b-hadron decays to charmless final states

This section provides branching fractions (BF), polarization fractions, partial rate 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 section 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. Results of CKM-matrix parameters obtained from A_{CP} measurements are listed and described by the HFLAV Unitary triangle angles group. 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 Chapter 3 of the latest HFLAV publication. We perform fits of the full likelihood function and do not use the approximation described in Section 3.1. For the cases where more than one measurement is available, in total 235 fits are performed, with on average (maximally) 1.3 (20) parameters and 2.9 (23) measurements per fit. Systematic uncertainties are taken as quoted without the scaling of multiplicative uncertainties discussed in Section 3.3. In our tables, the individual measurements and average of each parameter p_j are shown in one row. We quote numerical values of all direct measurements of a parameter p_j. We also show numerical values derived from measurements of branching-fraction ratios p_j/p_k, performed with respect to the branching fraction p_k of a normalization mode, as well as measurements of products $p_j p_k$ of the branching fraction of interest with that of a daughter decay. In these cases, the quoted value and uncertainty of the measurement are determined with the fitted value of p_k, and the uncertainty of p_k is included in the systematic uncertainty. A footnote "Using p_k" is added in these cases. Note that the fit uses p_j/p_k or $p_j p_k$ directly and not the derived value of p_j, which is quoted in our table in order to give a sense of the contribution of the measurement to the average. When the measurement depends on p_j in some other way, it is also included in our fit for p_j, but in the tables no derived value is shown. Instead, the measured function f of parameters is given in a footnote "Measurement of f used in our fit". Where available, correlations between measurements are taken into account. We consider correlations not only between measurements of the same parameter, as done in our previous publication [1], but also among parameters. The correlation coefficients among parameters are quoted in the detailed version of the tables in this web page.

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 (CL), unless mentioned otherwise. For observables that are not BFs, such as A_{CP} or polarization fractions, we include in our averages all the available

[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.

results, regardless of their significance. Most 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 Chapter 4 of the latest HFLAV publication), and we make no correction for it. 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 non-resonant component. When it applies we detail the model used for the non-resonant 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.

The order of entries in the tables of this section corresponds in most cases to that in the 2021 Review of Particle Physics (PDG 2021) [2]. In most of the tables the averages are compared to those from PDG 2021. When this is done, the "Average" column quotes the PDG averages (in grey) only if they differ from ours. In general, this is 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 appear in red are not included in the PDG 2021 average. They are new results published since the closing of PDG 2021 and before the closing of this report in June 2021. Input values in blue are results that were unpublished at the closing of this report (unpublished results are never included in the PDG averages).

Sections 1 and 2 provide compilations of branching fractions of B^0 and B^+ to mesonic and baryonic charmless final states, respectively. Secs. 3 and 4 give branching fractions of b-baryon and B_s^0-meson charmless decays, respectively. In Sec. 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. Sections 7 and 8 give CP asymmetries and results of polarization measurements, respectively, in various b-hadron charmless decays. Finally, Sec. 5 gives branching fractions of B_c^+ meson decays to charmless final states.

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

This section provides branching fractions of charmless mesonic decays. Tables 1 to 10 are for B^+ and Tables 11 to 24 are for B^0 mesons. For both, decay modes with and without strange mesons in the final state appear in different tables. Finally, Tables 25 and 26 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]	$23.97 \pm 0.53 \pm 0.71$	23.5 ± 0.7
	BaBar [4]	$23.9 \pm 1.1 \pm 1.0$	
	Belle II [5]	$21.4\,^{+2.3}_{-2.2} \pm 1.6$	
	CLEO [6]	$18.8\,^{+3.7}_{-3.3}\,^{+2.1}_{-1.8}$	23.7 ± 0.8
	LHCb [7][2]		
$\mathcal{B}(B^+ \to K^+\pi^0)$	Belle [3]	$12.62 \pm 0.31 \pm 0.56$	12.9 ± 0.5
	BaBar [8]	$13.6 \pm 0.6 \pm 0.7$	
	Belle II [9]	$11.9\,^{+1.1}_{-1.0} \pm 1.6$	
	CLEO [6]	$12.9\,^{+2.4}_{-2.2}\,^{+1.2}_{-1.1}$	
$\mathcal{B}(B^+ \to \eta' K^+)$	BaBar [10]	$71.5 \pm 1.3 \pm 3.2$	68.9 ± 2.3
	Belle [11]	$69.2 \pm 2.2 \pm 3.7$	
	Belle II [12]	$63.4\,^{+3.4}_{-3.3} \pm 3.4$	
	Belle [13]	$61\,^{+10}_{-8} \pm 1$	70.4 ± 2.5
	CLEO [14]	$80\,^{+10}_{-9} \pm 7$	
	LHCb [15][3]		
$\mathcal{B}(B^+ \to \eta' K^*(892)^+)$	BaBar [16]	$4.8\,^{+1.6}_{-1.4} \pm 0.8$	$4.8\,^{+1.8}_{-1.6}$
	Belle [17]	< 2.9	
$\mathcal{B}(B^+ \to \eta'(K\pi)_0^{*+})$	BaBar [16]	$6.0\,^{+2.2}_{-2.0} \pm 0.9$	6.0 ± 2.3
			none
$\mathcal{B}(B^+ \to \eta' K_0^*(1430)^+)$	BaBar [16]	$5.2 \pm 1.9 \pm 1.0$ [4]	5.2 ± 2.1
$\mathcal{B}(B^+ \to \eta' K_2^*(1430)^+)$	BaBar [16]	$28.0\,^{+4.6}_{-4.3} \pm 2.6$	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 $\mathcal{B}(B_s^0 \to \eta'\eta')/\mathcal{B}(B^+ \to \eta' K^+)$ 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 [18]	$2.12 \pm 0.23 \pm 0.11$	2.36 ± 0.21
	BaBar [10]	$2.94\,^{+0.39}_{-0.34} \pm 0.21$	$2.36\,^{+0.38}_{-0.37}$
	CLEO [14]	$2.2\,^{+2.8}_{-2.2}$	
$\mathcal{B}(B^+ \to \eta K^*(892)^+)$	BaBar [19]	$18.9 \pm 1.8 \pm 1.3$	
	Belle [20]	$19.3\,^{+2.0}_{-1.9} \pm 1.5$	19.3 ± 1.6
	CLEO [14]	$26.4\,^{+9.6}_{-8.2} \pm 3.3$	
$\mathcal{B}(B^+ \to \eta (K\pi)_0^{*+})$	BaBar [19]	$18.2 \pm 2.6 \pm 2.6$	18.2 ± 3.7
			none
$\mathcal{B}(B^+ \to \eta K_0^*(1430)^+)$[2]	BaBar [19]	$12.9 \pm 1.8 \pm 1.8$ [3]	12.9 ± 2.5
			18.2 ± 3.7
$\mathcal{B}(B^+ \to \eta K_2^*(1430)^+)$	BaBar [19]	$9.1 \pm 2.7 \pm 1.4$	9.1 ± 3.0
$\mathcal{B}(B^+ \to \eta(1295)K^+) \times \mathcal{B}(\eta(1295) \to \eta\pi\pi)$	BaBar [21]	$2.9\,^{+0.8}_{-0.7} \pm 0.2$	$2.9\,^{+0.8}_{-0.7}$
$\mathcal{B}(B^+ \to \eta(1405)K^+) \times \mathcal{B}(\eta(1405) \to \eta\pi\pi)$	BaBar [21]	< 1.3	< 1.3
$\mathcal{B}(B^+ \to \eta(1405)K^+) \times \mathcal{B}(\eta(1405) \to K^*K)$	BaBar [21]	< 1.2	< 1.2
$\mathcal{B}(B^+ \to \eta(1475)K^+) \times \mathcal{B}(\eta(1475) \to K^*K)$	BaBar [21]	$13.8\,^{+1.8}_{-1.7}\,^{+1.0}_{-0.6}$	$13.8\,^{+2.1}_{-1.8}$
$\mathcal{B}(B^+ \to f_1(1285)K^+) \times \mathcal{B}(f_1(1285) \to \eta\pi\pi)$	BaBar [21]	< 0.8	< 0.80
			none
$\mathcal{B}(B^+ \to f_1(1420)K^+) \times \mathcal{B}(f_1(1420) \to \eta\pi\pi)$	BaBar [21]	< 2.9	< 2.9
$\mathcal{B}(B^+ \to f_1(1420)K^+) \times \mathcal{B}(f_1(1420) \to K^*K)$	BaBar [21]	< 4.1	< 4.1
$\mathcal{B}(B^+ \to \phi(1680)K^+) \times \mathcal{B}(\phi(1680) \to K^*K)$	BaBar [21]	< 3.4	< 3.4
$\mathcal{B}(B^+ \to f_0(1500)K^+)$	BaBar [22]	$17 \pm 4 \pm 12$ [4]	17 ± 12
	BaBar [22]	$20 \pm 10 \pm 27$ [5]	4 ± 2
$\mathcal{B}(B^+ \to \omega(782)K^+)$[6]	Belle [23]	$6.8 \pm 0.4 \pm 0.4$	
	BaBar [24]	$6.3 \pm 0.5 \pm 0.3$	6.47 ± 0.40
	CLEO [25]	$3.2\,^{+2.4}_{-1.9} \pm 0.8$	
$\mathcal{B}(B^+ \to \omega(782)K^*(892)^+)$	BaBar [26]	< 7.4	< 7.4
$\mathcal{B}(B^+ \to \omega(782)(K\pi)_0^{*+})$	BaBar [26]	$27.5 \pm 3.0 \pm 2.6$	27.5 ± 4.0
$\mathcal{B}(B^+ \to \omega(782)K_0^*(1430)^+)$	BaBar [26]	$24.0 \pm 2.6 \pm 4.4$	24.0 ± 5.1
$\mathcal{B}(B^+ \to \omega(782)K_2^*(1430)^+)$	BaBar [26]	$21.5 \pm 3.6 \pm 2.4$	21.5 ± 4.3
$\mathcal{B}(B^+ \to a_0(980)^+K^0) \times \mathcal{B}(a_0(980)^+ \to \eta\pi^+)$	BaBar [27]	< 3.9	< 3.9
$\mathcal{B}(B^+ \to a_0(980)^0K^+) \times \mathcal{B}(a_0(980)^0 \to \eta\pi^0)$	BaBar [27]	< 2.5	< 2.5

[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] Result extracted from Dalitz-plot analysis of $B^+ \to K^+K^+K^-$ decays.
[5] Result extracted from Dalitz-plot analysis of $B^+ \to K_S^0K_S^0K^+$ decays.
[6] The measurement from the Dalitz-plot analysis of $B^+ \to K^+\pi^+\pi^-$ decays [28] was not included in this average. It is quoted as a separate entry.

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

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^+ \to K^*(892)^0\pi^+)$	BaBar [28]	$10.8 \pm 0.6\,^{+1.2}_{-1.4}$ [1]	10.4 ± 0.8
	Belle [29]	$9.67 \pm 0.64\,^{+0.81}_{-0.89}$ [1]	10.1 ± 0.8
	BaBar [30]	$14.6 \pm 2.4\,^{+1.4}_{-1.5}$ [2,3]	
$\mathcal{B}(B^+ \to K^*(892)^+\pi^0)$	BaBar [30]	$9.2 \pm 1.3\,^{+0.7}_{-0.8}$ [2,3]	8.8 ± 1.2
	BaBar [31]	$8.2 \pm 1.5 \pm 1.1$	6.8 ± 0.9
	CLEO [25]	$7.1\,^{+11.4}_{-7.1} \pm 1.0$	
$\mathcal{B}(B^+ \to K^+\pi^+\pi^-)$	LHCb [32]	$56.05 \pm 0.36 \pm 1.51$ [4]	55.7 ± 1.4
	BaBar [28]	$54.4 \pm 1.1 \pm 4.6$ [1]	51.0 ± 2.9
	Belle [29]	$48.8 \pm 1.1 \pm 3.6$ [1]	
$\mathcal{B}(B^+ \to K^+\pi^+\pi^-(\mathrm{NR}))$	BaBar [28]	$9.3 \pm 1.0\,^{+6.9}_{-1.7}$ [1,5]	$16.3\,^{+2.0}_{-1.8}$
	Belle [29]	$16.9 \pm 1.3\,^{+1.7}_{-1.6}$ [1]	$16.3\,^{+2.1}_{-1.5}$
$\mathcal{B}(B^+ \to \omega(782)K^+\ (K^+\pi^+\pi^-))$ [6]	BaBar [28]	$5.9\,^{+8.8}_{-9.0}\,^{+0.5}_{-0.4}$ [1]	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 [28]	$10.3 \pm 0.5\,^{+2.0}_{-1.4}$ [1]	$9.40\,^{+0.84}_{-0.92}$
	Belle [29]	$8.78 \pm 0.82\,^{+0.85}_{-1.76}$ [1]	$9.40\,^{+1.02}_{-1.18}$
$\mathcal{B}(B^+ \to f_2(1270)K^+)$	Belle [29]	$1.33 \pm 0.30\,^{+0.23}_{-0.34}$ [1]	1.07 ± 0.31
	BaBar [28]	$0.89\,^{+0.38}_{-0.33}\,^{+0.01}_{-0.03}$ [1]	1.07 ± 0.27
$\mathcal{B}(B^+ \to f_0(1370)K^+) \times \mathcal{B}(f_0(1370) \to \pi^+\pi^-)$	BaBar [33]	< 10.7 [1]	< 11
$\mathcal{B}(B^+ \to \rho(1450)^0K^+) \times \mathcal{B}(\rho(1450)^0 \to \pi^+\pi^-)$	BaBar [33]	< 11.7 [1]	< 12
$\mathcal{B}(B^+ \to f_2'(1525)K^+) \times \mathcal{B}(f_2'(1525) \to \pi^+\pi^-)$	BaBar [33]	< 3.4 [1]	< 3.4
$\mathcal{B}(B^+ \to \rho^0(770)K^+)$	BaBar [28]	$3.56 \pm 0.45\,^{+0.57}_{-0.46}$ [1]	3.74 ± 0.47
	Belle [29]	$3.89 \pm 0.47\,^{+0.43}_{-0.41}$ [1]	$3.74\,^{+0.48}_{-0.45}$
$\mathcal{B}(B^+ \to K_0^*(1430)^0\pi^+)$ [7]	BaBar [28]	$32.0 \pm 1.2\,^{+10.8}_{-6.0}$ [1]	46.9 ± 5.0
	Belle [29]	$51.6 \pm 1.7\,^{+7.0}_{-7.5}$ [1]	$39.0\,^{+5.7}_{-5.0}$
	BaBar [30]	$50.0 \pm 4.8\,^{+6.7}_{-6.6}$ [2,3]	
$\mathcal{B}(B^+ \to K_2^*(1430)^0\pi^+)$	BaBar [28]	$5.6 \pm 1.2\,^{+1.8}_{-0.8}$ [1]	$5.6\,^{+2.2}_{-1.4}$
	Belle [34]	< 6.9 [1]	$5.6\,^{+2.2}_{-1.5}$
$\mathcal{B}(B^+ \to K^*(1410)^0\pi^+)$	Belle [34]	< 45.0 [1]	< 45
$\mathcal{B}(B^+ \to K^*(1680)^0\pi^+)$	Belle [34]	< 12.0 [1]	< 12
	BaBar [33]	< 15.0 [1]	

[1] Result extracted from Dalitz-plot analysis of $B^+ \to K^+\pi^+\pi^-$ decays.
[2] Result extracted from Dalitz-plot analysis of $B^+ \to K_S^0\pi^+\pi^0$ decays.
[3] Multiple systematic uncertainties are added in quadrature.
[4] Using $\mathcal{B}(B^+ \to K^+K^+K^-)$.
[5] The total nonresonant contribution is obtained by combining an exponential nonresonant component with the effective-range part of the LASS lineshape.
[6] This result was not included in the main entry of $\mathcal{B}(B^+ \to \omega(782)K^+)$.
[7] The PDG uncertainty includes a scale factor.

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

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^+ \to K^+\pi^0\pi^0)$	BaBar [31]	$16.2 \pm 1.2 \pm 1.5$	16.2 ± 1.9
$\mathcal{B}(B^+ \to f_0(980)K^+) \times \mathcal{B}(f_0(980) \to \pi^0\pi^0)$			
	BaBar [31]	$2.8 \pm 0.6 \pm 0.5$	2.8 ± 0.8
$\mathcal{B}(B^+ \to K^-\pi^+\pi^+)$	LHCb [35]	< 0.046	
	BaBar [36]	< 0.95	< 0.046
	Belle [37]	< 4.5	
$\mathcal{B}(B^+ \to K^-\pi^+\pi^+(\mathrm{NR}))$	CLEO [38]	< 56	< 56
$\mathcal{B}(B^+ \to K_1(1270)^0\pi^+)$	BaBar [39]	< 40	< 40
$\mathcal{B}(B^+ \to K_1(1400)^0\pi^+)$	BaBar [39]	< 39	< 39
$\mathcal{B}(B^+ \to K^0\pi^+\pi^0)$	CLEO [40]	< 66.0	< 66
$\mathcal{B}(B^+ \to K_0^*(1430)^+\pi^0)$	BaBar [30]	$17.2 \pm 2.4\,^{+1.5}_{-3.0}$ [1,2]	$17.2\,^{+2.8}_{-3.8}$ $11.9\,^{+2.0}_{-2.3}$
$\mathcal{B}(B^+ \to \rho^+(770)K^0)$	BaBar [30]	$9.4 \pm 1.6\,^{+1.1}_{-2.8}$ [1,2]	$9.4\,^{+1.9}_{-3.2}$ $7.3\,^{+1.0}_{-1.2}$
$\mathcal{B}(B^+ \to K^*(892)^+\pi^+\pi^-)$	BaBar [41]	$75.3 \pm 6.0 \pm 8.1$	75 ± 10
$\mathcal{B}(B^+ \to K^*(892)^+\rho^0(770))$	BaBar [42]	$4.6 \pm 1.0 \pm 0.4$	4.6 ± 1.1
$\mathcal{B}(B^+ \to f_0(980)K^*(892)^+) \times \mathcal{B}(f_0(980) \to \pi^+\pi^-)$			
	BaBar [42]	$4.2 \pm 0.6 \pm 0.3$	4.2 ± 0.7
$\mathcal{B}(B^+ \to a_1(1260)^+K^0)$	BaBar [43]	$34.9 \pm 5.0 \pm 4.4$	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 [47]	$9.6 \pm 1.7 \pm 0.9$	9.6 ± 1.9
$\mathcal{B}(B^+ \to K^*(892)^0\rho^+(770))$	BaBar [44]	$9.6 \pm 1.7 \pm 1.5$	9.2 ± 1.5
	Belle [45]	$8.9 \pm 1.7 \pm 1.2$ [3]	
$\mathcal{B}(B^+ \to K_1(1400)^+\rho^0(770))$	ARGUS [46]	< 780	< 780
$\mathcal{B}(B^+ \to K_2^*(1430)^+\rho^0(770))$	ARGUS [46]	< 1500	< 1500
$\mathcal{B}(B^+ \to b_1(1235)^0K^+) \times \mathcal{B}(b_1(1235)^0 \to \omega(782)\pi^0)$			
	BaBar [48]	$9.1 \pm 1.7 \pm 1.0$	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 [49]	< 5.9	< 5.9
$\mathcal{B}(B^+ \to b_1(1235)^0K^*(892)^+) \times \mathcal{B}(b_1(1235)^0 \to \omega(782)\pi^0)$			
	BaBar [49]	< 6.7	< 6.7

[1] Result extracted from Dalitz-plot analysis of $B^+ \to K_S^0\pi^+\pi^0$ decays.
[2] Multiple systematic uncertainties are added in quadrature.
[3] See also Ref. [50].

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

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^+ \to K^+\overline{K}^0)$[1]	Belle [3]	$1.11 \pm 0.19 \pm 0.05$	1.31 ± 0.14
	LHCb [7]	$1.51 \pm 0.21 \pm 0.10$ [2]	1.31 ± 0.17
	BaBar [4]	$1.61 \pm 0.44 \pm 0.09$	
$\mathcal{B}(B^+ \to \overline{K}^0 K^+\pi^0)$	CLEO [40]	< 24.0	< 24
$\mathcal{B}(B^+ \to K^+K^0_SK^0_S)$[3]	Belle [51]	$10.42 \pm 0.43 \pm 0.22$	10.29 ± 0.37
	BaBar [22]	$10.1 \pm 0.5 \pm 0.3$ [4,5]	10.49 ± 0.37
$\mathcal{B}(B^+ \to f_0(980)K^+) \times \mathcal{B}(f_0(980) \to K^0_SK^0_S)$			
	BaBar [22]	$14.7 \pm 2.8 \pm 1.8$ [4]	14.7 ± 3.3
$\mathcal{B}(B^+ \to f_0(1710)K^+) \times \mathcal{B}(f_0(1710) \to K^0_SK^0_S)$			
	BaBar [22]	$0.48\,^{+0.40}_{-0.24} \pm 0.11$ [4]	$0.48\,^{+0.41}_{-0.26}$
$\mathcal{B}(B^+ \to K^+K^0_SK^0_S(\mathrm{NR}))$	BaBar [22]	$19.8 \pm 3.7 \pm 2.5$ [6]	19.8 ± 4.5
$\mathcal{B}(B^+ \to K^0_SK^0_S\pi^+)$	BaBar [52]	< 0.51	< 0.51
	Belle [51]	< 0.87	
$\mathcal{B}(B^+ \to K^+K^-\pi^+)$	LHCb [32]	$4.97 \pm 0.13 \pm 0.29$ [7]	5.06 ± 0.26
	Belle [53]	$5.38 \pm 0.40 \pm 0.35$ [8]	5.24 ± 0.42
	BaBar [54]	$5.0 \pm 0.5 \pm 0.5$	
$\mathcal{B}(B^+ \to K^+K^-\pi^+(\mathrm{NR}))$	LHCb [55]	$1.625 \pm 0.075 \pm 0.221$ [9,10]	$1.62\,^{+0.24}_{-0.23}$
			1.68 ± 0.26
$\mathcal{B}(B^+ \to \overline{K}^*(892)^0K^+)$	BaBar [56]	< 1.1	$0.57\,^{+0.07}_{-0.06}$
	LHCb [55][11,12]		0.59 ± 0.08
$\mathcal{B}(B^+ \to \overline{K}^*_0(1430)^0K^+)$	BaBar [56]	< 2.2	$0.37\,^{+0.13}_{-0.12}$
	LHCb [55][11,13]		0.38 ± 0.13

[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 $B^+ \to K^0_SK^0_SK^+$ decays.
[5] All charmonium resonances are vetoed. The analysis also reports $\mathcal{B}(B^+ \to K^0_SK^0_SK^+) = (10.6 \pm 0.5 \pm 0.3) \times 10^{-6}$ including the χ_{c0} intermediate state.
[6] The nonresonant amplitude is modelled using a polynomial function of order 2.
[7] Using $\mathcal{B}(B^+ \to K^+K^+K^-)$.
[8] Also measured in bins of $m_{K^+K^-}$.
[9] LHCb uses a model of non-resonant obtained from a phenomenological description of the partonic interaction that produces the final state. This contribution is called single pole in the paper, see Ref. [55] for details.
[10] Using $\mathcal{B}(B^+ \to K^+K^-\pi^+)$.
[11] Result extracted from Dalitz-plot analysis of $B^+ \to K^+K^-\pi^+$ decays.
[12] 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.
[13] 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.

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

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^+ \to K^+K^-\pi^+)$ $\pi\pi \leftrightarrow KK$ rescattering	LHCb [55]	$0.825 \pm 0.040 \pm 0.065$ [1,2]	$0.825^{+0.078}_{-0.075}$ 0.853 ± 0.094
$\mathcal{B}(B^+ \to K^+K^+\pi^-)$	LHCb [35] BaBar [36] Belle [37]	< 0.011 < 0.16 < 2.4	< 0.011
$\mathcal{B}(B^+ \to f_2'(1525)K^+)$[3]	BaBar [22] BaBar [22] Belle [34]	$1.56 \pm 0.36 \pm 0.30$ [4] $2.8 \pm 0.9^{+0.5}_{-0.4}$ [5] < 8.0 [4]	1.79 ± 0.42 1.79 ± 0.48
$\mathcal{B}(B^+ \to f_J(2220)K^+) \times \mathcal{B}(f_J(2220) \to p\overline{p})$	Belle [57]	< 0.41	< 0.41
$\mathcal{B}(B^+ \to K^*(892)^+\pi^+K^-)$	BaBar [41]	< 11.8	< 12
$\mathcal{B}(B^+ \to K^*(892)^+\overline{K}^*(892)^0)$	Belle [58] BaBar [59]	$0.77^{+0.35}_{-0.30} \pm 0.12$ $1.2 \pm 0.5 \pm 0.1$	0.91 ± 0.30 $0.91^{+0.30}_{-0.27}$
$\mathcal{B}(B^+ \to K^*(892)^+K^+\pi^-)$	BaBar [41]	< 6.1	< 6.1
$\mathcal{B}(B^+ \to K^+K^+K^-)$[3,6]	BaBar [22] Belle [34] Belle II [60] LHCb [32][8,9,10]	$34.6 \pm 0.6 \pm 0.9$ [4,7] $30.6 \pm 1.2 \pm 2.3$ [4] $32.0 \pm 2.2 \pm 1.4$	32.9 ± 0.8 34.0 ± 1.4
$\mathcal{B}(B^+ \to \phi(1020)K^+)$[3]	BaBar [22] Belle [34] Belle II [61] CDF [62] CLEO [63]	$9.2 \pm 0.4^{+0.7}_{-0.5}$ [4] $9.60 \pm 0.92^{+1.05}_{-0.85}$ [4] $6.7 \pm 1.1 \pm 0.5$ $7.6 \pm 1.3 \pm 0.6$ $5.5^{+2.1}_{-1.8} \pm 0.6$	8.53 ± 0.47 $8.83^{+0.67}_{-0.57}$
$\mathcal{B}(B^+ \to f_0(980)K^+) \times \mathcal{B}(f_0(980) \to K^+K^-)$	BaBar [22]	$9.4 \pm 1.6 \pm 2.8$ [4]	9.4 ± 3.2
$\mathcal{B}(B^+ \to a_2(1320)^0K^+) \times \mathcal{B}(a_2(1320)^0 \to K^+K^-)$	Belle [34]	< 1.1 [4]	< 1.1
$\mathcal{B}(B^+ \to \phi(1680)K^+) \times \mathcal{B}(\phi(1680) \to K^+K^-)$	Belle [34]	< 0.8 [4]	< 0.8
$\mathcal{B}(B^+ \to f_0(1710)K^+) \times \mathcal{B}(f_0(1710) \to K^+K^-)$	BaBar [22]	$1.12 \pm 0.25 \pm 0.50$ [4]	1.12 ± 0.56
$\mathcal{B}(B^+ \to K^+K^+K^-(\mathrm{NR}))$	Belle [34] BaBar [22]	$24.0 \pm 1.5^{+2.6}_{-6.0}$ [4] $22.8 \pm 2.7 \pm 7.6$ [11]	$23.7^{+3.0}_{-4.9}$ $23.8^{+2.8}_{-4.9}$

[1] 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. [55] for details.
[2] Using $\mathcal{B}(B^+ \to K^+K^-\pi^+)$.
[3] The PDG uncertainty includes a scale factor.
[4] Result extracted from Dalitz-plot analysis of $B^+ \to K^+K^+K^-$ decays.
[5] Result extracted from Dalitz-plot analysis of $B^+ \to K^0_S K^0_S K^+$ decays.
[6] Treatment of charmonium intermediate components differs between the results.
[7] 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}.
[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 7: Branching fractions of charmless mesonic B^+ decays with strange mesons (part 7).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^+ \to K^*(892)^+ K^+ K^-)$	BaBar [41]	$36.2 \pm 3.3 \pm 3.6$	36.2 ± 4.9
$\mathcal{B}(B^+ \to \phi(1020) K^*(892)^+)$[1]	BaBar [64]	$11.2 \pm 1.0 \pm 0.9$ [2]	
	Belle [65]	$6.7\,^{+2.1}_{-1.9}\,^{+0.7}_{-1.0}$	10.6 ± 1.1
	Belle II [61]	$21.7 \pm 4.6 \pm 1.9$	10.0 ± 2.0
	CLEO [63]	$10.6\,^{+6.4}_{-4.9}\,^{+1.8}_{-1.6}$	
$\mathcal{B}(B^+ \to \phi(1020)(K\pi)_0^{*+})$	BaBar [66]	$8.3 \pm 1.4 \pm 0.8$	8.3 ± 1.6
$\mathcal{B}(B^+ \to K_1(1270)^+ \phi(1020))$	BaBar [66]	$6.1 \pm 1.6 \pm 1.1$	6.1 ± 1.9
$\mathcal{B}(B^+ \to K_1(1400)^+ \phi(1020))$	BaBar [66]	< 3.2	< 3.2
$\mathcal{B}(B^+ \to K^*(1410)^+ \phi(1020))$	BaBar [66]	< 4.3	< 4.3
$\mathcal{B}(B^+ \to K_0^*(1430)^+ \phi(1020))$	BaBar [66]	$7.0 \pm 1.3 \pm 0.9$	7.0 ± 1.6
$\mathcal{B}(B^+ \to K_2^*(1430)^+ \phi(1020))$	BaBar [66]	$8.4 \pm 1.8 \pm 1.0$	8.4 ± 2.1
$\mathcal{B}(B^+ \to K_2(1770)^+ \phi(1020))$	BaBar [66]	< 15.0	< 15
$\mathcal{B}(B^+ \to \phi(1020) K_2(1820)^+)$	BaBar [66]	< 16.3	< 16
$\mathcal{B}(B^+ \to a_1(1260)^+ K^*(892)^0)$	BaBar [67]	< 3.6	< 3.6
$\mathcal{B}(B^+ \to \phi(1020)\phi(1020) K^+)$[1]	BaBar [68]	$5.6 \pm 0.5 \pm 0.3$ [3]	4.98 ± 0.52
	Belle [69]	$2.6\,^{+1.1}_{-0.9} \pm 0.3$ [3]	$4.98\,^{+1.22}_{-1.16}$
$\mathcal{B}(B^+ \to \eta' \eta' K^+)$	BaBar [70]	< 25.0	< 25
$\mathcal{B}(B^+ \to \phi(1020)\omega(782) K^+)$	Belle [71]	< 1.9	< 1.9
$\mathcal{B}(B^+ \to X(1812) K^+) \times \mathcal{B}(X(1812) \to \phi(1020)\omega(782))$			
	Belle [71]	< 0.32	< 0.32
$\mathcal{B}(B^+ \to h^+ X^0(\text{Familon}))$[4]	CLEO [72]	< 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 8: 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]	$5.86 \pm 0.26 \pm 0.38$	
	BaBar [8]	$5.02 \pm 0.46 \pm 0.29$	5.48 ± 0.33
	Belle II [9]	$5.5\,^{+1.0}_{-0.9} \pm 0.7$	5.48 ± 0.41
	CLEO [6]	$4.6\,^{+1.8}_{-1.6}\,^{+0.6}_{-0.7}$	
$\mathcal{B}(B^+ \to \pi^+\pi^+\pi^-)$	LHCb [32]	$16.06 \pm 0.16 \pm 0.48$ [2]	16.01 ± 0.49
	BaBar [73]	$15.2 \pm 0.6\,^{+1.3}_{-1.2}$ [3,4,5]	$15.20\,^{+1.43}_{-1.34}$
$\mathcal{B}(B^+ \to \rho^0(770)\pi^+)$	LHCb [74]	$8.82 \pm 0.10 \pm 0.50$ [3,6,5,7]	
	BaBar [73]	$8.1 \pm 0.7\,^{+1.3}_{-1.6}$ [3,5]	8.76 ± 0.47
	Belle [75]	$8.0\,^{+2.3}_{-2.0} \pm 0.7$	$8.29\,^{+1.20}_{-1.28}$
	CLEO [25]	$10.4\,^{+3.3}_{-3.4} \pm 2.1$	
$\mathcal{B}(B^+ \to f_0(980)\pi^+) \times \mathcal{B}(f_0(980) \to \pi^+\pi^-)$	BaBar [73]	< 1.5 [3]	< 1.5
$\mathcal{B}(B^+ \to f_2(1270)\pi^+) \times \mathcal{B}(f_2(1270) \to \pi^+\pi^-)$			
	LHCb [74]	$1.43 \pm 0.05 \pm 0.27$ [3,6,5,7]	$1.27\,^{+0.20}_{-0.23}$
	BaBar [73]	$0.9 \pm 0.2\,^{+0.3}_{-0.1}$ [3,5]	none
$\mathcal{B}(B^+ \to f_2(1270)\pi^+) \times \mathcal{B}(f_2(1270) \to K^+K^-)$			
	LHCb [55]	$0.377 \pm 0.040 \pm 0.040$ [8,9]	$0.377\,^{+0.058}_{-0.056}$
			none
$\mathcal{B}(B^+ \to \rho(1450)^0\pi^+) \times \mathcal{B}(\rho(1450)^0 \to \pi^+\pi^-)$			
	LHCb [74]	$0.83 \pm 0.05 \pm 0.89$ [3,6,5,7]	$1.14\,^{+0.59}_{-0.67}$
	BaBar [73]	$1.4 \pm 0.4\,^{+0.5}_{-0.8}$ [3,5]	$1.40\,^{+0.64}_{-0.89}$
$\mathcal{B}(B^+ \to \rho(1450)^0\pi^+) \times \mathcal{B}(\rho(1450)^0 \to K^+K^-)$			
	LHCb [55]	$1.544 \pm 0.060 \pm 0.089$ [8,9]	1.54 ± 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 [74]	$0.08 \pm 0.02 \pm 0.16$ [3,6,5,7]	0.08 ± 0.16
			none
$\mathcal{B}(B^+ \to \pi^+\pi^+\pi^-)$ $S-$wave	LHCb [74]	$4.04 \pm 0.08 \pm 0.64$ [10,5,7]	4.04 ± 0.64
			none
$\mathcal{B}(B^+ \to f_0(1370)\pi^+) \times \mathcal{B}(f_0(1370) \to \pi^+\pi^-)$	BaBar [73]	< 4.0 [3]	< 4.0
$\mathcal{B}(B^+ \to \pi^+\pi^-\pi^+(\mathrm{NR}))$	BaBar [73]	$5.3 \pm 0.7\,^{+1.3}_{-0.8}$ [11,5]	$5.3\,^{+1.4}_{-1.0}$
			$5.3\,^{+1.5}_{-1.1}$

[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. [76].
[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 $\mathcal{B}(B^+ \to K^+K^-\pi^+)$.
[10] LHCb accounts the S-wave component using a model that comprises the coherent sum of a σ pole. See Ref. [74] for details.
[11] The nonresonant amplitude is modelled using a sum of exponential functions.

Table 9: Branching fractions of charmless mesonic B^+ decays without strange mesons (part 2).

