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Sifting through the SM for the hints of an ALP

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Axion-like particles (ALPs) are at the forefront of physics research, especially at the intensity frontier, dealing with light weakly coupled particles. A plethora of different experiments search for signals of the ALP in many different final states using innovative search strategies. We present a different perspective on ALP searches, concentrating on the modifications that such a particle causes to the known Standard Model (SM) results. The presence of a low lying ALP modifies the SM in non-trivial ways. We systematically derive the leading order chiral lagrangian in the presence of an ALP (A□PT). Then, using the derived A□PT, we systematically discuss three distinct modifications to SM physics—which arise at the tree level itself: i) those to the meson mass spectrum, ii) those to hadronic form factors, leading to modified to partial decay rate distributions of the mesons, and iii) those to the sum rules constructed out of meson decay amplitudes. As a proof of concept example of our program, we analyse semi-leptonic Kaon decay data collected by the NA48/2 collaboration to find bounds on the ALP parameter space.

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