UPDATED RESULTS ON THE CKM MATRIX

Including results presented up to
ICHEP 2016

P r e l i m i n a r y

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The CKMfitter Group

Abstract

This document provides the collection of up-to-date inputs to the global CKM analysis, and numerical results obtained with the use of the fit package CKMfitter. The statistical method employed is the frequentist approach, using the *R*fit model to treat theoretical uncertainties. Detailed background information on the methodology and the treatment of experimental and theoretical uncertainties is provided in:

CP VIOLATION AND THE CKM MATRIX:
ASSESSING THE IMPACT OF THE ASYMMETRIC *B* FACTORIES
By CKMfitter Group
Eur. Phys. J. **C41**, 1-131, 2005 [hep-ph/0406184]

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1 Inputs

Parameter	Value ± Error(s)	Reference	Errors GS	TH
$\|V_{ud}\|$ (nuclei)	$0.97425 \pm 0 \pm 0.00022$	[1]	-	⋆
$\|V_{us}\| f_+^{K\to\pi}(0)$	0.2165 ± 0.0004	[3]	⋆	⋆
$\|V_{cd}\|$ (νN)	0.230 ± 0.011	[3]	⋆	-
$\|V_{cs}\|$ ($W \to c\bar{s}$)	$0.94^{+0.32}_{-0.26} \pm 0.13$	[3]	⋆	⋆
$\|V_{ub}\|$ (semileptonic)	$(3.98 \pm 0.08 \pm 0.22) \times 10^{-3}$	[4, 5]	⋆	⋆
$\|V_{cb}\|$ (semileptonic)	$(41.00 \pm 0.33 \pm 0.74) \times 10^{-3}$	[4, 5]	⋆	⋆
$\mathcal{B}(\Lambda_p \to p\mu^-\overline{\nu}_\mu)_{q^2>15}/\mathcal{B}(\Lambda_p \to \Lambda_c\mu^-\overline{\nu}_\mu)_{q^2>7}$	$(0.944 \pm 0.081) \times 10^{-2}$	[6], [7]	⋆	-
$\mathcal{B}(B^- \to \tau^-\overline{\nu}_\tau)$	$(1.08 \pm 0.21) \times 10^{-4}$	[4, 8]	⋆	-
$\mathcal{B}(D_s^- \to \mu^-\overline{\nu}_\mu)$	$(5.57 \pm 0.24) \times 10^{-3}$	[4]	⋆	-
$\mathcal{B}(D_s^- \to \tau^-\overline{\nu}_\tau)$	$(5.55 \pm 0.24) \times 10^{-2}$	[4]	⋆	-
$\mathcal{B}(D^- \to \mu^-\overline{\nu}_\mu)$	$(3.74 \pm 0.17) \times 10^{-4}$	[4]	⋆	⋆
$\mathcal{B}(K^- \to e^-\overline{\nu}_e)$	$(1.581 \pm 0.008) \times 10^{-5}$	[3]	⋆	-
$\mathcal{B}(K^- \to \mu^-\overline{\nu}_\mu)$	0.6355 ± 0.0011	[3]	⋆	-
$\mathcal{B}(\tau^- \to K^-\overline{\nu}_\tau)$	$(0.6955 \pm 0.0096) \times 10^{-2}$	[4]	⋆	-
$\mathcal{B}(K^- \to \mu^-\overline{\nu}_\mu)/\mathcal{B}(\pi^- \to \mu^-\overline{\nu}_\mu)$	1.3365 ± 0.0032	[3]	⋆	-
$\mathcal{B}(\tau^- \to K^-\overline{\nu}_\tau)/\mathcal{B}(\tau^- \to \pi^-\overline{\nu}_\tau)$	$(6.431 \pm 0.094) \times 10^{-2}$	[4]	⋆	-
$\mathcal{B}(B_s \to \mu\mu)$	$(2.8^{+0.7}_{-0.6}) \times 10^{-9}$	[9]	⋆	-
$\|V_{cd}\| f_+^{D\to\pi}(0)$	0.1425 ± 0.0019	[4]	⋆	-
$\|V_{cs}\| f_+^{D\to K}(0)$	0.7226 ± 0.0034	[4]	⋆	-
$\|\varepsilon_K\|$	$(2.228 \pm 0.011) \times 10^{-3}$	[3]	⋆	-
Δm_d	(0.5065 ± 0.0019) ps^{-1}	[4]	⋆	-
Δm_s	(17.757 ± 0.021) ps^{-1}	[4]	⋆	-
$\sin(2\beta)_{[c\bar{c}]}$	0.691 ± 0.017	[4]	⋆	-
$(\phi_s)_{[b\to c\bar{s}s]}$	-0.030 ± 0.033	[4]	⋆	-
$S_{\pi\pi}^{+-}$, $C_{\pi\pi}^{+-}$, $C_{\pi\pi}^{00}$,$\mathcal{B}_{\pi\pi}$ all charges	Inputs to isospin analysis	[10–18]	⋆	-
$S_{\rho\rho,L}^{+-}$, $C_{\rho\rho,L}^{+-}$, $S_{\rho\rho}^{00}$, $C_{\rho\rho}^{00}$,$\mathcal{B}_{\rho\rho,L}$ all charges	Inputs to isospin analysis	[19–25]	⋆	-
$B^0 \to (\rho\pi)^0 \to 3\pi$	Time-dependent Dalitz analysis	[26, 27]	⋆	-
$B^- \to D^{(*)}K^{(*)-}$	Inputs to GLW analysis	[28, 30]	⋆	-
$B^- \to D^{(*)}K^{(*)-}$	Inputs to ADS analysis	[29, 30]	⋆	-
$B^- \to D^{(*)}K^{(*)-}$	GGSZ Dalitz analysis	[31, 32]	⋆	-

