.32 \pm 0.09$	-0.10 ± 0.33
$A_{\rm CP}(B^0 \to \rho(1700)^-K^+)$	BaBar [99][1]	$-0.36 \pm 0.57 \pm 0.23$	-0.36 ± 0.61
$A_{\rm CP}(B^0 \to K^+\pi^-\pi^0({\rm NR}))$	BaBar [99][2]	$0.10 \pm 0.16 \pm 0.08$	0.10 ± 0.18
$A_{\rm CP}(B^0 \to K^0\pi^+\pi^-)$	BaBar [102][3]	$-0.01 \pm 0.05 \pm 0.01$	-0.01 ± 0.05
$A_{\rm CP}(B^0 \to K^*(892)^+\pi^-)$	LHCb [108][3,4]	$-0.308 \pm 0.060 \pm 0.016$	-0.274 ± 0.045
	BaBar [102][3,4]	$-0.21 \pm 0.10 \pm 0.02$	
	BaBar [99][1]	$-0.29 \pm 0.11 \pm 0.02$	
	Belle [393][3]	$-0.21 \pm 0.11 \pm 0.07$	
$A_{\rm CP}(B^0 \to (K\pi)_0^{*+}\pi^-)$	LHCb [108][3,4]	$-0.032 \pm 0.047 \pm 0.031$	0.017 ± 0.043
	BaBar [102][3,4]	$0.09 \pm 0.07 \pm 0.03$	
	BaBar [99][1]	$0.07 \pm 0.14 \pm 0.01$	
$A_{\rm CP}(B^0 \to K_2^*(1430)^+\pi^-)$	LHCb [108][3,4]	$-0.29 \pm 0.22 \pm 0.09$	-0.29 ± 0.24
$A_{\rm CP}(B^0 \to K^*(1680)^+\pi^-)$	LHCb [108][3,4]	$-0.07 \pm 0.13 \pm 0.04$	-0.07 ± 0.13
$A_{\rm CP}(B^0 \to f_0(980)K_S^0)$[5]	LHCb [108][3,4]	$0.28 \pm 0.27 \pm 0.15$	0.28 ± 0.31
$A_{\rm CP}(B^0 \to (K\pi)_0^{*0}\pi^0)$	BaBar [99][1]	$-0.15 \pm 0.10 \pm 0.04$	-0.15 ± 0.11
$A_{\rm CP}(B^0 \to K^*(892)^0\pi^0)$	BaBar [99][1]	$-0.15 \pm 0.12 \pm 0.04$	-0.15 ± 0.13

[1] Result extracted from Dalitz-plot analysis of $B^0 \to K^+\pi^-\pi^0$ decays.
[2] The nonresonant amplitude is taken to be constant across the Dalitz plane.
[3] Result extracted from Dalitz-plot analysis of $B^0 \to K_S^0\pi^+\pi^-$ decays.
[4] Multiple systematic uncertainties are added in quadrature.
[5] The official HFLAV average includes results from time-dependent analyses and is given in the section Measurements related to Unitarity Triangle angles.

Table 95: *CP* asymmetries of charmless hadronic B^0 decays (part 3).

Parameter	**Measurements**		**Average**
$A_{\rm CP}(B^0 \to K^*(892)^0\pi^+\pi^-)$	BaBar [112]	$0.07 \pm 0.04 \pm 0.03$	0.07 ± 0.05
$A_{\rm CP}(B^0 \to K^*(892)^0\rho^0(770))$	BaBar [113]	$-0.06 \pm 0.09 \pm 0.02$	-0.06 ± 0.09
$A_{\rm CP}(B^0 \to f_0(980)K^*(892)^0)$	BaBar [113]	$0.07 \pm 0.10 \pm 0.02$	0.07 ± 0.10
$A_{\rm CP}(B^0 \to K^*(892)^+\rho^-(770))$	BaBar [113]	$0.21 \pm 0.15 \pm 0.02$	0.21 ± 0.15
$A_{\rm CP}(B^0 \to K^*(892)^0K^+K^-)$	BaBar [112]	$0.01 \pm 0.05 \pm 0.02$	0.01 ± 0.05
$A_{\rm CP}(B^0 \to a_1(1260)^-K^+)$	BaBar [41]	$-0.16 \pm 0.12 \pm 0.01$	-0.16 ± 0.12
$A_{\rm CP}(B^0 \to \phi(1020)K^*(892)^0)$	Belle [124] BaBar [123]	$-0.007 \pm 0.048 \pm 0.021$ $0.01 \pm 0.06 \pm 0.03$	-0.001 ± 0.041
$A_{\rm CP}(B^0 \to K^*(892)^0\pi^+K^-)$	BaBar [112]	$0.22 \pm 0.33 \pm 0.20$	0.22 ± 0.39
$A_{\rm CP}(B^0 \to (K\pi)_0^{*0}\phi(1020))$	Belle [124] BaBar [123]	$0.093 \pm 0.094 \pm 0.017$ $0.20 \pm 0.14 \pm 0.06$	0.123 ± 0.081
$A_{\rm CP}(B^0 \to K_2^*(1430)^0\phi(1020))$	BaBar [123] Belle [124]	$-0.08 \pm 0.12 \pm 0.05$ $-0.155\,^{+0.152}_{-0.133} \pm 0.033$	-0.112 ± 0.099

Table 96: *CP* asymmetries of charmless hadronic B^0 decays (part 4).

