

Realization of Universal Quantum Gates with Spin-Qudits in Colloidal Quantum Dots

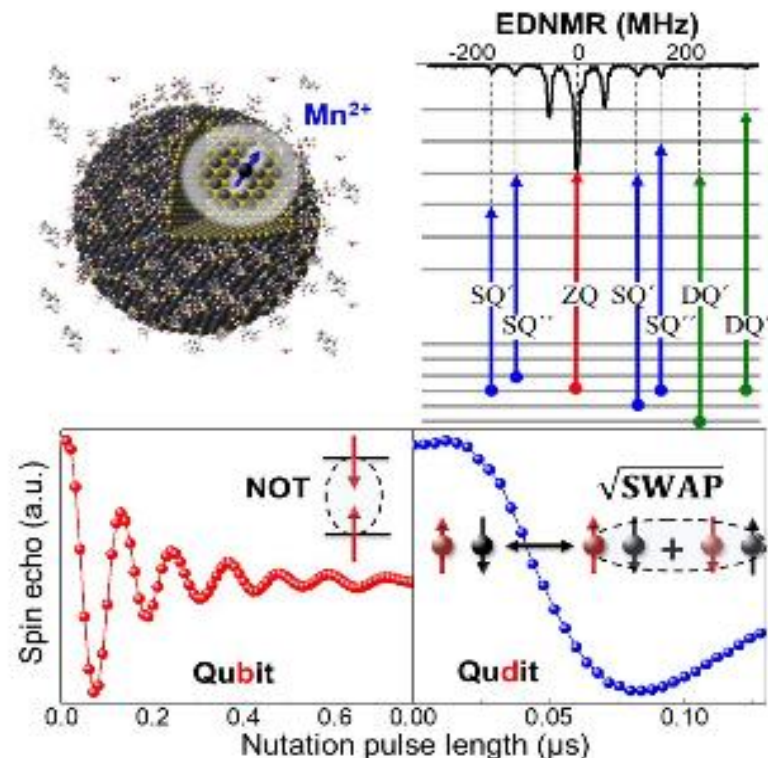
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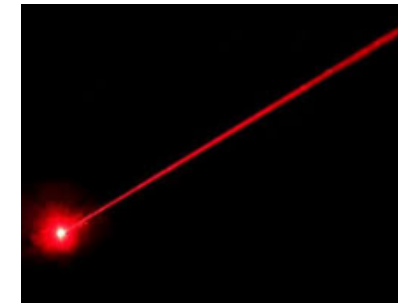
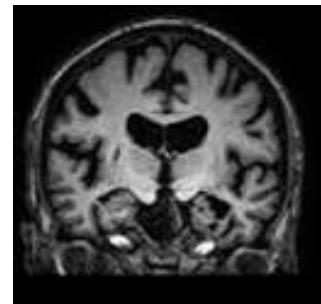
