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DarQ experiment - Wave-like dark matter searches using superconducting qubits

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Wave-like dark matter (dark photon and QCD axion) at the mass of μeV-meV range has a great motivation given the dark matter relic constraint and the naturalness consideration. While the haloscope experiments using cavity resonances have achieved a milestone sensitivity reaching the DFSZ limit in the axion search, the scheme tends to suffer from the standard quantum limit (SQL) as well as the narrow frequency tuning range, which prevents a high sensitivity search over the entire mass range.

Superconducting qubits have great potential to overcome the both difficulties, owing the single photon detection capability and the excellent frequency tunability. DarQ collaboration (Dark matter search using Qubits) has been formed to establish a set of novel searches utilizing qubits as either sensors directly excited by the dark matter [1-3], or as frequency tuners improving the cavity haloscope experiments [4]. In this contribution, we discuss the very first search results and the prospect, including the new techniques to be enabled in the FTQC era.

[1] T. Moroi et al. PRL 131 (21), 211001 (2023).
[2] T. Sichanugrist et al. PRL 133 (2), 021801 (2024).
[3] T. Sichanugrist et al. PRD 110 (11), 115021 (2024)
[4] K. Nakazono, "Search for dark photons around 34.4 μeV using direct excitations of superconducting qubits", Patras 2024.

Collaboration you are representing

DarQ collaboration

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