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Quantum Information: How does it μve through fluorides?

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The unitary evolution of a quantum system preserves its coherence, but interactions between the system and its environment result in decoherence, a process in which the quantum information stored in the system becomes degraded. A spin-polarized positively charged muon implanted in a fluoride crystal realizes such a coherent quantum system, and the entanglement of muon and nearest-neighbor fluorine nuclear spins gives rise to an oscillatory time dependence of the muon polarization that can be detected and measured. In this talk, we will show that the decohering effect of more distant nuclear spins can be modelled quantitatively, allowing a very detailed description of the decoherence processes coupling the muon-fluorine "system" with its "environment," and allowing us to track the system entropy as the quantum information degrades [1]. Examples of this approach to various fluorides will be presented, using these methods to gain knowledge of the nature of the muon stopping site, distinguish between different crystalline phases of a compound, and identify Frenkel defects [2].

References

[1] J. M. Wilkinson and S. J. Blundell, *Phys. Rev. Lett.*, **125** 087201 (2020).
[2] J. M. Wilkinson et al., *Phys. Rev. B*, **89** L220409 (2021).

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