Parameter $[10^{-6}]$	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^+ \to \pi^+\pi^0\pi^0)$	ARGUS [77]	< 890	< 890
$\mathcal{B}(B^+ \to \rho^+(770)\pi^0)$	BaBar [78]	$10.2 \pm 1.4 \pm 0.9$	10.9 ± 1.5
	Belle [79]	$13.2 \pm 2.3\,^{+1.4}_{-1.9}$	$10.9\,^{+1.4}_{-1.5}$
$\mathcal{B}(B^+ \to \pi^+\pi^+\pi^-\pi^0)$	ARGUS [77]	< 4000	< 4000
$\mathcal{B}(B^+ \to \rho^+(770)\rho^0(770))$	BaBar [80]	$23.7 \pm 1.4 \pm 1.4$	24.0 ± 1.9
	Belle [81]	$31.7 \pm 7.1\,^{+3.8}_{-6.7}$	
$\mathcal{B}(B^+ \to f_0(980)\rho^+(770)) \times \mathcal{B}(f_0(980) \to \pi^+\pi^-)$	BaBar [80]	< 2.0	< 2.0
$\mathcal{B}(B^+ \to a_1(1260)^+\pi^0)$	BaBar [82]	$26.4 \pm 5.4 \pm 4.1$	26.4 ± 6.8
$\mathcal{B}(B^+ \to a_1(1260)^0\pi^+)$	BaBar [82]	$20.4 \pm 4.7 \pm 3.4$	20.4 ± 5.8
$\mathcal{B}(B^+ \to \omega(782)\pi^+)$	BaBar [24]	$6.7 \pm 0.5 \pm 0.4$	$6.60\,^{+0.46}_{-0.45}$
	Belle [83]	$6.9 \pm 0.6 \pm 0.5$	6.88 ± 0.49
	CLEO [25]	$11.3\,^{+3.3}_{-2.9} \pm 1.4$	
	LHCb [74][1,2,3,4]		
$\mathcal{B}(B^+ \to \omega(782)\rho^+(770))$	BaBar [26]	$15.9 \pm 1.6 \pm 1.4$	15.9 ± 2.1
$\mathcal{B}(B^+ \to \eta\pi^+)$	Belle [18]	$4.07 \pm 0.26 \pm 0.21$	4.02 ± 0.27
	BaBar [10]	$4.00 \pm 0.40 \pm 0.24$	$4.02\,^{+0.27}_{-0.26}$
	CLEO [14]	$1.2\,^{+2.8}_{-1.2}$	
$\mathcal{B}(B^+ \to \eta\rho^+(770))$[5]	BaBar [84]	$9.9 \pm 1.2 \pm 0.8$	6.9 ± 1.0
	Belle [20]	$4.1\,^{+1.4}_{-1.3} \pm 0.4$	$7.0\,^{+2.9}_{-2.8}$
	CLEO [14]	$4.8\,^{+5.2}_{-3.8}$	
$\mathcal{B}(B^+ \to \eta'\pi^+)$[5]	BaBar [10]	$3.5 \pm 0.6 \pm 0.2$	2.68 ± 0.46
	Belle [11]	$1.76\,^{+0.67}_{-0.62}\,^{+0.15}_{-0.14}$	$2.70\,^{+0.87}_{-0.84}$
	CLEO [14]	$1.0\,^{+5.8}_{-1.0}$	
$\mathcal{B}(B^+ \to \eta'\rho^+(770))$	BaBar [16]	$9.7\,^{+1.9}_{-1.8} \pm 1.1$	9.8 ± 2.1
	CLEO [14]	$11.2\,^{+11.9}_{-7.0}$	$9.7\,^{+2.2}_{-2.1}$
	Belle [17]	< 5.8	

[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 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. [76].
[3] Multiple systematic uncertainties are added in quadrature.
[4] 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.
[5] The PDG uncertainty includes a scale factor.

Table 10: Branching fractions of charmless mesonic B^+ decays without strange mesons (part 3).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^+ \to \phi(1020)\pi^+)$	BaBar [85]	< 0.24	$0.031\,^{+0.015}_{-0.014}$
	Belle [86]	< 0.33	0.032 ± 0.015
	LHCb [55][1,2]		
$\mathcal{B}(B^+ \to \phi(1020)\rho^+(770))$	BaBar [87]	< 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 [27]	< 5.8	< 5.8
$\mathcal{B}(B^+ \to \pi^+\pi^+\pi^+\pi^-\pi^-)$	ARGUS [77]	< 860	< 860
$\mathcal{B}(B^+ \to a_1(1260)^+\rho^0(770))$	CLEO [88]	< 620.0 [3]	< 620
$\mathcal{B}(B^+ \to a_2(1320)^+\rho^0(770))$	CLEO [88]	< 720.0 [3]	< 720
$\mathcal{B}(B^+ \to b_1(1235)^0\pi^+) \times \mathcal{B}(b_1(1235)^0 \to \omega(782)\pi^0)$	BaBar [48]	$6.7 \pm 1.7 \pm 1.0$	6.7 ± 2.0
$\mathcal{B}(B^+ \to b_1^+\pi^0)$	BaBar [47]	< 3.3	< 3.3
$\mathcal{B}(B^+ \to \pi^+\pi^+\pi^+\pi^-\pi^-\pi^0)$	ARGUS [77]	< 6300	< 6300
$\mathcal{B}(B^+ \to b_1(1235)^+\rho^0(770)) \times \mathcal{B}(b_1(1235)^0 \to \omega(782)\pi^+)$			
	BaBar [49]	< 5.2	< 5.2
$\mathcal{B}(B^+ \to a_1(1260)^+a_1(1260)^0)$	ARGUS [77]	< 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 [49]	< 3.3	< 3.3

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

[2] 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.

[3] 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 11: 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]	$20.00 \pm 0.34 \pm 0.60$	
	BaBar [89]	$19.1 \pm 0.6 \pm 0.6$	
	Belle II [5]	$18.0 \pm 0.9 \pm 0.9$	19.5 ± 0.5
	CLEO [6]	$18.0\,^{+2.3}_{-2.1}\,^{+1.2}_{-0.9}$	19.6 ± 0.5
	CDF [90][1,2], [91][3,4], [92][5,6]		
	LHCb [93][5,6,1], [94][3,4]		
$\mathcal{B}(B^0 \to K^0\pi^0)$	Belle [3]	$9.68 \pm 0.46 \pm 0.50$	
	BaBar [95]	$10.1 \pm 0.6 \pm 0.4$	9.96 ± 0.48
	Belle II [60]	$10.9\,^{+2.9}_{-2.6} \pm 1.6$	9.93 ± 0.49
	CLEO [6]	$12.8\,^{+4.0}_{-3.3}\,^{+1.7}_{-1.4}$	
$\mathcal{B}(B^0 \to \eta' K^0)$[7]	BaBar [10]	$68.5 \pm 2.2 \pm 3.1$	
	Belle [11]	$58.9\,^{+3.6}_{-3.5} \pm 4.3$	65.0 ± 2.8
	Belle II [12]	$59.9\,^{+5.8}_{-5.5} \pm 2.7$	$66.1\,^{+4.5}_{-4.4}$
	CLEO [14]	$89.0\,^{+18.0}_{-16.0} \pm 9.0$	
	LHCb [96][8,9]		
$\mathcal{B}(B^0 \to \eta' K^*(892)^0)$	Belle [97]	$2.6 \pm 0.7 \pm 0.2$	2.8 ± 0.6
	BaBar [16]	$3.1\,^{+0.9}_{-0.8} \pm 0.3$	
$\mathcal{B}(B^0 \to \eta' K_0^*(1430)^0)$	BaBar [16]	$6.3 \pm 1.3 \pm 0.9$ [10]	6.3 ± 1.6
$\mathcal{B}(B^0 \to \eta'(K\pi)_0^{*0})$	BaBar [16]	$7.4\,^{+1.5}_{-1.4} \pm 0.6$	7.4 ± 1.6
			none
$\mathcal{B}(B^0 \to \eta' K_2^*(1430)^0)$	BaBar [16]	$13.7\,^{+3.0}_{-2.9} \pm 1.2$	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 $\mathcal{B}(B^0 \to K^+K^-)/\mathcal{B}(B^0 \to K^+\pi^-)$ used in our fit.
[4] 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.
[5] Measurement of $\mathcal{B}(B^0 \to \pi^+\pi^-)/\mathcal{B}(B^0 \to K^+\pi^-)$ used in our fit.
[6] 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.
[7] The PDG uncertainty includes a scale factor.
[8] Measurement of $\mathcal{B}(\Lambda_b^0 \to \Lambda^0\eta)/\mathcal{B}(B^0 \to \eta' K^0)$ used in our fit.
[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] Multiple systematic uncertainties are added in quadrature.

Table 12: 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 [18]	$1.27^{+0.33}_{-0.29} \pm 0.08$	1.23 ± 0.25
	BaBar [10]	$1.15^{+0.43}_{-0.38} \pm 0.09$	$1.23^{+0.27}_{-0.24}$
$\mathcal{B}(B^0 \to \eta K^*(892)^0)$	BaBar [19]	$16.5 \pm 1.1 \pm 0.8$	
	Belle [20]	$15.2 \pm 1.2 \pm 1.0$	15.9 ± 1.0
	CLEO [14]	$13.8^{+5.5}_{-4.6} \pm 1.6$	
$\mathcal{B}(B^0 \to \eta (K\pi)^{*0}_0)$	BaBar [19]	$11.0 \pm 1.6 \pm 1.5$	11.0 ± 2.2
			none
$\mathcal{B}(B^0 \to \eta K^*_0(1430)^0)$	BaBar [19]	$7.8 \pm 1.1 \pm 1.1$ [1]	7.8 ± 1.5
			11.0 ± 2.2
$\mathcal{B}(B^0 \to \eta K^*_2(1430)^0)$	BaBar [19]	$9.6 \pm 1.8 \pm 1.1$	9.6 ± 2.1
$\mathcal{B}(B^0 \to \omega(782) K^0)$	Belle [23]	$4.5 \pm 0.4 \pm 0.3$	
	BaBar [24]	$5.4 \pm 0.8 \pm 0.3$	4.78 ± 0.43
	CLEO [25]	$10.0^{+5.4}_{-4.2} \pm 1.4$	
$\mathcal{B}(B^0 \to a_0(980)^0 K^0) \times \mathcal{B}(a_0(980)^0 \to \eta\pi^0)$			
	BaBar [27]	< 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 [47]	< 7.8	< 7.8
$\mathcal{B}(B^0 \to a_0(980)^- K^+) \times \mathcal{B}(a_0(980)^- \to \eta\pi^-)$			
	BaBar [99]	< 1.9	< 1.9
$\mathcal{B}(B^0 \to b_1(1235)^- K^+) \times \mathcal{B}(b_1(1235)^- \to \omega(782)\pi^-)$			
	BaBar [48]	$7.4 \pm 1.0 \pm 1.0$	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 [49]	< 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 [49]	< 5.0	< 5.0
$\mathcal{B}(B^0 \to a_0(1450)^- K^+) \times \mathcal{B}(a_0(1450)^- \to \eta\pi^-)$			
	BaBar [99]	< 3.1	< 3.1
$\mathcal{B}(B^0 \to K^0_S X^0(\text{Familon}))$	CLEO [72]	< 53	< 53
$\mathcal{B}(B^0 \to \omega(782) K^*(892)^0)$	BaBar [26]	$2.2 \pm 0.6 \pm 0.2$	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 [26]	$18.4 \pm 1.8 \pm 1.7$	18.4 ± 2.5
$\mathcal{B}(B^0 \to \omega(782) K^*_0(1430)^0)$	BaBar [26]	$16.0 \pm 1.6 \pm 3.0$	16.0 ± 3.4
$\mathcal{B}(B^0 \to \omega(782) K^*_2(1430)^0)$	BaBar [26]	$10.1 \pm 2.0 \pm 1.1$	10.1 ± 2.3
$\mathcal{B}(B^0 \to \omega(782) K^+\pi^-(\text{NR}))$	Belle [98]	$5.1 \pm 0.7 \pm 0.7$ [2]	5.1 ± 1.0

[1] Multiple systematic uncertainties are added in quadrature.
[2] $0.755 < M_{K\pi} < 1.250$ GeV/c^2.

Table 13: Branching fractions of charmless mesonic B^0 decays with strange mesons (part 3).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^0 \to K^+\pi^-\pi^0)$	BaBar [100]	$38.5 \pm 1.0 \pm 3.9$ [1]	37.8 ± 3.2
	Belle [101]	$36.6\,^{+4.2}_{-4.1} \pm 3.0$	
$\mathcal{B}(B^0 \to \rho^-(770)K^+)$	BaBar [100]	$6.6 \pm 0.5 \pm 0.8$ [1]	7.01 ± 0.92
	Belle [101]	$15.1\,^{+3.4}_{-3.3}\,^{+2.4}_{-2.6}$ [2]	
$\mathcal{B}(B^0 \to \rho(1450)^-K^+)$	BaBar [100]	$2.4 \pm 1.0 \pm 0.6$ [1]	2.4 ± 1.2
$\mathcal{B}(B^0 \to \rho(1700)^-K^+)$	BaBar [100]	$0.6 \pm 0.6 \pm 0.4$ [1]	0.6 ± 0.7
$\mathcal{B}(B^0 \to K^+\pi^-\pi^0(\mathrm{NR}))$	BaBar [100]	$2.8 \pm 0.5 \pm 0.4$ [3]	2.8 ± 0.6
	Belle [101]	< 9.4	
$\mathcal{B}(B^0 \to (K\pi)_0^{*+}\pi^-) \times \mathcal{B}((K\pi)_0^{*+} \to K^+\pi^0)$			
	BaBar [100]	$34.2 \pm 2.4 \pm 4.1$ [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 [100]	$8.6 \pm 1.1 \pm 1.3$ [1]	8.6 ± 1.7
$\mathcal{B}(B^0 \to K_2^*(1430)^0\pi^0)$	BaBar [102]	< 4.0 [1]	< 4.0
$\mathcal{B}(B^0 \to K^*(1680)^0\pi^0)$	BaBar [102]	< 7.5 [1]	< 7.5
$\mathcal{B}(B^0 \to K_x^{*0}\pi^0)$	Belle [101]	$6.1\,^{+1.6}_{-1.5}\,^{+0.5}_{-0.6}$ [4]	6.1 ± 1.6
			$6.1\,^{+1.7}_{-1.6}$

[1] Result extracted from Dalitz-plot analysis of $B^0 \to K^+\pi^-\pi^0$ decays.
[2] Multiple systematic uncertainties are added in quadrature.
[3] The nonresonant amplitude is taken to be constant across the Dalitz plane.
[4] $1.1 < m_{K\pi} < 1.6$ GeV/c^2.

Table 14: 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 [103]	$50.15 \pm 1.47 \pm 1.76$ [3,4]	49.7 ± 1.8
	Belle [104]	$47.5 \pm 2.4 \pm 3.7$ [3]	
	CLEO [40]	$50.0\,^{+10.0}_{-9.0} \pm 7.0$	
	LHCb [105][4,5,6,7,8], [106][9], [107][10,11], [107][10,12], [107][10,13], [107][10,14], [107][10,15]		
$\mathcal{B}(B^0 \to K^0\pi^+\pi^-(\mathrm{NR}))$[16]	LHCb [108]	$12.60 \pm 0.67 \pm 3.05$ [3,17,4,18]	14.0 ± 1.7 p=1.6‰
	BaBar [103]	$11.07\,^{+2.51}_{-0.99} \pm 0.90$ [3,19,4]	$13.9\,^{+2.6}_{-1.8}$
	Belle [104]	$19.9 \pm 2.5\,^{+1.7}_{-2.0}$ [3,20]	
$\mathcal{B}(B^0 \to \rho^0(770)K^0)$[16]	BaBar [103]	$4.36\,^{+0.71}_{-0.62} \pm 0.31$ [3,4]	3.45 ± 0.48 p=1.6‰
	LHCb [108]	$1.97\,^{+0.57}_{-0.83} \pm 0.42$ [3,4,18]	$3.41\,^{+1.08}_{-1.14}$
	Belle [104]	$6.1 \pm 1.0\,^{+1.1}_{-1.2}$ [3]	

[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 $\mathcal{B}(\Lambda^0_b \to p\overline{K}^0\pi^-)/\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$ used in our fit.
[6] Measurement of $\mathcal{B}(\Lambda^0_b \to pK^0K^-)/\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$ used in our fit.
[7] Measurement of $\frac{f_{\Xi^0_b}}{f_d}\mathcal{B}(\Xi^0_b \to p\overline{K}^0\pi^-)/\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$ used in our fit.
[8] Measurement of $\frac{f_{\Xi^0_b}}{f_d}\mathcal{B}(\Xi^0_b \to p\overline{K}^0K^-)/\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$ used in our fit.
[9] 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.
[10] Regions corresponding to D, Λ^+_c and charmonium resonances are vetoed in this analysis.
[11] 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.
[12] Measurement of $\mathcal{B}(B^0 \to K^0K^+K^-)/\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$ used in our fit.
[13] Measurement of $\mathcal{B}(B^0_s \to K^0\pi^+\pi^-)/\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$ used in our fit.
[14] Measurement of $\mathcal{B}(B^0_s \to K^0K^+\pi^-\text{+c.c.})/\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$ used in our fit.
[15] Measurement of $\mathcal{B}(B^0_s \to K^0K^+K^-)/\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$ used in our fit.
[16] The PDG uncertainty includes a scale factor.
[17] The nonresonant component is modelled as a flat contribution over the Dalitz plane.
[18] Using $\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$.
[19] This value incldues 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.
[20] The nonresonant component is modelled using a sum of two exponential functions.

Table 15: Branching fractions of charmless mesonic B^0 decays with strange mesons (part 5).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^0 \to K^*(892)^+\pi^-)$	BaBar [103]	$8.29\,^{+0.92}_{-0.81} \pm 0.82$ [1,2]	
	BaBar [100]	$8.0 \pm 1.1 \pm 0.8$ [3]	7.64 ± 0.44
	Belle [104]	$8.4 \pm 1.1\,^{+1.0}_{-0.9}$ [1]	p=1.6‰
	CLEO [40]	$16.0\,^{+6.0}_{-5.0} \pm 2.0$	7.50 ± 0.44
	LHCb [109][4,5], [108][1,2,6]		
$\mathcal{B}(B^0 \to K_0^*(1430)^+\pi^-)$[7]	BaBar [103]	$29.9\,^{+2.3}_{-1.7} \pm 3.6$ [1,2]	$33.6\,^{+3.8}_{-4.0}$
	Belle [104]	$49.7 \pm 3.8\,^{+6.8}_{-8.2}$ [1]	$33.5\,^{+7.4}_{-7.2}$
$\mathcal{B}(B^0 \to K_x^{*+}\pi^-)$	Belle [101]	$5.1 \pm 1.5\,^{+0.6}_{-0.7}$ [8]	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 [104]	< 3.8 [1]	< 3.8
$\mathcal{B}(B^0 \to (K\pi)_0^{*+}\pi^-) \times \mathcal{B}((K\pi)_0^{*+} \to K^0\pi^+)$			
	LHCb [108]	$16.95 \pm 0.73 \pm 1.12$ [1,2,9]	18.6 ± 1.1
	BaBar [103]	$22.7\,^{+1.7}_{-1.3} \pm 1.3$ [1,2]	p=1.6‰
			16.2 ± 1.3
$\mathcal{B}(B^0 \to f_0(980)K^0) \times \mathcal{B}(f_0(980) \to \pi^+\pi^-)$[7]			
	LHCb [108]	$9.64 \pm 0.41 \pm 0.79$ [1,2,9]	8.38 ± 0.61
	BaBar [103]	$6.92 \pm 0.77 \pm 0.56$ [1,2]	p=1.6‰
	Belle [104]	$7.6 \pm 1.7\,^{+0.9}_{-1.3}$ [1]	$8.15\,^{+0.78}_{-0.79}$
$\mathcal{B}(B^0 \to f_0(500)K^0)$	LHCb [108]	$0.166\,^{+0.207}_{-0.041} \pm 0.155$ [1,2,9]	$0.17\,^{+0.26}_{-0.16}$
			p=1.6‰
			$0.16\,^{+0.25}_{-0.16}$
$\mathcal{B}(B^0 \to f_0(1500)K^0) \times \mathcal{B}(f_0(1500) \to \pi^+\pi^-)$			
			1.35 ± 0.79
	LHCb [108]	$1.348 \pm 0.280 \pm 0.734$ [1,2,9]	p=1.6‰
			1.29 ± 0.75
$\mathcal{B}(B^0 \to f_2(1270)K^0)$	BaBar [103]	$2.71\,^{+0.99}_{-0.83} \pm 0.87$ [1,2]	2.7 ± 1.3
	Belle [104]	< 2.5 [1,10]	$2.7\,^{+1.3}_{-1.2}$
$\mathcal{B}(B^0 \to f_x(1300)^0K^0) \times \mathcal{B}(f_x(1300)^0 \to \pi^+\pi^-)$			
	BaBar [103]	$1.81\,^{+0.55}_{-0.45} \pm 0.48$ [1,2]	$1.81\,^{+0.73}_{-0.66}$

[1] Result extracted from Dalitz-plot analysis of $B^0 \to K_S^0\pi^+\pi^-$ decays.
[2] Multiple systematic uncertainties are added in quadrature.
[3] Result extracted from Dalitz-plot analysis of $B^0 \to K^+\pi^-\pi^0$ decays.
[4] Measurement of $\mathcal{B}(B_s^0 \to K^*(892)^-\pi^+)/\mathcal{B}(B^0 \to K^*(892)^+\pi^-)$ used in our fit.
[5] 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.
[6] 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.
[7] The PDG uncertainty includes a scale factor.
[8] $1.1 < m_{K\pi} < 1.6$ GeV/c^2.
[9] Using $\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$.
[10] Using $\mathcal{B}(f_2(1270) \to \pi^+\pi^-)$.

Table 16: 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 [100]	$3.3 \pm 0.5 \pm 0.4$ [1]	3.3 ± 0.6
	Belle [101]	< 3.5	
$\mathcal{B}(B^0 \to K_2^*(1430)^+\pi^-)$	Belle [104]	< 6.3 [2]	3.82 ± 0.36
	BaBar [102]	< 16.2 [1]	p=1.6‰
	LHCb [108][2,3,4]		$3.65\,^{+0.34}_{-0.33}$
$\mathcal{B}(B^0 \to K^*(1680)^+\pi^-)$	Belle [104]	< 10.1 [2]	$14.7\,^{+1.5}_{-1.3}$
	BaBar [102]	< 25.0 [1]	p=1.6‰
	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]	$2.8 \pm 0.5 \pm 0.5$ [6]	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]	$1.4 \pm 0.4\,^{+0.3}_{-0.4}$ [6]	$1.4\,^{+0.5}_{-0.6}$
$\mathcal{B}(B^0 \to K^+\pi^-\pi^+\pi^-(\mathrm{NR}))$	Belle [111]	< 2.1 [6,7]	< 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]	$2.1\,^{+0.8}_{-0.7}\,^{+0.9}_{-0.5}$	$3.88\,^{+1.33}_{-1.25}$
$\mathcal{B}(B^0 \to f_0(980)K_0^*(892)^0) \times \mathcal{B}(f_0(980) \to \pi\pi)$[8]			
	Belle [111]	$1.4\,^{+0.6}_{-0.5}\,^{+0.6}_{-0.4}$	3.90 ± 0.55
	BaBar [113]	$5.7 \pm 0.6 \pm 0.4$	p=0.1‰
			$3.90\,^{+2.12}_{-1.85}$

[1] Result extracted from Dalitz-plot analysis of $B^0 \to K^+\pi^-\pi^0$ decays.
[2] Result extracted from Dalitz-plot analysis of $B^0 \to K_S^0\pi^+\pi^-$ 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 17: 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 [39]	< 30	< 30
$\mathcal{B}(B^0 \to K_1(1400)^+\pi^-)$	BaBar [39]	< 27	< 27
$\mathcal{B}(B^0 \to a_1(1260)^-K^+)$	BaBar [43]	$16.3 \pm 2.9 \pm 2.3$	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]	$28 \pm 10 \pm 6$ [1]	28 ± 12
$\mathcal{B}(B^0 \to K_1(1400)^0\rho^0(770))$	ARGUS [46]	< 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]	$27 \pm 4 \pm 4$ [1]	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
$\mathcal{B}(B^0 \to K_0^*(1430)^0f_0(980)) \times \mathcal{B}(f_0(980) \to \pi\pi)$	BaBar [113]	$2.7 \pm 0.7 \pm 0.6$ [1]	2.7 ± 0.9
$\mathcal{B}(B^0 \to K_2^*(1430)^0f_0(980)) \times \mathcal{B}(f_0(980) \to \pi\pi)$	BaBar [113]	$8.6 \pm 1.7 \pm 1.0$	8.6 ± 2.0
$\mathcal{B}(B^0 \to K^+K^-)$	LHCb [94] Belle [3] CDF [91] BaBar [89]	$0.0774 \pm 0.0126 \pm 0.0084$ [2] $0.10 \pm 0.08 \pm 0.04$ $0.23 \pm 0.10 \pm 0.10$ [2] < 0.5	0.080 ± 0.015 0.078 ± 0.015
$\mathcal{B}(B^0 \to K^0\overline{K}^0)$	Belle [3] BaBar [4]	$1.26 \pm 0.19 \pm 0.05$ $1.08 \pm 0.28 \pm 0.11$	1.21 ± 0.16
$\mathcal{B}(B^0 \to K^0K^+\pi^-$+c.c.)	LHCb [107] Belle [114] BaBar [115]	$6.11 \pm 0.45 \pm 0.78$ [3,4] $7.20 \pm 0.66 \pm 0.30$ $6.4 \pm 1.0 \pm 0.6$	6.7 ± 0.5
$\mathcal{B}(B^0 \to K^*(892)^-K^+$+c.c.)	LHCb [109]	< 0.38 [5]	< 0.4
$\mathcal{B}(B^0 \to K^*(892)^0\overline{K}^0$+c.c.)[6]	LHCb [106] BaBar [116]	< 1.0 [4] < 1.9	< 0.99 < 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 18: 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
$\mathcal{B}(B^0 \to K^0K^+K^-)$	LHCb [107]	$27.29 \pm 0.89 \pm 1.90$ [1,2]	26.8 ± 1.0
	BaBar [22]	$26.5 \pm 0.9 \pm 0.8$ [3,4]	26.8 ± 1.1
	Belle [37]	$28.3 \pm 3.3 \pm 4.0$	
$\mathcal{B}(B^0 \to \phi(1020)K^0)$	BaBar [22]	$7.1 \pm 0.6\,^{+0.4}_{-0.3}$ [3]	7.25 ± 0.60
	Belle II [61]	$5.9 \pm 1.8 \pm 0.7$	$7.32\,^{+0.69}_{-0.63}$
	Belle [65]	$9.0\,^{+2.2}_{-1.8} \pm 0.7$	
	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 [22]	$7.0\,^{+2.6}_{-1.8} \pm 2.4$ [3]	$7.0\,^{+3.5}_{-3.0}$
$\mathcal{B}(B^0 \to f_0(1500)K^0)$	BaBar [22]	$13.3\,^{+5.8}_{-4.4} \pm 3.2$ [3]	$13.3\,^{+6.6}_{-5.4}$
$\mathcal{B}(B^0 \to f'_2(1525)K^0)$	BaBar [22]	$0.29\,^{+0.27}_{-0.18} \pm 0.36$ [3]	$0.29\,^{+0.45}_{-0.40}$
$\mathcal{B}(B^0 \to f_0(1710)K^0) \times \mathcal{B}(f_0(1710) \to K^+K^-)$	BaBar [22]	$4.4 \pm 0.7 \pm 0.5$ [3]	4.4 ± 0.9
$\mathcal{B}(B^0 \to K^0K^+K^-(\mathrm{NR}))$	BaBar [22]	$33 \pm 5 \pm 9$ [8]	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 19: Branching fractions of charmless mesonic B^0 decays with strange mesons (part 9).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^0 \to K^0_S K^0_S K^0_S)$[1]	BaBar [121]	$6.19 \pm 0.48 \pm 0.19$ [2,3]	6.04 ± 0.50
	Belle [37]	$4.2\,^{+1.6}_{-1.3} \pm 0.8$	$6.04\,^{+0.53}_{-0.52}$
$\mathcal{B}(B^0 \to f_0(980)K^0_S) \times \mathcal{B}(f_0(980) \to K^0_S K^0_S)$			
	BaBar [121]	$2.7\,^{+1.3}_{-1.2} \pm 1.3$ [2,3]	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]	$0.50\,^{+0.46}_{-0.24} \pm 0.11$ [2,3]	$0.50\,^{+0.47}_{-0.26}$
$\mathcal{B}(B^0 \to f_2(2010)K^0_S) \times \mathcal{B}(f_2(2010) \to K^0_S K^0_S)$			
	BaBar [121]	$0.54\,^{+0.21}_{-0.20} \pm 0.52$ [2,3]	0.54 ± 0.56
$\mathcal{B}(B^0 \to K^0_S K^0_S K^0_S(\mathrm{NR}))$	BaBar [121]	$13.3\,^{+2.2}_{-2.3} \pm 0.6$ [4,3]	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]	< 16 [5]	< 16
$\mathcal{B}(B^0 \to K^*(892)^0 K^+ K^-)$	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]	$9.7 \pm 0.5 \pm 0.5$	
	Belle [124]	$10.4 \pm 0.5 \pm 0.6$	
	Belle II [61]	$11.0 \pm 2.1 \pm 1.1$	10.11 ± 0.48
	CLEO [63]	$11.5\,^{+4.5}_{-3.7}\,^{+1.8}_{-1.7}$	10.04 ± 0.52
	LHCb [125][3,6], [126][3,7], [127][3,8], [128][9]		
$\mathcal{B}(B^0 \to K^+\pi^-\pi^+K^-(\mathrm{NR}))$	Belle [129]	< 71.7 [10]	< 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]	$2.11\,^{+5.63}_{-5.26}\,^{+4.85}_{-4.75}$ [10]	
$\mathcal{B}(B^0 \to K^*(892)^0\overline{K}^*(892)^0)$[1]	LHCb [130]	$0.834 \pm 0.063 \pm 0.158$ [3,11]	0.83 ± 0.16
	Belle [129]	$0.26\,^{+0.33}_{-0.29}\,^{+0.10}_{-0.08}$	$0.83\,^{+0.25}_{-0.23}$
	BaBar [131]	$1.28\,^{+0.35}_{-0.30} \pm 0.11$	

[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.
[6] Measurement of $\mathcal{B}(B^0_s \to \phi(1020)\overline{K}^*(892)^0)/\mathcal{B}(B^0 \to \phi(1020)K^*(892)^0)$ used in our fit.
[7] Measurement of $\mathcal{B}(B^0_s \to \phi(1020)\phi(1020))/\mathcal{B}(B^0 \to \phi(1020)K^*(892)^0)$ used in our fit.
[8] Measurement of $\mathcal{B}(B^0_s \to K^*(892)^0\overline{K}^*(892)^0)/\mathcal{B}(B^0 \to \phi(1020)K^*(892)^0)$ used in our fit.
[9] 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.
[10] $0.70 < M(K\pi) < 1.70$ GeV/c^2.
[11] Using $\mathcal{B}(B^0_s \to K^*(892)^0\overline{K}^*(892)^0)$.

Table 20: Branching fractions of charmless mesonic B^0 decays with strange mesons (part 10).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^0 \to K^+\pi^-K^+\pi^-(\mathrm{NR}))$	Belle [129]	< 6.0 [1]	< 6.0
$\mathcal{B}(B^0 \to K^*(892)^0K^+\pi^-)$	BaBar [112]	< 2.2	< 2.2
	Belle [129]	< 7.6 [1]	
$\mathcal{B}(B^0 \to K^*(892)^0K^*(892)^0)$	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 [46]	< 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
$\mathcal{B}(B^0 \to K_0^*(1430)^0\pi^+K^-)$	Belle [129]	< 31.8 [1]	< 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 [46]	< 1100	< 1100
$\mathcal{B}(B^0 \to \phi(1020)K_2^*(1430)^0)$[2]	Belle [124]	$5.5\,^{+0.9}_{-0.7} \pm 1.0$	6.8 ± 0.8
	BaBar [123]	$7.5 \pm 0.9 \pm 0.5$	$6.8\,^{+1.0}_{-0.9}$
$\mathcal{B}(B^0 \to \phi(1020)\phi(1020)K^0)$	BaBar [68]	$4.5 \pm 0.8 \pm 0.3$ [3]	4.5 ± 0.9
$\mathcal{B}(B^0 \to \eta'\eta'K^0)$	BaBar [70]	< 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 21: 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 [93]	$5.10 \pm 0.18 \pm 0.35$ [1]	
	Belle [3]	$5.04 \pm 0.21 \pm 0.18$	
	CDF [92]	$5.04 \pm 0.33 \pm 0.33$ [1]	5.15 ± 0.19
	BaBar [89]	$5.5 \pm 0.4 \pm 0.3$	5.12 ± 0.19
	Belle II [5]	$5.8 \pm 0.7 \pm 0.3$	
	CLEO [6]	$4.5\,^{+1.4}_{-1.2}\,^{+0.5}_{-0.4}$	
$\mathcal{B}(B^0 \to \pi^0\pi^0)$[2]	Belle [134]	$1.31 \pm 0.19 \pm 0.19$	1.59 ± 0.18
	BaBar [95]	$1.83 \pm 0.21 \pm 0.13$	1.59 ± 0.26
$\mathcal{B}(B^0 \to \eta\pi^0)$	Belle [135]	$0.41\,^{+0.17}_{-0.15}\,^{+0.05}_{-0.07}$	0.41 ± 0.17
	BaBar [84]	< 1.5	$0.41\,^{+0.18}_{-0.17}$
	CLEO [14]	< 2.9	
$\mathcal{B}(B^0 \to \eta\eta)$	BaBar [10]	< 1.0	< 1.0
$\mathcal{B}(B^0 \to \eta'\pi^0)$[2]	BaBar [84]	$0.9 \pm 0.4 \pm 0.1$	1.2 ± 0.4
	Belle [11]	$2.79\,^{+1.02}_{-0.96}\,^{+0.25}_{-0.34}$	1.2 ± 0.6
$\mathcal{B}(B^0 \to \eta'\eta')$	BaBar [10]	< 1.7	< 1.7
	Belle [17]	< 6.5	
$\mathcal{B}(B^0 \to \eta'\eta)$	BaBar [84]	< 1.2	< 1.2
	Belle [17]	< 4.5	
$\mathcal{B}(B^0 \to \eta'\rho^0(770))$	Belle [17]	< 1.3	< 1.3
	BaBar [16]	< 2.8	
$\mathcal{B}(B^0 \to f_0(980)\eta') \times \mathcal{B}(f_0(980) \to \pi^+\pi^-)$			
	BaBar [16]	< 0.9	< 0.9
$\mathcal{B}(B^0 \to \eta\rho^0(770))$	BaBar [99]	< 1.5	< 1.5
	Belle [20]	< 1.9	
$\mathcal{B}(B^0 \to f_0(980)\eta) \times \mathcal{B}(f_0(980) \to \pi^+\pi^-)$			
	BaBar [99]	< 0.4	< 0.4
$\mathcal{B}(B^0 \to \omega(782)\eta)$	BaBar [10]	$0.94\,^{+0.35}_{-0.30} \pm 0.09$	$0.94\,^{+0.36}_{-0.31}$

[1] Using $\mathcal{B}(B^0 \to K^+\pi^-)$.
[2] The PDG uncertainty includes a scale factor.