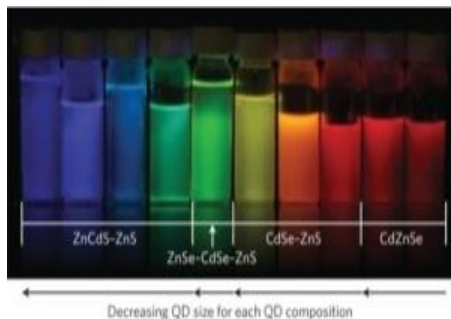
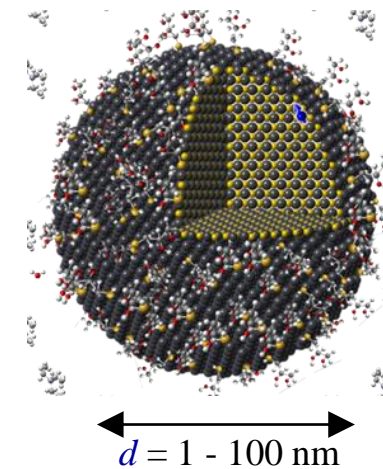
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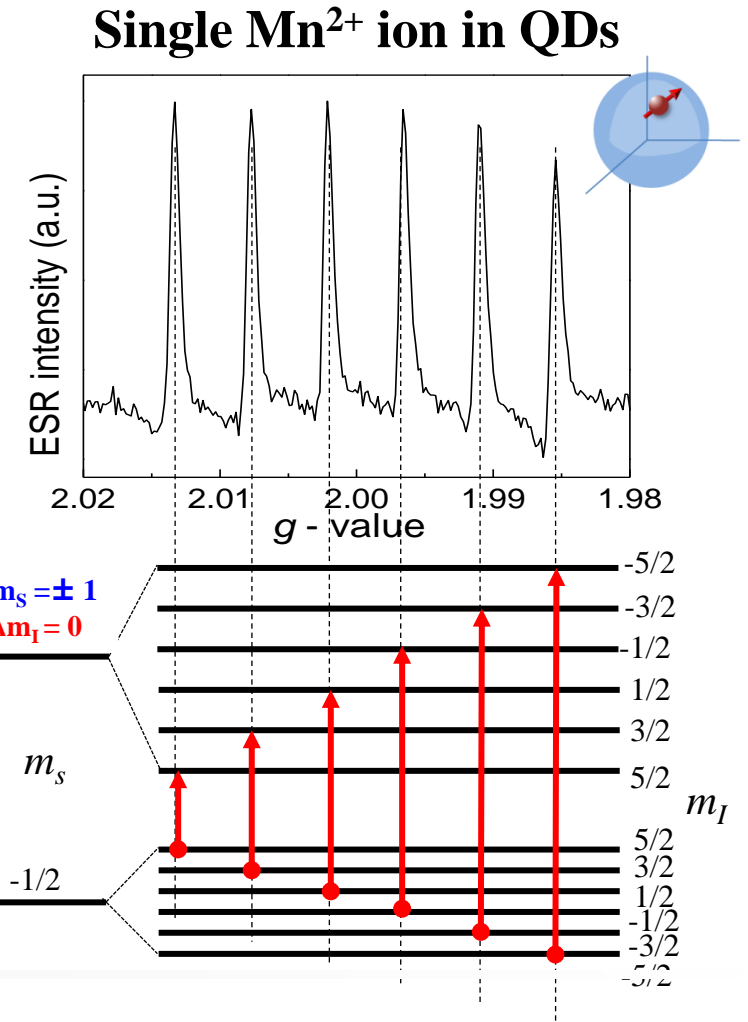
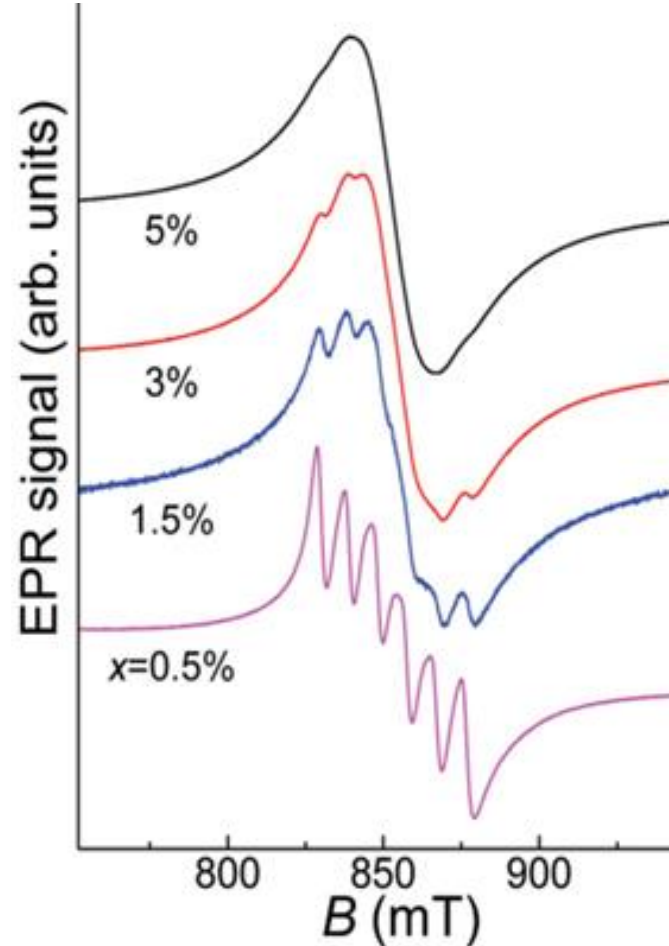
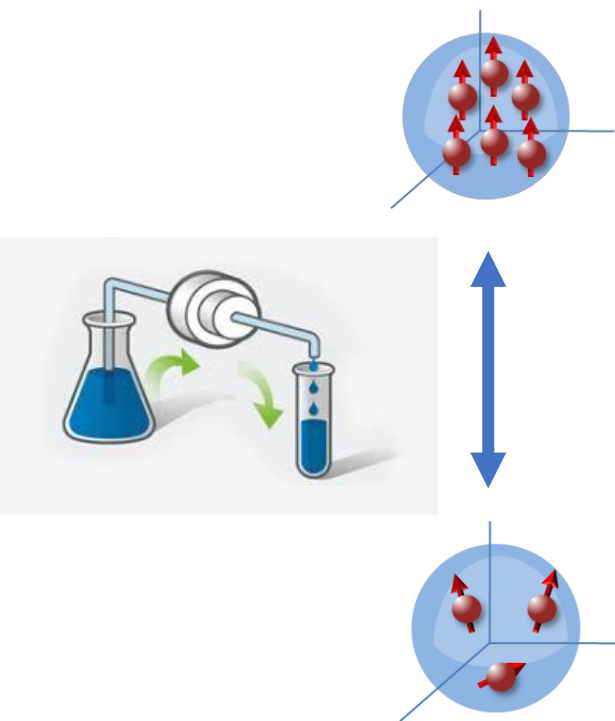


