

QUANTUM COMMUNICATION: HARNESSING ENTANGLEMENT FOR UNBREAKABLE INFORMATION TRANSFER

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Introduction. The field of quantum communication represents a fundamental shift in the way information is transmitted and secured. Classical communication systems, relying on classical bits, are vulnerable to eavesdropping due to their deterministic nature. Quantum communication, based on the principles of quantum mechanics, employs qubits and entanglement to provide a novel approach to secure information transfer. This paper explores the foundational concepts, recent developments, and future prospects of quantum communication.

Quantum Key Distribution. A pivotal utility within the realm of quantum communication is Quantum Key Distribution (QKD), a concept initially formulated by Bennett and Brassard in 1984 [1]. QKD capitalizes on the unique attributes of quantum states to establish a secure key shared between two communicating parties. This cryptographic key serves the dual purpose of encoding and decoding messages, rendering any surreptitious interception unmistakably conspicuous.

Entanglement in Quantum Communication. Entanglement, a phenomenon that gained fame through the exposition by Einstein, Podolsky, and Rosen in their 1935 publication [2], assumes a pivotal role in the domain of quantum communication. Entangled qubits exhibit an intricate correlation, where any measurement performed on one qubit instantaneously influences its entangled counterpart, irrespective of the spatial separation between them. This distinctive property is skillfully employed to identify any covert surveillance in Quantum Key Distribution (QKD) systems, thus fortifying the security of the communication channel.

Recent Advancements, Challenges and Future Directions. In recent times, quantum communication has experienced substantial progress. Remarkable breakthroughs encompass the deployment of satellite-based quantum communication systems to ensure global, secure information exchange [3], alongside the creation of pragmatic Quantum Key Distribution (QKD) devices tailored for real-world use [4]. These strides serve to propel quantum communication further toward its practical and extensive realization.

While quantum communication has made notable headway, it is not without its lingering hurdles. These encompass the necessity for innovating quantum repeater technologies, which are instrumental in augmenting the reach of quantum communication. Additionally, the mitigation of environmental interference in quantum channels remains a formidable challenge. Moreover, there exists a pressing demand for standardization and the enhancement of interoperability within quantum protocols. Continuous research endeavors persist in tackling these issues and propelling the field forward [5].

Conclusion. Quantum communication represents a paradigm shift in secure information transfer, with quantum entanglement at its core. Recent advancements

have brought the field closer to practical implementation, but challenges remain. As we move forward, it is crucial to address these challenges to unlock the full potential of quantum communication and revolutionize the way we transmit and secure information.

References

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INVESTIGATION OF THE PARAMETERS OF THE OUTPUT RESPONSE OF THE PORTABLE OPTICAL COMMUNICATION SYSTEM WITH SQUARE AND CIRCULAR APERTURE OF THE LIGHT BEAM

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The most important achievements of radio electronics in the modern world are the modern radio technical systems used for signal processing and distinguished by their high complexity [1-3]. Today, research aimed at solving various problems arising during data processing and using the results of other fields of science, as well as acousto-optics, has high scientific and practical importance. In the context of the transmission of large data arrays, the relevance of the synthesis of modern technical equipment complexes, as well as of atmospheric portable optical communication systems working on the "point-to-point" principle, the development of necessary methods and tools, and the study of their operational and technical characteristics is in the focus of attention.

The portable optical communication system presented for discussion belongs to a complex of technical tools. In practice, the effect of the shapes of apertures of laser radiation sources applied to the work of optical communication systems has been proven. The results of theoretical and experimental studies conducted on the study of the parameters of the output response of the portable optical communication system with a square and circular aperture of the light beam show that the shape of the laser beam has a serious effect on the output response of the system.

It is noted that the classical application time of portable optical communication system is used when the duration of the pulse exceeds the time of intersection with the