Pseudoscalar Meson Mixing in Effective Field Theory

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Abstract

We show that for any effective field theory of colorless meson fields, the mixing schemes of particle states and decay constants are not only related but also determined exclusively by the kinetic and mass Lagrangian densities. In general, these are bilinear and involve non-diagonal kinetic and mass matrices, rather than being quadratic as invoked from the Klein-Gordon equation for the physical fields. In order to reduce the Lagrangian into the standard quadratic form we transform the intrinsic fields into the physical fields via three consecutive steps. These steps are : (i) the diagonalization of the kinetic matrix, (ii) rescaling of the fields, and (iii) the diagonalization of the mass matrix. In the general case, where the dimensions of the non-diagonal kinetic and mass submatrices are respectively, $k \times k$ and $n \times n$, this procedure leads to a mixing scheme which involve $[k(k-1)/2] + [n(n-1)/2]$ angles and k field rescaling parameters. Since radiative corrections and interaction terms influence the values of matrix elements but not the form of the kinetic and mass matrices, this observation holds true irrespective with the type of interactions presumed. The commonly used mixing schemes, correspond to a proper choice of the kinetic and mass matrices, and can be derived as special cases of the general statement made above. In particular, η-η', requires one mixing angle, if and only if, the kinetic term for the intrinsic fields has a quadratic form.