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Online quantum computing

The operation of real quantum computers, including the implementation and characterization of a given quantum circuit or algorithm, has until recently been carried out exclusively by the experimental groups that design and make the hardware. In 2016, however, IBM Research opened their superconducting qubit devices to the quantum computing community, and Google has announced a similar intention. Several quantum computing start-ups have also announced their intent to provide some access to their technology for academic research purposes. The field is approaching a transition where a significant amount of quantum computing research and development can be performed online. And an online presence is especially important now because there are critical questions facing the realization of quantum computers that benefit from wide community input and experimentation. In this talk, I'll give an overview of our online quantum computing work, which is broadly focused on error modeling and error correction, quantum machine learning, and quantum simulation. In particular, I will discuss recent work (M. R. Geller, arXiv:1711.11026) on the Josephson Sampler circuit, used to embed classical information (e.g., images) into a chain of qubits. To assess the expressiveness of the Josephson Sampler circuit, we use it to generate pseudorandom unitaries, and we measure the quantum butterfly effect generated by the resulting quantum chaos. I will also discuss new work on the experimental measurement of the relative robustness of two common families of entangled states, GHZ states, and linear cluster states. We measure their fidelity and entanglement monotones versus time to study their decay in a noisy quantum computer, finding results that are in contrast with predictions of a standard T1, T2 Markovian decoherence model. These examples will show the rich variety of quantum computations that can already be accomplished using the IBM Quantum Experience API.

Biography

Michael R Geller received his PhD in physics from the University of California, Santa Barbara, in 1994, supervised by Walter Kohn. In 1997 he joined the faculty in the Department of Physics and Astronomy at the University of Georgia in Athens, where he is currently a Professor of Physics. His interests include superconducting quantum computation and quantum simulation. He has published more than 25 papers in this field, and his quantum computing research has been funded by the National Science Foundation and IARPA.

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