

Nanoscale Material and Detector Engineering of SNSPDs

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The growing number of quantum applications necessitates the optimization and customization of SNSPDs for specific experimental and industrial implementations. Key performance parameters include spectral range, detection efficiency, timing characteristics, noise levels, and optical coupling efficiency, among others. Of all the cryogenic and electronic components, the detector is the most crucial part in determining the overall performance and operational limits of the detection system.

Several strategies may be employed to meet these requirements, including optimization of thin-film deposition, the design and simulation of detector architectures, and the modification of detector properties through the introduction of defects and dislocations at the atomic scale. In my talk, I will explain several of these techniques for practical applications of SNSPDs based on NbTiN, WSi and MgB₂ films. I will demonstrate that the selection of an appropriate thin-film stoichiometry and substrate, combined with an optimized detector geometry, may lead to new solutions in quantum sensing.