Colloidal semiconducting nanocrystals Quantum dots (QDs)

- Zero dimensional systems
- Hybrid semiconductors: inorganic core + organic shell
- Cheap synthetic costs and scalable
- Strong quantum confinement effects
- Tunable energy band gap with the nanocrystal size.
- Applications:

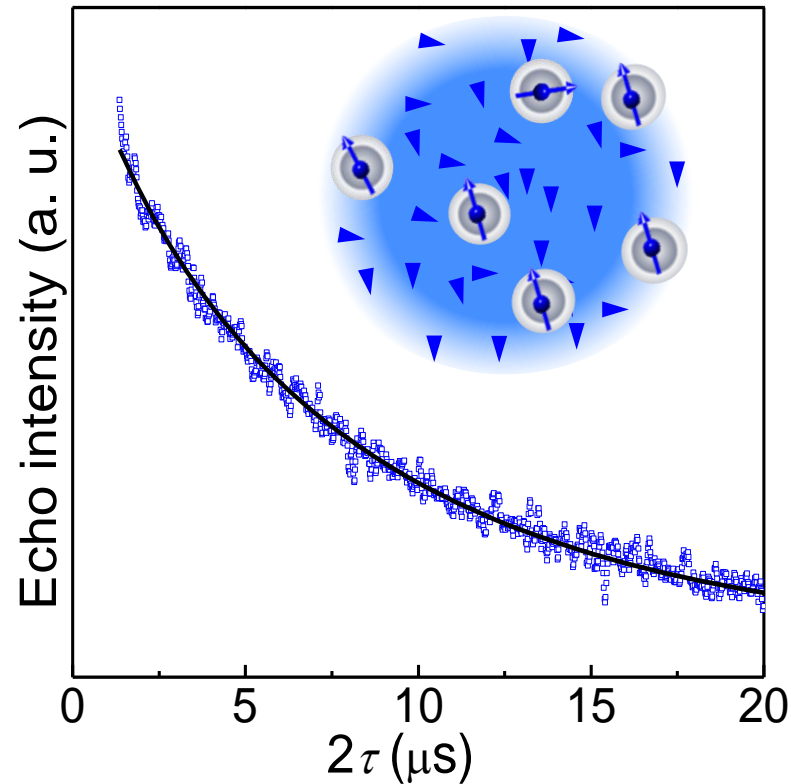


