

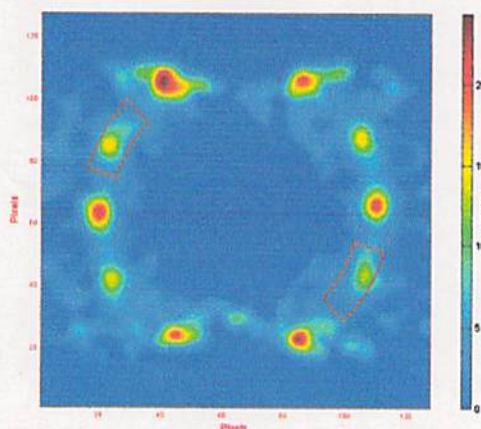
The vortex lattice study with higher quality single crystals of the pnictide superconductor $\text{BaFe}_2(\text{As/P})_2$

Ochanomizu University Hazuki Kawano-Furukawa

Small angle neutron scattering (SANS) experiments on superconducting vortex lattice (VL) states can give essential information to determine superconducting gap structures and therefore superconducting symmetries. For these two years, relying on having "clean" low-pinning materials, we successively succeeded in observing a well-ordered vortex lattice of the mixed state in the novel iron-based superconductors, KFe_2As_2 (KFA, $T_c=3.8\text{K}$) [1,2] and $\text{BaFe}_2(\text{As/P})_2$ (BFAP, $T_c = 30\text{K}$), which have the same ThCr_2Si_2 structure. For $\text{BaFe}_2(\text{As,P})_2$, however, we first failed to observe Bragg reflections from well ordered VL, indicating that the crystals has micro defects and/or distortions, which act as pinning centers, and distorted vortex lattice was formed. But the intensity of the ring diffraction itself was not weak. Then we searched conditions to improve the situation and prepared new sample by annealing crystals in vacuum at 500C . This improved the situation very much and we could observe Bragg spots from the ordered VL at $0.2\text{T} < H < 10\text{T}$.

For this time, we planned to extend this project at JRR-3 JAEA but we could not get any neutrons due to JRR-3 reactor shutdown, then we continued our measurements at ILL during June 2012 with a financial support of airfare by ISSP. There we focused on to measure clear Bragg reflections at higher fields above 10T and at lower fields under 0.2T .

Intensity from the vortex reflection at higher fields was quite weak and then we adopted "Bayesian rock analysis program" developed by Dr. Alex Holmes at Birmingham University in England, which would work on Grasp program developed by Dr. Charles Dewhurst at ILL. With these strong user support programs, we succeeded measuring Bragg patterns from the ordered vortex lattice at $11, 12, 14\text{T}$. The figure shows Bragg reflections from VL at 12T as an example. We succeeded constructing the phase diagram of the field dependence of vortex structure.



References

1. H. Kawano-Furukawa et al., Phys. Rev. B84, (2011) 024507.
2. M R Eskildsen, E M Forgan and H Kawano-Furukawa, Rep. Prog. Phys.74 (2011) 124504.