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# Dark pions at next-to-leading order

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QCD-like theories are of interest in various areas of beyond-Standard-Model phenomenology, including composite Higgs models and strongly interacting pionic dark matter. The low-energy effective field theories provide a framework for describing the dynamics of such strongly coupled gauge theories.
In this work, we present next-to-leading order (NLO) expressions for masses, condensates, decay constants, and scattering amplitudes in the chiral expansion of QCD-like theories with $N_f = 2$ quarks of different masses in both real and pseudoreal representations. These results offer a systematic approach for analyzing the impact of NLO corrections in such theories.
We apply the NLO formulas for masses, decay constants, and the scattering length to fit existing lattice spectroscopic and scattering data, extracting the NLO low-energy constants (LECs) of the $SU(4) \to Sp(4)$ theory. With these estimates, we refine previous NLO analyses and confirm that NLO contributions play a crucial role in determining the viable parameter space for strongly interacting massive particle (SIMP) dark matter.

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