Table 22: 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 [10]	$1.01\,^{+0.46}_{-0.38} \pm 0.09$	$1.01\,^{+0.47}_{-0.39}$
	Belle [17]	< 2.2	
$\mathcal{B}(B^0 \to \omega(782)\rho^0(770))$	BaBar [26]	< 1.6	< 1.6
$\mathcal{B}(B^0 \to f_0(980)\omega(782)) \times \mathcal{B}(f_0(980) \to \pi^+\pi^-)$			
	BaBar [26]	< 1.5	< 1.5
$\mathcal{B}(B^0 \to \omega(782)\omega(782))$	BaBar [136]	$1.2 \pm 0.3\,^{+0.3}_{-0.2}$	1.2 ± 0.4
$\mathcal{B}(B^0 \to \phi(1020)\pi^0)$	Belle [86]	< 0.15	< 0.15
	BaBar [85]	< 0.28	
$\mathcal{B}(B^0 \to \phi(1020)\eta)$	BaBar [10]	< 0.5	< 0.5
$\mathcal{B}(B^0 \to \phi(1020)\eta')$	Belle [17]	< 0.5	< 0.5
	BaBar [10]	< 1.1	
$\mathcal{B}(B^0 \to \phi(1020)\pi^+\pi^-)$	LHCb [137]	$0.182 \pm 0.025 \pm 0.043$ [1,2]	0.182 ± 0.050
$\mathcal{B}(B^0 \to \phi(1020)\rho^0(770))$	BaBar [87]	< 0.33	< 0.33
$\mathcal{B}(B^0 \to f_0(980)\phi(1020)) \times \mathcal{B}(f_0(980) \to \pi^+\pi^-)$			
	BaBar [87]	< 0.38	< 0.38
$\mathcal{B}(B^0 \to \omega(782)\phi(1020))$	BaBar [136]	< 0.7	< 0.7
$\mathcal{B}(B^0 \to \phi(1020)\phi(1020))$	LHCb [138]	< 0.027	< 0.027
	BaBar [87]	< 0.2	
$\mathcal{B}(B^0 \to a_0(980)^+\pi^-\text{+c.c.}) \times \mathcal{B}(a_0(980)^+ \to \eta\pi^+)$			
	BaBar [99]	< 3.1	< 3.1
$\mathcal{B}(B^0 \to a_0(1450)^+\pi^-\text{+c.c.}) \times \mathcal{B}(a_0(1450)^+ \to \eta\pi^+)$			
	BaBar [99]	< 2.3	< 2.3
$\mathcal{B}(B^0 \to \pi^+\pi^-\pi^0)$	ARGUS [77]	< 720	< 720
$\mathcal{B}(B^0 \to \rho^0(770)\pi^0)$	Belle [139]	$3.0 \pm 0.5 \pm 0.7$ [3]	2.0 ± 0.5
	BaBar [140]	$1.4 \pm 0.6 \pm 0.3$	
	CLEO [25]	$1.6\,^{+2.0}_{-1.4} \pm 0.8$	
$\mathcal{B}(B^0 \to \rho^+(770)\pi^-\text{+c.c.})$	Belle [139]	$22.6 \pm 1.1 \pm 4.4$ [3]	23.0 ± 2.3
	BaBar [141]	$22.6 \pm 1.8 \pm 2.2$	
	CLEO [25]	$27.6\,^{+8.4}_{-7.4} \pm 4.2$	
$\mathcal{B}(B^0 \to \pi^+\pi^-\pi^+\pi^-)$	Belle [142]	< 11.2 [4]	< 11
	BaBar [143]	< 23.1 [5]	

[1] $400 < M(\pi^+\pi^-) < 1600$ MeV/c^2.
[2] Multiple systematic uncertainties are added in quadrature.
[3] Result extracted from Dalitz-plot analysis of $B^0 \to \pi^+\pi^-\pi^0$ decays.
[4] $0.52 < m_{\pi^+\pi^-} < 1.15$ GeV/c^2.
[5] $0.55 < m_{\pi^+\pi^-} < 1.050$ GeV/c^2.

Table 23: Branching fractions of charmless mesonic B^0 decays without strange mesons (part 3).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^0 \to \rho^0(770)\pi^+\pi^-)$	BaBar [143]	< 8.8 [1]	< 8.8
	Belle [142]	< 12.0 [2]	
$\mathcal{B}(B^0 \to \rho^0(770)\rho^0(770))$	LHCb [128]	$0.95 \pm 0.17 \pm 0.10$ [3]	0.96 ± 0.15
	Belle [142]	$1.02 \pm 0.30 \pm 0.15$	
	BaBar [143]	$0.92 \pm 0.32 \pm 0.14$	
$\mathcal{B}(B^0 \to f_0(980)\pi^+\pi^-) \times \mathcal{B}(f_0(980) \to \pi^+\pi^-)$			
	Belle [142]	< 3.0 [2]	< 3.0
$\mathcal{B}(B^0 \to f_0(980)\rho^0(770)) \times \mathcal{B}(f_0(980) \to \pi^+\pi^-)$			
	Belle [142]	$0.78 \pm 0.22 \pm 0.11$	0.78 ± 0.25
	BaBar [143]	< 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 [143]	< 0.19	< 0.19
	Belle [142]	< 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 [87]	< 0.23	< 0.23
$\mathcal{B}(B^0 \to a_1(1260)^+\pi^- + \text{c.c.})$[4]	Belle [144]	$22.2 \pm 2.0 \pm 2.8$	25.9 ± 2.8
	BaBar [145]	$33.2 \pm 3.8 \pm 3.0$	25.9 ± 5.2
$\mathcal{B}(B^0 \to a_2(1320)^+\pi^- + \text{c.c.})$	Belle [144]	< 6.3	< 6.3
$\mathcal{B}(B^0 \to \pi^+\pi^-\pi^0\pi^0)$	ARGUS [77]	< 3100	< 3100
$\mathcal{B}(B^0 \to \rho^+(770)\rho^-(770))$	Belle [146]	$28.3 \pm 1.5 \pm 1.5$	27.7 ± 1.9
	BaBar [147]	$25.5 \pm 2.1\,^{+3.6}_{-3.9}$	
$\mathcal{B}(B^0 \to a_1(1260)^0\pi^0)$	ARGUS [77]	< 1100	< 1100
$\mathcal{B}(B^0 \to \omega(782)\pi^0)$	BaBar [84]	< 0.5	< 0.5
	Belle [83]	< 2.0	
$\mathcal{B}(B^0 \to \pi^+\pi^+\pi^-\pi^-\pi^0)$	ARGUS [77]	< 9000	< 9000
$\mathcal{B}(B^0 \to a_1(1260)^+\rho^-(770) + \text{c.c.})$	BaBar [148]	< 61.0	< 61
$\mathcal{B}(B^0 \to a_1(1260)^0\rho^0(770))$	ARGUS [77]	< 2400	< 2400

[1] $0.55 < m_{\pi^+\pi^-} < 1.050$ GeV/c^2.
[2] $0.52 < m_{\pi^+\pi^-} < 1.15$ GeV/c^2.
[3] Using $\mathcal{B}(B^0 \to \phi(1020)K^*(892)^0)$.
[4] The PDG uncertainty includes a scale factor.

Table 24: Branching fractions of charmless mesonic B^0 decays without strange mesons (part 4).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^0 \to b_1(1235)^+\pi^- + \text{c.c.}) \times \mathcal{B}(b_1(1235)^+ \to \omega(782)\pi^+)$			
	BaBar [48]	$10.9 \pm 1.2 \pm 0.9$	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 [47]	< 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 [49]	< 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 [49]	< 3.4	< 3.4
$\mathcal{B}(B^0 \to \pi^+\pi^+\pi^+\pi^-\pi^-\pi^-)$	ARGUS [77]	< 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 [149]	$11.8 \pm 2.6 \pm 1.6$	11.8 ± 3.1
$\mathcal{B}(B^0 \to \pi^+\pi^+\pi^+\pi^-\pi^-\pi^-\pi^0)$	ARGUS [77]	< 11000	< 11000

Table 25: Relative branching fractions of charmless mesonic B^+ decays.

Parameter	**Measurements**		**Average**
$\dfrac{\mathcal{B}(B^+ \to K^+K^-\pi^+)}{\mathcal{B}(B^+ \to K^+K^+K^-)}$	LHCb [32]	$0.151 \pm 0.004 \pm 0.008$	0.151 ± 0.009
$\dfrac{\mathcal{B}(B^+ \to K^+\pi^+\pi^-)}{\mathcal{B}(B^+ \to K^+K^+K^-)}$	LHCb [32]	$1.703 \pm 0.011 \pm 0.022$	1.703 ± 0.025
$\dfrac{\mathcal{B}(B^+ \to \pi^+\pi^+\pi^-)}{\mathcal{B}(B^+ \to K^+K^+K^-)}$	LHCb [32]	$0.488 \pm 0.005 \pm 0.009$	0.488 ± 0.010

Table 26: Relative branching fractions of charmless 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 [94] CDF [91]	$3.98 \pm 0.65 \pm 0.42$ $12 \pm 5 \pm 5$	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 [106]	< 2	< 2.0
$\frac{\mathcal{B}(B^0 \to \pi^+\pi^-)}{\mathcal{B}(B^0 \to K^+\pi^-)}$	LHCb [93] CDF [92]	$0.262 \pm 0.009 \pm 0.017$ $0.259 \pm 0.017 \pm 0.016$	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 [107]	$0.123 \pm 0.009 \pm 0.015$ [1]	0.123 ± 0.017
$\frac{\mathcal{B}(B^0 \to K^0K^+K^-)}{\mathcal{B}(B^0 \to K^0\pi^+\pi^-)}$	LHCb [107]	$0.549 \pm 0.018 \pm 0.033$ [1]	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]	$7.58 \pm 0.57 \pm 0.30$ [2]	7.58 ± 0.64
$\frac{f_s}{f_d}\frac{\mathcal{B}(B^0 \to K^+K^-)}{\mathcal{B}(B^0_s \to K^+K^-)}$ $[10^{-2}]$	LHCb [93]	$1.8\,^{+0.8}_{-0.7} \pm 0.9$	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]	$7.5 \pm 3.1 \pm 0.6$ [2]	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
$\frac{\mathcal{B}(B^0 \to \pi^+\pi^-\mu^+\mu^-)}{\mathcal{B}(B^0 \to J/\psi K^{*0}) \times \mathcal{B}(J/\psi \to \mu^+\mu^-) \times \mathcal{B}(K^{*0} \to K^+\pi^-)}$ $[10^{-4}]$	LHCb [150]	$4.1 \pm 1.0 \pm 0.3$ [3,4]	4.1 ± 1.0

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

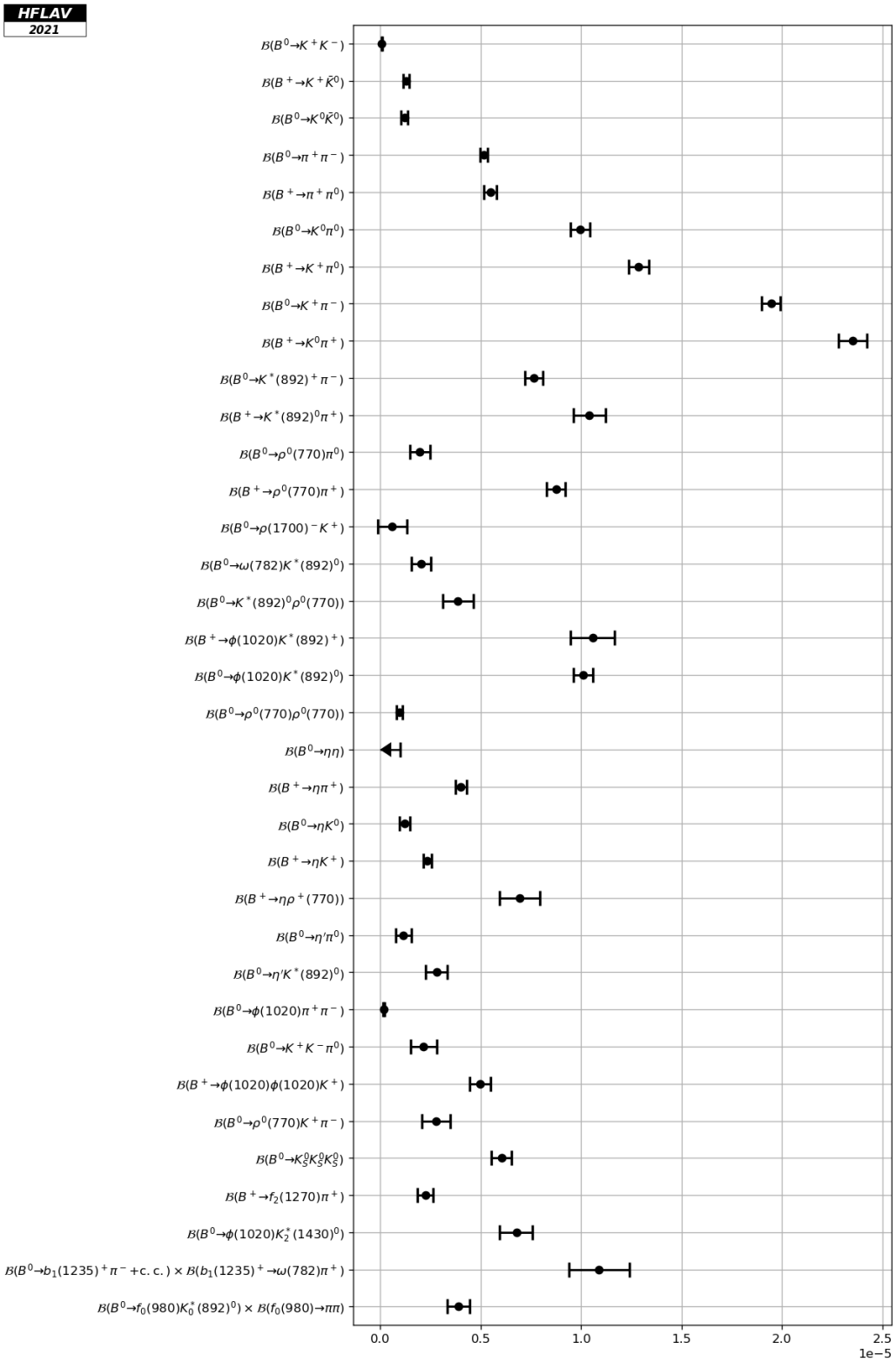

Figure 1: A selection of high-precision charmless mesonic B meson branching fraction measurements.

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 27-28 and 29-30, respectively. Relative branching fractions are given in Table 31. Figures 2 and 3 show graphic representations of a selection of results given in this section.

Table 27: Branching fractions of charmless baryonic B^+ decays (part 1).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^+ \to p\overline{p}\pi^+)$	Belle [151]	$1.60\,^{+0.22}_{-0.19} \pm 0.12$ [1]	1.62 ± 0.21
	BaBar [152]	$1.69 \pm 0.29 \pm 0.26$ [2]	$1.62\,^{+0.21}_{-0.19}$
$\mathcal{B}(B^+ \to p\overline{p}\pi^+),\ m_{p\overline{p}} < 2.85$ GeV/c^2	LHCb [153][3]		1.00 ± 0.11
			none
$\mathcal{B}(B^+ \to p\overline{p}\pi^+(\mathrm{NR}))$	CLEO [38]	< 53	< 53
$\mathcal{B}(B^+ \to p\overline{p}\pi^+\pi^0)$	Belle [154]	$4.58 \pm 1.17 \pm 0.67$ [4]	4.6 ± 1.3
$\mathcal{B}(B^+ \to p\overline{p}\pi^+\pi^+\pi^-)$	ARGUS [155]	< 520	< 520
$\mathcal{B}(B^+ \to p\overline{p}K^+)$[5]	Belle [151]	$5.54\,^{+0.27}_{-0.25} \pm 0.36$ [1]	5.9 ± 0.4
	BaBar [156]	$6.7 \pm 0.5 \pm 0.4$ [2]	5.9 ± 0.5
$\mathcal{B}(B^+ \to p\overline{p}K^+),\ m_{p\overline{p}} < 2.85$ GeV/c^2	LHCb [157][6]		$4.37\,^{+0.30}_{-0.29}$
			none
$\mathcal{B}(B^+ \to \Theta^{++}(1710)\overline{p}) \times \mathcal{B}(\Theta^{++}(1710) \to pK^+)$[7]			
	Belle [57]	< 0.091	< 0.091
$\mathcal{B}(B^+ \to f_J(2220)K^+) \times \mathcal{B}(f_J(2220) \to p\overline{p})$			
	Belle [57]	< 0.41	< 0.41
$\mathcal{B}(B^+ \to p\overline{\Lambda}(1520))$	BaBar [156]	< 1.5	$0.305\,^{+0.084}_{-0.081}$
	LHCb [153][8]		0.315 ± 0.055
$\mathcal{B}(B^+ \to p\overline{p}K^+(\mathrm{NR}))$	CLEO [38]	< 89	< 89

[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$\overline{\mathrm{p}}$)) used in our fit.
[4] $m_{\pi^+\pi^0} < 1.3$ GeV/c^2.
[5] The PDG uncertainty includes a scale factor.
[6] Measurement of $\mathcal{B}(B^+ \to p\overline{p}K^+),\ m_{p\overline{p}} < 2.85$ GeV/c^2/($\mathcal{B}$(B$^+ \to$ J/ψK$^+$)$\mathcal{B}$(J/$\psi \to$ p$\overline{\mathrm{p}}$)) used in our fit.
[7] Pentaquark candidate.
[8] 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.

Table 28: Branching fractions of charmless baryonic B^+ decays (part 2).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^+ \to p\overline{p}K^*(892)^+)$	Belle [158]	$3.38\,^{+0.73}_{-0.60} \pm 0.39$ [1]	$3.6\,^{+0.8}_{-0.7}$
	BaBar [152]	$5.3 \pm 1.5 \pm 1.3$ [2]	
$\mathcal{B}(B^+ \to f_J(2220)K^*(892)^+) \times \mathcal{B}(f_J(2220) \to p\overline{p})$			
	BaBar [152]	< 0.77	< 0.77
$\mathcal{B}(B^+ \to p\overline{\Lambda}^0)$	LHCb [159]	$0.24\,^{+0.10}_{-0.08} \pm 0.03$	$0.24\,^{+0.10}_{-0.09}$
	Belle [160]	< 0.32	
$\mathcal{B}(B^+ \to p\overline{\Lambda}^0\pi^0)$	Belle [161]	$3.00\,^{+0.61}_{-0.53} \pm 0.33$	$3.00\,^{+0.69}_{-0.62}$
$\mathcal{B}(B^+ \to p\overline{\Sigma}(1385)^0)$	Belle [161]	< 0.47	< 0.47
$\mathcal{B}(B^+ \to \Delta(1232)^+\overline{\Lambda}^0)$	Belle [161]	< 0.82	< 0.82
$\mathcal{B}(B^+ \to p\overline{\Lambda}^0\pi^+\pi^-)$	Belle [162]	$11.28\,^{+0.91}_{-0.72} \pm 1.03$	11.3 ± 1.3 $11.3\,^{+1.4}_{-1.3}$
$\mathcal{B}(B^+ \to p\overline{\Lambda}^0\pi^+\pi^-(\mathrm{NR}))$	Belle [162]	$5.92\,^{+0.88}_{-0.84} \pm 0.69$	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 [162]	$4.78\,^{+0.67}_{-0.64} \pm 0.60$	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 [162]	$2.03\,^{+0.77}_{-0.72} \pm 0.27$	2.0 ± 0.8
$\mathcal{B}(B^+ \to p\overline{\Lambda}^0 K^+K^-)$	Belle [163]	$4.10\,^{+0.45}_{-0.43} \pm 0.50$	4.1 ± 0.7
$\mathcal{B}(B^+ \to p\overline{\Lambda}^0\phi(1020))$	Belle [163]	$0.795 \pm 0.209 \pm 0.077$	0.80 ± 0.22
$\mathcal{B}(B^+ \to \overline{p}\Lambda^0 K^+K^-)$	Belle [163]	$3.70\,^{+0.39}_{-0.37} \pm 0.44$	3.7 ± 0.6
$\mathcal{B}(B^+ \to \Lambda^0\overline{\Lambda}^0\pi^+)$	Belle [164]	< 0.94 [3,4]	< 0.94
$\mathcal{B}(B^+ \to \Lambda^0\overline{\Lambda}^0 K^+)$	Belle [164]	$3.38\,^{+0.41}_{-0.36} \pm 0.41$ [3]	3.4 ± 0.6 $3.4\,^{+0.6}_{-0.5}$
$\mathcal{B}(B^+ \to \Lambda^0\overline{\Lambda}^0 K^*(892)^+)$	Belle [164]	$2.19\,^{+1.13}_{-0.88} \pm 0.33$ [3,4]	$2.2\,^{+1.2}_{-0.9}$
$\mathcal{B}(B^+ \to \Lambda(1520)\overline{\Lambda}^0 K^+)$	Belle [163]	$2.23 \pm 0.63 \pm 0.25$	2.2 ± 0.7
$\mathcal{B}(B^+ \to \overline{\Lambda}(1520)\Lambda^0 K^+)$	Belle [163]	< 2.08	< 2.1
$\mathcal{B}(B^+ \to \overline{\Delta}(1232)^0 p)$	Belle [151]	< 1.38	< 1.4
$\mathcal{B}(B^+ \to \Delta^{++}\overline{p})$	Belle [151]	< 0.14	< 0.14

[1] The charmonium mass region has been vetoed.
[2] Charmonium decays to $p\overline{p}$ have been statistically subtracted.
[3] The charmonium mass regions are vetoed.
[4] $M_{\Lambda^0\overline{\Lambda}^0} < 2.85$ GeV/c^2.

Table 29: Branching fractions of charmless baryonic B^0 decays (part 1).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^0 \to p\overline{p})$	LHCb [165]	$0.0125 \pm 0.0027 \pm 0.0018$	0.0125 ± 0.0032
	Belle [160]	< 0.11	
	BaBar [166]	< 0.27	
$\mathcal{B}(B^0 \to p\overline{p}\pi^+\pi^-)$	LHCb [167]	$2.7 \pm 0.1 \pm 0.2$ [1,2]	2.7 ± 0.2
			2.9 ± 0.2
$\mathcal{B}(B^0 \to p\overline{p}\pi^+\pi^-),\ m_{\pi^+\pi^-} < 1.22$ GeV/c^2			
	Belle [154]	$0.83 \pm 0.17 \pm 0.17$ [3]	0.83 ± 0.24
			none
$\mathcal{B}(B^0 \to p\overline{p}K^+\pi^-)$	LHCb [167]	$5.9 \pm 0.3 \pm 0.5$ [1,2]	5.9 ± 0.6
			6.3 ± 0.5
$\mathcal{B}(B^0 \to p\overline{p}K^0)$	Belle [158]	$2.51\,^{+0.35}_{-0.29} \pm 0.21$ [4]	2.7 ± 0.3
	BaBar [152]	$3.0 \pm 0.5 \pm 0.3$ [5]	
$\mathcal{B}(B^0 \to \Theta(1540)^+\overline{p}) \times \mathcal{B}(\Theta(1540)^+ \to pK^0_S)$ [6]			
	BaBar [152]	< 0.05	< 0.05
	Belle [57]	< 0.23	
$\mathcal{B}(B^0 \to f_J(2220)K^0) \times \mathcal{B}(f_J(2220) \to p\overline{p})$			
	BaBar [152]	< 0.45	< 0.45
$\mathcal{B}(B^0 \to p\overline{p}K^*(892)^0)$	Belle [158]	$1.18\,^{+0.29}_{-0.25} \pm 0.11$ [4]	1.24 ± 0.27
	BaBar [152]	$1.47 \pm 0.45 \pm 0.40$ [5]	$1.24\,^{+0.28}_{-0.25}$
$\mathcal{B}(B^0 \to f_J(2220)K^*(892)^0) \times \mathcal{B}(f_J(2220) \to p\overline{p})$			
	BaBar [152]	< 0.15	< 0.15

[1] $m_{p\overline{p}} < 2.85$ GeV/c^2.
[2] Multiple systematic uncertainties are added in quadrature.
[3] $0.46 < m_{\pi^+\pi^-} < 0.53$ GeV/c^2 invariant mass region has been excluded.
[4] The charmonium mass region has been vetoed.
[5] Charmonium decays to $p\overline{p}$ have been statistically subtracted.
[6] Pentaquark candidate.

Table 30: Branching fractions of charmless baryonic B^0 decays (part 2).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^0 \to p\overline{p}K^+K^-)$	LHCb [167]	$0.113 \pm 0.028 \pm 0.014$ [1,2]	0.113 ± 0.031 0.121 ± 0.032
$\mathcal{B}(B^0 \to p\overline{p}\pi^0)$	Belle [168]	$0.50 \pm 0.18 \pm 0.06$	0.50 ± 0.19
$\mathcal{B}(B^0 \to pp\overline{pp})$	BaBar [169]	< 0.2	< 0.2
$\mathcal{B}(B^0 \to p\overline{\Lambda}^0\pi^-)$	BaBar [170] Belle [161]	$3.07 \pm 0.31 \pm 0.23$ $3.23\,^{+0.33}_{-0.29} \pm 0.29$	3.14 ± 0.28 $3.14\,^{+0.29}_{-0.28}$
$\mathcal{B}(B^0 \to p\overline{\Sigma}(1385)^-)$	Belle [161]	< 0.26	< 0.26
$\mathcal{B}(B^0 \to \Delta(1232)^+\overline{p}$+c.c.)	Belle [168]	< 1.6	< 1.6
$\mathcal{B}(B^0 \to \Delta(1232)^0\overline{\Lambda}^0)$	Belle [161]	< 0.93	< 0.93
$\mathcal{B}(B^0 \to p\overline{\Lambda}^0K^-)$	Belle [171]	< 0.82	< 0.82
$\mathcal{B}(B^0 \to p\overline{\Sigma}^0\pi^-)$	Belle [171]	< 3.8	< 3.8
$\mathcal{B}(B^0 \to \overline{\Lambda}^0\Lambda^0)$	Belle [160]	< 0.32	< 0.32
$\mathcal{B}(B^0 \to \overline{\Lambda}^0\Lambda^0K^0)$	Belle [164]	$4.76\,^{+0.84}_{-0.68} \pm 0.61$ [3]	$4.8\,^{+1.0}_{-0.9}$
$\mathcal{B}(B^0 \to \Lambda^0\overline{\Lambda}^0K^*(892)^0)$	Belle [164]	$2.46\,^{+0.87}_{-0.72} \pm 0.34$ [3]	$2.46\,^{+0.93}_{-0.80}$
$\mathcal{B}(B^0 \to \Delta(1232)^0\overline{\Delta}(1232)^0)$	CLEO [88]	< 1500 [4]	< 1500
$\mathcal{B}(B^0 \to \Delta^{++}\overline{\Delta}^{--})$	CLEO [88]	< 110 [4]	< 110

[1] $m_{p\overline{p}} < 2.85$ 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.

Table 31: Baryonic Relative Branching Fractions.

Parameter	**Measurements**		**Average**
$\frac{\mathcal{B}(B^+\to p\overline{p}\pi^+, m_{p\overline{p}}<2.85\ \mathrm{GeV/c^2})}{\mathcal{B}(B^+\to J/\psi\pi^+)\times\mathcal{B}(J/\psi\to p\overline{p})}$	LHCb [153]	$12.0 \pm 1.2 \pm 0.3$	12.0 ± 1.2
$\frac{\mathcal{B}(B^+\to p\overline{p}K^+)}{\mathcal{B}(B^+\to J/\psi K^+)\times\mathcal{B}(J/\psi\to p\overline{p})}$	LHCb [157]	$4.91 \pm 0.19 \pm 0.14$ [1]	4.91 ± 0.24
$\frac{\mathcal{B}(B^+\to p\overline{p}K^+, m_{p\overline{p}}<2.85\ \mathrm{GeV/c^2})}{\mathcal{B}(B^+\to J/\psi\pi^+)\times\mathcal{B}(J/\psi\to p\overline{p})}$	LHCb [157]	$2.02 \pm 0.10 \pm 0.08$	2.02 ± 0.13
$\frac{\mathcal{B}(B^+\to\overline{\Lambda}(1520)p)\times\mathcal{B}(\overline{\Lambda}(1520)\to K^+\overline{p}))}{\mathcal{B}(B^+\to J/\psi\pi^+)\times\mathcal{B}(J/\psi\to p\overline{p})}$	LHCb [153]	$0.033 \pm 0.005 \pm 0.007$	0.033 ± 0.009
$\frac{\mathcal{B}(B^0\to p\overline{p}K^+K^-)}{\mathcal{B}(B^0\to p\overline{p}K^+\pi^-)}$	LHCb [167]	$0.019 \pm 0.005 \pm 0.002$ [2]	0.019 ± 0.005
$\frac{\mathcal{B}(B^0\to p\overline{p}\pi^+\pi^-)}{\mathcal{B}(B^0\to p\overline{p}K^+\pi^-)}$	LHCb [167]	$0.46 \pm 0.02 \pm 0.02$ [2]	0.46 ± 0.03

[1] Includes contribution where $p\overline{p}$ is produced in charmonium decays.
[2] $m_{p\overline{p}} < 2.85\ \mathrm{GeV/c^2}$.

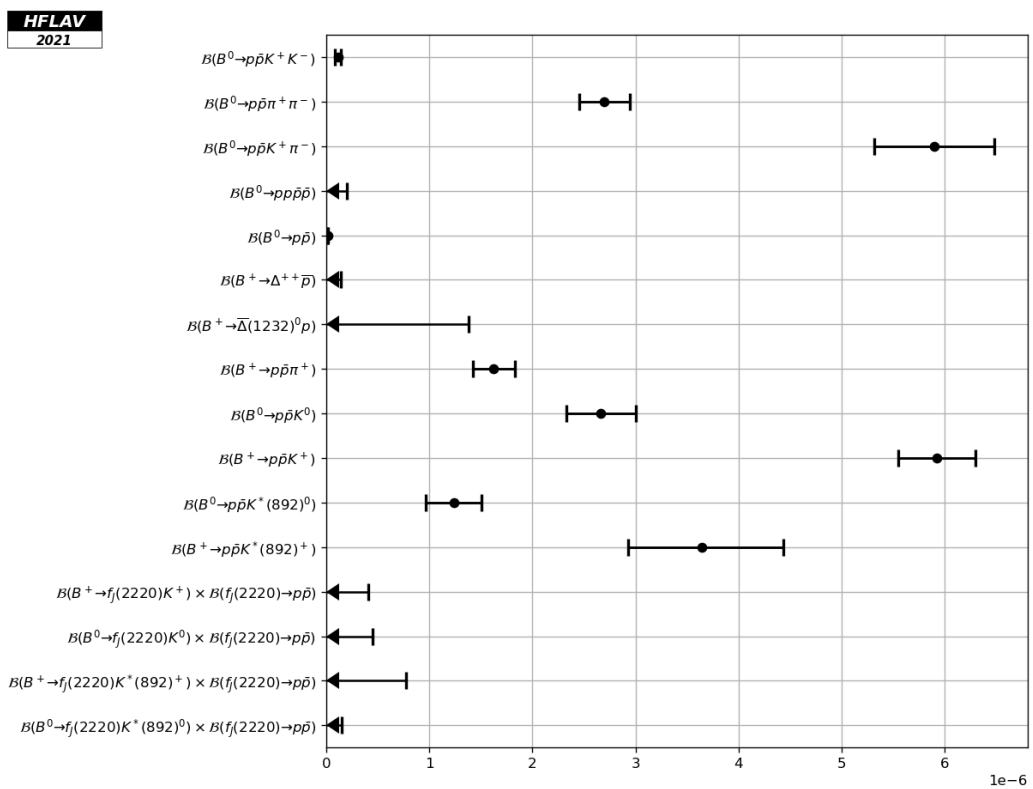

Figure 2: Branching fractions of charmless baryonic B^+ and B^0 decays into non-strange baryons.

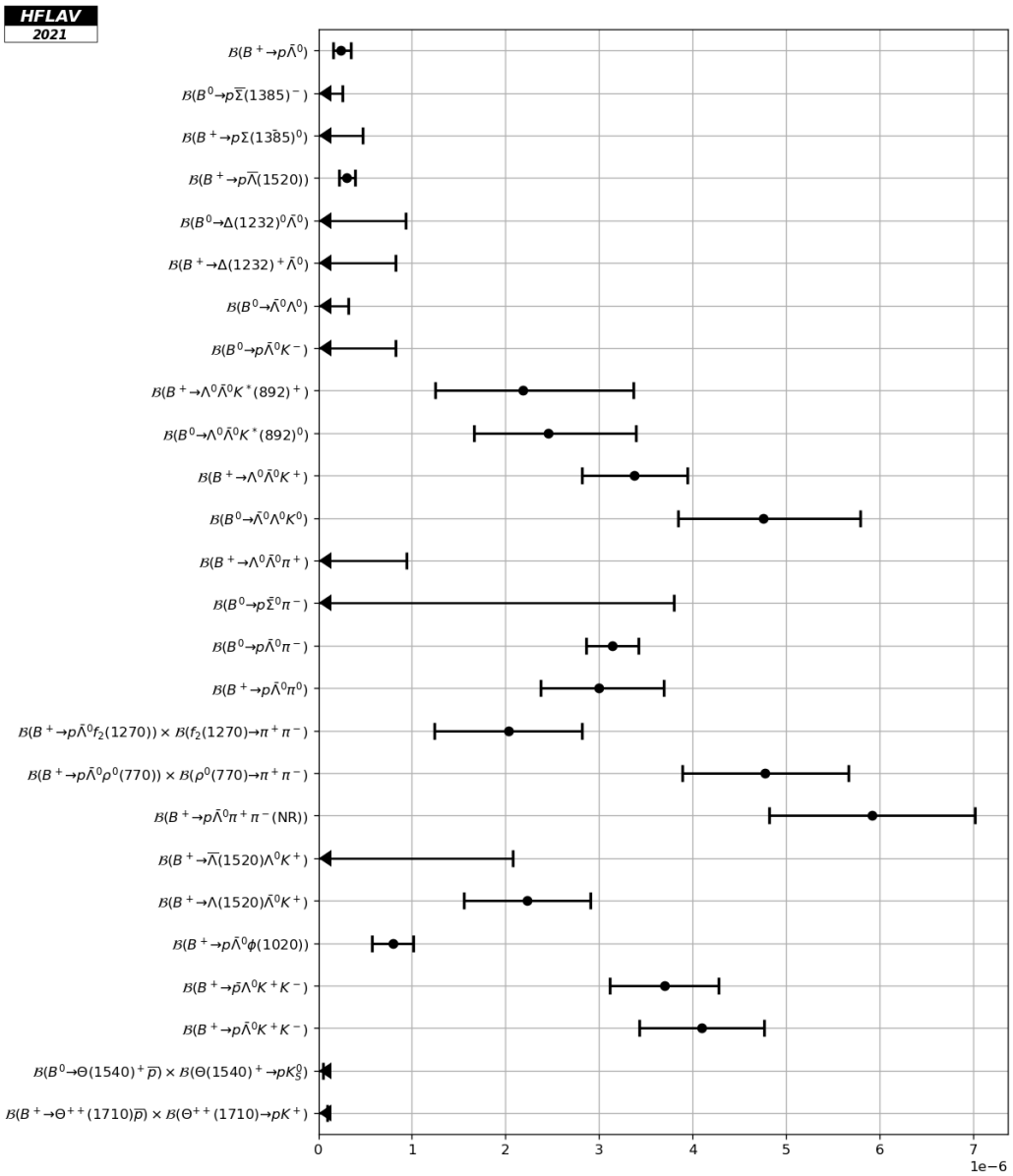

Figure 3: Branching fractions of charmless baryonic B^+ and B^0 decays into strange baryons.