Table 1: *Inputs to the standard CKM fit. If not stated otherwise: for two errors given, the first is statistical and accountable systematic and the second stands for systematic theoretical uncertainties. The last two columns indicate* R*fit treatment of the input parameters: measurements or parameters that have statistical errors (we include here experimental systematics) are marked in the "GS" column by a star; measurements or parameters that have systematic theoretical errors are marked in the "TH" column by a star. Upper part: experimental determinations of the CKM matrix elements. Lower part: CP-violation and mixing observables.*

Parameter	Value ± Error(s)	Reference	Errors	
			GS	TH
$\overline{m}_c(m_c)$	$(1.300 \pm 0.002 \pm 0.012)$ GeV	[2]	$\star$	$\star$
$\overline{m}_t(m_t)$	$(165.95 \pm 0.35 \pm 0.64)$ GeV	[33]	$\star$	$\star$
$\alpha_s(m_Z)$	$0.1185 \pm 0 \pm 0.0006$	[3]	-	$\star$
B_K	$0.7567 \pm 0.0021 \pm 0.0123$	[2]	$\star$	$\star$
κ_ϵ	$0.940 \pm 0.013 \pm 0.023$	[35, 36]	$\star$	$\star$
η_{cc}	$1.87 \pm 0 \pm 0.76$	[37]	-	$\star$
η_{ct}	$0.497 \pm 0 \pm 0.047$	[38]	-	$\star$
η_{tt}	$0.5765 \pm 0 \pm 0.0065$	[39]	-	$\star$
$\eta_B(\overline{\mathrm{MS}})$	$0.5510 \pm 0 \pm 0.0022$	[40, 41]	-	$\star$
f_{B_s}	$(225.1 \pm 1.5 \pm 2.0)$ MeV	[2]	$\star$	$\star$
B_s	$1.320 \pm 0.016 \pm 0.030$	[2]	$\star$	$\star$
f_{B_s}/f_{B_d}	$1.205 \pm 0.003 \pm 0.006$	[2]	$\star$	$\star$
B_s/B_d	$1.007 \pm 0.014 \pm 0.014$	[2]	$\star$	$\star$
f_K	$(155.2 \pm 0.2 \pm 0.6)$ MeV	[2]	$\star$	$\star$
f_K/f_π	$1.1959 \pm 0.0010 \pm 0.0029$	[2]	$\star$	$\star$
f_{D_s}	$(248.2 \pm 0.3 \pm 1.9)$ MeV	[2]	$\star$	$\star$
f_{D_s}/f_D	$1.175 \pm 0.001 \pm 0.004$	[2]	$\star$	$\star$
$f_+^{K\to\pi}(0)$	$0.9681 \pm 0.0014 \pm 0.0022$	[2]	$\star$	$\star$
$f_+^{D\to\pi}(0)$	$0.666 \pm 0.020 \pm 0.048$	[2]	$\star$	$\star$
$f_+^{D\to K}(0)$	$0.747 \pm 0.011 \pm 0.034$	[2]	$\star$	$\star$
$\zeta(\Lambda_p \to p\mu^-\overline{\nu}_\mu)_{q^2>15}/\zeta(\Lambda_p \to \Lambda_c\mu^-\overline{\nu}_\mu)_{q^2>7}$	$1.471 \pm 0.096 \pm 0.290$	[2]	$\star$	$\star$

