Using Two-Mode-Squeezing for Room-Temperature Photon-Number-Resolving Detection

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The purpose of this project is to determine whether two-mode squeezing (TMS) can be used for photon-number-resolving detectors (PNRDs) to generate an accurate photon count. We envisioned the setup to include a two-mode squeezer with a coincidence counter connecting the output modes, where the input contains a Fock state and a coherent state. We used Mathematica to calculate the average coincidence count and the error in the coincidence count for this setup for various Fock states and coherent states to observe the change in signal. We compared these calculations to those of a Fock-state-vacuum-state ($|n, 0\rangle$) input. We found that the Fock-state-coherent-state ($|n, \alpha\rangle$) setup produced far more distinctive signals than the $|n, 0\rangle$ setup for both the average coincidence count and the error in the coincidence count. This finding indicates that our proposed PNRD setup would be able to detect different Fock states more than a PNRD setup that did not use two-mode squeezing. In the future we hope to study the signals in a similar PNRD setup with an input of two coherent states and to compare the accuracy and efficiency of our PNRD setup to those of the superconducting-nanowire setup. Once these studies are done we will try to build this setup to experimentally verify our results.

Awards Won:

National Security Agency Research Directorate : Second Place Award "Science Security" of $1,000

Fourth Award of $500