Observation of Intrinsic Angular Momentum in A Phase of Superfluid ^{3}He

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The superfluid states of He-3 atoms are analogs of BCS superconductivity in electrons in metal. Both are fermions with spin of a half of Planck constant. For He-3 many theories have explored the idea of BCS paring in systems where the Cooper pair bound state is not in the usual L=0, zero angular momentum s-wave state, but in the L=1 or L=2 state. Now the superfluid state of He-3 is recognized as p-wave of L=1 and spin-triplet state. Two superfluid states have been discovered in weak magnetic field, so-called the A phase and the B phase. These phases correspond with ABM state and BW state as theoretical models, respectively. Each Cooper pair has (orbital) angular momentum called intrinsic angular momentum. In the B phase three components of L=1 angular momentum are possessed by Cooper pairs with three components in spin-triplet state. The net angular momentum due to intrinsic angular momentum is zero. In the A phase, however, one component of L=1 angular momentum is possessed by Cooper pairs with two components in spin-triplet state. Therefore a possibility of observing net intrinsic angular momentum has been considered in the A phase since the discovery of superfluidity.

We tried to observe intrinsic angular momentum in the A phase in thin cylinder. The changes of NMR absorption signal under rotation suggest an existence of angular momentum in liquid. This angular momentum is not only due to flow caused by texture but also to intrinsic angular momentum of Cooper pairs.

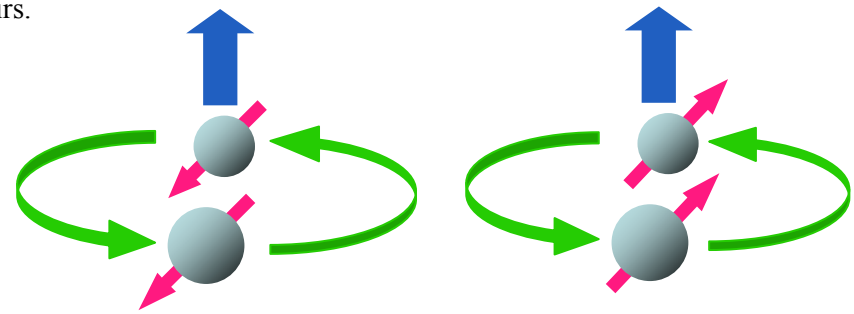

FIG.1: Schematic pictures of Cooper pairs in A phase with spin and angular momentum; red arrows are spin vectors and blue arrows are orbital angular momentum vectors