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Two-Baryon Systems with Twisted Boundary Conditions

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We explore the use of twisted boundary conditions in extracting the nucleon mass and the binding energy of two-baryon systems, such as the deuteron, from Lattice QCD calculations. Using the experimentally determined phase shifts and mixing angles, and utilizing the Luescher method extended to baryonic systems with twisted boundary conditions, we determine the expected energies of the deuteron states over a range of cubic lattice volumes for a selection of twisted boundary conditions. Certain choices of twist angles, as well as selected pair-wise averages, improves the volume dependence of the deuteron binding energy. The set of energy quantizations conditions obtained adds to the previously determined conditions with arbitrary center of mass momenta and is shown to be valuable in constraining the deuteron binding energy and S-D mixing parameter from upcoming lattice QCD calculations of two-nucleon systems at the physical light-quark masses.

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