MLF Experimental Report	提出日 Date of Report 2017/July/19
課題番号 Project No. 2017A0137 実験課題名 Title of experiment Local lattice distortion study of frustrated spin system of $HoBaFe_4O_7$ 実験責任者名 Name of principal investigator KAMAZAWA, Kazuya 所属 Affiliation CROSS	装置責任者 Name of responsible person Toshiya Otomo 装置名 Name of Instrument/（BL No.） BL21 NOVA 実施日 Date of Experiment 2017/Apr./13-2017/Apr./14

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.

HoBaFe4O7 powder sample

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.

We study cubic $HoBaFe_4O_7$ from view point of geometrical spin frustration. Interestingly, the system does not show any static lattice distortion to the lowest temperature that we measured, even though Fe^{2+} in tetrahedral symmetry is a Jahn-Teller active ion. Up to now, using inelastic neutron scattering, we observed discrete several energy excitations in the energy (ω) – wave vector (Q) space and we have successfully explained it by vibronic state of Fe^{2+} dynamical Jahn-Teller effect with LS-coupling [1]. Then, we are considering that this mechanism release the Jahn-Teller degeneracy. On the other hand, local lattice distortion has been proposed theoretically in frustrated spin Heisenberg system [2].

In order to clarify this issue, we observed local lattice distortion of $HoBaFe_4O_7$ by pair distribution function analysis. We measured 5 temperature points at 10K, 50K, 100K, 200K, and 300K to check also temperature dependences.

Figure 1shows experimental g(r) (upper) with Qmax~42, dr~0.01 at 295K and 4K as representatively and a model g(r) (bottom). At glance temperature dependence are little. In particular, bonds lengths of Ho-O, Ho-Ho have no distortion and no temperature dependence (See Fig.2). We think that it supports our inelastic result [1] On the other hand, we can see differences for Fe-O, Fe-Fe bonds lengths, etc (See Fig.2). Further analyses are still underway to better understand the data.

[1] Kazuya Kamazawa, Motoyuki Ishikado, Seiko Ohira-Kawamura, Yukinobu Kawakita, Kazuhisa Kakurai, Kenji Nakajima, and Masatoshi Sato, Submitted to Phys. Rev. B (2016).
[2] Kazushi Aoyama and Hikaru Kawamura, Phys. Rev. Lett. **116**, 257201 (2016)

