Title:	Wehrl-entropy-based quantification of nonclassicality for single-mode quantum optical states
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Abstract:	Nonclassical states of a quantized light are described in terms of Glauber–Sudarshan distribution, which is not a genuine classical probability distribution. Despite several attempts, defining a uniform measure of nonclassicality (NC) for the single-mode quantum states of light remains an open task. In our previous work Bose and Sanjay Kumar (2017 Phys. Rev. A 95 012330), we have shown that the existing well-known measures fail to quantify the NC of single-mode states that are generated under multiple NC-inducing operations. In this paper, we propose a new quantification of NC for the single-mode quantum states as the difference between the total Wehrl entropy of the state and the maximum Wehrl entropy arising due to its classical characteristics. The classical reference state is chosen at the same randomness, given by the von-Neumann entropy, as the state itself. We further suggest operational interpretation of the proposed measure in terms of phase-space sampling entropy, as well as potential to generate entanglement in the case of pure states. We obtain analytic expressions of NC for pure states and Gaussian mixed states. We show that, along with the states generated under single NC-inducing operations as well as the broader class of states that are generated under multiple NC-inducing operations, our quantification enumerates the NC consistently. However, the evaluation of NC for the non-Gaussian mixed states is subject to extensive numerical computation that lies beyond the scope of the current work. We finally conclude with certain open questions.
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