Electron Spin Resonance on Mn-doped PbS QDs

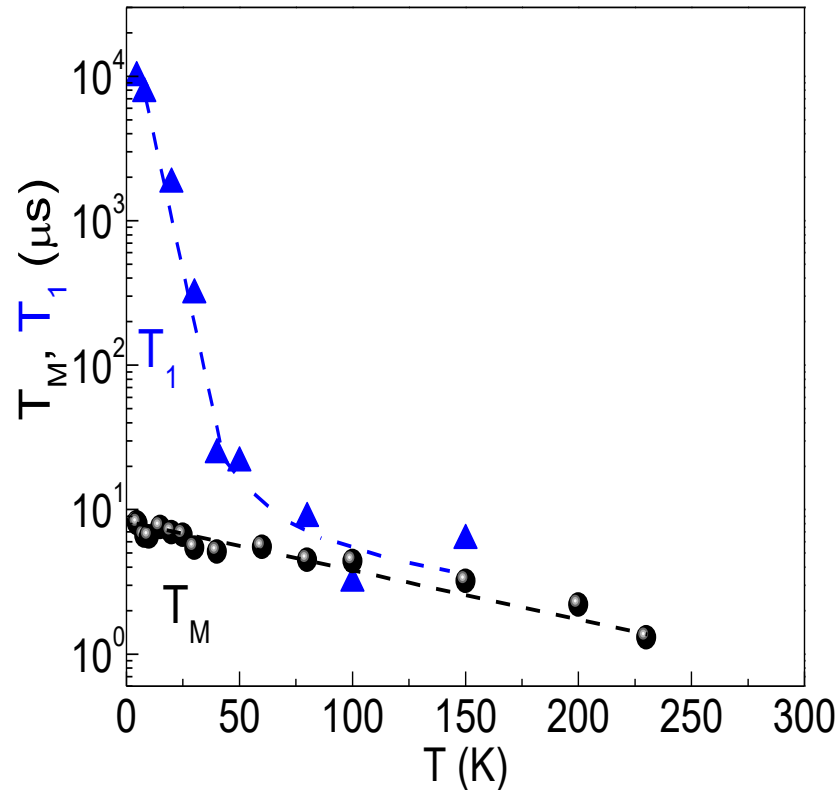


Electron Spin Resonance on Mn-doped PbS QDs

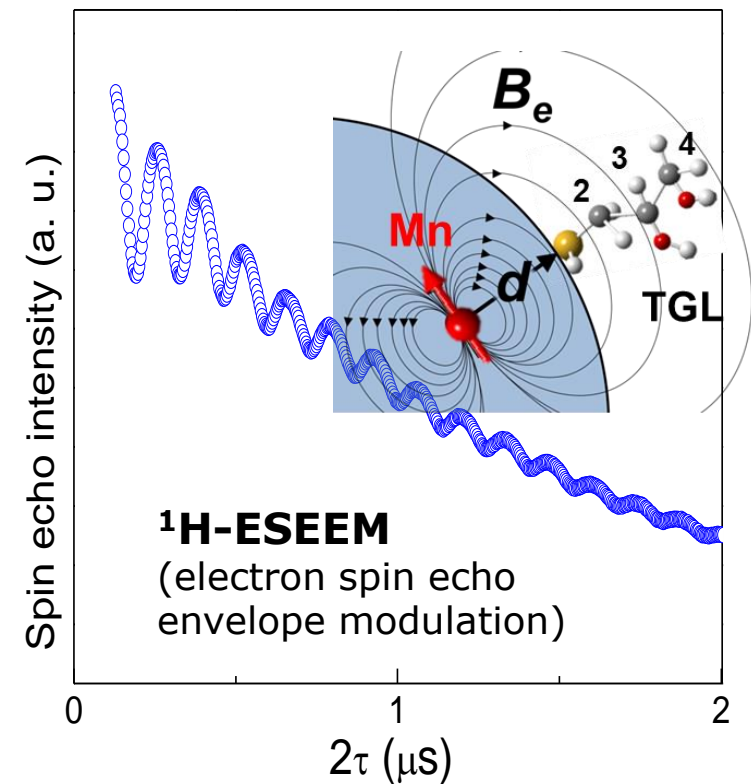
Long coherence time
 $T_M \sim 10 \mu\text{s}$ at $T = 5 \text{ K}$



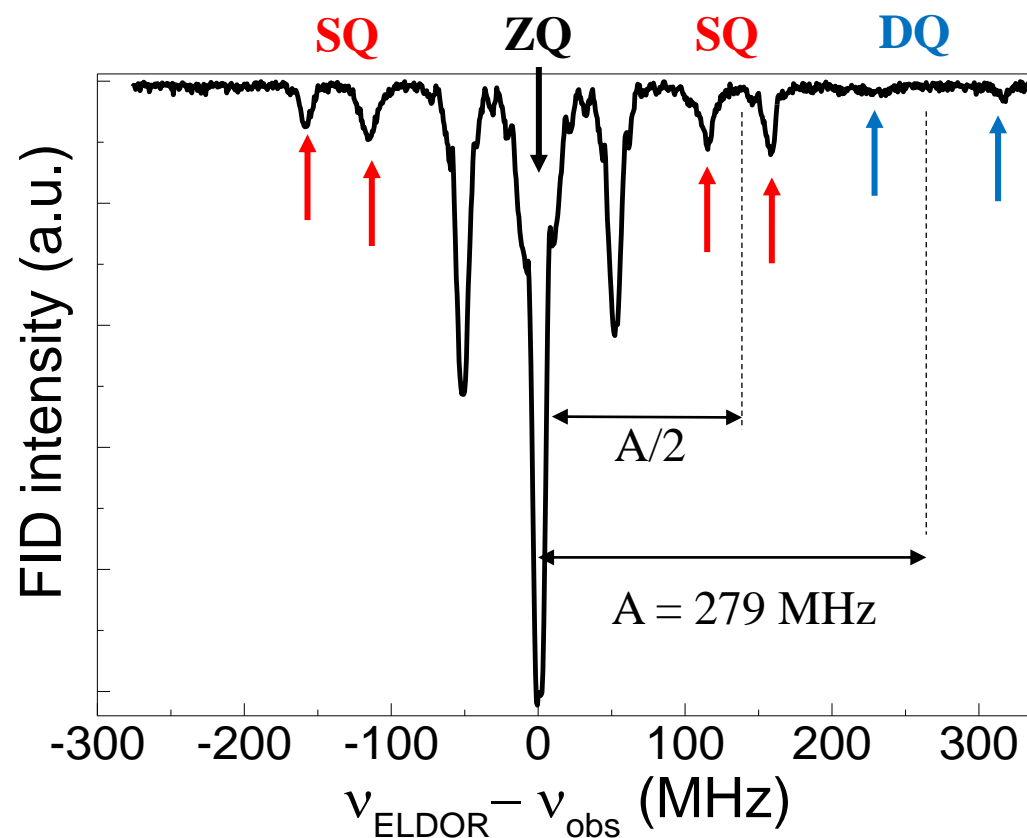
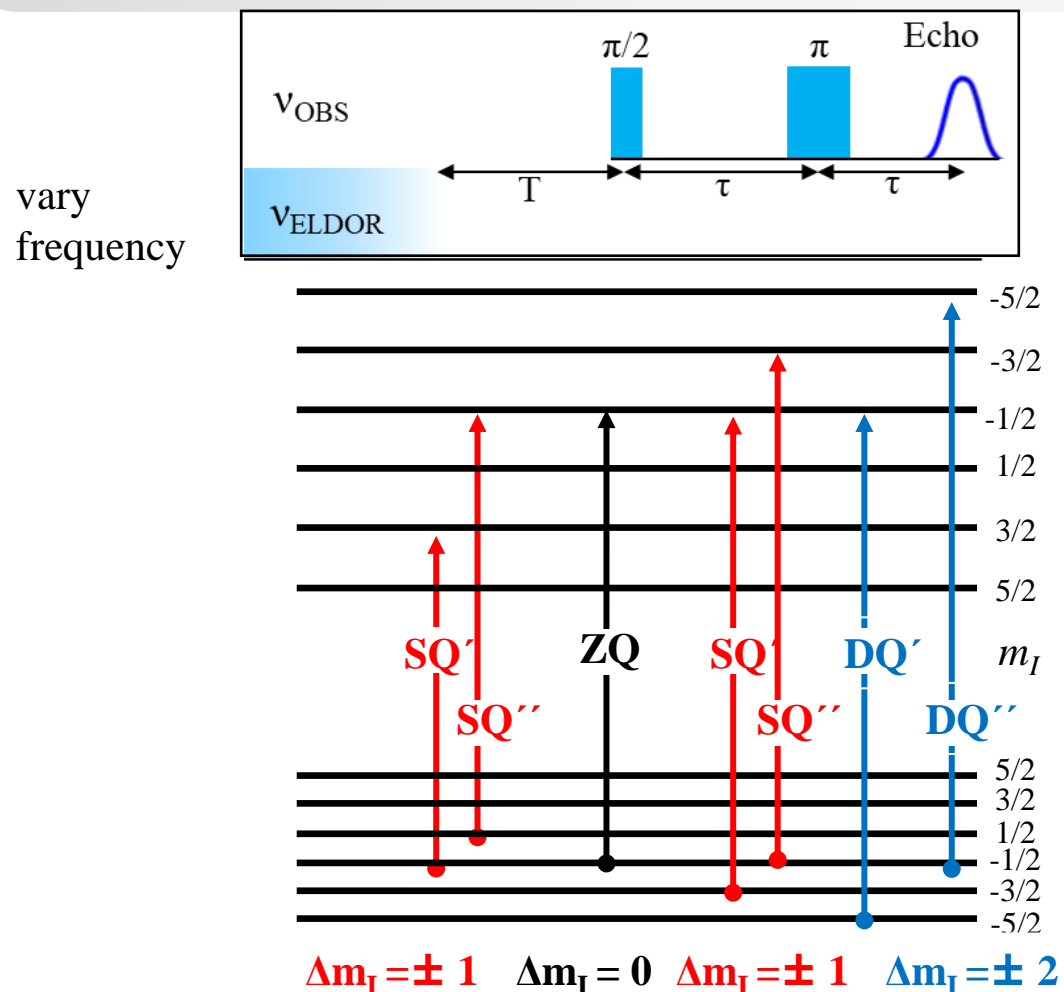
\sim room temperature
quantum coherence



