Towards Scalability and Fault Tolerance in Continuous-Variable Quantum Computation

RAFAEL N. ALEXANDER, Center for Quantum Information and Control, the University of New Mexico

Before they can be useful, quantum computers must be made large and robust to noise. I will discuss progress towards both requirements in the context of continuous-variable quantum information, where the data registers are Bosonic modes, such as spatial/temporal modes in quantum optics, or microwave resonator modes in superconducting qubit architectures. I will report on a recent experiment that deterministically generated large-scale quasi-two-dimensional resource states for measurement-based quantum computing [1]. I will also discuss the key challenges to using such states for quantum computation: the effects of limited squeezing and the requirement of a non-Gaussian operation. Fortunately, one can address both issues in one fell swoop: encoded qubits known as Gottesman-Kitaev-Preskill (GKP) states allow for universal quantum computing with a constant squeezing overhead in the entangled resource state, and simultaneously provide the necessary non-Gaussianity for universal quantum computation [2].

References:

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