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A coupled-channel system with anomalous thresholds and unitarity

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A first non-perturbative and unitary treatment of multichannel systems with anomalous thresholds based on realistic potentials is presented. We consider the isospin one-half example system, with $D\,\pi$, $D\,\eta$, $D_s\bar{K}$, $D^*\pi$, $D^*\eta$, $D^*\bar{K}$ coupled channels in the $J^P = 1^-$ partial wave, chosen such that various phenomena that come with the opening of an anomalous threshold can be illustrated in a step-wise procedure by a suitable variation of up, down and strange quark masses. We use a set of low-energy constants in the chiral Lagrangian that were adjusted to a large set of lattice QCD results. At the physical point the D^* meson decays into the $D\,\pi$ channel and an anomalous threshold develops in the $D^*\pi \leftrightarrow D^*\eta$ reaction. The six phase shifts and inelasticity parameters are presented for various choices of the pion mass. For a pion mass of 150 MeV there are no anomalous thresholds encountered. The small change from 150 MeV to 145 MeV pion mass causes a dramatic impact of the anomalous threshold on the phase shifts showing that our results are highly relevant for the extrapolation of lattice QCD calculations towards the physical pion mass.

Collaboration

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