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High-Efficiency Superconducting Single Photon Detectors for Quantum Information Processing

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Superconducting single-photon detectors have become the preferred technology for applications that require high detection efficiency, ultrafast timing performance and low noise for wide spectral sensitivity spanning UV to IR spectrum. The wide range of applications such as fundamental tests of quantum mechanics, fluorescence microscopy, optical communication and quantum computing, also requires various performance benchmarks which cannot be achieved in one single optimized detector. As a result, different technologies have been pursued with the goal of developing the ideal detector for specific applications. In our group, we have focused on two superconducting single-photon detectors: superconducting nanowire single-photon detectors (SNSPDs) and transition-edge sensors (TES).
I will review the progress on the development of the single-photon detectors tailored for specific applications, in our group. Materials investigations as well as device design were pursued for detector optimization for different applications such as: fundamental tests of quantum mechanics [1], characterization of optical quantum network components [2], ion trap integration for quantum information processing [3], advanced neuromorphic computing platforms [4], exoplanet spectroscopy and molecular spectroscopy in mid-infrared [5].

[1] Lynden K. Shalm et al. Phys. Rev. Lett. 115, 250402 (2015)
[2] Gerrits, T., et al., Optics Express, 2018. 26(12): p. 15519-15527.; Levine, Z.H., et al., Journal of the Optical Society of America B, 2012. 29(8): p. 2066-2073.
[3] D. H. Slichter et al. Optics Express Vol. 25, Issue 8, pp. 8705-8720 (2017)
[4] J. M. Shainline, et al., Phys. Rev. Applied 7, 034013 (2017)
[5] Li Chen, et al. Optics Express , 26, 14859 (2018)

Less than 5 years of experience since completion of Ph.D

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Student (Ph.D., M.Sc. or B.Sc.)

N

Primary author: Dr LITA, Adriana (NIST)

Co-authors: Dr VERMA, Varun (NIST); Dr GERRITS, Thomas (NIST); Dr MIRIN, Richard (NIST); Dr NAM, Sae Woo (NIST)

Presenter: Dr LITA, Adriana (NIST)

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