Diamond Spin Qubits for Quantum Communication and Computing

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A nitrogen vacancy (NV) center in diamond is a promising platform for both quantum communication and computation. We are challenging to build a quantum repeater to extend the distance of quantum communication networks (Fig. 1) [1-3], and a quantum interface or quantum transducer to scale up quantum computers by connecting superconducting qubits with an optical photon [4,5]. In this talk, I present the following recent research topics towards these applications. First, I show optically addressable universal holonomic quantum gates on diamond spins, which enables high fidelity Q-RAM [6]. Then, I show deterministic Bell state measurement with a single quantum memory, which enables scaling up the quantum repeater with only nitrogen spin quantum memories [7]. Finally, I show coherent electric field control of orbital state of a neutral nitrogen vacancy center, which enables highly efficient quantum transducers interfacing microwave photons and optical photons to scale-up superconducting quantum computers [8].

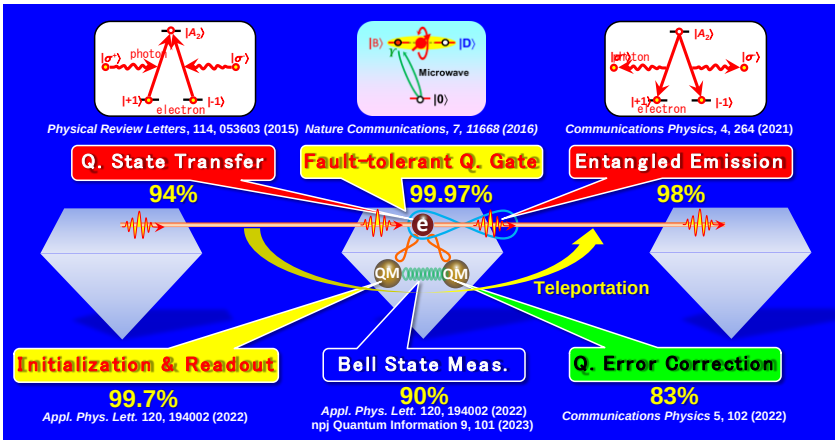

Fig.1. Basic elements for quantum repeater with a diamond NV center.

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