3 Decays of b baryons

A compilation of branching fractions of Λ_b^0 baryon decays is given in Tables 32 and 33. Table 34 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 35, 36, and 37, respectively. Finally, ratios of branching fractions of Λ_b^0, Ξ_b^0 and Ω_b^- baryon decays are detailed in Tables 38, 39 and 40, respectively. Figure 4 shows a graphic representation of branching fractions of Λ_b^0 decays.

Table 32: 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 [105]	$12.4 \pm 2.0 \pm 3.6$ [1,2]	12.4 ± 4.2 12.6 ± 4.1
$\mathcal{B}(\Lambda_b^0 \to pK^0K^-)$	LHCb [105]	< 3.5 [2]	< 3.5
$\mathcal{B}(\Lambda_b^0 \to p\pi^-)$[3]	LHCb [93] CDF [90][5]	$4.68 \pm 0.44 \pm 0.95$ [4]	$4.5^{+0.9}_{-0.8}$ 4.5 ± 0.8
$\mathcal{B}(\Lambda_b^0 \to pK^-)$[3]	CDF [90] LHCb [93][6]	$6.3 \pm 1.2 \pm 0.8$	5.4 ± 1.1 5.4 ± 1.0
$\mathcal{B}(\Lambda_b^0 \to \Lambda^0\mu^+\mu^-)$	LHCb [172] CDF [173]	$0.955 \pm 0.186 \pm 0.249$ [1,7] $1.520 \pm 0.366 \pm 0.387$ [7]	$1.09^{+0.34}_{-0.29}$ 1.08 ± 0.28
$\mathcal{B}(\Lambda_b^0 \to p\pi^-\mu^+\mu^-)$	LHCb [174][8]		$0.069^{+0.027}_{-0.023}$ $0.069^{+0.025}_{-0.024}$
$\mathcal{B}(\Lambda_b^0 \to pK^-e^+e^-)$	LHCb [175]	$0.311^{+0.044}_{-0.041}{}^{+0.061}_{-0.051}$ [9,10]	$0.31^{+0.08}_{-0.06}$ $0.31^{+0.07}_{-0.06}$
$\mathcal{B}(\Lambda_b^0 \to pK^-\mu^+\mu^-)$	LHCb [175]	$0.266 \pm 0.013^{+0.050}_{-0.040}$ [9,10]	$0.266^{+0.052}_{-0.041}$ $0.265^{+0.051}_{-0.041}$

[1] Multiple systematic uncertainties are added in quadrature.
[2] Using $\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$.
[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] Using $\mathcal{B}(\Lambda_b^0 \to J/\psi\Lambda^0)$.
[8] 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.
[9] 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.
[10] Using $\mathcal{B}(\Lambda_b^0 \to J/\psi pK^-)$.

Table 33: 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 [176][1]		6.9 ± 1.5 7.1 ± 1.7
$\mathcal{B}(\Lambda_b^0 \to \Lambda^0\eta)$	LHCb [96]	$9.23\,^{+7.15}_{-5.20} \pm 0.40$ [2]	$9.2\,^{+7.2}_{-5.2}$ $9.4\,^{+7.3}_{-5.3}$
$\mathcal{B}(\Lambda_b^0 \to \Lambda^0\eta')$	LHCb [96]	< 3.05 [2]	< 3.1
$\mathcal{B}(\Lambda_b^0 \to \Lambda^0\pi^+\pi^-)$	LHCb [177][3]		$4.7\,^{+2.0}_{-1.9}$ 4.7 ± 1.9
$\mathcal{B}(\Lambda_b^0 \to \Lambda^0K^+\pi^-)$	LHCb [177][4]		$5.7\,^{+1.3}_{-1.2}$ 5.7 ± 1.3
$\mathcal{B}(\Lambda_b^0 \to \Lambda^0K^+K^-)$	LHCb [177][5]		$16.1\,^{+2.4}_{-2.2}$ 16.2 ± 2.3
$\mathcal{B}(\Lambda_b^0 \to \Lambda^0\phi(1020))$	LHCb [119][6]		$10.1\,^{+2.9}_{-2.5}$ 9.8 ± 2.6
$\mathcal{B}(\Lambda_b^0 \to p\pi^+\pi^-\pi^-)$	LHCb [178][7,8,9]		$21.1\,^{+2.4}_{-2.3}$ 21.1 ± 2.3
$\mathcal{B}(\Lambda_b^0 \to pK^-K^+\pi^-)$	LHCb [178][8,10]		$4.06\,^{+0.66}_{-0.61}$ 4.07 ± 0.63
$\mathcal{B}(\Lambda_b^0 \to pK^-\pi^+\pi^-)$	LHCb [178][8,11]		$50.5\,^{+5.6}_{-5.3}$ 50.6 ± 5.4
$\mathcal{B}(\Lambda_b^0 \to pK^-K^+K^-)$	LHCb [178][8,12]		$12.6\,^{+1.5}_{-1.4}$ 12.7 ± 1.4

[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] Measurement of $\mathcal{B}(\Lambda_b^0 \to \Lambda^0\pi^+\pi^-)/(\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-)\mathcal{B}(\Lambda_c^+ \to \Lambda^0\pi^+))$ used in our fit.
[4] Measurement of $\mathcal{B}(\Lambda_b^0 \to \Lambda^0K^+\pi^-)/(\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-)\mathcal{B}(\Lambda_c^+ \to \Lambda^0\pi^+))$ used in our fit.
[5] Measurement of $\mathcal{B}(\Lambda_b^0 \to \Lambda^0K^+K^-)/(\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-)\mathcal{B}(\Lambda_c^+ \to \Lambda^0\pi^+))$ used in our fit.
[6] 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.
[7] Vetoes on charm and charmonium resonances are applied.
[8] Multiple systematic uncertainties are added in quadrature.
[9] 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.
[10] 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.
[11] 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.
[12] 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 34: 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 [179]	$0.72\,^{+0.24}_{-0.22} \pm 0.14$	0.7 ± 0.3
	CDF [173]	$0.15 \pm 2.01 \pm 0.05$	
$2.0 < m^2_{\mu^+\mu^-} < 4.3$ GeV^2/c^4			
	LHCb [179]	$0.253\,^{+0.276}_{-0.207} \pm 0.046$	$0.3\,^{+0.3}_{-0.2}$
	CDF [173]	$1.84 \pm 1.66 \pm 0.59$	
$4.3 < m^2_{\mu^+\mu^-} < 8.68$ GeV^2/c^4			
	LHCb [172]	$0.66 \pm 0.72 \pm 0.16$	0.5 ± 0.7
	CDF [173]	$-0.20 \pm 1.64 \pm 0.08$	
$10.09 < m^2_{\mu^+\mu^-} < 12.86$ GeV^2/c^4			
	LHCb [179]	$2.08\,^{+0.42}_{-0.39} \pm 0.42$	2.2 ± 0.6
	CDF [173]	$2.97 \pm 1.47 \pm 0.95$	
$14.18 < m^2_{\mu^+\mu^-} < 16.00$ GeV^2/c^4			
	LHCb [179]	$2.04\,^{+0.35}_{-0.33} \pm 0.42$	1.7 ± 0.4
	CDF [173]	$0.96 \pm 0.73 \pm 0.31$	1.7 ± 0.5
$m^2_{\mu^+\mu^-} > 16.00$ GeV^2/c^4			
	CDF [173]	$6.97 \pm 1.88 \pm 2.23$	7.0 ± 2.9

Table 35: 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 [105]	< 1.5 [1]	< 1.5 < 1.6
$\frac{f_{\Xi_b^0}}{f_d}\mathcal{B}(\Xi_b^0 \to p\overline{K}^0K^-)$	LHCb [105]	< 1.0 [1]	< 0.99 < 1.10
$\frac{f_{\Xi_b^0}}{f_{\Lambda_b^0}}\mathcal{B}(\Xi_b^0 \to \Lambda\pi^+\pi^-)$	LHCb [177]	< 1.7	< 1.7
$\frac{f_{\Xi_b^0}}{f_{\Lambda_b^0}}\mathcal{B}(\Xi_b^0 \to \Lambda K^-\pi^+)$	LHCb [177]	< 0.8	< 0.8
$\frac{f_{\Xi_b^0}}{f_{\Lambda_b^0}}\mathcal{B}(\Xi_b^0 \to \Lambda K^+K^-)$	LHCb [177]	< 0.3	< 0.3
$\frac{f_{\Xi_b^0}}{f_{\Lambda_b^0}}\mathcal{B}(\Xi_b^0 \to pK^-\pi^+\pi^-)$	LHCb [178][2,3]		$1.91\,^{+0.41}_{-0.38}$ 1.91 ± 0.40
$\frac{f_{\Xi_b^0}}{f_{\Lambda_b^0}}\mathcal{B}(\Xi_b^0 \to pK^-K^-\pi^+)$	LHCb [178][2,4]		$1.72\,^{+0.33}_{-0.30}$ 1.73 ± 0.32
$\frac{f_{\Xi_b^0}}{f_{\Lambda_b^0}}\mathcal{B}(\Xi_b^0 \to pK^+K^-K^-)$	LHCb [178][2,5]		0.18 ± 0.10

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

[2] Multiple systematic uncertainties are added in quadrature.

[3] 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.

[4] 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.

[5] 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.

Table 36: Relative branching fractions of charmless 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 [180]	$0.2650 \pm 0.0350 \pm 0.0470$	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 [180]	< 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 [180]	$0.2590 \pm 0.0640 \pm 0.0490$	0.259 ± 0.081
$\frac{\mathcal{B}(\Xi_b^- \to p\pi^-\pi^-)}{\mathcal{B}(\Xi_b^- \to pK^-K^-)}$	LHCb [180]	< 56	< 56
$\frac{\mathcal{B}(\Xi_b^- \to pK^-\pi^-)}{\mathcal{B}(\Xi_b^- \to pK^-K^-)}$	LHCb [180]	$98 \pm 27 \pm 9$	98 ± 28

Table 37: 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 [180]	< 0.59 [1]	< 0.59
$\frac{f_{\Omega_b^-}}{f_u} \times \mathcal{B}(\Omega_b^- \to pK^-\pi^-)$	LHCb [180]	< 1.68 [1]	< 1.7
$\frac{f_{\Omega_b^-}}{f_u} \times \mathcal{B}(\Omega_b^- \to p\pi^-\pi^-)$	LHCb [180]	< 3.59 [1]	< 3.6

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

Table 38: Relative branching fractions of charmless Λ_b^0 decays.

Parameter	**Measurements**		**Average**
$\frac{\mathcal{B}(\Lambda_b^0 \to p\pi^-)}{\mathcal{B}(\Lambda_b^0 \to pK^-)}$	LHCb [93]	$0.86 \pm 0.08 \pm 0.05$	0.86 ± 0.09
$\frac{\mathcal{B}(\Lambda_b^0 \to \Lambda^0\eta)}{\mathcal{B}(B^0 \to \eta' K^0)}$	LHCb [96]	$0.142\,^{+0.110}_{-0.080}$	$0.14\,^{+0.11}_{-0.08}$
$\frac{f_{\Lambda_b^0}}{f_d}\frac{\mathcal{B}(\Lambda_b^0\to p\pi^-)}{\mathcal{B}(B^0\to K^+\pi^-)}$	CDF [90]	$0.042 \pm 0.007 \pm 0.006$	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 [90]	$0.066 \pm 0.009 \pm 0.008$	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 [174]	$0.044 \pm 0.012 \pm 0.007$	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 [177]	$0.073 \pm 0.019 \pm 0.022$	0.073 ± 0.029
$\frac{\mathcal{B}(\Lambda_b^0\to \Lambda^0K^+\pi^-)}{\mathcal{B}(\Lambda_b^0\to \Lambda_c^+\pi^-)\times\mathcal{B}(\Lambda_c^+\to\Lambda^0\pi^+)}$	LHCb [177]	$0.089 \pm 0.012 \pm 0.013$	0.089 ± 0.018
$\frac{\mathcal{B}(\Lambda_b^0\to \Lambda^0K^+K^-)}{\mathcal{B}(\Lambda_b^0\to \Lambda_c^+\pi^-)\times\mathcal{B}(\Lambda_c^+\to\Lambda^0\pi^+)}$	LHCb [177]	$0.253 \pm 0.019 \pm 0.019$	0.253 ± 0.027
$\frac{\mathcal{B}(\Lambda_b^0\to p\pi^-\pi^+\pi^-)}{\mathcal{B}(\Lambda_b^0\to \Lambda_c^+\pi^-)\times\mathcal{B}(\Lambda_c^+\to pK^-\pi^+)}$	LHCb [178]	$0.0685 \pm 0.0019 \pm 0.0033$ [1]	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 [178]	$0.164 \pm 0.003 \pm 0.007$ [1]	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 [178]	$0.0132 \pm 0.0009 \pm 0.0013$ [1]	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 [178]	$0.0411 \pm 0.0012 \pm 0.0020$ [1]	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 [105]	$0.25 \pm 0.04 \pm 0.07$ [1]	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 [105]	< 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 [172]	$0.00154 \pm 0.00030 \pm 0.00020$ [1]	0.00154 ± 0.00036

[1] Multiple systematic uncertainties are added in quadrature.

Table 39: Relative branching fractions of charmless Ξ_b^0 decays.

Parameter [10^{-2}]	**Measurements**		**Average**
$\frac{f_{\Xi_b^0}}{f_d} \times \frac{\mathcal{B}(\Xi_b^0 \to p\overline{K^0}\pi^-)}{\mathcal{B}(B^0 \to K^0\pi^+\pi^-)}$	LHCb [105]	< 3	< 3.0
$\frac{f_{\Xi_b^0}}{f_d} \times \frac{\mathcal{B}(\Xi_b^0 \to p\overline{K^0}K^-)}{\mathcal{B}(B^0 \to K^0\pi^+\pi^-)}$	LHCb [105]	< 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 [178]	$0.057 \pm 0.028 \pm 0.013$ [1]	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 [178]	$0.62 \pm 0.08 \pm 0.08$ [1]	0.62 ± 0.11
$\frac{f_{\Xi_b^0}}{f_{\Lambda_b^0}} \times \frac{\mathcal{B}(\Xi_b^0 \to pK^-\pi^+K^-)}{\mathcal{B}(\Lambda_b^0 \to \Lambda_c^+\pi^-) \times \mathcal{B}(\Lambda_c^+ \to pK^-\pi^+)}$	LHCb [178]	$0.56 \pm 0.06 \pm 0.06$ [1]	0.560 ± 0.088

[1] Multiple systematic uncertainties are added in quadrature.

Table 40: Relative branching fractions of charmless 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 [180]	< 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 [180]	< 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 [180]	< 0.510	< 0.51

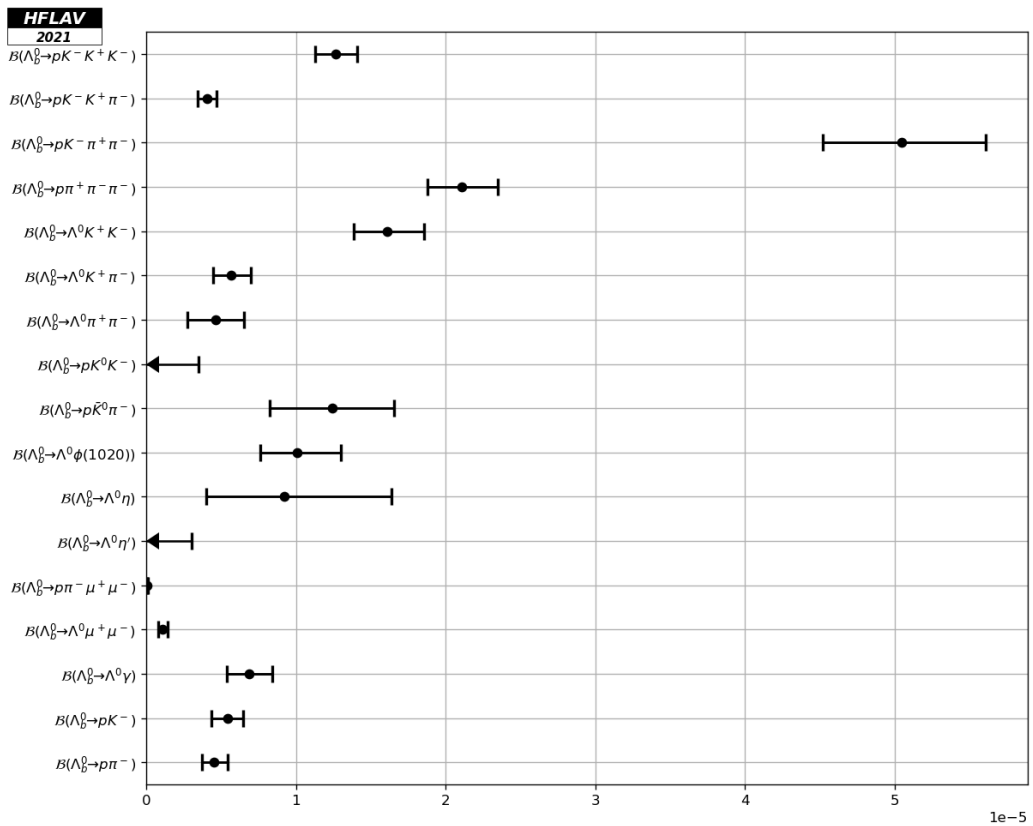

Figure 4: Branching fractions of charmless Λ_b^0 decays.

Measurements that are not included in the tables:

- In Ref. [181], 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. [182], 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.

4 Decays of B_s^0 mesons

Tables 41 to 44 and 45 to 46 detail branching fractions and relative branching fractions of B_s^0 meson decays, respectively. Figures 5 and 6 show graphic representations of a selection of results given in this section.

Table 41: 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 [183]	< 12	$0.72\,^{+0.11}_{-0.10}$
	CDF [91][1]		0.70 ± 0.10
	LHCb [94][1]		
$\mathcal{B}(B_s^0 \to \pi^0\pi^0)$	L3 [184]	< 210	< 210
$\mathcal{B}(B_s^0 \to \eta\pi^0)$	L3 [184]	< 1000	< 1000
$\mathcal{B}(B_s^0 \to \eta\eta)$	L3 [184]	< 1500	< 1500
$\mathcal{B}(B_s^0 \to \rho^0(770)\rho^0(770))$	SLD [185]	< 320	< 320
$\mathcal{B}(B_s^0 \to \eta'\eta')$	LHCb [15]	$32.4 \pm 6.2 \pm 3.0$ [2]	32 ± 7
			33 ± 7
$\mathcal{B}(B_s^0 \to \eta'\phi(1020))$	LHCb [186]	< 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 [137]	$1.12 \pm 0.16 \pm 0.14$ [3]	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 [137]	$0.61 \pm 0.13\,^{+0.13}_{-0.08}$ [3]	$0.61\,^{+0.19}_{-0.15}$
			$0.61\,^{+0.18}_{-0.15}$
$\mathcal{B}(B_s^0 \to \phi(1020)\rho^0(770))$	LHCb [137]	$0.27 \pm 0.07 \pm 0.03$ [3]	0.27 ± 0.08
$\mathcal{B}(B_s^0 \to \phi(1020)\pi^+\pi^-)$	LHCb [137]	$3.48 \pm 0.23 \pm 0.39$ [4,3]	3.48 ± 0.45
$\mathcal{B}(B_s^0 \to \phi(1020)\phi(1020))$	LHCb [126]	$18.6 \pm 0.5 \pm 1.6$ [3,5]	$18.7\,^{+1.5}_{-1.4}$
	CDF [187]	$19.1 \pm 1.5 \pm 2.5$ [6]	18.7 ± 1.5
$\mathcal{B}(B_s^0 \to K^-\pi^+)$	Belle [183]	< 26	$5.9\,^{+0.9}_{-0.8}$
	CDF [90][7]		5.8 ± 0.7
	LHCb [93][7]		
$\mathcal{B}(B_s^0 \to K^+K^-)$	Belle [183]	$38\,^{+10}_{-9} \pm 7$ [3]	$26.6\,^{+3.2}_{-2.7}$
	CDF [92][8]		26.6 ± 2.2
	LHCb [93][8]		
$\mathcal{B}(B_s^0 \to K^0\overline{K}^0)$	LHCb [120]	$16.7 \pm 2.9 \pm 2.1$ [3,9]	17.4 ± 3.1
	Belle [188]	$19.6\,^{+5.8}_{-5.1} \pm 2.2$ [3]	$17.6\,^{+3.2}_{-3.1}$

[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 $\mathcal{B}(B^+ \to \eta' K^+)$.
[3] Multiple systematic uncertainties are added in quadrature.
[4] $400 < M(\pi^+\pi^-) < 1600$ MeV/c^2.
[5] Using $\mathcal{B}(B^0 \to \phi(1020)K^*(892)^0)$.
[6] Using $\mathcal{B}(B_s^0 \to J/\psi\phi(1020))$.
[7] 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.
[8] 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.
[9] Using $\mathcal{B}(B^0 \to \phi(1020)K^0)$.

Table 42: Branching fractions of charmless B_s^0 decays (part 2).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B_s^0 \to K^0\pi^+\pi^-)$	LHCb [107]	$9.49 \pm 1.34 \pm 1.67$ [1,2]	9.5 ± 2.1
$\mathcal{B}(B_s^0 \to K^0K^+\pi^-$+c.c.)	LHCb [107]	$84.5 \pm 3.5 \pm 8.0$ [1,2]	84.5 ± 8.7 84.5 ± 8.8
$\mathcal{B}(B_s^0 \to K^*(892)^-\pi^+)$	LHCb [109]	$2.98 \pm 0.99 \pm 0.42$ [3]	3.0 ± 1.1 p=1.6‰ 2.9 ± 1.1
$\mathcal{B}(B_s^0 \to K^*(892)^+K^-$+c.c.)	LHCb [189]	$18.6 \pm 1.2 \pm 4.5$ [4,5]	18.6 ± 4.7
$\mathcal{B}(B_s^0 \to (K\pi)_0^{*+}K^-$+c.c.)	LHCb [189]	$24.9 \pm 1.8 \pm 20.2$ [4,5]	25 ± 20 none
$\mathcal{B}(B_s^0 \to K_0^*(1430)^+K^-$+c.c.)	LHCb [189]	$31.3 \pm 2.3 \pm 25.3$ [4,5]	31 ± 25
$\mathcal{B}(B_s^0 \to K_2^*(1430)^+K^-$+c.c.)	LHCb [189]	$10.3 \pm 2.5 \pm 16.4$ [4,5]	10 ± 17
$\mathcal{B}(B_s^0 \to K^*(892)^0\overline{K}^0$+c.c.)	LHCb [189]	$19.8 \pm 2.8 \pm 5.0$ [4,5]	19.8 ± 5.7
$\mathcal{B}(B_s^0 \to (K\pi)_0^{*0}\overline{K}^0$+c.c.)	LHCb [189]	$26.2 \pm 2.0 \pm 7.8$ [4,5]	26.2 ± 8.1 none
$\mathcal{B}(B_s^0 \to K_0^*(1430)^0\overline{K}^0$+c.c.)	LHCb [189]	$33.0 \pm 2.5 \pm 9.8$ [4,5]	33 ± 10
$\mathcal{B}(B_s^0 \to K_2^*(1430)^0\overline{K}^0$+c.c.)	LHCb [189]	$16.8 \pm 4.5 \pm 21.3$ [4,5]	17 ± 22
$\mathcal{B}(B_s^0 \to K_S^0K^*(892)^0$+c.c.)	LHCb [106]	$17.1 \pm 3.6 \pm 2.4$ [5,6]	17.1 ± 4.3 p=1.6‰ 16.4 ± 4.1

[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] Using $\mathcal{B}(B^0 \to K^*(892)^+\pi^-)$.
[4] Result extracted from Dalitz-plot analysis of $B_s^0 \to K_S^0K^+\pi^-$ decays.
[5] Multiple systematic uncertainties are added in quadrature.
[6] Using $\mathcal{B}(B^0 \to K^0\pi^+\pi^-)$.

Table 43: Branching fractions of charmless B_s^0 decays (part 3).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B_s^0 \to K^0 K^+ K^-)$	LHCb [107]	$1.29 \pm 0.55 \pm 0.36$ [1,2]	1.29 ± 0.66 1.29 ± 0.65
$\mathcal{B}(B_s^0 \to \overline{K}^*(892)^0 \rho^0(770))$	SLD [185]	< 767	< 767
$\mathcal{B}(B_s^0 \to K^*(892)^0 \overline{K}^*(892)^0)$	LHCb [127] LHCb [130][3,5]	$11.2 \pm 2.2 \pm 1.5$ [3,4]	11.0 ± 2.0 11.1 ± 2.7
$\mathcal{B}(B_s^0 \to \phi(1020) \overline{K}^*(892)^0)$	LHCb [125]	$1.14 \pm 0.24 \pm 0.17$ [3,4]	1.14 ± 0.29 1.14 ± 0.30
$\mathcal{B}(B_s^0 \to p\overline{p})$	LHCb [165]	< 0.015	< 0.015
$\mathcal{B}(B_s^0 \to p\overline{p} K^+ K^-)$	LHCb [167]	$4.2 \pm 0.3 \pm 0.4$ [6,3]	4.2 ± 0.5 4.5 ± 0.5
$\mathcal{B}(B_s^0 \to p\overline{p} K^+ \pi^-)$	LHCb [167]	$1.3 \pm 0.2 \pm 0.2$ [6,3]	1.3 ± 0.3 1.4 ± 0.3
$\mathcal{B}(B_s^0 \to p\overline{p} \pi^+ \pi^-)$	LHCb [167]	< 0.66 [6]	< 0.66 0.43 ± 0.20
$\mathcal{B}(B_s^0 \to p\overline{\Lambda}^0 K^- + \text{c.c.})$	LHCb [190]	$5.46 \pm 0.61 \pm 0.82$ [3]	5.5 ± 1.0

[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] Multiple systematic uncertainties are added in quadrature.
[4] Using $\mathcal{B}(B^0 \to \phi(1020) K^*(892)^0)$.
[5] 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.
[6] $m_{p\overline{p}} < 2.85$ GeV/c^2.

Table 44: Branching fractions of charmless B_s^0 decays (part 4).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B_s^0 \to \gamma\gamma)$	Belle [191]	< 3.1	< 3.1
$\mathcal{B}(B_s^0 \to \phi(1020)\gamma)$	LHCb [192]	$33.9 \pm 1.7 \pm 3.1$ [1]	34.1 ± 3.2
	Belle [191]	$36.0 \pm 5.0 \pm 7.0$	34.2 ± 3.6
$\mathcal{B}(B_s^0 \to \mu^+\mu^-)$[2]	ATLAS [193]	$0.0028\,^{+0.0008}_{-0.0007}$	0.00295 ± 0.00041
	LHCb [194]	$0.0030 \pm 0.0006\,^{+0.0003}_{-0.0002}$	$0.00294\,^{+0.00042}_{-0.00039}$
	CMS [195]	$0.0029 \pm 0.0007 \pm 0.0002$	
	CDF [196]	$0.013\,^{+0.009}_{-0.007}$	
$\mathcal{B}(B_s^0 \to e^+e^-)$	LHCb [197]	< 0.0094	< 0.0094
	CDF [198]	< 0.28	
$\mathcal{B}(B_s^0 \to \tau^+\tau^-)$[3]	LHCb [199]	< 5200.0	< 5200
			< 6800
$\mathcal{B}(B_s^0 \to \mu^+\mu^-\mu^+\mu^-)$	LHCb [200]	< 0.0025 [4]	< 0.0025
$\mathcal{B}(B_s^0 \to \phi(1020)\mu^+\mu^-)$[5,6]	LHCb [201]	$0.859 \pm 0.023 \pm 0.061$ [7,8]	$0.865\,^{+0.066}_{-0.064}$
	CDF [173]	$1.21 \pm 0.20 \pm 0.11$ [8]	$0.823\,^{+0.119}_{-0.116}$
$\mathcal{B}(B_s^0 \to \overline{K}^*(892)^0\mu^+\mu^-)$	LHCb [202]	$0.029 \pm 0.010 \pm 0.004$ [7]	0.029 ± 0.011
$\mathcal{B}(B_s^0 \to \pi^+\pi^-\mu^+\mu^-)$	LHCb [150][9,10]		0.084 ± 0.016
			0.084 ± 0.017
$\mathcal{B}(B_s^0 \to \phi(1020)\nu\overline{\nu})$	DELPHI [110]	< 5400	< 5400
$\mathcal{B}(B_s^0 \to e^+\mu^-+\text{c.c.})$	LHCb [203]	< 0.0054	< 0.0054
	CDF [198]	< 0.2	
$\mathcal{B}(B_s^0 \to \tau^+\mu^-+\text{c.c.})$[3]	LHCb [204]	< 34.0	< 34
			< 42
$\mathcal{B}(B_s^0 \to \eta'\eta)$	Belle [205]	< 65	< 65
			none
$\mathcal{B}(B_s^0 \to f_2'(1525)\mu^+\mu^-)$	LHCb [201]	$0.166 \pm 0.020 \pm 0.015$ [7,8]	$0.166\,^{+0.026}_{-0.024}$
			none

[1] Using $\mathcal{B}(B^0 \to K^*(892)^0\gamma)$.
[2] The ATLAS measurement is correlated with $\mathcal{B}(B^0 \to \mu^+\mu^-)$. This correlation is not taken into account in our average. For more information see Ref. [206].
[3] PDG shows the result obtained at 95% CL.
[4] At CL=95 %.
[5] The PDG uncertainty includes a scale factor.
[6] Treatment of charmonium intermediate components differs between the results.
[7] Multiple systematic uncertainties are added in quadrature.
[8] Using $\mathcal{B}(B_s^0 \to J/\psi\phi(1020))$.
[9] $0.5 < m_{\pi^+\pi^-} < 1.3$ GeV/c^2.
[10] 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 45: Relative branching fractions of charmless 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 [94] CDF [91]	$0.915 \pm 0.071 \pm 0.083$ $0.8 \pm 0.2 \pm 0.1$	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 [93]	$5.0\,^{+1.1}_{-0.9} \pm 0.4$	$5.0\,^{+1.2}_{-1.0}$
$\frac{\mathcal{B}(B_s^0 \to \phi(1020)\phi(1020))}{\mathcal{B}(B_s^0 \to J/\psi\phi(1020))}$ [1]	CDF [187]	$1.78 \pm 0.14 \pm 0.20$	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 [126]	$184 \pm 5 \pm 13$ [2]	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 [93] CDF [90]	$7.4 \pm 0.6 \pm 0.6$ $7.1 \pm 1.0 \pm 0.7$	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 [93] CDF [92]	$31.6 \pm 0.9 \pm 1.9$ $34.7 \pm 2.0 \pm 2.1$	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 [107]	$19.1 \pm 2.7 \pm 3.3$ [3,2]	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 [107]	$170 \pm 7 \pm 15$ [3,2]	170 ± 16
$\frac{\mathcal{B}(B_s^0 \to K^0K^+K^-)}{\mathcal{B}(B^0 \to K^0\pi^+\pi^-)}$	LHCb [107]	< 5.1 [3]	< 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 [127]	$111 \pm 22 \pm 13$ [2]	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]	$11.3 \pm 2.4 \pm 1.6$ [2]	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 [201] CDF [173]	$0.0800 \pm 0.0021 \pm 0.0016$ [2] $0.113 \pm 0.019 \pm 0.007$	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 46: Relative branching fractions of charmless 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 [167]	$22 \pm 4 \pm 2$ [1,2]	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 [167]	$31 \pm 5 \pm 2$ [1]	31 ± 5
$\frac{\mathcal{B}(B_s^0 \to \overline{K}^*(892)^0\mu^+\mu^-)}{\mathcal{B}(B_s^0 \to J/\psi\overline{K}^*(892)^0)\times\mathcal{B}(J/\psi\to\mu^+\mu^-)}$	LHCb [202]	$1.4 \pm 0.4 \pm 0.1$ [2]	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 [202]	$3.3 \pm 1.1 \pm 0.4$ [2]	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 [207]	$11.7 \pm 3.0 \pm 1.5$	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]	$230 \pm 40 \pm 22$ [2]	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 [106]	$33 \pm 7 \pm 4$ [2]	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 [201]	$0.0155 \pm 0.0019 \pm 0.0008$ [2]	0.0155 ± 0.0021
$\frac{\mathcal{B}(B_s^0 \to \pi^+\pi^-\mu^+\mu^-)}{\mathcal{B}(B^0 \to J/\psi K^{*0})\times\mathcal{B}(J/\psi\to\mu^+\mu^-)\times\mathcal{B}(K^{*0}\to K^+\pi^-)}$	LHCb [150]	$0.167 \pm 0.029 \pm 0.013$ [3]	0.167 ± 0.032

[1] $m_{p\overline{p}} < 2.85$ GeV/c^2.
[2] Multiple systematic uncertainties are added in quadrature.
[3] $0.5 < m_{\pi^+\pi^-} < 1.3$ GeV/c^2.

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

- In Ref. [201], LHCb reports the differential $B_s^0 \to \phi\mu^+\mu^-$ branching fraction in bins of $m^2(\mu^+\mu^-)$.
- In Ref. [208], LHCb performs an angular analysis of $B_s^0 \to \phi\mu^+\mu^-$ decays and reports the differential branching fractions, F_L, S_3, S_4, S_7, A_5, A_6, A_8 and A_9 in bins of $m^2(\mu^+\mu^-)$.
- In Ref. [209], LHCb reports the photon polarization in $B_s^0 \to \phi\gamma$ decays.

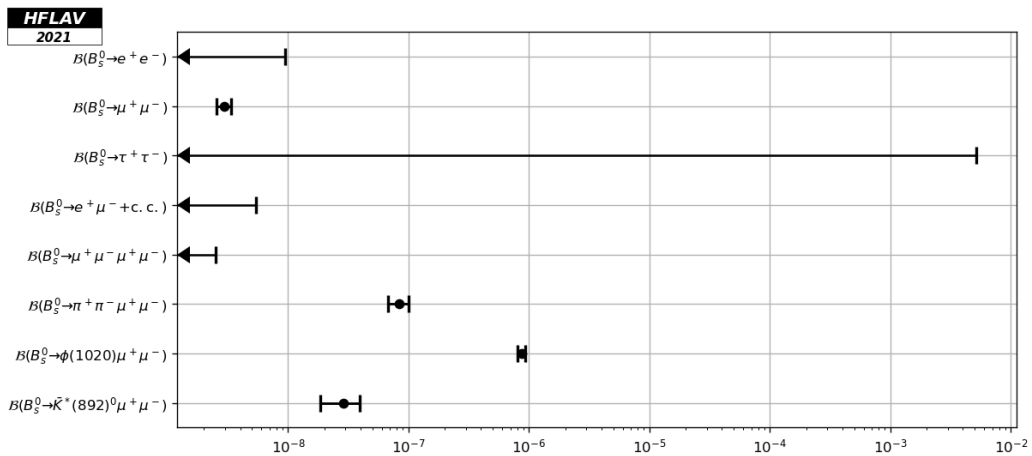

Figure 5: Branching fractions of charmless leptonic B_s^0 decays.

