Quantum Coherence of Strongly Correlated Deffects in Spin Chains

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The quantum technology is based on the principle of a quantum superposition of wave functions and more particularly for electron spins, the superposed state is achieved by the resonance of the spins: two non-degenerated states are mixed by an electromagnetic wave of a certain duration. The problem is this state is very fragile. The interactions with the environment (other electron spins, nuclear spins, phonons...) tend to destroy the quantum superposition: this is the **decoherence**. One standard method to reduce the decoherence is to minimize the interactions with the environment mostly by magnetic dilution ie: use a diamagnetic host with few nuclear spins dopped by a small amount of paramagnetic ions.
On a contrary, we have chosen an opposite way : the host matrix is a strongly correlated spin system : the o-(DMTTF)2X (with X=Br, I, Cl), an organic quantum spin chain with spin Peierls state at low temperature [1]. A non-magnetic defect like a stacking fault or a chain break polarized dozens of spins around it leading to a "many body" spin S=1/2 effective spin [2,3].
I will present results performed by electron spin resonance. I will show Rabi oscillations (signature of the quantum coherence) measured on these strongly correlated defects and show how the strong correlation of the spin chain protects the effective spin to the decoherence with the environment.

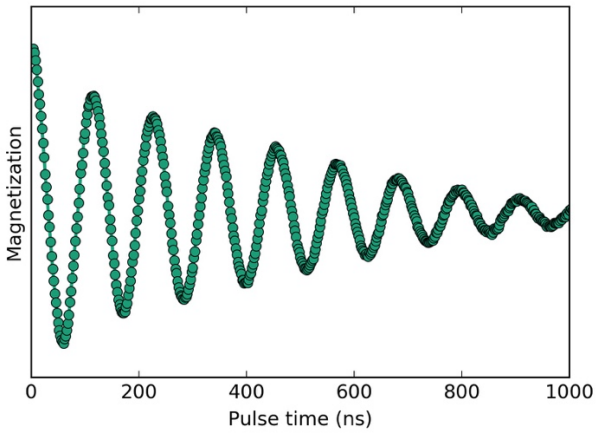

Fig. 1. Rabi oscillations of strongly correlated defects in o-(DMTTF)2I recorder at 8K. Each oscillation is a coherent inversion of the spin states.

References

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