Abstract

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Bell's inequality is investigated in $\mathcal{PT}$-symmetric quantum mechanics, using a recently developed and more straightforward form of the inequality by Maccone [Am. J. Phys. 81, 854 (2013)], with two $\mathcal{PT}$-symmetric qubits in the unbroken phase. It is shown that the inequality produces a bound that is consistent with the standard quantum mechanics, and therefore, further it implies that entanglement invariance is not violated in the $\mathcal{PT}$-symmetric formulation of quantum mechanics and the no-signaling principle for a two-qubit system in $\mathcal{PT}$-symmetric quantum theory is preserved. Consequently, it becomes clear that Bell's inequality is an exceptionally powerful tool as the bound obtained is independent of the internal intricacies of the theory except for the assumptions of locality and realism. To enforce our understanding of the broken $\mathcal{PT}$ symmetric case, we study different types of inner product structures in the regimes of frame theory, i.e., by using the concept of bi-orthogonality and recently developed form of the inner product in pseudo-Hermitian systems [J. Math. Phys. 51, 042103 (2010)].