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Quantum codes with low weight stabilizers[1] ALEXEY A. KOVALEV, Department of Physics & Astronomy, University of California, Riverside, California 92521, USA, ILYA DUMER, Department of Electrical Engineering, University of California, Riverside, California 92521, USA, LEONID P. PRYADKO, Department of Physics & Astronomy, University of California, Riverside, California 92521, USA — We study quantum cyclic stabilizer codes whose stabilizer can be always defined by one or two stabilizer generators. Our main goal is to construct low-weight stabilizer generators that can yield quantum codes with high code rate and simple error correction. To do so, we apply the classical quaternary representation of stabilizer codes and extend our recent study of one-generator cyclic codes [1]. For any stabilizer generator of weight four or five, we formulate a necessary and sufficient condition for its commutativity. We then proceed with a design of additive cyclic codes with such generators. In some cases, we also extend our commutativity condition and code design to generators of weight six. In particular, quantum cyclic codes with stabilizers of weight four are mapped to the generalized toric codes. Here we also extend the notion of toric codes using a translationally invariant generator and periodic boundary conditions on a two dimensional lattice. Some of our numerically constructed codes can be redefined by means of Code Word Stabilized (CWS) representation [1] as quantum versions of repetition codes. We particularly concentrate on codes with a fixed nonzero rate for which the minimum distance asymptotically grows as the blocklength grows.

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Alexey A. Kovalev
Department of Physics & Astronomy,
University of California, Riverside, California 92521, USA

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