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Topological liquid nucleation induced by vortex-vortex interactions in Kitaev's honeycomb model VILLE LAHTINEN, Nordita, ANDREAS LUDWIG, University of Santa Barbara, JIANNIS PACHOS, University of Leeds, SIMON TREBST, Station Q — We provide a microscopic understanding of the nucleation of topological quantum liquids for interacting non-Abelian anyons by making an explicit connection between the microscopics of the pairwise interactions - typically showing oscillations in sign, but decaying exponentially with distance - and the nature of the collective many-anyon state. We investigate this issue in the context of Kitaev's honeycomb lattice model, where non-Abelian vortex excitations can be arranged on superlattices. Depending on microscopic parameters such as the vortex-spacing, we observe the nucleation of several distinct Abelian topological phases. By reformulating the collective behavior of the interacting vortex superlattice in terms of an effective lattice model of tunneling Majorana fermion zero modes, we show that the pairwise interactions fully determine the phase diagram of the nucleated phases. We find that due to the oscillations longer-range interactions beyond nearest neighbor can influence the nature of the collective state and thus need to be included for a comprehensive microscopic picture. Correspondind results should hold for vortices forming an Abrikosov lattice in a p-wave superconductor or quasiholes forming a Wigner crystal in non-Abelian quantum Hall states.

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