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Yuichiro Fujiwara* (yfujiwar@mtu.edu), 1400 Townsend Drive, Houghton, MI 49931. *A combinatorial approach to entanglement-assisted quantum low-density parity-check codes.*

The entanglement-assisted stabilizer formalism is a generalized form of the stabilizer formalism for quantum error correction. This framework makes it possible to import any binary or quaternary linear codes into the quantum domain by exploiting pairs of qubits in a maximally entangled state (or ebits). Low-density parity-check (LDPC) codes are among the best known classical error-correcting codes in terms of error correction performance and decoding complexity and can also be imported into the quantum domain in a simple manner through the entanglement-assisted stabilizer formalism. Because excessive reliance on ebits can be an obstacle for implementation, it is desirable to use fewer ebits while keeping high error correction ability. We present necessary and sufficient conditions for the existence of quantum LDPC codes consuming only one ebit with the largest possible girth which are obtainable from pairs of identical LDPC codes, and give explicit constructions based on finite geometry. We also show relations of entanglement-assisted quantum LDPC codes to some fundamental classes of combinatorial designs. (Received December 10, 2011)