Parameter	**Measurements**		**Average**
$A_{\rm CP}(B^0 \to K^*(892)^0\gamma)$	LHCb [205]	$0.008 \pm 0.017 \pm 0.009$	-0.012 ± 0.010
	Belle [240]	$-0.013 \pm 0.017 \pm 0.004$	
	BaBar [242]	$-0.016 \pm 0.022 \pm 0.007$	
	Belle II [241]	$-0.033 \pm 0.023 \pm 0.004$	
$A_{\rm CP}(B^0 \to K^+\pi^-\gamma)$	Belle [240][1]	$-0.013 \pm 0.017 \pm 0.004$	-0.014 ± 0.014
	BaBar [242][2]	$-0.016 \pm 0.022 \pm 0.007$	
$A_{\rm CP}(B^0 \to K_2^*(1430)^0\gamma)$	BaBar [254]	$-0.08 \pm 0.15 \pm 0.01$	-0.08 ± 0.15
$A_{CP}(B^0 \to X_s\gamma)$	Belle [337][3]	$-0.0094 \pm 0.0174 \pm 0.0047$	-0.009 ± 0.018

[1] $m_{K\pi} < 2.0$ GeV/c^2.
[2] $0.78 < m_{K\pi} < 1.1$ GeV/c^2.
[3] $m_{X_s} < 2.8$ GeV/c^2.

Table 97: *CP* asymmetries of charmless hadronic B^0 decays (part 5).

Parameter	**Measurements**		**Average**
$A_{\rm CP}(B^0 \to b_1(1235)^+\pi^- + \text{c.c.})$	BaBar [50]	$-0.05 \pm 0.10 \pm 0.02$	-0.05 ± 0.10
$A_{\rm CP}(B^0 \to p\bar{p}K^*(892)^0)$[1]	BaBar [154]	$0.11 \pm 0.13 \pm 0.06$	0.05 ± 0.12
	Belle [160]	$-0.08 \pm 0.20 \pm 0.02$	
$A_{\rm CP}(B^0 \to p\overline{\Lambda}^0\pi^-)$	BaBar [174]	$-0.10 \pm 0.10 \pm 0.02$	-0.06 ± 0.07
	Belle [163]	$-0.02 \pm 0.10 \pm 0.03$	
$A_{\rm CP}(B^0 \to K^*(892)^0\ell^+\ell^-)$	Belle [275]	$-0.08 \pm 0.12 \pm 0.02$	-0.05 ± 0.10
	BaBar [267]	$0.02 \pm 0.20 \pm 0.02$	
$A_{\rm CP}(B^0 \to K^*(892)^0 e^+e^-)$	Belle [275]	$-0.21 \pm 0.19 \pm 0.02$	-0.21 ± 0.19
$A_{\rm CP}(B^0 \to K^*(892)^0\mu^+\mu^-)$	LHCb [389][2,3]	$-0.035 \pm 0.024 \pm 0.003$	-0.034 ± 0.024
	Belle [275][4]	$0.00 \pm 0.15 \pm 0.03$	

[1] Treatment of charmonium intermediate components differs between the results.
[2] A_{CP} is also measured in bins of $m_{\mu^+\mu^-}$
[3] Mass regions corresponding to ϕ, J/ψ and $\psi(2S)$ are vetoed.
[4] Mass regions corresponding to J/ψ and $\psi(2S)$ are vetoed.

Table 98: *CP* asymmetries of charmless hadronic decays of $B^\pm/B^0$ admixture.

Parameter	**Measurements**		**Average**
$A_{\rm CP}(B \to K^*\gamma)$	Belle [240]	$-0.004 \pm 0.014 \pm 0.003$	-0.0088 ± 0.0097
	BaBar [242]	$-0.003 \pm 0.017 \pm 0.007$	
	Belle II [241]	$-0.024 \pm 0.019 \pm 0.003$	
$A_{CP}(B \to X_s\gamma)$	Belle [337][1]	$0.0144 \pm 0.0128 \pm 0.0011$	0.015 ± 0.011
	BaBar [394][2]	$0.017 \pm 0.019 \pm 0.010$	
$A_{CP}(B \to X_{s+d}\gamma)$	Belle [395][3]	$0.022 \pm 0.039 \pm 0.009$	0.032 ± 0.034
	BaBar [294][4]	$0.057 \pm 0.060 \pm 0.018$	
$A_{CP}(B \to X_s\ell^+\ell^-)$	BaBar [300]	$0.04 \pm 0.11 \pm 0.01$	0.04 ± 0.11
$A_{\rm CP}(B \to K^*e^+e^-)$	Belle [275]	$-0.18 \pm 0.15 \pm 0.01$	-0.18 ± 0.15
$A_{\rm CP}(B \to K^*\mu^+\mu^-)$	Belle [275]	$-0.03 \pm 0.13 \pm 0.02$	-0.03 ± 0.13
$A_{\rm CP}(B \to K^*\ell^+\ell^-)$	Belle [275]	$-0.10 \pm 0.10 \pm 0.01$	-0.05 ± 0.08
	BaBar [304]	$0.03 \pm 0.13 \pm 0.01$	
$A_{CP}(B \to X_s\eta)$	Belle [332][5]	$-0.13 \pm 0.04\,^{+0.02}_{-0.03}$	$-0.13\,^{+0.04}_{-0.05}$
$A_{\rm CP}(B \to K\ell^+\ell^-)$	BaBar [304]	$-0.03 \pm 0.14 \pm 0.01$	-0.03 ± 0.14

[1] $m_{X_s} < 2.8$ GeV/c^2.
[2] $0.6 < m_{X_s} < 2.0$ GeV/c^2.
[3] $E^*_\gamma \geq 2.1$ GeV where E^*_γ is the photon energy in the center-of-mass frame.
[4] $2.1 < E^*_\gamma < 2.8$ GeV where E^*_γ is the photon energy in the center-of-mass frame.
[5] $0.4 < m_X < 2.6$ GeV/c^2.

