Erratum: kaon mixing beyond the SM from $N_f = 2$ tmQCD and model independent constraints from the UTA

The ETM collaboration

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This erratum concerns the correction of our numerical estimates for the block matrix of the renormalisation constants (RCs) Z_Q^{ij} (where $i, j = 2, 3$) of the four-fermion operators, expressed in the lattice basis. A mistake has been discovered in the numerical application of removing the $O(a^2g^2)$ cutoff effects from the RCs estimators, a topic presented in appendix B (see section B.4). At the level of the RI-MOM procedure only the non-diagonal matrix elements Z_Q^{ij} ($i, j = 2, 3$ with $i \neq j$) need to be corrected. While expressing results in different scales and schemes, due to the mixing between the block elements, all four matrix elements of the block matrix are affected.

The correction implicates a slight shift on the continuum limit estimates of B_4 and R_4 and a larger shift (of about one or two standard deviations depending on the quantity) on the continuum limit estimates of B_5 and R_5 .

In this Erratum we do not present updates of the plots, since the corresponding changes would be barely visible to the eye.

We should add that the changes in the values of the B -parameters have a completely negligible impact on the results of the phenomenological analysis presented in section 3 of the paper. In the effective Hamiltonian used in this study, given in eq. (2.1) of the paper, we introduce a multiplicative factor of $1/4$, which was previously missing without affecting the results. This factor takes into account the difference by a factor of four between the operators defined in eqs. (2.2) and (2.3) of the current work and those defined in ref. [9].¹

In tables 1 and 2 we gather the correct results for the M1- and M2-type $Z_Q^{22}, Z_Q^{23}, Z_Q^{32}$ and Z_Q^{33} (the full 5×5 matrices for Z_Q are given in appendix C of the paper) expressed in the $\overline{\text{MS}}$ and RI-MOM schemes at 2 GeV respectively, at the four values of the lattice spacing.

Tables 1, 2, 21, 22, 23, 24 of the paper should be replaced by tables 3, 4, 5, 6, 7 and 8, respectively, of the Erratum. In all tables only B_i and R_i with $i = 4, 5$ have been

¹We thank Robert Ziegler for pointing out to us the necessity to clarify this point.

$\overline{\text{MS}}$ (2 GeV)				
M1-type				
β	Z_Q^{22}	Z_Q^{23}	Z_Q^{32}	Z_Q^{33}
3.80	0.492(13)	0.238(7)	0.022(2)	0.227(10)
3.90	0.503(9)	0.231(4)	0.023(1)	0.250(6)
4.05	0.546(6)	0.240(5)	0.023(1)	0.281(5)
4.20	0.571(9)	0.243(6)	0.021(1)	0.292(8)
M2-type				
3.80	0.489(9)	0.136(5)	0.017(2)	0.362(5)
3.90	0.496(5)	0.158(4)	0.019(1)	0.348(5)
4.05	0.543(6)	0.197(4)	0.020(1)	0.333(6)
4.20	0.579(6)	0.239(3)	0.019(1)	0.299(5)

Table 1. Z_Q^{ij} ($i, j = 2, 3$) for M1- and M2-type RCs in the $\overline{\text{MS}}$ at the scale of 2 GeV.

RI-MOM (2 GeV)				
M1-type				
β	Z_Q^{22}	Z_Q^{23}	Z_Q^{32}	Z_Q^{33}
3.80	0.504(13)	0.265(7)	0.017(2)	0.195(9)
3.90	0.515(8)	0.260(5)	0.018(1)	0.215(5)
4.05	0.559(6)	0.273(5)	0.017(1)	0.242(4)
4.20	0.585(9)	0.278(7)	0.016(1)	0.251(7)
M2-type				
3.80	0.501(9)	0.175(5)	0.013(2)	0.311(5)
3.90	0.508(5)	0.196(4)	0.015(1)	0.299(4)
4.05	0.556(6)	0.234(4)	0.015(1)	0.287(5)
4.20	0.593(6)	0.274(4)	0.014(1)	0.257(4)

Table 2. Z_Q^{ij} ($i, j = 2, 3$) for M1- and M2-type RCs in the RI-MOM scheme at the scale of 2 GeV.

corrected. On the second column of table 5 of the paper results for B_i ($i = 4, 5$) should read: $B_4 = 1.00(4)$ and $B_5 = 0.69(5)$. On the second column of table 6 of the paper results for R_i ($i = 4, 5$) should read: $R_4 = 21.2(7)$ and $R_5 = 4.7(3)$. The rest of the results is unchanged.

