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Surface Majorana fermions and bulk collective modes in superfluid ^{3}He-B JOSEPH MACIEJKO, University of Alberta, YEJE PARK, Korea Advanced Institute of Science and Technology (KAIST), SUK BUM CHUNG, Seoul National University — The theoretical study of topological superfluids and superconductors has so far been carried out largely as a translation of the theory of noninteracting topological insulators into the superfluid language, whereby one replaces electrons by Bogoliubov quasiparticles and single-particle band Hamiltonians by Bogoliubov-de Gennes Hamiltonians. Band insulators and superfluids are, however, fundamentally different. In particular, unlike the static energy gap of a band insulator, the gap in a superfluid is due to a dynamical order parameter that is subject to both thermal and quantum fluctuations. We explore the consequences of bulk quantum fluctuations of the order parameter in ^{3}He-B on the topologically protected Majorana surface states. We find that one of the three spin-orbit Goldstone modes couples to the surface Majorana fermions, which induces an effective short-range two-body interaction between the Majorana fermions with coupling constant inversely proportional to the strength of the nuclear dipole-dipole interaction. A mean-field theory estimate of the value of this coupling suggests that the surface Majorana fermions in ^{3}He-B are in the vicinity of a quantum phase transition to a gapped time-reversal symmetry breaking phase.

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