Topological superconductor beta-PdBi2

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In topological superconductors, it has been predicted that special particles, so-called Majorana fermions, will appear on the surface of the material. Recently, spin- and angle-resolved photoemission spectroscopy measurements revealed that Palladium-Bismuth superconductor, β-PdBi2 (tetragonal structure, space group I4/mmm, Tc = 5.4 K [1]), has topologically protected surface state [2] and it attracts much attention.

In order to study bulk properties of PdBi2, including superconducting paring symmetry and other characteristic behavior of this material, we performed a small-angle neutron scattering (SANS) experiment and measured diffractions from vortex lattice. For the measurements, we grew single crystals of PdBi2 by a melt growth method and Tc of the crystals was evaluated to be Tc = 5.2 K by magnetization measurements. The experiment was carried out at the SANS-1 instrument in installed FRM-II from 17th to 22th Aug. 2017.

A single crystal of PdBi2 (0.75 g) was set with Nb (Fig.1) in a 3He insert with its cleavable c-plane vertical, and it was installed into a magnet with horizontal field. We first measured vortex lattice created in field cooled process. A magnetic field was applied parallel to the c-axis of the sample. Incident neutron beam was almost parallel to the magnetic field. Depending on the fields, we used neutrons with λ = 6, 8, 12 . Figures 2 (a) and (b) show typical diffraction patterns from vortex lattice. Clear spots were observed. Q-dependence of the intensity indicates the system has hexagonal vortex lattice.Next we measured temperature dependence of integrated intensity at H = 0.15, 0.2, 0.3, 0.4 and 0.45 T by rotating the sample with the magnetic field around phi angle (around a vertical axis).

This travel was done with a financial support by ISSP, University of Tokyo. We appreciate it pretty much since it could not be done without it.

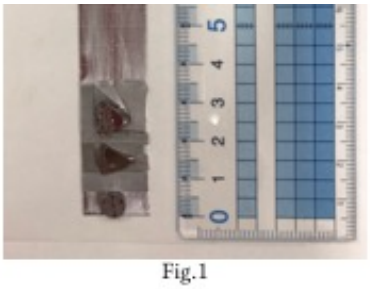

Fig.1

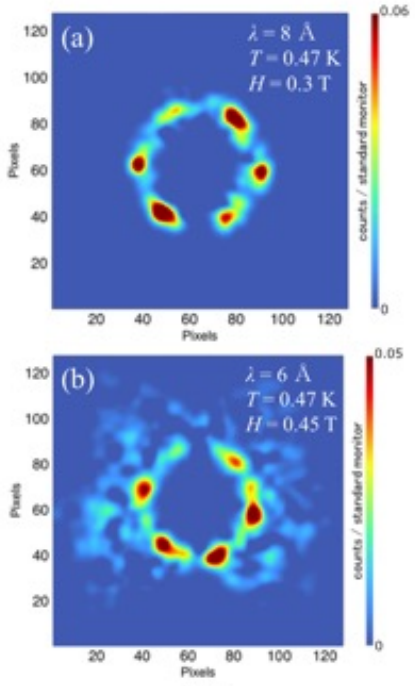

Fig.2

Fig. 1. Sample setting on an Al plate. From the top two single crystals of PdBi2 and one single crystal of Nb (bottom). Fig.2 SANS patterns at T = 0.47 K in (a) 0.3 T and (b) 0.45 T