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Calculations of kaonic nuclei based on chiral meson-baryon coupled channel interaction models

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Collaboration

Abstract content

We review our latest calculations of K^- nuclear quasi-bound states. We apply a self-consistent scheme for constructing K^--nuclear potentials V_K from subthreshold chirally inspired in-medium $\bar{K}N$ scattering amplitudes, which was introduced in Ref. [1,2]. We consider two in-medium versions of the scattering amplitudes: the version which takes into account only Pauli blocking in the intermediate states, and the version which adds self-consistently hadron self-energies. To explore the model dependence of our calculations, we constructed the underlying $\bar{K}N$ amplitudes within chirally motivated meson-baryon coupled-channel interaction models: Prague [3], Kyoto- Munich [4], Murcia [5], and Bonn [6]. They capture the physics of the $\Lambda(1405)$ and reproduce low energy $\bar{K}N$ observables, including the recent $1s$ level shift and width in the K^- hydrogen atom from the SIDDHARTA experiment [7].

Energy dependence of the in-medium scattering amplitudes, particularly in the K^-N subthreshold region, is the decisive mechanism that controls the self-consistent evaluation of corresponding K^- optical potentials. The role of hadron self-energies in the self-consistent calculations of the K^- binding energies B_K is less pronounced than the model dependence of predicted B_K.

The widths of low-lying K^- states due to $K^-N \to \pi Y$ conversions are substantially reduced in the self-consistent calculations, thus reflecting the proximity of the $\pi\Sigma$ threshold. On the contrary, the widths of higher excited K^- states are quite large even if only the pion conversion modes on a single nucleon are considered. After including 2 body $K^-NN \to YN$ absorption modes, the total decay widths Γ_K are comparable with the corresponding binding energies B_K for all K^- nuclear quasi-bound states, exceeding considerably the level spacing.

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