Mn spin senses
surface protons

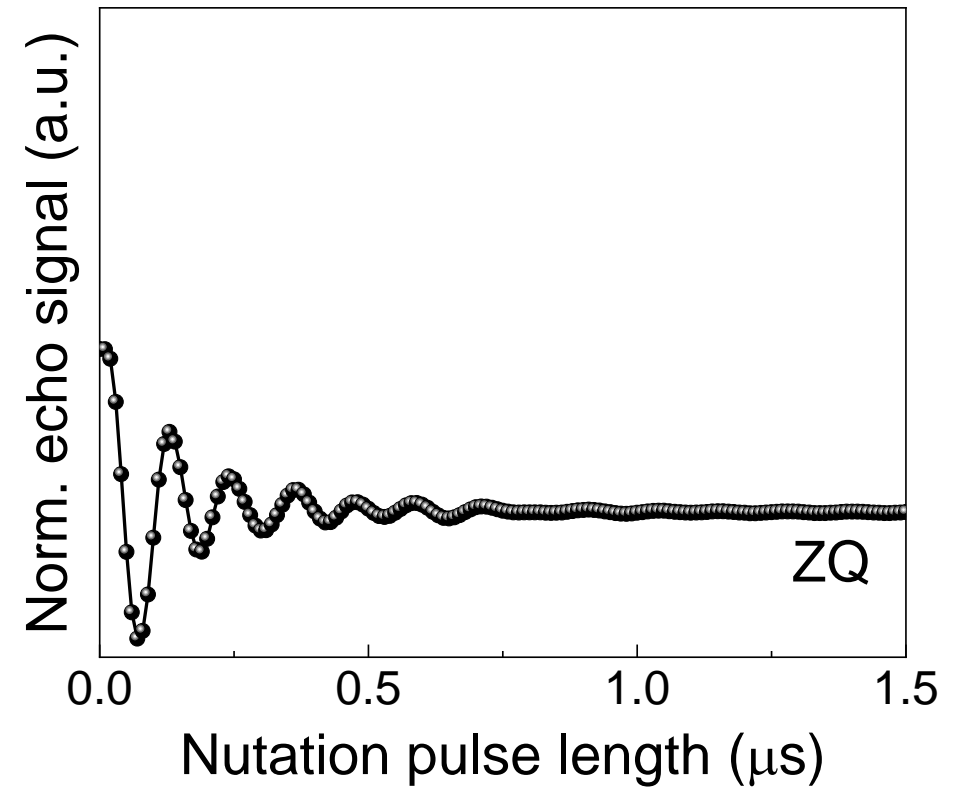
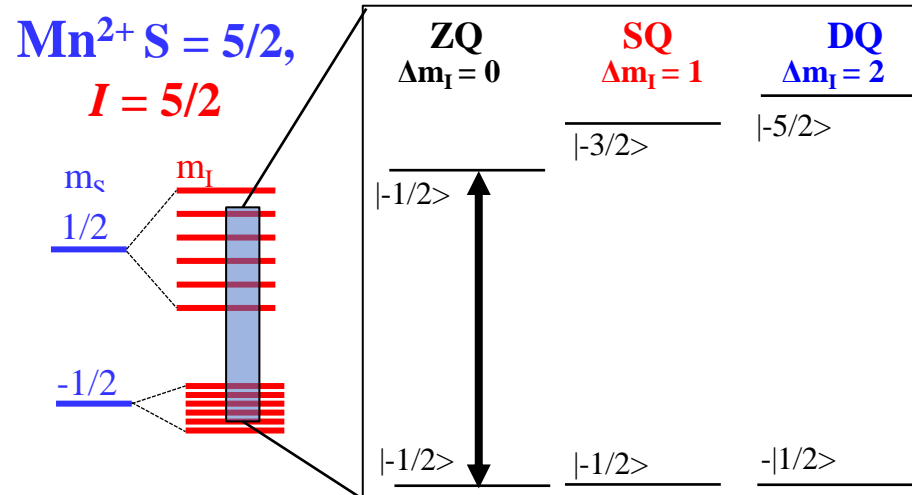
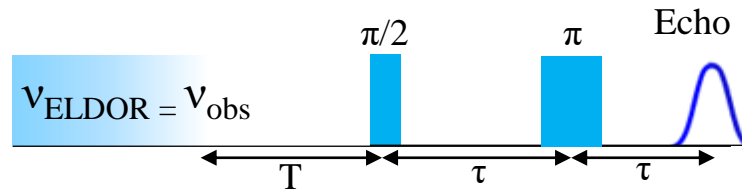


