Quantum Steering and CHSH-type Nonlocality of Quantum Vortex State Under Thermal Environment

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Quantum key distribution (QKD), which allows for the creation of a secret key between authorised partners connected by a quantum channel and a classical authenticated channel, is one of the most important applications of quantum information processing. QKD can be performed with both discrete and continuous-variable systems and can be divided into three basic categories, (i) standard QKD (S-QKD), (ii) one-sided device independent QKD (1SDI-QKD) and (iii) device independent QKD (DI-QKD), according to different security conditions and different degrees of quantum correlations required. The 1SDI-QKD, in particular, requires one trustful apparatus and quantum correlations at the level of Einstein-Podolsky-Rosen (EPR) steering [1]. Cavalcanti et al. [2] derived a necessary and sufficient condition for the demonstration of quantum steering. The correlations in quantum steering is more robust against environmental noise than the ones in the CHSH inequalities and its loophole-free detection is feasible with present-day technology. We study violations of quantum steering and CHSH inequalities for quantum vortex state, a non-Gaussian state, and their robustness against thermal environment using Wigner function approach. We find more robustness of quantum steering as compared to that of CHSH inequalities under thermal environment for some conditions.

References:

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