FUTURE SENSITIVITY TO NEW PHYSICS IN B_d, B_s and K MIXINGS

P r e l i m i n a r y

September 6th, 2013

Abstract

This document provides the collection of inputs to the model-independent analysis of new physics in $\Delta F = 2$ transitions at diferent past, present and future stages, and numerical results obtained with the use of the fit package CKMfitter. The statistical method employed is the frequentist approach *R*fit. 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]

ANATOMY OF NEW PHYSICS IN $B - \overline{B}$ MIXING
by A. Lenz *et al.*
Phys.Rev. **D83** (2011) 036004 [arXiv:1008.1593 [hep-ph]]

FUTURE SENSITIVITY TO NEW PHYSICS IN B_d, B_s and K MIXINGS
by J. Charles *et al.*
eprint: arXiv:1309.2293 [hep-ph]

Z. Ligeti [1] and M. Papucci [2],

and for the CKMfitter Group
J. Charles [a,b], S. Descotes-Genon [c], S. Monteil [d], K. Trablesi [e]

[1] *Ernest Orlando Lawrence Berkeley National Laboratory,*
University of California, Berkeley, CA 94720, United States
e-mail: ligeti@lbl.gov

[2] *Michigan Center for Theoretical Physics,*
University of Michigan, Ann Arbor, MI 48109
e-mail: mpapucci@lbl.gov

[a] *Aix-Marseille Université, CNRS, CPT, UMR 7332, 13288 Marseille, France*
[b] *Université de Toulon, CNRS, CPT, UMR 7332, 83957 La Garde, France*
e-mail: charles@cpt.univ-mrs.fr

[c] *Laboratoire de Physique Théorique*
Bâtiment 210, Université Paris-Sud 11, F-91405 Orsay Cedex, France
(UMR 8627 du CNRS associée à l'Université de Paris-Sud 11)
e-mail: Sebastien.Descotes-Genon@th.u-psud.fr

[d] *Laboratoire de Physique Corpusculaire de Clermont-Ferrand*
Université Blaise Pascal, 24 Avenue des Landais F-63177 Aubiere Cedex
(UMR 6533 du CNRS-IN2P3 associée à l'Université Blaise Pascal)
e-mail: monteil@in2p3.fr

[e] *High Energy Accelerator Research Organization, KEK*
1-1 Oho, Tsukuba, Ibaraki 305-0801, Japan
e-mail: karim.trabelsi@kek.jp

