Electrical Control of Nuclear Spin Coherences in Rare-Earth Doped Crystals

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Nuclear spin levels of rare-earth ions in solids are very attractive candidates for qubits in quantum memories and other quantum information applications because of their long coherence times T_2. Using nuclear spins in open shell ions with narrow optical resonances, such as rare earths (RE), introduces the possibility of transferring coherence between nuclear and electronic states. The importance of RE doped crystals for quantum information processing is shown for example by the recent demonstration of a photon to crystal quantum state teleportation [1]. Moreover, it has been found that the coherence times of RE nuclear spin states can be greatly extended by the application of specific external magnetic fields or the application of specific rf pulse sequences [2,3].

We will review recent results obtained in our group on electric field effects on nuclear spin levels in RE doped crystals and their application to optical and microwave photon storage [4,5].

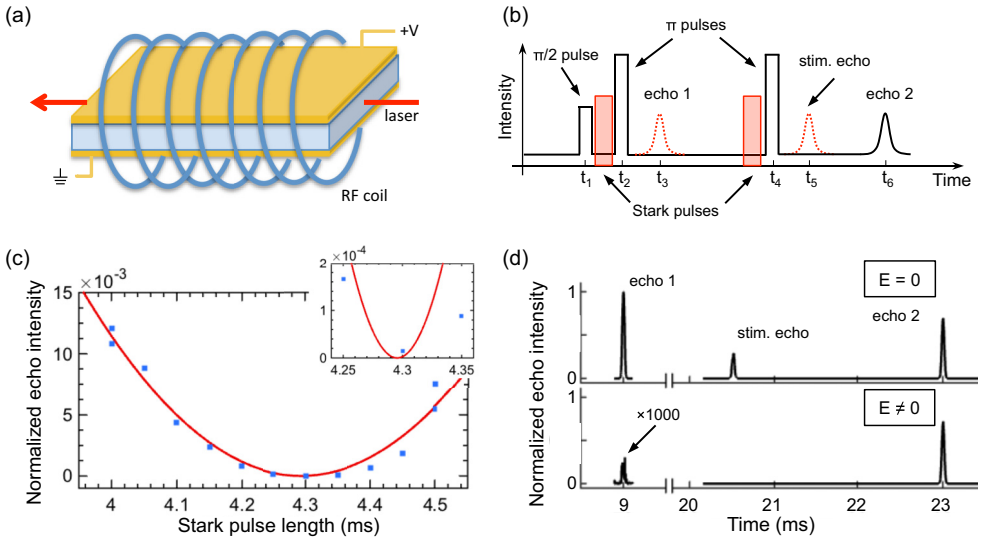

Figure 1: Stark Echo Modulation Memory protocol demonstrated in $^{151}Eu:Y_2SiO_5$ [6]. (a) experimental set-up, (b) rf and Stark pulse sequence, (c) echo 1 suppression, (d) experimental memory results.

References:

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