Table 2: *Inputs to the standard CKM fit. If not stated otherwise: for two errors given, the first is statistical and accountable systematic and the second stands for systematic theoretical uncertainties. The last two columns indicate* R*fit treatment of the input parameters: measurements or parameters that have statistical errors (we include here experimental systematics) are marked in the "GS" column by a star; measurements or parameters that have systematic theoretical errors are marked in the "TH" column by a star. Upper part: parameters used in SM predictions that are obtained from experiment. Lower part: parameters of the SM predictions obtained from theory.*

2 Lattice QCD averages

Several hadronic inputs are required for the fits presented by CKMfitter, and we mostly rely on lattice QCD simulations to estimate these quantities. The presence of results from different collaborations with various statistics and systematics make it all the more necessary to combine them in a careful way. We explain below the procedure that we have chosen to determine these lattice averages.

2.1 Method of averaging

We collect the relevant calculations of the quantity that we are interested in: we take only unquenched results with 2 or 2+1 dynamical fermions, even those from proceedings without a companion article. For the calculations published before the end of November 2015, we have followed the classification of the Flavour Lattice Averaging Group [42] and kept only results with green squares. However, we stress that we perform our averages in a different manner from FLAG.

In these results, we separate the error estimates into a Gaussian part and a flat part that is treated à la Rfit. The Gaussian part collects the uncertainties from purely statistical origin, but also the systematics that can be controlled and treated in a similar way (e.g., interpolation or fitting in some cases). The remaining systematics constitute the Rfit error. If there are several sources of error in the Rfit category, we add them linearly [1].

The Rfit model is simple but also very strict. It amounts to assuming that the theoretical uncertainty is rigorously constrained by a mathematical bound that is our only piece of information. If Rfit is taken stricto sensu and the individual likelihoods are combined in the usual way (by multiplication), the final uncertainty can be underestimated, in particular in the case of marginally compatible values.

We correct this effect by adopting the following averaging recipe. The central value is obtained by combining the whole likelihoods. Then we combine the Gaussian uncertainties by combining likelihoods restricted to their Gaussian part. Finally we assign to this combination the smallest of the individual Rfit uncertainties. The underlying idea is twofold:

- the present state of art cannot allow us to reach a better theoretical accuracy than the best of all estimates
- this best estimate should not be penalized by less precise methods (as it would happen be the case if one would take the dispersion of the individual central values as a guess of the combined theoretical uncertainty).

It should be stressed that the concept of a theoretical uncertainty is ill-defined, and the combination of them even more. Thus our approach is only one among the alternatives that can be found in the literature. In contrast to some of the latter, ours is algorithmic and can be reproduced.

3 Decay constants

3.1 Light mesons

f_K

[1] keeping in mind that in many papers in the literature, this combination is done in quadrature and the splitting between different sources is not published.

Reference	Article	N_f	Mean	Stat	Syst
ETM09	[43]	2	158.1	0.8	3.1
HPQCD07	[44]	2+1	157	0.6	3.3
MILC10	[45]	2+1	156.1	0.4	$^{+0.6}_{-0.9}$
RBC-UKQCD12	[46]	2+1	152.4	3.0	2.2
HPQCD13	[47]	2+1+1	155.4	0.2	0.6
ETM14	[48]	2+1+1	155.0	1.4	2.0
Our average			155.2	0.2	0.6

f_K/f_π

Reference	Article	N_f	Mean	Stat	Syst
ETM09	[43]	2	1.210	0.006	0.024
HPQCD/UKQCD07	[44]	2+1	1.189	0.002	0.014
BMW10	[49]	2+1	1.192	0.007	0.013
MILC10	[45]	2+1	1.197	0.002	$^{+0.003}_{-0.007}$
RBC-UKQCD12	[46]	2+1	1.1991	0.0116	0.0185
HPQCD13	[47]	2+1+1	1.1948	0.0015	0.0039
FNAL-MILC14	[50]	2+1+1	1.1956	0.0010	$^{+0.0033}_{-0.0024}$
ETM14	[48]	2+1+1	1.188	0.011	0.020
Our average			1.1959	0.001	0.0029

The results have been corrected to yield the decay constants defined in QCD (electromagnetic corrections are applied at the level of the branching ratios).

