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 MLF Experimental Report	提出日 Date of Report 2013/5/24
課題番号 Project No 2012B0118 実験課題名 Title of experiment Mutipolar excitations in Ce _{0.7} La _{0.3} B ₆ 実験責任者名 Name of principal investigator Keitaro Kuwahara 所属 Affiliation Ibaraki Univ.	装置責任者 Name of responsible person Kenji Nakajima 装置名 Name of Instrument/(BL No.) BL14 実施日 Date of Experiment 2013/3/11-3/19

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.
9 gram powder sample of 11B enriched (Ce _{0.7} ,La _{0.3})B ₆

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.
<p>La-doped alloy (Ce_{0.7}La_{0.3})B₆ shows an antiferrooctupolar (AFO) order with the wave vector $\mathbf{Q}_{\text{AFO}} = (1/2, 1/2, 1/2)$ below the phase transition temperature 1.4 K and is also known as a typical Kondo lattice system with the Kondo temperature of ~ 1 K. Reflecting the octupole order as well as the heavy electron state, the dynamical properties of 4f electrons at low temperatures below 1 K are expected to have unique characteristics.</p> <p>The purpose of this experiment is to clarify the low-energy dynamics of 4f electrons in the AFO phase of (Ce_{0.7}La_{0.3})B₆ by high-resolution inelastic neutron scattering (INS) experiment. In order to study on such materials of low characteristic temperature, the sample environment below 1 K must be necessary. Thus we installed the cryogen-free 3He refrigerator at MLF and checked that it cooled sample below 300 mK for more than 1 day in several cooling tests without a neutron beam before doing INS experiment. In the INS experiment performed in 2013 March, however, we have failed to cool the sample below 1 K by using the refrigerator. The precise cause of the failure is unclear at present.</p>

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

Although we could not do the INS experiment on $(\text{Ce}_{0.7}\text{La}_{0.3})\text{B}_6$ in the AFO phase below 1.4 K unfortunately, we got the preliminary data in the paramagnetic phase. Figure 1 shows the intensity maps around 290 K ~ 180 K and at 4 K. Interestingly, around $Q=0.7\text{\AA}^{-1}$ and below 0.2 meV, the strong enhancement of excitations was observed at 4 K. The magnitude of the wave vector $Q=0.7\text{\AA}^{-1}$ corresponds to $\mathbf{Q}=(1/2,0,0)$. This is an unexpected result because the magnitude of the ordering vector $\mathbf{Q}_{\text{AFO}} = (1/2,1/2,1/2)$ is $Q = 1.3\text{\AA}^{-1}$, where intensity enhancement is not visible as shown in Fig.1(b). As common characteristics of rare earth hexaborides RB₆, they are known to have lattice instability of $(1/2,0,0)$ and the nearly spherical Fermi surface centered on the X points in the Brillouin zone. The present result might be related to the common characteristics.

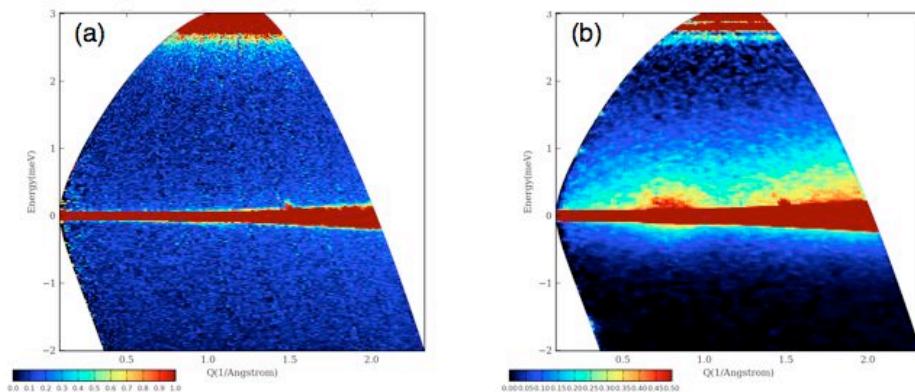


Fig.1 Dynamical structure factor of $(\text{Ce}_{0.7}\text{La}_{0.3})\text{B}_6$ powder sample measured with $E_i = 3.13 \text{ meV}$

(a) around 290K ~ 180 K and (b) at 4 K.

Now we are preparing a new outer vacuum chamber of the ^3He refrigerator for neutron scattering experiments and will retry to do INS experiment on $\text{Ce}_{0.7}\text{La}_{0.3}\text{B}_6$ at low temperatures.