$\overline{\text{MS}} \text{ (2 GeV)}$				
B_1	B_2	B_3	B_4	B_5
0.53(2)	0.52(2)	0.89(5)	0.78(3)	0.57(4)
R_1	R_2	R_3	R_4	R_5
1	-14.0(5)	4.8(3)	24.2(8)	5.9(4)

Table 3. Corrected estimates for B_i and R_i where $i = 4, 5$; cf. table 1 of the paper. The rest of the results is unchanged.

$\text{RI-MOM} \text{ (2 GeV)}$				
B_1	B_2	B_3	B_4	B_5
0.52(2)	0.70(2)	1.22(7)	1.00(4)	0.69(5)
R_1	R_2	R_3	R_4	R_5
1	-12.9(4)	4.5(2)	21.2(7)	4.7(3)

Table 4. Corrected estimates for B_i and R_i where $i = 4, 5$; cf. table 2 of the paper. The rest of the results is unchanged.

Fit	i	R_i	R_i (via eq. (5.6))	B_i
ChPT	1	1	1	0.53(2)
	2	-13.7(3)	-15.4(2.2)	0.52(2)
	3	4.8(2)	5.3(8)	0.89(5)
	4	24.7(6)	28.3(4.1)	0.79(3)
	5	5.9(3)	6.9(1.1)	0.58(4)
Pol	1	1	1	0.53(2)
	2	-14.3(5)	-15.5(2.3)	0.52(2)
	3	4.9(3)	5.3(9)	0.89(7)
	4	24.7(8)	27.7(4.2)	0.77(4)
	5	5.9(5)	6.8(1.2)	0.57(5)
L	1	1	1	0.53(2)
	2	-13.7(3)	-15.7(2.2)	0.52(2)
	3	4.8(2)	5.4(8)	0.90(5)
	4	23.5(6)	27.7(4.0)	0.78(3)
	5	5.8(3)	6.7(1.1)	0.57(4)

Table 5. Corrected estimates for B_i and R_i where $i = 4, 5$; cf. table 21 of the paper. The rest of the results is unchanged.

Fit	i	R_i	R_i (via eq. (5.6))	B_i
ChPT	1	1	1	0.53(2)
	2	-13.6(2)	-14.9(2.1)	0.50(1)
	3	4.7(1)	5.1(7)	0.87(3)
	4	24.7(4)	27.5(3.4)	0.77(2)
	5	5.9(2)	6.5(9)	0.55(2)
Pol	1	1	1	0.53(2)
	2	-14.0(4)	-15.0(2.2)	0.50(2)
	3	4.8(2)	5.2(8)	0.87(5)
	4	24.4(7)	26.4(3.9)	0.74(3)
	5	5.8(3)	6.3(1.0)	0.53(4)
L	1	1	1	0.54(2)
	2	-13.6(2)	-15.0(2.1)	0.51(1)
	3	4.7(1)	5.2(8)	0.88(3)
	4	23.7(4)	26.5(3.5)	0.75(2)
	5	5.7(2)	6.2(9)	0.53(2)

Table 6. Corrected estimates for B_i and R_i where $i = 4, 5$; cf. table 22 of the paper. The rest of the results is unchanged.

$\overline{\text{MS}}$ (3 GeV)				
B_1	B_2	B_3	B_4	B_5
0.51(2)	0.47(2)	0.78(4)	0.76(3)	0.58(3)
R_1	R_2	R_3	R_4	R_5
1	-15.6(5)	5.3(3)	28.5(9)	7.3(4)

Table 7. Corrected estimates for B_i and R_i where $i = 4, 5$; cf. table 23 of the paper. The rest of the results is unchanged.

RI-MOM (3 GeV)				
B_1	B_2	B_3	B_4	B_5
0.51(2)	0.61(2)	1.02(5)	0.92(4)	0.68(5)
R_1	R_2	R_3	R_4	R_5
1	-14.6(5)	5.0(3)	25.6(9)	6.2(4)

Table 8. Corrected estimates for B_i and R_i where $i = 4, 5$; cf. table 24 of the paper. The rest of the results is unchanged.