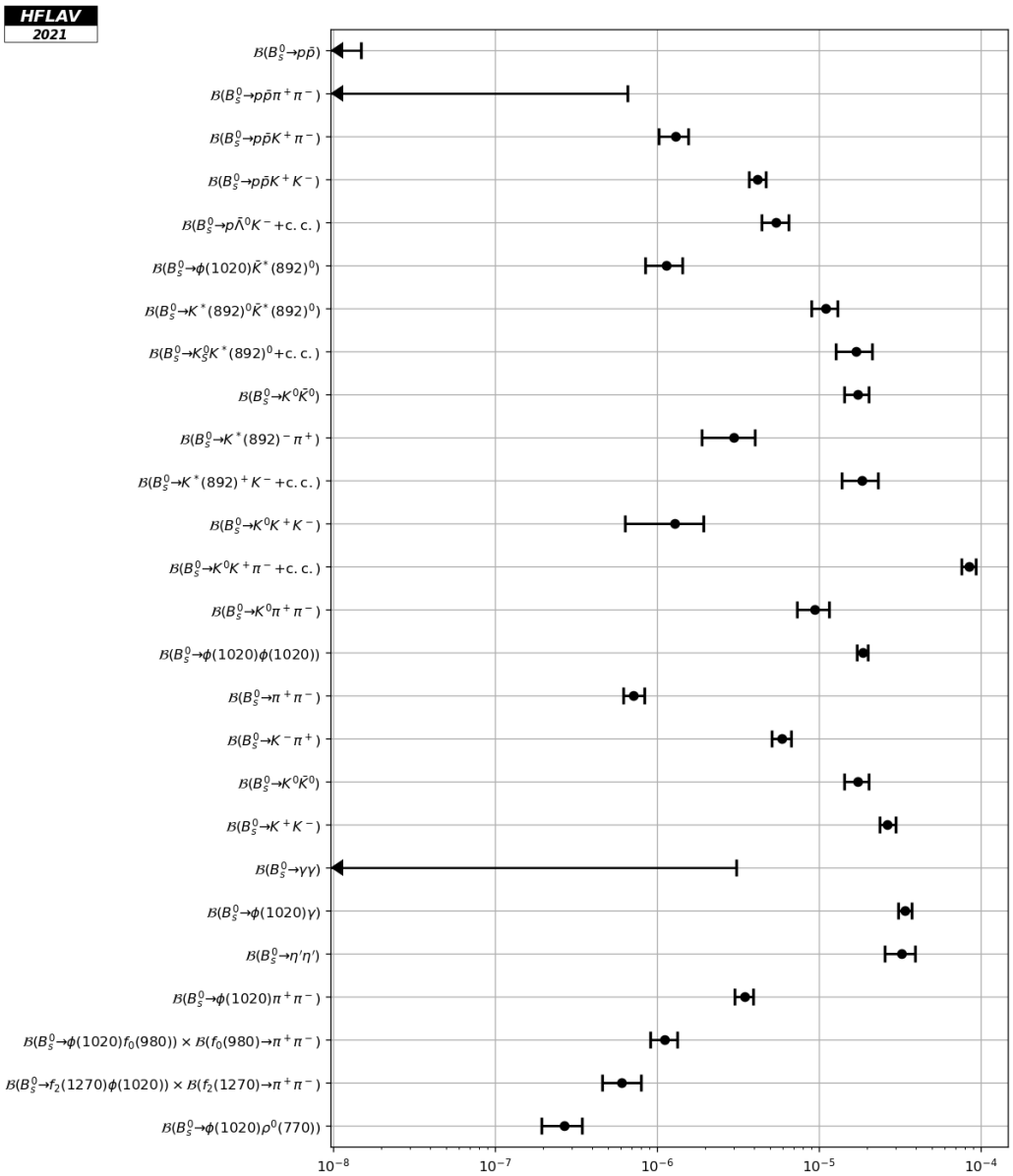

Figure 6: Branching fractions of charmless non-leptonic B_s^0 decays.

5 Decays of B_c^+ mesons

Table 47 details branching fractions and ratios of branching fractions of B_c^+ meson decays to charmless hadronic final states.

Table 47: Branching fractions and relative branching fractions of B_c^+ decays.

Parameter	**Measurements**		**Average**
$\mathcal{B}(B_c^+ \to p\overline{p}\pi^+) \times \frac{f_c}{f_u}$ $[10^{-8}]$	LHCb [210]	< 2.8 [1]	< 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]	< 5.8	< 5.8
$\mathcal{B}(B_c^+ \to K^+ \overline{K}^0)$[2] $[10^{-4}]$	LHCb [7]	< 4.6	< 4.6
$\mathcal{B}(B_c^+ \to K^+ K^- \pi^+) \times \frac{f_c}{f_u}$ $[10^{-7}]$	LHCb [211]	< 1.50 [3]	< 1.5
$\mathcal{B}(B_c^+ \to B_s^0 \pi^+) \times \frac{f_c}{f_s}$ $[10^{-3}]$	LHCb [212]	$2.37 \pm 0.31\,^{+0.20}_{-0.17}$ [4,5]	2.37 ± 0.36

[1] Measured in the region $m(p\overline{p}) < 2.85$ GeV/c^2, $p_T(B) < 20$ GeV/c and $2.0 < y(B) < 4.5$.
[2] Derived from the ratio in the previous entry using $\mathcal{B}(B^+ \to K^0\pi^+) = (23.97 \pm 0.53 \pm 0.71) \times 10^{-6}$, $f_u = 0.33$ and $f_c = 0.001$.
[3] 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 $2.0 < y(B) < 4.5$
[4] In the pseudorapidity range $2 < \eta(B) < 5$.
[5] Multiple systematic uncertainties are added in quadrature.

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 48 to 50, 51 to 54 and 55 to 57 provide compilations of branching fractions of radiative and FCNC decays with leptons of B^+ mesons, B^0 mesons and their admixture, respectively. Tables 54 and 57 also include LFV/LNV decays. Tables 58 and 59 contain branching fractions of leptonic and radiative-leptonic B^+ and B^0 decays. These are followed by Tables 60 and 61, which give relative branching fractions of B^+ and B^0 decays, then Table 62, which gives a compilation of inclusive decays. In the modes listed in Table 62, the radiated particle is a gluon, which is an exception in this section. Table 63 contains isospin asymmetry measurements. Finally, Tables 64 to 65 and 66 provide compilations of branching fractions of B^+ and B^0 mesons to lepton-flavour/number-violating final states, respectively. Figures 7 to 12 show graphic representations of a selection of results given in this section.

Table 48: Branching fractions of charmless radiative and FCNC decays with leptons of B^+ mesons (part 1).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^+ \to K^*(892)^+\gamma)$[1]	Belle [213]	$37.6 \pm 1.0 \pm 1.2$	39.2 ± 1.2
	BaBar [214]	$42.2 \pm 1.4 \pm 1.6$	39.2 ± 2.2
	CLEO [215]	$37.6\,^{+8.9}_{-8.3} \pm 2.8$	
$\mathcal{B}(B^+ \to K_1(1270)^+\gamma)$	BaBar [216]	$44.1\,^{+6.3}_{-4.4} \pm 5.8$ [2]	$43.8\,^{+7.0}_{-6.3}$
	Belle [217]	$43.0 \pm 9.0 \pm 9.0$ [3]	$43.8\,^{+7.1}_{-6.3}$
$\mathcal{B}(B^+ \to \eta K^+\gamma)$	BaBar [218]	$7.7 \pm 1.0 \pm 0.4$ [4]	7.89 ± 0.92
	Belle [219]	$8.4 \pm 1.5\,^{+1.2}_{-0.9}$ [5]	$7.88\,^{+0.94}_{-0.92}$
$\mathcal{B}(B^+ \to \eta' K^+\gamma)$	Belle [220]	$3.6 \pm 1.2 \pm 0.4$ [6]	2.9 ± 1.0
	BaBar [221]	$1.9\,^{+1.5}_{-1.2} \pm 0.1$ [4]	$2.9\,^{+1.0}_{-0.9}$
$\mathcal{B}(B^+ \to \phi(1020)K^+\gamma)$[1]	Belle [222]	$2.48 \pm 0.30 \pm 0.24$	2.71 ± 0.34
	BaBar [223]	$3.5 \pm 0.6 \pm 0.4$ [7]	2.71 ± 0.42
$\mathcal{B}(B^+ \to K^+\pi^-\pi^+\gamma)$[1]	BaBar [216]	$24.5 \pm 0.9 \pm 1.2$ [8]	24.6 ± 1.3
	Belle [217]	$25.0 \pm 1.8 \pm 2.2$ [3]	25.8 ± 1.5
$\mathcal{B}(B^+ \to K^*(892)^0\pi^+\gamma)$	BaBar [216]	$23.4 \pm 0.9\,^{+0.8}_{-0.7}$ [8]	23.3 ± 1.2
	Belle [224]	$20.0\,^{+7.0}_{-6.0} \pm 2.0$ [9]	$23.3\,^{+1.2}_{-1.1}$
$\mathcal{B}(B^+ \to K^+\rho^0(770)\gamma)$	BaBar [216]	$8.2 \pm 0.4 \pm 0.8$ [8]	8.2 ± 0.9
	Belle [224]	< 20.0 [9]	
$\mathcal{B}(B^+ \to (K\pi)_0^{*0}\pi^+\gamma) \times \mathcal{B}((K\pi)_0^{*0} \to K^+\pi^-)$[10]			
	BaBar [216]	$10.3\,^{+0.7}_{-0.8}\,^{+1.5}_{-2.0}$ [8]	$10.3\,^{+1.7}_{-2.2}$
			none
$\mathcal{B}(B^+ \to K^+\pi^-\pi^+\gamma(\mathrm{NR}))$	BaBar [216]	$9.9 \pm 0.7\,^{+1.5}_{-1.9}$ [8,11]	$9.9\,^{+1.7}_{-2.0}$
	Belle [224]	< 9.2 [12]	

[1] The PDG uncertainty includes a scale factor.
[2] Multiple systematic uncertainties are added in quadrature.
[3] $1 < M_{K\pi\pi} < 2$ GeV/c^2.
[4] $M_{K\eta^{(\prime)}} < 3.25$ GeV/c^2.
[5] $M_{K\eta} < 2.4$ GeV/c^2.
[6] $M_{K\eta'} < 3.4$ GeV/c^2
[7] $M_{\phi K} < 3.0$ GeV/c^2.
[8] $M_{K\pi\pi} < 1.8$ GeV/c^2.
[9] $M_{K\pi\pi} < 2.4$ GeV/c^2.
[10] This corresponds to the $(K\pi)$ S-wave obtained with LASS parameterisation [225].
[11] $M_{K\pi} < 1.6$ GeV/c^2.
[12] $1.25 < M_{K\pi} < 1.6$ GeV/c^2 and $M_{K\pi\pi} < 2.4$ GeV/c^2.

Table 49: Branching fractions of charmless radiative and FCNC decays with leptons of B^+ mesons (part 2).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^+ \to K^0\pi^+\pi^0\gamma)$	BaBar [226]	$45.6 \pm 4.2 \pm 3.1$ [1]	45.6 ± 5.2
$\mathcal{B}(B^+ \to K_1(1400)^+\gamma)$	BaBar [216] Belle [217]	$9.7\,^{+4.6}_{-2.9}\,^{+2.9}_{-2.4}$ [1,2] < 15.0	$9.7\,^{+5.4}_{-3.8}$
$\mathcal{B}(B^+ \to K^*(1410)^+\gamma)$	BaBar [216]	$27.1\,^{+5.4}_{-4.8}\,^{+5.9}_{-3.7}$ [1,2]	$27.1\,^{+8.0}_{-6.1}$
$\mathcal{B}(B^+ \to K_0^*(1430)^0\pi^+\gamma)$	BaBar [216]	$1.32\,^{+0.09}_{-0.10}\,^{+0.24}_{-0.30}$ [1,2]	$1.32\,^{+0.26}_{-0.31}$ $1.32\,^{+0.26}_{-0.32}$
$\mathcal{B}(B^+ \to K_2^*(1430)^+\gamma)$	BaBar [227] BaBar [216]	$14.5 \pm 4.0 \pm 1.5$ $8.7\,^{+7.0}_{-5.3}\,^{+8.7}_{-10.4}$ [1,2]	13.8 ± 4.0
$\mathcal{B}(B^+ \to K^*(1680)^+\gamma)$	BaBar [216]	$66.7\,^{+9.3}_{-7.8}\,^{+14.4}_{-11.4}$ [1,2]	$67\,^{+17}_{-14}$
$\mathcal{B}(B^+ \to K_3^*(1780)^+\gamma)$	Belle [219]	< 9.7	< 9.7 < 39.0
$\mathcal{B}(B^+ \to K_4^*(2045)^+\gamma)$	ARGUS [228]	< 9900	< 9900
$\mathcal{B}(B^+ \to \rho^+(770)\gamma)$	Belle [229] BaBar [230]	$0.87\,^{+0.29}_{-0.27}\,^{+0.09}_{-0.11}$ $1.2 \pm 0.4 \pm 0.2$	0.98 ± 0.24 $0.98\,^{+0.25}_{-0.24}$
$\mathcal{B}(B^+ \to p\overline{\Lambda}^0\gamma)$	Belle [161]	$2.45\,^{+0.44}_{-0.38} \pm 0.22$	$2.45\,^{+0.49}_{-0.44}$
$\mathcal{B}(B^+ \to p\overline{\Sigma}^0\gamma)$	Belle [231]	< 4.6	< 4.6
$\mathcal{B}(B^+ \to \pi^+\ell^+\ell^-)$[3]	Belle [232] BaBar [233]	< 0.049 < 0.066	< 0.049
$\mathcal{B}(B^+ \to \pi^+e^+e^-)$[3]	Belle [232] BaBar [233]	< 0.08 < 0.125	< 0.08
$\mathcal{B}(B^+ \to \pi^+\mu^+\mu^-)$[3]	BaBar [233] Belle [232] LHCb [234][4,5]	< 0.055 < 0.069	0.0178 ± 0.0023
$\mathcal{B}(B^+ \to \pi^+\nu\overline{\nu})$	Belle [235] BaBar [236]	< 14.0 < 100.0	< 14

[1] $M_{K\pi\pi} < 1.8$ GeV/c^2.
[2] Multiple systematic uncertainties are added in quadrature.
[3] Treatment of charmonium intermediate components differs between the results.
[4] LHCb also reports the branching fraction in bins of $m^2_{\ell^+\ell^-}$.
[5] 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 50: Branching fractions of charmless radiative and FCNC decays with leptons of B^+ mesons (part 3).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^+ \to K^+\ell^+\ell^-)$[1]	LHCb [237]	$0.429 \pm 0.007 \pm 0.021$ [2]	0.463 ± 0.019
	Belle [238]	$0.599\,^{+0.045}_{-0.043} \pm 0.014$	p=3.3‰
	BaBar [239]	$0.476\,^{+0.092}_{-0.086} \pm 0.022$	0.471 ± 0.046
$\mathcal{B}(B^+ \to K^+e^+e^-)$[1]	Belle [238]	$0.575\,^{+0.064}_{-0.061} \pm 0.015$	0.561 ± 0.056
	BaBar [239]	$0.51\,^{+0.12}_{-0.11} \pm 0.02$	$0.560\,^{+0.058}_{-0.055}$
$\mathcal{B}(B^+ \to K^+\mu^+\mu^-)$[3,1]	LHCb [237]	$0.429 \pm 0.007 \pm 0.021$	0.450 ± 0.021
	Belle [238]	$0.624\,^{+0.065}_{-0.061} \pm 0.016$	0.453 ± 0.035
	BaBar [239]	$0.41\,^{+0.16}_{-0.15} \pm 0.02$	
$\mathcal{B}(B^+ \to K^+\tau^+\tau^-)$	BaBar [240]	< 2250.0	< 2250
$\mathcal{B}(B^+ \to K^+\nu\overline{\nu})$	BaBar [241]	< 16.0	< 16
	Belle [235]	< 19.0	
	Belle II [242]	< 41.0	
$\mathcal{B}(B^+ \to \rho^+(770)\nu\overline{\nu})$	Belle [235]	< 30.0	< 30
$\mathcal{B}(B^+ \to K^*(892)^+\ell^+\ell^-)$[3,1]	LHCb [237]	$0.924 \pm 0.093 \pm 0.067$ [2]	1.010 ± 0.099
	Belle [243]	$1.24\,^{+0.23}_{-0.21} \pm 0.13$	$1.009\,^{+0.113}_{-0.112}$
	BaBar [239]	$1.40\,^{+0.40}_{-0.37} \pm 0.09$	
$\mathcal{B}(B^+ \to K^*(892)^+e^+e^-)$[1]	BaBar [239]	$1.38\,^{+0.47}_{-0.42} \pm 0.08$	1.55 ± 0.33
	Belle [243]	$1.73\,^{+0.50}_{-0.42} \pm 0.20$	$1.55\,^{+0.36}_{-0.31}$
$\mathcal{B}(B^+ \to K^*(892)^+\mu^+\mu^-)$[1]	LHCb [237]	$0.924 \pm 0.093 \pm 0.067$	0.96 ± 0.10
	Belle [243]	$1.11\,^{+0.32}_{-0.27} \pm 0.10$	
	BaBar [239]	$1.46\,^{+0.79}_{-0.75} \pm 0.12$	
$\mathcal{B}(B^+ \to K^*(892)^+\nu\overline{\nu})$	Belle [244]	< 40.0	< 40
	Belle [235]	< 61.0	
	BaBar [241]	< 64.0	
$\mathcal{B}(B^+ \to K^+\pi^+\pi^-\mu^+\mu^-)$	LHCb [245]	$0.4337\,^{+0.0287}_{-0.0268} \pm 0.0254$ [4]	0.434 ± 0.038
			$0.433\,^{+0.038}_{-0.037}$
$\mathcal{B}(B^+ \to \phi(1020)K^+\mu^+\mu^-)$	LHCb [245]	$0.0790\,^{+0.0180}_{-0.0160}\,^{+0.0114}_{-0.0072}$ [5]	$0.079\,^{+0.022}_{-0.017}$
			$0.079\,^{+0.021}_{-0.017}$
$\mathcal{B}(B^+ \to \overline{\Lambda}^0 p\nu\overline{\nu})$	BaBar [246]	< 30.0	< 30

[1] Treatment of charmonium intermediate components differs between the results.
[2] Only muons are used.
[3] The PDG uncertainty includes a scale factor.
[4] Using $\mathcal{B}(B^+ \to \psi(2S)K^+)$.
[5] Using $\mathcal{B}(B^+ \to J/\psi\phi(1020)K^+)$.

Table 51: Branching fractions of charmless radiative and FCNC decays with leptons of B^0 mesons (part 1).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^0 \to \eta K^0 \gamma)$	BaBar [218]	$7.1\,^{+2.1}_{-2.0} \pm 0.4$ [1]	7.6 ± 1.8
	Belle [219]	$8.7\,^{+3.1}_{-2.7}\,^{+1.9}_{-1.6}$ [2]	$7.6\,^{+1.8}_{-1.7}$
$\mathcal{B}(B^0 \to \eta' K^0 \gamma)$	Belle [220]	< 6.4 [3]	< 6.4
	BaBar [221]	< 6.6 [1]	
$\mathcal{B}(B^0 \to \phi(1020) K^0 \gamma)$	Belle [222]	$2.74 \pm 0.60 \pm 0.32$	2.74 ± 0.68
	BaBar [223]	< 27 [4]	
$\mathcal{B}(B^0 \to K^+ \pi^- \gamma)$	Belle [224]	$4.6\,^{+1.3}_{-1.2}\,^{+0.5}_{-0.7}$ [5]	4.6 ± 1.4
$\mathcal{B}(B^0 \to K^*(892)^0 \gamma)$[6]	Belle [213]	$39.6 \pm 0.7 \pm 1.4$	
	BaBar [214]	$44.7 \pm 1.0 \pm 1.6$	41.8 ± 1.2
	CLEO [215]	$45.5\,^{+7.2}_{-6.8} \pm 3.4$	41.8 ± 2.5
	LHCb [192][7], [176][8]		
$\mathcal{B}(B^0 \to K^*(1410)^0 \gamma)$	Belle [224]	< 130.0 [5]	< 130
$\mathcal{B}(B^0 \to K^+ \pi^- \gamma(\mathrm{NR}))$	Belle [224]	< 2.6 [5]	< 2.6
$\mathcal{B}(K^{*0} X(214)) \times \mathcal{B}(X(214) \to \mu^+ \mu^-)$			
	Belle [247]	< 0.0226 [9]	< 0.023
$\mathcal{B}(B^0 \to K^0 \pi^+ \pi^- \gamma)$	BaBar [216]	$20.5 \pm 2.0\,^{+2.6}_{-2.2}$ [10]	
	BaBar [226]	$18.5 \pm 2.1 \pm 1.2$ [10]	19.9 ± 1.8
	Belle [217]	$24.0 \pm 4.0 \pm 3.0$ [11]	
$\mathcal{B}(B^0 \to K^+ \pi^- \pi^0 \gamma)$	BaBar [226]	$40.7 \pm 2.2 \pm 3.1$ [10]	40.7 ± 3.8
$\mathcal{B}(B^0 \to K_1(1270)^0 \gamma)$	Belle [217]	< 58.0	< 58

[1] $M_{K\eta^{(\prime)}} < 3.25$ GeV/c^2.
[2] $M_{K\eta} < 2.4$ GeV/c^2.
[3] $M_{K\eta'} < 3.4$ GeV/c^2
[4] $M_{\phi K} < 3.0$ GeV/c^2.
[5] $1.25 < M_{K\pi} < 1.6$ GeV/c^2.
[6] The PDG uncertainty includes a scale factor.
[7] Measurement of $\mathcal{B}(B_s^0 \to \phi(1020)\gamma)/\mathcal{B}(B^0 \to K^*(892)^0\gamma)$ used in our fit.
[8] 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.
[9] $X(214)$ is searched in the mass range $[212, 300]$ MeV/c^2.
[10] $M_{K\pi\pi} < 1.8$ GeV/c^2.
[11] $1 < M_{K\pi\pi} < 2$ GeV/c^2.

Table 52: Branching fractions of charmless radiative and FCNC decays with leptons of B^0 mesons (part 2).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^0 \to K_1(1400)^0\gamma)$	Belle [217]	< 12.0	< 12
$\mathcal{B}(B^0 \to K_2^*(1430)^0\gamma)$	BaBar [227] Belle [224]	$12.2 \pm 2.5 \pm 1.0$ $13.0 \pm 5.0 \pm 1.0$	12.4 ± 2.4
$\mathcal{B}(B^0 \to K_3^*(1780)^0\gamma)$	Belle [219]	< 21	< 21 < 83
$\mathcal{B}(B^0 \to \rho^0(770)\gamma)$	Belle [229] BaBar [230]	$0.78\,^{+0.17}_{-0.16}\,^{+0.09}_{-0.10}$ $0.97\,^{+0.24}_{-0.22} \pm 0.06$	0.86 ± 0.15
$\mathcal{B}(\rho^0 X(214)) \times \mathcal{B}(X(214) \to \mu^+\mu^-)$	Belle [247]	< 0.0173 [1]	< 0.017
$\mathcal{B}(B^0 \to \omega(782)\gamma)$	Belle [229] BaBar [230]	$0.40\,^{+0.19}_{-0.17} \pm 0.13$ $0.50\,^{+0.27}_{-0.23} \pm 0.09$	0.44 ± 0.17 $0.44\,^{+0.18}_{-0.16}$
$\mathcal{B}(B^0 \to \phi(1020)\gamma)$	Belle [248] BaBar [249]	< 0.1 < 0.85	< 0.1
$\mathcal{B}(B^0 \to p\overline{\Lambda}^0\pi^-\gamma)$	Belle [250]	< 0.65	< 0.65
$\mathcal{B}(B^0 \to \pi^0\ell^+\ell^-)$ [2]	BaBar [233] Belle [232]	< 0.053 < 0.154	< 0.053
$\mathcal{B}(B^0 \to \pi^0 e^+e^-)$ [2]	BaBar [233] Belle [232]	< 0.084 < 0.227	< 0.084
$\mathcal{B}(B^0 \to \pi^0\mu^+\mu^-)$ [2]	BaBar [233] Belle [232]	< 0.069 < 0.184	< 0.069

[1] $X(214)$ is searched in the mass range $[212, 300]$ MeV/c^2.
[2] Treatment of charmonium intermediate components differs between the results.

Table 53: Branching fractions of charmless radiative and FCNC decays with leptons of B^0 mesons (part 3).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^0 \to \eta\ell^+\ell^-)$	BaBar [233]	< 0.064	< 0.064
$\mathcal{B}(B^0 \to \eta e^+e^-)$	BaBar [233]	< 0.108	< 0.11
$\mathcal{B}(B^0 \to \eta\mu^+\mu^-)$	BaBar [233]	< 0.112	< 0.11
$\mathcal{B}(B^0 \to \pi^0\nu\overline{\nu})$	Belle [235]	< 9.0	< 9.0
$\mathcal{B}(B^0 \to K^0\ell^+\ell^-)$[1]	LHCb [237]	$0.327 \pm 0.034 \pm 0.017$ [2]	0.328 ± 0.032
	Belle [238]	$0.351\,^{+0.069}_{-0.060} \pm 0.010$	$0.329\,^{+0.063}_{-0.055}$
	BaBar [239]	$0.21\,^{+0.15}_{-0.13} \pm 0.02$	
$\mathcal{B}(B^0 \to K^0e^+e^-)$[1]	Belle [238]	$0.306\,^{+0.098}_{-0.086} \pm 0.008$	0.249 ± 0.072
	BaBar [239]	$0.08\,^{+0.15}_{-0.12} \pm 0.01$	$0.247\,^{+0.109}_{-0.094}$
$\mathcal{B}(B^0 \to K^0\mu^+\mu^-)$[1]	LHCb [237]	$0.327 \pm 0.034 \pm 0.017$	0.341 ± 0.034
	Belle [238]	$0.394\,^{+0.096}_{-0.084} \pm 0.012$	0.339 ± 0.035
	BaBar [239]	$0.49\,^{+0.29}_{-0.25} \pm 0.03$	
$\mathcal{B}(B^0 \to K^0\nu\overline{\nu})$	Belle [235]	< 26.0	< 26
	BaBar [241]	< 49.0	
$\mathcal{B}(B^0 \to \rho^0(770)\nu\overline{\nu})$	Belle [235]	< 40.0	< 40
$\mathcal{B}(B^0 \to K^*(892)^0\ell^+\ell^-)$[1]	Belle [243]	$0.97\,^{+0.13}_{-0.11} \pm 0.07$	0.99 ± 0.12
	BaBar [239]	$1.03\,^{+0.22}_{-0.21} \pm 0.07$	$0.99\,^{+0.12}_{-0.11}$
$\mathcal{B}(B^0 \to K^*(892)^0e^+e^-)$[1]	Belle [243]	$1.18\,^{+0.27}_{-0.22} \pm 0.09$	1.04 ± 0.17
	BaBar [239]	$0.86\,^{+0.26}_{-0.24} \pm 0.05$	$1.03\,^{+0.19}_{-0.17}$
$\mathcal{B}(B^0 \to K^*(892)^0\mu^+\mu^-)$[1]	LHCb [251]	$0.904\,^{+0.016}_{-0.015} \pm 0.062$ [3]	0.94 ± 0.06
	Belle [243]	$1.06\,^{+0.19}_{-0.14} \pm 0.07$	0.94 ± 0.05
	BaBar [239]	$1.35\,^{+0.40}_{-0.37} \pm 0.10$	

[1] Treatment of charmonium intermediate components differs between the results.
[2] Only muons are used.
[3] Multiple systematic uncertainties are added in quadrature.

Table 54: Branching fractions of charmless radiative and FCNC decays with leptons of B^0 mesons (part 4).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV PDG
$\mathcal{B}(B^0 \to \pi^+\pi^-\mu^+\mu^-)$	LHCb [150][1,2,3]		0.021 ± 0.005
$\mathcal{B}(B^0 \to K^*(892)^0\nu\overline{\nu})$	Belle [235]	< 18.0	< 18
	Belle [244]	< 55.0	
	BaBar [241]	< 120.0	
$\mathcal{B}(B^0 \to \phi(1020)\nu\overline{\nu})$	Belle [244]	< 127.0	< 127
$\mathcal{B}(B^0 \to \pi^0 e^+\mu^-$+c.c.)	BaBar [252]	< 0.14	< 0.14
$\mathcal{B}(B^0 \to K^0 e^+\mu^-$+c.c.)	Belle [238]	< 0.038	< 0.038
	BaBar [253]	< 0.27	
$\mathcal{B}(B^0 \to K^*(892)^0 e^+\mu^-)$	Belle [254]	< 0.16	< 0.16
	BaBar [253]	< 0.53	
$\mathcal{B}(B^0 \to K^*(892)^0 e^-\mu^+)$	Belle [254]	< 0.12	< 0.12
	BaBar [253]	< 0.34	
$\mathcal{B}(B^0 \to K^*(892)^0 e^+\mu^-$+c.c.)	Belle [254]	< 0.18	< 0.18
	BaBar [253]	< 0.58	
$\mathcal{B}(B^0 \to \Lambda_c^+\mu^-)$	BaBar [255]	< 1.4	< 1.4
$\mathcal{B}(B^0 \to \Lambda_c^+ e^-)$	BaBar [255]	< 4.0	< 4.0

[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.

Table 55: Branching fractions of charmless 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 [219]	$8.5 \pm 1.3\,^{+1.2}_{-0.9}$ [1]	$8.5\,^{+1.8}_{-1.6}$
$\mathcal{B}(B \to K_1(1400)\gamma)$	CLEO [215]	< 127	< 127
$\mathcal{B}(B \to K_2^*(1430)\gamma)$	CLEO [215]	$16.6\,^{+5.9}_{-5.3} \pm 1.3$	$16.6\,^{+6.0}_{-5.5}$
$\mathcal{B}(B \to K_3^*(1780)\gamma)$	Belle [219]	< 9.3	< 9.3 < 37.0
$\mathcal{B}(B \to X_s\gamma)$	Belle [256] BaBar [257] Belle [258] BaBar [259] CLEO [260] BaBar [261]	$347 \pm 15 \pm 40$ [2] $332 \pm 16 \pm 31$ [2] $375 \pm 18 \pm 35$ [2] $352 \pm 20 \pm 51$ [2] $329 \pm 44 \pm 29$ [2] $390 \pm 91 \pm 64$ [2]	349 ± 19
$\mathcal{B}(B \to X_d\gamma)$	BaBar [262]	$9.2 \pm 2.0 \pm 2.3$	9.2 ± 3.0
$\mathcal{B}(B \to \rho\gamma)$ [3]	Belle [229] BaBar [230]	$1.21\,^{+0.24}_{-0.22} \pm 0.12$ $1.73\,^{+0.34}_{-0.32} \pm 0.17$	1.40 ± 0.22 $1.39\,^{+0.25}_{-0.24}$
$\mathcal{B}(B \to \rho/\omega\gamma)$ [3]	Belle [229] BaBar [230]	$1.14 \pm 0.20\,^{+0.10}_{-0.12}$ $1.63\,^{+0.30}_{-0.28} \pm 0.16$	1.30 ± 0.18 $1.30\,^{+0.23}_{-0.24}$
$\mathcal{B}(B \to X_s e^+e^-)$ [3,4,5]	BaBar [263] Belle [264]	$7.69\,^{+0.82}_{-0.77}\,^{+0.71}_{-0.60}$ [6] $4.04 \pm 1.30\,^{+0.87}_{-0.83}$	6.67 ± 0.83 $6.67\,^{+1.76}_{-1.63}$
$\mathcal{B}(B \to X_s \mu^+\mu^-)$ [4,5]	Belle [264] BaBar [263]	$4.13 \pm 1.05\,^{+0.85}_{-0.81}$ $4.41\,^{+1.31}_{-1.17}\,^{+0.63}_{-0.50}$ [6]	4.27 ± 0.95 $4.27\,^{+0.99}_{-0.92}$
$\mathcal{B}(B \to X_s \ell^+\ell^-)$ [4,3,5]	BaBar [263] Belle [264]	$6.73\,^{+0.70}_{-0.64}\,^{+0.60}_{-0.56}$ [6] $4.11 \pm 0.83\,^{+0.85}_{-0.81}$	5.84 ± 0.69 $5.84\,^{+1.31}_{-1.23}$

[1] $M_{K\eta} < 2.4$ GeV/c^2.

[2] Measurement extrapolated to $E_\gamma > 1.6$ GeV using the method from Ref. [265].

[3] The PDG uncertainty includes a scale factor.

[4] Belle uses $m_{\ell^+\ell^-} > 0.2$ GeV/c^2, Babar uses $m_{\ell^+\ell^-} > 0.1$ GeV/c^2.

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

[6] Multiple systematic uncertainties are added in quadrature.

Table 56: Branching fractions of charmless 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 [233]	< 0.059	< 0.059
	Belle [232]	< 0.062	
$\mathcal{B}(B \to \pi e^+e^-)$	BaBar [233]	< 0.11	< 0.11
$\mathcal{B}(B \to \pi\mu^+\mu^-)$	BaBar [233]	< 0.05	< 0.05
$\mathcal{B}(B \to Ke^+e^-)^1$	Belle [243]	$0.48\,^{+0.08}_{-0.07} \pm 0.03$	0.44 ± 0.06
	BaBar [239]	$0.388\,^{+0.090}_{-0.083} \pm 0.020$	
$\mathcal{B}(B \to K^*e^+e^-)^{2,1}$	Belle [243]	$1.39\,^{+0.23}_{-0.20} \pm 0.12$	1.20 ± 0.16
	BaBar [239]	$0.99\,^{+0.23}_{-0.21} \pm 0.06$	$1.19\,^{+0.21}_{-0.19}$
$\mathcal{B}(B \to K\mu^+\mu^-)^1$	CDF [173]	$0.42 \pm 0.04 \pm 0.02$	0.442 ± 0.036
	Belle [243]	$0.50 \pm 0.06 \pm 0.03$	
	BaBar [239]	$0.41\,^{+0.13}_{-0.12} \pm 0.02$	
$\mathcal{B}(B \to K^*\mu^+\mu^-)^1$	CDF [173]	$1.01 \pm 0.10 \pm 0.05$	1.06 ± 0.09
	Belle [243]	$1.10\,^{+0.16}_{-0.14} \pm 0.08$	
	BaBar [239]	$1.35\,^{+0.35}_{-0.33} \pm 0.10$	
$\mathcal{B}(B \to K\ell^+\ell^-)^1$	Belle [243]	$0.48\,^{+0.05}_{-0.04} \pm 0.03$	0.48 ± 0.04
	BaBar [266]	$0.47 \pm 0.06 \pm 0.02$	
$\mathcal{B}(B \to K^*\ell^+\ell^-)^1$	Belle [243]	$1.07\,^{+0.11}_{-0.10} \pm 0.09$	1.05 ± 0.10
	BaBar [266]	$1.02\,^{+0.14}_{-0.13} \pm 0.05$	

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

[2] The PDG uncertainty includes a scale factor.

