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# Theoretical approaches to low energy $\bar{K}N$ interactions

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## Collaboration

## Abstract content

Several theoretical groups [1-4] describe the antikaon-nucleon interaction at low energies within approaches based on the chiral SU(3) dynamics and including next-to-leading order (NLO) contributions. We present a comparative analysis of the pertinent models and discuss in detail their pole contents. We note that the Kyoto-Munich [1] and Prague [2] models have relatively small NLO contributions (representing only moderate corrections to the LO chiral interactions) while the Murcia [3] and Bonn [4] models introduce sizable NLO terms that generate inter-channel couplings very different from those obtained by only the Weinberg-Tomozawa interaction.
The models reproduce the experimental data on a qualitatively very similar level and in mutual agreement especially concerning the data available at the $\bar{K}N$ threshold. They also tend to agree on a position of the higher energy of the two poles generated for the $\Lambda(1405)$ resonance. However, in our recent work [5] we demonstrated that the approaches lead to very different predictions for the $K^-p$ amplitude extrapolated to subthreshold energies as well as for the $K^-n$ amplitude. The theoretical ambiguities observed below the $\bar{K}N$ threshold are much larger then those indicated by uncertainty bounds derived from variations of the $K^-p$ scattering length within constraints enforced by a recent SIDDHARTA measurement of the kaonic hydrogen characteristics [6].
We have also analysed the origin of the poles of the scattering $T$-matrix generated by the various theoretical models by following the pole movements to the so-called zero coupling limit, in which the inter-channel couplings are switched off. This procedure enabled us to reveal different concepts of forming the $\Lambda(1405)$ resonance and provided us with new insights related to the appearance of poles in a given approach. In particular, we discuss a possible isovector $\bar{K}N$ pole located below the $\bar{K}N$ threshold and demonstrate that an appearance of a pole in a given approach can be related to conditions imposed on the subtraction constants or inverse interaction ranges, the parameters fitted to reproduce the experimental data.
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