Weekly Seminar

Unusual Aspects of Transport of an Electron Trapped Below a Free Surface of Topological Superfluid ^{3}He

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Time: 4:00pm, Dec. 4, 2013 (Wednesday)
时间： 2013年12月4日（周三）下午4:00
Venue: Room 607, Science Building 5
地点： 理科五号楼607会议室

Abstract

The A and B phases of the p-wave superfluid 3He are topologically nontrivial. The nontrivial topology gives rise to many exotic phenomena at a surface as well as in bulk. In this talk, I will show unusual aspects in transport of an electron (electron bubble) trapped below a free surface of the superfluid 3He, which arise from the nontrivial topology of the superfluid states.

The A phase (3He-A) is a chiral p-wave superfluid with broken time-reversal symmetry. In this phase, the nontrivial topology of the order parameter associated with the orbital angular momentum of Cooper pairs generates the unusual intrinsic Magnus force on an electron moving in 3He-A[1,2]. We discover the intrinsic Magnus force by transport measurements of electrons trapped below a free surface, thanks to the uniform orientation of the order parameter at the surface[3]. This is the first direct detection of chirality in 3He-A. I also show chiral symmetry breaking and discuss formation of single and multiple chiral domains.

In the B phase (3He-B), which is a time-reversal invariant topological superfluid, the nontrivial topology of the bulk generates surface Andreev bound states (SABSs) at a surface. The SABSs should show unusual Majorana nature; their antiparticle is identical to their own particle. To detect the Majorana SABSs, we carry out mobility measurements of electrons trapped below a free surface by varying the depth of the ions. The observed mobility shows no depth dependence even if the depth is changed over the coherence length[4]. I will discuss the lack of depth dependence in connection with unusual Majorana nature of the SABSs .

[1] R. H. Salmelˈin et al., Phys. Rev. Lett. 63, 868 (1989).
[2] R. H. Salmelˈin and M. M. Salomaa, Phys. Rev. B 41, 4142 (1990)
[3] H. Ikegami et al., Science 341, 59-62 (2013).
[4] H. Ikegami et al., Phys. Soc. Jpn. 82, 124607 (2013).

About the Speaker

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Education:
March 1995: B.S. Dept. of Applied Physics, University of Tokyo.
March 1997: M.S. Dept. of Applied Physics, University of Tokyo.
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Apr. 1999 - Sep. 2001: Scientific Associate, University of Tokyo.
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