Table 99: *CP* asymmetries of charmless hadronic B_s^0 decays.

Parameter	Measurements		Average
$A_{CP}(B_s^0 \to \pi^+ K^-)$	LHCb [390][1]	0.225 ± 0.012	0.225 ± 0.012
	CDF [391]	$0.22 \pm 0.07 \pm 0.02$	

[1] LHCb combines results of the 1.9 fb^{-1} run 2 data analysis with those based on Run 1 dataset [392]. The full statistical and systematic covariance matrices are used in the combination.

Table 100: *CP* asymmetries of charmless hadronic Λ_b^0 decays.

Parameter	Measurements		Average
$A_{\rm CP}(\Lambda_b^0 \to p\pi^-)$	LHCb [396]	$0.002 \pm 0.008 \pm 0.004$	0.0028 ± 0.0089
	CDF [391]	$0.06 \pm 0.07 \pm 0.03$	
$A_{\rm CP}(\Lambda_b^0 \to pK^-)$	LHCb [396]	$-0.011 \pm 0.007 \pm 0.004$	-0.0117 ± 0.0080
	CDF [391]	$-0.10 \pm 0.08 \pm 0.04$	
$A_{\rm CP}(\Lambda_b^0 \to p\overline{K}^0\pi^-)$	LHCb [178]	$0.034 \pm 0.019 \pm 0.009$	0.034 ± 0.021
$A_{\rm CP}(\Lambda_b^0 \to \Lambda^0 K^+\pi^-)$	LHCb [184][1]	$-0.118 \pm 0.045 \pm 0.021$	-0.133 ± 0.049
	LHCb [397]	$-0.53 \pm 0.23 \pm 0.11$	
$A_{\rm CP}(\Lambda_b^0 \to \Lambda^0 K^+K^-)$	LHCb [184][1]	$0.083 \pm 0.023 \pm 0.016$	0.065 ± 0.027 p=0.38%
	LHCb [397]	$-0.28 \pm 0.10 \pm 0.07$	
$A_{\rm CP}(\Lambda_b^0 \to \Lambda^0\pi^+\pi^-)$	LHCb [184][1]	$-0.013 \pm 0.053 \pm 0.018$	-0.013 ± 0.056
$A_{\rm CP}(\Lambda_b^0 \to pK^0K^-)$	LHCb [178]	$0.02 \pm 0.13 \pm 0.09$	0.02 ± 0.16

[1] LHCb reports the ACP difference relative to control mode, $\Lambda_b^0 \to \Lambda_c^+(\to \Lambda\pi^+)\pi^-$, assumed to have no CP asymmetry.

Table 101: *CP* asymmetries of charmless hadronic Ξ_b decays.

Parameter	Measurements		Average
$A_{\rm CP}(\Xi_b^- \to \Sigma(1385)^0 K^-)$	LHCb [187]	$-0.01 \pm 0.24 \pm 0.32$	-0.01 ± 0.40
$A_{CP}(\Xi_b^- \to \Lambda(1405)K^-)$	LHCb [187]	$-0.27 \pm 0.34 \pm 0.73$	-0.27 ± 0.81
$A_{CP}(\Xi_b^- \to \Lambda(1520)K^-)$	LHCb [187]	$-0.05 \pm 0.09 \pm 0.08$	-0.05 ± 0.12
$A_{CP}(\Xi_b^- \to \Lambda(1670)K^-)$	LHCb [187]	$0.03 \pm 0.14 \pm 0.10$	0.03 ± 0.17
$A_{CP}(\Xi_b^- \to \Sigma(1775)K^-)$	LHCb [187]	$-0.47 \pm 0.26 \pm 0.14$	-0.47 ± 0.30
$A_{CP}(\Xi_b^- \to \Sigma(1915)K^-)$	LHCb [187]	$0.11 \pm 0.26 \pm 0.22$	0.11 ± 0.34
$A_{\rm CP}(\Xi_b^0 \to \Lambda^0 K^-\pi^+)$	LHCb [184][1]	$0.27 \pm 0.12 \pm 0.05$	0.27 ± 0.13
$A_{\rm CP}(\Xi_b^0 \to pK^0K^-)$	LHCb [178]	$0.22 \pm 0.15 \pm 0.11$	0.22 ± 0.19

[1] LHCb reports the ACP difference relative to a control mode, $\Lambda_b^0 \to \Lambda_c^+(\to \Lambda\pi^+)\pi^-$, assumed to have no CP asymmetry.

Measurements that are not included in the tables (the definitions of observables can be found in the corresponding experimental papers):

- In Ref. [398], LHCb reports the triple-product asymmetries ($a_{CP}^{\hat{T}-odd}$, $a_{P}^{\hat{T}-odd}$) for the decays $\Lambda_b^0 \to p\pi^-\pi^+\pi^-$ and $\Lambda_b^0 \to p\pi^- K^+ K^-$.

