Investigating Photon Bunching in STM-Induced Light

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Abstract
Quantum light sources (QLS) are essential building blocks for future quantum technologies [1]. These sources are characterized by non-classical photon statistics, which can be investigated by measuring the second-order photon correlation function, $g^{(2)}(\tau)$. Over the past decades, this approach has enabled the identification of single-photon emitters ($g^{(2)}(0) < 0.5$) in solid-state and molecular systems, as well as the detection of superbunched light emitters ($g^{(2)}(0) > 2$) [2,3]. Metallic tip–surface tunnel junctions have been shown to emit photon bunches with $g^{(2)}(0)$ values as high as 70. Interestingly, these photon pairs appear to originate from individual tunneling electrons ($1e^- \rightarrow 2\gamma$ processes) [4]. In this work, we study the properties of these photon bunches generated in metallic junctions by combining light emission induced in a Scanning Tunneling Microscope (STM) with Hanbury Brown–Twiss (HBT) interferometry. We investigate the energy of the bunched photons, their emission directions, their dependence on the applied bias voltage, and consider the possibility of higher-order processes.

References

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