Quantum Computers: Are We There Yet?
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In recent years, there has been a dramatic increase worldwide in the scientific research as well as financial investment in developing a *quantum computer*, a device that theoretically could solve specific problems much faster than or impractical on any classical computing system. Despite a few well-known quantum algorithms, such as Shor's factoring algorithm and Grover's search algorithm, there is a limited set of known specific problems for which a quantum computer is advantageous. Experimentally, a few quantum computational operations have been experimentally performed to date on a small number of quantum bits – units of quantum information which are analogous to the classical logical bits 0 and 1. There are still several fundamental scientific challenges to overcome in scaling up these small quantum systems into large-scale quantum computers which could demonstrate a quantum speedup for known problems as well as help discover new quantum algorithms.

In this session, our first speaker, Sara Gamble (Army Research Office), will introduce the concept of quantum computing and provide some possible applications. As a program manager, Dr. Gamble will use her broad perspective to provide an overview of the different approaches to achieving such a computational device. Next, Shelby Kimmel (Middlebury College), will discuss quantum algorithms and the power of quantum systems to process information. Sarah Sheldon (IBM Thomas J. Watson Research Center) will delve into logical quantum computing, a method of quantum computation based on logic gates similar to classical digital circuits. With her experience in developing the IBM Quantum Experience, Dr. Sheldon will also explore cloud-based quantum computing. Finally, Prof. Norman Yao (University of California, Berkeley) will discuss quantum simulation, a type of quantum computer that allows simulation of quantum phenomenon that are too difficult to study otherwise.