	2003	2013	Stage I	Stage II
$\lvert V_{ud}\rvert$	0.9738 ± 0.0004	$0.97425 \pm 0 \pm 0.00022$	id	id
$\lvert V_{us}\rvert$ $(K_{\ell 3})$	$0.2228 \pm 0.0039 \pm 0.0018$	$0.2258 \pm 0.0008 \pm 0.0012$	0.22494 ± 0.0006	id
$\lvert\epsilon_K\rvert$	$(2.282 \pm 0.017) \times 10^{-3}$	$(2.228 \pm 0.011) \times 10^{-3}$	id	id
Δm_d [ps^{-1}]	0.502 ± 0.006	0.507 ± 0.004	id	id
Δm_s [ps^{-1}]	> 14.5 [95% CL]	17.768 ± 0.024	id	id
$\lvert V_{cb}\rvert \times 10^3$ $(b \to c\ell\bar{\nu})$	$41.6 \pm 0.58 \pm 0.8$	$41.15 \pm 0.33 \pm 0.59$	42.3 ± 0.4	42.3 ± 0.3
$\lvert V_{ub}\rvert \times 10^3$ $(b \to u\ell\bar{\nu})$	$3.90 \pm 0.08 \pm 0.68$	$3.75 \pm 0.14 \pm 0.26$	3.56 ± 0.10	3.56 ± 0.08
$\sin 2\beta$	0.726 ± 0.037	0.679 ± 0.020	0.679 ± 0.016	0.679 ± 0.008
α (mod π)	—	$(85.4^{+4.0}_{-3.8})^\circ$	$(91.5 \pm 2)^\circ$	$(91.5 \pm 1)^\circ$
γ (mod π)	—	$(68.0^{+8.0}_{-8.5})^\circ$	$(67.1 \pm 4)^\circ$	$(67.1 \pm 1)^\circ$
$(\beta_s)_{J/\psi\phi}$	—	$0.0065^{+0.0450}_{-0.0415}$	0.0178 ± 0.012	0.0178 ± 0.004
$\mathcal{B}(B \to \tau\nu) \times 10^4$	—	1.15 ± 0.23	0.83 ± 0.10	0.83 ± 0.05
$\mathcal{B}(B \to \mu\nu) \times 10^7$	—	—	3.7 ± 0.9	3.7 ± 0.2
$A^d_{\rm SL} \times 10^4$	10 ± 140	23 ± 26	-7 ± 15	-7 ± 10
$A^s_{\rm SL} \times 10^4$	—	-22 ± 52	0.3 ± 6.0	0.3 ± 2.0
$\bar{m}_c$	$1.2 \pm 0 \pm 0.2$	$1.286 \pm 0.013 \pm 0.040$	1.286 ± 0.020	1.286 ± 0.010
$\bar{m}_t$	167.0 ± 5.0	$165.8 \pm 0.54 \pm 0.72$	id	id
$\alpha_s(m_Z)$	$0.1172 \pm 0 \pm 0.0020$	$0.1184 \pm 0 \pm 0.0007$	id	id
B_K	$0.86 \pm 0.06 \pm 0.14$	$0.7615 \pm 0.0026 \pm 0.0137$	0.774 ± 0.007	0.774 ± 0.004
f_{B_s} [GeV]	$0.217 \pm 0.012 \pm 0.011$	$0.2256 \pm 0.0012 \pm 0.0054$	0.232 ± 0.002	0.232 ± 0.001
B_{B_s}	1.37 ± 0.14	$1.326 \pm 0.016 \pm 0.040$	1.214 ± 0.060	1.214 ± 0.010
f_{B_s}/f_{B_d}	$1.21 \pm 0.05 \pm 0.01$	$1.198 \pm 0.008 \pm 0.025$	1.205 ± 0.010	1.205 ± 0.005
B_{B_s}/B_{B_d}	1.00 ± 0.02	$1.036 \pm 0.013 \pm 0.023$	1.055 ± 0.010	1.055 ± 0.005
$\tilde{B}_{B_s}/\tilde{B}_{B_d}$	—	$1.01 \pm 0 \pm 0.03$	1.03 ± 0.02	id
$\tilde{B}_{B_s}$	—	$0.91 \pm 0.03 \pm 0.12$	0.87 ± 0.06	id
η_B	$0.55 \pm 0 \pm 0.01$	$0.5510 \pm 0 \pm 0.0022$	id	id
κ_ϵ	1	$0.940 \pm 0.013 \pm 0.023$	id	id
δ_1	$0 \pm 0 \pm 1$	–	id	id
η_{cc}	–	$1.87 \pm 0 \pm 0.76$	id	id
η_{ct}	$0.47 \pm 0 \pm 0.04$	$0.497 \pm 0 \pm 0.047$	id	id
η_{tt}	$0.5765 \pm 0 \pm 0.0065$	$0.5765 \pm 0 \pm 0.0065$	id	id

Table 1: Central values and uncertainties used in our analysis. When two uncertainties are shown, the first is statistical and the second systematic. The entries "id" refer to the value in the same row in the previous column.

1 Inputs

We consider the sensitivity to NP in mixing for past (2003), present (2013) and future (Stage I and Stage II). Stage I corresponds to anticipated 7 fb^{-1} LHCb data and 5 ab^{-1} Belle II data, where Stage II corresponds to 50 fb^{-1} LHCb and 50 ab^{-1} Belle II data, based on Refs. [1, 2]. We also take into account lattice projections for hadronic inputs, mainly based on Ref. [3].

The 2003 and 2013 values correspond to Lepton-Photon 2003 and FPCP 2013 conferences [4]. For Stage I and Stage II, inputs have been chosen to have a best-fit point in agreement with SM expectations.

References

[1] T. Aushev *et al.*, arXiv:1002.5012 [hep-ex].

[2] R. Aaij *et al.* [LHCb Collaboration], Eur. Phys. J. C **73** (2013) 2373 [arXiv:1208.3355 [hep-ex]].

[3] T. Blum *et al.*, "Lattice QCD at the Intensity Frontier" http://www.usqcd.org/documents/13flavor.pdf.

[4] J. Charles *et al.* [CKMfitter Group], Eur. Phys. J. C **41** (2005) 1 [hep-ph/0406184]; and updates at http://ckmfitter.in2p3.fr/.