3.2 Charmed mesons

f_{D_s}

Reference	Article	N_f	Mean	Stat	Syst
ETM13	[51]	2	250	5	5
HPQCD10	[52]	2+1	248.0	1.4	4.5
FNAL-MILC11	[53]	2+1	260.1	8.9	16.2
ChiQCD14	[54]	2+1	254	2.2	10.2
FNAL-MILC14	[50]	2+1+1	249.0	0.3	$^{+1.7}_{-2.1}$
ETM14	[48]	2+1+1	247.2	3.9	2.2
Our average			248.2	0.3	1.9

f_{D_s}/f_D

Reference	Article	N_f	Mean	Stat	Syst
ETM13	[51]	2	1.201	0.007	0.020
FNAL-MILC11	[53]	2+1	1.188	0.014	0.054
HPQCD12	[55]	2+1	1.187	0.004	0.023
FNAL-MILC14	[50]	2+1+1	1.1712	0.0010	$^{+0.0037}_{-0.0040}$
ETM14	[48]	2+1+1	1.192	0.019	0.017
Our average			1.175	0.001	0.004

3.3 Beauty mesons

f_{B_s}

Reference	Article	N_f	Mean	Stat	Syst
ETM13	[51]	2	228	5	9
ALPHA14	[56]	2	224	14	2
HPQCD11	[57]	2+1	225.0	2.9	5.4
FNAL-MILC11	[53]	2+1	242.0	5.1	21.2
RBC-UKQCD14	[58]	2+1	235.4	5.2	28.1
HPQCD13	[59]	2+1+1	224.0	2.5	7.2
ETM16	[60]	2+1+1	229	3.9	4.8
Our average			225.1	1.5	2.0

Ref. [61] is not included due to the significant correlation with HPQCD13, as discussed in Ref. [62]. The same argument for Ref. [63] compared to RBC-UKQCD14 (with the additional issue of the uncertainty from the infinite quark limit).

f_{B_s}/f_B

Reference	Article	N_f	Mean	Stat	Syst
ETM13	[51]	2	1.206	0.010	0.026
ALPHA14	[56]	2	1.203	0.062	0.019
FNAL-MILC11	[53]	2+1	1.229	0.013	0.046
HPQCD12	[61]	2+1	1.188	0.012	0.025
RBC-UKQCD14	[58]	2+1	1.223	0.013	0.106
HPQCD13	[59]	2+1+1	1.205	0.004	0.007
ETM16	[60]	2+1+1	1.188	0.018	0.028
Our average			1.205	0.003	0.006

Ref. [61] is not included due to the significant correlation with HPQCD13, as discussed in Ref. [62]. The same argument for Ref. [63] compared to RBC-UKQCD14 (with the additional issue of the uncertainty from the infinite quark limit).

4 Semileptonic form factors

4.1 $K \to \pi \ell \nu$

$f_+(0)$

Reference	Article	N_f	Mean	Stat	Syst
ETM09	[64]	2	0.9560	0.0057	0.0118
MILC12	[65]	2+1	0.9667	0.0023	0.0055
RBC-UKQCD15	[67]	2+1	0.9670	0.0034	0.0019
MILC13	[68]	2+1+1	0.9704	0.0024	0.0022
ETM16	[69]	4	0.9697	0.0045	0.0036
Our average			0.9681	0.0014	0.0022

4.2 $D \to \pi \ell \nu$

$f_+(0)$

Reference	Article	N_f	Mean	Stat	Syst
HPQCD11	[70]	2+1	0.666	0.021	0.048
Our average			0.666	0.021	0.048

4.3 $D \to K \ell \nu$

$f_+(0)$

Reference	Article	N_f	Mean	Stat	Syst
HPQCD10	[71]	2+1	0.747	0.011	0.034
Our average			0.747	0.011	0.034

