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Coupling between a deuteron and a lattice

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We recently put forth a new fundamental lattice Hamiltonian based on an underlying picture of electrons and deuterons as elementary Dirac particles. Within this model there appears a term in which lattice vibrations are coupled to internal nuclear transitions. This is interesting as it has the potential to provide a connection between experiment and models that describe coherent energy transfer between two-level systems and an oscillator. In this work we describe a calculation of the coupling matrix element in the case of the deuteron based on the old empirical Hamada-Johnston model for the nucleon-nucleon interaction. The triplet S and D states of the the deuteron in the rest frame couples to a singlet P state through this new interaction. The singlet P state in this calculation is a virtual state with an energy of 125 MeV, and a coupling matrix element for z-directed motion given by $2.98 \times 10^{-3} ~M_J c \hat{P}_z$.

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