# Parametric single-qubit gate protocol for the Majorana-transmon.

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Newly proposed hybrid qubit designs that combine novel solid-state elements with superconducting platforms promise to improve controllability and decrease sensitivity to decoherence mechanisms. Among these, the Majorana transmon [1] employs solid-state nanowires that give rise to localized, topologically-protected Majorana zero modes (MZM). It encodes the quantum information in a basis of fermion parity states originating from an additional hybridization between two MZMs through a Josephson Junction. Inevitably, the additional coupling is done at the expense of maintaining the full topological protection of the MZMs. However, when working in the "Majorana transmon" regime of high Josephson energy and low MZMs' hybridization, the high anharmonicity generated in the energy spectrum and the exponentially suppressed intra-doublet dipole coupling make it a promising tool either for the qubit manipulation and readout [2] or in general for a reliable detection method of the Majorana modes [3]. In this poster, I will present a new protocol for implementing single-qubit gates in the Majorana transmon [4], exploiting the non-linear driving term generated by a parametric modulation of the offset-charge of the system. I will argue that this protocol represents an attractive alternative to microwave control or other gate-based schemes and that it can be experimentally implemented straightforwardly via a time-dependent external gate voltage bias. In addition, I will describe the effects of wide-band 1/f charge noise on both the free and driven evolution, obtaining the system's coherence times and the loss of fidelity, using analytical and numerical methods.

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## References

[1] E. Ginossar and E. Grosfeld, Nat. Commun. 5, 4772 (2014)
[2] K. Yavilberg, E. Ginossar and E. Grosfeld, Phys. Rev. B 92 (7), 075143 (2015)
[3] K. Yavilberg, E. Ginossar, and E. Grosfeld, Phys. Rev. B 100, 241408 (2019)
[4] E. Lupo, E. Grosfeld, E. Ginossar, PRX Quantum (in press)