Small angle neutron scattering (SANS) experiments on non-centrosymmetric superconductor $LaNiC_2$

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Superconductors without inversion symmetry have gained a lot of attention lately. Conventional superconductors can only have one spin states either singlet or triplet due to Pauli's principle and law of conservation of parity, but the superconductors without inversion symmetry can have a mixed spin states. Furthermore, a new type of vortex state, so called helical vortex state, can be realized in the case of type II superconductors. In helical vortex state the superconducting order parameter has phase shift which leads very similar state with Fulde-Ferrell-Larkin-Ovchinnikov (FFLO) state. The FFLO state is realized in very low T and very high H region but the helical state can be realized in all vortex states under Tc. This fact makes the helical state being easier to be explored than FFLO state by SANS.

In this research, we are trying to observe vortex signal in non-centrosymmetric superconductor in $LaNiC_2$ and compare the results with other conventional systems.

The SANS experiments were carried out at CG2, ORNL. Our beam time was assigned from morning on Oct 8th to morning on Oct 11th. However the beam was down during the daytime on 8th, and we could start our experiment from night on Oct 8. Neutrons with wavelength λ=15.2 Å was used for the measurements, and the detector was set at 18.5m from the sample. Tc of $LaNiC_2$ is 2.7K, and the measurement of foreground data was performed at T= 1.4K after field cooling process.

At first we performed SANS measurements on single crystal $LaNiC_2$ sample which was grown by floating zone method. We could not get clear vortex signal, which might indicate that the crystal has micro defects and/or distortions. Therefore we decided to change sample to arc-melted polycrystalline $LaNiC_2$ sample. We measured the polycrystalline sample for magnetic field H= 0.05T, 0.072T, and 0.1T. The clear intensity was not observed for H= 0.05T, 0.1T, but there appeared some intensity at appropriate q position for H= 0.072T, 0.0037~0.0040 $Å^{-1}$.