4.4 $\Lambda_b \to p \mu^- \bar{\nu}_\mu$ and $\Lambda_b \to \Lambda_c \bar{\nu}_\mu$

$\zeta(\Lambda_b \to p \mu^- \bar{\nu}_\mu)_{q^2>15} / \zeta(\Lambda_b \to \Lambda_c \mu^- \bar{\nu}_\mu)_{q^2>7}$

Reference	Article	N_f	Mean	Stat	Syst
DLM15	[72]	2+1	1.471	0.096	0.290
Our average			1.471	0.096	0.290

5 Meson mixing

5.1 Kaon mixing

$B_K^{\overline{\rm MS}}(2{\rm GeV})$

Reference	Article	N_f	Mean	Stat	Syst
ETM12	[73]	2	0.531	0.016	0.009
LVdW11	[74]	2+1	0.5572	0.0028	0.0257
BMW11	[75]	2+1	0.5644	0.0059	0.0100
RBC-UKQCD14	[76]	2+1	0.5477	0.002	0.011
SWME15	[77]	2+1	0.537	0.004	0.041
ETM15	[78]	4	0.5237	0.0131	0.0351
Our average for $B_K^{\overline{\rm MS}}(2{\rm GeV})$			0.5527	0.0015	0.0090
Our average for $\hat{B}_K$			0.7567	0.0021	0.0123

5.2 $B_{d,s}$ mixing

$\hat{B}_{B_s}$

Reference	Article	N_f	Mean	Stat	Syst
ETM13	[51]	2	1.32	0.04	0.03
HPQCD09	[79]	2+1	1.326	0.018	0.040
RBC-UKQCD14	[63]	2+1	1.22	0.06	0.32
Our average			1.320	0.016	0.030

Ref. [79] provide only f_{B_s} and $f_{B_s}\sqrt{\hat{B}_{B_s}}$, and we assumed that the systematics were completely correlated to extract $\hat{B}_{B_s}$.

$\hat{B}_{B_s}/\hat{B}_{B_d}$

Reference	Article	N_f	Mean	Stat	Syst
ETM13	[51]	2	1.007	0.015	0.014
FNAL/MILC12	[80]	2+1	1.064	0.076	0.193
RBC-UKQCD14	[63]	2+1	1.028	0.060	0.100
Our average			1.007	0.014	0.014

Refs. [79] and [80] provide only ξ and f_{B_s}/f_{B_d}. For Ref. [79], we have extracted $\hat{B}_{B_s}/\hat{B}_{B_d}$ cases assuming a total correlation in the systematics of ξ and $\hat{B}_{B_s}/\hat{B}_{B_d}$. For Ref. [80], we have considered all uncertainties as uncorrelated, as the studies of the decay constants and the bag parameters have been performed in different settings, with different categories of systematics.

Ref. [81] is not included yet, as it provides ξ and $f_{B_s}\sqrt{\hat{B}_{B_s}}$, but relies on an external PDG input for the decay constants.

6 Quark masses

$\bar{m}_c(\bar{m}_c)$

Reference	Article	N_f	Mean	Stat	Syst
ETM10B	[82]	2	1.28	0.030	0.051
HPQCD10	[83]	2+1	1.273	0.0022	0.0120
ChiQCD14	[54]	2+1	1.304	0.0050	0.0449
ETM14A	[84]	2+1+1	1.3478	0.0027	0.0195
HQPCD14	[85]	2+1+1	1.2715	0.0030	0.0225
Our average			1.300	0.002	0.012

