Can Majorana zero modes be truly robust against decoherence in topological quantum computation?

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"It is commonly believed that topological quantum computer has the advantage from other quantum computer architectures because it takes Majorana zero modes as the basic building blocks for qubit operations which is robust against decoherence. Although several previous investigations have already questioned such robustness, the methods in solving Majorana decoherence in these previous works contain various approximations. In this lecture, I will discuss our recent work on the decoherence dynamics of Majorana zero modes in the elementary Kitaev model, a one-dimensional p-wave spinless topological superconducting chain (TSC), that is disturbed by gate-induced charge fluctuations. We rigorously show that no matter how low the temperature is, even at zero temperature, and also how big the energy gap has between the zero and non-zero energy states, Majorana zero modes cannot be immune to local charge fluctuations and Majorana amplitude damping always occurs. This may indicate that qubit decoherence in topological quantum computer is inevitable under local perturbations, and topological quantum computer, if it is feasible, will face the similar decoherence problem as any other quantum computer device does today."