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Quantum Error Correction with Mixed State Ancilla Qubits[1]
MIKIO NAKAHARA, YASUSHI KONDO, CHIARA BAGNASCO, Department of Physics, Kinki University — It is commonly assumed that ancilla qubits must be in a pure state for successful quantum error correction. We show in our talk that they can initially be in any mixed state if the error operator acts simultaneously on all the physical qubits (fully correlated noise). In particular, they can be in the uniformly mixed state, which makes implementation of our scheme extremely cheap. We also note that 1-qubit gate operations can be implemented easily within the codeword. We experimentally demonstrated our scheme by using a liquid state NMR quantum computer. The encoded state has an interesting nature in terms of quantum discord, which is purely quantum correlations between the data qubit and the ancilla qubits.

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