7 Results

Observable	**central** ± CL ≡ 1σ	± CL ≡ 2σ	± CL ≡ 3σ
A	$0.8250^{+0.0071}_{-0.0111}$	$0.825^{+0.014}_{-0.027}$	$0.825^{+0.020}_{-0.037}$
λ	$0.22509^{+0.00029}_{-0.00028}$	$0.22509^{+0.00059}_{-0.00058}$	$0.22509^{+0.00091}_{-0.00071}$
$\bar{\rho}$	$0.1598^{+0.0076}_{-0.0072}$	$0.160^{+0.024}_{-0.014}$	$0.160^{+0.034}_{-0.021}$
$\bar{\eta}$	$0.3499^{+0.0063}_{-0.0061}$	$0.350^{+0.015}_{-0.015}$	$0.350^{+0.024}_{-0.024}$
J $[10^{-5}]$	$3.099^{+0.052}_{-0.063}$	$3.10^{+0.13}_{-0.17}$	$3.10^{+0.23}_{-0.27}$
$\sin 2\alpha$	$-0.068^{+0.038}_{-0.041}$	$-0.068^{+0.075}_{-0.139}$	$-0.07^{+0.11}_{-0.20}$
$\sin 2\alpha$ (!)	$-0.073^{+0.040}_{-0.058}$	$-0.073^{+0.077}_{-0.159}$	$-0.07^{+0.12}_{-0.21}$
$\sin 2\beta$	$0.7094^{+0.0098}_{-0.0094}$	$0.709^{+0.023}_{-0.020}$	$0.709^{+0.037}_{-0.030}$
$\sin 2\beta$ (!)	$0.740^{+0.020}_{-0.025}$	$0.740^{+0.050}_{-0.041}$	$0.740^{+0.073}_{-0.056}$
α [°]	$92.0^{+1.3}_{-1.1}$	$92.0^{+4.1}_{-2.2}$	$92.0^{+5.7}_{-3.3}$
α [°] (!)	$92.1^{+1.5}_{-1.1}$	$92.1^{+4.6}_{-2.2}$	$92.1^{+6.0}_{-3.3}$
α [°] (dir. meas.)	$-2.2^{+3.7}_{-4.9} \vert\vert 88.8^{+2.3}_{-2.3}$	$-2.2^{+7.4}_{-8.9} \vert\vert 88.8^{+9.9}_{-6.3}$	$-2^{+12}_{-16} \vert\vert 88.8^{+17.8}_{-9.7}$
β [°]	$22.60^{+0.36}_{-0.35}$	$22.60^{+0.87}_{-0.76}$	$22.6^{+1.5}_{-1.2}$
β [°] (!)	$23.74^{+1.13}_{-0.98}$	$23.7^{+2.4}_{-1.6}$	$23.7^{+3.4}_{-2.2}$
β [°] (dir. meas.)	$21.85^{+0.68}_{-0.67}$	$21.9^{+1.4}_{-1.3}$	$21.9^{+2.1}_{-2.0}$
γ [°]	$65.40^{+0.97}_{-1.16}$	$65.4^{+2.1}_{-3.7}$	$65.4^{+3.1}_{-5.2}$
γ [°] (!)	$65.33^{+0.96}_{-2.54}$	$65.3^{+2.1}_{-4.5}$	$65.3^{+3.1}_{-5.6}$
γ [°] (dir. meas.)	$72.1^{+5.4}_{-5.8}$	72^{+10}_{-12}	72^{+15}_{-21}
R_u	$0.3846^{+0.0057}_{-0.0059}$	$0.385^{+0.015}_{-0.012}$	$0.385^{+0.025}_{-0.019}$
R_t	$0.9101^{+0.0072}_{-0.0080}$	$0.910^{+0.014}_{-0.025}$	$0.910^{+0.021}_{-0.035}$
$\bar{\rho}_s$	$-0.00853^{+0.00039}_{-0.00035}$	$-0.00853^{+0.00077}_{-0.00127}$	$-0.0085^{+0.0011}_{-0.0018}$
$\bar{\eta}_s$	$-0.01868^{+0.00032}_{-0.00033}$	$-0.01868^{+0.00077}_{-0.00080}$	$-0.0187^{+0.0013}_{-0.0013}$
$\beta_s \equiv -\arg\left(-\frac{V_{cs}V_{cb}^*}{V_{ts}V_{tb}^*}\right)$ [rad]	$0.01852^{+0.00032}_{-0.00032}$	$0.01852^{+0.00078}_{-0.00083}$	$0.0185^{+0.0013}_{-0.0013}$
$\sin 2\beta_s$	$0.03702^{+0.00066}_{-0.00064}$	$0.0370^{+0.0016}_{-0.0016}$	$0.0370^{+0.0026}_{-0.0026}$

(!) means that the quantity was not included in the fit, || indicates the union of the confidence intervals considered.