- In Ref. [399], LHCb reports $a_{CP}^{\hat{T}-odd}$, $a_{P}^{\hat{T}-odd}$ and $\Delta(A_{CP}) = A_{CP}(\Lambda_b^0 \to pK^-\mu^+\mu^-) - A_{CP}(\Lambda_b^0 \to pK^- J/\psi)$.

- In Ref. [400], LHCb reports $a_{CP}^{\hat{T}-odd}$ and $a_{P}^{\hat{T}-odd}$ for the decays $\Lambda_b^0 \to pK^-\pi^+\pi^-$, $\Lambda_b^0 \to pK^-K^+K^-$ and $\Xi_b^0 \to pK^-K^-\pi^+$.

- In Ref. [401] LHCb measures differences of *CP* asymmetries between Λ_b^0 and Ξ_b^0 charmless decays into a proton and three charged mesons and the decays to the same final states with an intermediate charmed baryon.

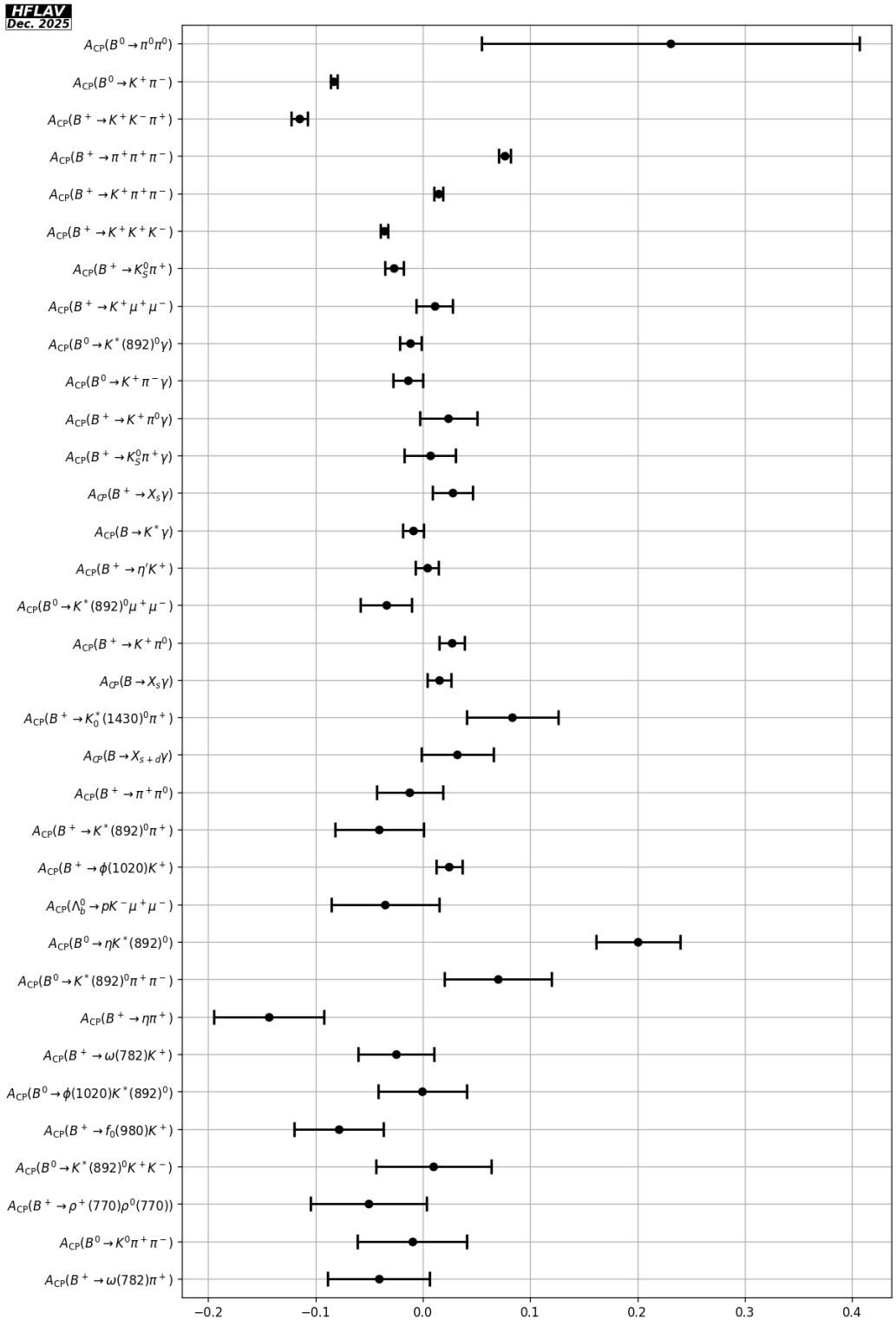

Figure 14: A selection among the most precise direct CP asymmetries (A_{CP}) measured in charmless B^+ and B^0 decay modes.

0.8 Polarization measurements in *b*-hadron decays

In this section, compilations of polarization measurements in b-hadron decays are given. Tables 102, 103, and 104 detail measurements of the longitudinal polarization fraction f_L in B^+ B^0, and B_s^0 decays, respectively. They are followed by Tables 105, 106 and 107, which list polarization fractions and CP parameters measured in full angular analyses of B^+, B^0 and B_s^0 decays. Figures 15 and 16 show graphic representations of a selection of results shown in this section.

