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Hyperon-nucleon and hyperon-hyperon interactions constructed via Marchenko inversion approach: Application to hypernuclear spectroscopy

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The knowledge of the hyperon-nucleon (YN) and hyperon-hyperon (YY) interactions is vital toward our deeper understanding of the nature of the nucleon-nucleon interaction. However, the direct study of the YN and YY interactions is practically impossible due to the limited or no data available. This is because the hyperon has a very short lifetime, making experiments with hyperon beams extremely difficult. Currently the study of the nonzero strangeness hypernuclear spectroscopy proceeds via theoretically constructed models. For example, the YN and YY interactions can be constructed ab initio via the Chiral Effective Field Theory (χEFT). This method has been extensively studied and is based on the chiral power counting of Weinberg. That is, starting with the field theoretical Lagrangian for the interacting particles, one reduce the infinite dimensional equation of motion to a finite and solvable one in the particles' degrees of freedom. That is the reduced or effective Schrodinger equation is the one to solve. The process of power counting can be laborious and in general requires large computer power. On the other hand, one may employ the Marchenko Inversion method to construct the interactions. In this work, we constructed the YN and YY potentials from the limited available YN experimental data and simulated YY data to study the structure and dynamics of selected hypernuclear systems within the three-particle model. We employ the differential Faddeev equations to construct the wave functions with the constructed YN and YY potentials as input and study the dynamics of the systems.

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