NSE Faculty Seminar
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Wiring up a Quantum Computer

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Abstract

Quantum control of radiation-matter interactions at the nano-scale could yield significant improvements in fields ranging from atomic physics to magnetic resonance and chemistry. Although small quantum systems can be manipulated with high precision, there is still no clear path to build scalable quantum devices. We address this challenge with a bottom-up approach, where small quantum registers are assembled in a larger modular architecture.

In this talk I will focus on a key element of this proposal, quantum spin wires that connect the registers and transmit information among them. I will present recent results on quantum information transport in spin wire networks, in particular protocols that permit perfect transfer in far more relaxed conditions that previously thought, thus opening the possibility of a practical implementation. I will then show the first experimental study of these quantum information transport protocols in a unique, quasi-1D solid-state spin system.

These results can be extended to other physical implementations and pave the way toward a scalable quantum computer.

References:

A. Ajoy and P. Cappellaro, "Mixed-state quantum transport in correlated spin networks"
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G. Kaur and P. Cappellaro, "Initialization and Readout of Spin Chains for Quantum Information Transport"
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C. Ramanathan, P. Cappellaro, L. Viola and D.G. Cory, "Experimental characterization of coherent magnetization transport in a one-dimensional spin system"
arXiv:1102.3400 - *New J. Phys*. 13 103015 (2011)

P. Cappellaro, L. Viola, C. Ramanathan, "Coherent state transfer via highly mixed quantum spin chains"
arXiv:1011.0736 - *Phys. Rev*. A 83, 032304 (2011)