



Contribution ID: 33

Type: **Talk**

Electrical two-qubit gates within a pair of clock-qubit magnetic molecules

Tuesday 30 May 2023 17:20 (20 minutes)

Enhanced coherence in HoW₁₀ molecular spin qubits has been demonstrated by use of clock-transitions (CTs). More recently it was shown by some of us that, while operating at the CTs, it was possible to use an electrical field to selectively address HoW₁₀ molecules pointing in a given direction, within a crystal that contains two kinds of identical but inversion-related molecules [2]. Herein we theoretically explore the possibility of employing the electric field to effect entangling two-qubit quantum gates within a 2-qubit Hilbert space resulting from dipolar coupling of two CT-protected HoW₁₀ molecules in a diluted crystal. We estimate the thermal evolution of T₁, T₂, find that CTs are also optimal operating points from the point of view of phonons, and lay out how to combine a sequence of microwave and electric field pulses to achieve coherent control within a switchable two-qubit operating space between symmetric and asymmetric qubit states that are protected both from spin-bath and from phonon-bath decoherence. This two-qubit gate approach presents an elegant correspondence between physical stimuli and logical operations, meanwhile avoiding any spontaneous unitary evolution of the qubit states. Finally, we found a highly protected 1-qubit subspace resulting from the interaction between two clock molecules [3].

Indico rendering error

Could not include image: Cannot read image data. Maybe not an image file?

Indico rendering error

Could not include image: [404] Error fetching image

[1] Shiddiq, Muhandis, et al. "Enhancing coherence in molecular spin qubits via atomic clock transitions." *Nature* 531.7594 (2016): 348-351.

[2] Liu, Junjie, et al. "Quantum coherent spin-electric control in a molecular nanomagnet at clock transitions." *Nature Physics* 17.11 (2021): 1205-1209.

[3] Ullah, Aman, et al. "Electrical two-qubit gates within a pair of clock-qubit magnetic molecules." *npj Quantum Information* 8.1 (2022): 133.

Authors: Dr ULLAH, Aman (Instituto de Ciencia Molecular, Universitat de Valencia, Paterna 46980, Spain); Dr GAITA-ARIÑO, Alejandro (Instituto de Ciencia Molecular, Universitat de Valencia, Paterna 46980, Spain)

Co-authors: Dr HU, Ziqi (Instituto de Ciencia Molecular, Universitat de Valencia, Paterna 46980, Spain); Dr CERDÁ, Jesús (Instituto de Ciencia Molecular, Universitat de Valencia, Paterna 46980, Spain); Dr ARAGO, Juan (Instituto de Ciencia Molecular, Universitat de Valencia, Paterna 46980, Spain)

Presenter: Dr ULLAH, Aman (Instituto de Ciencia Molecular, Universitat de Valencia, Paterna 46980, Spain)

Session Classification: Session 3.4