Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Modulation of the phase in SC order parameter in Kitaev chain and its consequences SHO NAKOSAI, Univ of Tokyo, YUKIO TANAKA, Nagoya Univ, NAOTO NAGAOSA, RIKEN — Kitaev's superconducting chain model, one dimensional spinless p-wave superconductor, is a prototype of topological superconductors and supports Majorana modes at the ends of the system. There have been intensive researches on the model since the role of topology in condensed mater physics is highlighted, and recently not a few experimental results show the model can be effectively generated in designed systems. Anytime soon, we will arrange it as we like. A simple extension of the model is two-parallel-aligned chains. It possesses four Majorana states in total. When we take into account the modulation of the phase in the superconducting order parameter, however, the degeneracy of the energy levels is resolved. We investigate the physical consequence of it. The phase should change along the chain to reduce the total energy of the system, and the deterministic equation for it is in the form of sine-Gordon equation. The distribution of the supercurrent due to the modulation leaves the degeneracy in the ground states. Then we can regard the system as a flux qubit. In the presence of external magnetic field, these modulations will couple with the spontaneous field associated with the phase modulation, and result in control of states and an unusual Josephson effect.

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Date submitted: 14 Nov 2014 Electronic form version 1.4