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Can Two-photon Correlation of Chaotic Light Be Considered as Correlation of Intensity Fluctuations?[1] GIULIANO SCARCELLI, VINCENZO BERARDI, YANHUA SHIH, University of Maryland, Baltimore County — Unlike first-order correlation, which is considered as a coherent effect of the electromagnetic field, the second-order correlation of radiation is considered as the classical statistical correlation of intensity fluctuations. The first second-order correlation experiment was demonstrated by Hanbury Brown and Twiss (HBT) stimulating a debate about the classical or quantum nature of the phenomenon. Although quantum models of HBT experiment have been attempted, the classical statistical interpretation has been widely accepted. The concept of intensity fluctuation has even been extended to quantum models: "photon bunching" is a phenomenological extension to quantum theory of the statistical correlation on photon number fluctuations. We argue that two-photon correlation phenomena, including HBT, have to be understood as a two-photon coherent effect: quantum interference between two-photon probability amplitudes. To do so, we present a "ghost" imaging experiment of chaotic light to show that the classical understanding in terms of intensity fluctuations does not give a correct interpretation for the observation. From a practical point of view, this experiment shows the possibility of having high contrast lensless two- photon imaging with chaotic light, suggesting imaging applications for radiations for which no effective lens is available.

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Giuliano Scarcelli
University of Maryland, Baltimore County

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