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Generalized Knill–Laflamme theorem for families of isoclinic subspaces

Isoclinic subspaces have been studied for over a century. Quantum error correcting codes were recently shown to define a subclass of families of isoclinic subspaces. The Knill–Laflamme theorem is a seminal result in the theory of quantum error correction, a central topic in quantum information. We show there is a generalized version of the Knill–Laflamme result and conditions that applies to all families of isoclinic subspaces. In the case of quantum stabilizer codes, the expanded conditions are shown to capture logical operators. We apply the general conditions to give a new perspective on a classical subclass of isoclinic subspaces defined by the graphs of anti-commuting unitary operators. We show how the result applies to recently studied mutually unbiased quantum measurements (MUMs), and we give a new construction of such measurements motivated by the approach.