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Quantum Amplifiers for the Axion Dark Matter Experiment (ADMX)

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One of the most interesting problems in physics and cosmology today is what makes up dark matter. The QCD axion is a well motivated candidate and is predicted to be very light (μeV mass) and very cold, meaning it would interact more like a radio wave then an ionizing particle. The Axion Dark Matter Experiment (ADMX) uses the "haloscope technique" to search for axions resonantly converting to detectable photons in a microwave cavity immersed in a strong magnetic field. The critical components for enabling an efficient search for dark matter axions are near quantum limited superconducting amplifiers. Here I will describe the implementation in ADMX of both a Microstrip SQUID amplifiers (MSA) and a Josephson Parameteric Amplifiers (JPAs), both of which were developed at UC Berkeley. These quantum amplifiers enable ADMX to cover the entire range of potential axion couplings for the first time. I will also discuss the potential to use single-photon counting to enable higher frequency axion searches where the standard-quantum limit may become the limiting factor.

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