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Error Correction I

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Abstract

The ability to correct for bit-flip and phase flip qubit errors and simultaneously preserve quantum states is an essential step on the way to a reliable quantum computer. This talk is based on a recent experiment in this field [J. Kelly et al., *State preservation by repetitive error detection in a superconducting quantum circuit*, Nature 519, 66-69 (2015)]. We first provide an insight into both classical and quantum error correction. Subsequently a procedure is presented where a logical bit is mapped onto a group of physical qubits. A series of repeated parity measurements between neighboring qubits is used to detect bit-flip errors without destroying the quantum state. If two consecutive measurements vary, a detection event is registered. Based on the resulting pattern of such detection events a classical algorithm eventually decides which qubits are likely to have flipped and corrects them accordingly. Experimental results show that hereby quantum states are preserved and that the reliability of the system increases with the number of physical qubits representing a logical bit.