

Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Berry phase effect on Majorana braiding¹ YINGPING HE, Peking Univ, BAOZONG WANG, University of Science and Technology of China, XIONG-JUN LIU, Peking Univ — Majorana zero modes are predicted to exhibit Non-Abelian braiding, which can be applied to fault-tolerant quantum computation. An essential signature of the non-Abelian braiding is that after a full braiding each of the two Majorana modes under braiding gets a minus sign, namely, a π Berry phase. In this work we find a novel effect in Majorana braiding that during the adiabatic transport a Majorana mode may or may not acquire a staggered minus sign under each step that the Majorana is transported, corresponding to two different types of parameter manipulation. This additional minus sign is shown to be a consequence of translational Berry phase effect, which can qualitatively affect the braiding of Majorana modes. Furthermore, we also study the effect of vortices on the Majorana braiding, with the similar additional Berry phase effect being obtained. Our work may provide new understanding of the non-Abelian statistics of Majorana modes and help improve the experiment setup for quantum computation.

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Date submitted: 11 Nov 2016

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