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1) Title of the presentation: Deterministic measurement of a nuclear spin in diamond under a zero field

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3. Presentation type (please, check where it applies)

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Deterministic measurement of a nuclear spin in diamond under a zero field

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Quantum repeaters, which enables long-distance quantum communications, require complete Bell measurement with extremely high fidelity for the entanglement swapping or the quantum teleportation [1]. However, it is impossible to measure a quantum state deterministically by itself. We thus devised a technique of the QND-like read out, which allows to measure the quantum state repeatedly.

We demonstrate the deterministic measurement of the quantum state of a nuclear spin in a nitrogen vacancy (NV) center in diamond under a zero field [2,3]. We were able to measure the nuclear spin of the target ^{14}N impurity atom by repeatedly measuring the spin state of the entangled ancillary electron (Fig. 1). After preparing the nuclear spin into the m_I=0 state, we observed 5.2 photons on average over 96-time repeated optical readouts of the electron spin in the m_S=0 state. It showed clear separation in the count distribution depending on the m_I state (bars in Fig.2), indicating that we can perform the deterministic measurement to distinguish the nuclear spin state whether m_I=0 or ± 1 with a fidelity of 93% in average (line in Fig.2) even under a zero field, which is ideal for our quantum repeater scheme.

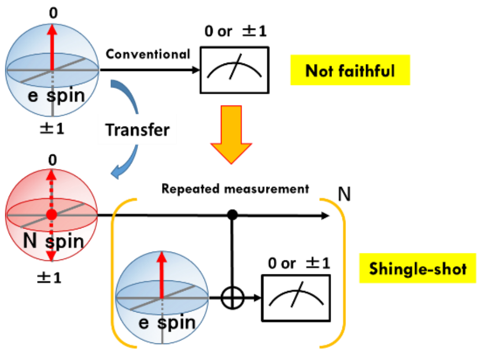

Fig.1 Quantum circuit for the conventional (upper) and the deterministic (lower) measurements.

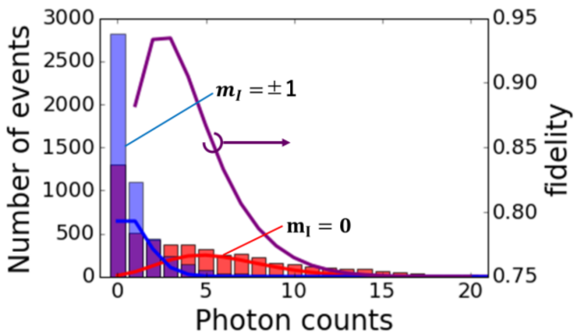

Fig.2 The distribution of the photon counts and the corresponding fidelity to distinguish the nuclear spin state.

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