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

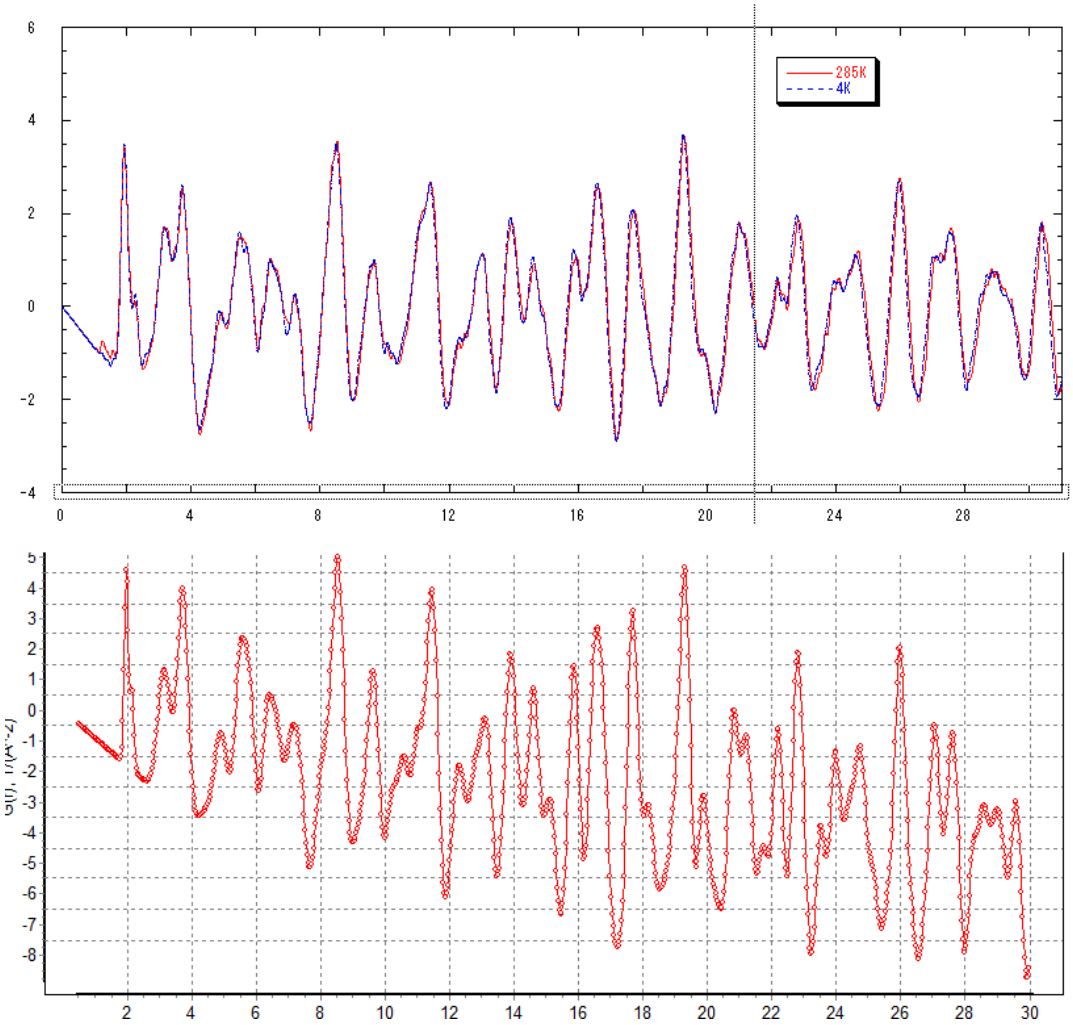

Fig.1 Experimental g(r) (upper) with Qmax~42, dr~0.01 at 295K and 4K and a model g(r) (bottom).

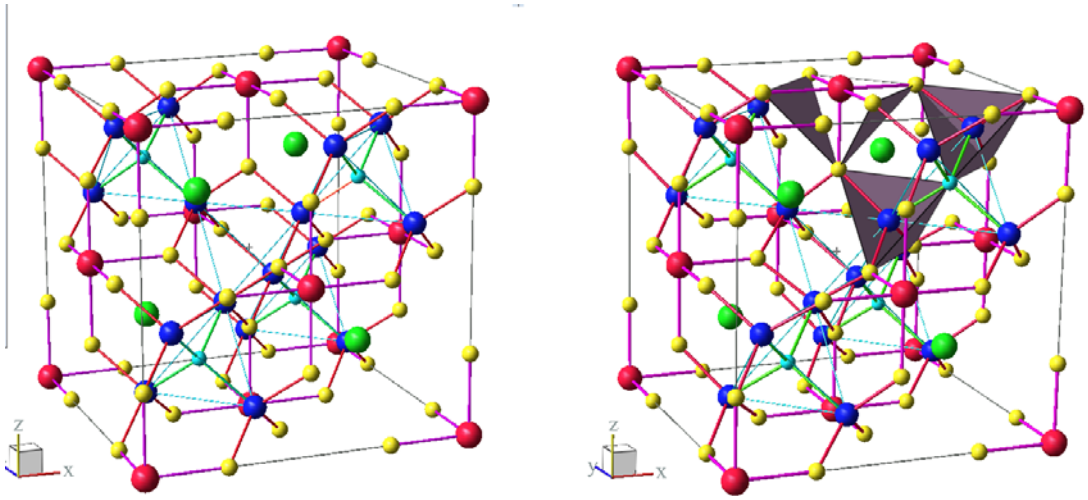

Fig.2 Atomic structure which is reproduced by the experimental results (left), v.s. a ideal cubic structure of HoBaFe4O7 (right).