Table 57: Branching fractions of charmless 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 [235]	< 16.0	< 16
	BaBar [241]	< 17.0	
$\mathcal{B}(B \to K^*\nu\overline{\nu})$	Belle [235]	< 27.0	< 27
	BaBar [241]	< 76.0	
$\mathcal{B}(B \to \pi\nu\overline{\nu})$	Belle [235]	< 8.0	< 8.0
$\mathcal{B}(B \to \rho\nu\overline{\nu})$	Belle [235]	< 28.0	< 28
$\mathcal{B}(B \to \pi e^{\pm}\mu^{\mp})$	BaBar [252]	< 0.092	< 0.092
$\mathcal{B}(B \to \rho e^{\pm}\mu^{\mp})$	CLEO [267]	< 3.2	< 3.2
$\mathcal{B}(B \to Ke^{\pm}\mu^{\mp})$	BaBar [253]	< 0.038	< 0.038
$\mathcal{B}(B \to K^*e^{\pm}\mu^{\mp})$	BaBar [253]	< 0.51	< 0.51

Table 58: Branching fractions of charmless 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 [268]	< 9.8	< 9.8
	BaBar [269]	< 19	
$\mathcal{B}(B^+ \to \mu^+\nu_\mu)$	Belle [270]	< 8.6	< 8.6
	BaBar [269]	< 10	
	Belle [271]	< 10.7	
$\mathcal{B}(B^+ \to \tau^+\nu_\tau)$[1]	Belle [272]	$720\,^{+270}_{-250} \pm 110$	1094 ± 208
	Belle [273]	$1250 \pm 280 \pm 270$	
	BaBar [274]	$1830\,^{+530}_{-490} \pm 240$	$1094\,^{+247}_{-236}$
	BaBar [275]	$1700 \pm 800 \pm 200$	
$\mathcal{B}(B^+ \to \ell^+\nu_\ell\gamma)$	Belle [276]	< 30 [2]	< 30
	BaBar [277]	< 156	
$\mathcal{B}(B^+ \to e^+\nu_e\gamma)$	Belle [276]	< 43 [2]	< 43
	BaBar [277]	< 170	
$\mathcal{B}(B^+ \to \mu^+\nu_\mu\gamma)$	Belle [276]	< 34 [2]	< 34
	BaBar [277]	< 260	
$\mathcal{B}(B^0 \to \gamma\gamma)$	BaBar [278]	< 3.3	< 3.3
	Belle [279]	< 6.2	< 3.2
$\mathcal{B}(B^0 \to e^+e^-)$	LHCb [197]	< 0.025	< 0.025
	CDF [198]	< 0.83	
	BaBar [280]	< 1.13	
	Belle [281]	< 1.9	
$\mathcal{B}(B^0 \to e^+e^-\gamma)$	BaBar [282]	< 1.2	< 1.2
$\mathcal{B}(B^0 \to \mu^+\mu^-)$	ATLAS [193]	< 0.0021 [3]	< 0.0021
	LHCb [194]	< 0.0034 [3]	
	CMS [195]	< 0.0036 [3]	
	CDF [196]	< 0.038	$0.0005\,^{+0.0017}_{-0.0015}$
	BaBar [280]	< 0.52	
	Belle [281]	< 1.6	

[1] The PDG uncertainty includes a scale factor.
[2] $E_\gamma > 1$ GeV.
[3] At CL=95 %.

Table 59: Branching fractions of charmless 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 [282]	< 1.5	< 1.5 < 1.6
$\mathcal{B}(B^0 \to \mu^+\mu^-\mu^+\mu^-)$	LHCb [200]	< 0.0069 [1,2]	< 0.0069
$\mathcal{B}(B^0 \to SP) \times \mathcal{B}(S \to \mu^+\mu^-) \times \mathcal{B}(P \to \mu^+\mu^-)$			
	LHCb [200]	< 0.006 [1,2]	< 0.0060
$\mathcal{B}(B^0 \to \tau^+\tau^-)$	LHCb [199]	< 21000 [2]	< 21000
	BaBar [283]	< 41000	
$\mathcal{B}(B^0 \to \nu\overline{\nu})$	BaBar [284]	< 240	< 240
	Belle [285]	< 780	
$\mathcal{B}(B^0 \to \nu\overline{\nu}\gamma)$	Belle [285]	< 160 [3]	< 160
	BaBar [284]	< 170 [4]	
$\mathcal{B}(B^+ \to \mu^+\mu^-\mu^+\nu_\mu)$	LHCb [286]	< 0.16 [2]	< 0.16

[1] The mass windows corresponding to ϕ and charmonium resonances decaying to $\mu\mu$ are vetoed.
[2] At CL=95 %.
[3] $E_\gamma > 0.5$ GeV.
[4] $E_\gamma > 1.2$ GeV.

Table 60: Relative branching fractions of charmless radiative and FCNC decays with leptons of B^+ and B^0 mesons (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 [234]	$0.038 \pm 0.009 \pm 0.001$	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 [238]	$1.08\,^{+0.16}_{-0.15} \pm 0.02$	1.08 ± 0.16
$\frac{\mathcal{B}(B^+\to K^+\mu^+\mu^-)}{\mathcal{B}(B^+\to K^+e^+e^-)}$, $1.1 < m^2_{\ell^+\ell^-} < 6.0$ GeV^2/c^4			
	LHCb [287]	$0.846\,^{+0.042}_{-0.039}\,^{+0.013}_{-0.012}$ [1]	0.846 ± 0.042
$\frac{\mathcal{B}(B^+\to K^+\mu^+\mu^-)}{\mathcal{B}(B^+\to K^+e^+e^-)}$, $0.10 < m^2_{\ell^+\ell^-} < 8.12$ GeV^2/c^4 and m$^2_{\ell^+\ell^-} > 10.11$ GeV^2/c^4			
	BaBar [266]	$1.00\,^{+0.31}_{-0.25} \pm 0.07$	$1.00\,^{+0.32}_{-0.26}$
$\frac{\mathcal{B}(B^+\to K^+\mu^+\mu^-)}{\mathcal{B}(B^+\to K^+e^+e^-)}$, $1.0 < m^2_{\ell^+\ell^-} < 6.0$ GeV^2/c^4 [2]			
	Belle [238]	$1.39\,^{+0.36}_{-0.33} \pm 0.02$	1.39 ± 0.35
$\frac{\mathcal{B}(B^0\to K^0_S\mu^+\mu^-)}{\mathcal{B}(B^0\to K^0_S e^+e^-)}$, Full m$^2_{\ell^+\ell^-}$ range	Belle [238]	$1.29\,^{+0.52}_{-0.45} \pm 0.01$	$1.29\,^{+0.52}_{-0.45}$
$\frac{\mathcal{B}(B^0\to K^0_S\mu^+\mu^-)}{\mathcal{B}(B^0\to K^0_S e^+e^-)}$, $1.0 < m^2_{\ell^+\ell^-} < 6.0$ GeV^2/c^4 [2]			
	Belle [238]	$0.55\,^{+0.46}_{-0.34} \pm 0.01$	$0.55\,^{+0.46}_{-0.34}$
$\frac{\mathcal{B}(B\to K\mu^+\mu^-)}{\mathcal{B}(B\to Ke^+e^-)}$, Full m$^2_{\ell^+\ell^-}$ range	Belle [238]	$1.10\,^{+0.16}_{-0.15} \pm 0.02$	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 [2]			
	Belle [238]	$1.03\,^{+0.28}_{-0.24} \pm 0.01$	$1.03\,^{+0.28}_{-0.24}$

[1] LHCb has also measured the branching fraction of $B^+ \to K^+e^+e^-$ in the $m^2_{\ell^+\ell^-}$ bin $[1.1, 6.0]$ GeV^2/c^4.

[2] For the other bins see the article.

Table 61: Relative branching fractions of charmless radiative and FCNC decays with leptons of B^+ and B^0 mesons (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 [243]	$0.83 \pm 0.17 \pm 0.08$	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 [266]	$1.13\,^{+0.34}_{-0.26} \pm 0.10$	$1.13\,^{+0.35}_{-0.28}$
$\frac{\mathcal{B}(B\to K^*\mu^+\mu^-)}{\mathcal{B}(B\to K^*e^+e^-)}$, $0.045 < m^2_{\ell^+\ell^-} < 1.1$ GeV^2/c^4			
	Belle [288]	$0.52\,^{+0.36}_{-0.26} \pm 0.06$	$0.52\,^{+0.36}_{-0.27}$
$\frac{\mathcal{B}(B\to K^*\mu^+\mu^-)}{\mathcal{B}(B\to K^*e^+e^-)}$, $1.1 < m^2_{\ell^+\ell^-} < 6.0$ GeV^2/c^4			
	Belle [288]	$0.96\,^{+0.45}_{-0.29} \pm 0.11$	$0.96\,^{+0.46}_{-0.31}$
$\frac{\mathcal{B}(B\to K^*\mu^+\mu^-)}{\mathcal{B}(B\to K^*e^+e^-)}$, $15 < m^2_{\ell^+\ell^-} < 19$ GeV^2/c^4			
	Belle [288]	$1.18\,^{+0.52}_{-0.32} \pm 0.11$	$1.18\,^{+0.53}_{-0.34}$
$\frac{\mathcal{B}(B^0\to K^*(892)^0\mu^+\mu^-)}{\mathcal{B}(B^0\to K^*(892)^0e^+e^-)}$, $0.045 < m^2_{\ell^+\ell^-} < 1.1$ GeV^2/c^4			
	LHCb [289]	$0.66\,^{+0.11}_{-0.07} \pm 0.03$	$0.65\,^{+0.11}_{-0.07}$
	Belle [288]	$0.46\,^{+0.55}_{-0.27} \pm 0.13$	
$\frac{\mathcal{B}(B^0\to K^*(892)^0\mu^+\mu^-)}{\mathcal{B}(B^0\to K^*(892)^0e^+e^-)}$, $1.1 < m^2_{\ell^+\ell^-} < 6.0$ GeV^2/c^4			
	LHCb [289]	$0.69\,^{+0.11}_{-0.07} \pm 0.05$	$0.72\,^{+0.12}_{-0.09}$
	Belle [288]	$1.06\,^{+0.63}_{-0.38} \pm 0.14$	
$\frac{\mathcal{B}(B^0\to K^*(892)^0\mu^+\mu^-)}{\mathcal{B}(B^0\to K^*(892)^0e^+e^-)}$, $15 < m^2_{\ell^+\ell^-} < 19$ GeV^2/c^4			
	Belle [288]	$1.12\,^{+0.61}_{-0.36} \pm 0.10$	$1.12\,^{+0.62}_{-0.37}$
$\frac{\mathcal{B}(B^+\to K^*(892)^+\mu^+\mu^-)}{\mathcal{B}(B^+\to K^*(892)^+e^+e^-)}$, $0.045 < m^2_{\ell^+\ell^-} < 1.1$ GeV^2/c^4			
	Belle [288]	$0.62\,^{+0.60}_{-0.36} \pm 0.09$	$0.62\,^{+0.61}_{-0.37}$
$\frac{\mathcal{B}(B^+\to K^*(892)^+\mu^+\mu^-)}{\mathcal{B}(B^+\to K^*(892)^+e^+e^-)}$, $1.1 < m^2_{\ell^+\ell^-} < 6.0$ GeV^2/c^4			
	Belle [288]	$0.72\,^{+0.99}_{-0.44} \pm 0.15$	$0.7\,^{+1.0}_{-0.5}$
$\frac{\mathcal{B}(B^+\to K^*(892)^+\mu^+\mu^-)}{\mathcal{B}(B^+\to K^*(892)^+e^+e^-)}$, $15 < m^2_{\ell^+\ell^-} < 19$ GeV^2/c^4			
	Belle [288]	$1.40\,^{+1.99}_{-0.68} \pm 0.12$	$1.4\,^{+2.0}_{-0.7}$
$\frac{\mathcal{B}(B^0 \to K^*(892)^0\gamma)}{\mathcal{B}(B^0_s \to \phi(1020)\gamma)}$	LHCb [192]	$1.23 \pm 0.06 \pm 0.11$ [1]	1.21 ± 0.11
	Belle [213]	$1.10 \pm 0.16 \pm 0.20$ [1]	

[1] Multiple systematic uncertainties are added in quadrature.

Table 62: Branching fractions of $B^+/B^0 \to \overline{q}$ gluon decays.

Parameter [10^{-4}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B \to \eta X)$	Belle [290]	$2.610 \pm 0.300\,^{+0.440}_{-0.740}$ [1]	$2.61\,^{+0.53}_{-0.80}$
	CLEO [291]	< 4.400 [2]	
$\mathcal{B}(B \to \eta' X)$	BaBar [292]	$3.90 \pm 0.80 \pm 0.90$ [3]	4.24 ± 0.87
	CLEO [293]	$4.60 \pm 1.10 \pm 0.60$ [3]	
$\mathcal{B}(B \to K^+ X)$	BaBar [294]	< 1.87 [4]	< 1.9
$\mathcal{B}(B \to K^0 X)$	BaBar [294]	$1.95\,^{+0.51}_{-0.45} \pm 0.50$ [4]	1.95 ± 0.69 $1.95\,^{+0.71}_{-0.67}$
$\mathcal{B}(B \to \pi^+ X)$	BaBar [294]	$3.72\,^{+0.50}_{-0.47} \pm 0.59$ [5]	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 63: Isospin asymmetry in radiative and FCNC decays with leptons of B mesons. 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 [295]	$-0.0048 \pm 0.0149 \pm 0.0150$ [1,2]	-0.005 ± 0.020
	BaBar [296]	$-0.006 \pm 0.058 \pm 0.026$ [1,2]	
$\Delta_{0^-}(B \to X_{s+d}\gamma)$	BaBar [261]	$-0.06 \pm 0.15 \pm 0.07$ [3]	-0.06 ± 0.17
$\Delta_{0^+}(B \to K^*\gamma)$	Belle [213]	$0.062 \pm 0.015 \pm 0.013$ [2]	0.063 ± 0.017
	BaBar [214]	$0.066 \pm 0.021 \pm 0.022$	
$\frac{\Gamma(B^+\to\rho^+\gamma)}{2\Gamma(B^0\to\rho^0\gamma)} - 1$	Belle [229]	$-0.48\,^{+0.21}_{-0.19}\,^{+0.08}_{-0.09}$	-0.46 ± 0.17
	BaBar [230]	$-0.43\,^{+0.25}_{-0.22} \pm 0.10$	
$\Delta_{0^-}(B \to K\ell^+\ell^-)$[4]	LHCb [237]	$-0.10\,^{+0.08}_{-0.09} \pm 0.02$ [5]	$-0.191\,^{+0.073}_{-0.071}$
	Belle [238]	$-0.31\,^{+0.13}_{-0.11} \pm 0.01$ [6]	-0.150 ± 0.060
	BaBar [266]	$-0.41 \pm 0.25 \pm 0.01$ [6]	
$\Delta_{0^-}(B \to K^*\ell^+\ell^-)$[4]	BaBar [266]	$-0.20\,^{+0.30}_{-0.23} \pm 0.03$ [6]	$-0.01\,^{+0.11}_{-0.09}$
	Belle [243]	$0.33\,^{+0.37}_{-0.43} \pm 0.08$ [6]	$-0.03\,^{+0.08}_{-0.07}$
	LHCb [237]	$0.00\,^{+0.12}_{-0.10} \pm 0.02$ [5]	
$\Delta_{0^-}(B \to K^{(*)}\ell^+\ell^-)$[4]	Belle [243]	$-0.30\,^{+0.12}_{-0.11} \pm 0.08$ [7]	-0.45 ± 0.10
	BaBar [239]	$-0.64\,^{+0.15}_{-0.14} \pm 0.03$ [8]	-0.45 ± 0.17

[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.

Table 64: Branching fractions of charmless 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 [252]	< 0.17	< 0.17
$\mathcal{B}(B^+ \to \pi^+ e^+ \tau^-)$	BaBar [297]	< 74.0	< 74
$\mathcal{B}(B^+ \to \pi^+ e^- \tau^+)$	BaBar [297]	< 20.0	< 20
$\mathcal{B}(B^+ \to \pi^+ e^+ \tau^- + \text{c.c.})$	BaBar [297]	< 75.0	< 75
$\mathcal{B}(B^+ \to \pi^+ \mu^+ \tau^-)$	BaBar [297]	< 62.0	< 62
$\mathcal{B}(B^+ \to \pi^+ \mu^- \tau^+)$	BaBar [297]	< 45.0	< 45
$\mathcal{B}(B^+ \to \pi^+ \mu^+ \tau^- + \text{c.c.})$	BaBar [297]	< 72.0	< 72
$\mathcal{B}(B^+ \to K^+ e^+ \mu^-)$	LHCb [298] Belle [238] BaBar [253]	< 0.0070 < 0.03 < 0.091	< 0.007
$\mathcal{B}(B^+ \to K^+ e^- \mu^+)$	LHCb [298] Belle [238] BaBar [253]	< 0.0064 < 0.085 < 0.13	< 0.0064
$\mathcal{B}(B^+ \to K^+ e^+ \mu^- + \text{c.c.})$	BaBar [253]	< 0.091	< 0.091
$\mathcal{B}(B^+ \to K^+ e^+ \tau^-)$	BaBar [297]	< 43.0	< 43
$\mathcal{B}(B^+ \to K^+ e^- \tau^+)$	BaBar [297]	< 15.0	< 15
$\mathcal{B}(B^+ \to K^+ e^+ \tau^- + \text{c.c.})$	BaBar [297]	< 30.0	< 30
$\mathcal{B}(B^+ \to K^+ \mu^+ \tau^-)$	BaBar [297]	< 45.0	< 45
$\mathcal{B}(B^+ \to K^+ \mu^- \tau^+)$	BaBar [297] LHCb [299]	< 28.0 < 39.0	< 28
$\mathcal{B}(B^+ \to K^+ \mu^+ \tau^- + \text{c.c.})$	BaBar [297]	< 48.0	< 48
$\mathcal{B}(B^+ \to K^*(892)^+ e^+ \mu^-)$	BaBar [253]	< 1.30	< 1.3
$\mathcal{B}(B^+ \to K^*(892)^+ e^- \mu^+)$	BaBar [253]	< 0.99	< 0.99
$\mathcal{B}(B^+ \to K^*(892)^+ e^+ \mu^- + \text{c.c.})$	BaBar [253]	< 1.40	< 1.4
$\mathcal{B}(B^+ \to \pi^- e^+ e^+)$	BaBar [300]	< 0.023	< 0.023
$\mathcal{B}(B^+ \to \pi^- \mu^+ \mu^+)$	LHCb [301] BaBar [300]	< 0.0040 [1] < 0.107	< 0.004
$\mathcal{B}(B^+ \to \pi^- e^+ \mu^+)$	BaBar [302]	< 0.15	< 0.15
$\mathcal{B}(B^+ \to \rho^-(770) e^+ e^+)$	BaBar [302]	< 0.17	< 0.17
$\mathcal{B}(B^+ \to \rho^-(770) \mu^+ \mu^+)$	BaBar [302]	< 0.42	< 0.42
$\mathcal{B}(B^+ \to \rho^-(770) e^+ \mu^+)$	BaBar [302]	< 0.47	< 0.47

[1] At CL=95 %.

Table 65: Branching fractions of charmless semileptonic B^+ decays to LFV and LNV final states (part 2).

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^+ \to K^- e^+ e^+)$	BaBar [300]	< 0.030	< 0.030
$\mathcal{B}(B^+ \to K^- \mu^+ \mu^+)$	LHCb [303] BaBar [300]	< 0.041 < 0.067	< 0.041
$\mathcal{B}(B^+ \to K^- e^+ \mu^+)$	BaBar [302]	< 0.16	< 0.16
$\mathcal{B}(B^+ \to K^*(892)^- e^+ e^+)$	BaBar [302]	< 0.40	< 0.40
$\mathcal{B}(B^+ \to K^*(892)^- \mu^+ \mu^+)$	BaBar [302]	< 0.59	< 0.59
$\mathcal{B}(B^+ \to K^*(892)^- e^+ \mu^+)$	BaBar [302]	< 0.30	< 0.30
$\mathcal{B}(B^+ \to D^- e^+ e^+)$	BaBar [302] BELLE [304]	< 2.6 < 2.6	< 2.6
$\mathcal{B}(B^+ \to D^- e^+ \mu^+)$	BELLE [304] BaBar [302]	< 1.8 < 2.1	< 1.8
$\mathcal{B}(B^+ \to D^- \mu^+ \mu^+)$	LHCb [305] BELLE [304] BaBar [302]	< 0.69 [1] < 1.0 < 1.7	< 0.69
$\mathcal{B}(B^+ \to D^*(2010)^- \mu^+ \mu^+)$	LHCb [305]	< 2.4 [1]	< 2.4
$\mathcal{B}(B^+ \to D_s^- \mu^+ \mu^+)$	LHCb [305]	< 0.58 [1]	< 0.58
$\mathcal{B}(B^+ \to \overline{D}^0 \pi^- \mu^+ \mu^+)$	LHCb [305]	< 1.5 [1]	< 1.5
$\mathcal{B}(B^+ \to \Lambda^0 \mu^+)$	BaBar [255]	< 0.061	< 0.061 < 0.060
$\mathcal{B}(B^+ \to \Lambda^0 e^+)$	BaBar [255]	< 0.032	< 0.032
$\mathcal{B}(B^+ \to \overline{\Lambda}^0 \mu^+)$	BaBar [255]	< 0.062	< 0.062 < 0.060
$\mathcal{B}(B^+ \to \overline{\Lambda}^0 e^+)$	BaBar [255]	< 0.081	< 0.081 < 0.080

[1] At CL=95 %.

Table 66: Branching fractions of charmless semileptonic B^0 decays to LFV and LNV final states.

Parameter [10^{-6}]	**Measurements**		**Average** HFLAV / PDG
$\mathcal{B}(B^0 \to K^*(892)^0 e^- \mu^+)$	Belle [254]	< 0.12	< 0.12
	BaBar [253]	< 0.34	
$\mathcal{B}(B^0 \to K^*(892)^0 e^+ \mu^-)$	Belle [254]	< 0.16	< 0.16
	BaBar [253]	< 0.53	
$\mathcal{B}(B^0 \to K^0 e^+ \mu^- + \text{c.c.})$	Belle [238]	< 0.038	< 0.038
	BaBar [253]	< 0.27	
$\mathcal{B}(B^0 \to \pi^0 e^+ \mu^- + \text{c.c.})$	BaBar [252]	< 0.14	< 0.14
$\mathcal{B}(B^0 \to e^+ \mu^- + \text{c.c.})$	LHCb [203]	< 0.0010	< 0.001
	CDF [198]	< 0.064	
	BaBar [280]	< 0.092	
	Belle [281]	< 0.17	
$\mathcal{B}(B^0 \to e^+ \tau^- + \text{c.c.})$	BaBar [306]	< 28.0	< 28
$\mathcal{B}(B^0 \to \mu^+ \tau^- + \text{c.c.})$	LHCb [204]	< 12.0	< 12
	BaBar [306]	< 22.0	< 14

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

- In Ref. [307], 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 $B \to K\ell^-\ell^+$ channel, 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 [308]. Belle measures F_L and $A_{\rm FB}$ in 6 $m^2(\ell^+\ell^-)$ [243].

- 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 [309]. In Ref. [310], LHCb determines the branching fraction in the dilepton mass region $[0.0009, 1.0]$ GeV$^2/c^4$.
  - $B \to K^*\ell^-\ell^+$: Belle measures F_L, $A_{\rm FB}$, isospin asymmetry in 6 $m^2(\ell^+\ell^-)$ bins [243] and P'_4, P'_5, P'_6, P'_8 in 4 $m^2(\ell^+\ell^-)$ bins [311]. In a more recent paper [312], 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 [313].
  - $B^0 \to K^{*0}\mu^-\mu^+$: 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 [314]. An updated measurement of the *CP*-averaged observables is presented in Ref. [315]. CMS measures F_L and $A_{\rm FB}$ in 7 $m^2(\ell^+\ell^-)$ bins [316], as well as P_1, P'_5 [317]. ATLAS measures F_L, $S_{3,4,5,7,8}$ and $P'_{1,4,5,6,8}$ in 6 $m^2(\ell^+\ell^-)$ bins [318].
  - $B^+ \to K^{*+}\mu^-\mu^+$: LHCb reports the full set of *CP*-averaged angular observables in 8 $m^2(\ell^+\ell^-)$ bins [319]. CMS measures F_L and $A_{\rm FB}$ in 3 $m^2(\ell^+\ell^-)$ bins [320].

- $B \to X_s\ell^-\ell^+$ (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 [321].

- $B^0 \to K^+\pi^-\mu^+\mu^-$, 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 [322].

- In Ref. [323], 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. [324], 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.

- In Ref. [325], 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 $214 < m(\chi) < 4350$ MeV/$c^2$and $0 < \tau(\chi) < 1000$ ps.

- In Ref. [326], 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 $\tau(\chi)$.

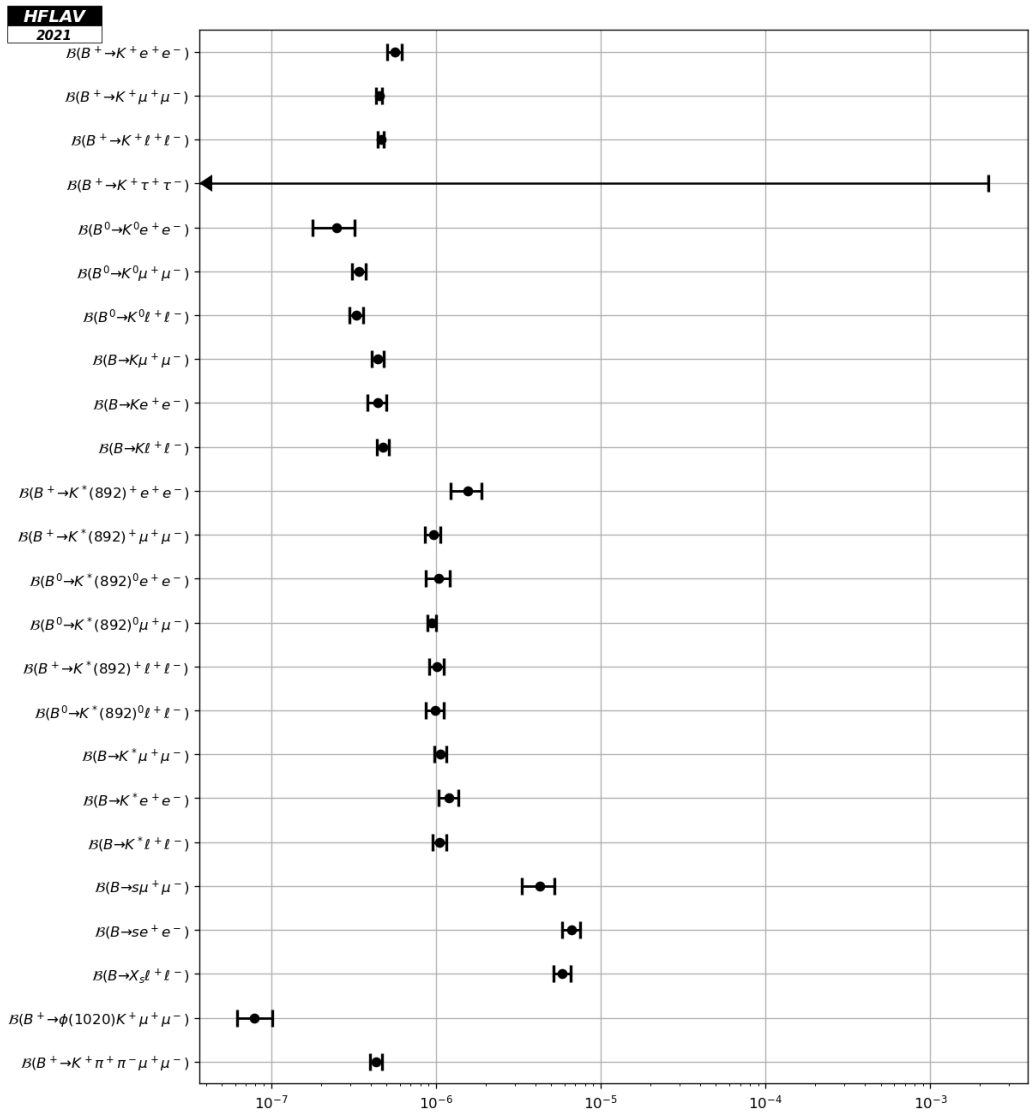

Figure 7: Branching fractions of B^+ and B^0 decays of the type $b \to s\ell^+\ell^-$.

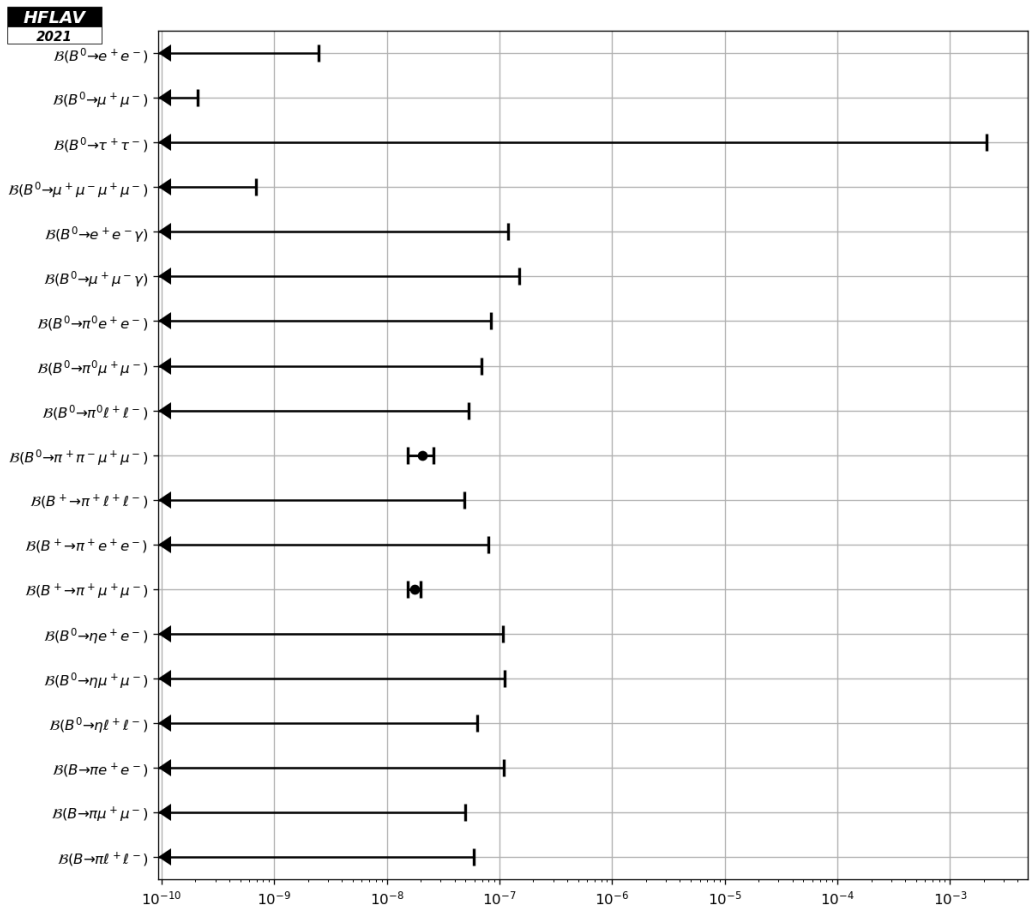

Figure 8: Branching fractions of B^+ and B^0 decays of the type $b \to u\ell^+\ell^-$, purely leptonic and leptonic radiative.

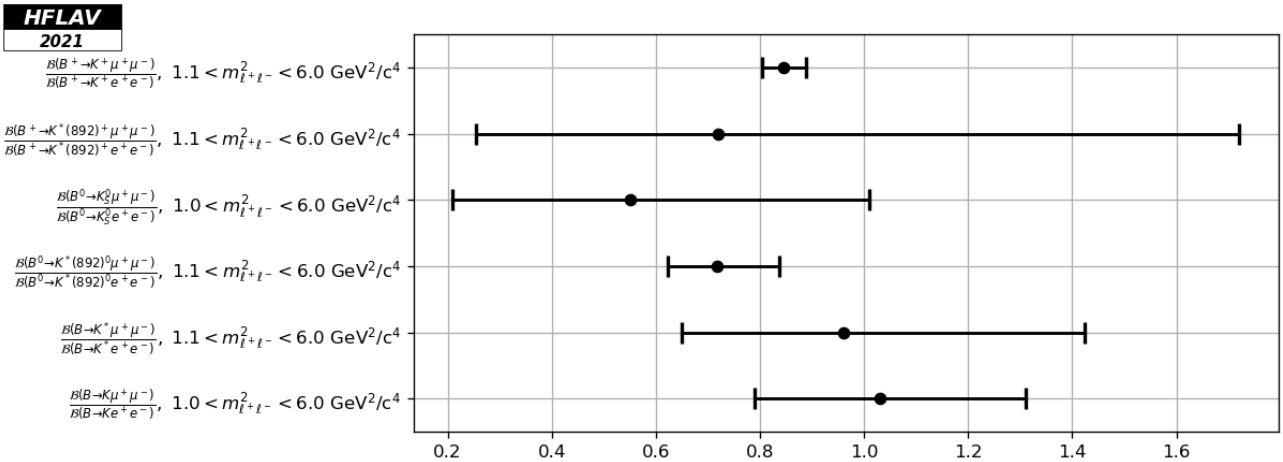

Figure 9: Compilation of $R_K^{(*)}$ ratios in the low dilepton invariant-mass region. These are ratios between branching fractions of B-meson decays to $K^{(*)}\mu^+\mu^-$ and $K^{(*)}e^+e^-$, which provide information on lepton universality.

