# Dark Matter Search Using SNSPDs in the QROCODILE Experiment

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Dark matter remains one of the major unsolved mysteries of modern physics. After decades of research at the electroweak scale, significant research effort has shifted towards sub-GeV mass ranges. Among various emerging detector techniques, superconducting nanowire single photon detectors (SNSPDs) offer an unprecedented combination of a high system detection efficiency, ultra-low noise and high-count rate capability. Their intrinsic sensitivity to sub-eV energy depositions makes them particularly attractive for rare-event searches.

Using the SNSPD as target and sensor simultaneously, we report the first results of the QROCODILE experiment, which employs a microwire-based SNSPD for rare-event detection. The detector is based on a $W_{45}Si_{55}$ thin film with an active area of 600 × 600 μm$^2$ and 1 μm wire width, optimized for an increased effective volume while maintaining high internal detection efficiency (IDE). In this work, we demonstrate saturation of the count rate for 11-μm photons, corresponding to an energy threshold of 0.11eV, indicating near-unity IDE in the mid-infrared regime.

The thin-layer geometry of the SNSPD modifies the electronic response function anisotropically, enabling the possibility of directional sensitivity to dark matter interactions, depending on the achieved threshold. This feature could position SNSPD-based detectors as scalable platforms capable of discriminating between signal and background through directional information. Conducting an ongoing experiment in an underground facility could provide valuable insights into mitigating and understanding unwanted background noise, ultimately improving the precision of dark matter detection.

During a 415-hour dark count science run at 100mK, we recorded 15 unique, non-periodic events, corresponding to a count rate of $10^{-5}$ cps. Using this exposure, we set new boundaries on sub-MeV dark matter which scatters on electrons as a function of the dark matter mass. Furthermore, we can provide new bounds on DM absorption in SNSPDs for a relic dark photon for 112 meV.

## References

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