

Abstract Submitted
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Forbidden coherent transfer observed between two realizations of quasi-harmonic spin systems¹ IRINEL CHIORESCU, GUANG YUE, Florida State University, CHARLES-EMANUEL DUTOIT, SYLVAIN BERTAINA, Aix-Marseille Université, CNRS — Using a multi-level quantum system, we demonstrate Rabi oscillations between states belonging to different realizations of quasi-harmonic oscillators. The Mn ions diluted in a MgO matrix have tunable equally-spaced S_z spin states ². The hyperfine field is large enough to separate sets of states $\{I_z, S_z = -5/2+5/2\}$ of consecutive I_z values. Due to the combined action of the hyperfine and crystal-field operators, such sets are coupled. If this coupling is strong enough and the coherence times of the electro-nuclear states are large enough, a level repulsion of corresponding dressed states is to be observed. Experimentally, we have been able to implement a two-tone technique allowing us to excite the multi-level system at any detuning, and then read it with a resonant pulse. This technique allows us to achieve a strong coupling regime when a splitting between Rabi oscillations of the electro-nuclear states is observable, although the states belong to different I_z values. This demonstrates the possibility of including long-lived nuclear states as a degree of freedom in quantum computing based on multi-level systems.

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²Bertaina et al, **PRL** 102 (2009), **PRB** 84 (2011),**PRB** 92 (2015)

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