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On the quark-mass dependence of meson masses and decay constants

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We study the dependence of meson masses and decay constants on the up, down and strange quark masses [1,2,3]. The role of dynamical vector meson degrees of freedom is scrutinized in terms of an effective chiral Lagrangian based on the hadrogenesis conjecture. At the one-loop level, we derive the chiral corrections to the self-energies of the Goldstone bosons and vector mesons as well as the decay constants of the Goldstone bosons. It is illustrated that an order-by-order renormalizability arises once specific conditions on the low-energy constants are imposed. We consider QCD lattice data from PACS, QCDSF-UKQCD and HSC on the vector meson masses. Particular attention is paid to the $\omega - \phi$ mixing phenomenon, which is demonstrated to show a strong mass dependence. The pion and kaon decay constants on lattice ensembles of HPQCD, CLS and ETMC are well reproduced. It is illustrated that dynamical vector mesons lead to significant impact on Gasser and Leutwyler's LECs.

[1] R. Bavontaweepanya, X.-Y. Guo, M.F.M. Lutz, Phys.Rev.D98 (2018) 056005.

[2] X.-Y. Guo, M.F.M. Lutz, Nucl.Phys.A in print, arXiv:1810.07376 [hep-lat].

[3] X.-Y. Guo, M.F.M. Lutz, Nucl.Phys.A in print, arXiv:1811.00478 [hep-lat].

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