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SERAPH: Dark Matter Searches with SRF Cavities and Transmon Qubits

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The Superconducting Quantum Materials and Systems Center, led by Fermi National Accelerator Laboratory, is one of five research centers funded by the U.S. Department of Energy as part of a national initiative to develop and deploy the world's most powerful quantum computers and sensors. SQMS will also apply the same technologies used for quantum computing, such as SRF cavities and superconducting qubits, to search for fundamental physics.

This presentation will focus on the SERAPH experiment, a family of superconducting haloscopes being developed by SQMS to search for wavelike dark matter like axions and dark photons. In this presentation, I will focus on the progress of the current phase of SERAPH, which will search dark photon dark matter using a widely-tunable SRF cavity (4-7 GHz) with $Q > 10^8$. In parallel, SQMS has recently developed superconducting transmon qubits with leading coherence times. I will report new results for SQMS dark matter searches implementing these qubits to subvert the Standard Quantum Limit noise.

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