Most of the final states considered in the tables are pairs of vector mesons and thus, we detail below the corresponding definitions. For specific definitions, for example regarding vector-tensor final states or vector recoiling against dispin-half states, please refer to the articles. In the decay of a pseudoscalar meson into two vector mesons, momentum conservation allows for three helicity configurations: $H_0, H_{\pm 1}$. They can be expressed in terms of longitudinal polarisation amplitudes, $A_0 = H_0$, and transverse polarization amplitudes, $A_\perp = (H_{+1} - H_{-1})/\sqrt{2}$ and $A_\parallel = (H_{+1} + H_{-1})/\sqrt{2}$. The corresponding amplitudes for the charge conjugate decays are denoted $\overline{A_0}$, $\overline{A_\parallel}$, and $\overline{A_\perp}$. Using the definition

$$F_{k=0,\parallel,\perp} = \frac{|A_k|^2}{|A_0|^2 + |A_\perp|^2 + |A_\parallel|^2}, \quad \overline{F}_{k=0,\parallel,\perp} = \frac{|\overline{A_k}|^2}{|\overline{A_0}|^2 + |\overline{A_\perp}|^2 + |\overline{A_\parallel}|^2}, \tag{2}$$

the following CP conserving and CP violating observables, which are used in our tables, are defined:

$$f_{k=0,\parallel,\perp} = \frac{1}{2}(F_k + \overline{F_k}), \quad A_{CP}^{k=0,\perp} = \frac{F_k - \overline{F_k}}{F_k + \overline{F_k}}. \tag{3}$$

Note that, in the literature, f_0 and f_L are used interchangeably to denote the longitudinal polarization fraction.

Table 102: Longitudinal polarization fraction, f_L, in B^+ decays.

Parameter	**Measurements**		**Average**
$f_L(B^+ \to \omega(782)K^*(892)^+)$	BaBar [25]	$0.41 \pm 0.18 \pm 0.05$	0.41 ± 0.19
$f_L(B^+ \to \omega(782)K_2^*(1430)^+)$	BaBar [25]	$0.56 \pm 0.10 \pm 0.04$	0.56 ± 0.11
$f_L(B^+ \to K^*(892)^+\overline{K}^*(892)^0)$	BaBar [58]	$0.75\,^{+0.16}_{-0.26} \pm 0.03$	$0.82\,^{+0.13}_{-0.17}$
	Belle [57]	$1.06 \pm 0.30 \pm 0.14$	
$f_L(B^+ \to \phi(1020)K^*(892)^+)$	BaBar [62][1]	$0.49 \pm 0.05 \pm 0.03$	0.50 ± 0.05
	Belle [388]	$0.52 \pm 0.08 \pm 0.03$	
$f_L(B^+ \to \phi(1020)K_1(1270)^+)$	BaBar [64]	$0.46\,^{+0.12}_{-0.13}\,^{+0.06}_{-0.07}$	0.46 ± 0.14
$f_L(B^+ \to \phi(1020)K_2^*(1430)^+)$	BaBar [64]	$0.80\,^{+0.09}_{-0.10} \pm 0.03$	0.80 ± 0.10
$f_L(B^+ \to K^*(892)^+\rho^0(770))$	LHCb [387]	$0.720 \pm 0.028 \pm 0.009$	0.723 ± 0.029
	BaBar [40]	$0.78 \pm 0.12 \pm 0.03$	
$f_L(B^+ \to K^*(892)^0\rho^+(770))$	BaBar [42]	$0.52 \pm 0.10 \pm 0.04$	0.48 ± 0.08
	Belle [43][2]	$0.43 \pm 0.11\,^{+0.05}_{-0.02}$	
$f_L(B^+ \to \rho^+(770)\rho^0(770))$	BaBar [78]	$0.950 \pm 0.015 \pm 0.006$	0.950 ± 0.016
	Belle [79]	$0.948 \pm 0.106 \pm 0.021$	
$f_L(B^+ \to \omega(782)\rho^+(770))$	BaBar [25]	$0.90 \pm 0.05 \pm 0.03$	0.90 ± 0.06
$f_L(B^+ \to p\overline{p}K^*(892)^+)$	Belle [160]	$0.32 \pm 0.17 \pm 0.09$	0.32 ± 0.19

[1] Combination of two final states of the $K^*(892)^\pm$, $K_S^0\pi^\pm$ and $K^\pm\pi^0$. In addition to the combined results, the paper reports separately the results for each individual final state.
[2] See also Ref. [46].

Table 103: Longitudinal polarization fraction, f_L, in B^0 decays.

