Beyond classical computing with near-term quantum computers

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Over the last few years significant attention has been devoted to devising experimental demonstrations of quantum computational supremacy: namely using a quantum computer to solve a computational task in a regime that goes beyond what is possible on a classical, digital, machine. This is, in part, driven by the hope that a clear demonstration of post-classical computation can be performed with a device that is intermediate between the small quantum circuits that can currently be built and a full-scale, fault-tolerant, quantum computer. The theoretical challenge that this poses is twofold: firstly we must identify the physically least expensive quantum computations that are classically unachievable; and we must also determine if this advantage can be maintained in the presence of physical noise. In this talk I will review the IQP, Boson Sampling, and chaotic circuit approaches to quantum computational supremacy, how they can be generalized to other intermediate quantum computing models, and to what extent the experimental resource requirements of these problems can be reduced.

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