Using Boson Sampling for Efficient Simulation of Molecular Spectra on a Small Quantum Processor

Steven Mark Girvin

Yale University, PO Box 208333, New Haven 06520-8333, USA

'Circuit QED' is non-linear quantum optics extended to superconducting electrical circuits and represents a leading architecture for the eventual creation of large-scale fault-tolerant quantum computers. Recent remarkable theoretical and experimental progress in our ability to measure and manipulate the quantum states of individual microwave photons is leading to novel applications in quantum information processing, bosonic quantum error correcting codes and quantum simulations of bosonic systems. In this talk I will discuss how the ability to make repeated quantum non-demolition (QND) measurements of photon numbers allow accurate quantum simulation of the vibrational spectra (Franck-Condon factors) of small molecules using efficient boson sampling.

[1] 'Efficient multi-photon sampling of molecular vibronic spectra on a superconducting bosonic processor,' Christopher S. Wang, Jacob C. Curtis, Brian J. Lester, Yaxing Zhang, Yvonne Y. Gao, Jessica Freeze, Victor S. Batista, Patrick H. Vaccaro, Isaac L. Chuang, Luigi Frunzio, Liang Jiang, S. M. Girvin, and Robert J. Schoelkopf, Phys. Rev. X 10, 021060 (2020).