

# Averaging Tool (for HFLAV rare decays and b2charm groups)

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12.01.2021

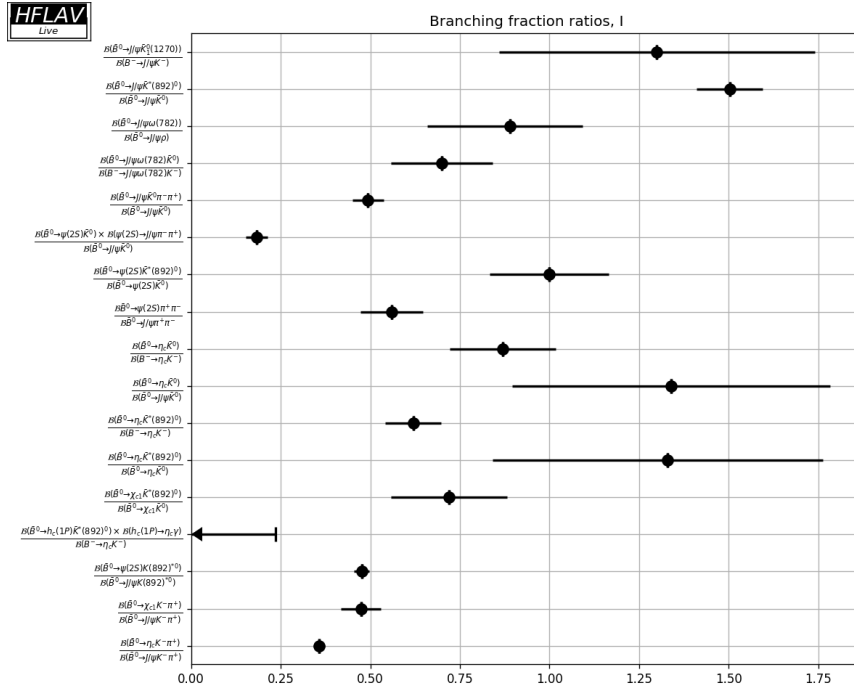


# Introduction

Heavy Flavor Averaging group (HFLAV) - April 2019  
 $B^+$  Branching Fractions (decays with strange mesons part 1) ( $\times 10^{-6}$ ) - UL at 90% CL  
 Preliminary Updated results not included in PDG Live as of Dec. 31, 2017