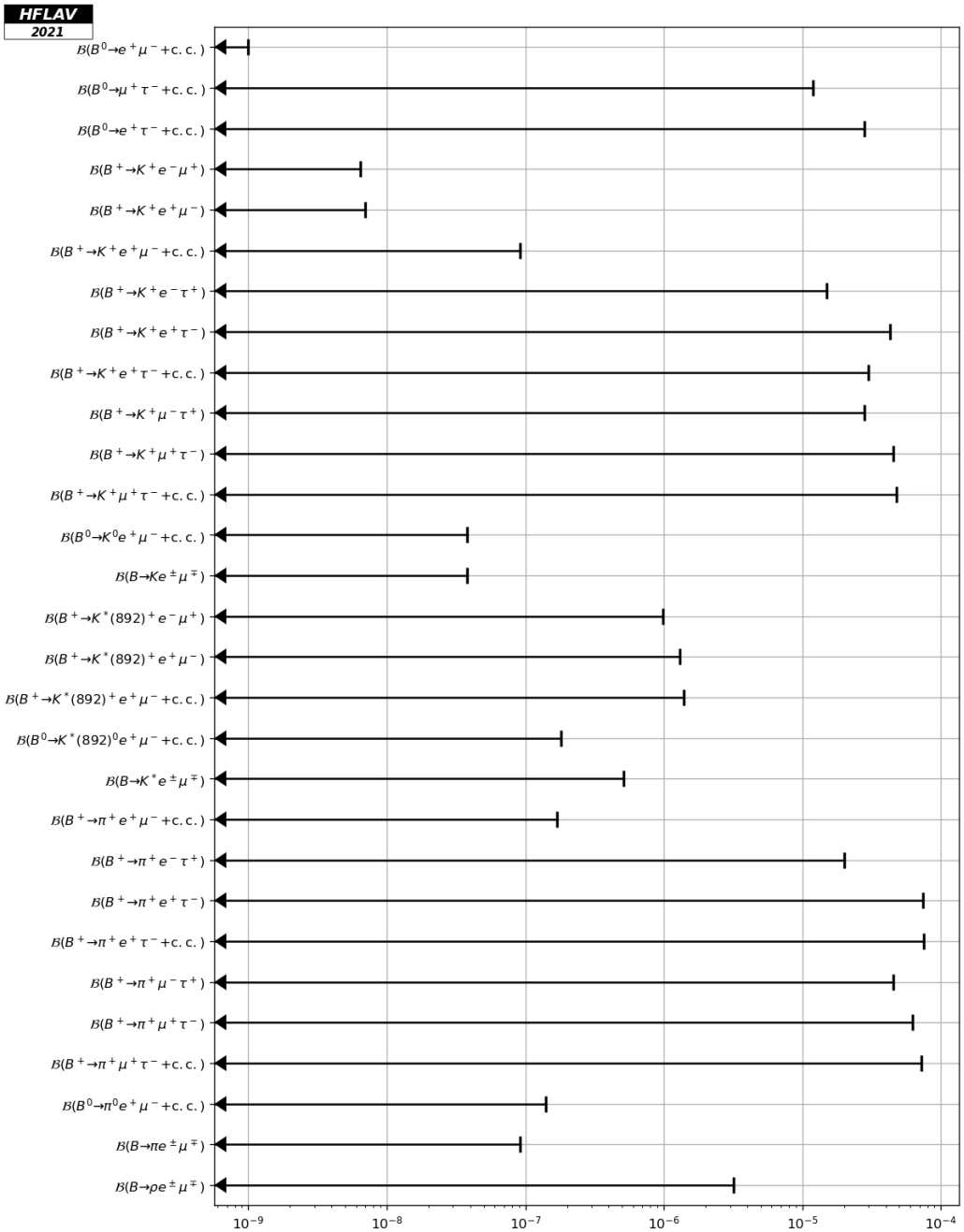

Figure 10: Limits on branching fractions of lepton-flavour-violating B^+ and B^0 decays.

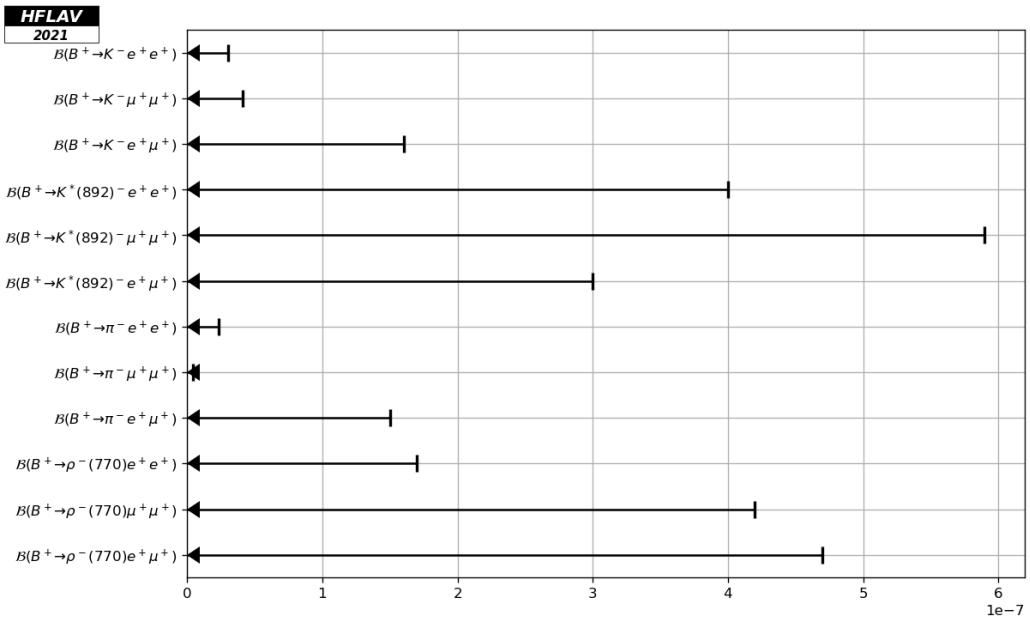

Figure 11: Limits on branching fractions of lepton-number-violating B^+ and B^0 decays.

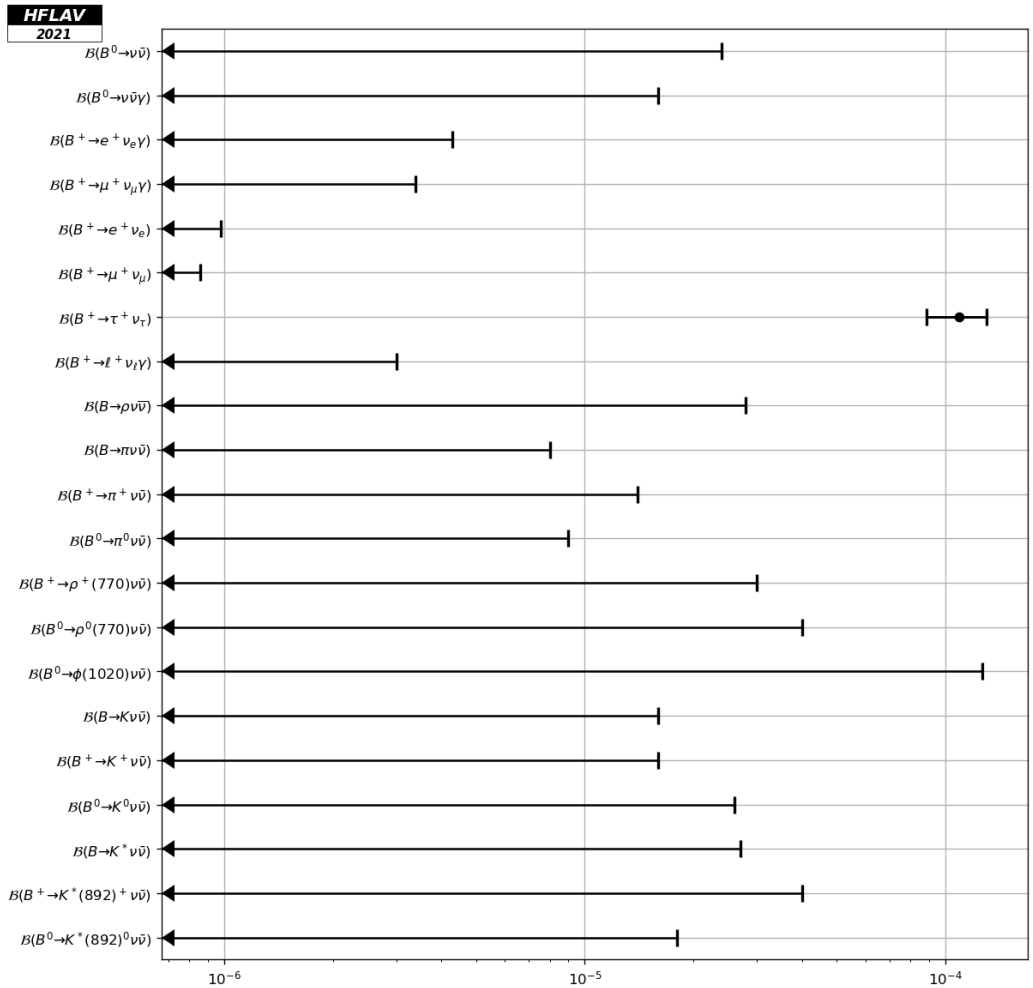

Figure 12: Branching fractions of charmless B decays with neutrinos.

7 Charge asymmetries in b-hadron decays

This section contains, in Tables 67 to 78, 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). This definition is consistent with that of Eq. (**??**) in Sec. **??**. Measurements of time-dependent CP asymmetries are not listed here but are discussed in Sec. **??**. Figure 13 shows a graphic representation of a selection of results given in this section.

Table 67: *CP* asymmetries of charmless hadronic B^+ decays (part 1).

Parameter	**Measurements**		**Average**
$A_{\rm CP}(B^+ \to K^0_S\pi^+)$	Belle [3]	$-0.011 \pm 0.021 \pm 0.006$	-0.016 ± 0.015
	LHCb [7]	$-0.022 \pm 0.025 \pm 0.010$	
	BaBar [4]	$-0.029 \pm 0.039 \pm 0.010$	
	Belle II [5]	$-0.01 \pm 0.08 \pm 0.05$	
	CLEO [327]	$0.18 \pm 0.24 \pm 0.02$	
$A_{\rm CP}(B^+ \to K^+\pi^0)$	LHCb [328]	$0.025 \pm 0.015 \pm 0.007$ [1]	0.027 ± 0.013
	Belle [3]	$0.043 \pm 0.024 \pm 0.002$	
	BaBar [8]	$0.030 \pm 0.039 \pm 0.010$	
	Belle II [9]	$-0.09 \pm 0.09 \pm 0.03$	
	CLEO [327]	$-0.29 \pm 0.23 \pm 0.02$	
$A_{\rm CP}(B^+ \to \eta' K^+)$	LHCb [15]	$-0.002 \pm 0.012 \pm 0.006$ [1]	0.004 ± 0.011
	BaBar [10]	$0.008\,^{+0.017}_{-0.018} \pm 0.009$	
	Belle [11]	$0.028 \pm 0.028 \pm 0.021$	
	CLEO [327]	$0.03 \pm 0.12 \pm 0.02$	
$A_{\rm CP}(B^+ \to \eta' K^*(892)^+)$	BaBar [16]	$-0.26 \pm 0.27 \pm 0.02$	-0.26 ± 0.27
$A_{\rm CP}(B^+ \to \eta'(K\pi)^{*+}_0)$	BaBar [16]	$0.06 \pm 0.20 \pm 0.02$	0.06 ± 0.20
$A_{\rm CP}(B^+ \to \eta' K^*_2(1430)^+)$	BaBar [16]	$0.15 \pm 0.13 \pm 0.02$	0.15 ± 0.13
$A_{\rm CP}(B^+ \to \eta K^+)$	BaBar [10]	$-0.36 \pm 0.11 \pm 0.03$	-0.37 ± 0.08
	Belle [18]	$-0.38 \pm 0.11 \pm 0.01$	
$A_{\rm CP}(B^+ \to \eta K^*(892)^+)$	BaBar [19]	$0.01 \pm 0.08 \pm 0.02$	0.02 ± 0.06
	Belle [20]	$0.03 \pm 0.10 \pm 0.01$	
$A_{\rm CP}(B^+ \to \eta(K\pi)^{*+}_0)$	BaBar [19]	$0.05 \pm 0.13 \pm 0.02$	0.05 ± 0.13
$A_{\rm CP}(B^+ \to \eta K^*_2(1430)^+)$	BaBar [19]	$-0.45 \pm 0.30 \pm 0.02$	-0.45 ± 0.30
$A_{\rm CP}(B^+ \to \omega(782)K^+)$	Belle [23]	$-0.03 \pm 0.04 \pm 0.01$	-0.025 ± 0.036
	BaBar [24]	$-0.01 \pm 0.07 \pm 0.01$	
$A_{\rm CP}(B^+ \to \omega(782)K^*(892)^+)$	BaBar [26]	$0.29 \pm 0.35 \pm 0.02$	0.29 ± 0.35
$A_{\rm CP}(B^+ \to \omega(782)(K\pi)^{*+}_0)$	BaBar [26]	$-0.10 \pm 0.09 \pm 0.02$	-0.10 ± 0.09
$A_{\rm CP}(B^+ \to \omega(782)K^*_2(1430)^+)$	BaBar [26]	$0.14 \pm 0.15 \pm 0.02$	0.14 ± 0.15
$A_{\rm CP}(B^+ \to K^*(892)^0\pi^+)$	BaBar [28]	$0.032 \pm 0.052\,^{+0.016}_{-0.013}$ [2,1]	-0.04 ± 0.04
	Belle [29]	$-0.149 \pm 0.064 \pm 0.022$ [2,1]	
	BaBar [30]	$-0.12 \pm 0.21\,^{+0.08}_{-0.14}$ [3,1]	
$A_{\rm CP}(B^+ \to K^*(892)^+\pi^0)$	BaBar [30]	$-0.52 \pm 0.14\,^{+0.06}_{-0.04}$ [3,1]	-0.39 ± 0.13
	BaBar [31]	$-0.06 \pm 0.24 \pm 0.04$	

[1] Multiple systematic uncertainties are added in quadrature.
[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.

Table 68: CP asymmetries of charmless hadronic B^+ decays (part 2).

Parameter	**Measurements**		**Average**
$A_{\rm CP}(B^+ \to K^+\pi^+\pi^-)$[1]	LHCb [329]	$0.025 \pm 0.004 \pm 0.008$ [2]	0.0268 ± 0.0084
	BaBar [28]	$0.028 \pm 0.020 \pm 0.023$ [3,2]	
	Belle [29]	$0.049 \pm 0.026 \pm 0.020$ [3]	
$A_{\rm CP}(B^+ \to K^+K^+K^-(\mathrm{NR}))$	BaBar [22]	$0.060 \pm 0.044 \pm 0.019$ [4]	0.06 ± 0.05
$A_{\rm CP}(B^+ \to f_0(980)K^+)$	BaBar [28]	$-0.106 \pm 0.050\,^{+0.036}_{-0.015}$ [3,2]	-0.08 ± 0.04
	Belle [29]	$-0.077 \pm 0.065\,^{+0.046}_{-0.026}$ [3,2]	
	BaBar [22]	$-0.08 \pm 0.08 \pm 0.04$ [5]	
	BaBar [31]	$0.18 \pm 0.18 \pm 0.04$	
$A_{\rm CP}(B^+ \to f_2(1270)K^+)$	BaBar [28]	$-0.85 \pm 0.22\,^{+0.26}_{-0.13}$ [3,2]	-0.67 ± 0.19
	Belle [29]	$-0.59 \pm 0.22 \pm 0.04$ [3,2]	
$A_{\rm CP}(B^+ \to f_2'(1525)K^+)$	BaBar [22]	$0.14 \pm 0.10 \pm 0.04$ [5]	0.14 ± 0.11
$A_{\rm CP}(B^+ \to \rho^0(770)K^+)$	BaBar [28]	$0.44 \pm 0.10\,^{+0.06}_{-0.14}$ [3,2]	0.37 ± 0.12
	Belle [29]	$0.30 \pm 0.11\,^{+0.11}_{-0.04}$ [3,2]	
$A_{\rm CP}(B^+ \to K^0\pi^+\pi^0)$	BaBar [30]	$0.07 \pm 0.05 \pm 0.04$ [6,2]	0.07 ± 0.06
$A_{\rm CP}(B^+ \to K_0^*(1430)^0\pi^+)$	Belle [29]	$0.076 \pm 0.038\,^{+0.028}_{-0.022}$ [3,2]	0.084 ± 0.043
	BaBar [30]	$0.14 \pm 0.10\,^{+0.14}_{-0.06}$ [6,2]	
$A_{\rm CP}(B^+ \to (K\pi)_0^{*0}\pi^+)$	BaBar [28]	$0.032 \pm 0.035\,^{+0.034}_{-0.028}$ [3,2]	0.032 ± 0.046
$A_{\rm CP}(B^+ \to K_0^*(1430)^+\pi^0)$	BaBar [30]	$0.26 \pm 0.12\,^{+0.14}_{-0.08}$ [6,2]	$0.26\,^{+0.19}_{-0.14}$
$A_{\rm CP}(B^+ \to K_2^*(1430)^0\pi^+)$	BaBar [28]	$0.05 \pm 0.23\,^{+0.18}_{-0.08}$ [3,2]	$0.05\,^{+0.29}_{-0.24}$
$A_{\rm CP}(B^+ \to K^+\pi^0\pi^0)$	BaBar [31]	$-0.06 \pm 0.06 \pm 0.04$	-0.06 ± 0.07
$A_{\rm CP}(B^+ \to \rho^+(770)K^0)$	BaBar [30]	$0.21 \pm 0.19\,^{+0.24}_{-0.20}$ [6,2]	$0.21\,^{+0.31}_{-0.28}$
$A_{\rm CP}(B^+ \to K^*(892)^+\pi^+\pi^-)$	BaBar [41]	$0.07 \pm 0.07 \pm 0.04$	0.07 ± 0.08
$A_{\rm CP}(B^+ \to K^*(892)^+\rho^0(770))$	BaBar [42]	$0.31 \pm 0.13 \pm 0.03$	0.31 ± 0.13
$A_{\rm CP}(B^+ \to f_0(980)K^*(892)^+)$	BaBar [42]	$-0.15 \pm 0.12 \pm 0.03$	-0.15 ± 0.12
$A_{\rm CP}(B^+ \to a_1(1260)^+K^0)$	BaBar [43]	$0.12 \pm 0.11 \pm 0.02$	0.12 ± 0.11
$A_{\rm CP}(B^+ \to b_1(1235)^+K^0)$	BaBar [47]	$-0.03 \pm 0.15 \pm 0.02$	-0.03 ± 0.15
$A_{\rm CP}(B^+ \to K^*(892)^0\rho^+(770))$	BaBar [44]	$-0.01 \pm 0.16 \pm 0.02$	-0.01 ± 0.16
$A_{\rm CP}(B^+ \to b_1(1235)^0K^+)$	BaBar [48]	$-0.46 \pm 0.20 \pm 0.02$	-0.46 ± 0.20

[1] Treatment of charmonium intermediate components differs between the results.
[2] Multiple systematic uncertainties are added in quadrature.
[3] Result extracted from Dalitz-plot analysis of $B^+ \to K^+\pi^+\pi^-$ decays.
[4] The nonresonant amplitude is modelled using a polynomial function including S-wave and P-wave terms.
[5] Result extracted from Dalitz-plot analysis of $B^+ \to K^+K^+K^-$ decays.
[6] Result extracted from Dalitz-plot analysis of $B^+ \to K_S^0\pi^+\pi^0$ decays.

Table 69: CP asymmetries of charmless hadronic B^+ decays (part 3).

Parameter	**Measurements**		**Average**
$A_{\rm CP}(B^+ \to K^+ K^0_S)$	LHCb [7]	$-0.21 \pm 0.14 \pm 0.01$	-0.086 ± 0.100
	Belle [3]	$0.014 \pm 0.168 \pm 0.002$	
	BaBar [4]	$0.10 \pm 0.26 \pm 0.03$	
$A_{\rm CP}(B^+ \to K^+ K^0_S K^0_S)$[1]	Belle [51]	$0.016 \pm 0.039 \pm 0.009$ [2]	0.025 ± 0.032
	BaBar [22]	$0.04\,^{+0.04}_{-0.05} \pm 0.02$ [3]	
$A_{\rm CP}(B^+ \to K^+ K^- \pi^+)$[1]	LHCb [329]	$-0.123 \pm 0.017 \pm 0.014$ [4]	-0.122 ± 0.021
	Belle [53]	$-0.170 \pm 0.073 \pm 0.017$ [5]	
	BaBar [54]	$0.00 \pm 0.10 \pm 0.03$	
$A_{\rm CP}(B^+ \to K^+ K^- \pi^+(\text{NR}))$	LHCb [55]	$-0.107 \pm 0.053 \pm 0.035$ [6]	-0.107 ± 0.064
$A_{\rm CP}(B^+ \to \overline{K}^*(892)^0 K^+)$	LHCb [55]	$0.123 \pm 0.087 \pm 0.045$ [7]	0.123 ± 0.098
$A_{\rm CP}(B^+ \to \overline{K}^*_0(1430)^0 K^+)$	LHCb [55]	$0.104 \pm 0.149 \pm 0.088$ [7]	0.10 ± 0.17
$A_{\rm CP}(B^+ \to \phi(1020)\pi^+)$	LHCb [55]	$0.098 \pm 0.436 \pm 0.266$ [7]	0.10 ± 0.51
$A_{CP}(B^+ \to K^+ K^- \pi^+)$ $\pi\pi \leftrightarrow KK$ rescattering			
	LHCb [55]	$-0.664 \pm 0.038 \pm 0.019$ [7]	-0.664 ± 0.042
$A_{\rm CP}(B^+ \to K^+ K^+ K^-)$	LHCb [329]	$-0.036 \pm 0.004 \pm 0.007$ [4]	-0.033 ± 0.007
	BaBar [22]	$-0.017\,^{+0.019}_{-0.014} \pm 0.014$ [8]	
	Belle II [60]	$-0.049 \pm 0.063 \pm 0.022$	
$A_{\rm CP}(B^+ \to \phi(1020) K^+)$	LHCb [15]	$0.017 \pm 0.011 \pm 0.006$ [4]	0.024 ± 0.012
	BaBar [22]	$0.128 \pm 0.044 \pm 0.013$ [8]	
	Belle [65]	$0.01 \pm 0.12 \pm 0.05$	
	CDF [62]	$-0.07 \pm 0.17\,^{+0.03}_{-0.02}$	

[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] Multiple systematic uncertainties are added in quadrature.
[5] Also measured in bins of $m_{K^+K^-}$.
[6] LHCb uses a model of non-resonant obtained from a phenomenological description of the partonic interaction that produces the final state. This contribution is called single pole in the paper, see Ref. [55] for details.
[7] Result extracted from Dalitz-plot analysis of $B^+ \to K^+ K^- \pi^+$ decays.
[8] Result extracted from Dalitz-plot analysis of $B^+ \to K^+ K^+ K^-$ decays.

Table 70: *CP* asymmetries of charmless hadronic B^+ decays (part 4).

Parameter	**Measurements**		**Average**
$A_{\rm CP}(B^+ \to K^*(892)^+ K^+ K^-)$	BaBar [41]	$0.11 \pm 0.08 \pm 0.03$	0.11 ± 0.09
$A_{\rm CP}(B^+ \to \phi(1020) K^*(892)^+)$	Belle [330]	$-0.02 \pm 0.14 \pm 0.03$	-0.01 ± 0.08
	BaBar [64]	$0.00 \pm 0.09 \pm 0.04$ [1]	
$A_{\rm CP}(B^+ \to (K\pi)_0^{*+} \phi(1020))$	BaBar [66]	$0.04 \pm 0.15 \pm 0.04$	0.04 ± 0.16
$A_{\rm CP}(B^+ \to K_1(1270)^+ \phi(1020))$	BaBar [66]	$0.15 \pm 0.19 \pm 0.05$	0.15 ± 0.20
$A_{\rm CP}(B^+ \to K_2^*(1430)^+ \phi(1020))$	BaBar [66]	$-0.23 \pm 0.19 \pm 0.06$	-0.23 ± 0.20
$A_{\rm CP}(B^+ \to \phi(1020)\phi(1020) K^+)$	BaBar [68]	$-0.10 \pm 0.08 \pm 0.02$ [2]	-0.10 ± 0.08
$A_{\rm CP}(B^+ \to K^*(892)^+ \gamma)$	Belle [213]	$0.011 \pm 0.023 \pm 0.003$	0.014 ± 0.018
	BaBar [214]	$0.018 \pm 0.028 \pm 0.007$	
$A_{CP}(B^+ \to X_s \gamma)$	Belle [295]	$0.0275 \pm 0.0184 \pm 0.0032$ [3]	0.028 ± 0.019
$A_{\rm CP}(B^+ \to \eta K^+ \gamma)$	Belle [219]	$-0.16 \pm 0.09 \pm 0.06$ [4]	-0.12 ± 0.07
	BaBar [218]	$-0.090\,^{+0.104}_{-0.098} \pm 0.014$ [5]	
$A_{\rm CP}(B^+ \to \phi(1020) K^+ \gamma)$	Belle [222]	$-0.03 \pm 0.11 \pm 0.08$ [6]	-0.13 ± 0.10
	BaBar [223]	$-0.26 \pm 0.14 \pm 0.05$ [7]	
$A_{\rm CP}(B^+ \to \rho^+(770)\gamma)$	Belle [229]	$-0.11 \pm 0.32 \pm 0.09$	-0.11 ± 0.33

[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] Measured in the $\phi\phi$ invariant mass range below the η_c resonance ($M_{\phi\phi} < 2.85$ 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.

Table 71: CP asymmetries of charmless hadronic B^+ decays (part 5).

Parameter	**Measurements**		**Average**
$A_{\rm CP}(B^+ \to \pi^+\pi^0)$	Belle [3]	$0.025 \pm 0.043 \pm 0.007$	0.02 ± 0.04
	BaBar [8]	$0.03 \pm 0.08 \pm 0.01$	
	Belle II [9]	$-0.04 \pm 0.17 \pm 0.06$	
$A_{\rm CP}(B^+ \to \pi^+\pi^+\pi^-)$[1]	LHCb [329]	$0.058 \pm 0.008 \pm 0.011$ [2]	0.057 ± 0.014
	BaBar [73]	$0.032 \pm 0.044\,^{+0.040}_{-0.037}$ [3,2]	
$A_{\rm CP}(B^+ \to \rho^0(770)\pi^+)$	LHCb [74]	$0.007 \pm 0.011 \pm 0.040$ [3,4,2]	$0.016\,^{+0.041}_{-0.039}$
	BaBar [73]	$0.18 \pm 0.07\,^{+0.05}_{-0.15}$ [3,2]	
$A_{\rm CP}(B^+ \to f_2(1270)\pi^+)$	LHCb [74]	$0.468 \pm 0.061 \pm 0.103$ [3,4,2]	0.365 ± 0.079
	LHCb [55]	$0.267 \pm 0.102 \pm 0.048$ [5]	
	BaBar [73]	$0.41 \pm 0.25\,^{+0.18}_{-0.15}$ [3,2]	
$A_{\rm CP}(B^+ \to \rho(1450)^0\pi^+)$	LHCb [74]	$-0.129 \pm 0.033 \pm 0.421$ [3,4,2]	-0.109 ± 0.049
	LHCb [55]	$-0.109 \pm 0.044 \pm 0.024$ [5]	
	BaBar [73]	$-0.06 \pm 0.28\,^{+0.23}_{-0.40}$ [3,2]	
$A_{\rm CP}(B^+ \to \rho_3(1690)^0\pi^+)$	LHCb [74]	$-0.801 \pm 0.114 \pm 0.511$ [3,4,2]	-0.80 ± 0.52
$A_{\rm CP}(B^+ \to f_0(1370)\pi^+)$	BaBar [73]	$0.72 \pm 0.15 \pm 0.16$ [3,2]	0.72 ± 0.22
$A_{CP}(B^+ \to \pi^+\pi^+\pi^-), S-$ wave			
	LHCb [74]	$0.144 \pm 0.018 \pm 0.026$ [3,4,2]	0.144 ± 0.032
$A_{\rm CP}(B^+ \to \pi^+\pi^+\pi^-(\mathrm{NR}))$	BaBar [73]	$-0.14 \pm 0.14\,^{+0.18}_{-0.08}$ [6,2]	$-0.14\,^{+0.23}_{-0.16}$
$A_{\rm CP}(B^+ \to \rho^+(770)\pi^0)$	BaBar [78]	$-0.01 \pm 0.13 \pm 0.02$	0.01 ± 0.11
	Belle [79]	$0.06 \pm 0.19\,^{+0.04}_{-0.06}$	
$A_{\rm CP}(B^+ \to \rho^+(770)\rho^0(770))$	BaBar [80]	$-0.054 \pm 0.055 \pm 0.010$	-0.051 ± 0.054
	Belle [81]	$0.00 \pm 0.22 \pm 0.03$	
$A_{\rm CP}(B^+ \to \omega(782)\pi^+)$	LHCb [74]	$-0.048 \pm 0.065 \pm 0.049$ [3,4,2]	-0.041 ± 0.048
	BaBar [24]	$-0.02 \pm 0.08 \pm 0.01$	
	Belle [83]	$-0.02 \pm 0.09 \pm 0.01$	
	CLEO [327]	$-0.34 \pm 0.25 \pm 0.02$	
$A_{\rm CP}(B^+ \to \omega(782)\rho^+(770))$	BaBar [26]	$-0.20 \pm 0.09 \pm 0.02$	-0.20 ± 0.09

[1] Treatment of charmonium intermediate components differs between the results.
[2] Multiple systematic uncertainties are added in quadrature.
[3] Result extracted from Dalitz-plot analysis of $B^+ \to \pi^+\pi^+\pi^-$ decays.
[4] 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. [76].
[5] Result extracted from Dalitz-plot analysis of $B^+ \to K^+K^-\pi^+$ decays.
[6] The nonresonant amplitude is modelled using a sum of exponential functions.

Table 72: CP asymmetries of charmless hadronic B^+ decays (part 6).

Parameter	**Measurements**		**Average**
$A_{\rm CP}(B^+ \to \eta\pi^+)$	Belle [18]	$-0.19 \pm 0.06 \pm 0.01$	-0.14 ± 0.05
	BaBar [10]	$-0.03 \pm 0.09 \pm 0.03$	
$A_{\rm CP}(B^+ \to \eta\rho^+(770))$	BaBar [84]	$0.13 \pm 0.11 \pm 0.02$	0.11 ± 0.11
	Belle [20]	$-0.04\,^{+0.34}_{-0.32} \pm 0.01$	
$A_{\rm CP}(B^+ \to \eta'\pi^+)$	BaBar [10]	$0.03 \pm 0.17 \pm 0.02$	0.06 ± 0.15
	Belle [11]	$0.20\,^{+0.37}_{-0.36} \pm 0.04$	
$A_{\rm CP}(B^+ \to \eta'\rho^+(770))$	BaBar [16]	$0.26 \pm 0.17 \pm 0.02$	0.26 ± 0.17
$A_{\rm CP}(B^+ \to b_1(1235)^0\pi^+)$	BaBar [48]	$0.05 \pm 0.16 \pm 0.02$	0.05 ± 0.16
$A_{\rm CP}(B^+ \to p\overline{p}\pi^+)$	BaBar [152]	$0.04 \pm 0.07 \pm 0.04$	0.04 ± 0.08
$A_{CP}(B^+ \to p\overline{p}\pi^+), m_{p\overline{p}} < 2.85$ GeV/c^2			
	LHCb [153]	$-0.041 \pm 0.039 \pm 0.005$	-0.058 ± 0.037
	Belle [151]	$-0.17 \pm 0.10 \pm 0.02$	
$A_{CP}(B^+ \to p\overline{p}K^+), m_{p\overline{p}} < 2.85$ GeV/c^2			
	LHCb [153]	$0.021 \pm 0.020 \pm 0.004$	
	Belle [151]	$-0.02 \pm 0.05 \pm 0.02$	0.007 ± 0.019
	BaBar [156]	$-0.16\,^{+0.07}_{-0.08} \pm 0.04$	
$A_{\rm CP}(B^+ \to p\overline{p}K^*(892)^+)$[1]	BaBar [152]	$0.32 \pm 0.13 \pm 0.05$	0.21 ± 0.11
	Belle [158]	$-0.01 \pm 0.19 \pm 0.02$	
$A_{\rm CP}(B^+ \to p\overline{\Lambda}^0\gamma)$	Belle [161]	$0.17 \pm 0.16 \pm 0.05$	0.17 ± 0.17
$A_{\rm CP}(B^+ \to p\overline{\Lambda}^0\pi^0)$	Belle [161]	$0.01 \pm 0.17 \pm 0.04$	0.01 ± 0.17
$A_{\rm CP}(B^+ \to K^+\ell^+\ell^-)$	Belle [243]	$0.04 \pm 0.10 \pm 0.02$	0.02 ± 0.08
	BaBar [266]	$-0.03 \pm 0.14 \pm 0.01$	
$A_{\rm CP}(B^+ \to K^+e^+e^-)$	Belle [243]	$0.14 \pm 0.14 \pm 0.03$	0.14 ± 0.14
$A_{\rm CP}(B^+ \to K^+\mu^+\mu^-)$	LHCb [331]	$0.012 \pm 0.017 \pm 0.001$ [2,3]	0.011 ± 0.017
	Belle [243]	$-0.05 \pm 0.13 \pm 0.03$ [4]	
$A_{\rm CP}(B^+ \to \pi^+\mu^+\mu^-)$	LHCb [234]	$-0.11 \pm 0.12 \pm 0.01$	-0.11 ± 0.12
$A_{\rm CP}(B^+ \to K^*(892)^+\ell^+\ell^-)$	Belle [243]	$-0.13\,^{+0.17}_{-0.16} \pm 0.01$	-0.09 ± 0.14
	BaBar [239]	$0.01\,^{+0.26}_{-0.24} \pm 0.02$	
$A_{\rm CP}(B^+ \to K^*(892)^+e^+e^-)$	Belle [243]	$-0.14\,^{+0.23}_{-0.22} \pm 0.02$	-0.14 ± 0.23
$A_{\rm CP}(B^+ \to K^*(892)^+\mu^+\mu^-)$	Belle [243]	$-0.12 \pm 0.24 \pm 0.02$	-0.12 ± 0.24

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

Parameter	**Measurements**		**Average**
$A_{\rm CP}(B^0 \to K^+\pi^-)$	LHCb [332]	-0.0831 ± 0.0034 [1]	-0.0836 ± 0.0032
	CDF [333]	$-0.083 \pm 0.013 \pm 0.004$	
	Belle [3]	$-0.069 \pm 0.014 \pm 0.007$	
	BaBar [95]	$-0.107 \pm 0.016\,^{+0.006}_{-0.004}$	
	Belle II [5]	$-0.16 \pm 0.05 \pm 0.01$	
$A_{\rm CP}(B^0 \to \eta' K^*(892)^0)$	BaBar [16]	$0.02 \pm 0.23 \pm 0.02$	-0.07 ± 0.18
	Belle [97]	$-0.22 \pm 0.29 \pm 0.07$	
$A_{\rm CP}(B^0 \to \eta'(K\pi)^{*0}_0)$	BaBar [16]	$-0.19 \pm 0.17 \pm 0.02$	-0.19 ± 0.17
$A_{\rm CP}(B^0 \to \eta' K^*_2(1430)^0)$	BaBar [16]	$0.14 \pm 0.18 \pm 0.02$	0.14 ± 0.18
$A_{\rm CP}(B^0 \to \eta K^*(892)^0)$	BaBar [19]	$0.21 \pm 0.06 \pm 0.02$	0.19 ± 0.05
	Belle [20]	$0.17 \pm 0.08 \pm 0.01$	
$A_{\rm CP}(B^0 \to \eta(K\pi)^{*0}_0)$	BaBar [19]	$0.06 \pm 0.13 \pm 0.02$	0.06 ± 0.13
$A_{\rm CP}(B^0 \to \eta K^*_2(1430)^0)$	BaBar [19]	$-0.07 \pm 0.19 \pm 0.02$	-0.07 ± 0.19
$A_{\rm CP}(B^0 \to b_1(1235)^- K^+)$	BaBar [48]	$-0.07 \pm 0.12 \pm 0.02$	-0.07 ± 0.12
$A_{\rm CP}(B^0 \to \omega(782) K^*(892)^0)$	BaBar [26]	$0.45 \pm 0.25 \pm 0.02$	0.45 ± 0.25
$A_{\rm CP}(B^0 \to \omega(782)(K\pi)^{*0}_0)$	BaBar [26]	$-0.07 \pm 0.09 \pm 0.02$	-0.07 ± 0.09
$A_{\rm CP}(B^0 \to \omega(782) K^*_2(1430)^0)$	BaBar [26]	$-0.37 \pm 0.17 \pm 0.02$	-0.37 ± 0.17
$A_{\rm CP}(B^0 \to K^+\pi^-\pi^0)$	BaBar [102]	$-0.030\,^{+0.045}_{-0.051} \pm 0.055$ [2]	-0.00 ± 0.06
	Belle [101]	$0.07 \pm 0.11 \pm 0.01$	
$A_{\rm CP}(B^0 \to \rho^-(770) K^+)$	BaBar [100]	$0.20 \pm 0.09 \pm 0.08$ [2]	0.20 ± 0.11
	Belle [101]	$0.22\,^{+0.22}_{-0.23}\,^{+0.06}_{-0.02}$	
$A_{\rm CP}(B^0 \to \rho(1450)^- K^+)$	BaBar [100]	$-0.10 \pm 0.32 \pm 0.09$ [2]	-0.10 ± 0.33
$A_{\rm CP}(B^0 \to \rho(1700)^- K^+)$	BaBar [100]	$-0.36 \pm 0.57 \pm 0.23$ [2]	-0.36 ± 0.61
$A_{\rm CP}(B^0 \to K^+\pi^-\pi^0({\rm NR}))$	BaBar [100]	$0.10 \pm 0.16 \pm 0.08$ [3]	0.10 ± 0.18
$A_{\rm CP}(B^0 \to K^0\pi^+\pi^-)$	BaBar [103]	$-0.01 \pm 0.05 \pm 0.01$ [4]	-0.01 ± 0.05
$A_{\rm CP}(B^0 \to K^*(892)^+\pi^-)$	LHCb [108]	$-0.308 \pm 0.060 \pm 0.016$ [4,5]	-0.274 ± 0.045
	BaBar [103]	$-0.21 \pm 0.10 \pm 0.02$ [4,5]	
	BaBar [100]	$-0.29 \pm 0.11 \pm 0.02$ [2]	
	Belle [334]	$-0.21 \pm 0.11 \pm 0.07$ [4]	

[1] LHCb combines results of the 1.9fb^{-1} run 2 data analysis with those based on Run 1 dataset [335]. The full statistical and systematic covariance matrices are used in the combination.
[2] Result extracted from Dalitz-plot analysis of $B^0 \to K^+\pi^-\pi^0$ decays.
[3] The nonresonant amplitude is taken to be constant across the Dalitz plane.
[4] Result extracted from Dalitz-plot analysis of $B^0 \to K^0_S\pi^+\pi^-$ decays.
[5] Multiple systematic uncertainties are added in quadrature.

