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VENTURES AND LICENSING

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UIRF Case Patent Filings: Teleportation System for Electronic Many-Qubit States Using Individual Photons
US7667995

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Quantum Teleportation by Qubit-Photon-Qubit Entanglement

A teleportation concept which requires only single-photon measurements for teleporting many-qubit entangled states.

Technology Primer:

Quantum computing devices hold the promise of greater computational power and exponential growth in processing speed. Quantum computing technology, which originated in the 1980s and remained a theory throughout the 1990s, was first demonstrated in practice in 2007 in the form of a quantum computing processor. Quantum teleportation is one of the key enabling elements in a quantum computer. In traditional computing technology, information is processed in bits controlled by the switching function (on: 1, off: 0). A quantum computer processor, however, uses qubits (quantum bits), which contain the quantum mechanical information of particles, thus increasing the processorï¿½s capabilities. Quantum teleportation, once achieved, provides the means of transmitting qubits from origin to destination, which is the vital part of the information processing operation carried out in quantum computers.

Technology Benefit:

ELECTRONIC SPIN-PHOTON POLARIZATION ENTANGLEMENT. When a photon is entangled with two qubits to form a Greenberger-Horne-Zeilinger (GHZ) state, teleportation by measurements on a single photon is achieved without requiring intermediate electronic qubits. This teleportation scheme also provides the means of exchanging information between spintronic and photonic quantum information processing devices.

UTILIZES QUBITS IN QUANTUM DOT SYSTEM. This arrangement can be applied to teleportation of many qubits since the quantum dot system can include many quantum states in the arrays of microcavities.

QDRAM (QUANTUM DYNAMIC RAM). Since the link between spintronic and quantum information devices can be established, electronic spin information can be transferred to and from photon states. Storing spin information as photonic information gives the ability to control the time of teleportation of qubits and increases the distance of teleportation since photons generally have much longer decoherence times than electronic spins.

Technology Description:

Researchers at the University of Iowa have developed a teleportation concept that relies only on single-photon measurements and can be composed of only two qubits and a photon. This simple composition separates this concept from more conventional methods, which require both the generation of an entangled two-photon pair in a known quantum state and the measurements of one member of this pair along with the photonic qubit at the origin. This requires a three-particle or -qubit arrangement - the origin, destination, and an intermediate quibit entangled only with the destination qubit. This new methodology utilizes the Greenberger-Horne-Zeilinger (GHZ) state of the qubit-photon-qubit Hilbert space to entangle a single photon with each of the qubits at the origin and destination. In this scenario, the photon first interacts with the destination qubit contained in microcavities of a quantum dot system, establishing a spin-photon entanglement naturally by conditional Faraday rotation. When the photon is allowed to interact with the origin qubit, a GHZ state in the hybrid spin-phton-spin system is achieved. By measuring the photon polarization resulting from the entanglement with both qubits and the spin orientation of the origin qubit, the spin orientation of the origin qubit can now be reconstructed at the destination and the teleportation of a qubit via a single photon is complete.

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Complementary Technologies:
04004 - Semiconductor Spintronic Transistor and Spin Resonant Tunn...
03055 - Spintronic Magnetic Bipolar Semiconductor Transistor
00083 - Unipolar Semiconductor Spintronic Devices

Category: Engineering & Physical Science
Primary Sub-Category: Physics
Secondary Sub-Categories:
MEMS
Hardware Systems