Error-Correcting Codes for Quantum Computers (Binary and Quaternary) from Subfield of Subcodes of AG codes and their Parameters

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To compute on modern quantum computers, one needs to correct large numbers of quantum errors. It has been shown that classical codes, such as the Reed-Muller codes, provide families quantum codes which correct multiple quantum errors. To find better-performing quantum error-correcting codes we show that it is possible to use subfield subcodes from algebraic curves in extensions of binary fields. However, it is necessary to prove the required properties of self-orthogonality (of the type Euclidean, Trace, or Hermitian), to yield classes of binary and quaternary codes for quantum error-control.

We present results on the parameters of Binary and Quaternary subfield subcodes of algebraic geometric codes from Hermitian curves, Castle curves, and hyperbolic curves. By way of theorems on our results trace codes, dual codes, and subfield subcodes, we derive the error-correction capabilities for applications to quantum computing.

Keywords: Quantum error-correcting codes, CSS pair, AG codes, Hermitian, Castle curves.