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信息科学

100 km量子纠缠分发实验捕获跟踪技术

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摘要： 介绍了100 km量子纠缠分发实验中的捕获跟踪瞄准（ATP）技术。以Alice接收端的700 mm望远镜为例分析了ATP系统的技术指标、光路布局和高带宽跟踪精度的实现方法。为了抑制近地面水平大气湍流引起的量子信息传输光束和信标光束的到达角起伏， 在经典复合轴跟踪模式的基础上，设计了具有粗跟踪、精跟踪和超精跟踪功能的双重复合轴跟踪系统和双快速控制反射镜融合的跟踪算法，用高帧频CMOS探测器和压电快速控制反射镜构建了超精跟踪回路。采用这些方法有效解决了跟踪动态范围和跟踪精度之间的矛盾，更好地发挥了高帧频探测器的性能，提高了抑制带宽和跟踪精度。将该双重复合轴跟踪系统成功应用于100 km量子纠缠分发实验，结果显示捕获跟踪系统的跟踪精度为4 μrad，抑制带宽达到了70 Hz。

关键词： 量子通信 量子纠缠分发 捕获跟踪瞄准

ATP technology for 100-kilometer Quantum Entanglement Distribution Experiment

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Abstract: Acquiring， tracking and pointing(ATP) technique in a 100 km quantum entanglement distribution experiment was introduced in detail. By taking a 700 mm telescope at Alice receiving terminal as an example, the technological specification, light path layout, and tracking accuracy of the ATP system were analyzed. In order to reduce the angle-of-arrival fluctuations of quantum information transmission beams and beacon beams caused by air turbulence, a cascade acquisition and tracking system with coarse tracking, fine tracking and a ultra-fine loop was designed and a dual fast-steering mirror tracking algorithm was proposed. On the basis of a higher frame frequency CMOS detector and a piezoelectric fast -steering mirror, the ultra-fine tracking circuit was developed. Experiments show that these methods solve the contradiction between tracking dynamic range and tracking accuracy, promote the performance of the detector and improve band width and tracking accuracy. The system was used in a ground 100 km quantum entanglement distribution experiment and the results indicate that the tracking error of the system is 4 μrad for a 70 Hz bandwidth.

Keywords: Quantum communication Quantum entanglement distribution Acquiring tracking and pointing

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