

Addendum: Light-cone distribution amplitudes of pseudoscalar mesons from lattice QCD

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ABSTRACT: We update our lattice determination of the two lowest Gegenbauer moments of the leading-twist pion and kaon light-cone distribution amplitudes [1] using the recently calculated three-loop matching factors for the conversion from the RI'/SMOM to the $\overline{\text{MS}}$ scheme [2, 3]. We find $a_2^\pi = 0.116_{-20}^{+19}$ for the pion, $a_1^K = 0.0525_{-33}^{+31}$ and $a_2^K = 0.106_{-16}^{+15}$ for the kaon. Updated plots can be found in the appendix in the arXiv submission.

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We have rerun our analysis [1] using the newly available three-loop matching (N^3LO) for the conversion from the RI'/SMOM to the $\overline{\text{MS}}$ scheme [2, 3]. The results can be taken from table 1, which is an updated version of table 3 in the main article [1]. As one can see, the errors of the renormalization procedure are reduced considerably. The new N^3LO results for a_2^π and a_2^K are slightly larger, but are still consistent with the previous NNLO result within errors. Considering the first moment of the kaon distribution amplitude, where we can compare results using RI'/SMOM or RI'/MOM as intermediate schemes, it

M	RI'	order	$\langle \xi^2 \rangle_M$	a_2^M
π	SMOM	N ³ LO	$0.240_{-6}^{+6}(2)_r(3)_a(2)_m$	$0.116_{-17}^{+16}(4)_r(9)_a(5)_m$
π	SMOM	NNLO	$0.234_{-6}^{+6}(4)_r(4)_a(2)_m$	$0.101_{-17}^{+17}(12)_r(10)_a(5)_m$
π	SMOM	NLO	$0.227_{-6}^{+6}(5)_r(5)_a(2)_m$	$0.078_{-19}^{+18}(16)_r(13)_a(5)_m$
K	SMOM	N ³ LO	$0.236_{-4}^{+3}(1)_r(3)_a(1)_m$	$0.106_{-12}^{+10}(4)_r(9)_a(4)_m$
K	SMOM	NNLO	$0.231_{-4}^{+4}(4)_r(4)_a(1)_m$	$0.090_{-12}^{+10}(11)_r(11)_a(4)_m$
K	SMOM	NLO	$0.223_{-5}^{+4}(5)_r(5)_a(2)_m$	$0.067_{-13}^{+11}(16)_r(14)_a(5)_m$
η^8	SMOM	N ³ LO	$0.235_{-4}^{+3}(1)_r(3)_a(1)_m$	$0.103_{-13}^{+10}(4)_r(9)_a(4)_m$
η^8	SMOM	NNLO	$0.230_{-4}^{+4}(4)_r(4)_a(1)_m$	$0.087_{-13}^{+10}(11)_r(11)_a(4)_m$
η^8	SMOM	NLO	$0.222_{-5}^{+4}(6)_r(5)_a(2)_m$	$0.063_{-14}^{+11}(16)_r(14)_a(5)_m$
M	RI'	order	$\langle \xi^1 \rangle_M$	a_1^M
K	SMOM	N ³ LO	$0.0315_{-11}^{+10}(2)_r(12)_a(10)_m$	$0.0525_{-19}^{+17}(3)_r(20)_a(17)_m$
K	SMOM	NNLO	$0.0320_{-12}^{+11}(3)_r(13)_a(11)_m$	$0.0533_{-19}^{+18}(6)_r(22)_a(18)_m$
K	SMOM	NLO	$0.0327_{-12}^{+11}(6)_r(14)_a(11)_m$	$0.0545_{-20}^{+18}(9)_r(23)_a(18)_m$
K	MOM	N ³ LO	$0.0315_{-11}^{+11}(1)_r(11)_a(10)_m$	$0.0525_{-19}^{+18}(2)_r(19)_a(17)_m$
K	MOM	NNLO	$0.0319_{-12}^{+11}(1)_r(11)_a(10)_m$	$0.0531_{-19}^{+18}(2)_r(18)_a(17)_m$

Table 1. Continuum limit extrapolated values for the first two moments of the octet mesons. The results have been converted to the $\overline{\text{MS}}$ scheme at $\mu = 2 \text{ GeV}$ using intermediate RI' schemes and different loop orders in the perturbative matching. The statistical error given as sub- and superscript reflects the errors of the data after extrapolation. The numbers in parentheses give estimates of the systematic uncertainties due to the nonperturbative renormalization (r) as described in section 2.3 of ref. [1], the continuum extrapolation (a), and the chiral extrapolation (m). As discussed in section 3.1 of ref. [1], finite volume effects are negligible in our setting.

is encouraging to see that the final results in the $\overline{\text{MS}}$ scheme agree perfectly, if one uses three-loop matching in both cases.

Adding all errors in quadrature we obtain with three-loop matching

$$\begin{aligned}
 a_2^\pi &= 0.116_{-20}^{+19}, \\
 a_1^K &= 0.0525_{-33}^{+31}, \\
 a_2^K &= 0.106_{-16}^{+15}.
 \end{aligned}$$

We include updates of the figures of ref. [1], using the new, slightly shifted values as an appendix in the arXiv submission.

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References

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