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Search for Hidden Photon Dark Matter Using Direct Excitation of Superconducting Qubits

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We present a search for hidden photon dark matter using superconducting qubits, based on the method proposed by our group (Moroi et al., Phys. Rev. Lett. 131, 211001 (2023)). Hidden photon dark matter induces an AC electric field through the kinetic mixing with ordinary photons. This electric field can excite a qubit on resonance. Assuming that fake excitations are uniformly distributed in the frequency domain, a narrow dark matter signal can be detected by sweeping the frequency of tunable qubits. To determine the excitation rate at each frequency, we repeatedly let the qubit idle for a fixed time and measure its state. In this presentation, we show the latest results of hidden photon searches by this detection method. Compared to the experiment reported last year [1], we have improved the qubit quality and optimized the resonator geometry, resulting in enhanced sensitivity. These results pave the way for comprehensive broadband searches and axion searches under strong magnetic fields.

[1] K. Watanabe et al., 2024, 19th Patras Workshop on Axions, WIMPs and WISPs (poster presentation, Patras, September 16–20).

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