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J Laser Opt Photonics 2017, 4:3(Suppl)
DOI: 10.4172/2469-410X-C1-015

2nd International Conference on

Quantum Physics and Quantum Technology

September 25-26, 2017 Berlin, Germany

Construction of binary quantum codes on closed orientable surfaces

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In this paper we construct classes of new binary quantum error-correcting codes on closed orientable surfaces. These codes are derived from self-dual orientable embeddings of complete bipartite graphs and complete multipartite graphs on the corresponding closed orientable surfaces. We also show a table comparing the rate of these quantum codes when fixing the minimum distance to 3 and 4. Introduction. One of the essential difficulties in the construction of quantum computers is decoherence of quantum bites caused by interaction between the system and the surrounding environment. Quantum error-correcting codes (QECs) is used to protect quantum information from errors due to decoherence and other quantum noise. The first quantum error-correcting code was proposed by Shor. Calderbank et al. introduced a systematic way for constructing the QECs from classical error-correcting code. The problem of constructing toric quantum codes has motivated considerable interest in the literature. This problem was generalized within the context of surface codes and color codes. The most popular toric code was proposed for the first time by Kitaev's. This code defined on a square lattice of size on the torus. Leslie proposed a new type of sparse CSS quantum error correcting codes based on the homology of hypermaps defined on an square lattice. The parameters of hypermap-homology codes are These codes are more efficient than Kitaev's toric codes. This seemed suggests good quantum that is constructed by using hypergraphs. But there are other surface codes with better parameters than the toric code. There exist surface codes with parameters, called homological quantum codes. These codes were introduced by Bombin and Martin-Delgado. Authors in presented a new class of toric quantum codes with parameters, where. In six classes of topological quantum codes are presented derived from self-dual, quasi self-dual and denser tessellations associated with embeddings of self-dual complete graphs and complete bipartite graphs on compact surfaces. In, Yu et al. presented an explicit construction for all the optimal stabilizer codes of distance that saturates the bound where if or for some integer and otherwise. In two new classes of binary quantum codes with minimum distance of at least three presented by self-complementary self-dual orientable embeddings of voltage graphs and Paley graphs. The aim of this paper is to present two classes of binary quantum codes derived from embeddings of self-dual complete bipartite graphs and complete multipartite graphs on closed orientable surfaces. The codes can correct an arbitrary quantum error and their encoding rate is such that approaches 1 as goes to infinity. Binary quantum codes are defined by pair of -matrices with These codes have parameters , where logical qubits are encoded into physical qubits with minimum distance A minimum distance code can correct all errors up to qubits.

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