Thursday, July 31st :: 4:30-5:30pm :: Haus Room (36-428)

Control in Quantum Coherent Systems

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Tremendous research activity worldwide has focused on attempting to harness the exotic properties of quantum physics for new applications in metrology, computation, and communications - a push to develop engineered quantum systems. Underlying any such capability is the need to exert control over a chosen quantum system in order to coax it into performing useful tasks. In this talk we describe the physics and engineering challenges faced in controlling quantum coherent systems. We introduce and validate an efficient transfer-function-based framework for predicting quantum dynamics [1] through experiments using trapped Ytterbium ions [2]. This framework reveals novel insights into the physics underlying the performance of a wide variety of NMR and quantum-information inspired control techniques. We then demonstrate how combining this new understanding of controlled quantum dynamics with functional analysis allows us to address challenging problems ranging from quantum computation and simulation [3-4] to precision frequency metrology [5].

[1] New Journal of Physics 15, 095004 (2013). Phys. Rev. Lett. 109, 020501 (2012).
[2] Phys. Rev. A. 89, 042329 (2014). arXiv:1404.0820 (2014).
[3] Nat. Comms. 4, 2045 (2013).
[4] arXiv:1309.6736 (2013). Accepted to New J. Phys. Nature 484, 489 (2012).
[5] arXiv:1407.3902 (2014)