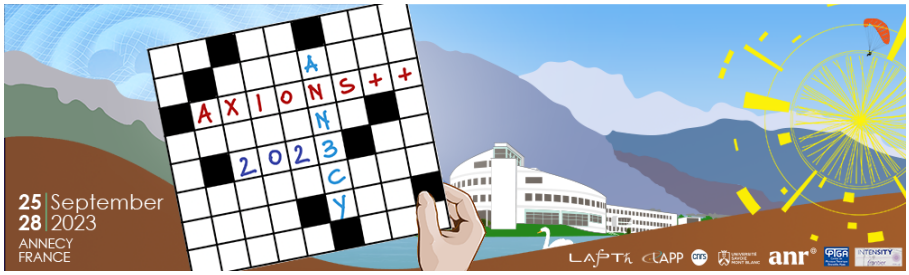

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The Chiral Lagrangian for CP-violating Axion-like particles

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CP-violating probes are among the most promising and yet relatively unexplored ways to look for Axion-Like Particles (ALPs) and to investigate their phenomenology. With this work we construct the most general effective Chiral Lagrangian describing the interactions of a light CP-violating ALP ϕ with mesons, baryons, leptons and photons at energies below the QCD confinement scale ($m_\phi < E < \Lambda_{\rm QCD}$), both in a 2-flavors setting and in a 3-flavors one. Starting from the most general dimension-5, $SU(3)_{\rm c} \times U(1)_{\rm em}$ invariant effective Lagrangian for a CP-violating ALP at the electroweak (EW) scale, we provide the running of its Wilson coefficients down to the QCD one, where we discuss the matching conditions onto its chiral counterpart. We then report the minimal set of Jarlskog invariants measuring in a basis-independent way the amount of CP violation introduced by the theory at low energies, which can then be bounded by experiments and directly related to the Wilson coefficients of the EW-scale Lagrangian. The Feynman rules for the low-energy theory can be extracted directly from the FeynRules model we have constructed, which can be employed as well for future dedicated phenomenological analyses.

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