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DMRadio-GUT: quantum advantage at the GUT scale

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The DMRadio series of experiments is designed to probe pre-inflationary dark matter axions in the peV-neV range. Specifically, DMRadio-GUT is the ultimate DMRadio experiment with sensitivity to dark matter axions at DFSZ coupling in the $0.4\text{--}120\text{ neV}$ ($100\text{ kHz--}30\text{ MHz}$) range. To achieve this sensitivity to DFSZ axions at such low masses, new technologies are necessary to scan the desired parameter space within reasonable scan times. As a result, future experiments must employ novel magnet technologies, high Q resonators, and quantum devices with noise levels that have never been achieved before at these frequencies. In this talk we present requirements to achieve the required sensitivity, as well as first results from tests of high Q resonators and quantum amplifiers, namely radio frequency quantum upconverters (RQUs) which can achieve frequency-integrated sensitivity beyond the standard quantum limit. These results provide concrete paths forward in achieving the DMRadio-GUT requirements.

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