

Abstract Submitted  
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**Quantum sensing for axions below  $1\mu\text{eV}$** <sup>1</sup> STEPHEN KUENSTNER, Stanford Univ, DMRADIO COLLABORATION — There are compelling reasons to use quantum metrology techniques in axion searches below  $1\mu\text{eV}$ , which aim to detect electromagnetic signals below 300MHz. Comparatively little work has been done to develop quantum metrology techniques in this frequency range, and well-established techniques like squeezing and photon counting are not useful due to the residual thermal excitations in MHz circuits. In this work we present the RQU, a flexible device that we are developing to enable quantum acceleration in DMRadio-50L, DMRadio-GUT, and other axion searches. The RQU uses Josephson junctions to parametrically upconvert signals from MHz frequencies to microwave frequencies. This upconversion paradigm allows the RQU to take advantage of several mature microwave Circuit QED technologies, including high Q microwave resonators, JPAs, and microwave squeezers. The RQU is optimized for quantum metrology in practical axion searches, with a design that isolates the RQU's microwave drive signals from the axion receiver. The RQU can be operated in a several modes by choosing the frequencies, phases, and amplitudes of the microwave drive signals. A variety of quantum metrology techniques, including sideband cooling, two-mode squeezing, and backaction-evading readout are possible.

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