Parameter	Measurements		Average
$f_L(B^0 \to \omega(782)K^*(892)^0)$	BaBar [25]	$0.72 \pm 0.14 \pm 0.02$	0.69 ± 0.11
	LHCb [402]	$0.68 \pm 0.17 \pm 0.16$	
	Belle [98]	$0.56 \pm 0.29\,^{+0.18}_{-0.08}$	
$f_L(B^0 \to \omega(782)K_2^*(1430)^0)$	BaBar [25]	$0.45 \pm 0.12 \pm 0.02$	0.45 ± 0.12
$f_L(B^0 \to K^*(892)^0\overline{K}^*(892)^0)$	LHCb [130]	$0.600 \pm 0.020 \pm 0.020$	0.61 ± 0.03
	BaBar [131]	$0.80\,^{+0.10}_{-0.12} \pm 0.06$	
$f_L(B^0 \to \phi(1020)K^*(892)^0)$	LHCb [403]	$0.497 \pm 0.019 \pm 0.015$	0.497 ± 0.017
	Belle [124]	$0.499 \pm 0.030 \pm 0.018$	
	BaBar [123]	$0.494 \pm 0.034 \pm 0.013$	
$f_L(B^0 \to \phi(1020)K_2^*(1430)^0)$	Belle [124]	$0.918\,^{+0.029}_{-0.060} \pm 0.012$	$0.912\,^{+0.032}_{-0.046}$
	BaBar [123]	$0.901\,^{+0.046}_{-0.058} \pm 0.037$	
$f_L(B^0 \to K^*(892)^0\rho^0(770))$	LHCb [402]	$0.164 \pm 0.015 \pm 0.022$	0.173 ± 0.026
	BaBar [113]	$0.40 \pm 0.08 \pm 0.11$	
$f_L(B^0 \to K^*(892)^+\rho^-(770))$	BaBar [113]	$0.38 \pm 0.13 \pm 0.03$	0.38 ± 0.13
$f_L(B^0 \to \rho^+(770)\rho^-(770))$	Belle [147]	$0.988 \pm 0.012 \pm 0.023$	$0.970\,^{+0.015}_{-0.016}$
	BaBar [148]	$0.992 \pm 0.024\,^{+0.026}_{-0.013}$	
	Belle II [149]	$0.921\,^{+0.024\,+0.017}_{-0.025\,-0.015}$	
$f_L(B^0 \to \rho^0(770)\rho^0(770))$[1]	LHCb [128]	$0.745\,^{+0.048}_{-0.058} \pm 0.034$	0.71 ± 0.06
	BaBar [144]	$0.75\,^{+0.11}_{-0.14} \pm 0.04$	
	Belle [143]	$0.21\,^{+0.18}_{-0.22} \pm 0.15$	
$f_L(B^0 \to a_1(1260)^+a_1(1260)^-)$	BaBar [151]	$0.31 \pm 0.22 \pm 0.10$	0.31 ± 0.24
$f_L(B^0 \to p\bar{p}K^*(892)^0)$	Belle [160]	$1.01 \pm 0.13 \pm 0.03$	1.01 ± 0.13
$f_L(B^0 \to \Lambda^0\overline{\Lambda}^0K^*(892)^0)$	Belle [166][2,3]	$0.60 \pm 0.22 \pm 0.08$	0.60 ± 0.23
$f_L(B^0 \to K^*(892)^0\mu^+\mu^-), 0.04 < q^2 < 6.0$ GeV^2/c^4			
	ATLAS [372]	$0.50 \pm 0.06 \pm 0.04$	0.50 ± 0.07
$f_L(B^0 \to K^*(892)^0e^+e^-), 0.002 < q^2 < 1.120$ GeV^2/c^4			
	LHCb [358]	$0.044 \pm 0.026 \pm 0.014$	0.04 ± 0.03
$f_L(B^0 \to K^*(892)^0e^+e^-)$, $1.1 < q^2 < 6.0\,\mathrm{GeV}^2/c^4$			
	LHCb [360]	$0.58 \pm 0.04 \pm 0.05$	0.580 ± 0.064

[1] The PDG uncertainty includes a scale factor.
[2] The charmonium mass regions are vetoed.
[3] $m_{\Lambda^0\overline{\Lambda}^0} < 2.85$ GeV/c^2.

Table 104: Longitudinal polarization fraction, f_L, in B_s^0 decays.

Parameter	Measurements		Average
$f_L(B_s^0 \to \phi(1020)\phi(1020))$	LHCb [404]	$0.381 \pm 0.007 \pm 0.012$	0.378 ± 0.013
	CDF [200]	$0.348 \pm 0.041 \pm 0.021$	
$f_L(B_s^0 \to K^*(892)^0\overline{K}^*(892)^0)$	LHCb [130]	$0.159 \pm 0.010 \pm 0.007$	0.16 ± 0.01
$f_L(B_s^0 \to \phi(1020)\overline{K}^*(892)^0)$	LHCb [125]	$0.51 \pm 0.15 \pm 0.07$	0.51 ± 0.17
$f_L(B_s^0 \to \overline{K}_2^*(1430)^0 K^*(892)^0)$	LHCb [405]	$0.911 \pm 0.020 \pm 0.165$	0.91 ± 0.17
$f_L(B_s^0 \to K_2^*(1430)^0\overline{K}^*(892)^0)$	LHCb [405]	$0.62 \pm 0.16 \pm 0.25$	0.62 ± 0.30
$f_L(B_s^0 \to K_2^*(1430)^0\overline{K}_2^*(1430)^0)$	LHCb [405]	$0.25 \pm 0.14 \pm 0.18$	0.25 ± 0.23
$f_L(B_s^0 \to \phi(1020)e^+e^-)$, $0.0009 < q^2 < 0.2615\,\mathrm{GeV}^2/c^4$			
	LHCb [229]	$0.004 \pm 0.056 \pm 0.012$	0.004 ± 0.057
$f_L(B_s^0 \to \phi(1020)e^+e^-)$, $0.1 < q^2 < 1.1\,\mathrm{GeV}^2/c^4$			
	LHCb [228]	$0.25 \pm 0.12 \pm 0.06$	0.25 ± 0.13
$f_L(B_s^0 \to \phi(1020)e^+e^-)$, $1.1 < q^2 < 6.0\,\mathrm{GeV}^2/c^4$			
	LHCb [228]	$0.67\,^{+0.12}_{-0.13} \pm 0.06$	0.67 ± 0.14
$f_L(B_s^0 \to \phi(1020)e^+e^-)$, $15.0 < q^2 < 19.0\,\mathrm{GeV}^2/c^4$			
	LHCb [228]	$0.43\,^{+0.11}_{-0.10} \pm 0.05$	0.43 ± 0.12

Table 105: Results of full angular analyses of B^+ decays.

