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Phase-modulated decoupling and error suppression in qubit-oscillator systems TODD GREEN, MICHAEL BIERCUK, ARC Centre for Engineered Quantum Systems, School of Physics, The University of Sydney, Australia
— A key requirement for scalable QIP is the ability to controllably produce high-fidelity multi-particle entanglement on demand. This is accomplished in experimental systems using a variety of techniques, but a prominent approach relies on the realization of an indirect interaction between basic quantum systems mediated by bosonic oscillator modes. A significant source of infidelity in these experiments is the presence of residual qubit-oscillator entanglement at the conclusion of an interaction period. We demonstrate how the exclusive use of discrete phase shifts in the field moderating the qubit-oscillator interaction - easily implemented with modern synthesizers - is sufficient to both ensure multiple oscillator modes are decoupled and to suppress the effects of fluctuations in the driving field. We present detailed example protocols tailored to the execution of Molmer-Sorensen entangling gates in trapped ion systems and demonstrate that our approach allows multiqubit gate implementation with a significant reduction in technical complexity relative to previously deomstrated protocols.

Todd Green
ARC Centre for Engineered Quantum Systems,
School of Physics, The University of Sydney, Australia

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