Abstract Submitted
for the DAMOP13 Meeting of
The American Physical Society

Multi-photon interference and quantum optical interferometry

RICHARD BIRRITTELLA, JIHANE MIMIH, CHRISTOPHER GERRY, Lehman College, The City University of New York — We study multi-photon quantum interference effects at a beam splitter and its connection to the prospect of attaining interferometic phase shift measurements with noise levels below the standard quantum limit. Specifically, we consider the mixing of the most classical states of light, coherent states, with the most non-classical states of light, number states, at a 50:50 beam splitter. Multi-photon quantum interference effects from mixing photon number states of small photon numbers with coherent states of arbitrary amplitudes are dramatic even at the level of a single photon. For input vacuum and coherent states, the joint photon number distribution after the beam splitter is unimodal, a product of Poisson distributions for each of the output modes, but with the input of a single photon, the original distribution is symmetrically bifurcated into a bimodal distribution. With a two-photon number state mixed with a coherent state a tri-modal distribution is obtained, etc. The obtained distributions are shown to be structured so as to be conducive for approaching Heisenberg-limited sensitivities in photon number parity based interferometry. We show that mixing a coherent state with even a single photon results in a significant reduction in noise over that of the shot-noise limit. Based on the results of mixing coherent light with single photons, we consider the mixing coherent light with the squeezed vacuum and the squeezed one-photon states and find the latter yields higher sensitivity in phase-shift measurements for the same squeeze parameter owing to the absence of the vacuum state.

Christopher Gerry
Lehman College, The City University of New York

Date submitted: 25 Jan 2013 Electronic form version 1.4