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研究成果報告書

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無条件安全通信による次世代セキュア通信環境の開発

Development of next-generation secure communication environment with unconditional secure communication

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Abstract

In this study, we will develop technologies to enable quantum communication and cloud quantum computing through the development of long-distance quantum network system. This will lead to a blind quantum computing network that combines the advantages of quantum communication and quantum computing to ensure the unconditional security of the Internet and classified information communication networks to protect the confidentiality of the users of such networks.

To achieve the above goals, we have developed the following element technologies.

1) a quantum entangled photon source that efficiently couples with a quantum memory,

2) wavelength conversion system that links an entangled photon source and quantum memory,

3) frequency stabilization technology that links an entangled photon source and quantum memory,

4) a quantum memory for multiplexed communication,

The first is the development of a quantum entangled photon source with quantum correlation, which is indispensable for long-distance communications, and a narrow linewidth (<10 MHz) is necessary for highly efficient coupling of the source and quantum memory. 2nd is necessary since entangled photon and quantum memory generally lie at different wavelengths, so an interface technology, wavelength conversion technology, was needed to connect them. 3) To connect a quantum memory with a narrow linewidth and a quantum entangled photon source, it is necessary to develop a frequency stabilization technology to implement a high frequency stability over a long period of time. 4 is the development of rare earth-doped crystals as quantum memory, which can be used for quantum communications. In this study, the above four elemental technologies were developed with the following specifications: 1. quantum entangled photon source (linewidth of 1 MHz or less), 2. wavelength conversion efficiency of 60%, 3. frequency stability (kHz), 4. quantum memory (wavelength multiplexing of 25). These were integrated and coupled through a 10 km optical fiber transmission.