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The ORGAN Experiment: Results, Status, and Future Plans

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We present the status and plans of The Oscillating Resonant Group AxioN (ORGAN) Experiment Collaboration, which develops microwave cavity axion haloscopes. ORGAN is a collaboration of various Australian universities, with the main experiment hosted at The University of Western Australia.

The ORGAN Experiment is a high mass haloscope (~60-200 micro-eV) broken down into various phases, having commenced in 2021, and running until 2026 [1]. Phase 1 recently concluded, excluding ALP Cogenesis models of dark matter in the relevant mass ranges [2,3], along with scalar dark matter and dark photon limits. Phase 2 is in research and development, expected to commence in late 2024/early 2025 and achieve deeper sensitivity. Active avenues of research and development for ORGAN Phase 2 include novel high frequency cavity design [4,5], superconducting materials, and single photon counting –we will report on the status of R&D in these areas.

ORGAN-Q is a pathfinder experiment (~25 micro-eV), designed as a testbed for various techniques to be integrated into the main ORGAN Experiment in Phase 2, such as quantum-limited amplification, and other improvements. It commenced in late 2023, and recently concluded [6]. We will report on the results, and the components to be integrated in ORGAN Phase 2.

ORGAN-Low Frequency is a lower-mass experiment hosted at Swinburne University, designed to utilise an MRI magnet and novel cavities to push into the low frequency regime, and search for different models of dark matter. It is currently in development, expected to commence in late 2024.

We will summarize each experiment in terms of the relevant experimental details, current status, run plans, and projected reach.

1. Ben T. McAllister, Graeme Flower, Eugene N. Ivanov, Maxim Goryachev, Jeremy Bourhill, Michael E. Tobar, 'The ORGAN experiment: An axion haloscope above 15 GHz', Physics of the Dark Universe 18, 67-72
2. Aaron P. Quiskamp, Ben T. McAllister, Paul Altin, Eugene N. Ivanov, Maxim Goryachev, Michael E. Tobar, 'Direct Search for Dark Matter Axions Excluding ALP Cogenesis in the 63-67 micro-eV Range, with The ORGAN Experiment', Science Advances 8, Issue 27
3. Aaron P. Quiskamp, Ben T. McAllister, Paul Altin, Eugene N. Ivanov, Maxim Goryachev, Michael E. Tobar, 'Exclusion of Axionlike-Particle Cogenesis Dark Matter in a Mass Window above 100 micro-eV' , Phys. Rev. Lett 132, 031601
4. Ben T. McAllister, Aaron P. Quiskamp, and Michael E. Tobar, 'Tunable Rectangular Resonant Cavities for Axion Haloscopes', Phys. Rev. D 109, 015013
5. Aaron P. Quiskamp, Ben T. McAllister, Gray Rybka, and Michael E. Tobar, 'Dielectric-Boosted Sensitivity to Cylindrical Azimuthally Varying Transverse-Magnetic Resonant Modes in an Axion Haloscope', Phys. Rev. Applied 14, 044051
6. Forthcoming Article

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