UNIVERSITÄT BIELEFELD

Faculty of Physics

Physics Colloquium

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Spin relaxation in solid-state materials: case closed…?

The possibility to use spin as a fundamental building block for quantum technologies is conditional on our ability to generate coherent quantum states and coherently drive them. Despite the success of some physical platforms based on spin, the coherence of these systems is critically limited by temperature. The interaction between spin and lattice vibrations, namely the spin-phonon coupling, is the main limitation to spin coherence, and understanding this fundamental interaction plays an important role in the design of highly coherent spin qubits. Despite its importance, spin-phonon interaction is yet not understood. In this seminar, I will show the progress in building a quantitative quantum theory of spin-phonon decoherence for solid-state materials. I will explore the theoretical framework behind relaxation theories and how it can be implemented in a fully non-parametric fashion thanks to advanced electronic structure simulations. Results for several chemical systems, ranging from molecules to solid-state defects and impurities, will be presented in order to demonstrate that a universal understanding of spin-phonon relaxation has been virtually achieved. I will then discuss how this information can be integrated together with machine learning and high-throughput numerical techniques to advance the design of new materials with ideal properties for quantum technologies based on molecular spin qubits .

Tuesday, 16 May 2023, 2:15 p.m.

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