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The interaction between positive muons and multiple quadrupolar nuclei

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A positively charged muon implanted in copper sits at an octahedral interstitial site and experiences a magnetic dipolar coupling with six nearest-neighbour quadrupolar $I = 3/2$ copper nuclei [1]. The resulting avoided level crossing resonance observed as a function of magnetic field [2] provides a means of studying these interactions and understanding the effect of the electric-field gradient due to the muon experienced by the quadrupolar nuclei. The effect is usually modelled by considering the interaction between the positive muon and a single copper nucleus, but the other five copper nuclei are equally important. By solving the problem in the full $2(2I + 1)^6 = 8192$-dimensional Hilbert space, we demonstrate the effect of these additional interactions.

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[2] G. M. Luke, J. H. Brewer, S. R. Kreitzman, D. R. Noakes, M. Celio, R. Kadono, E. J. Ansaldo, Phys. Rev. B 43, 3284 (1991).

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