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Toward single-photon detector based on Josephson effect for dark matter search

Dark matter (DM) is one of the most challenging problems of modern physics. Nowadays, its nature remains elusive and multiple theoretical models have been proposed to explain DM phenomenology. A DM candidate that has attracted increasing attention is the axion, a hypothetical elementary particle postulated to solve the strong CP problem in quantum chromodynamics. One of the possible ways to detect axions is to observe their conversion into photons as they interact with a strong magnetic field. The axions conversion events are expected to be very rare and therefore a photon detector sensitive to a single light quantum has to be employed. Josephson junctions (JJ) based single-photon detectors are ideal for this purpose since they are extremely sensitive to external stimuli. We present our latest results obtained using superconducting qubit network (SQN) as a photon detector. We exploit the coherent collective excitation of the SQN as a mechanism for detection of microwave photons in a three-ports device [1–3] (Supergalax project, funded by the European union through Horizon2020, grant number 863313).

1. Brehm, J. D. et al. npj Quantum Mater. <https://doi.org/10.1038/s41535-021-00310-z>.
2. Navez, P. et al. Phys. Rev. B (2021) <https://doi.org/10.1103/PhysRevB.103.064503>
3. Zagoskin, A. M. et al.(2013) <https://doi.org/10.1038/srep03464>

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