Universal SU(d) holonomic quantum computing with cat-qudits

VICTOR V. ALBERT, Yale Univ, STEFAN I. KRASTANOV, CHAO SHEN, ZAKI LEGHTAS, Yale University, REN-BAO LIU, The Chinese University of Hong Kong, MAZYAR MIRRAHIMI, Yale University, INRIA Paris-Rocquencourt, ROBERT J. SCHOELKOPF, LIANG JIANG, Yale University — We present a holonomic computation scheme with engineered dissipation of a multi-photon process, a generalization of the driven dissipative 2-photon process studied in [1]. The engineered $d$-photon process can stabilize a $d$-dimensional steady state manifold spanned by $d$ coherent states. Universal control is achieved with two types of non-Abelian holonomic gates [2]. The first type consists of adiabatically moving a coherent state around a closed path in phase space, resulting in a relative Berry phase between that state and the other states. The second type consists of adiabatically colliding two coherent states, resulting in a unitary evolution with coherent population transfer between those two components. We outline a way to realize the $d = 2$ case using circuit QED.