Table 74: CP asymmetries of charmless hadronic B^0 decays (part 2).

Parameter	**Measurements**		**Average**
$A_{\rm CP}(B^0 \to (K\pi)_0^{*+}\pi^-)$	LHCb [108]	$-0.032 \pm 0.047 \pm 0.031$ [1,2]	0.017 ± 0.043
	BaBar [103]	$0.09 \pm 0.07 \pm 0.03$ [1,2]	
	BaBar [100]	$0.07 \pm 0.14 \pm 0.01$ [3]	
$A_{\rm CP}(B^0 \to K_2^*(1430)^+\pi^-)$	LHCb [108]	$-0.29 \pm 0.22 \pm 0.09$ [1,2]	-0.29 ± 0.24
$A_{\rm CP}(B^0 \to K^*(1680)^+\pi^-)$	LHCb [108]	$-0.07 \pm 0.13 \pm 0.04$ [1,2]	-0.07 ± 0.13
$A_{\rm CP}(B^0 \to f_0(980)K_S^0)$	LHCb [108]	$0.28 \pm 0.27 \pm 0.15$ [1,2]	0.28 ± 0.31
$A_{\rm CP}(B^0 \to (K\pi)_0^{*0}\pi^0)$	BaBar [100]	$-0.15 \pm 0.10 \pm 0.04$ [3]	-0.15 ± 0.11
$A_{\rm CP}(B^0 \to K^*(892)^0\pi^0)$	BaBar [100]	$-0.15 \pm 0.12 \pm 0.04$ [3]	-0.15 ± 0.13
$A_{\rm CP}(B^0 \to K^*(892)^0\pi^+\pi^-)$	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 [43]	$-0.16 \pm 0.12 \pm 0.01$	-0.16 ± 0.12
$A_{\rm CP}(B^0 \to K^0\overline{K}^0)$	Belle [336]	$-0.58\,^{+0.73}_{-0.66} \pm 0.04$ [4]	$-0.58\,^{+0.73}_{-0.66}$
$A_{\rm CP}(B^0 \to \phi(1020)K^*(892)^0)$	Belle [124]	$-0.007 \pm 0.048 \pm 0.021$	-0.001 ± 0.041
	BaBar [123]	$0.01 \pm 0.06 \pm 0.03$	
$A_{\rm CP}(B^0 \to K^*(892)^0\pi^+K^-)$	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]	$0.093 \pm 0.094 \pm 0.017$	0.123 ± 0.081
	BaBar [123]	$0.20 \pm 0.14 \pm 0.06$	
$A_{\rm CP}(B^0 \to K_2^*(1430)^0\phi(1020))$	BaBar [123]	$-0.08 \pm 0.12 \pm 0.05$	-0.112 ± 0.099
	Belle [124]	$-0.155\,^{+0.152}_{-0.133} \pm 0.033$	
$A_{\rm CP}(B^0 \to K^*(892)^0\gamma)$	LHCb [192]	$0.008 \pm 0.017 \pm 0.009$	-0.006 ± 0.011
	Belle [213]	$-0.013 \pm 0.017 \pm 0.004$	
	BaBar [214]	$-0.016 \pm 0.022 \pm 0.007$	
$A_{\rm CP}(B^0 \to K_2^*(1430)^0\gamma)$	BaBar [227]	$-0.08 \pm 0.15 \pm 0.01$	-0.08 ± 0.15
$A_{CP}(B^0 \to X_s\gamma)$	Belle [295]	$-0.0094 \pm 0.0174 \pm 0.0047$ [5]	-0.009 ± 0.018

[1] Result extracted from Dalitz-plot analysis of $B^0 \to K_S^0\pi^+\pi^-$ decays.
[2] Multiple systematic uncertainties are added in quadrature.
[3] Result extracted from Dalitz-plot analysis of $B^0 \to K^+\pi^-\pi^0$ decays.
[4] Result extracted from a time-dependent analysis.
[5] $M_{X_s} < 2.8$ GeV/c^2.

Table 75: CP asymmetries of charmless hadronic B^0 decays (part 3).

Parameter	**Measurements**		**Average**
$A_{\rm CP}(B^0 \to \rho^+(770)\pi^-)$	BaBar [337]	$0.09\,^{+0.05}_{-0.06} \pm 0.04$ [1]	0.13 ± 0.05
	Belle [338]	$0.21 \pm 0.08 \pm 0.04$ [1]	
$A_{\rm CP}(B^0 \to \rho^-(770)\pi^+)$	BaBar [337]	$-0.12 \pm 0.08\,^{+0.04}_{-0.05}$ [1]	-0.08 ± 0.08
	Belle [338]	$0.08 \pm 0.16 \pm 0.11$ [1]	
$A_{\rm CP}(B^0 \to a_1(1260)^+\pi^-$+c.c.)	Belle [144]	$-0.06 \pm 0.05 \pm 0.07$ [2]	-0.07 ± 0.06
	BaBar [339]	$-0.07 \pm 0.07 \pm 0.02$ [2]	
$A_{\rm CP}(B^0 \to b_1(1235)^+\pi^-$+c.c.)	BaBar [48]	$-0.05 \pm 0.10 \pm 0.02$	-0.05 ± 0.10
$A_{\rm CP}(B^0 \to p\overline{p}K^*(892)^0)$[3]	BaBar [152]	$0.11 \pm 0.13 \pm 0.06$	0.05 ± 0.12
	Belle [158]	$-0.08 \pm 0.20 \pm 0.02$	
$A_{\rm CP}(B^0 \to p\overline{\Lambda}^0\pi^-)$	BaBar [170]	$-0.10 \pm 0.10 \pm 0.02$	-0.06 ± 0.07
	Belle [161]	$-0.02 \pm 0.10 \pm 0.03$	
$A_{\rm CP}(B^0 \to K^*(892)^0\ell^+\ell^-)$	Belle [243]	$-0.08 \pm 0.12 \pm 0.02$	-0.05 ± 0.10
	BaBar [239]	$0.02 \pm 0.20 \pm 0.02$	
$A_{\rm CP}(B^0 \to K^*(892)^0e^+e^-)$	Belle [243]	$-0.21 \pm 0.19 \pm 0.02$	-0.21 ± 0.19
$A_{\rm CP}(B^0 \to K^*(892)^0\mu^+\mu^-)$	LHCb [331]	$-0.035 \pm 0.024 \pm 0.003$ [4,5]	-0.034 ± 0.024
	Belle [243]	$0.00 \pm 0.15 \pm 0.03$ [6]	

[1] Result extracted from Dalitz-plot analysis of $B^0 \to \pi^+\pi^-\pi^0$ decays.
[2] Result extracted from a time-dependent analysis.
[3] Treatment of charmonium intermediate components differs between the results.
[4] A_{CP} is also measured in bins of $m_{\mu^+\mu^-}$
[5] Mass regions corresponding to ϕ, J/ψ and $\psi(2S)$ are vetoed.
[6] Mass regions corresponding to J/ψ and $\psi(2S)$ are vetoed.

Table 76: CP asymmetries of charmless hadronic decays of $B^{\pm}/B^0$ admixture.

Parameter	**Measurements**		**Average**
$A_{\rm CP}(B \to K^*\gamma)$	Belle [213]	$-0.004 \pm 0.014 \pm 0.003$	-0.004 ± 0.011
	BaBar [214]	$-0.003 \pm 0.017 \pm 0.007$	
$A_{CP}(B \to X_s\gamma)$	Belle [295]	$0.0144 \pm 0.0128 \pm 0.0011$ [1]	0.015 ± 0.011
	BaBar [340]	$0.017 \pm 0.019 \pm 0.010$ [2]	
$A_{CP}(B \to X_{s+d}\gamma)$	Belle [341]	$0.022 \pm 0.039 \pm 0.009$ [3]	0.032 ± 0.034
	BaBar [257]	$0.057 \pm 0.060 \pm 0.018$ [4]	
$A_{CP}(B \to X_s\ell^+\ell^-)$	BaBar [263]	$0.04 \pm 0.11 \pm 0.01$	0.04 ± 0.11
$A_{\rm CP}(B \to K^*e^+e^-)$	Belle [243]	$-0.18 \pm 0.15 \pm 0.01$	-0.18 ± 0.15
$A_{\rm CP}(B \to K^*\mu^+\mu^-)$	Belle [243]	$-0.03 \pm 0.13 \pm 0.02$	-0.03 ± 0.13
$A_{\rm CP}(B \to K^*\ell^+\ell^-)$	Belle [243]	$-0.10 \pm 0.10 \pm 0.01$	-0.05 ± 0.08
	BaBar [266]	$0.03 \pm 0.13 \pm 0.01$	
$A_{CP}(B \to X_s\eta)$	Belle [290]	$-0.13 \pm 0.04\,^{+0.02}_{-0.03}$ [5]	$-0.13\,^{+0.04}_{-0.05}$
$A_{\rm CP}(B \to K\ell^+\ell^-)$	BaBar [266]	$-0.03 \pm 0.14 \pm 0.01$	-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 77: CP asymmetries of charmless hadronic B^0_s decays.

Parameter	**Measurements**		**Average**
$A_{CP}(B^0_s \to \pi^+K^-)$	LHCb [332]	0.225 ± 0.012 [1]	0.225 ± 0.012
	CDF [333]	$0.22 \pm 0.07 \pm 0.02$	

[1] LHCb combines results of the 1.9fb^{-1} run 2 data analysis with those based on Run 1 dataset [335]. The full statistical and systematic covariance matrices are used in the combination.

Table 78: *CP* asymmetries of charmless hadronic Λ_b^0 decays.

Parameter	**Measurements**		**Average**
$A_{\rm CP}(\Lambda_b^0 \to p\pi^-)$	LHCb [342]	$-0.035 \pm 0.017 \pm 0.020$	-0.025 ± 0.025
	CDF [333]	$0.06 \pm 0.07 \pm 0.03$	
$A_{\rm CP}(\Lambda_b^0 \to pK^-)$	LHCb [342]	$-0.020 \pm 0.013 \pm 0.019$	-0.025 ± 0.022
	CDF [333]	$-0.10 \pm 0.08 \pm 0.04$	
$A_{\rm CP}(\Lambda_b^0 \to p\overline{K}^0\pi^-)$	LHCb [105]	$0.22 \pm 0.13 \pm 0.03$	0.22 ± 0.13
$A_{\rm CP}(\Lambda_b^0 \to \Lambda^0 K^+\pi^-)$	LHCb [177]	$-0.53 \pm 0.23 \pm 0.11$	-0.53 ± 0.25
$A_{\rm CP}(\Lambda_b^0 \to \Lambda^0 K^+K^-)$	LHCb [177]	$-0.28 \pm 0.10 \pm 0.07$	-0.28 ± 0.12

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

- In Ref. [343], 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. [344], 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. [345], 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. [346] 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.

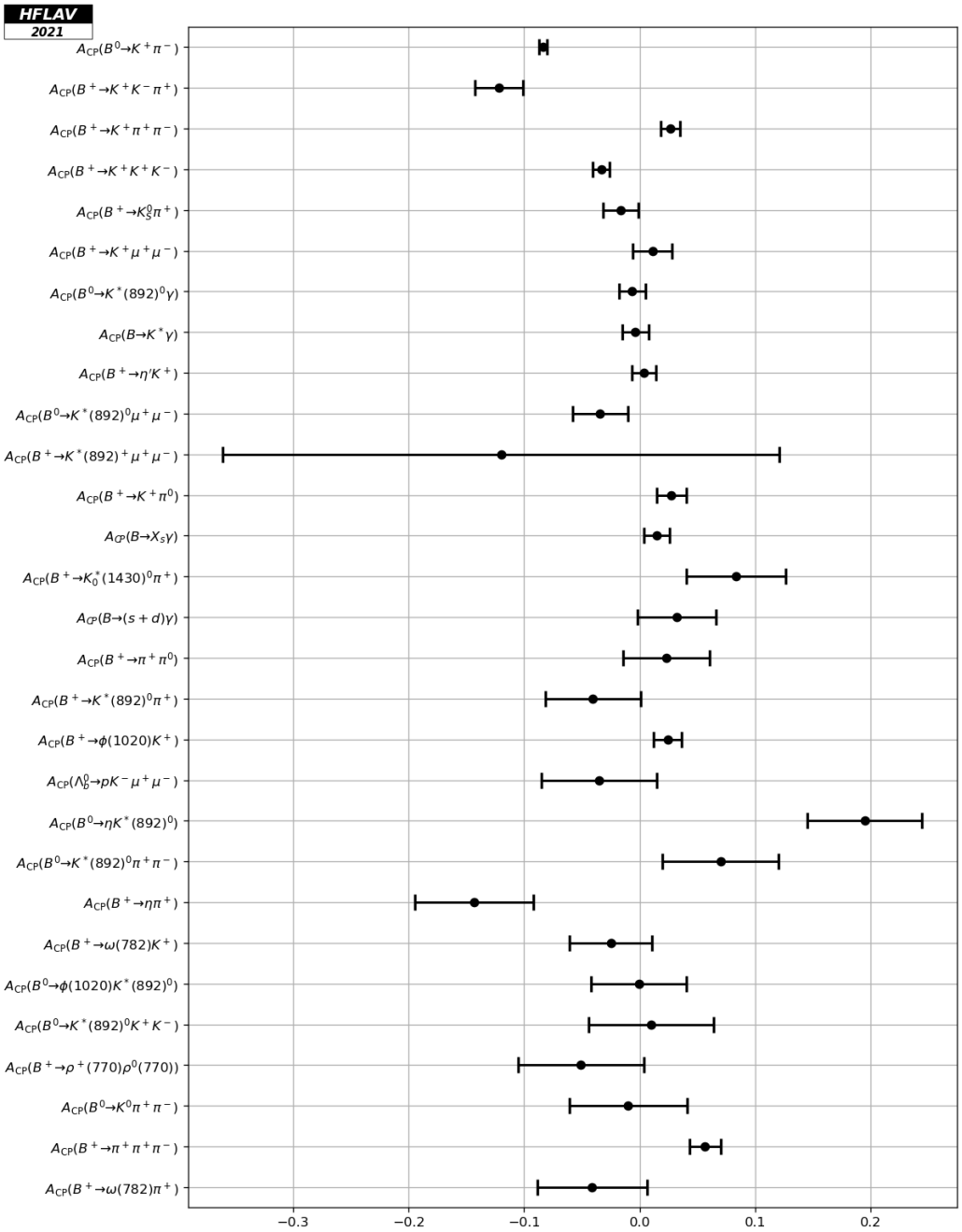

Figure 13: A selection among the most precise direct CP asymmetries (A_{CP}) measured in charmless B^+ and B^0 decay modes.

8 Polarization measurements in b-hadron decays

In this section, compilations of polarization measurements in b-hadron decays are given. Tables 79, 80, and 81 detail measurements of the longitudinal fraction, f_L, in B^+ B^0, and B_s^0 decays, respectively. They are followed by Tables 82, 83 and 84, which list polarisation fractions and CP parameters measured in full angular analyses of B^+, B^0 and B_s^0 decays. Figures 14 and 15 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 di-spin-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 polarisation amplitudes, $A_\perp = (H_{+1} - H_{-1})/\sqrt{2}$ and $A_\parallel = (H_{+1} + H_{-1})/\sqrt{2}$ and their charge conjugates: $\overline{A_0}$, $\overline{A_\parallel}$, and $\overline{A_\perp}$. Using the definitions:

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

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

Parameter	**Measurements**		**Average** HFLAV / PDG
$f_L(B^+ \to \omega(782)K^*(892)^+)$	BaBar [26]	$0.41 \pm 0.18 \pm 0.05$	0.41 ± 0.19
$f_L(B^+ \to \omega(782)K_2^*(1430)^+)$	BaBar [26]	$0.56 \pm 0.10 \pm 0.04$	0.56 ± 0.11
$f_L(B^+ \to K^*(892)^+\overline{K}^*(892)^0)$	BaBar [59]	$0.75\,^{+0.16}_{-0.26} \pm 0.03$	$0.82\,^{+0.13}_{-0.17}$
	Belle [58]	$1.06 \pm 0.30 \pm 0.14$	$0.82\,^{+0.15}_{-0.21}$
$f_L(B^+ \to \phi(1020)K^*(892)^+)$	BaBar [64]	$0.49 \pm 0.05 \pm 0.03$ [1]	0.50 ± 0.05
	Belle [330]	$0.52 \pm 0.08 \pm 0.03$	
	Belle II [61]	$0.58 \pm 0.23 \pm 0.02$	
$f_L(B^+ \to \phi(1020)K_1(1270)^+)$	BaBar [66]	$0.46\,^{+0.12}_{-0.13}\,^{+0.06}_{-0.07}$	0.46 ± 0.14
$f_L(B^+ \to \phi(1020)K_2^*(1430)^+)$	BaBar [66]	$0.80\,^{+0.09}_{-0.10} \pm 0.03$	0.80 ± 0.10
$f_L(B^+ \to K^*(892)^+\rho^0(770))$	BaBar [42]	$0.78 \pm 0.12 \pm 0.03$	0.78 ± 0.12
$f_L(B^+ \to K^*(892)^0\rho^+(770))$	BaBar [44]	$0.52 \pm 0.10 \pm 0.04$	0.48 ± 0.08
	Belle [45]	$0.43 \pm 0.11\,^{+0.05}_{-0.02}$ [2]	
$f_L(B^+ \to \rho^+(770)\rho^0(770))$	BaBar [80]	$0.950 \pm 0.015 \pm 0.006$	0.950 ± 0.016
	Belle [81]	$0.948 \pm 0.106 \pm 0.021$	
$f_L(B^+ \to \omega(782)\rho^+(770))$	BaBar [26]	$0.90 \pm 0.05 \pm 0.03$	0.90 ± 0.06
$f_L(B^+ \to p\overline{p}K^*(892)^+)$	Belle [158]	$0.32 \pm 0.17 \pm 0.09$	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. [50].

Table 80: Longitudinal polarization fraction, f_L, in B^0 decays.

Parameter	**Measurements**		**Average** HFLAV / PDG
$f_L(B^0 \to \omega(782)K^*(892)^0)$	BaBar [26]	$0.72 \pm 0.14 \pm 0.02$	0.69 ± 0.11
	LHCb [347]	$0.68 \pm 0.17 \pm 0.16$	
	Belle [98]	$0.56 \pm 0.29\,^{+0.18}_{-0.08}$	
$f_L(B^0 \to \omega(782)K_2^*(1430)^0)$	BaBar [26]	$0.45 \pm 0.12 \pm 0.02$	0.45 ± 0.12
$f_L(B^0 \to K^*(892)^0\overline{K}^*(892)^0)$	LHCb [130]	$0.724 \pm 0.051 \pm 0.016$	0.73 ± 0.05
	BaBar [131]	$0.80\,^{+0.10}_{-0.12} \pm 0.06$	0.74 ± 0.05
$f_L(B^0 \to \phi(1020)K^*(892)^0)$	LHCb [348]	$0.497 \pm 0.019 \pm 0.015$	0.497 ± 0.017
	Belle [124]	$0.499 \pm 0.030 \pm 0.018$	
	BaBar [123]	$0.494 \pm 0.034 \pm 0.013$	
	Belle II [61]	$0.57 \pm 0.20 \pm 0.04$	
$f_L(B^0 \to \phi(1020)K_2^*(1430)^0)$	Belle [124]	$0.918\,^{+0.029}_{-0.060} \pm 0.012$	$0.912\,^{+0.032}_{-0.046}$
	BaBar [123]	$0.901\,^{+0.046}_{-0.058} \pm 0.037$	$0.913\,^{+0.028}_{-0.050}$
$f_L(B^0 \to K^*(892)^0\rho^0(770))$	LHCb [347]	$0.164 \pm 0.015 \pm 0.022$	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 [146]	$0.988 \pm 0.012 \pm 0.023$	0.990 ± 0.020
	BaBar [147]	$0.992 \pm 0.024\,^{+0.026}_{-0.013}$	$0.990\,^{+0.021}_{-0.019}$
$f_L(B^0 \to \rho^0(770)\rho^0(770))$[1]	LHCb [128]	$0.745\,^{+0.048}_{-0.058} \pm 0.034$	0.71 ± 0.06
	BaBar [143]	$0.75\,^{+0.11}_{-0.14} \pm 0.04$	$0.71\,^{+0.08}_{-0.09}$
	Belle [142]	$0.21\,^{+0.18}_{-0.22} \pm 0.15$	
$f_L(B^0 \to a_1(1260)^+a_1(1260)^-)$	BaBar [149]	$0.31 \pm 0.22 \pm 0.10$	0.31 ± 0.24
$f_L(B^0 \to p\overline{p}K^*(892)^0)$	Belle [158]	$1.01 \pm 0.13 \pm 0.03$	1.01 ± 0.13
$f_L(B^0 \to \Lambda^0\overline{\Lambda}^0K^*(892)^0)$	Belle [164]	$0.60 \pm 0.22 \pm 0.08$ [2,3]	0.60 ± 0.23
$f_L(B^0 \to K^{*0}\mu^+\mu^-), 0.04 < q^2 < 6.0$ GeV^2/c^4			
	ATLAS [318]	$0.50 \pm 0.06 \pm 0.04$	0.50 ± 0.07
$f_L(B^0 \to K^{*0}e^+e^-), 0.002 < q^2 < 1.120$ GeV^2/c^4			
	LHCb [349]	$0.16 \pm 0.06 \pm 0.03$	0.16 ± 0.07

[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 81: Longitudinal polarization fraction, f_L, in B_s^0 decays.

Parameter	**Measurements**		**Average** HFLAV / PDG
$f_L(B_s^0 \to \phi(1020)\phi(1020))$	LHCb [138]	$0.381 \pm 0.007 \pm 0.012$	0.378 ± 0.013
	CDF [187]	$0.348 \pm 0.041 \pm 0.021$	
$f_L(B_s^0 \to K^*(892)^0\overline{K}^*(892)^0)$	LHCb [130]	$0.240 \pm 0.031 \pm 0.025$	0.24 ± 0.04
$f_L(B_s^0 \to \phi(1020)\overline{K}^*(892)^0)$	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 [350]	$0.911 \pm 0.020 \pm 0.165$	0.91 ± 0.17
$f_L(B_s^0 \to K_2^*(1430)^0\overline{K}^*(892)^0)$	LHCb [350]	$0.62 \pm 0.16 \pm 0.25$	0.62 ± 0.30
$f_L(B_s^0 \to K_2^*(1430)^0\overline{K}_2^*(1430)^0)$	LHCb [350]	$0.25 \pm 0.14 \pm 0.18$	0.25 ± 0.23

Table 82: Results of full angular analyses of B^+ decays.

Parameter	**Measurements**		**Average** HFLAV / PDG
$f_\perp(B^+ \to \phi(1020)K^*(892)^+)$	BaBar [64]	$0.21 \pm 0.05 \pm 0.02$ [1]	0.20 ± 0.05
	Belle [330]	$0.19 \pm 0.08 \pm 0.02$	
$A_{CP}^0\,(B^+ \to \phi(1020)K^*(892)^+)$	BaBar [64]	$0.17 \pm 0.11 \pm 0.02$ [1]	0.17 ± 0.11
$A_{CP}^\perp\,(B^+ \to \phi(1020)K^*(892)^+)$	BaBar [64]	$0.22 \pm 0.24 \pm 0.08$ [1]	0.22 ± 0.25

[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 83: Results of full angular analyses of B^0 decays.

Parameter	**Measurements**		**Average** HFLAV / PDG
$f_\perp(B^0 \to \phi(1020)K^*(892)^0)$	LHCb [348]	$0.221 \pm 0.016 \pm 0.013$	0.224 ± 0.015
	Belle [124]	$0.238 \pm 0.026 \pm 0.008$	
	BaBar [123]	$0.212 \pm 0.032 \pm 0.013$	
$A_{CP}^0\,(B^0 \to \phi(1020)K^*(892)^0)$	LHCb [348]	$-0.003 \pm 0.038 \pm 0.005$	-0.007 ± 0.030
	Belle [124]	$-0.030 \pm 0.061 \pm 0.007$	
	BaBar [123]	$0.01 \pm 0.07 \pm 0.02$	
$A_{CP}^\perp\,(B^0 \to \phi(1020)K^*(892)^0)$	LHCb [348]	$0.047 \pm 0.074 \pm 0.009$	-0.02 ± 0.06
	Belle [124]	$-0.14 \pm 0.11 \pm 0.01$	
	BaBar [123]	$-0.04 \pm 0.15 \pm 0.06$	
$f_\perp(B^0 \to \phi(1020)K_2^*(1430)^0)$[1]	BaBar [123]	$0.002\,^{+0.018}_{-0.002} \pm 0.031$	$0.029\,^{+0.024}_{-0.026}$
	Belle [124]	$0.056\,^{+0.050}_{-0.035} \pm 0.009$	$0.027\,^{+0.031}_{-0.025}$
$A_{CP}^0\,(B^0 \to \phi(1020)K_2^*(1430)^0)$	Belle [124]	$-0.016\,^{+0.066}_{-0.051} \pm 0.008$	-0.03 ± 0.04
	BaBar [123]	$-0.05 \pm 0.06 \pm 0.01$	
$A_{CP}^\perp\,(B^0 \to \phi(1020)K_2^*(1430)^0)$	Belle [124]	$-0.01\,^{+0.85}_{-0.67} \pm 0.09$	$-0.01\,^{+0.85}_{-0.68}$

[1] The PDG uncertainty includes a scale factor.

Table 84: Results of full angular analyses of B_s^0 decays.

Parameter	**Measurements**		**Average** HFLAV / PDG
$f_\perp(B_s^0 \to \phi(1020)\phi(1020))$	LHCb [138]	$0.290 \pm 0.008 \pm 0.007$	0.293 ± 0.010
	CDF [187]	$0.365 \pm 0.044 \pm 0.027$	0.292 ± 0.009
$f_\parallel(B_s^0 \to \phi(1020)\overline{K}^*(892)^0)$	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]	$0.526 \pm 0.032 \pm 0.019$	0.526 ± 0.037
			0.380 ± 0.120
$f_\parallel(B_s^0 \to K^*(892)^0\overline{K}^*(892)^0)$	LHCb [130]	$0.234 \pm 0.025 \pm 0.010$	0.23 ± 0.03
			0.30 ± 0.05

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 [348], in addition to the results quoted in Table 83, LHCb reports observables related to the S-wave component contributing the 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 84, LHCb, in Ref. [351], 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. [187] also reports the triple-product asymmetries A_U and A_V.

- In Ref. [350], LHCb presents a flavour-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 $\phi_s^{d\bar{d}}$.

- Ref. [347] 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.

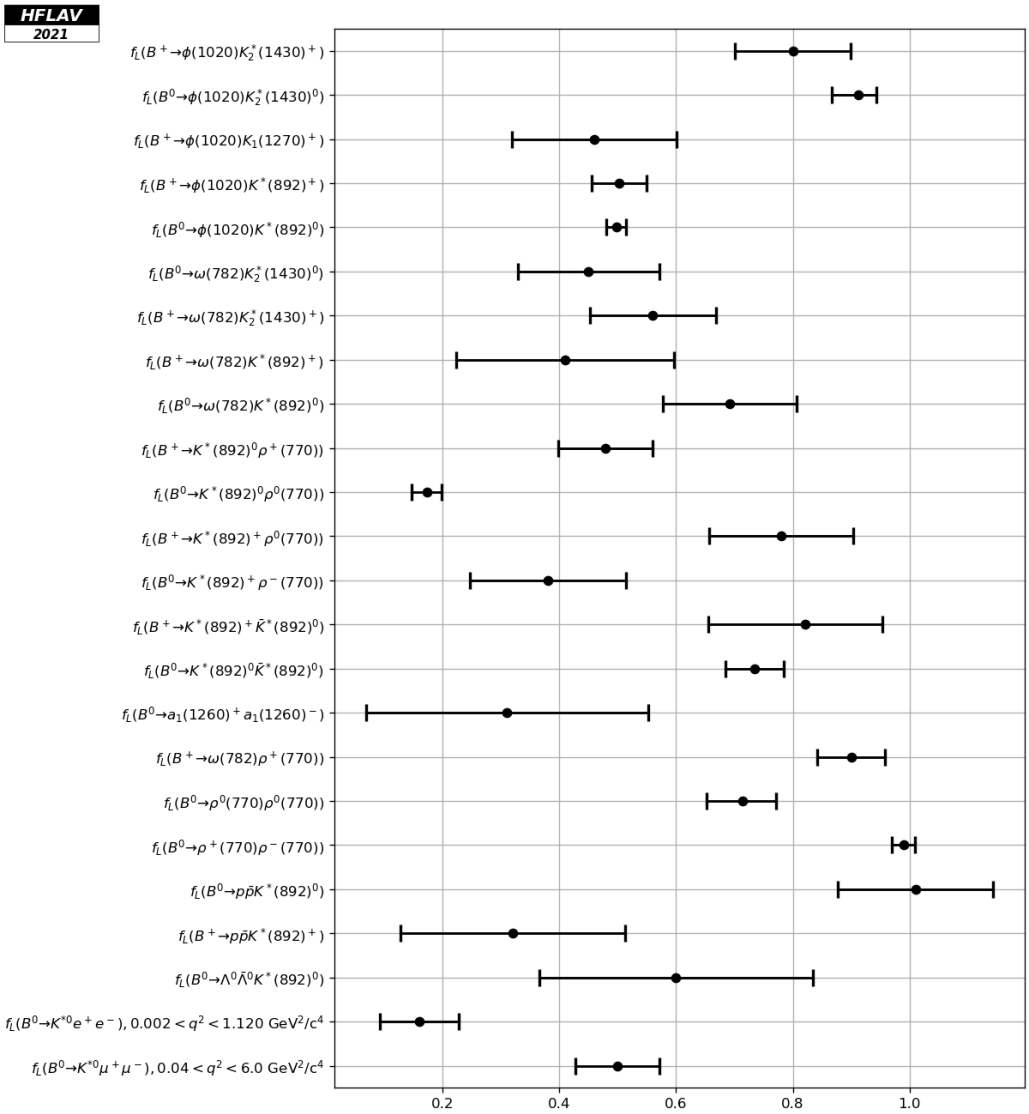

Figure 14: Longitudinal polarization fraction in charmless B decays.

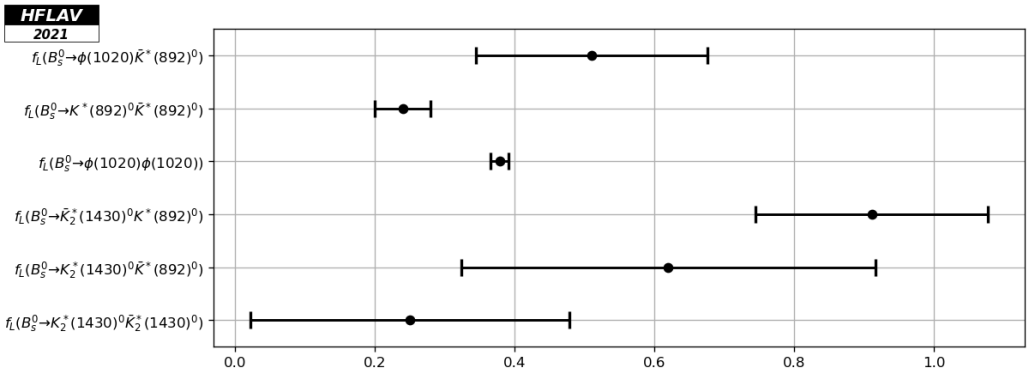

Figure 15: Longitudinal polarization fraction in charmless B_s^0 decays.

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