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Polarization correlations of entangled and classical two-photon states

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Two-photon maximally entangled states or so called Bell states are the most popular objects for the study of quantum entanglement, which is the most fascinating feature of micro world. Most commonly, the tests of the entanglement are performed by measuring the polarization correlations of the corresponding photons. Such correlation has a specific behavior expressed by cosine function with some normalizing amplitude. Generally, this behavior is assigned as a feature inherent to quantum systems. Nevertheless, simple theoretical considerations and Monte Carlo simulation of classical systems reveal that similar cosine-like polarization correlations are observed also for separable photons with correlated polarizations. As the same time, the amplitude of the correlation for classical systems is a factor of 2 smaller comparing to that for quantum entangled two-photon states. These results stress the necessity of the accurate measurement of the polarimeters efficiencies. It is especially important for the study of the entangled annihilation photons through the Compton scattering, since the analyzing power of corresponding Compton polarimeters is inherently small and results in low amplitude of polarization correlations.

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