Topological Superfluidity of ^{3}He

Takeshi Mizushima

Department of Physics, Okayama University, Okayama 700-8530, Japan

We here clarify the topological superfluidity of ^{3}He-A and -B under a restricted geometry. The topological superfluidity of the B-phase of ^{3}He originates from the hidden Z_2 symmetry, which ensures the existence of Majorana fermions and Ising-like anisotropy of magnetic response at the surface.[1,2] Here, we unveil the direct relation between the Majorana Ising spins and odd-frequency even-parity Cooper pairs through the topological order, where the latter is generated by the breaking of translational symmetry at the surface. In ^{3}He-A, it has been widely believed that half quantum vortices are indispensable to realize topological stable Majorana fermions. Contrary to this wisdom, we here demonstrate that integer quantum vortices can host Majorana fermions protected by the mirror Chern number.[3]

1. T. Mizushima, M. Sato, and K. Machida, Phys. Rev. Lett. **109**, 165301 (2012).
2. T. Mizushima, Phys. Rev. B **86**, 094518 (2012).
3. M. Sato, A. Yamakage, and T. Mizushima, arXiv:1305.7469.