RFP#	Mode	PDG2017 Avg.	BBM	Belle	CLEO	CDF	LHCb	Our Avg.
327	$K^0 \pi^+$	$23.7 \pm 0.8$	$23.9 \pm 1.1 \pm 1.0$	$23.97 \pm 0.53 \pm 0.71$	$18.8^{+3.7+2.1}_{-3.2-1.8}$	$12.0^{+2.4+1.2}_{-2.2-1.1}$		$23.79 \pm 0.75$
328	$K^+ \pi^0$	$12.9 \pm 0.5$	$13.6 \pm 0.6 \pm 0.7$	$12.62 \pm 0.31 \pm 0.56$				$12.94^{+0.52}_{-0.51}$
329	$\eta' K^+$	$70.6 \pm 2.5$	$71.5 \pm 1.3 \pm 3.2$	$69.2 \pm 2.2 \pm 3.7$				$70.6 \pm 2.7$
330	$\eta' K^0$	$4.8^{+1.8}_{-1.6}$	$4.8^{+1.9}_{-1.4}$	$< 2.9$				$4.8^{+1.8}_{-1.6}$
331	$\eta' K_S^0(1430)^+$	$5.2 \pm 2.1$	$5.2 \pm 1.9 \pm 1.0$	$< 2.9$				$5.2 \pm 2.1$
332	$\eta' K_S^0(1430)^+$	$28 \pm 5$	$28.0^{+4.6}_{-3.0}$	$< 2.9$				$28.0^{+5.3}_{-5.0}$
333	$\eta K^+$	$2.4 \pm 0.4$	$2.94^{+0.39}_{-0.34} \pm 0.21$	$2.12 \pm 0.23 \pm 0.11$	$2.2^{+2.8}_{-2.2}$			$2.36^{+0.22}_{-0.21}$
334	$\eta K^0$	$19.3 \pm 1.6$	$18.9 \pm 1.8 \pm 1.3$	$19.3^{+2.0}_{-1.9} \pm 1.5$	$26.4^{+9.6}_{-8.2} \pm 3.3$			$19.3 \pm 1.6$
335	$\eta K_S^0(1430)^+$	$18 \pm 4$	$18.2 \pm 2.6 \pm 2.6$					$18.2 \pm 3.7$
336	$\eta K_S^0(1430)^+$	$9.1 \pm 3.0$	$9.1 \pm 2.7 \pm 1.4$					$9.1 \pm 3.0$
337	$\eta(1295)K^+$	$2.9^{+0.8}_{-0.7}$	$2.9^{+0.8}_{-0.7} \pm 0.2 \uparrow$					$2.9^{+0.8}_{-0.7}$
339	$\eta(1405)K^+$	$< 1.2$	$< 1.2$					$< 1.2$
340	$\eta(1475)K^+$	$13.8^{+2.1}_{-1.8}$	$13.8^{+2.1}_{-1.7-0.6}$					$13.8^{+2.1}_{-1.8}$
341	$f_1(1285)K^+$	$< 2.0$	$< 2.0$					$< 2.0$
342	$f_1(1420)K^+$	$< 2.9$	$< 2.9$					$< 2.9$
344	$\phi(1680)K^+$	$< 3.4$	$< 3.4$					$< 3.4$
345	$f_0(1500)K^+$	$3.7 \pm 2.2$	$3.7 \pm 2.2 \uparrow$					$3.7 \pm 2.2$
346	$\omega K^+$	$6.5 \pm 0.4$	$6.3 \pm 0.5 \pm 0.3$	$6.8 \pm 0.4 \pm 0.4$	$3.2^{+2.4}_{-1.9} \pm 0.8$			$6.5 \pm 0.4$
347	$\omega K^0$	$< 7.4$	$< 7.4$					$< 7.4$
348	$\omega(K^+) \pi^+$	$28 \pm 4$	$27.5^{+3.0}_{-2.6}$					$27.5^{+3.0}_{-2.6}$
349	$\omega K_S^0(1430)^+$	$24 \pm 5$	$24.0 \pm 2.6 \pm 4.4$					$24.0 \pm 5.1$
350	$\omega K_S^0(1430)^+$	$21 \pm 4$	$21.5 \pm 3.6 \pm 2.4$					$21.5 \pm 4.3$
351	$\omega_0(980)^+ K^0 \uparrow$	$< 3.9$	$< 3.9$					$< 3.9$
352	$\omega_0(980)^0 K^+ \uparrow$	$< 2.5$	$< 2.5$					$< 2.5$
353	$K^0 \pi^+$	$10.1 \pm 0.9$	$10.8 \pm 0.6^{+1.2}_{-1.4}$	$9.7 \pm 0.6^{+0.8}_{-0.9}$	$7.1^{+11.4}_{-7.1} \pm 1.0$			$10.1^{+0.8}_{-0.9}$
354	$K^+ \pi^0$	$8.2 \pm 1.9$	$8.2 \pm 1.5 \pm 1.1$					$8.2 \pm 1.8$
355	$K^+ \pi^+ \pi^-$	$51 \pm 2.9$	$54.4 \pm 1.1 \pm 4.6$	$48.8 \pm 1.1 \pm 3.6$				$51.0 \pm 3.0$
356	$K^+ \pi^+ \pi^- (NR)$	$16.3^{+2.1}_{-1.5}$	$9.3 \pm 1.0^{+6.9}_{-1.7}$	$16.9 \pm 1.3^{+1.7}_{-1.6}$				$16.3 \pm 2.0$
357	$\omega(782)K^+ (K^+ \pi^+ \pi^-)$	$6 \pm 9$	$5.9^{+8.8+0.5}_{-9.0-1.7}$					$5.9^{+8.8}_{-9.0}$
358	$f_0(980)K^+ (K^+ \pi^+ \pi^-)$	$9.4^{+1.0}_{-1.2}$	$10.3 \pm 0.5^{+2.0}_{-0.9}$	$8.8 \pm 0.8^{+0.9}_{-0.9}$				$9.4^{+1.0}_{-1.0}$
359	$f_2(1270)^0 K^+ (K^+ \pi^+ \pi^-)$	$1.07 \pm 0.27$	$0.88^{+0.38+0.01}_{-0.33-0.03}$	$1.33 \pm 0.30^{+0.23}_{-0.34}$				$1.07 \pm 0.29$
360	$f_0(1370)^0 K^+ (K^+ \pi^+ \pi^-)$	$< 10.7$	$< 10.7$					$< 10.7$
361	$\rho(1450)^0 K^+ (K^+ \pi^+ \pi^-)$	$< 11.7$	$< 11.7$					$< 11.7$
362	$f_2'(1525)K^+ (K^+ \pi^+ \pi^-)$	$< 3.4$	$< 3.4$					$< 3.4$
363	$\rho^0 K^+ (K^+ \pi^+ \pi^-)$	$3.7 \pm 0.5$	$3.56 \pm 0.45^{+0.57}_{-0.46}$	$3.89 \pm 0.47^{+0.43}_{-0.41}$				$3.74^{+0.49}_{-0.45}$

Results for LHCb are relative BF's converted to absolute BF's.  
 CLEO upper limits that have been greatly superseded are not shown.  
 $\uparrow$  In this product of BF's, all daughter BF's not shown are set to 100%.  
 $\uparrow$  The value quoted is  $B(B^+ \rightarrow \eta(1295)K^+) \times B(\eta(1295) \rightarrow \eta\pi\pi)$ .  
 $\uparrow$  Average of results in  $K_S^0 K^+ K^+$ ,  $K_S^0 K_S^0 K^+$  [?] and  $K^+ \pi^+ \pi^-$  [?]. Includes an  $f_X$  resonance with parameters that are compatible with  $f_0(1500)$ .



- Hundreds of averages to be calculated
- ➔ Only reasonably feasible with appropriate tools
- Challenge very similar for rare decays and b2charm groups (and maybe other groups)
- ➔ Exploit synergies and use the same tools

# Purpose of this Meeting

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## ➤ Review status of existing tools

**09:10** → 09:30 **b2charm framework**

Speaker: Thomas Kuhr (Ludwig Maximilians Universität (DE))

**09:30** → 09:50 **rare decays framework**

Speaker: Eli Ben Haim (Centre National de la Recherche Scientifique (FR))

**09:50** → 10:10 **ODSL framework**

Speakers: Dr Daniel Greenwald (Technische Universität München) , Jakob Knollmüller (Max-Planck-Institute for Astrophysics)

## ➤ Discussions about requirements, synergies, and work plan

- What do we want?
  - What existing code can we (re)use?
  - What do we have to develop in addition?
  - Who can do what on which time scale?
- ➔ Google doc linked on indico agenda