凝縮系物理学インフォーマルセミナー
Condensed Matter Informal Seminar

Location: Room 115, School of Science Bldg. 5 (理学 5 号館 115 号室)
Time and date: 13:00 – 14:30, Monday, 21 April 2014

Angular Momentum in Two-Dimensional Chiral Superfluids

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Abstract:

It is known that physical quantities can be quantized in topological insulators/superconductors, such as the quantized Hall conductivity in integer quantum Hall systems. Such quantization is a manifestation of non-trivial topology of the ground states in these systems and is crucially important for experimental identification of topological characters. In two dimensional chiral superfluids which we will discuss in this seminar, one may expect that orbital angular momentum is quantized. Indeed, in the context of the helium-3 A-phase, many theories have predicted that the angular momentum is quantized in chiral p-wave superfluids as $L = N/2$ where N is the total number of fermions. This result seems to be consistent with the naive expectation that the angular momentum is given by $L = 1 \times$ (# of Cooper pairs) in which a Cooper pair is assumed to carry angular momentum 1. According to this expectation, angular momentum in chiral superfluids with Chern number ν would be $L = \nu N/2$.

In order to investigate validity of this expectation and roles of topology, we study angular momentum in the two dimensional chiral superfluids on a disc. We show that the angular momentum is much smaller than $L = \nu N/2$ when $\nu \geq 2$ in the BCS regime in contrast to the above naive expectation. On the other hand, $L = \nu N/2$ is obtained in the BEC regime for all $\nu \geq 1$. These results are simply understood in terms of structures of edge modes and ground state wavefunctions. We also investigate the angular momentum in other geometries and discuss its (non-)intrinsic properties.