Parameter	Measurements		Average
$f_\perp(B^+ \to \phi(1020)K^*(892)^+)$	BaBar [62][1]	$0.21 \pm 0.05 \pm 0.02$	0.20 ± 0.05
	Belle [388]	$0.19 \pm 0.08 \pm 0.02$	

[1] Combination of two final states of the $K^*(892)^\pm$, $K_S^0\pi^\pm$ and $K^\pm\pi^0$. In addition to the combined results, the paper reports separately the results for each individual final state.

Table 106: Results of full angular analyses of B^0 decays.

Parameter	Measurements		Average
$f_\perp(B^0 \to \phi(1020)K^*(892)^0)$	LHCb [403]	$0.221 \pm 0.016 \pm 0.013$	0.224 ± 0.015
	Belle [124]	$0.238 \pm 0.026 \pm 0.008$	
	BaBar [123]	$0.212 \pm 0.032 \pm 0.013$	
$f_\perp(B^0 \to \phi(1020)K_2^*(1430)^0)$[1]	BaBar [123]	$0.002\,^{+0.018}_{-0.002} \pm 0.031$	$0.029\,^{+0.024}_{-0.026}$
	Belle [124]	$0.056\,^{+0.050}_{-0.035} \pm 0.009$	
$f_\perp(B^0 \to K^*(892)^0\overline{K}^*(892)^0)$	LHCb [130]	$0.24 \pm 0.02 \pm 0.02$	0.240 ± 0.028
$f_\parallel(B^0 \to K^*(892)^0\overline{K}^*(892)^0)$	LHCb [130]	$0.17 \pm 0.02 \pm 0.02$	0.170 ± 0.028

[1] The PDG uncertainty includes a scale factor.

Table 107: Results of full angular analyses of B_s^0 decays.

Parameter	**Measurements**		**Average**
$f_\perp(B_s^0 \to \phi(1020)\phi(1020))$	LHCb [404]	$0.290 \pm 0.008 \pm 0.007$	0.293 ± 0.010
	CDF [200]	$0.365 \pm 0.044 \pm 0.027$	
$f_\parallel(B_s^0 \to \phi(1020)\overline{K}^*(892)^0)$	LHCb [125]	$0.21 \pm 0.11 \pm 0.02$	0.21 ± 0.11
$f_\perp(B_s^0 \to K^*(892)^0\overline{K}^*(892)^0)$	LHCb [130]	$0.500 \pm 0.014 \pm 0.003$	0.500 ± 0.014
$f_\parallel(B_s^0 \to K^*(892)^0\overline{K}^*(892)^0)$	LHCb [130]	$0.342 \pm 0.013 \pm 0.010$	0.34 ± 0.02

Measurements that are not included in the tables (the definitions of observables can be found in the corresponding experimental papers):

- In the angular analysis of $B^0 \to \phi K^*(892)^0$ decays [403], in addition to the results quoted in Table 106, LHCb reports observables related to the S-wave component contributing the final state $K^+K^-K^+\pi^-$: $f_S(K\pi)$, $f_S(KK)$, $\delta_s(K\pi)$, $\delta_s(KK)$, $\mathcal{A}_S(K\pi)^{CP}$, $\mathcal{A}_S(KK)^{CP}$, $\delta_S(K\pi)^{CP}$, $\delta_S(KK)^{CP}$.

- In the amplitude analysis of $B_s^0 \to \phi\phi$ decays, in addition to the results quoted in Table 107, LHCb, in Ref. [404], extracts the CP-violating phase $\phi_s^{s\bar{s}s}$ and the CP-violating parameter $|\lambda|$ from a decay-time-dependent and polarisation independent fit. The CP-violating phases $\phi_{s,\parallel}$ and $\phi_{s,\perp}$ are obtained in a polarisation-dependent fit. A time-integrated fit is performed to extract the triple-product asymmetries A_U and A_V. CDF, in Ref. [200] also reports the triple-product asymmetries A_U and A_V.

- In Ref. [405], LHCb presents a flavor-tagged, decay-time-dependent amplitude analysis of $B_s^0 \to (K^+\pi^-)(K^-\pi^+)$ decays in the $K^\pm\pi^\mp$ mass range from 750 to 1600 MeV/c^2. The paper includes measurements of 19 CP-averaged amplitude parameters corresponding to scalar, vector and tensor final states as well as the first measurement of the CP-violating phase $\phi_s^{d\bar{d}}$.

- Reference [402] presents an amplitude analysis of $B^0 \to \rho K^*(892)^0$ realised by LHCb. Scalar (S) and vector (V) contributions to the final state $(\pi^+\pi^+)(K^+\pi^-)$ are considered through partial waves sharing the same angular dependence (VV, SS, SV, VS) and the corresponding amplitudes are extracted for each case. Triple product asymmetries are also reported.

- The angular analysis of $B^0 \to K^*(892)^0 e^+e^-$ performed by LHCb in Ref. [] also incldues S- and P-basis angular observables, as well as Q_i LFU observables.

