Flux Line Lattice in $CeCoIn_5$

H. Kawano-Furukawa[A], A. Yoshida[A], S. Ohira-Kawamura[B], H. Shishido[C], K. Shirahata[A], and S. Konno[1]

[A]*Department of Physics, Ochanomizu University*

[B]*Academic and Information Board, Ochanomizu University*

[C]*Department of Physics, Kyoto University*

$CeCoIn_5$ is a new heavy fermion superconductor with quasi two-dimensional electronic structure and the superconducting transition temperature T_c = 2.3 K. Recently the specific heat[1], ultrasound velocity[2] and NMR[3] measurements pointed out a possibility of an occurrence of a Fulde-Ferrell-Larkin-Ovchinnikov (FFLO) phase. In the FFLO phase, modulation of the magnetic field in the flux line appears along the vortex direction. It is necessary to know the flux line lattice (FLL) structure before observation of the FFLO state.

We performed a SANS experiment on $CeCoIn_5$ at the C1-2 spectrometer (SANS-U). The single crystal samples (the average size is $3 \times 3 \times 0.5$ mm^3) were aligned on the sample holder so that the *c*-axis is parallel to the neutron beam. A ^{4}He (orange) cryostat with a 3 T magnet was used, and cool the sample down to 1.6 K. The magnetic field was applied parallel to the *c*-axis and the neutron beam to make the vortices along this direction. The neutron wave length of 7.08 Åwas selected, and the PSD was set to 8 m and 16 m positions.

From a recent report[4], a phase transition from a triangular FLL to a square one at ~0.55 T is suggested. However, it is not easy to observe the FLL in this system, because the absorption factors of Co and In are so high. Totally 12 scattering spots are expected to be observed at the nearest position from the origin in the triangular FLL, because of nonequivalent two directions of the FLL. On the other hand, only 4 spots should be observed in the square FLL, presumably with higher intensity. We tried observation of the square one. Fig. 1 shows a neutron scattering intensity as a function of the radius from the origin on the detector, *r*, (in pixel) at 1.6 K under 1.5 T. The background has already been subtracted. A small peak is observed at around 29 pixel. In this study, we succeeded in the observation of the FLL in $CeCoIn_5$ even under a magnetic field of 1.5 T.

References

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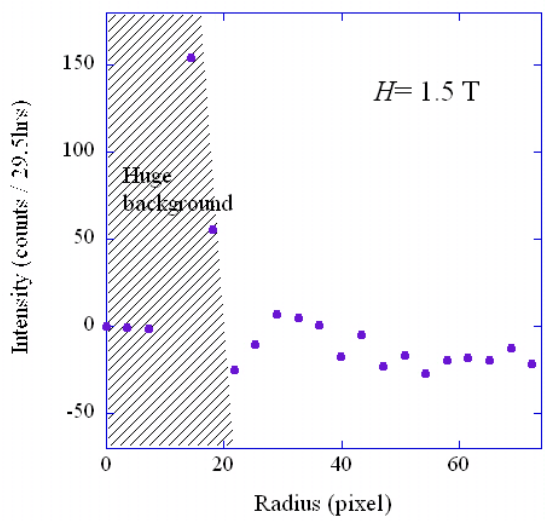

Fig. 1. Neutron scattering intensity at 1.6 K as a function of the radius from the origin of the detector. Uniform background has already been subtracted.