MLF Experimental Report	提出日 Date of Report
課題番号 Project No. 2016B0070 実験課題名 Title of experiment Anomalous excitations study of spin frustrated RBaFe4O7 (R=Yb, Lu) system 実験責任者名 Name of principal investigator KAMAZAWA, Kazuya 所属 Affiliation CROSS Tokai	装置責任者 Name of responsible person Nakajima, Kenji 装置名 Name of Instrument/（BL No.） BL14 AMATERAS 実施日 Date of Experiment 2016/Dec./07-2016/Dec./13

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.

RBaFe4O7 (R=Yb, Lu) polycrystalline samples

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.

Based on our previous neutron scattering studies of $YBaFe_4O_{7-\delta}$ and $HoBaFe_4O_7$, in order to verify our hypothesis, that is spin dynamic becomes very fluctuate when the rare earth ion R is nonmagnetic while the spin dynamic becomes rather static when the magnetic moment of R is large, we have carried out another neutron scattering measurements of $YbBaFe_4O_7$ and $LuBaFe_4O_7$. We used multi-incident neutron energies with E_i of 30.27, 11.60, and 6.077 meV in the measurements. From the elastic profiles around $\omega \sim 0$ meV, any additional Bragg peak and peak broadening are not observed in all temperature (T) for both $YnBaFe_4O_7$ and $LuBaFe_4O_7$. Therefore, there is no structural and magnetic transition, and they keep cubic symmetry to the lowest T that we measured. In inelastic scattering region, a streak scattering which is seen in $YBaFe_4O_7$ was observed in both $LuBaFe_4O_7$ and $YbBaFe_4O_7$. (Fig. 1(a)(b)) We can confirm reproducibility for the streak scattering in non-magnetic R ion system. Therefore we can emphasize that the streak scattering is not a fake signal but a real signal. It is interesting that even in $YbBaFe_4O_7$, we can see almost the same intensity of the streak scattering (although we can not identify why the intensity at around 10 meV becomes weak in the streak). The similar spin dynamics which keeps antiferromagnetic hexagon spin cluster correlation is realized in $YbBaFe_4O_7$.

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

In $YbBaFe_4O_7$ of 4 K, the strong dispersionless excitation is observed at ω= 1 meV, and it originates from the YBO_6 crystal field excitation (Fig. 2(a)). At 10 K, the ω= 1 meV excitation disappear and another dispersionless excitation is observed at 0.5 meV. Although there are back ground signals from ^{3}He cryostat which can be identified with the data of $LuBaFe_4O_7$, the 0.5meV excitation is too strong to identify as the background. It is a real single indicating a phase transition relating with YbO_6 crystal field (Fig. 2(c)). For the ω = 18 meV excitation, since it is not observed in $LuBaFe_4O_7$, it is considered to be intrinsic signal of $YbBaFe_4O_7$. At least it does not originate from YbO_6 crystal field excitation, but the origin is not identified yet. In summary, spin dynamics of $YbBaFe_4O_7$ is rather similar to that of $YBaFe_4O_7$ and $LuBaFe_4O_7$ than that of $HoBaFe_4O_7$. Then our expected state that has spin dynamic in between R'=Ho and Y seemed to be realized. In case of R'=Ho, spin dynamics of Fe ions is made weaken by adhesive force due to large Ho magnetic moment, that is, spin fluctuation originated from frustration effect becomes more static and dynamical Jahn-Teller effect appears. On the other hand, in case of R'=Yb as we predicted that the moment of Yb is small, the adhesive force is smaller and the similar effect did not realize. This is consistent with the results of the magnetic susceptibility that the effective magnetic moment of $HoBaFe_4O_7$ is observed very smaller than that we expected, but that of $YbBaFe_4O_7$ is observed almost full value.