ELDOR-detected NMR of Mn hyperfine states



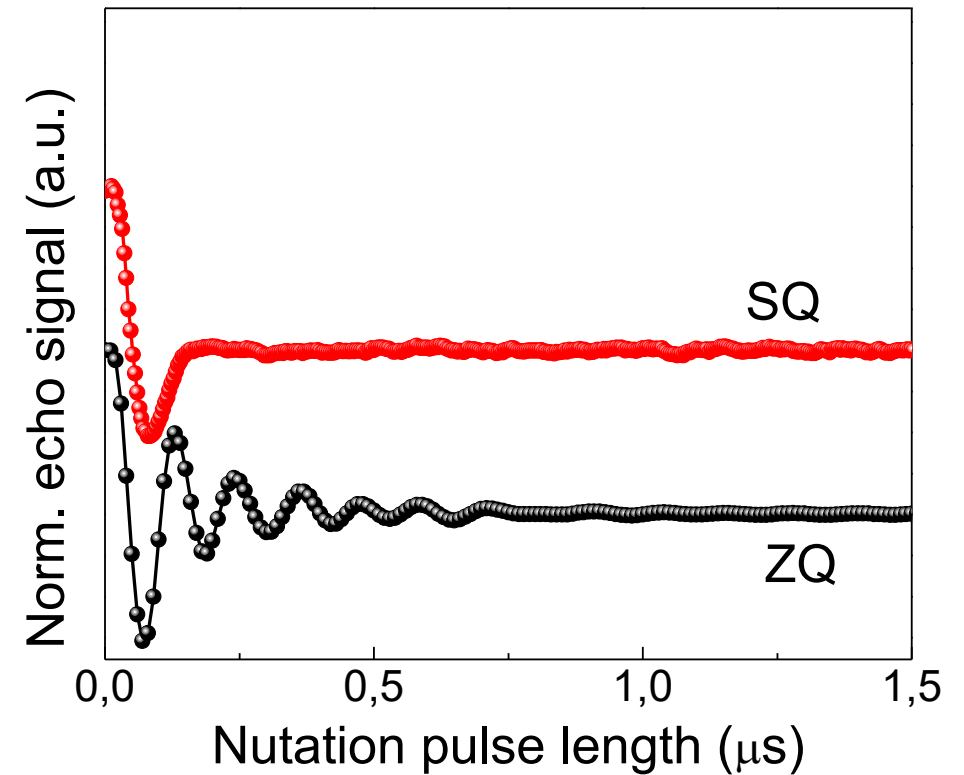
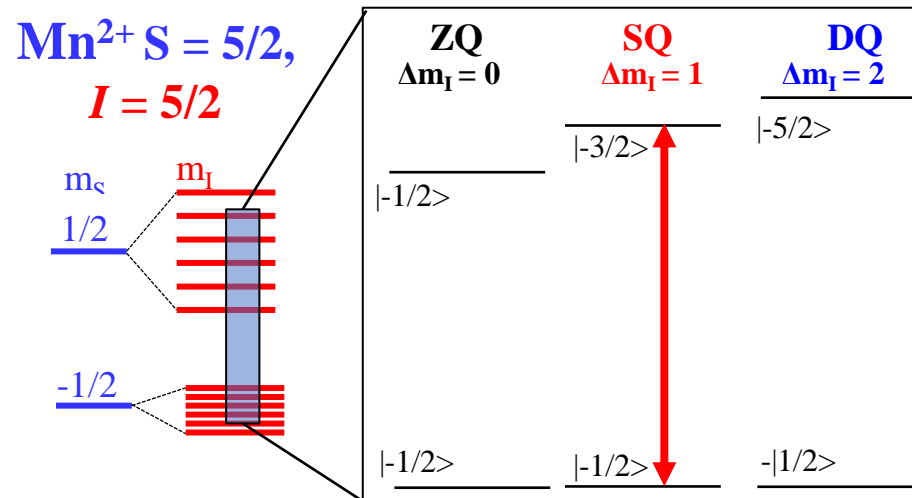
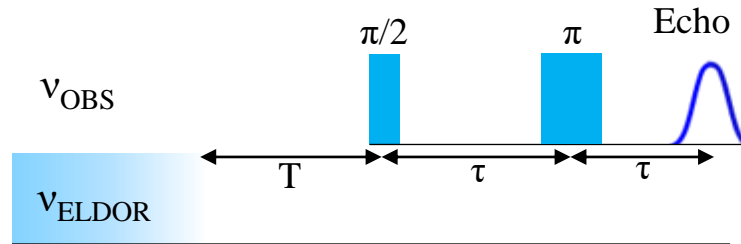
Nutation – EDNMR: Manipulation of the ZQ transition

