MLF Experimental Report	提出日 Date of Report
課題番号 Project No. 2016B0055 実験課題名 Title of experiment Magnetic structure of new structure Fe based superconductor $EuRbFe_4As_4$ 実験責任者名 Name of principal investigator Kazuki Iida 所属 Affiliation CROSS Tokai	装置責任者 Name of responsible person Toru Ishigaki 装置名 Name of Instrument/(BL No.) BL20, iMATERIA 実施日 Date of Experiment 2017/3/31 – 2017/4/1

試料、実験方法、利用の結果得られた主なデータ、考察、結論等を、記述して下さい。（適宜、図表添付のこと）
Please report your samples, experimental method and results, discussion and conclusions. Please add figures and tables for better explanation.

1. 試料 Name of sample(s) and chemical formula, or compositions including physical form.

Polycrystalline $EuRbFe_4As_4$.

2. 実験方法及び結果 （実験がうまくいかなかった場合、その理由を記述してください。）
Experimental method and results. If you failed to conduct experiment as planned, please describe reasons.

Recently, new-structure-type iron-based superconducting materials $AeAFe_4As_4$ (*Ae* = Ca, Sr, Eu and *A* = K, Rb, Cs) were reported, one of which is $EuRbFe_4As_4$. $EuRbFe_4As_4$ shows bulk superconductivity below T_c = 36.5 K. $BaFe_2As_2$ is a non-superconducting parent material with antiferromagnetic transition at T_N = 143 K, and upon K^+ substitution at Ba^{2+} site, $(Ba_{0.5}K_{0.5})Fe_2As_2$ shows superconductivity below T_c ~ 38 K. Similar to $BaFe_2As_2$, $EuFe_2As_2$ is also a non-superconducting parent material with antiferromagnetic transition at T_N = 190 K. As in $(Ba_{0.5}K_{0.5})Fe_2As_2$, Rb^+ substitution at Eu^{2+} site in $EuFe_2As_2$ gives rise to hole doping, resulting in superconductivity in $EuRbFe_4As_4$. Furthermore, Eu sublattice in $EuRbFe_4As_4$ shows ferromagnetic order below 15 K. However, no detailed diffraction measurement has been performed on $EuRbFe_4As_4$. Therefore, the magnetic structure as well as microscopic measurement on possible interplay between superconductivity and ferromagnetism in $EuRbFe_4As_4$ was investigated using iMATERIA.

Polycrystalline $EuRbFe_4As_4$ was put into the annular type Vanadium cell whose outer and inner radii are 10 and 9 mm. The cell was attached to the GM refrigerator, and measurements were performed at 4 and 20 K.

2. 実験方法及び結果（つづき） Experimental method and results (continued)

Single frame mode was used and the data shown here is obtained by the LA15 bank. All index shown this report are described assuming the $P4/mmm$ symmetry.

Figure 1 shows the neutron diffraction patterns from $EuRbFe_4As_4$ below and above T_C (4 and 20 K). Below T_C, the magnetic Bragg peaks of (100) at Q = 1.62 Å^{-1} was observed. Since weak nuclear Bragg peak also exist at (100), observed magnetic peak is consistent with the ferromagnetic structure indicated by the bulk measurements. On the other hand, the clear magnetic peak is also observed at Q = 0.52 Å^{-1} at 3.7 K. Since Q = 0.52 Å^{-1} correspond to (0.224 0.224 0), (0.317 0 0), or (0 0 0.111), either of which is incommensurate. Thus, the magnetic structure of $EuRbFe_4As_4$ is not simple ferromagnetic structure. Since the current sample is the strong absorber of neutrons, we are doing careful analysis to obtain the magnetic structure.

Finally, we would like to appreciate the iMATERIA team for their help.

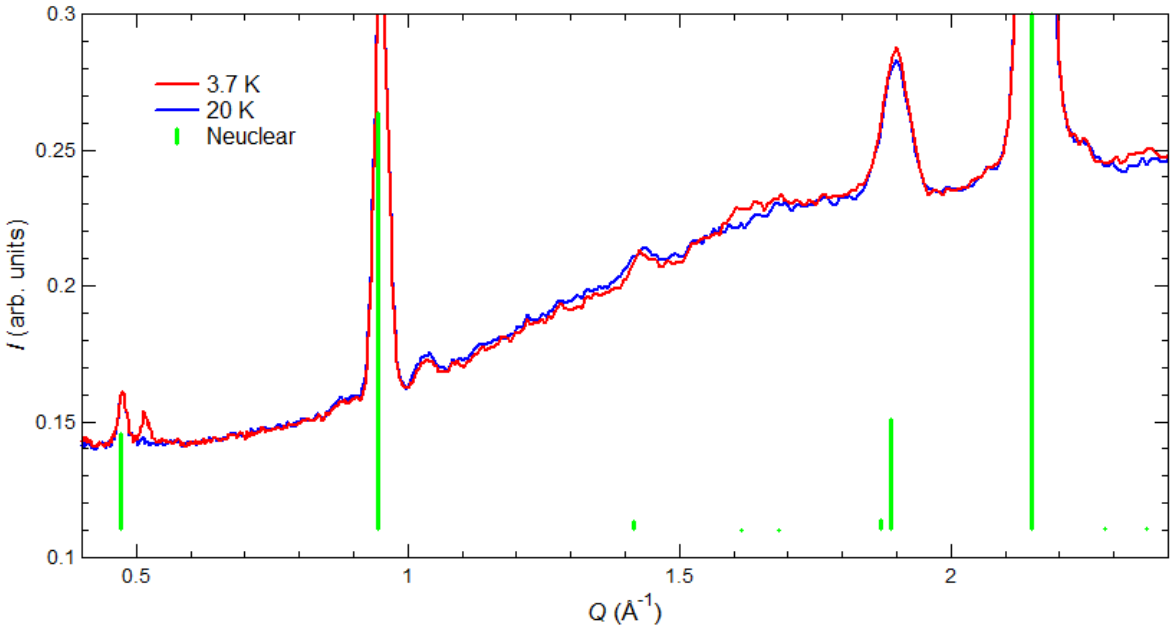

Figure 1. Neutron powder diffraction patterns from $EuRbFe_4As_4$ at 3.7 and 20 K using the LA15 bank of iMATERIA. Positions of nuclear Bragg peaks are also shown.