Observable	**central** $\pm$ CL $\equiv 1\sigma$	$\pm$ CL $\equiv 2\sigma$	$\pm$ CL $\equiv 3\sigma$
$\|V_{ud}\|$	$0.974334^{+0.000064}_{-0.000068}$	$0.97433^{+0.00013}_{-0.00014}$	$0.97433^{+0.00016}_{-0.00021}$
$\|V_{us}\|$	$0.22508^{+0.00030}_{-0.00028}$	$0.22508^{+0.00060}_{-0.00057}$	$0.22508^{+0.00092}_{-0.00070}$
$\|V_{ub}\|$	$0.003715^{+0.000060}_{-0.000060}$	$0.00371^{+0.00014}_{-0.00012}$	$0.00371^{+0.00024}_{-0.00019}$
$\|V_{cd}\|$	$0.22494^{+0.00029}_{-0.00028}$	$0.22494^{+0.00059}_{-0.00057}$	$0.22494^{+0.00092}_{-0.00070}$
$\|V_{cs}\|$	$0.973471^{+0.000067}_{-0.000067}$	$0.97347^{+0.00014}_{-0.00014}$	$0.97347^{+0.00021}_{-0.00021}$
$\|V_{cb}\|$	$0.04181^{+0.00028}_{-0.00060}$	$0.04181^{+0.00059}_{-0.00141}$	$0.04181^{+0.00091}_{-0.00181}$
$\|V_{td}\|$	$0.008575^{+0.000076}_{-0.000098}$	$0.00857^{+0.00016}_{-0.00034}$	$0.00857^{+0.00026}_{-0.00053}$
$\|V_{ts}\|$	$0.04108^{+0.00030}_{-0.00057}$	$0.04108^{+0.00062}_{-0.00132}$	$0.04108^{+0.00093}_{-0.00177}$
$\|V_{tb}\|$	$0.999119^{+0.000024}_{-0.000012}$	$0.999119^{+0.000055}_{-0.000026}$	$0.999119^{+0.000075}_{-0.000040}$
$\|V_{ud}\|$ (!)	$0.974334^{+0.000065}_{-0.000067}$	$0.97433^{+0.00013}_{-0.00014}$	$0.97433^{+0.00020}_{-0.00021}$
$\|V_{us}\|$ (!)	$0.224485^{+0.001386}_{-0.000064}$	$0.22449^{+0.00200}_{-0.00013}$	$0.22449^{+0.00208}_{-0.00019}$
$\|V_{ub}\|$ (!)	$0.003601^{+0.000101}_{-0.000095}$	$0.00360^{+0.00021}_{-0.00022}$	$0.00360^{+0.00033}_{-0.00030}$
$\|V_{cb}\|$ (!)	$0.04235^{+0.00074}_{-0.00069}$	$0.0424^{+0.0012}_{-0.0018}$	$0.0424^{+0.0016}_{-0.0023}$
Δm_d [ps^{-1}] (!)	$0.554^{+0.035}_{-0.028}$	$0.554^{+0.066}_{-0.064}$	$0.554^{+0.095}_{-0.102}$
Δm_s [ps^{-1}] (!)	$16.89^{+0.47}_{-0.35}$	$16.9^{+1.6}_{-1.1}$	$16.9^{+2.5}_{-1.8}$
$\|\epsilon_K\|$ [10^{-3}] (!)	$2.27^{+0.21}_{-0.42}$	$2.27^{+0.38}_{-0.65}$	$2.27^{+0.49}_{-0.78}$
m_t [GeV/c^2] (!)	$160.3^{+6.3}_{-2.0}$	$160.3^{+12.9}_{-4.3}$	$160.3^{+19.9}_{-6.6}$
B_K (!)	$0.79^{+0.17}_{-0.11}$	$0.79^{+0.24}_{-0.14}$	$0.79^{+0.33}_{-0.17}$
f_{B_s}/f_{B_d} (!)	$1.243^{+0.027}_{-0.020}$	$1.243^{+0.072}_{-0.063}$	$1.24^{+0.10}_{-0.11}$
f_{B_s} (!)	$0.2260^{+0.0040}_{-0.0051}$	$0.2260^{+0.0100}_{-0.0083}$	$0.226^{+0.015}_{-0.011}$
B_{B_s}/B_{B_d} (!)	$1.114^{+0.046}_{-0.047}$	$1.114^{+0.098}_{-0.122}$	$1.11^{+0.15}_{-0.20}$
B_{B_s} (!)	$1.332^{+0.040}_{-0.067}$	$1.332^{+0.105}_{-0.097}$	$1.33^{+0.17}_{-0.12}$

(!) means that the quantity was not included in the fit.