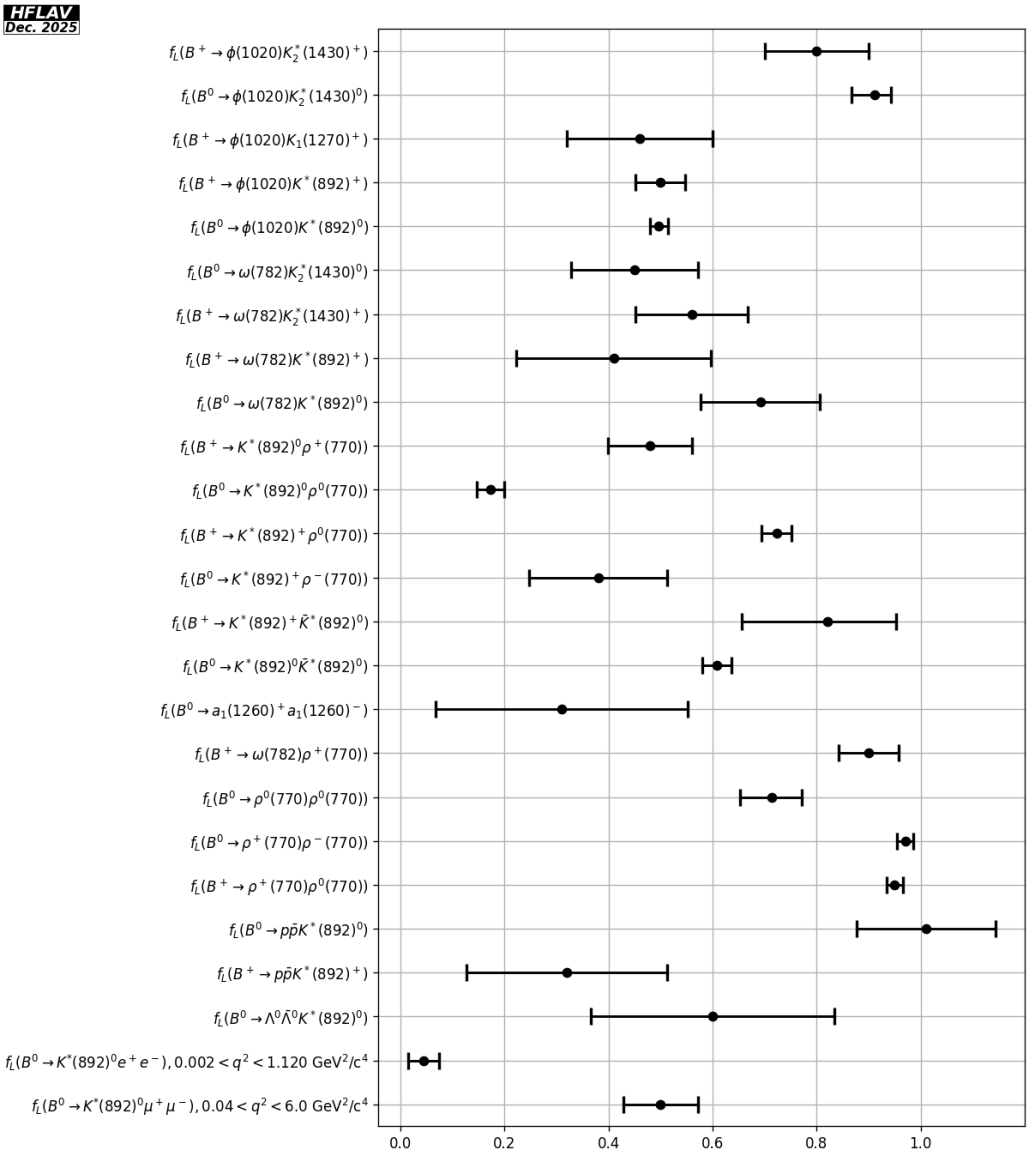

Figure 15: Longitudinal polarization fraction in charmless B decays.

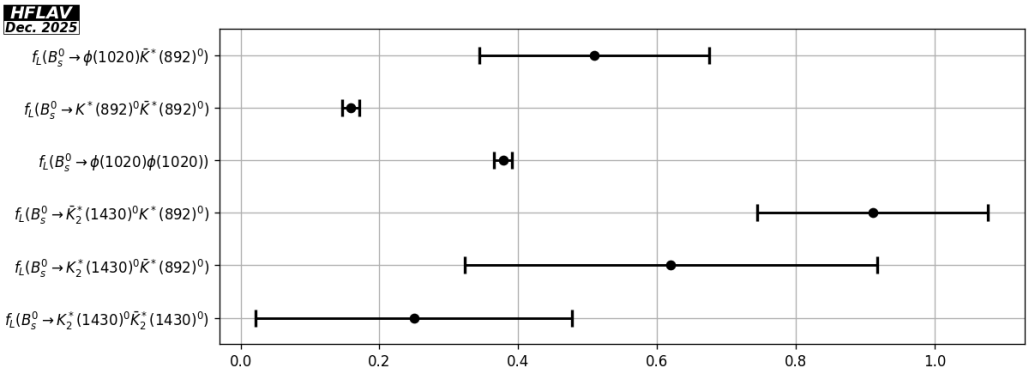

Figure 16: Longitudinal polarization fraction in charmless B_s^0 decays.

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