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# A Nonlocal Quantum Many-Body Wave Equation 非定域量子多体波动方程

Quantum entanglement and its formation mechanism, a topic of debate for 90 years, continue to plague the theoretical physics community and remain unresolved. Physical experiments have shown that quantum behavior does not adhere to Newton's laws and violates Bell's inequality. Its violation directly reveals the nonlocal nature of quantum mechanics. The results necessitate the definition of a nonlocal momentum force in complex quantum systems, the discovery of a nonlocal quantum many-body wave equation, and the revelation of the underlying mechanisms of non-Gauss distribution in complex quantum entanglement. However, finding a nonlocal quantum many-body wave equation and a unified paradigm with the Schrödinger wave equation is challenging since an open quantum many-body system is typically complex. From the perspective of complex systems sciences, the authors define that the momentum force in one-dimensional nonlocal quantum systems is a cumulative observable in a time interval, find a nonlocal quantum many-body wave equation, and obtain two sets of explicit non-Gauss distributions or wave functions over a sensitive variable and their formations written by explicit mathematical expressions, consistent with experimental results. The study has the testable interpretation of the underlying mechanism of interactively coherent entanglement. It is predicted that interactively coherent entanglement has higher fidelity and stronger decoherent resistance than superposition entanglement and the ability to self-repair, making it a high-quality entangled resource. It will provide a theoretical criterion and technical guidance for the industrial production of high-quality entangled resources.
Keywords: Nonlocal quantum many-body, complex systems, interactively coherent entanglement criterion, Bessel distribution entanglement
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围绕量子纠缠的争论已经持续了 90 年，其形成机制至今还困扰着理论物理学界。物理实验揭示了量子行为偏离牛顿定律的预测，确认了量子的贝尔不等式违背和非定域性。因此，量子力学需要定义量子系统的非定域动量力，建立非定域量子多体波动方程，揭示复杂量子纠缠非高斯分布形成的底层机制。然而，开放的量子多体系统是典型的复杂系统，发现非定域量子多体波动方程并且建立它与薛定谔波动方程的统一范式面临着许多挑战。本文从复杂系统科学的角度出发，定义了一维非定域量子系统的动量力是单位时间内的累计观测量，发现了非定域量子多体波动方程，得到了两组与实验结果一致的累计观测量强度在敏感变量区间的非高斯分布波函数和形成机制的数学表达式，从而提出了可检验的相互作用相干纠缠形成机制。由此预测，它比叠加纠缠态保真度高，抗退相干能力强，且具有自我修复能力，是一种高质量的纠缠态资源，可为产业化生产高质量纠缠资源提供理论判据和技术指引。
关键词: 非定域量子多体，复杂系统，相互作用相干纠缠判据，贝塞尔分布纠缠

**Primary authors:** SHI 石, Leilei 磊磊 (1) University of Science and Technology of China, School of Management; 2) Beijing YourenXiantan Science & Technology Co., Ltd. ); GUO 郭, Xinshuai 新帅 (University of Science and Technology of China, School of Management); WEI 魏, Jiuchang 玖长 (University of Science and Technology of China, School of Management); ZHANG 张, Wei 伟 (Beijing YourenXiantan Science & Technology Co., Ltd.); WANG 汪, Bing-Hong 秉宏 (University of Science and Technology of China, Department of Modern Physics )

**Presenter:** SHI 石, Leilei 磊磊 (1) University of Science and Technology of China, School of Management; 2) Beijing YourenXiantan Science & Technology Co., Ltd. )

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