世纪物理情·系列讲座

Quantum information processing based on bosonic modes

【摘要】

Quantum error correction (QEC) is essential for the practical implementation of a quantum computer due to the unavoidable interaction of quantum systems with the surrounding environment. The utilization of bosonic modes for encoding quantum information in QEC has attracted significant attention due to its hardware efficiency. This approach leverages the infinite-dimensional Hilbert space of a harmonic oscillator for encoding redundant information, requiring monitoring of only one error syndrome. Furthermore, bosonic modes serve as fundamental and versatile physical systems that can readily interface with a variety of other systems. As a result, they also find widespread applications in quantum communication, quantum simulation, and quantum metrology. In this talk, I will outline our experimental advancements in QEC utilizing bosonic codes, including surpassing the break-even point of QEC and protecting entanglement between two bosonic logical qubits through QEC. Additionally, I will discuss our research on quantum metrology utilizing bosonic modes, showcasing the potential of these systems in precision measurements and sensing applications.



Dr. Luyan Sun earned his Ph.D. from the University of Maryland, College Park, in

【报告人】 孙麓岩 清华大学交叉信息研究院

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2008. He then joined Yale University as a postdoctoral researcher, focusing on quantum computation utilizing superconducting circuits. Since September 2013, Dr. Sun has been conducting research at the Institute for Interdisciplinary Information Sciences at Tsinghua University, where he leads his own laboratory dedicated to superconducting quantum computation. His research interests include quantum error correction, quantum control, quantum machine learning, and quantum metrology. In 2019, he was selected to "The National Science Fund for Distinguished Young Scholars". Currently, he undertakes the Key Program from the National Natural Science Foundation of China, National Key Research and Development Program of China, and Innovation Program for Quantum Science and Technology.