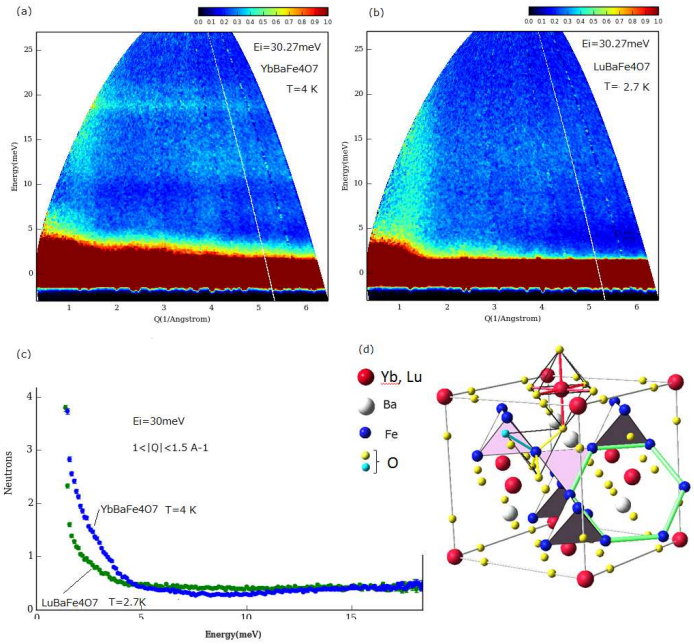

Fig.1 $I(Q, \omega)$ map of $YbBaFe_4O_7$ at 4 K (a), $LuBaFe_4O_7$ at 2.7K (b). (c). Positive side of energy spectra sliced at $1<|Q|<1.5A^{-1}$. Here all data are obtained by incident energy E_i = 30.27 meV. (d) Crystal structure of Yb,$LuBaFe_4O_7$. Green sticks indicate a hexagon cluster.

The data analysis still continues for publication.

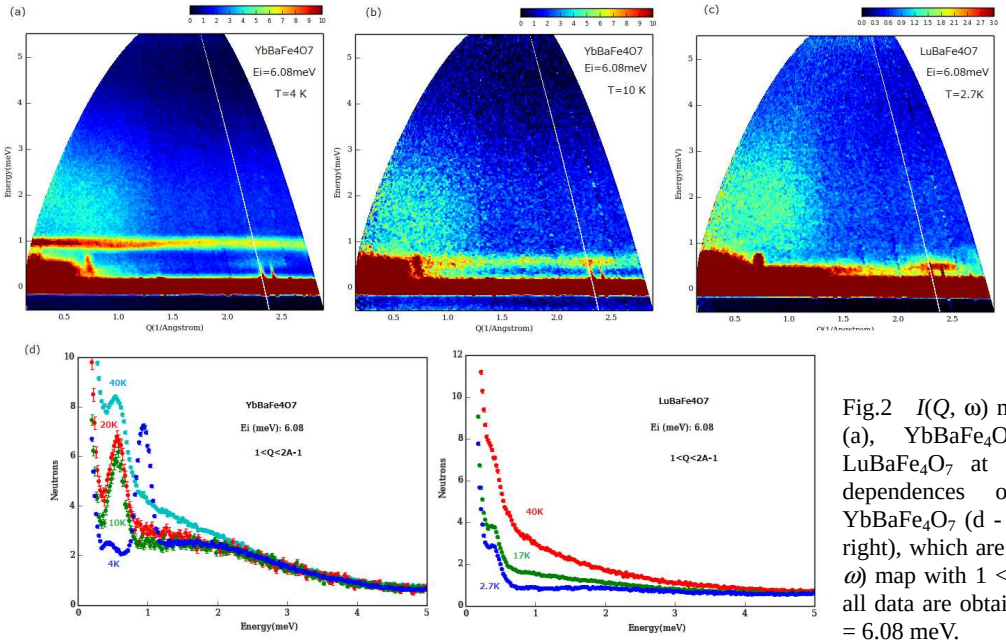

Fig.2 $I(Q, \omega)$ map of $YbBaFe_4O_7$ at 4 K (a), $YbBaFe_4O_7$ at 10K (b), and $LuBaFe_4O_7$ at 2.7 K (c). Temperature dependences of energy spectra of $YbBaFe_4O_7$ (d - left) and $LuBaFe_4O_7$ (d - right), which are obtained from sliced $I(Q, \omega)$ map with $1 < |Q| < 2$ A^{-1} region. Here, all data are obtained by incident energy E_i = 6.08 meV.