Fix ν_{ELDOR} frequency
 Vary ν_{ELDOR} pulse length



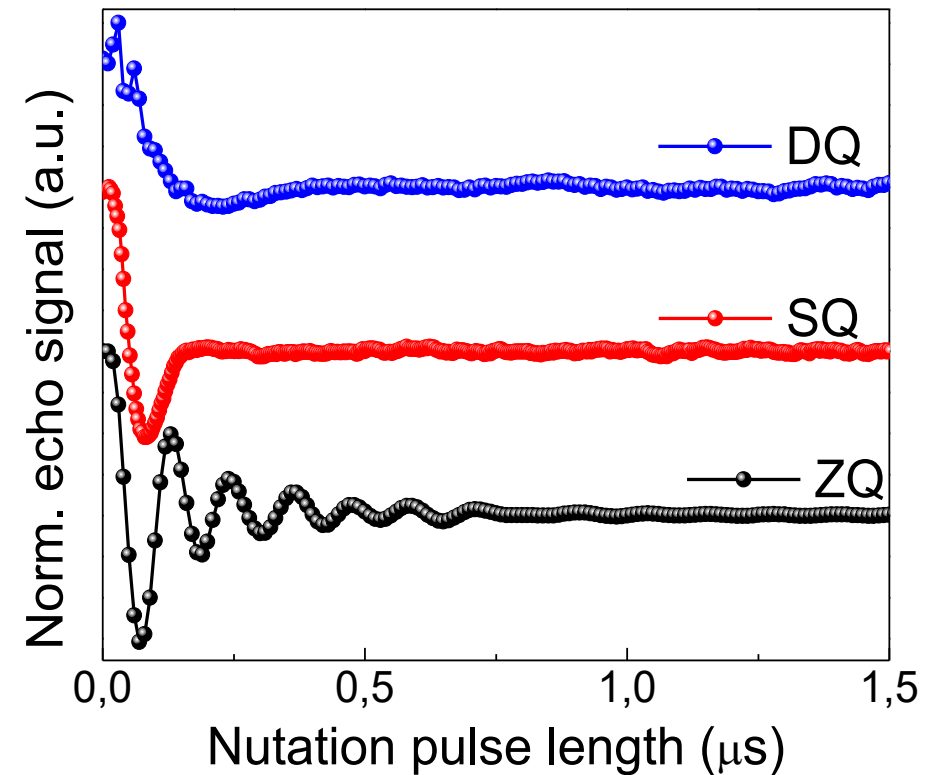
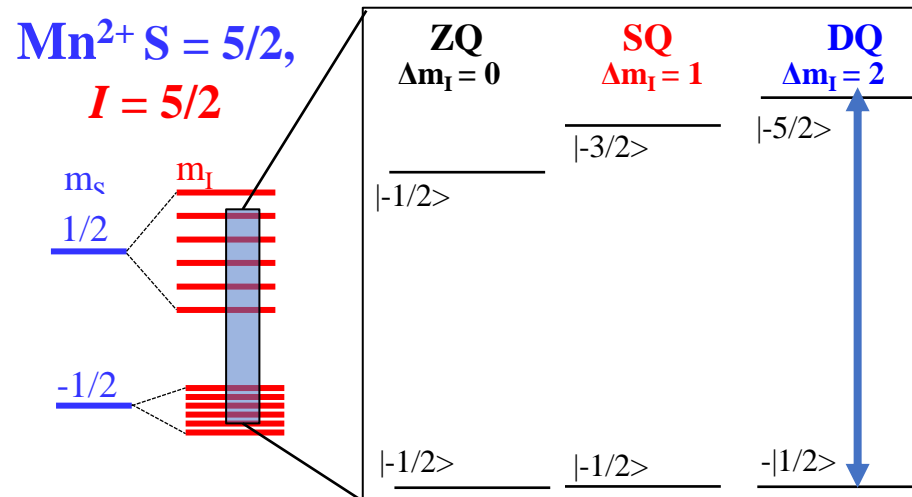
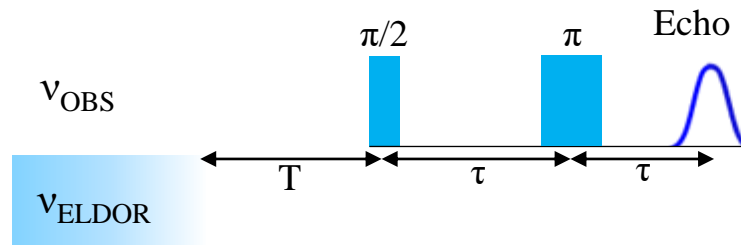
Nutation – EDNMR: Manipulation of the **SQ** transition

