Quantum Physics

Generalized structure of higher order nonclassicality

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A generalized notion of higher order nonclassicality (in terms of higher order moments) is introduced. Under this generalized framework of higher order nonclassicality, conditions of higher order squeezing and higher order subpoissonian photon statistics are derived. A simpler form of the Hong-Mandel higher order squeezing criterion is derived under this framework by using an operator ordering theorem introduced by us in [J. Phys. A. 33 (2000) 5607]. It is also generalized for multi-photon Bose operators of Brandt and Greenberg. Similarly, condition for higher order subpoissonian photon statistics is derived by normal ordering of higher powers of number operator. Further, with the help of simple density matrices, it is shown that the higher order antibunching (HOA) and higher order subpoissonian photon statistics (HOSPS) are not the manifestation of the same phenomenon and consequently it is incorrect to use the condition of HOA as a test of HOSPS. It is also shown that the HOA and HOSPS may exist even in absence of the corresponding lower order phenomenon. Binomial state, nonlinear first order excited squeezed state (NLESS) and nonlinear vacuum squeezed state (NLVSS) are used as examples of quantum state and it is shown that these states may show higher order nonclssical characteristics. It is observed that the Binomial state which is always antibunched, is not always higher order squeezed and NLVSS which shows higher order squeezing does not show HOSPS and HOA. The opposite is observed in NLESS and consequently it is established that the HOSPS and HOS are two independent signatures of higher order nonclassicality

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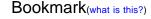
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