

The Promise of Superconducting Quantum Processing

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Abstract— Quantum mechanics describes the physical world around us with exquisite precision, with no known violations of the theory. Ironically, this precision comes with some additional baggage: the theory permits a host of complex, delicate states of the physical world, many of which are yet to be produced or observed. The debate of whether their subtle, entangled structure really captures the fundamental nature of the world, and is an engineering resource, is reaching a critical moment, with experiments straddling the threshold of quantum supremacy where hitherto inaccessible computations are enabled with quantum computing hardware. Superconducting circuit-based quantum processors are an advanced technology platform for such quantum information processing. Current progress in quantum hardware and algorithms is reviewed, along with a discussion of near-term research needs as viewed through the lens of materials science and cryogenic technology.

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