Observable	**central** $\pm$ CL $\equiv 1\sigma$	$\pm$ CL $\equiv 2\sigma$	$\pm$ CL $\equiv 3\sigma$
$\mathcal{B}(B^+ \to \tau\nu)$ $[10^{-4}]$	$0.851^{+0.035}_{-0.038}$	$0.851^{+0.079}_{-0.077}$	$0.85^{+0.13}_{-0.11}$
$\mathcal{B}(B^+ \to \tau\nu)$ $[10^{-4}]$ (!)	$0.821^{+0.034}_{-0.028}$	$0.821^{+0.096}_{-0.057}$	$0.821^{+0.151}_{-0.086}$
$\mathcal{B}(B^+ \to \mu\nu)$ $[10^{-6}]$	$0.378^{+0.018}_{-0.017}$	$0.378^{+0.038}_{-0.032}$	$0.378^{+0.062}_{-0.045}$
$\mathcal{B}(B^+ \to e\nu)$ $[10^{-11}]$	$0.901^{+0.032}_{-0.046}$	$0.901^{+0.080}_{-0.085}$	$0.90^{+0.13}_{-0.12}$
$\mathcal{B}(B_d \to e^+e^-)$ $[10^{-15}]$	$2.164^{+0.097}_{-0.050}$	$2.16^{+0.25}_{-0.13}$	$2.16^{+0.30}_{-0.18}$
$\mathcal{B}(B_d \to \mu^+\mu^-)$ $[10^{-11}]$	$9.55^{+0.25}_{-0.44}$	$9.55^{+0.75}_{-0.84}$	$9.55^{+0.99}_{-1.05}$
$\mathcal{B}(B_s \to e^+e^-)$ $[10^{-14}]$	$7.37^{+0.42}_{-0.15}$	$7.37^{+0.73}_{-0.25}$	$7.37^{+0.84}_{-0.34}$
$\mathcal{B}(B_s \to \mu^+\mu^-)$ $[10^{-9}]$	$3.145^{+0.150}_{-0.069}$	$3.14^{+0.32}_{-0.11}$	$3.14^{+0.36}_{-0.14}$
$\mathcal{B}(B_s \to \mu^+\mu^-)$ $[10^{-9}]$ (!)	$3.364^{+0.071}_{-0.192}$	$3.36^{+0.11}_{-0.32}$	$3.36^{+0.16}_{-0.36}$
$\mathcal{B}(D_s \to \tau\nu)$ (!)	$0.05098^{+0.00097}_{-0.00074}$	$0.05098^{+0.00112}_{-0.00089}$	$0.0510^{+0.0013}_{-0.0010}$
$\mathcal{B}(D_s \to \mu\nu)$ $[10^{-2}]$ (!)	$0.5272^{+0.0061}_{-0.0098}$	$0.5272^{+0.0076}_{-0.0129}$	$0.5272^{+0.0089}_{-0.0143}$
$\mathcal{B}(D^+ \to \mu\nu)$ $[10^{-3}]$ (!)	$0.4066^{+0.0045}_{-0.0052}$	$0.4066^{+0.0062}_{-0.0137}$	$0.4066^{+0.0080}_{-0.0181}$
$\mathcal{B}(K^+ \to \mu\nu)$ (!)	$0.6329^{+0.0022}_{-0.0024}$	$0.6329^{+0.0044}_{-0.0043}$	$0.6329^{+0.0067}_{-0.0067}$
$\mathcal{B}(K^+ \to e\nu)$ $[10^{-4}]$ (!)	$0.15677^{+0.00029}_{-0.00038}$	$0.15677^{+0.00061}_{-0.00068}$	$0.15677^{+0.00091}_{-0.00098}$
$\mathcal{B}(\tau \to K^+\nu)$ $[10^{-2}]$ (!)	$0.7164^{+0.0011}_{-0.0013}$	$0.7164^{+0.0024}_{-0.0025}$	$0.7164^{+0.0036}_{-0.0038}$

(!) means that the quantity was not included in the fit.

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