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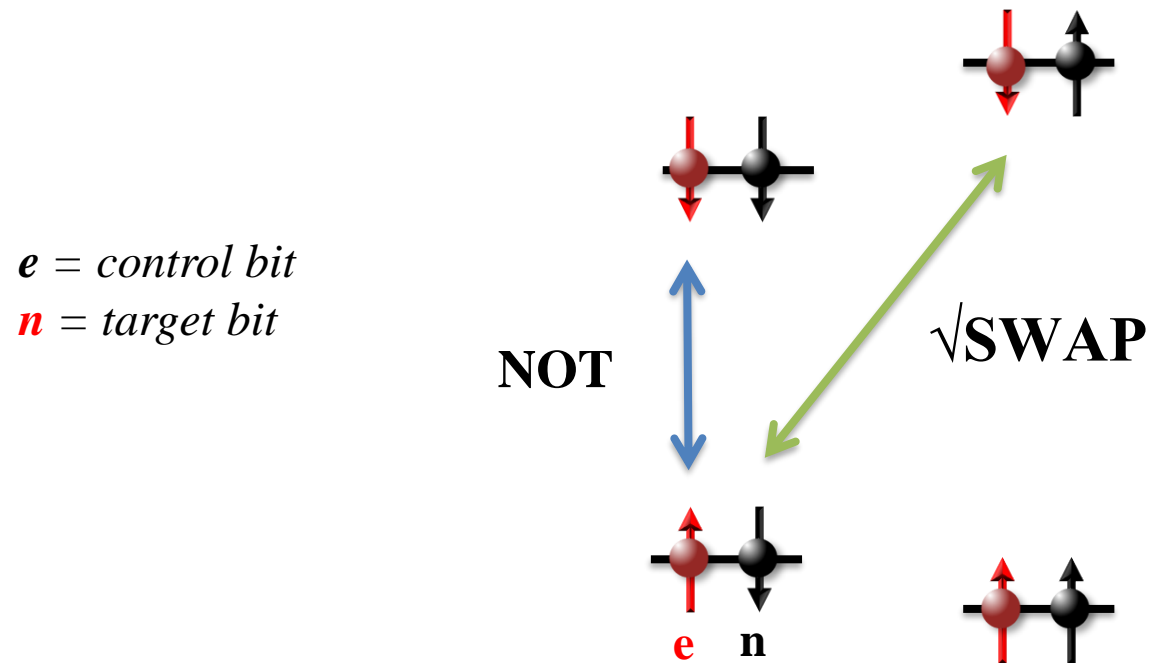
Nutation – EDNMR: Manipulation of the **DQ** transition

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 Vary ν_{ELDOR} pulse length



Electron-nuclear spin *Qudits*

Electron and nuclear spin in transition metal ions and lanthanides



Thank you for your attention!